Data Report for Evidence-Based Training

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1st Edition

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International Air Transport Association
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NOTICE

Data Report for Evidence-Based Training
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OBJECTIVE

The contents will be useful to the following entities:

1. Civil Aviation Authorities (CAAs)
2. Operators
3. Approved training organizations (ATOs)
4. Course developers
5. Pilot representative bodies

CONTENT

The material in this manual is intended to complement the following documents:

- ICAO Annex 1
- ICAO Annex 6
- ICAO Doc 9625 Manual of Criteria for the Qualification of Flight Simulation Training Devices, Volume 1 – Aeroplanes
- ICAO Doc 9841 Manual on the Approval of Training Organizations
- ICAO Doc 9868 PANS-TRG Chapter 5 and 6
- ICAO Doc 9995 Manual of Evidence-Based Training

STRUCTURE OF THE REPORT

The document is structured as a report of the objectives, methodology, analysis and conclusions resulting from the review of the data conducted in support of EBT development. It is intended as the first step in a process of continual review of real world data from accidents, incidents, flight operations and training to feed and validate course development. The purpose of the data collection and analysis is to provide the necessary information for the development of a program of events based upon aircraft generations, to be utilized for the development of pilot competencies through the baseline EBT program. Data analyses described in this report have been used to construct the baseline EBT program, and will be reviewed and updated on a continual basis. The enhanced EBT program described in this manual is intended to create a delta to the baseline program, utilizing operator specific data.

UPDATES

While the EBT data analysis is substantial and supportive of the program, there is a clear need for regular and where necessary, substantial update and expansion. New data will be acquired and analyzed according to the key principles established in this report. The IATA Global Aviation Data Management (GADM) database will provide a continuing and expanding review of operations, training and safety events. The training criticality survey will be developed to provide corroboration and correlation across multisource data results and more importantly, will provide continual access to professional expertise. Data analysis undertaken with the rigor and spirit of the EBT data study is a key foundation for improving safety through improvements in training.

EBT is focused on developing and maintaining pilot competencies in identified areas specific to aircraft groupings and, in the case of an enhanced EBT programs, specific to an air operator. EBT represents a paradigm shift in recurrent training methodologies that will supplement the more traditional regulatory-prescribed training practices. EBT will continue to evolve as a result of continuous feedback and the incorporation of new evidence as it becomes available. This report will be updated based upon the analyses of new data.

EXECUTIVE SUMMARY

The existing international standards and regulations for airline pilot training were originally derived in response to accidents involving early generation jet aircraft. Apart from ‘bolt–on’ additions, usually in the form of maneuver-based practices, standards have remained virtually unchanged since inception. During the same period progressive changes in aircraft design, including the developments in automation, system integration, reliability and significant changes in the operating environment have demonstrably improved operational safety, but also revealed new operational challenges.

The Evidence-Based Training (EBT) project is a global safety initiative, which arose from concerns that recurrent and type-rating training were no longer meeting the needs of airline pilots.

At the inception of the EBT project, a review of available data sources, their scope, and relative reliability was undertaken. This was followed by comprehensive analyses of the data sources chosen. The objective of these analyses was to determine the relevance of existing pilot training and to identify the most critical areas of training focus according to aircraft generation.

This report corroborates independent evidence from multiple sources, which include flight data analysis, reporting programs and a statistical treatment of factors reported from an extensive database of aircraft accident reports. Both process and results were peer-reviewed by experts in pilot training drawn from airline operators, pilot associations, civil aviation authorities and original equipment manufacturers, so as to provide transparency and to bring a qualitative and practical perspective. During this study, critical core competencies were examined, in technical and non-technical areas presenting the opportunity to train and assess flight crews according to a defined, useful and comprehensive set of measurement criteria.

Pilots often do not have the confidence and capability to operate the aircraft in all regimes of flight and to be able to recognize and manage unexpected situations. Results show that manual aircraft control, management of go-arounds, procedural knowledge of automation and flight management systems (FMS), monitoring, crosschecking, error detection and management of adverse weather are issues of concern. The report also reveals a significant and pervasive rate of unstable approaches continued to landing, illustrative of an endemic culture of intentional non-compliance across many flight regimes.

It is important that non-technical performance becomes part of an integrated approach to training, and the report reveals the significance of certain non-technical competencies in reducing risk in operations. The challenge of maintaining Situation Awareness in a highly automated and highly reliable system needs to be addressed through more effective training and exposure to rapidly developing and dynamic situations. Competencies of Leadership and Communication are revealed as key risk reducing countermeasures and should be a primary area of focus in training.

Data indicate a need for pilots to be exposed to the unexpected in a learning environment, and be more challenged and immersed in dealing with complex situations, rather than repetitively being tested in the execution of maneuvers. Training programs constrained by repetitive testing in the execution of maneuvers to comply with outdated regulation, lack the variability to train effectively in this way.

The report indicates significant differences across what can be considered as three different aircraft generations of jet transport aircraft and two generations of turbo-prop aircraft. While overlap in training clearly exists, there are quite distinct generational differences in patterns of existing risk that are not adequately addressed by current training.

This report evidentially illustrates inadequacies in the perpetuation of historical airline flight training regimes and identifies areas in which major change is necessary. It strongly supports the implementation of such change in both the regulation and development of recurrent airline pilot assessment and training. It identifies the areas for improvement, providing the prioritization of germane and relevant training topics to guide in the construction of suitable EBT programs.

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1 INTRODUCTION

The Evidence-Based Training project is a major safety initiative. It arose from an industry-wide consensus that, in order to reduce the airline accident rate, a strategic review of recurrent and type-rating training for airline pilots was necessary. Essential to ensuring regulatory support for this initiative was the objective consolidation of empirical data that provided substantial evidence that current training and checking practices were not, of themselves, fulfilling the safety needs of the industry. Keeping in mind that international standards and commensurate national regulations for airline pilot training largely evolved from the evidence of accidents involving early generation jet aircraft, the analysis of safety data involving other groupings of more modern aeroplanes did not always show a relationship to those prescriptive requirements. For the most part, the belief was that simply repeating pilot exposure to “worst case” events in training was considered sufficient to satisfy the industry’s safety needs. Over time, ‘novel’ events resulting in serious occurrences were simply added to the requirements of progressively crowded training programs, which eventually resulted in an inventory or "tick box" approach to training being adopted. As a result, the industry was being forced to focus on their flight crews meeting the ever-increasing regulatory-imposed minimum performance standards rather than enhancing their overall abilities.

This report clearly demonstrates that training methodologies must and can be significantly improved. This improvement process begins with applying a different philosophy when developing and implementing recurrent training programs; a philosophy that inculcates best operating practices, which are relevant to both the equipment in use and the specific needs of the air operator.

The availability of data from both flight operations and training activity has improved substantially over the last 20 years. Sources such as the IATA Flight Data Exchange Services (FDX), flight data analysis (FDA), IATA Safety Trend Evaluation, Analysis & Data Exchange System (STEADES), as well as all data sources available in the IATA GADM, flight observations (e.g., line observation safety audits (LOSA) programs) and air safety reports give a detailed insight into the threats, errors and undesired aircraft states encountered in modern airline flight operations as well as their relationship to unwanted consequences. In light of evidence from these data sources, it was considered timely and important to review current training practices

A large-scale comprehensive study of a range of available data sources and analyses was conducted and important differences emerged between what can be considered as six different aircraft generations. The process and results of this quantitative analysis were reviewed by a team of internationally recognized experts in pilot training, representing airline operators, pilot associations, regulators, and original equipment manufacturers. This provided transparency as well as a bringing a well-rounded and experiential perspective to the data. Analysis of multiple sources using differing methods and tools revealed consistent findings and it became apparent that, while there remains overlap in areas of training needs across aircraft generations, there are also quite distinct differences in patterns of risk in the later generation aircraft that are currently not addressed. Certain critical pilot competencies emerged in technical and non–technical areas that clearly illustrate the need for a change of focus of airline pilot training, both in terms of concept and curriculum with respect to generational characteristic.

This report presents the methodology and results of a meta–analysis and makes a strong case for changes in recurrent airline pilot training. The data analysis team comprised experts from many fields in the area of operational and flight data, pilot instructors, scientists, academic research professionals and a statistician, in addition to volunteer pilots-analysts from various locations around the world.

Results of the analyses described in this report have been used by the EBT working group, consisting of experienced instructors, to build the training scenarios for the Baseline Recurrent EBT Training Program specified for the different aircraft generations. The data sub-group worked directly with pilots developing the content for the suggested recurrent training programs. Results, while unsurprising to many industry experts, are too important to ignore. According to the EBT Pilot Survey, 54% of the respondents encountered an operational situation in 6 months prior to the survey, for which they felt insufficiently trained. 43.6% of respondents reported that the instructor in their last training session did not raise the level of their confidence.

Results contained within this report are drawn from multiple sources, some of which are readily available to the public via the IATA website. Some come from information, access to which is restricted to industry specialists, while other results were inferred from confidential, de-identified data, the specifics of which are made known only to the EBT project group and then only on a "need-to-know” basis.

While the EBT Data Report is not a meta-analysis in a pure sense, it is derived from an analysis of analyses using a variety of sources and techniques to corroborate and challenge its own findings. It consists of a large collection of results from primary and secondary studies that are consolidated to determine training needs.

Findings of this nature in this multi-sourced report come from various external studies, in addition to internally designed studies focusing on specific research questions. The criteria defining the usefulness of the various studies in this report are the following:

1. It is relevant from a training perspective (e.g., if incorporating a training change mitigates the risk found in the study).
2. There is evidence that it will assist with the identification of competencies to be developed in training in order to mitigate risks encountered in the evolving operational environment.
3. The study addresses one or more of the following objectives:
    a. Substantiate the need for change in the assessment and training programs for commercial transport pilots.
    b. Provide evidence from data analyses to support the development of training topics, prioritized according to aircraft generation.
    c. Challenge and/or corroborate the Training Criticality Survey and the Training Guidance with operational data.
    d. Provide feedback to determine the effectiveness of changes implemented through the adoption of competency-based training methodologies.

4. The findings of the study are corroborative or challenging across the spectrum of the multi-analysis study.
5. The findings from an outside report come from an industry-respected study.
6. Varied data sources and/or varied methodology mitigate inherent biases associated with individual types of source data.

Data were collected from the following sources:

1. IATA Global Aviation Data Management (GADM)
2. Operators
3. Original Equipment Manufacturers – Aircraft (OEM)
4. Accident Investigating bodies
6. Civil aviation authorities

Note: Some of the data and/or results in this report are sensitive either in terms of their context or in that the donor specifically provided data on a confidential basis.

1.1 DATA STREAMS

1. All analyses are based on 7 data streams that are listed in figure 1.1.
2. There are 18 specific data sources, which are presented in figure 1.1a.
3. The data streams represent not only a large set of relevant data, but also a variety of different kinds of data (e.g., flight data, observational data from LOSA, and scientific reports). The cross sectional approach strengthens the basis for analysis, by providing compensation for bias inherent within each data type. This is a strong rationale for the use of multiple data sources.

Data Streams
1. Cockpit Observation Reporting
2. Flight Data Analysis (FDA) Studies
3. Accident/Incident analyses
4. Training Studies
5. Airline Pilot Survey on Training Effectiveness
6. Scientific Reports
7. Training Criticality Survey

Figure 1.1

The data streams used can be divided into 3 categories based upon the means by which data are used in the analysis.

Data Sources	
LOSA Reports	
EBT Accident & Incident Study	
EBT Flight Data Analysis	
UK CAA Accident Reports	CAP 776
	CAP 780
IATA Safety Reports	2008
	2009
AQP Study	
ATQP Installation Data	
STEADES Training Query	
Airline Pilot Survey on Training Effectiveness	
Factors that Influence Skill Decay and Retention	
Skill Retention after Training - FAA	
Automation Training Practitioners' Guide	
The Interfaces Between Flight Crews & Modern Flight Deck Systems - FAA	
Long Aircraft Type/Variant difference on Landing	
A Study of Normal Operational Landing Performance on Subsonic Civil Narrow Body Jet Aircraft during ILS Approaches - NLR	
TAWS - 'Saves'	
Augmented CAST Accident Study	
Training Criticality Survey (TCS)	
Corrrelation of Risk Between Training Criticality Survey/Accident and Incident Study	

Figure 1.1a

1.2 DATA SOURCE – CATEGORY 1

The first data category contains data from sources that are highlighted in blue in Fig 1.1a. Evidence from these sources has been formulated in the form of statements recorded in the Evidence Table (ET) [See section 1.5 for brief description of ET]. The specific methodology associated with each data source category is described in Chapter 3. The Evidence Table is a tool in the analysis, the specific evidence statements within being linked to different parameters.

1.3 DATA SOURCE – CATEGORY 2

The second data category consists of the data from the EBT Accident and Incident Study, which is highlighted in red in Fig 1.1a. The results from these analyses provide several means of ranking according to defined training need. The processes involved (described in section 3.2.) are algorithmic and result in distributions that do not translate easily into evidence statements, and therefore are not incorporated in the Evidence Table.

Merging of all results to reach a final training prioritization by generation is described in Chapter 3 Methodology.

1.4 DATA SOURCE – CATEGORY 3

The third data source category consists of the results from the Training Criticality Study, which are described in section 3.9, 3.10 and Appendix.11 are highlighted in amber.

1.5 EVIDENCE TABLE

Specific evidence taken from the particular studies of category 2 are consolidated into single declarative statements and entered into a database with links to the following:

1. Flight phases
2. Competencies
3. Objectives of the study
4. Training Topics
5. Context of the evidence if relevant
6. Factors analyzed in the Accident-Incident Study
7. Sources
8. Keywords associated with the conclusions of the report
9. Applicability to aircraft generations, if determined

The Evidence Table is displayed in Appendix 12 and the methodology associated with it is in Chapter 3

1.6 TYPES OF DATA

The following two types of data are used to provide systemic feedback for training criticality analysis in this report:

Training data, including the elements and structure of transition courses, recurrent training, line flights under supervision in addition to measurements of system performance. This type of data provides information relating to the effectiveness of the training system, the instructor and trainees, and for the purposes of this report is known as the internal training ‘feedback’ loop.

Operational & Safety data – Operators are required to collect data from operations, and this is sometimes used to analyze and determine risk mitigations through training. This is combined with subsequent measurement of the effectiveness of remedies. LOSA, pilot reports and flight data analysis (FDA) are prime examples. (The external training ‘feedback’ loop)

1.7 APPLICATION OF THE RESULTS

One of the major results of the data analyses is a collection of training topics ranked by criticality for each generation of aircraft.

All the results are detailed by training topics in chapter 4, (Analysis and Results) of the report and form the topics sections in this chapter.

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2 MAJOR FINDINGS

2.1 PREFACE

The term 'major' denotes not only the importance of the finding, but also the strength of the evidence and the preceding analysis. There are 6 major findings detailed in this chapter, five specific topics, and a synopsis of the most important results in the EBT study.

The major findings are not surprising to those experienced in training, but there are aspects of findings that initially appeared counterintuitive during the analysis. In such cases it wasn't until the analysis was complete, that the situation clarified and became consistent with professional experience and expectations. The unstable approach paradox is a good example of this phenomenon; the more it was investigated, the clearer the problems associated with these approaches became, including the means for resolution..

A comprehensive major finding, the ranking of the training topics, is based on a type of modeling, which uses risk as one of its major components. It is important to realize that while training has made a major contribution to the reduction of risk in the history of airline transport aviation, it is by no means the only contributor. Aircraft safety by almost any measure is a resounding success story for many reasons. When, for example, comparing generation 2 to generation 4, the safety situation is very different and when making cross-generational comparisons in terms of risk, it is important to normalize either by flight hours or by the number of take-offs. In this study, normalization was achieved by reference to the number of take-offs.

On the other hand, when comparing factors within a particular generation, it is the ordering of the factors in terms of risk that is important and while a specific factor may have a similar likelihood of occurrence in another generation; it may well have a very different ordering because its position in the order depends on all the other factors. Since the mission of the study is to provide evidence in the design of training programs for each specific generation; it is important to prioritize factors accordingly and therefore in this context, i.e., view risk relative to the generation of aircraft for which the training program is being built.

The focus of this chapter is on some powerful and interesting findings. It is important to note that these findings are by no means comprehensive. For a more comprehensive presentation of results, refer to Chapter 4, where there are more findings completing the report and providing the necessary scope and insight to be able to define the particular baseline recurrent training programs.

2.2 FLIGHT PATH – MANUAL AIRCRAFT CONTROL

Several data sources highlight, in different ways, that manual aircraft control skills of pilots are deteriorating over time, as aircraft design improves and the use of automation increases. It should be emphasized that manual control skills consistently remain an issue. As other contributing factors decrease through improved design and reliability, manual control skills remain a substantial issue as a factor in accident rates.

The EBT Accident-Incident Study shows that manual aircraft control was a factor in 52% of all fatal accidents. In addition, manual aircraft control was a factor in 84% of accidents and serious incidents having a high probability of mitigation through training. The importance of manual aircraft control as a factor is increasing proportionally in the total number of accidents and serious incidents.

According to reports derived from LOSA data and IATA's STEADES, observed manual aircraft control errors are revealed in adverse weather and turbulence, and with demanding and challenging ATC clearances. Pilots need to be able to confidently control the flight path without automation, understanding when and how to revert to manual flight. [Automation Training Practitioners' Guide (Lyall)]

Errors in manual aircraft control are the most frequently cited failures in flight crew performance, according to the IATA Safety Report/Accident Study. Manual aircraft control is the preeminent flight crew error, according to the IATA Safety Report/Accident Study. The top Undesired Aircraft State (UAS) in the same report is “Improper Landing”, which has within it manual aircraft control elements. Industry comments from the report indicate the need to reinforce manual aircraft control skills and note that pilots are reluctant to revert to manual flight. Procedures not routinely flown present the greatest difficulty to crews and manual aircraft control is a key contributor to this, according to training data from ATQP.

The LOSA error management report indicates that pilots detect only around 40% of aircraft handling errors. In the case of self-detection, commanders detect 39% of handling errors of their first officers but only 9% of their own.

Degradation of manual aircraft control skills of pilots who use automation frequently, or who primarily fly very long sectors, is a concern, according to an FAA 1996 report.[1] Runway excursions accounted for almost 30% of all fatal accidents from 2000-2010, most included a manual aircraft control factor. This amounted to a 12% increase in fatal accidents classified as runway excursion compared to the previous decade. [Accident Study using augmented CAST data]

Skill decay/retention reports indicate that skill decay is currently not an issue in retaining manual flying skills. While this could be considered paradoxical, the manual skills required to execute maneuvers as part of maneuver validation, or skill test are resistant to decay but that test is given a vacuum of realism, with no attendant distractions or environmental challenges. The question of how good these skills are and how resistant to decay they are when required in a complex and dynamic situation is difficult to measure. However, there are indications from data to support the fact that manual handling is an increasing problem, when distracting factors, malfunctions and the environment draws pilot attention. This observation has to be considered in close relationship with indicated difficulties faced by pilots in the effective use of automation and the operator policies governing its use.

Automation has been the most important change in the operating environment of pilots in the last 30 years. There has been concern by many that manual aircraft control skills have decreased during this time. The evidence from the data is consistent with this concern.

Studies show that manual aircraft control is as important as always, with the attendant skills often being needed in unexpected and difficult situations.

2.3 THE UNSTABLE APPROACH PARADOX

The unstable approach is addressed as follows: “While airline Standard Operating Procedures (SOP’s) mandate a go-around if an approach is unstable, data indicates that landing from an unstable approach may be less risky.” Landings that follow an unstable approach are usually uneventful. 97% of unstable approaches result in a landing, of which 90% are uneventful, according to the LOSA report. The EBT flight data analysis supports the LOSA results that in almost all cases (Approximately 98%) pilots land from unstable approaches as opposed to executing a go-around. Additionally, according to FDA when looking at the percentages of landings following unstable approaches versus stable approaches, the percentages of flights with FDA events do not differ significantly between the two categories of approaches.

To add to this, the go-arounds are not usually well performed. Results from flight data analysis show that a go-around from an unstable approach is almost twice as likely to produce FDA high severity risk events as one from a stable approach. [See Fig 2.3a] This result may underestimate the real risk because flight data analysis is not capable of detecting some excursions from the missed approach profile. Evidence from LOSA also indicates that a go-around is rarely performed without error.

[1] FAA Human Factors team report 1996 on: The Interfaces Between Flightcrews and Modern Flight Deck Systems

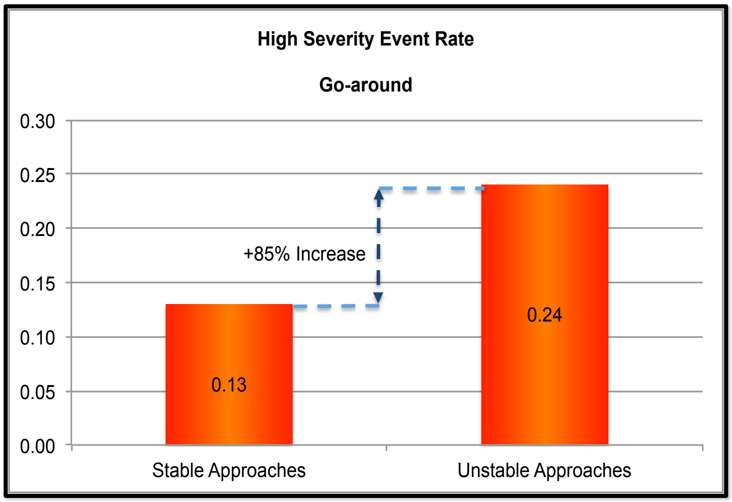

Figure 2.3a

To summarize the paradox; pilots are expected to go-around from unstable approaches, but they usually do not; when they do go around: "the missed approach is rarely handled well by the crew". [LOSA]. In contrast, when landing from an unstable approach, they overwhelmingly do it "without issue" (90%) [LOSA]

This situation brings up various questions, such as:

- Why do pilots have difficulties with go-arounds?
- How serious are unstable approaches?
- Is landing really the best option from unstable approaches?

Looking firstly at the reasons why pilots have difficulties with go-arounds shows the following reasons:

1. A go-around is usually unexpected
2. Go-arounds rarely occur from the altitudes practiced in training
3. Go-arounds are usually performed with relatively low gross weight, at the end of a sector and with all engines operating.
4. Go-arounds performed in training are usually from defined approach minima without visual reference and with one engine inoperative.

The overall rate of go-arounds is very low in general, approximately 0.31%. [FDA] According to almost all airline SOPs, a go-around should occur every time there is an unstable approach, but in fact, it only occurs a very small percentage of the time [3% LOSA] [1.4% FDA]

The reasons why pilots continue unstable approaches to landing are as follows:

1. Failure to recognize deviations or to remember the stabilized approach criteria. [LOSA]
2. A belief that the aircraft will be stabilized shortly after the mandatory stabilization altitude. [LOSA]
3. PF/PM over reliance on each other to call excessive deviations or to call for a go-around. [LOSA]
4. Excessive confidence by the PM that the PF will achieve a timely stabilization before landing. [LOSA]
5. According to the judgment by the pilot, the landing can be performed safely. [Pilot Survey – per 82% of respondents]
6. Successful experience from previous landings reinforces continuation in an unstable state. [Multiple Sources]
7. Pilots are not routinely exposed to go-arounds in training except in routinely conducted exercises at expected altitudes. This is likely to produce a reluctance to execute the go-around maneuver due to lack of confidence when conditions are different from those for which they have been trained. [Confirmed by multiple data sources]
8. Both crewmembers seem willing to continue the approach even though it is unstable. [according to the LOSA report]
9. There frequently appears to be unspoken agreement between the crew that the approach will continue. This has been rationalized over time into normal behavior. [LOSA]
10. It is clear that the decision to continue is consciously and evidently made by both crewmembers, even if it is unspoken. [LOSA]

Looking at the flights with at least one event on landing, the profile is remarkably similar when comparing the sets of stable approaches and unstable approaches. (See figs 2.3b and 2.3c.) Surprising though it may be, it indicates that landings from stable approaches are not without problems and that eliminating unstable approaches will only partially solve landing problems

While the frequency of approaches with landing events is roughly the same as for stable and unstable approaches, (See Fig 2.3b and Fig 2.3c) data indicate that unstable approaches are more risky for both the subsequent landing or go-around if we look at the type of events that occur.

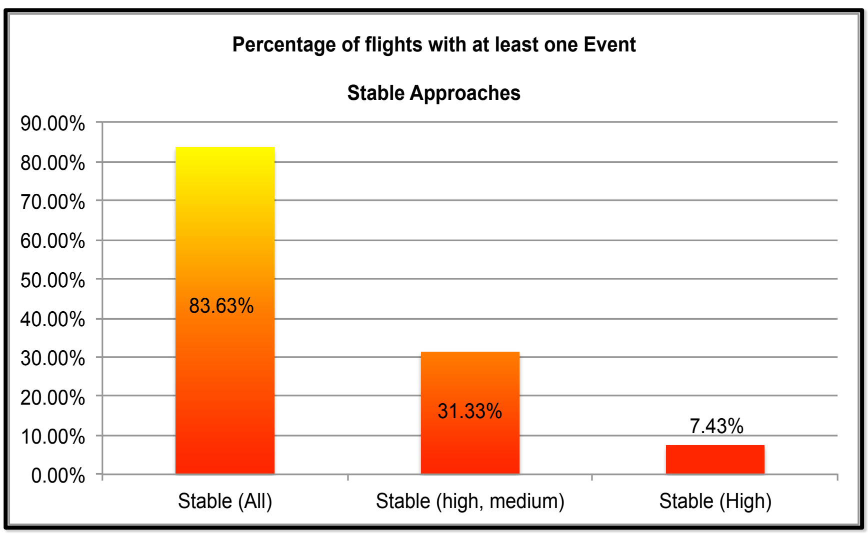

Figure 2.3b

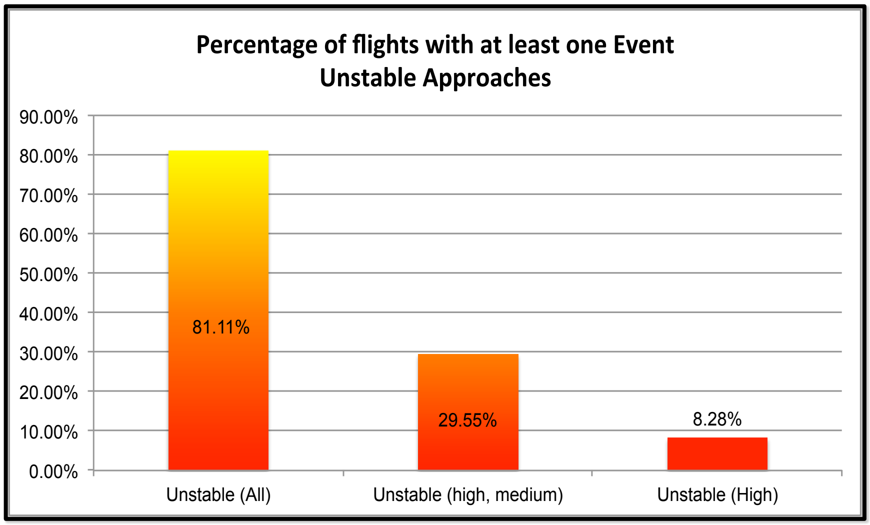

Figure 2.3c

Even though the frequency of approaches with at least one landing events is approximately the same for stable and unstable approaches, data indicate that unstable approaches are more risky for the subsequent landing or go-around when we look at the event rate and severity of events that occur.

The all-event rate is higher, by a magnitude of 20% for landings and by a almost 60% for go-arounds. (See Fig 2.3c and Fig 2.3d)

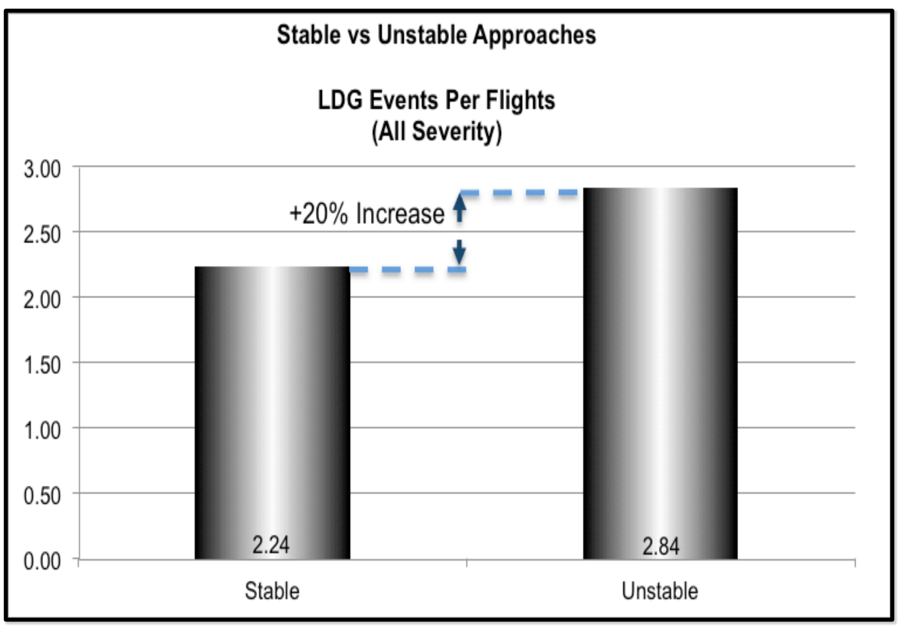

Figure 2.3d

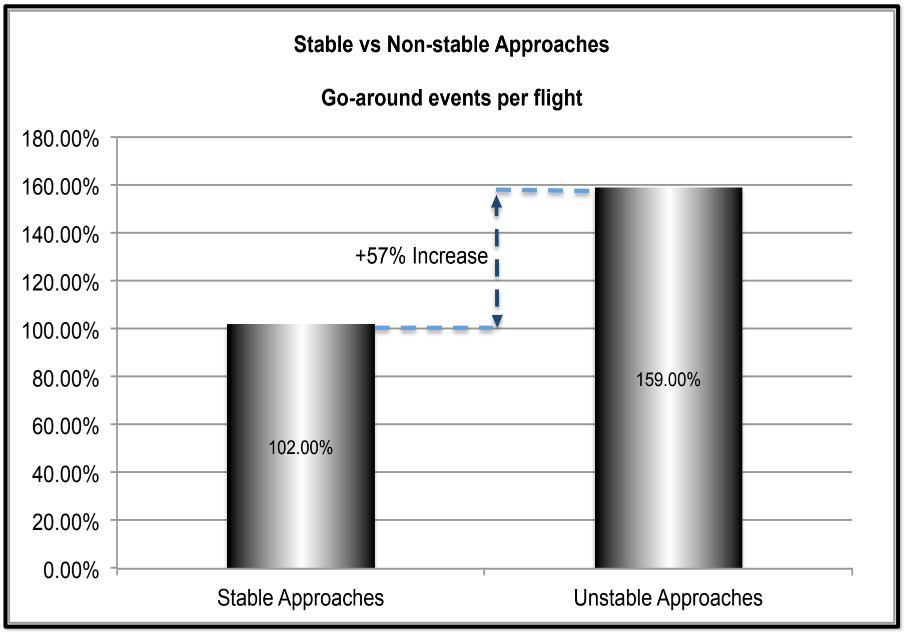

Figure 2.3e

The event rate for landings is 140% higher for high severity events and 85% higher for go-arounds. (See Fig 2.3e and Fig 2.3f)

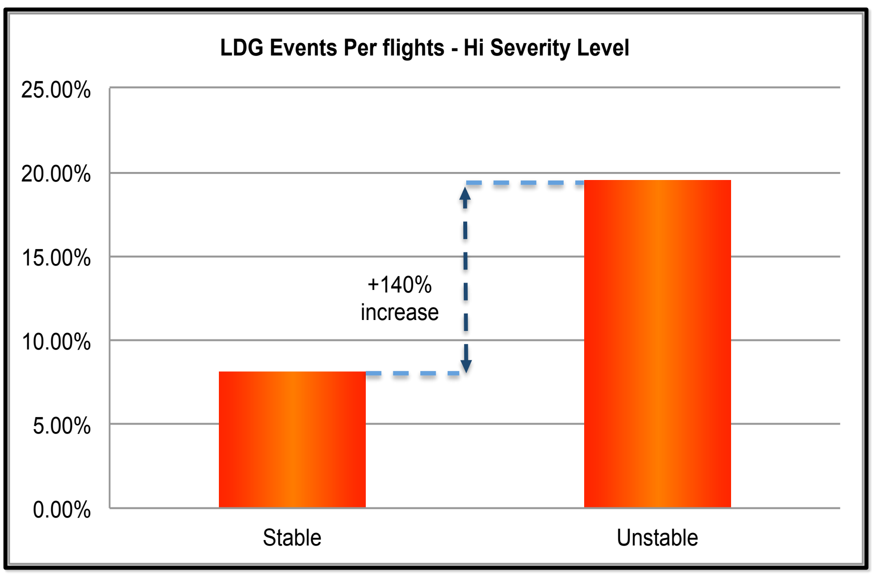

Figure 2.3f

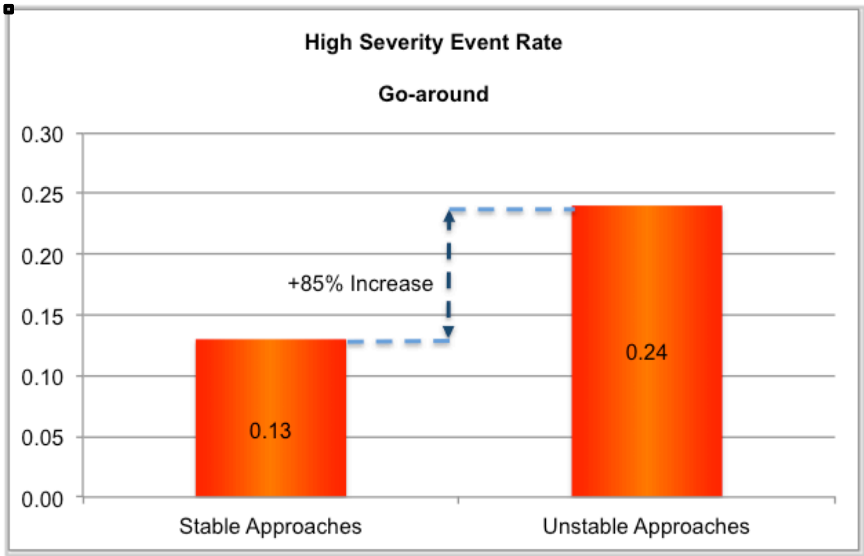

Figure 2.3g

The event rate for the most dangerous landing events is 179% higher. (See Fig 2.3h)

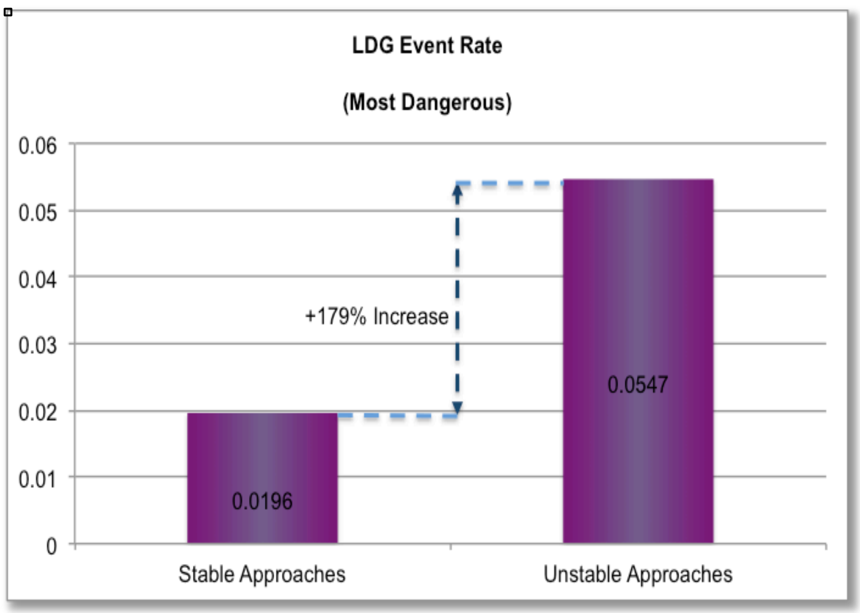

Figure 2.3h

After examining the landing and the go-around phases, we have a clearer picture of the associated risk. A subsidiary question naturally arises, about the quality of flight phases other than approach and landing in flights that have stable versus unstable approaches. According to flight data the overall event rate in those ‘other’ phases is approximately 20% higher for flights having unstable approaches and the severe event rate is 35% higher. (See Figures 2.3i and 2.3j)

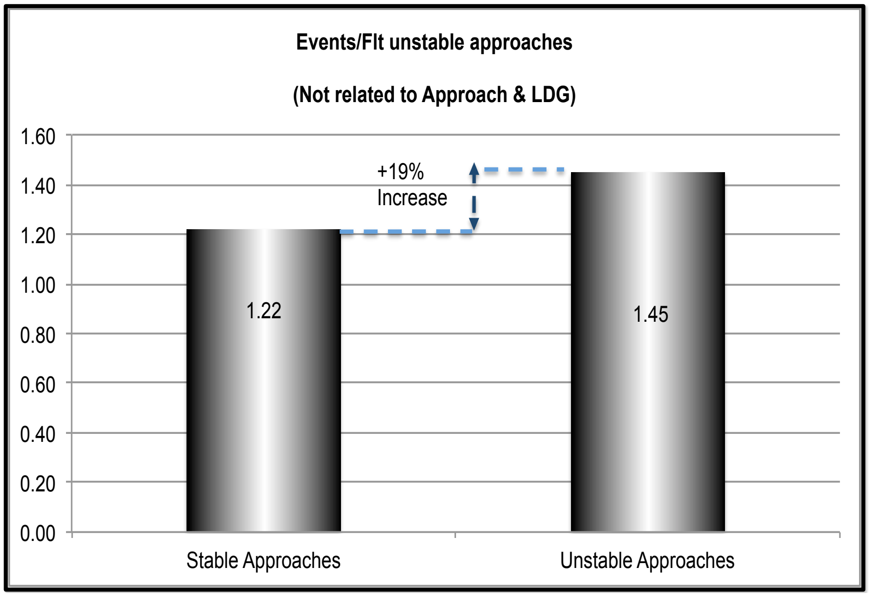

Figure 2.3i

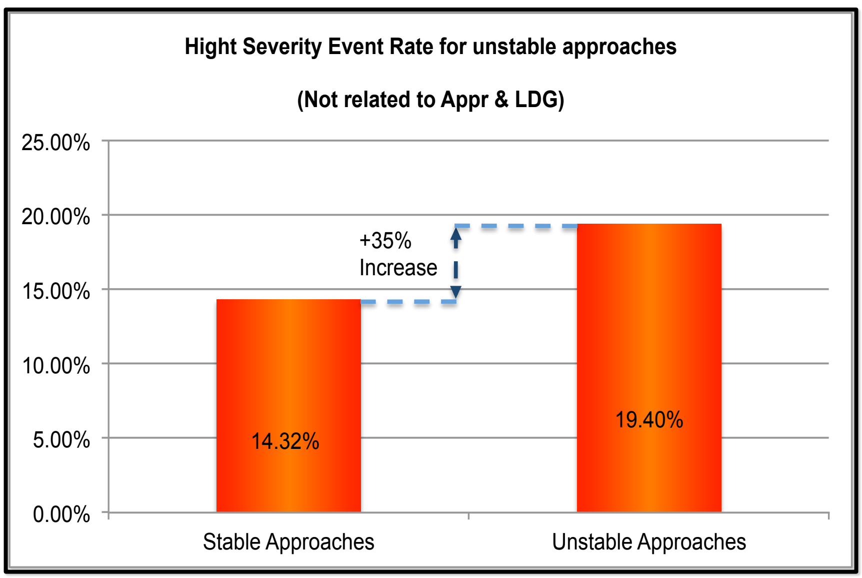

Figure 2.3j

In summary, unstable approaches are endemic across the spectrum of aircraft operations, regions and types. However, landing problems are an important training topic for all types of approaches, keeping in mind that the frequency of high severity landing events is much more of a concern with unstable approaches. Given that the rate of flights with landing events is approximately the same for stable and unstable approaches, solving the unstable approach problem will not necessarily solve all landing problems. This is particularly concerning when we note that the ratio of stabilized approaches to unstable approaches is approximately 27:1.

Despite efforts to eradicate unstable approaches and to mandate a go-around when conditions require, the rate of occurrence remains significant. A major concern of unstable approaches is the disregard of the SOP's, in addition to the efficacy of threat and error management during the entire flight. According to the LOSA report, there is a "90% (SOP) violation factor" in terms of not executing a go-around from an unstable approach.

Unstable approaches are often a barometer for the flight itself. If an approach is poorly executed, there are strong indications that the rate of errors and risk events will be higher across the entire flight, according to FDA and LOSA. Data from multiple sources indicate problems with the go-around, because it is not usually expected, and may have to be executed under demanding environmental conditions, from altitudes other than those practiced in training, with all engines operating and necessarily often higher energy states. When unraveling the unstable approach paradox, one issue remained clear throughout: the flight crew clearly should be trained to confidently and effectively perform a go-around during the approach in almost any situation and condition.

2.4 CATALYSTS IN THE COCKPIT

A catalyst is defined as an agent that provokes or speeds significant change or action. There are 2 types of catalysts: promoters and inhibitors. A promoter is a catalyst that accelerates and promotes a change or action; an inhibitor is a catalyst that slows or inhibits a change or action. As part of making assessments of the deployment of threat and error countermeasures, LOSA observers are asked to rate and comment on command leadership and the communication environment during the flight. The rating is completed on a 4-point scale: poor, marginal, good, and outstanding. The table below shows that flights with outstanding leadership and communication environment have on average 2.3 errors per flight versus an average 7.0 errors per flight for those with poor leadership and communication.

Ratings for Leadership, Communication Environment and TEM Indicators

TEM Indicator Average Number per Flight	LOSA Observer Ratings for Captain Leadership and Communication Environment		
	Outstanding Leadership Outstanding Communication	Good/Outstanding Leadership Poor Communication	Poor Leadership Poor Communication
Threats	4.9	4.3	5.0
Mismanaged Threats	0.3	0.7	1.1
Errors	2.3	5.6	7.0
UAS	0.4	1.4	1.8

Figure 2.4

The flights with poor ratings have approximately 3 times as many mismanaged threats, errors and undesired aircraft states as a flights with outstanding leadership and communication environment, even though the number of threats is approximately the same for both categories of flights (4.9 versus 5.0 respectively). Looking at the chart it seems clear that both command leadership and outstanding communication are catalysts of the promoter type. It is also interesting to note that even when the command leadership is rated good or outstanding, a poor communication environment in the cockpit still produces a high rate of mismanaged threats, errors and undesired aircraft states.

These LOSA results highlight the value of effective working relationships in the cockpit and are reinforced by a study completed in 2001 by Lufthansa. According to an extensive study of AQP results, leadership is a competency that can be developed. The analysis further shows the growing importance of communication in the latest generation of aircraft, and how effective communication substantially mitigates risk in the cockpit. But even though the importance of effective communication in the cockpit is clear, the LOSA report indicates and 1996 FAA Automation Report stipulates: (there is… a lack of verbalization skills to share mental models particularly in regard to automation.")

In addition to these two positive catalysts, command leadership and communication, studies also determined the presence of a negative catalyst: intentional non-compliance. According to the LOSA Report: "there is a significant correlation between the number of intentional non-compliance errors observed on a flight and the number of mismanaged threats, unintentional errors, mismanaged errors, and undesired aircraft states". (See Figure 2.4a)

Intentional Noncompliance & TEM Indexes

TEM Indicator	Flights with zero Intentional Noncompliance errors	Flights with one Intentional Noncompliance error	Flights with two or more Intentional Noncompliance errors
% of Flights in LOSA Archive	56%	24%	20%
Average number of threats per flight	4.4	4.7	4.8
Average number of errors per flight	1.9	3.7	6.6
% of flights with a mismanaged threat	23%	37%	50%
% of flights with a mismanaged error	27%	45%	65%
% of flights with an undesired aircraft state	25%	42%	59%

Figure 2.4a

The LOSA report states: "As the rate of intentional non-compliance increases, the rate of errors detected and acted on decreases." There is a negative correlation between the rate of non-compliance and the rate of errors detected and acted upon." That is to say that non-compliance is an inhibitor to detection and correction (i.e., multiplier in a negative sense). This is true across all error types".

Of the various intentional non-compliance error types, the higher rates generally occur with procedural errors. Commanders display significantly more non-compliance than first officers. Over 50% of checklist errors involve some form of intentional non-compliance. The vast majority of non-compliance checklist errors are attributable to the crew, only around 10% to external influences such as ATC. Almost half of all non-compliance checklist errors occur during pre-flight and taxi out, which may be related to on time performance pressures and distractions. There are multiple examples of high-risk situations exacerbated by non-compliance behavior, according to the LOSA Report, e.g., terrain, weather, traffic in addition to as well as approach and runway issues. Compliance issues are also highlighted in the IATA 2008/2009 accident reports. Furthermore, compliance is listed as one of the top 3 threats to safety according to the UK CAA CAP 776, "Global Fatal Accident Review 1997-2006". According to the EBT Pilot Survey on Training Effectiveness, 18% of respondents admit to deviating from checklists frequently and 21% of pilot respondents admit to deviations to standard call outs on virtually every flight.

One of the encouraging results from the EBT Accident Incident Study is that CRM has been improving over time. Compliance is not necessarily following this trend. Examining competencies as a percentage of accidents with high training effect over the last 15 years; deficiency in application of procedures according to published operating instructions was a factor in 49% of accidents. This evidence demands a change in compliance behavior of the flight crews by deliberate and focused attention during recurrent assessment and training in an EBT program.

2.5 THE SURPRISE EFFECT

The element of surprise adds difficulty in dealing with any given situation. When determining the effect of surprise, it is important to clarify the meaning of the term, which in the context of this study denotes the appearance of something unexpected. It does not necessarily refer to a completely unforeseeable event (black swan), nor does it refer to physiological effects, typically referred to as 'startle;' although it is recognized that the emotional response to an unexpected event may be a factor in the crew's capability to handle it Pilots need to be provided with more opportunities to learn and practice, especially how to handle surprising situations according to the FAA Automation Report from 1996. Many abnormal situations that pilots encounter during normal operations are not addressed in training, according to the IATA Accident Classification Task Force (ACTF), These include automation surprises (sudden, slow, and subtle) as well as go-arounds from above DA/MDA. When examining the notion of surprise, it is important to analyze situation awareness, because the appearance of surprise can indicate the absence of situation awareness (SA), as pilots are by definition not necessarily anticipating and planning for those eventualities.

The later generations of aircraft present crews with sophisticated tools and displays to assist situation awareness, and so it seems counter intuitive, but in fact is the case, that these aircraft (generations 3 and 4) have a higher percentage of accidents where SA is a factor as opposed to aircraft with more primitive displays. Poor SA was noted to be present in a higher percentage of fatal accident than for non-fatal accidents. [EBT Accident-Incident study] In the set of accidents that were rated highly preventable by training, the presence of the SA problems occurred in over 41% with an increasing trend over the last 15 years. [EBT Accident-Incident study] Situation Awareness issues include vulnerabilities in automation mode awareness, flight path awareness including insufficient terrain awareness, energy awareness (especially low energy state) [FAA Automation Report 1996]. Traditional training and checking do not usually address the element of surprise.

2.6 PRIORITIZATION OF TRAINING TOPICS

Prioritization of the training topics is probably the most important result from the EBT data analysis. It is a key part in the process for translating data into useful events and scenarios to assess and develop pilot performance in recurrent training programs. This result is the first rigorous attempt to rank parameters such as, threats, errors, competencies, along with factors affecting accidents and serious incidents, from multiple data sources systematically to formulate a recurrent training program.

The exercise shows the feasibility of collecting an adequate set of operational and training data; developing the necessary methods to analyze that data, while corroborating results to produce a criticality ranking of training topics. The prioritization process occurs for each of the 6 generations of aircraft by ordering critical parameters so as to highlight differences and commonality. There is sufficient flexibility in the process to allow enhancement according to mission, culture and type of aircraft. The data in the process is also used as material to build scenarios for use in recurrent assessment and training in an FSTD qualified for the purpose according to the Manual of Criteria for the Qualification of Flight Simulation Training Devices (Doc 9625), Volume I Aeroplanes.

The process used is transparent and repeatable and results in a unique prioritization, according to aircraft generation. Three levels of priority A, B and C, with A having the highest priority, were used to determine the frequency of pilot exposure to the defined training topics within a 3-year rolling recurrent training program.

Most data referred to in this report have been analyzed and are contained within the Evidence Table, and the EBT Accident and Incident Study. The Evidence Table consists of data from multiple sources and has the capability to sort as well as corroborate analytical results. It represents a robust set of evidence and it is a primary tool used in determining results. The EBT Accident Incident Study has 3045 reports feeding the analysis, making it comprehensive as well as sensitive in developing prioritization of results and discriminating by aircraft generation. Prioritization of training topics by generation uses both of these tools. In some cases, depending on the data, the assessment and training topics are drawn from both sources, in some from the Evidence Table alone, and in some from the Accident Incident Study alone. While the prioritization itself results from an algorithmic process, all analytical results were provided to the EBT Project Group comprising training experts and professionals in training scenario creation. Their utilization of the results served as an experiential validation.

Any set of historical data is necessarily finite. Using these data assumes that a large set of experience will have strong predictive validity even though the environment is constantly changing. These challenges were accepted because statistical and quality control principles were adhered to and more importantly, the results from data analysis were applied in the context of professional experience and expertise. For the creation of the EBT recurrent training program defined in this manual, a cautious approach was taken, and frequency of training suggested is equal to or higher than the results suggest unless the corroborating data is very strong. An example of this could be illustrated in the EBT Accident and Incident Study where the data imply different training frequency in adjacent generations. If the data are quite strong in the generation that demands more training, the training category in the adjacent generation is upgraded.

Operational and training data from multiple sources indicate that pilots operating the more modern generation aircraft take less time to achieve competence in the performance of certain maneuvers. Modern generation aircraft are also more complex, and pilots have more to learn in achieving a defined level of competency to operate. While the number of assessment and training topics is slightly fewer in early aircraft generations; the training time in the FTSD should be largely the same.

2.7 SUMMARY OF MAJOR FINDINGS

It is important to note that these major findings are simply a small part of the results, and that further results are detailed in Chapter 4, where there are many opportunities to make additional inferences. The Evidence Table contains over 300 evidential statements that clearly indicate and demonstrate a need for change in the regulation of flight crew training. In addition, they reveal a disconnection between existing training content and the reality of exposure to events in flight operations.

An underlying hypothesis of EBT is that there is a set of competencies that span the capabilities needed by flight crews in operations. This notion is supported by the analyses in this report. Competency issues rank very highly on the relative risk scale when analyzed over accidents and incidents. Competencies were almost always judged as being deficient in any accident or incident that was classified as being possible to mitigate by improvements in training.

There are significant aircraft generational differences in the flight phases of accident occurrence, e.g., Ground and Landing phases are the two most significant flight phases for accidents in Generation 4 Jets, but for Generation 3, the Take-Off phase is particularly critical. Approach is the most significant phase for Generation 2 aircraft. Engine failure ranks as the fourth priority for Generation 2 Jets, and seventeenth for Generation 3 and 4 Jets.

Clear trends were established, for example, the **need for training** becomes more and more critical according to several interesting trends:

- Firstly, as the severity of the accidents increase (i.e., in each generation High training effect is substantially higher for fatal accidents).
- Secondly as the generations become newer and the design and reliability improve. (fig 2.7)

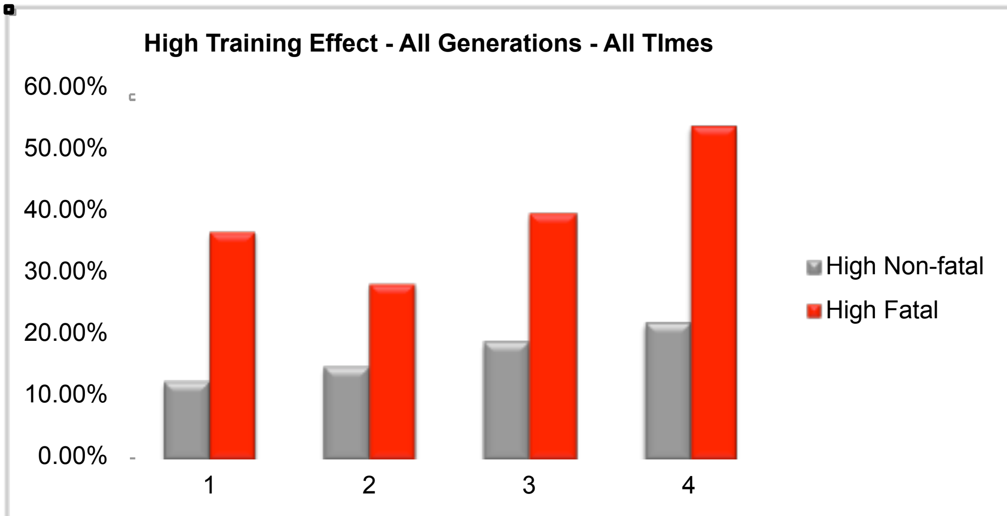

Figure 2.7

While the results of this study are in most cases not surprising, they are compelling when considered as a whole. It is clear that the current framework of regulated training requirements, usually based on an over-simplified view that replicating the same set of events and maneuvers, does not meet the need for pilots to maintain competence in modern air transport operations, nor does it prepare pilots for the challenges that they face in operations today.

Additionally we must:

1. Assess performance differently, and continue to develop and train, thereby maximizing learning throughout a pilots career.
2. Build upon the identified pilot core competencies to deal with much more than the simple maneuvers and standardized events used in checking and training today.
3. Understand and measure the factors, which contribute towards pilot performance, in order to develop and improve systematically, as well as determine the effectiveness of remediation in training through the EBT system.

There are many sources of data utilized in this study. Managing this volume of data was challenging and rewarding at the same time. In most cases results from independent sources relating to key topics showed consistent convergence.

While the process, analysis and findings represent an excellent beginning; a more comprehensive and structured use of pilot and instructor expertise is critical to the data gathering and analytical process. With any data source, there are always gaps between the information sought and what is available. The only exception to this comes from the professional experience of our flight crews within the system.

This EBT data report represents a big step in the process of making pilot training much more relevant to today's needs. However, the analysis must be updated on a continual basis as more information becomes available and the aviation system itself continues to evolve. Moving forward, the IATA GADM will provide a valuable source of data for further analysis and training purposes.

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3 DATA SOURCES AND METHODOLOGY

INTRODUCTION

This chapter describes in detail the methodologies applied during the analysis of each data source as well as the process that combines the data from various sources into meaningful results with respect to training. There are many graphical examples. The examples are intended to describe the methodology, and should not be used as excerpts of data analyzed. Source data is contained within the appendices, which should always be considered as the primary reference for any conclusions and findings.

3.1 LOSA STUDY

3.1.1 Objective

The objective of the LOSA Study for EBT is to provide a listing of systemic and pilot performance issues gathered from the LOSA Archive of over 9000 observations across 45 airlines around the world. The study identifies pilot performance issues according to both risk and the potential for mitigation through FSTD based recurrent training. The insight gained from the LOSA Study provides the EBT focus group with a unique contextual perspective of flight crew performance collected from the cockpit during normal operations. Findings provided from the study complement the findings from analyses of other data sources.

3.1.2 Background

LOSA data is collected using the Threat and Error Management (TEM) framework. The LOSA Collaborative conducted a research study designed to highlight 10 areas of pilot performance, agreed between the LOSA Collaborative and the EBT Data Sub-group. Each target is supported with aggregated LOSA/TEM results and excerpts from de-identified observer narratives. Additionally, the LOSA Collaborative provided a supplementary report on error detection. (See Appendix 1 for copies of the LOSA reports.)

All notable, specific evidentiary results were taken from the study and entered into the Evidence Table. (See Appendix 12 for the Evidence Table.)

3.1.3 Strengths and Weaknesses of LOSA

Pilot behavior can be influenced by the presence of an observer. While this can be considered a weakness, the LOSA collaborative employs strict protocols in selection, training and operational guidance to observers in order to minimize bias emphasizing standardization, neutrality and objectivity.

The LOSA methodology enables the determination “what happened” in addition to detailed contextual data, recorded according to defined standardized parameters. This provides deeper insight and some indications of “why it happened”. This strength comes from direct observation. The method provides a comprehensive insight into line operations as any data method in use today. Analysis of the LOSA database can be targeted and the EBT data study uses this focus to provide insight in the data analysis.

3.2 EBT ACCIDENT – INCIDENT STUDY

The accident incident analysis conducted by the EBT data subgroup is a two-stage analysis. The first stage involved reading the accident and incident reports by qualified pilot analysts to determine which factors and/or competency issues were involved in the accident or incident. Additionally, the analysts were asked to rate the degree to which improved training may have mitigated the results of the accident or incident. This general process was repeated by a second analyst for quality control and resulted in a spreadsheet for each individual type of aircraft analyzed. See Appendix 3 for the set of guidance provided for the analysts and figure 3.2.1.6 for an example of the spreadsheet.

The second stage of the study was based on the results of the first stage and involved analysis globally and individually within the 6 generations of aircraft. The process resulted in the prioritization of training topics by training criticality from a generational perspective, using the dimensionality of risk, clustering, and effectiveness of training.

3.2.1 Stage 1

3.2.1.1 Background

The NTSB database was used as the primary source of accident reports. The following western built aircraft types were considered:

1. Turbojet aircraft certified in accordance with CS-25 or FAR-25 with a seating capacity of 50 or more.
2. Turbo propeller aircraft certified in accordance with CS-25 or FAR-25 with a seating capacity of 30 or more.
3. 3045 accidents and incidents were considered over a period from 1962 up to 2010. Reports in this targeted group were omitted from the analysis if they were considered incomplete. Approximately 4% of the reports catalogued by the NTSB in our targeted category were not analyzed for this reason. If the report contained creditable and useful information to determine relevant factors it was used. In some of the cases the NTSB was not the investigating authority of record. In those cases, the official report or references to the official report were used.
4. Approximately 2600 jet aircraft and approximately 350 turbo propeller driven aircraft events were analyzed. Figure 3 below is the list of aircraft by generation. There are six defined aircraft generations, four applicable to jet aircraft and 2 applicable to turbo propeller aircraft.
5. Most aircraft in figure 3.2.1.1 were analyzed, but some aircraft types had almost no data available or a qualified analyst was not available. This was particularly the case with very old aircraft.

Aircraft by Generation	
Generation 4 Jet	A318/A319/A320/A321, A330, A340-200/300, A340-500/600, B777, A380, B787, A350, Bombardier C Series, Embraer E170/E175/E190/E195
Generation 3 Jet	A310/A300-600, B737-300/400/500, B737-600/700/800 (NG), B757, B767, B747-400, B747-8, B717, BAE 146, MD11, MD80, MD90, F70, F100, Bombardier CRJ Series, Embraer ERJ 135/145
Generation 3 Turboprop	ATR 42-600, ATR 72-600, Bombardier Dash 8 Q Series
Generation 2 Jet	A300 (except A300-600), BAC111, B727, B737-100/200, B747-100/200/300, DC9, DC10, F28, L1011
Generation 2 Turboprop	ATR 42, ATR 72 (all series except -600), Embraer EMB-120
Generation 1 Jet	DC8, B707

Figure 3.2.1.1

Aircraft Generations Analyzed in Accident and Incident Study	
Generation 4 Jet	Airbus A319, Airbus A320, Airbus A321, Airbus A330, Airbus A340, Boeing 777, Embraer 170/190
Generation 3 Jet	Airbus A300-600, Airbus A310, Boeing 737-300,400,500,600,700,800, Boeing 747- 400, 800, Boeing 757, Boeing 767, Embraer ERJ 135/145, McDonnell Douglas MD-80 Series, McDonnell Douglas MD-11
Generation 3 Turboprop	Bombardier Dash 8, British Aerospace Jetstream ATP, Embraer 120, Fokker F-27, SAAB 340
Generation 2 Jet	Airbus A300, Boeing 727, Boeing 737-100, 200, Boeing 747-100, 200, 300, McDonnell Douglas DC-9, McDonnell Douglas DC-10
Generation 2 Turboprop	ATR 42, ATR 72, British Aerospace Jetstream 41, Convair 580/600 Series, De Havilland DH7, Fairchild-Dornier 328, Fokker F-27, Shorts SD330/360
Generation 1	Boeing 707

Figure 3.2.1.1a

The data sample of accidents and serious incidents analyzed is highly representative of Aircraft Generations 2, 3 and 4, both for jets and turbo propellers as applicable.

Only the B707 was analyzed in Generation 1. Because there are very few remaining in operation, the effect on the analysis is minimal. Generation 1 was only analyzed in stage 1 and its value lies in providing historical contextual reference.

A total of 27 pilot-analysts participated in stage 1 of the study. The analysts chosen were pilots currently or previously qualified on the relevant type. The only exception to this was for several Generation 2 turboprop types, where it was not possible to find type qualified pilots. In these few cases, experienced analysts on similar types from the same generation were used. Work done by the volunteer pilot analysts was extensive. The group worked in excess of 2,000 man-hours reading and analyzing accident and incident reports.

The NTSB database provided a convenient template for defining the database of accidents and incidents to be analyzed because of its large size, but wherever possible the report from the primary investigating authority was used to determine the necessary information for the analysis.

The NTSB classified approximately 50% of events analyzed as serious incidents, the remainder being accidents, 17% of which were fatal and 83% non-fatal.

3.2.1.2 Description of the Method – Factor Analysis

For the purpose of this study, a factor is defined as a condition affecting an accident or incident with which the flight crew had to cope. The criterion for inclusion in the analysis was if a factor was mentioned directly in the report or if in the analyst's expert opinion the report logically implied the presence of a factor.

The accident-incident study is a factor analysis, consisting of the recording of factors related to the event. These factors may or may not be considered directly causal but should be relevant to the event.

The factors were originally defined in the Training Criticality Study by the EBT working group and can be described in character as threats, errors and "end-states" with the potential to become the focus of FSTD based training. These same factors were used in the EBT Accident-Incident Study enabling statistical correlation between the risk rankings for each study.

There are 40 factors and they are listed in figure 3.2.1.3.

A factor was noted if it was relevant to the event for the following reasons:

1. It was specifically listed in the report, or described with sufficient accuracy to be deemed present and relevant by the pilot analyst, without undue inference.
2. The factor may or may not have been causal; but it existed during and was relevant to the event.
3. The crew needed to manage or mitigate the factor.

Factor analysis is used to determine the distribution or frequency of factors occurring in accidents and incidents. (See Appendix 2 and 3)

3.2.1.3 Factors used in the Analysis

Factors in EBT Accidents and Incidents Study	
Ground Equipment	Runway Incursion
Ground Maneuvering	Poor Visibility
Runway/Taxi Condition	Upset
Adverse Weather/Ice	Wake Vortex
Windshear	Terrain
Crosswind	Birds
Air Traffic Control	Engine Failure
Navigation	Minimum Equipment List
Loss of Communications	Fire
Traffic	System Malfunction
Operation/Type Specific	Crew Resource Management
Cabin	Physio
Compliance	Workload Distraction Pressure
Deficiency in Manuals	Manual Aircraft Control
Deficiency in Operational Data	Dangerous Goods
Deficiency in Charts	Loading, Fuel, Performance
Deficiency in Check Lists	Mismanaged-AFS
Deficiency in Data Bases	Mismanaged Aircraft State
Deficiency in Procedures	Mismanaged System
Fatigue	Pilot Incapability

Figure 3.2.1.3

3.2.1.4 Competencies

All incident and accident reports were further analyzed to determine whether an area of competency was in some way reported as an issue and contributory to the event. For the purposes of the study, 9 competencies (technical and non-technical) were considered and they are listed and described in figure 3.2.1.4. Analysts were restricted to note only the 2 most important non-technical competencies in the report. That restriction was lifted for the technical competencies for which any deficiency could be noted. The reason for the restriction is the overlapping nature of non-technical competencies, leading to a tendency to over assign them. By limiting the number available in each event the analysts tended to be more careful in the selection process.

Note: The competencies listed in figure 3.2.1.4 were used for the accident and incident analysis. There have subsequently been some changes to this, which are reflected in ICAO Doc 9995 Manual of EBT.

Competencies			
Competency	**Competency Description**	**Performance Indicator – Observable Behaviour**	**Key**
Demonstrates the application of procedures	Applies procedures according to published operating instructions	Follows SOP's unless a higher degree of safety dictates otherwise Identifies and applies all (operating instructions) in a timely manner Correctly uses aircraft systems, controls and instruments Safely manages the aircraft to achieve best value for the operation, including fuel, the environment, passenger comfort and punctuality	Technical
Demonstrates effective communication	Demonstrates effective use of language, responsiveness to feedback and that plans are stated and ambiguities resolved.	Knows what, when, how much and with whom he or she needs to communicate Ensures the recipient is ready and able to receive the information Passes messages and information clearly, accurately, timely and adequately Checks that the other party has the correct understanding when passing important information Listens actively, patiently and demonstrates understanding when receiving information Asks relevant and effective questions, and offers suggestions Uses appropriate body language, eye contact and tone, and correctly interprets non-verbal communication of other crew members Is receptive to other people's views and is willing to compromise	Non-technical
Demonstrates effective flight path management, through proper use of flight management system(s), guidance and automation	Demonstrates proficient and appropriate use of flight management system(s), guidance and automation including transitions between modes, monitoring, mode	Knows how and when to use flight management system(s), guidance and automation Demonstrates correct methods for engagement and disengagement of auto flight system(s) Demonstrates appropriate use of flight guidance, auto thrust and other automation systems Maintains mode awareness of auto flight system(s), including engagement and automatic transitions Reverts to different modes when appropriate Detects deviations from the desired aircraft state (flight path, speed, attitude, thrust, etc.) and takes appropriate action	Technical
Demonstrates knowledge	Demonstrates knowledge and understanding of relevant information, operating instructions, aircraft systems and the operating environment.	Demonstrates practical and applicable knowledge of limitations and systems and of their interaction Demonstrates required knowledge of published operating instructions Demonstrates knowledge of the physical environment, the air traffic environment including routings, weather, airports and the operational infrastructure Demonstrates knowledge of and compliance with applicable legislation. Knows where to source required information	Technical
Demonstrates leadership and teamwork	Uses appropriate authority to ensure focus on the task. Supports others in completing tasks.	Agrees with and is clear about the team's objectives and the crew members' roles Is approachable, positive, motivating and considerate of others Uses initiative, gives direction and takes responsibility when required Anticipates other crew members' needs and carries out instructions when directed Is open and honest about thoughts, concerns and intentions Gives and receives both criticism and praises well, and admits mistakes Confidently says and does what is important Demonstrates empathy, respect and tolerance for other people Involves others in planning and allocates activities fairly and appropriately according to abilities	Non-technical
Demonstrates manual aircraft control	Maintains control of the aircraft in order to assure the successful outcome of a procedure or manoeuvre.	Demonstrates manual aircraft control skills with smoothness and accuracy as appropriate to the situation Detects deviations through instrument scanning Maintains spare mental capacity during manual aircraft control Maintains the aircraft within the flight envelope Applies knowledge of the relationship between aircraft attitude, speed and thrust	Technical
Demonstrates effective problem solving and decision making	Detects deviations from the desired state, evaluates problems, identifies risk, considers alternatives and selects the best course of action. Continuously reviews progress and adjust plans.	Identifies and verifies why things have gone wrong and does not jump to conclusions or make uninformed assumptions Seeks accurate and adequate information from appropriate sources Perseveres in working through a problem Uses or agrees to an appropriate decision making process Applies essential and desirable criteria and prioritizes Considers as many options as practicable Makes decisions when needed, reviews and changes them if required Considers risks but does not take unnecessary risks Improvises appropriately when faced with unforeseen circumstances to achieve the safest outcome	Non-technical
Demonstrates situation awareness	Has an awareness of the aircraft state in its environment; projects and anticipates changes.	Is aware of what the aircraft and its systems are doing Is aware of where the aircraft is and what its environment is Keeps track of time and fuel Is aware of the condition of people involved in the operation including passengers Recognises what is likely to happen, plans and stays ahead of the situation Develops "what if" scenarios and plans for contingencies Identifies threats to the safety of the aircraft and people, and takes appropriate action	Non-technical
Demonstrates effective workload management	Prioritises, delegates and receives assistance to maximise focus on the task. Continuously monitors the flight progress.	Is calm, relaxed, careful and not impulsive Prepares, prioritises and schedules tasks effectively Uses time efficiently when carrying out tasks Offers and accepts assistance, delegates when necessary and asks for help early Reviews, monitors and cross-checks actions conscientiously Follows procedures appropriately and consistently Ensures tasks are completed Manages interruptions, distractions, variations and failures effectively	Non-technical

Key: Technical (green); Non-technical (orange)

Figure 3.2.1.4

3.2.1.5 Training Effect

Training effect is considered as the potential effect of FSTD training in preventing the accident or incident from occurring or mitigating the severity of the event, on a 5-point scale, as follows:

- U Unknown
- N No effect
- L Low effect
- M Medium effect
- H High effect

3.2.1.6 Summary of Parameters in the Report Analysis

Other parameters were recorded for analysis in the EBT report as follows:

1. Date
2. Severity of event (fatal, non-fatal or serious incident)
3. Phase of flight
4. Aircraft generation
5. Location
6. Region of the world
7. Aircraft type
8. Competencies
9. Training effect

See Fig 3.2.1.6 for an excerpt sample of the analysis matrix. (See Appendix 3 for a full representation accident-incident analysis including the entire analysis matrix.)

Accidents Info							Threats and Errors													Competencies								
Date	Fatal Non-Fatal Incidents	Link	Phase	Gen	Region	Type	Ground equipment	Ground maneuvering	Runway/Taxi Condition	Adverse Weather/Ice	Windshear		Crosswind	ATC	L.F.P.	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control
06/28/10	N	http:	CRZ	3	NA	EMB-145				1		**Note:** For this example, 28 factors have been removed.																
06/16/10	N	http:	LDG	3	EUR	EMB-145			1								1											1
04/03/10	N	http:	CRZ	4	NA	EMB-170				1																		
03/12/10	I	http:	APR	3	NA	EMB-145				1																		
12/07/09	N	http:	LDG	3	NA	EMB-135			1	1							1				1							1
07/27/09	N	http:	CLB	4	NA	EMB-170				1																		
07/11/09	N	http:	APR	4	NA	EMB-170				1																		
06/26/09	I	http:	GRD	3	NA	EMB-145		1						1														
06/03/09	I	http:	GRD	3	NA	EMB-145		1						1														
05/21/09	N	http:	GRD	3	NA	EMB-135		1									1				1							1
12/26/08	N	http:	DES	4	NA	EMB-170				1																		
12/11/08	I	http:	LDG	3	NA	EMB-145																						
08/14/08	N	http:	LDG	3	NA	EMB-145											1							1		1		1
07/21/08	I	http:	TO	3	NA	EMB-145								1														
05/27/08	N	http:	CRZ	3	NA	EMB-140				1																		
02/17/08	N	http:	GRD	4	NA	EMB-170		1									1				1							1
02/15/08	N	http:	CLB	3	NA	EMB-145																						
12/17/07	I	http:	TO	3	NA	EMB-145																						
12/14/07	N	http:	GRD	4	NA	EMB-190		1	1																			
08/07/07	N	http:	DES	3	NA	EMB-145				1																		
06/20/07	I	http:	LDG	3	NA	EMB-145																						

EXAMPLE

Figure 3.2.1.6

3.2.1.7 Quality Control

In order to achieve consistency and standardization across stage 1 of the analysis, two different pilot experts independently analyzed each accident or incident. The first analysis was conducted by a pilot currently or previously qualified on the aircraft type (the analyst), the second was conducted by a pilot (the checker) qualified on type, or on an aircraft of the same generation. Any discrepancy between the first and second analysis was noted, then reconciled by a separate team of 3 pilots, at least 2 of which working together to reconcile the differences. The reconciliation team was limited to the same 3 pilots for the entire study.

3.2.1.8 Strengths and Weaknesses

Accident analysis has been the bedrock of safety analysis for a very long time, providing the context and framework for all other safety analysis and reporting. The NTSB database consists of an extensive collection of accidents and incidents spanning 60 years, providing historical perspective and trending data over time, thereby enabling dimensional comparisons across generations of aircraft. It is the largest single source of this kind of data. The biggest strength of accident and incident type of data is its relevancy to safety and training (i.e., evidence based training in a pure sense). The substantial amount of data over an extended period provides, in most cases, statistical significance in terms of frequency and risk. A large sample such as this was considered necessary in order to provide a sufficient data source for factor analysis.

The biggest weakness in accident-incident reports is the inconsistency and lack of standardization of reports. Older reports lack information on human factors as well as factors that were relevant but not judged as causal. While the NTSB database is the largest collection of accident and incident reports, a number of accidents outside North America are not included.

The search for direct and final causation means that some underlying factors are missing from reports.

In order to obtain realistic values from analysis, a large number of events are needed. Conversely if the events sample size is small, the usefulness of the analysis diminishes. When ‘drilling down’ the data sample can become small very quickly with a resulting impact on reliability, so that in-depth analysis for specific factors must be done very carefully by re-reading source reports, itself a very time consuming process.

The factor analysis is primarily statistical in nature, but whenever the result could be questioned for consistency, or there was a need for additional information, a “drill down” was accomplished.

Aircraft Analyzed in EBT Accident and Incident Study	
Generation 4 Jet	Airbus A319, Airbus A320, Airbus A321, Airbus A330, Airbus A340, Boeing 777, Embraer 170/190
Generation 3 Jet	Airbus A300-600, Airbus A310, Boeing 737-300,400,500,600,700,800, Boeing 747- 400, 800, Boeing 757, Boeing 767, Embraer ERJ 135/145, McDonnell Douglas MD-80 Series, McDonnell Douglas MD-11
Generation 3 Turboprop	Bombardier Dash 8, British Aerospace Jetstream ATP, Embraer 120, Fokker F-27, SAAB 340
Generation 2 Jet	Airbus A300, Boeing 727, Boeing 737-100, 200, Boeing 747-100, 200, 300, McDonnell Douglas DC-9, McDonnell Douglas DC-10
Generation 2 Turboprop	ATR 42, ATR 72, British Aerospace Jetstream 41, Convair 580/600 Series, De Havilland DH7, Fairchild-Dornier 328, Fokker F-27, Shorts SD330/360
Generation 1	Boeing 707

Figure 3.2.1.1a (duplicate)

3.2.2 EBT Accident-Incident Study – Stage 2

3.2.2.1 Purpose

The purpose of the stage 2 analyses is to utilize results from stage 1 to analyze accidents and incidents in each aircraft generation and across all generations.

3.2.2.2 The Master File

Stage 2 analyses are completed in one master file unlike stage one where the analysis is done in individual files for each type. The master file is created by integrating files from the analysis of different aircraft types from stage 1. The analysis for a specific generation could only be carried out after all the aircraft types for that generation had been through the stage 1 process.

Files from each aircraft generation are integrated into the master file as they became available. Each row in the master file represents one accident or incident (event).

Columns of the master file contain the following data for each event from the Stage 1 analysis:

1. Date
2. Severity class (fatal accident/non-fatal accident/incident)
3. Active link to the event narrative in the NTSB database
4. Phase of flight during which the accident occurred
5. Generation of aircraft
6. Location of accident Region
7. Aircraft type
8. Factor – one for each of the 40 factors defined [Ref Figure 3.2.1.3]
9. Competencies – one for each of the 9 Competencies defined [Ref Figure 3.2.1.4]
10. Training effect

[See Figure 3.2.1.6 for an example or Appendix 1 Core Analysis Matrix Stage 1]

In order to accomplish the stage two analyses, 6 additional parameters are studied, adding 6 columns as follows:

1. Year of event (directly derived from the event date)
2. Column indicating whether the event took place within the last 15 years or not
3. The decade of the event
4. Event Identification number
5. Sum of Factors present in the event. This helped in calculating the Clustering tendency of each factor and to make integrity checks on the Master File.
6. Sum of competencies present in the event, for same reasons as 5 above.

(See Figure 3.2.2.2 for an example)

Accidents Info							Threats and Errors								Competencies									Stage Two Parameters								
Date	Fatal Non-Fatal Incidents	Link	Phase	Gen	Region	Type	Ground equipment	Ground maneuvering	Runway/Taxi Condition		Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	YEAR (nb)	Last 15 Y	Decade	wo blanks	YEAR (text)	Event ID number	nb of Factors	nb of KSAs
05/09/04	N	Proba	LDG	P3	NA	ATR72													1				1	H	2004	Last 15 Y	2000	5/9/2004	2004	2554	1	2
08/06/05	F	Proba	CRZ	P3	EUR	ATR72																		N	2005	Last 15 Y	2000	8/6/2005	2005	2557	3	0
04/28/07	N	Proba	DES	P3	NA	ATR72																		N	2007	Last 15 Y	2000	4/28/2007	2007	2558	1	0
03/01/03	N	Proba	CRZ	P3	NA	ATR72				**Note:** For this example, 33 factors have been removed.														N	2003	Last 15 Y	2000	3/1/2003	2003	2559	1	0
02/08/03	N	Proba	GRD	P3	NA	ATR72																		N	2003	Last 15 Y	2000	2/8/2003	2003	2560	1	0
11/20/00	N	Proba	DES	P3	NA	ATR72									1									M	2000	Last 15 Y	2000	11/20/2000	2000	2561	2	2
03/10/00	N	Proba	CRZ	P3	NA	ATR72																		N	2000	Last 15 Y	2000	3/10/2000	2000	2562	1	0
12/01/98	N	Proba	DES	P3	NA	ATR72																	1	M	1998	Last 15 Y	1990	12/1/1998	1998	2563	1	1
10/31/94	F	Proba	CRZ	P3	NA	ATR72																		H	1994	Older	1990	10/31/1994	1994	2569	6	0
06/04/93	N	Proba	CLB	P3	NA	ATR72						1				1			1					H	1993	Older	1990	6/4/1993	1993	2571	3	2
04/20/09	N	Proba	GRD	P3	NA	DHC8	1	1																H	2009	Last 15 Y	2000	4/20/2009	2009	2574	3	1
02/12/09	F	Proba	APR	P3	NA	DHC8					1									1	1		1	H	2009	Last 15 Y	2000	2/12/2009	2009	2575	7	3
02/03/08	N	Proba	DES	P3	NA	DHC8																		L	2008	Last 15 Y	2000	2/3/2008	2008	2577	1	0
01/31/07	N	Proba	DES	P3	NA	DHC8																		L	2007	Last 15 Y	2000	1/31/2007	2007	2578	1	0
08/29/05	N	Proba	GRD	P3	NA	DHC8		1																N	2005	Last 15 Y	2000	8/29/2005	2005	2579	1	0
01/08/03	N	Proba	APR	P3	NA	DHC8																		N	2003	Last 15 Y	2000	1/8/2003	2003	2583	2	0
10/14/02	N	Proba	APR	P3	NA	DHC8																		L	2002	Last 15 Y	2000	10/14/2002	2002	2584	2	0
03/06/01	N	Proba	APR	P3	NA	DHC8																		N	2001	Last 15 Y	2000	3/6/2001	2001	2587	2	0
10/06/99	N	Proba	CRZ	P3	NA	DHC8																		N	1999	Last 15 Y	1990	10/6/1999	1999	2589	1	0
09/27/98	N	Proba	APR	P3	NA	DHC8																		L	1998	Last 15 Y	1990	9/27/1998	1998	2590	1	0

EXAMPLE

Figure 3.2.2.2

3.2.2.3 Methodology for Analysis

Demographics of the data set are considered, in order to determine the opportunities and limitations of the analysis

1. **Time** is an important parameter for charting the evolution of accidents and incidents and understanding the most critical factors for consideration in training today. In addition to sorting data by decades, events are divided into 2 intervals, the last fifteen years and the preceding 35. Several important studies, including the FAA Automation Report, the UK CAA Accident Studies (CAP 776 & 780) and other safety studies in the meta-analysis, focus on changes in safety and training during the last 15 to 20 years.
2. **Severity**, a component of risk, classified in terms of fatal accidents, non-fatal accidents and incidents.
3. **Flight phases** as they vary in the types of demands on flight crews.
4. **Regional distinctions** enable a regional geographical perspective.
5. **Training Effect** is an important dimension as it can be a measure of how effective potential training can be in mitigating accidents and incidents. Just as importantly, in this study it is used to sort the data set itself such that the competencies, factors, generations can be viewed in terms of training effectiveness.

Data is normalized in two ways in the stage two analyses:

1. The percentages of all accidents, fatal accidents, and incidents for each generation. This is important as it shows the frequency of factor occurrence within each generation of aircraft indicating likelihood, a component of risk that is one of the dimensions of Training Criticality, which is subsequently calculated.
2. Normalizing by 1M TOs (1 million take-offs) relates to a more universal and comparable reference. It is useful in showing trends across aircraft generations (and/or time periods.) It also has the notion of probability: i.e., what is the probability within a certain time interval and/or generation of encountering an accident with a particular factor.

Examining the ranking of factors with all the dimensions listed above for each of the 6 generations creates 2x3x9x8x6=2592 charts. In addition, ranking by factor is only one aspect of the data analysis. After experimenting for some time with what could be the most informative ways to look at the data, the following views were chosen to be the standard set for each aircraft generation

3.2.2.4 General View of Accidents and Incidents

In this section all accidents, fatal accidents and/or incidents are broken down by decades in terms of:

- Generations
- Raw numbers
- Percentage of occurrences
- Rate of occurrences (per 1 million Take-offs)
- Flight phases

The following figures are some examples of these partitions of the EBT accident incident database to demonstrate the steps of the analysis; a more complete breakdown for each generation occurs in Chapter 4 Analysis and Appendix 2:

1. The first illustration (fig 3.2.2.4) shows the actual raw number of accidents and incidents by generation per decade from 1960 to 2010. This allows a basic look at which aircraft generations dominate the safety scene and a general look at the historical trends.

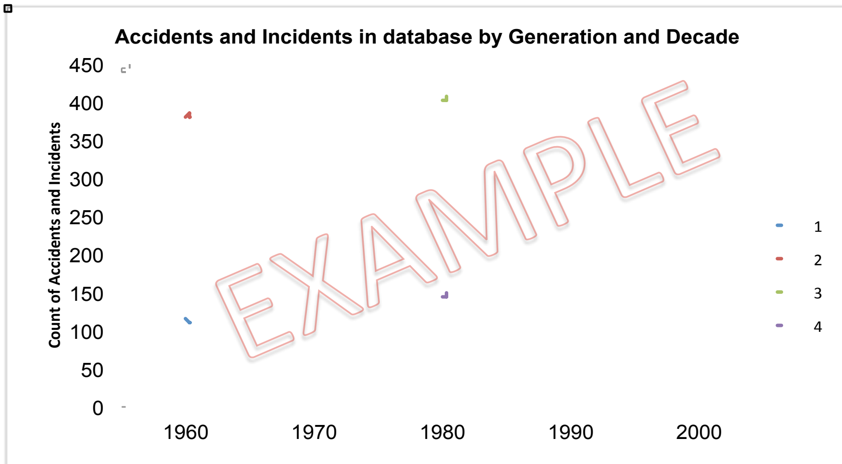

Figure 3.2.2.4

2. The next chart (fig 3.2.2.4a) shows all accidents (Fatal and Nonfatal) divided by generation in percentages per decades from 1960 to 2010. The breakdown here is similar to the previous graph except that it is normalized by percentages and only refers to accidents.

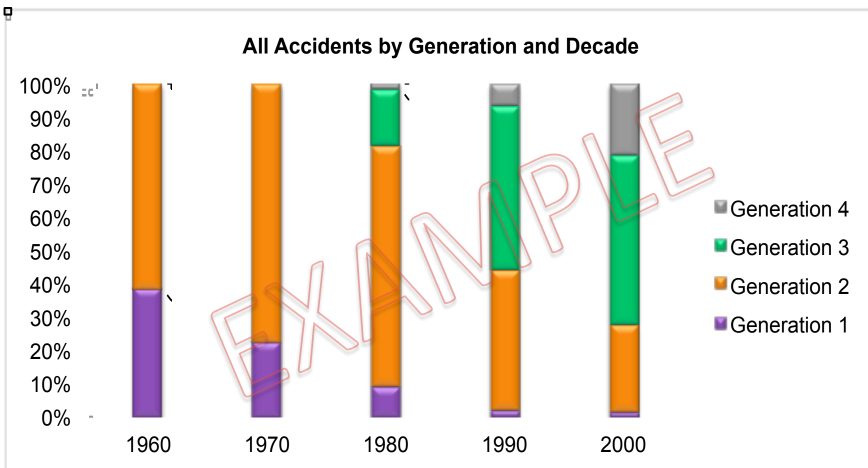

Figure 3.2.2.4a

3. Figure 3.2.2.4b denotes the number of accidents (Fatal and Non fatal) for each flight phase by decade.

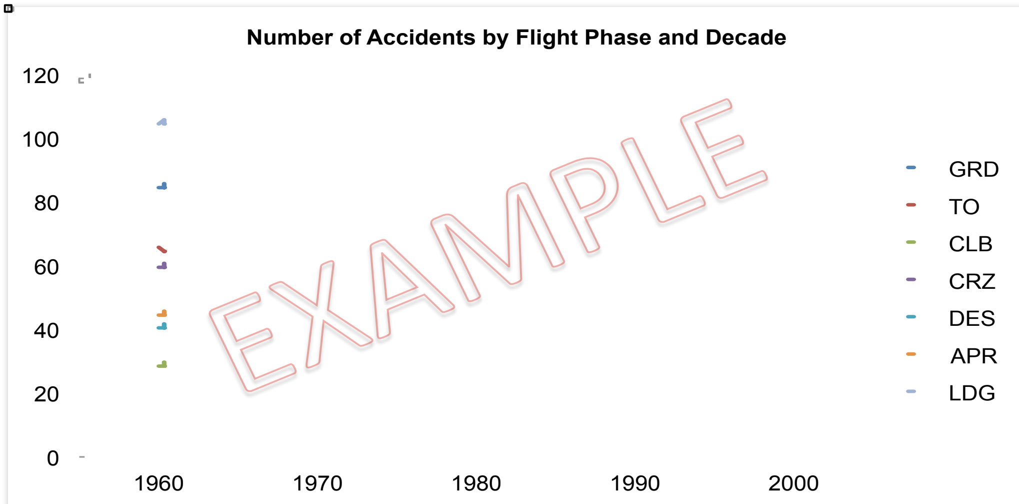

Figure 3.2.2.4b

4. Figure 3.2.2.4c shows the same breakdown of the data except as an accident rate (normalized per 1 million take-offs).
5.

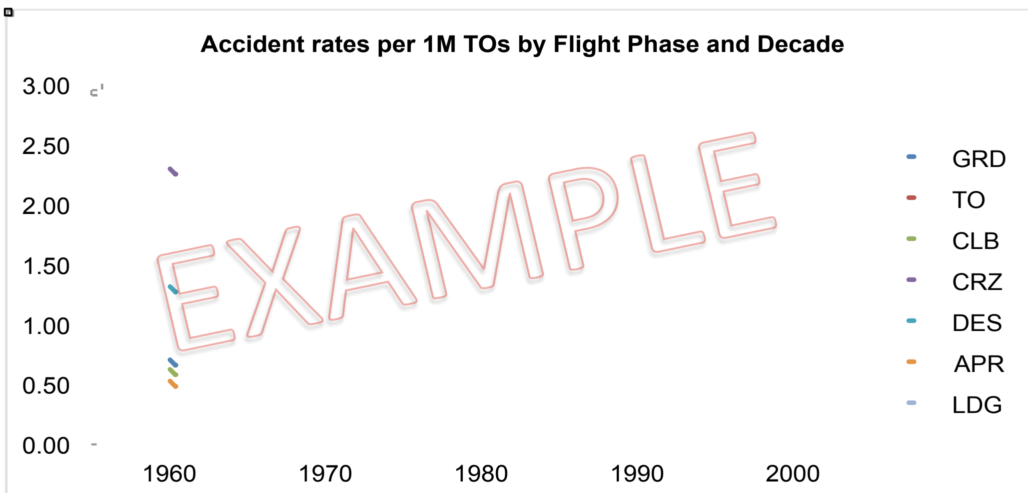

Figure 3.2.2.4c

3.2.2.5 View of Accidents Historically and by Phase of Flight

When looking at accidents as evidence for training from a historical perspective, more recent occurrences tend to be more useful for training criticality analysis than the older accidents. However, the older period does provide a good measure for comparison. Interestingly when splitting the EBT accident database into two equal parts, the corresponding time periods turn out to be the last 15 years and the previous 33. The next set of illustrations show some examples providing a breakdown of the above two time periods by aircraft generation in terms of phases of flight and:

- Number of accidents (all accidents and fatal only)
- Percentage of accident occurrence (all accidents and fatal only)
- Proportion of factors involved

These few examples demonstrate the type of analyses performed; the values and the inferences will be looked at more closely in the next chapters with a more complete breakdown and exhaustive case review. The purpose of the graphs in this chapter is to exemplify methods and process.

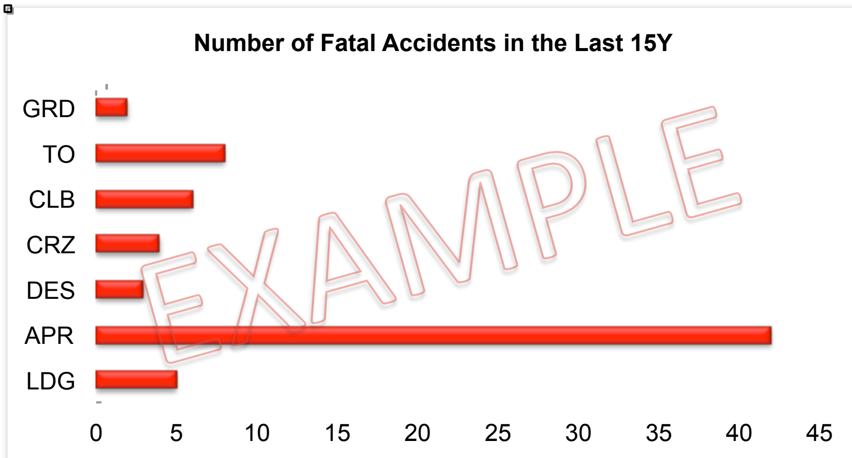

Figure 3.2.2.5 – Example Gen 2 Jet

Note: Breakdown is number of fatal accidents per phase of flight in the last 15 years for a specific generation.

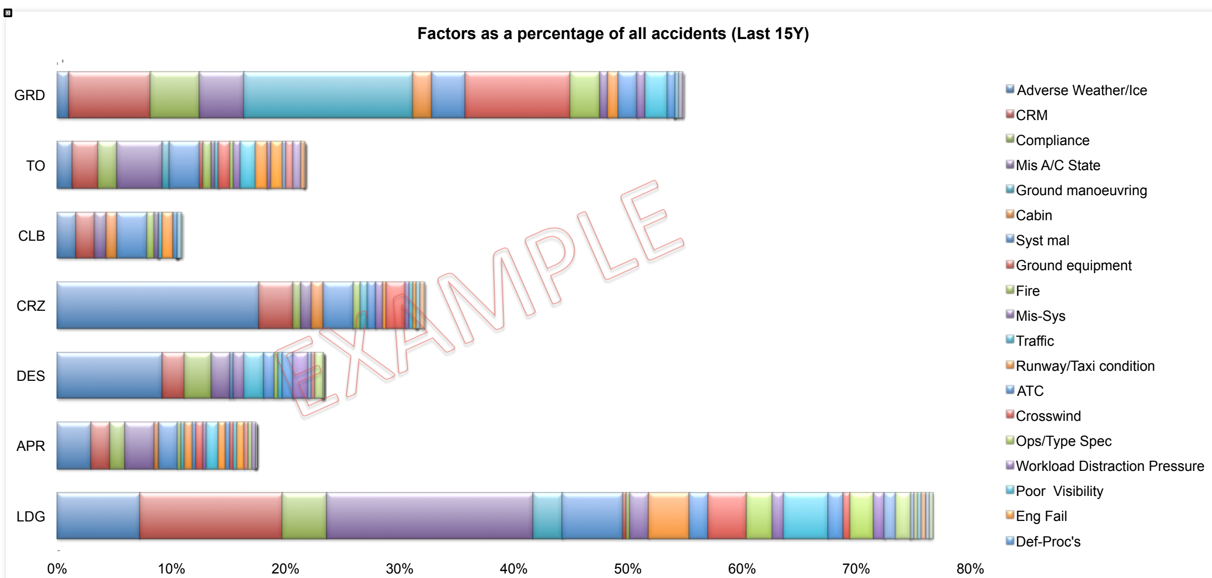

Figure 3.2.2.5a – Example Gen 3 Jets

The breakdown in figure 3.2.2.5 is percentages of all accidents per flight phase for a specific generation. Additionally proportionality of factors depicted by color. Notice the sum of the bars exceeds 100%, since each accident normally contains more than one factor.

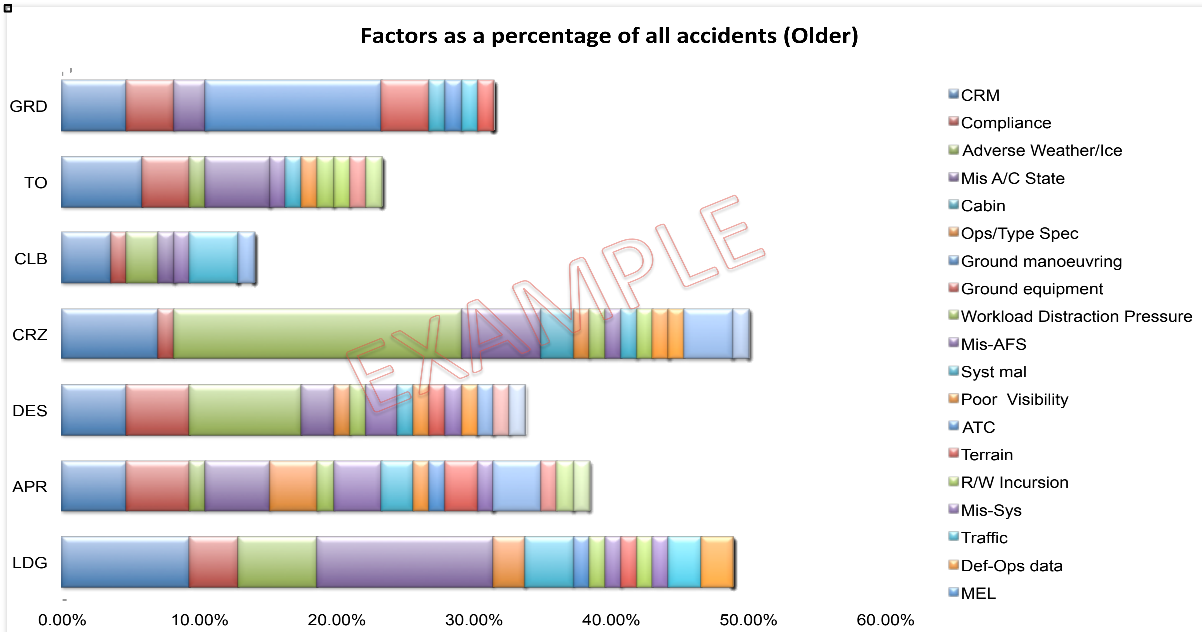

Figure 3.2.2.5b – Example Gen 3 Jets – Previous time period

The next chart (figure 3.2.2.5c) shows an alternate view (i.e., complete percentage breakdown of factors in each phase) to better highlight the dominating factors in each phase. In this calculation each bar represents the proportion of the factors occurring for the set of accidents within that specific phase; meaning that color length is not comparable across phases.

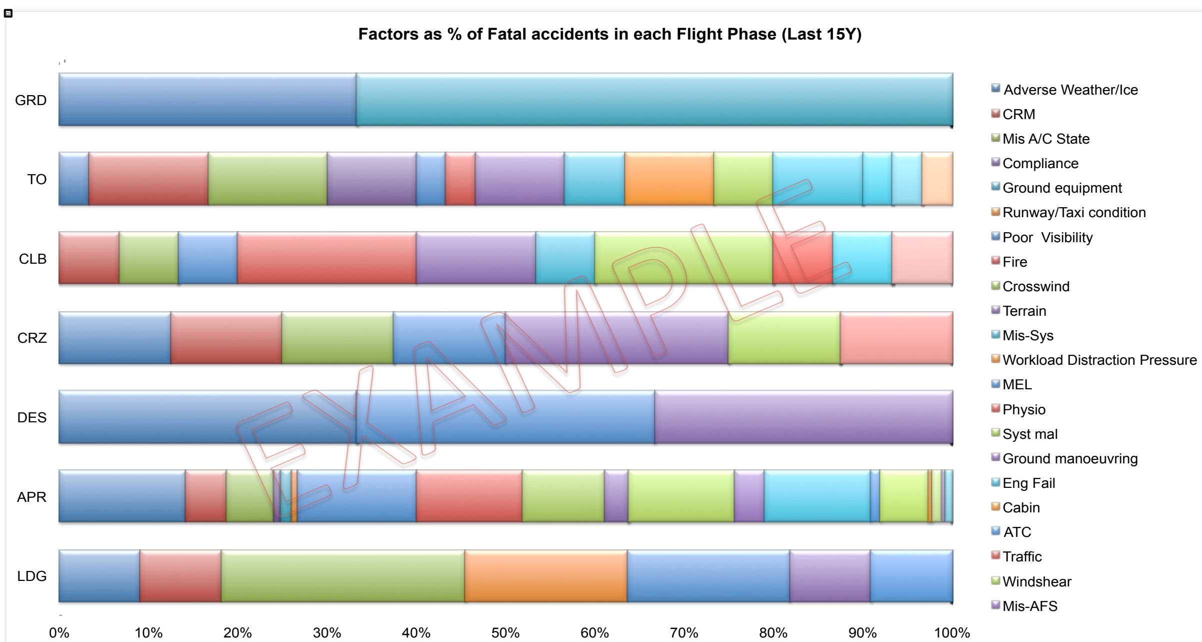

Figure 3.2.2.5c – Example Gen 2 Jets

3.2.2.6 Ranking Factors in Accidents by Occurrence

This step in the EBT accident and incident analysis orders and compares the factors by frequency of occurrence in the last 15 years versus the previous time period. Figure 3.2.2.6 is an example of the comparative rankings in terms of percentage of all accidents with each factor while figure 3.2.2.6a makes the same comparison but normalized by exposure (i.e., 1 million take-offs).

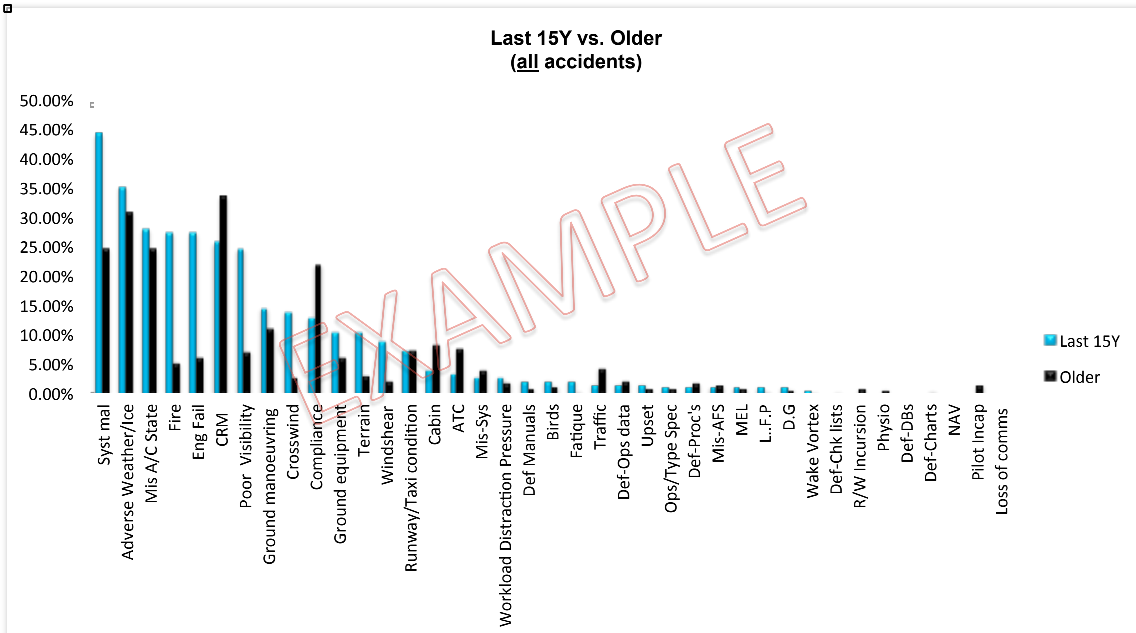

Figure 3.2.2.6 – Gen 2 Jet

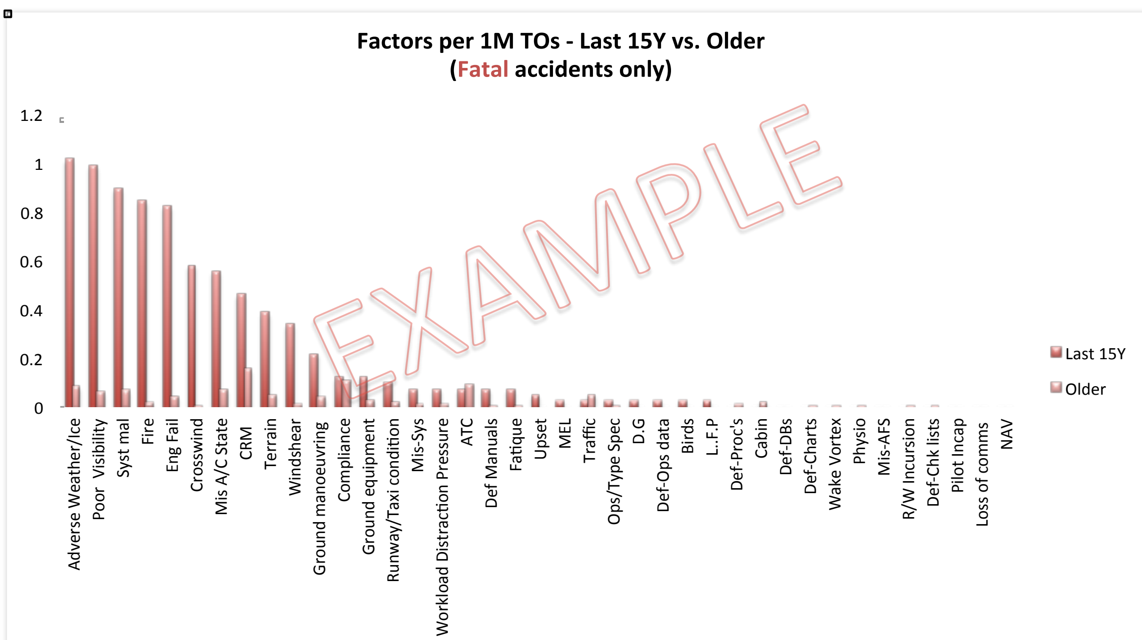

Figure 3.2.2.6a – Gen 2 Jet

3.2.2.7 Comparing Competencies Historically

A similar study is made for each of the generations for the competencies in terms of time periods. The display is alphabetical but the results are easily understood, as there are only 9 competencies. Figure 3.2.2.7 is a singular example of this analysis showing accident rates, with specific competency issues as a rate of occurrence per 1 million flights. See Chapter 4 and Appendix 2 for the generations, normalizations and accident/incident classifications.

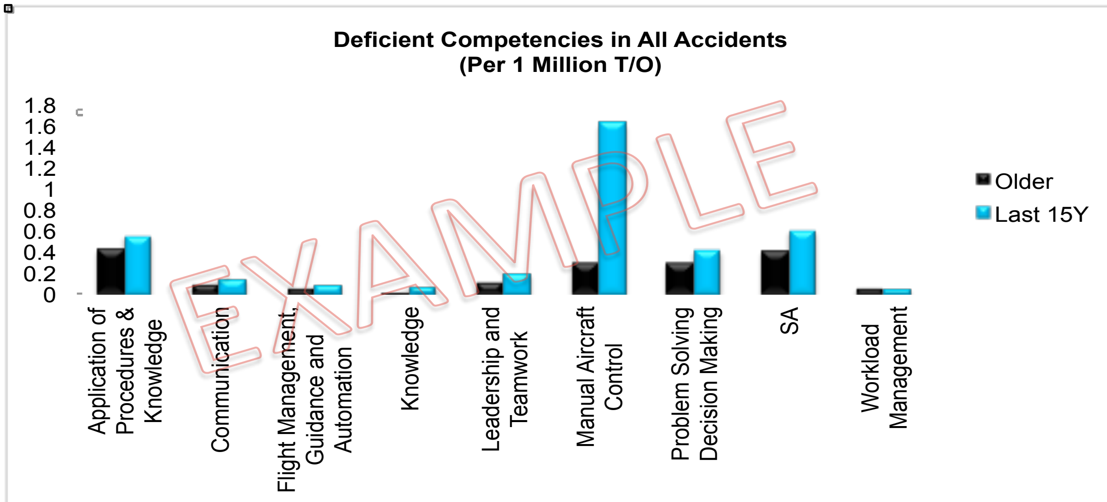

Figure 3.2.2.7

3.2.2.8 Competencies by Flight Phase

Analogous to the study of factor proportionality by flight phase above, a study of the occurrence of competency issues in accidents by flight phase is shown in the next two figures. The breakdown is for all accidents, all time periods. Figure 3.2.2.8 and 3.2.2.8a are alternative examples of these distributions for Gen 3 Jets.

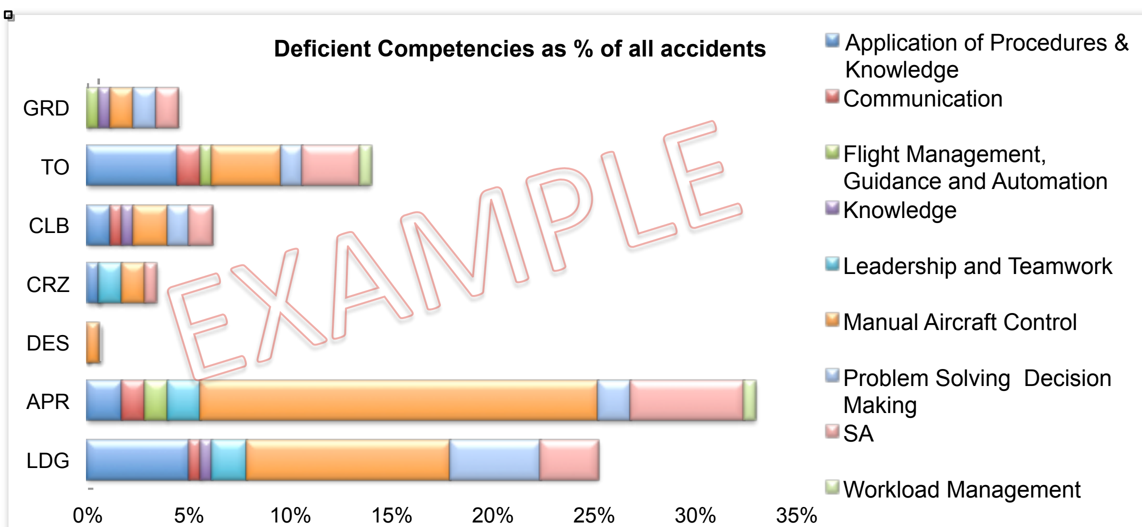

Figure 3.2.2.8

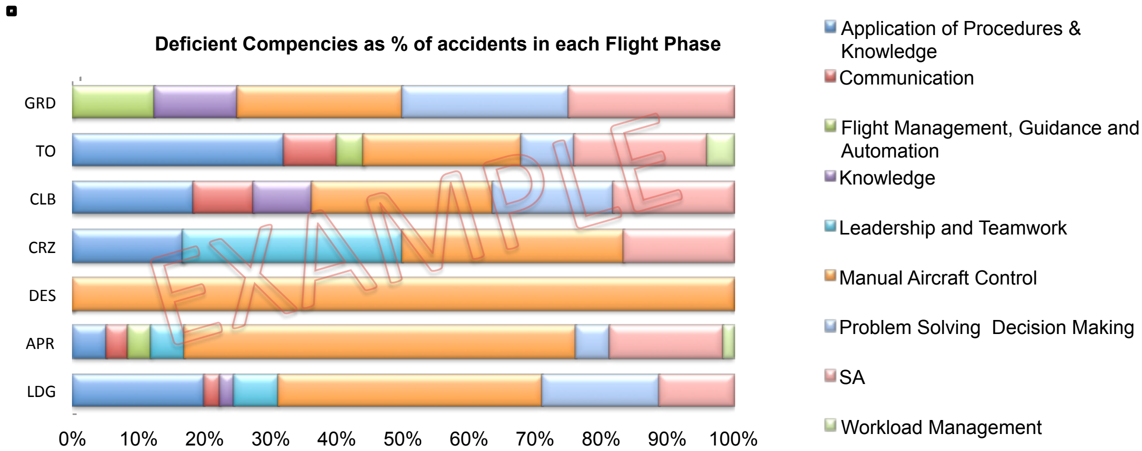

Figure 3.2.2.8a – shows the proportions in terms of percentages within a given flight phase.

3.2.2.9 Training Effect

Training effect is considered as the potential effect of FSTD training in preventing or mitigating an accident or incident. It is calculated by generation, time period and/or phase of flight, to be able to indicate the mitigating effect training has in a particular dimension (In the case of figure 3.2.2.9 training effectiveness is measured by generation in terms of percentage of occurrence in accidents. Additionally it is used as a sorting parameter offering valuable insight as to how effective training is with respect to specific factors for other partitions, such as shown in figure 3.2.2.9 where it is depicted as a function of time.

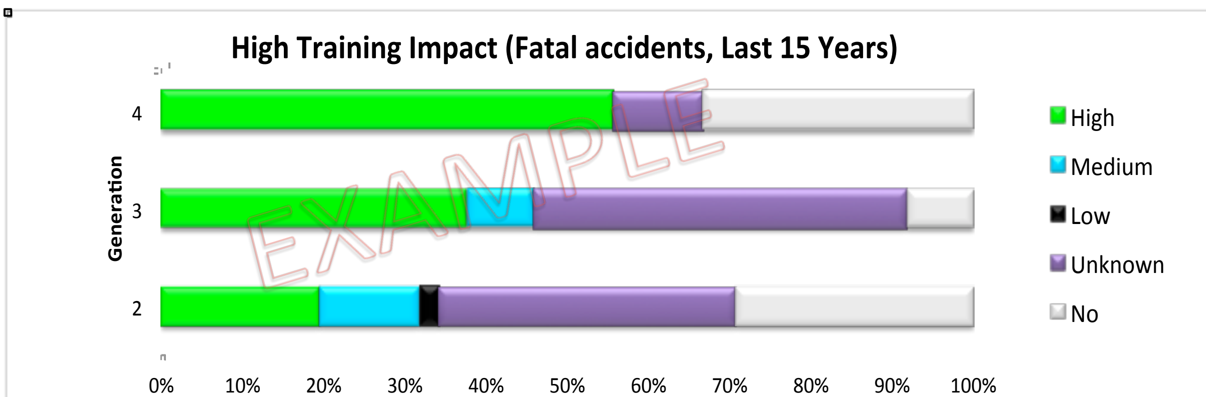

Figure 3.2.2.9

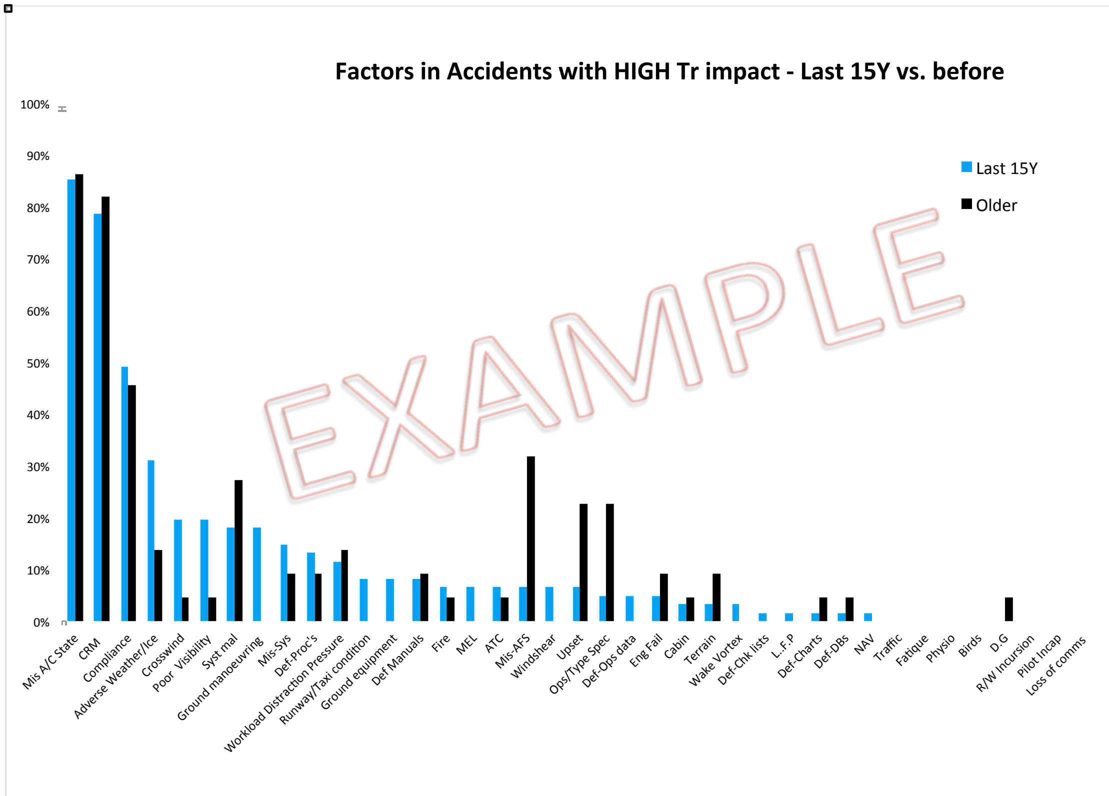

Figure 3.2.2.9a

Master analysis sheets are created for each generation, with the above-listed panes. The analysis of the accident-incident data is carried out with several different methods. Initially two approaches are used in the methodology:

1. Comparative approach – The same set of agreed charts and histograms are created for all aircraft generations, grouping charts thematically on Excel panes. Each pane is analyzed by the two analysts and their analytical comments are noted and presented in Chapter 4.2.2; they are integrated into the overall analyses in the Analysis Worksheets for Topics (See Appendix 13) and presented in Chapter 4.1: Summary Analysis by Topics. The analysts create specific drill-in charts and/or tables to study questions raised based on questions elicited during the comparison. The comparative analysis is used to:
   a. Ensure that the overall results are consistent.
   b. Cross check for anomalies in the RRR results.
   c. Feed interesting findings directly to the instructors in the EBT group, thereby enriching the creation of the training content
2. "Data-Mining" approach. The whole data set (for generations 2-4) is analyzed with a data-mining tool called "R". This shows general footprints of the events in a visual format, which is ideal for detecting patterns. It is also the easiest way to see how much the factors cluster with each other. A dedicated analyst knowledgeable with the tool carried out the data mining analysis. (See Appendix 14.)

3.2.2.10 Relative Risk Ranking (RRR)

Relative risk ranking (RRR) is the next step in the process of measuring parameters enabling translating data into training. It is an important input that is used in an algorithm to prioritize training topics and determine training criticality.

Specifically RRR is the ordering of risk for a given factor in each generation. For example, if we look at system malfunction (sys mal) in generation 3 Jets, we see in the table below that it is ranked 3rd in total risk for gen 3 jets. (See figure 3.2.2.10.) Notice that the percentage of occurrence of sys mal is 29% for fatal accidents, 19% for non-fatal accidents and 55% for incidents. The word ‘Relative’ refers to the notion that the resulting value is only valid relative to the generation for which it is calculated and cannot be compared cross generationally except in terms of order or ranking.

Relative Risk Ranking										
	Frequency						Frequency x Severity			
	% of events in the last 15 years			(0.01) % x 5			Separately at 3 Severity levels			
	% of recent fatal accidents	% of recent non-fatal accidents	% of recent incidents	Fatal accidents	Non-fatal Accidents	Incidents	Fatal Acc (5)	Non-fatal Accidents (3)	Incidents (1)	Total risk
Mis A/C State	56%	32%	17%	2.79	1.62	0.83	13.97	4.87	0.83	19.67
CRM	47%	30%	12%	2.35	1.52	0.59	11.76	4.57	0.59	16.93
System malfunction	29%	19%	55%	1.47	0.93	2.75	7.35	2.80	2.75	12.90
Adverse Weather/Ice	21%	41%	8%	1.03	2.05	0.41	5.15	6.15	0.41	11.70
Compliance	21%	14%	7%	1.03	0.72	0.36	5.15	2.16	0.36	7.67
Poor Visibility	18%	9%	3%	0.88	0.46	0.15	4.41	1.38	0.15	5.94
Fire	12%	5%	18%	0.59	0.26	0.88	2.94	0.79	0.88	4.61
Mis-Sys	15%	4%	1%	0.74	0.20	0.05	3.68	0.59	0.05	4.32
Ground manoeuvring	3%	18%	14%	0.15	0.90	0.69	0.74	2.70	0.69	4.14
Terrain	15%	2%	0%	0.74	0.10	0.02	3.68	0.30	0.02	3.99
Crosswind	12%	5%	2%	0.59	0.25	0.08	2.94	0.74	0.08	3.76
ATC	9%	5%	11%	0.44	0.26	0.54	2.21	0.79	0.54	3.54
Workload Distraction Pressure	12%	3%	1%	0.59	0.16	0.07	2.94	0.49	0.07	3.50
Ground equipment	6%	10%	4%	0.29	0.49	0.22	1.47	1.48	0.22	3.17
Def-Proc's	9%	4%	2%	0.44	0.18	0.08	2.21	0.54	0.08	2.83
Upset	9%	2%	2%	0.44	0.08	0.08	2.21	0.25	0.08	2.54
Eng Fail	3%	3%	13%	0.15	0.15	0.64	0.74	0.44	0.64	1.82
Cabin	3%	4%	3%	0.15	0.20	0.14	0.74	0.59	0.14	1.46
Windshear	6%	2%	1%	0.29	0.08	0.03	1.47	0.25	0.03	1.75
Runway/Taxi condition	3%	5%	3%	0.15	0.26	0.17	0.74	0.79	0.17	1.69
Traffic	3%	3%	5%	0.15	0.15	0.25	0.74	0.44	0.25	1.43

Figure 3.2.2.10

For consistency in the ranking process and so that risk will have the same range as it has in the Training Criticality Study, the percentages are normalized so that values are between 0 and 5. This is simply done by multiplying the percentages by 5 and moving the decimal point two places to the left. The results for sys mal in gen 4 jets are the following:

- Fatal – 1.47
- All accidents – 0.93
- Incidents – 2.75

Because risk is generally measured by likelihood times severity, a value must be assigned for severity to be able to calculate RRR. Again we chose values to be consistent with the TCS, which uses a five-point scale. The severity values are defined by the seriousness of the event in which the factor was involved and are as follows:

- Fatal accidents – 5
- All accidents – 3
- Incidents – 1

Then likelihood and severity are multiplied for each factor and the risk values are summed to provide a total risk for the factor relative to a given generation. This ranking is useful for comparative purposes across generations, phases of flight and to be able to correlate to other risk rankings of sets or subsets incorporating the same factors. RRR is not only a ranking of the factors, but also a proportional representation of the importance of a factor in terms of the classical notion of risk within (or relative to) the generation of aircraft.

The weakness of this model is that assigning specific coefficients of severity, however several sets of coefficients were tried assuming axiomatically that fatal accidents are more severe than accidents in general and that accidents are more severe than incident. The results being that the ordering only changed when the data became very sparse. Additionally the process rests on the assumption that the severity associated with a factor is dependent on the severity of the event itself, or put another way: factors which are present more frequently in more severe events carry more risk. This is not always the case, but the factors themselves were defined to be relevant to the event and with a large sample of events, and generally the relationship holds. Lastly, there is the usual assumption that the past is a predictor of the future. Again there is more confidence with large and recent sets of data like the set that is used in this study.

3.2.2.11 Clustering and Training effect of each factor

Risk is an important factor in the prioritization but it is not the only consideration, for it has the following limitations:

- It focuses on individual factors separately, as if they did not have any influences on each other or their combined effects.
- It only highlights what should be addressed and not the efficiency of pilot training in the mitigation process.

Hence, two additional analytical results are included in the prioritization process:

1. Factor clustering – the extent to which a factors cluster with other factors is important from a training point of view. Factors that cluster significantly can be considered more important to address in training because they appear in complex and difficult situations, potentially requiring a higher level of competency than simpler and more straight forward events. Figure 3.2.2.11 is an example of a table that represents clustering as a function of additional factor occurrence in accidences and incidents.

Factor	Raw Cluster	Filter	Clustering
Crosswind	9.0	1	9.0
Terrain	9.0	1	9.0
Physio	9.0	1	9.0
Mis-Sys	8.8	1	8.8
MEL	8.3	1	8.3
Workload Distraction Pressure	7.6	1	7.6
Poor Visibility	7.5	1	7.5
Runway/Taxi Condition	7.3	1	7.3
Mis A/C State	6.9	1	6.9
Compliance	6.2	1	6.8
CRM	6.2	1	6.2
ATC	4.2	1	4.2
Ground Maneuvering	3.0	1	3.0
Adverse Weather/Ice	2.7	1	2.7
Syst Mal	2.5	1	2.5
Ground Equipment	2.2	1	2.2
Fire	2.0	1	2.0
Eng Fail	1.9	1	1.8
Windshear	11.0	0	0.0
NAV	0.0	0	0.0
Loss of Communications	0,0	0	0.0

Figure 3.2.2.11 – Factor Clustering

2. The last dimension considered in the prioritization process is the Training Effect. Training Effect is a measure of the mitigation that training could have on accidents and incidents. When deciding how important training is to cope with a situation, it is not only important to identify what needs to be addressed, but also how effective the training remedy is for that situation. Refer to Figure 3.2.2.9, which is an example that depicts the percentages of the levels of Training Effect for Jet Generations 2, 3 and 4 (Fig 3.2.2.9) and (Fig 2.3.3.9a), which shows the ranking of factors with high training effect for a specific generation over two time periods.

3.2.2.12 Final Step

The final result of the Accident-Incident Study is the prioritization of factors in terms of training criticality, which is the arithmetic combining of three resulting ranking lists from the processes described (RRR, Clustering and Training Effect).

The preference is to use a simple arithmetic algorithm taking into consideration all the variables and producing results that are in line with expert opinion and analyses from other data.

When examining the rankings in the form of graphs (e.g., RRR in figure 3.2.2.12), there are some natural breaking points. If a curve were superimposed over the bar graphs, then some of the points of inflection can be seen and used to determine natural groupings. In this way the first three groupings in terms of importance are found.

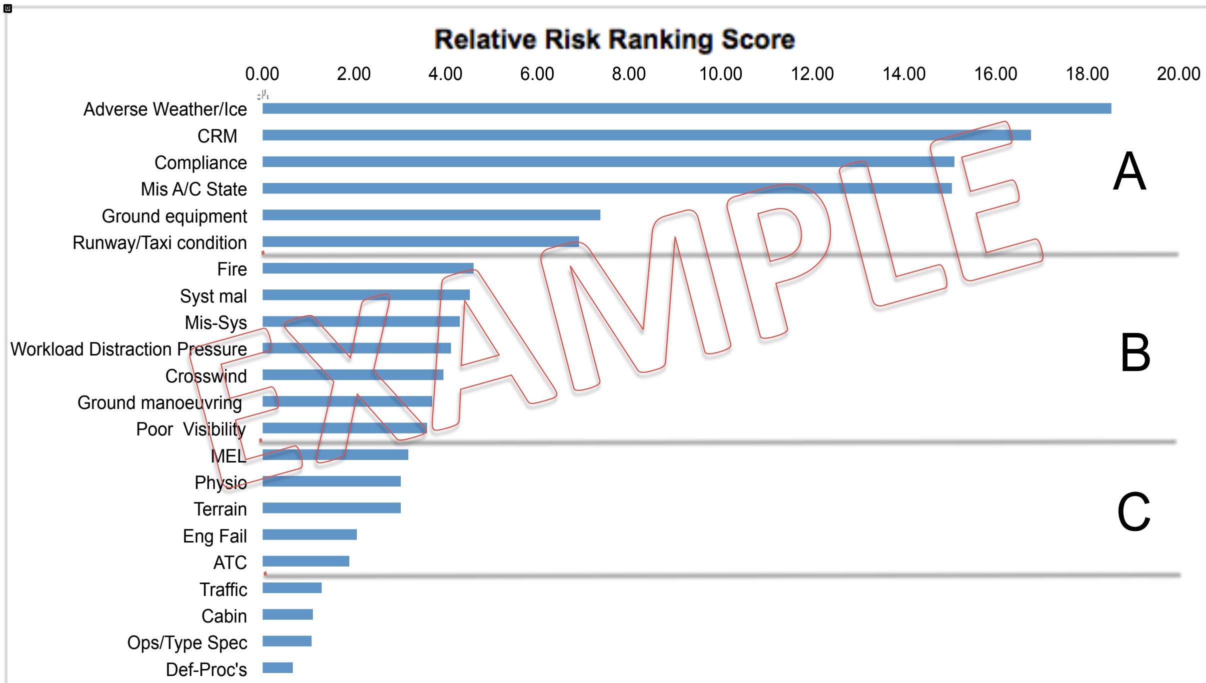

Figure 3.2.2.12

The first three groupings in the order of importance are labeled A, B and C The boundaries between classes are determined graphically by respecting the natural cut-points in the data while also maintaining a degree of consistency among different ranking lists and aircraft generations. Because the analysts agree that relative risk is the most important component of training criticality, more weight is given to the RRR compared to the other two ranking lists. Simply allowing a higher number of factors to populate the groupings A, B, and C for the RRR parameter does this.

The method described above results in each factor having a 3-dimensional ranking.

The dimensions are collapsed arithmetically and a final ranking is obtained in the following way:

1. The letters ABC are assigned numerical values, such that: A=3, B=2, C=1.
2. The score for each factor is summed using these numerical values. For example, if the particular factor in the RRR ranking is in group A and the same factor is in group C for the clustering, and that same factor is in group B for the Training effect, then the result is: 3+1+2=6.
3. Such summations give values in the range from 0 to 9. This result then is an additive measure of the training criticality taking into consideration all three dimensions and resulting in prioritizing the need for training.

Training is considered as a broad concept with a variety of methods and tools. The mandate for this analysis is limited to training conducted in a qualified FSTD, creating a need to consider how well each factor could be mitigated by training according to industry standard FSTD capability. This constraint is treated in the following way in the analysis:

1. The capability and the need to train are treated as two separate issues and are kept separate in this analysis. This is because it is firstly most important to determine the need, and then to consider whether an FSTD environment can be effective in meeting this need.
2. Instructors within the EBT working group dedicated a specific session to assess the FSTD trainability (i.e., the capability to train in a qualified FSTD) for each factor. This was done on a five point scale from A to E (A being the highest capability)
3. The EBT Working Group agreed that any factor rated below a C for "trainability" should be filtered out from the final ranking list as being too difficult to train in the FSTD device.

It is also important to grade the need and ability separately for the following reasons:

1. The risk ascribed to a factor does not diminish just because the factor is difficult mitigate in FSTD training.
2. Such factors should remain in the analysis to highlight the need to improve the trainability in the FSTD, thereby feeding FSTD improvement projects.

Figure 3.2.2.12a demonstrates an example of the algorithm for combining the 3 dimensional ranking and the filtering for trainability.

Result					Rank Value	Priority Level
Factor	RRR	Cluster	Hi Tr Effect	Sim Tr (FILTER)		
CRM	3	3	3	Yes	9	A
Mis A/C State	3	3	3	Yes	9	A
Compliance	3	3	2	Yes	8	A
Weather	3	2	2	Yes	7	A
Syst mal	3	2	1	Yes	6	B
Poor Visibility	3	2	1	Yes	6	B
Mis-Sys	2	3	0	Yes	5	B
Crosswind	2	2	1	Yes	5	B
Ground manoeuvring	2	2	1	Yes	5	B
Workload Distraction Pressure	2	2	0	Yes	4	B
Runway/Taxi condition	1	2	0	No	3	
Fire	2	1	0	Yes	3	C
Terrain	2	1	0	Yes	3	C
ATC	2	1	0	Yes	3	C
Windshear	1	2	0	yes	3	C
Ground equipment	1	1	0	No	2	
Eng Fail	1	1	0	Yes	2	C
Upset	1	1	0	Yes	2	C
MEL	0	0	0	Yes	0	
Cabin	0	0	0	Yes	0	
Traffic	0	0	0	Yes	0	
Physio	0	0	0	No	0	

Level	Factors	Cmb Score
A	CRM	9A
	Mis A/C State	9A
	Compliance	8C
	Weather	7C
B	Syst mal	6A
	Poor Visibility	6A
	Crosswind	5A
	Mis-Sys	5B
	Ground manoeuvring	5C
	Workload Distraction Pressure	4C
C	Fire	3A
	ATC	3C
	Windshear	3B
	Terrain	C
	Eng Fail	3A
	Upset	2C

Cmb Score is the Combination Score - Rank value (9 highest) and the Simulator Trainability (A being most Trainable)

Figure 3.2.2.12a – Algorithm Demonstrating Factor Priority for Training

3.2.2.13 Strengths and Weaknesses

The development of the training priorities is based on proportionality rankings of factors in a given generation of accidents and incidents, rather than the rate of occurrence per million flights. The advantage is that, this provides results from the perspective of type or generation (i.e., training criticality for a specific group of aircraft), which is the main concern of a fleet training manager. The ranking process included multiple criteria to provide comprehensive results. By taking into account event severity, the ranking reflects risk and not only likelihood. The use of clustering and training effect provides more effective and compelling results for the development of programs. FSTD "trainability" ensures the results are pragmatic as well as providing information about improvements for FSTD future development. Merging of the various criteria based on the simple A-B-C classification is straightforward and consistent with the natural distribution of the data. The selection of 5-point scales for frequency, severity and training effect are subjective but were done to be as consistent as possible with the Training Criticality Study, thereby enabling cross correlations of the two studies. (See Appendix 11) Training experts in the working group are in agreement with the principles behind the 3-dimensional analysis. The decision on the weight to be assigned to each criterion and the inflection points for each of the rankings, are decisions that were taken by the data group to provide as much standardization as possible recognizing the variance in the data. The purpose is to try to maintain a consistency of approach across aircraft generations and other ranking lists.

3.3 EBT FLIGHT DATA ANALYSIS & ADDITIONAL FDA REPORTS

3.3.1 EBT Flight Data Analysis

3.3.1.1 Background

Flight Data Analysis is a tool intended for safety monitoring and is capable of providing continual feedback from flight operations. It has many potential uses in terms of influencing procedural development, evaluating operations into specific airports and most importantly has tremendous potential to determine systemic issues and provide data for remediation in training. There are 3 types of FDA data in this report.

1. Specific EBT Flight Data Analysis (the subject of this section)
2. FDA studies undertaken by organizations provided to IATA (secondary data typical of a meta-study)
3. The Long Body Aircraft Studies (secondary data typical of a meta-study)

Note: The 2nd and 3rd study are discussed in later sections of this report.

The EBT Flight Data Analysis is a primary data study created for specific objectives defined as follows:

1. To study unstable approaches in relation to landings and go-around across aircraft generations over several regions.
2. To determine a representative sample of go-around initiation altitudes for go-arounds in operational situations
3. To challenge and/or validate evidence from other data sources, specifically LOSA, secondary FDA studies, and to the Pilot Survey.

Flight data used in this study were collected from three regions of the world:

1. Europe
2. Middle-East
3. Asia

In excess of 1.7 million flights were collected for generation 3 and generation 4 aircraft spanning 9 different types from several manufacturers. The data available for this study were collected from 2005 to 2010, with all participating operators providing a continuous data stream. The shortest duration of operator specific data was for a 3-year period. Operators participating in the study either provided raw data and/or data processed through a flight data analysis application.

3.3.1.2 Data Processing

Flight recorder raw data is processed by a flight data analysis application into an event database. The analysis was done at a statistical level rather than drilling down into Individual flights. The analysis is conducted in terms of the risk of the member events from specially defined sets of FDA events rather than looking at individual flights. In order to facilitate a consistent approach, a standard FDA flight profile was created, by which all data received could be analyzed. This meant that the same or equivalent events, triggers and parameters are used in order to derive all results and make valid comparisons. All data and events are validated for consistency beforebeing used for analysis.

3.3.1.3 Objectives of the Study

The main purpose of this FDA data analysis is to study the effects of unstable approaches on the safety of flight, particularly in the landing and go-around phases. The study generally compares unstable with stable approaches by identifying risk events in the phases immediately following the approach (i.e., landing or go-around). The second purpose of the study is to corroborate the results of LOSA (See Analysis Chapter for LOSA results regarding unstable approaches) in terms of:

1. The rates of unstable approaches
2. Landing performance
3. Go around performance
4. Go around initiation altitude

3.3.1.4 The Analysis Process

3.3.1.4.1 Defining Unstable Approaches

The first step of the analysis involved finding a set of events that would capture all flights that contained an unstable approach. To do this, events that showed continuous deviations from the approach trajectory and speed were chosen. (See Figure 3.3.1.4.1) The particular events used to do this in the study are called combination events because they consist of a set of specified individual events over a time period and are more dynamic, continuous and nuanced than simply measuring speed, vertical speed and altitude and certain gates on the approach.

Unstable Approach Event Set	
2000	Continuously Low during final
2001	Continuously Slow during final
2002	Continuously High during final
2003	Continuously Fast during final
2004	Continuously Steep during final
2009	Late Offset in Short Final
2012	Roll Oscillations prior to Flare

Figure 3.3.1.4.1

If an approach triggers any event from this set, it is defined as an unstable approach. If an approach does not trigger an event from the set it is defined to be a stabilized approach. This effectively partitions all the flights in the database into two classes, the class of flights with stable approaches and the class of flights with unstable approaches.

3.3.1.4.2 Sorting Process

Data (numerical counts) are collected in an excel file for the following categories for each type of aircraft per operator per year in the sample. Figure 3.3.1.4.2 show the parameters for which raw counts and rates are calculated.

EBT FDA Partitions
All flights
All go-arounds
All stable approaches
All unstable approaches
Go-arounds from unstable approaches
Go-arounds from stable approaches
Landing from unstable approaches
Landing from unstable approaches with a detected event at landing (high, medium or low)
Landing from unstable approaches with a detected event at landing (high, medium)
Landing from unstable approaches with a detected event at landing (high)
Landing from stable approaches
Landing from stable approaches with a detected event at landing (high, medium or low)
Landing from stable approaches with a detected event at landing (high, medium)
Landing from stable approaches with a detected event at landing (high)
Events in stable landings (high, medium or low)
Events in stable landings (high, medium)
Events in stable landings (high)
Events in unstable landings (high, medium or low)
Events in unstable landings (high, medium)
Events in unstable landings (high)

Figure 3.3.1.4.2

Specific panes are created to depict event distributions in the following situations:

1. Unstable approaches (before potential go-around)
2. GA following both unstable and stable approaches
3. Landing following both unstable and approaches

Results are calculated as a rate of occurrence in percentage to allow comparisons.

3.3.1.4.3 Research Questions

The research questions can be summarized as follows:

1. How frequent are unstable approaches, in other words, what is the unstable approach rate?
   a. For each aircraft type in the sample
   b. For each aircraft type specific to operator
   c. For each aircraft type specific to operator, per year
2. What percentage of unstable approaches result in a go-around?
3. To what extent does an unstable approach continued to a landing result in risk events in the landing phase?
4. What are the landing events triggered? (See Figure 3.3.1.4.4) below for a list of landing events.)
5. What is the landing event rate triggered per level of severity? (In most cases, each event in the landing set has three levels of severity.)
   a. Low
   b. Medium
   c. High
6. What are the landing event rates according to the level of severity:
   a. For each aircraft type in the sample
   b. For each aircraft type specific to operator
   c. For each aircraft type specific to operator, per year
7. Compare the landings from unstable approaches to the landing from stable approaches in each of the above, defined cases.
8. Compare flight data from go-arounds performed from unstable approaches with go-arounds performed from stable approaches, using a defined set of events and a corresponding severity scale. (See Figure 3.3.1.4.4a below for the list of go-around Events.) A total of 21 major queries were created to determine approach rates, go-around rates, landing rates and performance in terms of risks for the related phase of flight.

Specific panes were created to list which events are triggered in a given situation:

a. Event distribution during an unstable approach (before potential go-around)
b. Event distributions in GA following a unstable and stable approaches
c. Event distribution at landing following a unstable and stable approaches

Results are calculated as a rate of occurrence in percentage to allow comparisons.
Data for landings for both stable and unstable approaches are combined in one table to allow easy comparisons. The events applicable to landing are highlighted on the column listing all events.

3.3.1.4.4 Comparing Risk as a Function of the Approach

To look at the ramifications of unstable approaches and compare them to stabilized approaches; a landing event set and a go-around event set are also defined. See Figure 3.3.1.4.4 and 3.3.1.4.4a. (See Appendix 8 for the definitions of the events used in EBT FDA)

EBT Flight Data Analysis	
Event ID	**Landing Events**
1022	Speed High at Touch Down
1023	Speed Low at Touch Down
1024	Speed Above Maximum Tire Speed
1029	Braking Delayed at Landing
1033	Tail Wind High at Landing
1035	Braking Questionable at Landing
1105	Pitch Input Cycling at Landing (below 100ft)
1108	Pitch High at Touch Down
1109	Pitch low at Touch Down
1111	Pitch Rate High at Landing
1200	Bank High in Approach (below 100ft)
1205	Roll Input Cycling (below 200ft)
1210	Bank High during Flare (below 100ft)
1211	Bank Oscillation in Approach (below 100ft)
1219	Roll Spoilers Extension at Landing (below 50ft)
1405	Path High at Landing (below 20ft)
1504	Vertical Acceleration High at Touchdown
1505	High Lateral Load at Touch Down
1510	Lateral Acceleration High at Touchdown
1602	Flaps Questionable Setting at Landing
1611	Late Reverser Use at Landing
1619	Reversers High Thrust at Low Speed
1703	Thrust Reduction Late at Landing
1706	Thrust Asymmetry in Reverse
1714	Thrust Low at Landing (50ft)
1807	Heading Deviation at Landing (above 60kts)
1808	Long Flare Time
1812	Height Low at Threshold
1813	Height High at Threshold
1815	Heading Excursion During Landing Roll
1817	Short Flare Distance
1818	Long Flare Distance
1819	Short Flare Time
1820	High Vertical Speed before Touchdown
1821	Localizer Deviation at Landing (threshold)
1822	Aircraft not on Center Line
1905	Engine Reverser Selected in Flight
1906	Bounced Landing
1917	Dual Input
1950	Questionable Decrab
2206	Wing Strike Risk at Landing
2207	Hard Landing Risk

Figure 3.3.1.4.4

EBT Flight Data Analysis	
Event ID	**Go-Around Events**
1008	Speed Above VLO Retraction
1009	Speed Above VLE
1016	Speed Above VLO Extension
1017	Speed Above VFE
1025	Speed Above Recommended Turbulence Speed
1028	Speed Low
1032	Speed High in Climb (below 1000ft)
1038	Speed Low in Climb (100ft – 1500ft)
1100	Pitch High at Take Off
1101	Pitch Rate High at Take Off
1102	Pitch Rate Low at Take Off
1103	Pitch High in Climb
1104	Pitch Low in Climb
1206	Bank High in Climb (Take Off – 100ft)
1207	Bank High in Climb (100ft – 400ft))
1208	Bank High in Climb (400ft – 1000ft)
1209	Bank Cycling at Take Off
1407	Rate of Climb Low in Climb (below 1000ft AFE)
1500	Vertical Acceleration High at Take Off
1501	Vertical Acceleration Hi in Flight
1600	Flaps Early Retraction at Take Off
1605	Configuration Change Questionable during Go-Around
1609	Landing Gear at Late Retraction
1913	Speed Brakes Out with Significant Thrust
1618	Rudder Large Inputs (above 200ft)
1702	EGT High
1800	HDG Deviation at Take Off (100kts – Rotation)
1903	Windshear Warning
1909	Alpha Floor
1910	Alternate Law
1911	Direct Law
1917	Dual Inputs
1918	TCAS Resolution Advisory
1921	GPWS Warning (1000ft – 500ft)
1922	GPWS Warning (below 500ft)
1930	Stall Warning

Figure 3.3.1.4.4a

The landing event set contains risk events from the landing phase as defined in the flight data analysis system in addition to certain events occurring during the last 50 ft. before touchdown.

Note: This system contains two types of events: risk events and information events. While both types are used in the study, any result expressed in event rates only includes risk events.

The go-around event set contains risk events from the following phases of flight:

1. Go-around
2. Touch and go with low speed events restricted to after the approach phase.
3. Initial climb phase restricted to events after the approach phase.
4. Climb phase restricted to events after approach.

In order to determine degree of risk in the phases following the approach, risk event rates are examined by categories of severity. The events themselves have a 3-point severity scale (low, medium and high) allowing for the definition of the following 3 categories:

1. Cat I – Rate of any event (low, medium or high severity) or sometimes referred to as the all event rate.
2. Cat II – Rate of events of concern (medium or high severity)
3. Cat III – Rate of high risk events (high severity only)

Even though each event usually has three severity levels (Low, Medium and High), the events intrinsically are not all equal in terms of risk. Some events are more much more serious in terms of safety than others with the same severity level. To compensate for this factor as well as increase the sensitivity of the analysis, a relatively small set of serious events is selected for the landing phase. (See Figure 3.3.1.4.4b) This enables extending the trending along the severity axis (e.g., a landing with an event with high severity from the serious category is classified as a dangerous event). Serious events allowed the examination of the rate of events that could be considered as near accidents.

EBT Flight Data Analysis	
Event ID	**Serious Landing Events**
1200	Bank High in Approach (below 100ft)
1210	Bank High During Flare (below 10ft)
1211	Bank Oscillation in Approach (below 100ft)
1812	Height Low at Threshold
1815	Heading Excursion During Landing Roll
1906	Bounced Landing
2206	Wing Strike Risk at Landing
2207	Hard Landing Risk
1922	GPWS Warning (below 500ft)

Figure 3.3.1.4.4b

3.3.1.5 Initial Approach Altitude

The FDA system used creates a specific go-around report, which records altitude at the time of initial power application even though it is not part of the event itself (See definition of event in Appendix 8). A special analysis of these reports is done to retrieve the altitudes as evidence to corroborate similar findings from others sources. See Chapter 4 Analysis and Results.

3.3.2 Long Body Aircraft Studies

3.3.2.1 Landing Study

A study of in-service flight data focusing on long body aircraft operations during final approach and landing was reviewed and analyzed. The review had been triggered by airline reports of incidents of high acceleration landings for aircraft with a long fuselage. An aircraft manufacturer decided to launch a wide-scale flight data analysis project to address this subject. 6 operators provided large volumes of flight data recordings. These data recordings were analyzed with strong emphasis placed on establishing statistically generated findings from a substantial number of flights.

The project aimed to provide an overview of in-service events from a variety of operations, focused on handling behavior related parameters in the final 200ft prior to touchdown, comparing between types and variants based on fuselage length. The purpose is to identify contributing factors associated with high acceleration landings and use the results to make recommendations for operations, training and aircraft design. In addition, participating operators are provided with a statistical view of their own operations in comparison with operations from the worldwide fleet. Data from all participating airlines are grouped together into one de-identified database. The number of flights used for the project is 3575 long-fuselage variants and 2051 shorter variants. Some of the following parameters are monitored and analyzed closely across the two variants during the last 200ft before touchdown:

1. Max vertical acceleration at touchdown.
2. Max vertical speed at touchdown.
3. Flare initiation height.
4. Evolution of vertical speed.
5. Time from 30 feet to touchdown.
6. Evolution of pitch inputs.
7. Evolution of pitch angle.
8. Average slope before flare
9. Slope at start of flare.
10. Evolution of thrust.
11. Evolution of lateral handling.
12. Weather conditions at landing.

3.3.2.2 Take-off Study

A similar study was done for take-offs comparing long and shorter aircraft variants within the same type. Similar techniques are used as described above. The notable difference is that the study only involved a single aircraft type.

The standard process for entering evidence in the Evidence Table is used for this source. Several analysts read the report, working collaboratively to draft related evidence statements. The content and detailed wording of the evidence statements are reviewed and edited by the core analysts in the data-analysis working group. Evidence statements are reviewed and verified independently to ensure accurate reflection of the original source report material.

3.3.3 A Study of Normal Operational Landing Performance on Subsonic Civil Narrow Body Jet Aircraft during ILS Approaches

The purpose of the study is to examine operational landing performance on subsonic, civil, narrow body jet aircraft during ILS approaches. The study is conducted using in-flight recorded data collected from landings in normal operations. These data are obtained from the quick access recorder for two types of narrow body jet aircraft, one belonging to Generation 3 and one to Generation 4. Data from quick access recorders can be used effectively to analyze performance from engine and aerodynamic to pilot handling. A statistical analysis is undertaken in this study to examine performance and flight control parameters with respect to the landing phase of flight. The purpose is to identify empirical distributions of the landing distance parameters such as the approach speed at threshold, the touchdown point, rollout distance, and total landing distance. Both aircraft types are comparable in size and general performance (e.g., range, payload) and are used by many operators all over the world. All flight data analyzed in this study were obtained from a European operator. The recording effort lasted for more than 7 months over winter, spring and summer time operations. In addition to flight data, relevant aviation routine weather reports (METAR) are collected. The data collection effort was set to obtain landing data for 50,000 landings in total (all types combined). [Figure 3.3.3 Landings in NLR Study]

Landings in NLR Study	
Aircraft Type	Number of Landings
$G4_1$	7,474
$G4_2$	12,245
$G4_3$	5,952
$G3_1$	12,093
Aircraft Types have been de-identified.	
Subscripts indicate de-identified type.	

Figure 3.3.3

The data quality is good with a high level of consistency. There were some limitations in the data frames that required some derivations and smoothing (See Appendix 6 for the explanation in the Report.)

The standard process for entering evidence in the Evidence Table was used for this source. Several analysts read the report, working collaboratively to draft related evidence statements. The content and detailed wording of the evidence statements are reviewed and edited by the core analysts in the data-analysis working group. Evidence statements were reviewed and verified independently to ensure accurate reflection of the original source report material.

3.3.4 Strengths and Weaknesses

The analyses for the Long Aircraft Study exceeded the usual scope of FDA analysis, and a number of special algorithms were created for the study. In addition, some more precise techniques than normally used in FDA analysis are incorporated. The data used for the study represents flights flown in a variety of different operator route networks, airports, ATC and geographic environments. The obvious limitation of this study is that it is limited to very specific aircraft.

In contrast, the EBT FDA Analysis involves considerably more aircraft types as well as a very large number of flights. This research is quite focused and the technique is statistical in nature, which is in line with the strength of FDA. While FDA is designed primarily for safety trend monitoring, it is capable of identifying a near accident, in addition to measuring flight parameters precisely subject to the defined events and the sampling rate. The data is quantifiable for comparison, trending and benchmarking, and if the volume of recorded flights is sufficient, drilling down to examine operational and training issues more closely can be undertaken. Data analyzed only shows what occurred and provides little context. By the nature of parameters available for capture, there are many flight crew errors that cannot be captured. Results are constrained by event design, meaning that the analysis generally shows what the analyst expects to find. Any surprises in the findings are usually restricted to severity and frequencies of the exceedances of the events. Event sets, their associated parameters and triggers are nonstandard across types, and manufacturers of flight data analysis software. However in EBT FDA study, all flights were processed using the same software, parameters, and event sets making the study more rigorous than normal. Additionally because of the extensive data set, some novel opportunities were available to use in this analysis.

The Study of Normal Operational Landing Performance on Subsonic Civil Narrow Body Jet Aircraft during ILS Approaches utilized a data sample that is very large, but limited to one European operator and 2 aircraft types. Due to the scope limitations, only a few results are taken from this study for the EBT evidence table. The results are considered scientifically reliable.

FDA analysis results generally are very compelling due to the precise and mathematical means with which they can be displayed. But it is this attribute that is its biggest trap, for in many cases the results lack context and present an incomplete picture requiring it to be used specifically, carefully and validated by other sources.

3.4 TRAINING DATA (AQP & ATQP)

3.4.1 AQP Study

3.4.1.1 Background

The Advanced Qualification Program (AQP) is a voluntary alternative to the traditional regulatory requirements under the FARs for pilot training and checking. Under the AQP the FAA is authorized to approve significant departures from traditional requirements, subject to justification of an equivalent or better level of safety.

Specific data were provided for this study, from an existing and mature AQP program. AQP programs are highly developed, sophisticated training programs that share many goals set by EBT. The advantages of collecting information on these programs are obvious. Airlines are providing information on course structure and content, flight operational data as well as metrics on training system performance. Additionally, all AQP programs have the capability to provide insight into continual proficiency and skill decay because of their continual monitoring of training and operations.

The data package received from donor airlines was substantial, encompassing grading data from all pilot training events (i.e., type rating related, recurrent, IOE and line checks) for a period of two years. The data set includes over 600 pages, including charts, data tables and instructor comments related to specific training events. The data set includes drill-ins to all sub-topics within the training events, e.g., Engine Failure at V1, and Windshear. There are multiple aircraft types in the data set, including generations 2, 3 and 4. The data analyzed for this report are based on the numeric pilot grades across all measured training events over a 2-year period from 2008 to 2010 and were derived from more than 12000 training events.

The data set is presented in a de-identified format in Chapter 4 and Appendix 9. The findings from this study are presented in 2 formats:

1. Results from the donor airlines' own analyses.
2. Results from the EBT data subgroup analysis using the airline results and raw data provided to re-sort from a training topic perspective. (See Chapter 4.2.4. and Appendix 9)

The data describing the pilot grading results are based on a multi-level grading system where the grading scale can be divided in three categories:

1. Failed
2. Passed but not reaching the desired company standard and requiring additional training
3. Reaching the company standard

Note: For the purpose of this study, scores in the first and second category are given the term PNG (Pilot Non-Proficient Grade).

The performance scores utilized in this particular AQP program are at the level of a training topic within a specific training event for a given aircraft type. (e.g., CAT I precision approach in the Maneuver Validation at the conclusion Type Rating course). The study compares and contrasts the percentages of the graded pilots who did not meet the company standard during validation. For practical purposes, this is the Percentage of Non-Conforming Grades (PNG).

3.4.1.2 Purpose

The objectives of the AQP analysis were:

1. To view a large sample of training data and quantitatively measure developmental apprehension, skill mastery, and knowledge and skill retention over a two-year training cycle.
2. To determine where learning takes place in training as well as on the line.
3. To determine which learning objectives present difficulty to the pilots and whether aircraft from different generations behave similarly or differently in this respect.

Average values over the 24 months are entered in separate excel tables for the analysis. For each training period (e.g., maneuver training in recurrent training), a histogram is created comparing the PNG (Pilot Non-proficient Grade) for the different aircraft types per training topic. (See Appendix 8) Footprints for the different types of aircraft are compared but the specific focus is to compare aircraft generations rather than just types. Queries resulting from these comparisons determine the scope of further analysis and drill down into detailed instructor comments.

Another analysis using the same numerical data trends the PNG’s of the different training events over the period starting from the Type Rating, through IOE to the Line Check and subsequent Recurrent Training. This is an attempt to examine the spectrum of pilot performance according to defined norms at different stages of training. The rate of PNG is considered as indicative, and can highlight problem areas during the training process. This evolution is plotted for Generation 3 Jets and Generation 4 Jets. For each generation, the average PNGs by types and generation are compared for each defined training event.

A third study measures pilot error types by fleet for each training event.

A fourth study, done by the airline solely and provided to the EBT data subgroup, considers skill decay, based upon the continual measurement and grading of psychomotor skill based maneuvers over time, comparing pilots with different exposures to training according to fleet specific programs. Domestic pilots complete a ‘First Look’ exercise during continuing qualification once a year. International pilots undergo the same ‘First Look’ exercise twice a year. The operator uses ‘First Look’ to evaluate pilot performance in maneuvers, which depend largely on psychomotor skill, at the end of the interval between the continuing qualification training periods.

The standard process for entering evidence in the Evidence Table is used for this source. Several analysts read the report, working collaboratively to draft related evidence statements. The content and detailed wording of the evidence statements are reviewed and edited by the core analysts in the data-analysis working group. Evidence statements are reviewed and verified independently to ensure accurate reflection of the original source report material.

3.4.1.3 Strengths and Weaknesses

The Study was comprehensive with multiple aircraft over an extended period of time. The data ranged from results provided by the airline, to the EBT subgroup re-sorting the data from different pilot training perspectives to raw instructor comments allowing many issues to be examined in depth. The grading was multi-point, providing sensitivity. It was also well instructor-calibrated, and the program had been in use for an extended period of time. Results range from pre-analyzed findings by the airline to the EBT analysts trending of the raw grades and drill downs of instructor comments.

Once the results were ready, they are shown to the data donors to ensure integrity. There was agreement on the findings, plus the provision of additional background information providing additional perspective for the analyses.

3.4.2 ATQP Implementation Data

The objective of this study is to examine lessons learned during the process of ATQP implementation with a major European operator. The ATQP study is distinct from the AQP study used in this report; the latter being derived from data from a very mature training system while the former being analysis of the data focused on measuring the effect of program implementation.

3.4.2.1 Background

Data were provided from several ATQP operators, with, (in certain cases) extensive and highly sensitive information. As might be expected, most of the important results come from these sources. The ATQP implementation at one operator was a four-step process, which comprised the following elements in accordance with EU-OPS 1.978 (Alternative Training and Qualification Program):

1. A job task analysis defining pilot tasks during operations
2. A training needs analysis, identifying tasks o be trained
3. Developing the means of training
4. Establishing the mechanism for monitoring the outcomes of training

Several precautions were taken in order to minimize possible risks to safety including a phased implementation. ATQP is part of a system that monitors safety performance in normal operations, and consequently, the effectiveness of remediation through training. A “First-Look” analysis was also implemented as well as an enhanced data analysis. Simultaneously with implementation of ATQP, a new and comprehensive risk model was created to monitor any effects on safety and training that could result due to change.

The pilot performance grading structure was redesigned to meet the following objectives:

1. To measure system performance
2. To reflect the assessment of non-technical skills
3. To develop realistic Line Orientated Evaluation (LOE) scenarios
4. To develop a new program for instructor qualification and training
5. To develop a sophisticated instructor calibration program

A data management and reporting system was also developed to:

1. Build and implement a risk assessment model
2. Analyze data from multiple data streams
3. Track and trend key incidents based upon recent LOSA experience

The implementation process was monitored closely for risk over 2-years, as follows:

1. Monitoring of grades that were determined to be below the operator standard over the two-year implementation process
2. Training system performance over 2 years for crew capability in managing 32 categories of training events
3. Training system performance over 2 years for crew capability in 8 competency areas
4. Unstable approach trends from operations data
5. Landing performance in operations across several variables by FDA and a pilot reporting system.
6. Go-arounds in operations by cause and initiation altitude

The operator provided data to this study over the 2-year implementation process, as follows:

1. Continual risk assessment data.
2. FDA results and reports.
3. All training and checking data for pilots and instructors, including instructor calibration data.
4. Voluntary and mandatory occurrence reporting by pilots.
5. Detailed safety performance indicators of pilot errors and aircraft limit exceedances, including trends.
6. Altitude excursion information by cause.
7. Detailed analysis of engine-out pilot performance in training prior to, and post implementation.
8. Detailed analysis from operations of rejected take-offs by cause over a two-year period.
9. Airline's own analysis of the data above, in addition to recommendations and raw numbers

Data and results from all the above numbered items were made available to the EBT data subgroup as well as consultations with the key training and operational analysts from the airlines to well understand the processes and the results.

The standard process for entering evidence in the Evidence Table was used for this source. Several analysts read the report, working collaboratively to draft related evidence statements. The content and detailed wording of the evidence statements are reviewed and edited by the core analysts in the data-analysis working group. Evidence statements are reviewed and verified independently to ensure accurate reflection of the original source report material.

3.4.2.2 Strengths and Weaknesses

Most evidence coming from the data sources were processed by the airlines and while some of it could be crosschecked, much of it was accepted at face value. The spectrum of data provided by the donors was wide and extremely useful in verifying results from other sources. Unlike data from AQP, which are extremely focused with long standing experience, the information and analysis provided from ATQP is broader in scope but less specific in some respects. Most of the results were discussed with their source providing perspective and better understanding of the analyses.

3.5 AIRLINE PILOT SURVEY ON TRAINING EFFECTIVENESS

A survey was created by the EBT data group with a series of questions to airline pilots relating to the effectiveness of training they had received. The survey was made available via a link through the website of the International Federation of Air Line Pilots Association (IFALPA). The survey was active for a 110-day period from 17th November 2010 – 7th March 2011.

3.5.1 Background

An independent web-survey provider hosted it and all responses were anonymous. There were a total of 966 respondents, pilots being notified via an announcement on the IFAPLA daily news message and by word of mouth. IFALPA provided a means to reach a global sample of airline pilots. Data were collected from the web site into a data file, then summarized by survey probe.

3.5.2 Purpose

The survey probes are designed to fill gaps in existing EBT data set, to probe additional specific topics of interest for this study and verify and cross check results from other sources. The probe formats include multiple choices, and open-ended questions with percentage distributions.

Data are then grouped by topic and analyzed qualitatively for trends. Results of the analysis are included in the topic analysis in chapter 4 and the complete pilot survey “Airline Pilot Perceptions of Training Effectiveness” is reproduced in Appendix 4. Respondents were allowed to make comments, which are analyzed for trends. Evidence statements from the analysis of the survey are entered into the Evidence Table.

The standard process for entering evidence in the Evidence Table is used for this source.

Several analysts studied the statistical results and had access to the textual comments. One analyst drafts the evidence statements relating to training issues. The content and detailed wording of the Evidence Statements are reviewed and edited by the core analysts then reviewed independently for completeness and accuracy in representing information from the source report. The textual comments create a very large additional source of information, especially two open-ended questions. This textual material is analyzed separately by one analyst and reviewed by the core team. (See Appendix 4 for the survey questions and results.)

3.5.3 Strengths and Weaknesses

Surveys are based on samples of populations and are subject to sampling error, which reflects the effects of chance and uncertainty in the sampling process. The pilot survey attracted a fairly large number of respondents from many areas of the world providing balance and minimizing bias. Expert opinion is particularly useful as a data source. Surveying line pilots provide balance to the training criticality survey, which sampled largely the opinions of training experts. The margin of error in terms of pilot point of view for the questions, subject to its demographic distribution, is approximately 3% in this pilot survey. The pilot survey is anonymous allowing the respondents to express themselves with no accountability, which generally gives rise to comments and responses that are more pejorative than would normally be given if the names were attached to the survey. The strength of any survey is its ability to focus on very specific issues and elicit data that are difficult to find using other methods of research. Because of the voluntary nature of the pilot survey, it necessarily had to be short so as to attract a suitable number of respondents, which, in some respects, can limit the scope.

3.6 META DATA FROM ACCIDENT & INCIDENT STUDIES

3.6.1 IATA Safety Report 2008 & 2009

3.6.1.1 Background

IATA produces safety reports on an annual basis including a detailed summary of statistics, trends and contributing factors involved in accidents. This study includes an analysis of the 2008 and 2009 safety reports. The first part of the reports contains a summary review of western built jet hull losses and passenger fatality rates for the preceding 10-year period. In addition, the reports contain comments from the Accident Classification Task Force (ACTF), an industry-working group charged with accident analysis, identifying contributory factors, determining trends and areas of concern relating to safety, and developing prevention strategies. (See figures 3.6.1.1 and 3.6.1.1a for ACTF membership list.)

Accident Classification Task Force	
2008	
Name	Organization
Capt. Georges Merkovic	Air France
Mr. Jean Daney	Airbus Industrie
Dr. Dieter Reisinger	Austrian Airlines (Chairman)
Capt. David. C. Carbaugh	The Boeing Company
Mr. David Fisher	Bombardier Aerospace
Capt. Mattias Pak	Cargolux Airlines International
Mr. Mišo Klarić	Croatia Airlines
Mr. Savio dos Santos	Embraer Aviation International
Mr. Don Bateman	Honeywell
Mr. Martin Maurino	IATA
Capt. Karel Mündel	IFALPA
Mr. Bert Ruitenberg	IFATCA
Capt. Keiji Kushino	Japan Airlines International
Mr. Richard Fosnot	Jeppesen
Capt. Joachim Fleger	Lufthansa German Airlines
Capt. Jean-Lucien Tarrillon	Régional
Capt. Ayedh N. Al-Motairy	Saudi Arabian Airlines
Capt. Peter Eggler	Swiss International Airlines
Mr. Gustavo Rocha	Tam Linhas Aéreas
Capt. Carlos dos Santos Nunes	TAP Air Portugal

Figure 3.6.1.1

Accident Classification Task Force	
2009	
Name	Organization
Mr. Marcel Comeau	Air Canada
Capt. Georges Merkovic	Air France
Mr. Albert Urdiroz	Airbus Industrie
Dr. Dieter Reisinger	Austrian Airlines (Chairman)
Capt. David. C. Carbaugh	The Boeing Company
Capt. Thomas Philips	The Boeing Company
Mr. Andre Tousignant	Bombardier Aerospace
Capt. Mattias Pak	Cargolux Airlines International
Mr. Savio dos Santos	Embraer Aviation International
Mr. Don Bateman	Honeywell
Mr. Michael Goodfellow	IATA
Capt. Karel Mündel	IFALPA
Capt. Keiji Kushino	Japan Airlines International
Mr. Richard Fosnot	Jeppesen
Capt. Peter Krupa	Lufthansa German Airlines
Capt. Jean-Lucien Tarrillon	Régional
Capt. Peter Eggler	Swiss International Airlines
Mr. Gustavo Rocha	Tam Linhas Aéreas
Capt. Carlos dos Santos Nunes	Tap Air Portugal

Figure 3.6.1.1a

Aircraft accidents are categorized and analyzed according to:

1. Region
2. Threat and Error Management – As part of the report ACTF analyzed accidents using a taxonomy based on TEM) The purpose of this taxonomy is to:
   a. Acquire more meaningful data
   b. Extract further information and intelligence
   c. Formulate relevant mitigation strategies and safety recommendations
3. Hull losses – The IATA report breaks down accidents using hull loss as a category to provide a notion of severity.
4. Phase of flight.
5. Consequences, as follows:
   a. Controlled flight into terrain (CFIT)
   b. Gear-up landing
   c. Ground damage
   d. Hard landing
   e. In-flight damage
   f. Loss of control in flight
   g. Mid-air collision
   h. Runway excursion
   i. Tail strike
   j. Undershoot
6. Contributing factors as follows:
   a. Latent conditions
   b. Threats
   c. Flight crew errors
   d. Undesired aircraft states

Correlations of interest are made to highlight some results that imply mitigating strategies. These correlations are between the classifications and other types of breakdowns of the accident analysis. The technique is generally used where causality is suspected in order to support it. Most often in these reports an accident classification is correlated to a threat or error. For example: In 33% of CFIT accidents, the flight crew committed errors relating to SOP adherence and/or SOP cross-verification and the aircraft underwent vertical, lateral or speed deviations prior to a potential terrain proximity event.

The IATA safety reports are primarily used in the EBT study to challenge and validate analyses from other sources, particularly LOSA, FDA, EBT Accident and Incident Study and the meta analysis from the UK CAA publications CAP 776 and 780. The standard process for entering evidence in the Evidence Table is used for this source. Several analysts read the reports, working collaboratively to draft related evidence statements. The content and detailed wording of the evidence statements are reviewed and edited by the core analysts in the data-analysis working group.

Evidence statements were reviewed and verified independently to ensure accurate reflection of the original source report material.

3.6.1.2 Strengths and Weaknesses

The IATA safety reports have the same strengths and weaknesses as other accident reports. Accident analysis has been the bedrock of safety analysis, providing the context and framework for all other safety analysis and reporting. The biggest strength of accident and incident data is its relevancy to safety and training (i.e., Evidence Based Training in a pure sense).

The biggest weakness in accident-incident analysis is the inconsistency and lack of standardization among the original investigative reports from which the analysis is drawn. Additionally some reports lack information on human factors and in the search for direct and final causation some underlying factors are usually missing. Because the IATA accident reports are annual studies, it is helpful that at the beginning of the report a 10-year accident review is made. It is also helpful that the IATA safety reports analyze the data from various perspectives including causality, factors, and a threat and error framework.

3.6.2 Incidents During Training

This study includes a query of an Air Safety Report database to compare frequency distributions of the top 20 STEADES descriptors of normal flights versus training flights. A search of the STEADES database was performed using a word search “training/trainee flight”. The intent is to denote the differences between the pilot performance during Initial Operating Experience (IOE), where pilots are supervised during line flying on a new type versus their performance in normal operations. The analysis highlights the descriptors that differ significantly. (See figure 3.6.2.1 STEADES Descriptors used.)

3.6.2.1 STEADES – Global Aviation Safety Data Sharing Program

The STEADES database (now part of IATA GADM) of de-identified airline incident reports is the world’s largest, offering a secure environment for airlines to pool safety information for global benchmarking and analysis needs. STEADES provides rates on safety performance indicators as well as continually producing report on many safety subjects.

STEADES Top 20 Descriptors	
During Training Flights	**During Normal Operations**
Severe Weather	Flight/Ground Crew Communications
Communications with ATC Lost	Approach/Landing Aids
Windshear	Hard/Heavy Landing
Flight Crew Auto Handlings	Flight Plan
Flight/Ground Crew	Other Operational Data
Communications Flight Plan	Operational Procedures
Flight Crew Fatigue/Stress	Severe Weather
EGPWS/GPWS – Sink Rate	Flight Crew Fatigue/Stress
Tailwind	Insufficient Visual Reference
Other Operational Data	Tailwind
Aircraft Anti/De-Icing	Communications with ATC Lost
Checklist/SOP Use	Flight Crew Manual Handling
Aircraft Limit Exceedence	Checklist/SOP Use
EGPWS/GPWS – Glideslope	Inadequate Separation
Operational Procedures	Windshear
Deep Landing	Other Aircraft – Slow to Clear Runway
Hard/Heavy Landing	Flight Crew Mis-Selection
Flight Crew Mis-Selection	Turbulence
Flight Crew Manual Handling	High Energy/Unstable Approach
High Energy/Unstable Approach	Aircraft Limit Exceedence

Figure 3.6.2.1

3.6.2.2 Strengths and Weaknesses

Since STEADES does not provide a differentiation in IOE phase or regular operations, and the reporting is not standardized to make reference as to whether the occurrence was during a training flight or a regular commercial flight, it was not possible to take the findings from STEADES into consideration at this point. Further development of STEADES, within the GADM framework, will offer this differentiation in the near future.

3.6.3 UK CAA Accident Reports

3.6.3.1 Background

Two CAA (UK) 10 year global fatal accident reviews are referenced and excerpted in this report, as follows:

- CAP 776 – Global Fatal Accident Review 1997 – 2006, published July 2008
- CAP 780 – Aviation Safety Review 2008, published November 2008

Additionally, assistance from the UK CAA was provided, creating a mapping of some of the applicable results of the reports to factors defined in the EBT Training Criticality Survey. The outcome of this process appears in the Evidence Table and the mappings appear in Chapter 4.2.8 Analysis and in the appendices (See Appendix 6).

The EBT study draws information from the CAA accident reports themselves as well as the additional analysis provided from the CAA and makes inferences from the findings relating to training need. The Inferences are entered in the Evidence Table.

3.6.3.2 CAP 776

The primary aim of the CAA analysis is to extract safety related information from fatal accidents so that strategies could be developed to help reduce the worldwide fatal accident rate in the future. In this endeavor, the UK CAA Accident Analysis Group (AAG) decided to routinely assess all fatal accidents on a worldwide basis. The AAG's assessment process consisted of three main parts:

1. Causal factors
2. Circumstantial factors
3. Consequences

This is accompanied, according to AAG, by an evaluation of the level of confidence in the information available.

3.6.3.3 Causal Factors

For the purpose of the study and this report, a causal factor is an event or item, which is judged to be directly instrumental in the causal chain of events leading to the accident. AAG select 1 primary causal factor for each accident. The causal factors are listed in groups such as "Flight Crew" and then divided further into specific factors such as "Lack of positional awareness – in air". An accident may have been allocated any number of causal factors from any one group, and any combination of groups. There are a total of 67 causal factors from which to choose.

3.6.3.4 Circumstantial Factors

A circumstantial factor is an event or item, which was judged not to be directly in the causal chain of events but could have contributed to the accident. These factors are present in the situation and are felt to be potentially relevant to the accident. There are a total of 22 circumstantial factors.

3.6.3.5 Consequences

A list of consequences is used to record the outcomes of fatal accidents. An accident may have been allocated any number of consequences. There are a total of 15 consequences from which to choose:

1. Controlled flight into terrain (CFIT)
2. Collision with terrain, water or obstacle
3. Mid-air collision
4. Ground collision with other aircraft
5. Ground collision with object or obstacle
6. Loss of control in flight
7. Fuel exhaustion
8. Runway Excursion or overrun
9. Undershoot
10. Structural failure
11. Post crash fire
12. Fire or smoke during operation
13. Emergency evacuation difficulties
14. Forced landing – land or water
15. Other cause of fatality

3.6.3.6 Cap 780

The Aviation Safety Review, CAP 780 covers the ten-year period 1998-2007. The document includes an overview of worldwide and European Union aviation safety statistics, before concentrating in more detail on UK aviation safety. For the purpose of the EBT data study, the focus is on worldwide data.

The data for this Review is derived from a variety of sources:

1. Worldwide accident statistics by the International Civil Aviation Organization (ICAO)
2. European Union fatal accident statistics and worldwide utilization have been derived from Ascend*
3. UK accident, serious incident and occurrence data is sourced from the CAA Mandatory Occurrence Reporting Scheme
4. UK utilization is supplied by the CAA Air Transport Statistics Department, CAA Aircraft Register,
5. NATS
6. Eurocontrol
7. Airprox statistics, from the UK Airprox Board. (An Airprox is a situation in which, in the opinion of a pilot or a controller, the distance between aircraft as well as their relative positions and speed have been such that the safety of the aircraft involved was or may have been compromised.)

*Ascend is a private provider of specialized information and consultancy to the global air transport industry with various aviation data including accident and logistical information on most all aircraft types and categories of aircraft. Some of the databases maintained by Ascend are as follows:

- World Aircraft Accident Summary (WAAS) – Researched and published on behalf of the UK CAA, WAAS includes detailed descriptions for 8,000 accidents involving jet and turbo-powered aircraft and helicopter accidents.
- Jet Operator Statistics (JOS) – Accident and exposure statistics over 45 years, across more than 1200 airlines, available as a comprehensive database or a subset of.

- Special Bulletin – When a major accident occurs, Ascend publishes a Special Bulletin summarizing all the available information about the event and following up with quarterly updates and a special end-of-year report.
- Major Loss Record (MLR) – MLR provides comprehensive details of 7,000 accidents incurred by jet, turbo-props and business jets since entry into service.
- Airliner Loss Rates (ALR) – ALR provides annual figures for all major airline types covering the different measures of exposure and five-year accident rates.

3.6.3.7 Strengths and Weaknesses

The source of data is used as a secondary (meta) source analysis for this report. Both CAP reports are quite exhaustive in terms of data assimilated and the analysis conducted. While the studies performed by the UK CAA and the EBT accident/incident analysis are not directly comparable, (the CAA study is more causal in nature while the EBT accident study is a factor analysis) the results can be contrasted and both are used in this Meta study. All accident studies suffer from the lack of capability to provide depth in certain areas. This is because the data becomes thin rapidly when drilling down, as accidents fortunately are limited. As soon as we begin to partition the accident sample by almost any parameter, it quickly becomes statistically less significant and of limited value as a predictor of future probability, hence risk. An additional problem with a causal accident analysis is that it does not compare easily with a threat and error analysis. CAP 776 mitigates this limitation by analyzing circumstantial factors as well as consequences and causal factors.

3.6.3.8 Special CAA Analysis of Global Fatal Accident Data using EBT factors

Worldwide fatal accidents were analyzed using the EBT Training Criticality Survey listing of potential threats, errors and aircraft states. The following criteria are applied to the data:

1. Fixed-wing jet and turbo-prop aircraft originally certified MTWA above 5,700 kg or 12,500 lbs.
2. Civil passenger and cargo flights only
3. Fatalities within 30 days of the accident (as per ICAO Annex 13 definition)
4. Occurring between 1 January 1997 and 31 December 2008 (inclusive)
5. Excluding violent acts (e.g., sabotage, terrorism, etc.)

Data is also analyzed for the following five separate categories:

1. All fatal accidents
2. Passenger flights only
3. Cargo flights only
4. Western-built jets only
5. Western-built jets on passenger flights only

See Appendix 6 for the study.

3.7 SCIENTIFIC REPORTS

3.7.1 Skill Retention after Training (FAA Unpublished Report)

3.7.1.1 Background

This study was undertaken during 2008 analyzing a very large set of pilot performance data obtained from the Federal Aviation Administration. The data is de-identified Maneuver Validation (MV) and First Look (FL) grades given to pilots during continuing qualification evaluations from operators applying the AQP. The primary purpose of the analyses is to examine skill decay over the course of the retention interval between successive training visits during the program. In addition, several other variables are examined including:

1. Phase of flight
2. Normal and abnormal maneuvers
3. Aircraft type

The objective of the study is to identify data that would support optimal intervals of retraining for different types of pilots and different types of tasks, in addition to determining optimal recurrent training intervals.

The following data were examined:

1. Retention interval
2. Practice level
3. Task type

The data analyzed in this study are de-identified maneuvers validation grades collected from 8 operators, with a total of 25 fleets ranging from B747, B777, B757/767 to turbo-prop aircraft across a range of operations. The data set comprises in excess of 2,000,000 maneuver grades collected between 2000 and 2008. The data represent an extensive range of maneuvers occurring across all phases of flight under both normal and abnormal (e.g., engine-out) conditions. All pilots were subject to a 12-month training exposure interval. Each training session began with a first look (FL) evaluation prior to any retraining, followed by maneuvers validation (MV) training, which enabled the assessment of psychomotor skill retention by comparing grades collected during MV training with FL grades collected 12 months later, the decay effect being equivalent to MV-FL. This calculation of the decay effect was repeated annually over the period. (See Appendix 5 for the full study.) Among all the 2,098,946 evaluations, 1,685 evaluations were excluded giving a study sample of 2,097,261.

The study investigated whether simulator effect within these three fleets was confounded with a certain maneuver type, retention interval or phase of flight.

3.7.1.2 Strengths and Weaknesses

This study had access to a substantial amount of data, was highly controlled and analyzed according to rigorous statistical principles. The study was very narrow in scope but it did provide definitive results and allow cross checking with the AQP study in 2 areas:

1. Skill decay
2. Training proficiency by phase of flight.

3.7.2 FAA Human Factors Team Report 1996 on: The Interfaces between Flightcrews and Modern Flight Deck Systems

3.7.2.1 Background

The objective of the study is to evaluate current generation transport category airplane flight deck design with respect to human interfaces with aircraft systems and the effect of these interfaces on airplane safety. The study concentrates on the design, training/flight-crew qualification, and operation of those systems dealing with flight path management.

The report considers all factors that can influence the pilot's ability to safely operate the airplane during all phases of flight, including, but not limited to, mode and situation awareness, pilot expectations regarding the automatic systems and the subsequent pilot response when those expectations are not met, in addition to crew resource management in modern flight decks.

The following aircraft types are included in the evaluation:

1. Airbus: Models A300-600/A310/A320/A330/A340
2. Boeing: Models 737/757/767/747-400/777
3. Fokker: Model F28-0100/-0070
4. McDonnell Douglas: Models MD-80/MD-90/MD-11

The standard process for entering evidence in the Evidence Table was used for this source. Several analysts read the report. One analyst drafts the evidence statements relating to training issues. The content and detailed wording of the Evidence Statements are reviewed and edited by the core analysts. The evidence statements are reviewed independently for completeness and accuracy in representing information from the source report.

3.7.2.2 Strengths and Weaknesses

The Report was issued in 1996 and changes and improvements in automation systems have been implemented since publication. The Generation 4 aircraft sample is small, so results are limited in this area. Discussions with the authors updating the study confirmed the relevance of many issues reported in the original report in the area of training today.

3.7.3 Automation Training Practitioners' Guide

3.7.3.1 Background

This work was supported by the Federal Aviation Administration through FAA grants to George Mason University and to the University of Central Florida; and through a contract to Research Integrations, Inc. The guide was first published in May 2008. The document serves to provide a consolidated and concise review of research addressing pilot training for automated aircraft, ("automation training" for short). The research is based on accidents, incidents, research experiments and studies. Each section begins with a brief summary of the concept followed by two subsections: Best Practices and More Information. In the Best Practices subsection, recommendations based on the research are made for improving automation training. Relevant best practices and supporting rationale in this document that deal directly with training itself in FSTD's are paraphrased into evidence statements and entered into the EBT evidence table.

3.7.3.2 Strengths and Weaknesses

This document is based on professional interpretation of a large a body of various types of data. It is a meta-analysis with the challenge of assimilating data from various sources. The study relates directly to training issues and specifically automation, and this is considered strength. The study is supported by an extensive human factors database.

3.7.4 Factors that Influence Skill Decay and Retention

3.7.4.1 Background

This Report was created by Winfred Arthur Jr., Pamela L Standush, and Theresa L McNelly from the Department of Psychology at Texas A & M as well as Winston Bennett Jr. from Armstrong laboratory. Copyright 1998

The study uses meta-analytic techniques that apply to data extracted from 53 studies. The study presents a review of skill retention and skill decay that focuses on factors that influence the loss of trained skills and/or knowledge over extended periods of non-use. The objective of the study is to review scientific skill decay and skill retention literature to delineate the effects of factors that influence the retention of trained skills over extended periods of non-use. The study presents a review of the following factors hypothesized to affect knowledge and skill retention:

1. Length of the retention interval
2. The degree of over-learning
3. Task characteristics e.g.,
   a. Closed loop versus open loop tasks
   b. Physical versus cognitive tasks
4. Methods of testing for learning
5. Instructional strategies or training methods
6. Differences among individuals

3.7.4.2 Strengths and Weaknesses

This is part of the meta-analysis and the study involves a well-researched paper. A substantial volume of data was analyzed. Much of the data is not related to aviation, but is rather analogical in nature.

The results of this study are applicable to the tasks as well the type of training germane to commercial airline flight crews. Even though the results are qualitative, they are useful in principle when designing flight crew training programs particularly in terms of program efficiency.

While meta-analysis of secondary data is useful in providing a large source of data to analyze, they have some standardization issues and can sometimes be difficult to quantify.

3.7.5 TAWS 'Saves'

3.7.5.1 Background

This paper studies six approach and landing incidents involving the potential for a Controlled Flight Into Terrain (CFIT) event. The term 'saves' is defined as accidents avoided. All had the potential to become fatal accidents, but were avoided by the Terrain Awareness Warning System (TAWS) alerting the crews to the hazard. The analyses below were conducted by the author and reviewed by a select group of safety professionals in addition to a number of airline pilots.

There were no narrative reports or crew interviews. EGPWS digital memory data provided aircraft location, altitude, and speed information; the approach charts were used to determine the expected flight path in normal operations. All 6 events involved premature descents and the incidents were examined for the attending threats and errors. The technique was to hypothesize realistic scenarios that fit the data to derive lessons learned, in a process similar to that used in the analysis of accidents.

3.7.5.2 Strengths and Weaknesses

The data sample was extremely limited forcing the author to speculate in terms of flight profile and scenarios. The results as well were limited. The major strength of this study is that it could be performed because the data were available to the analysts in a non-accident situation. The evolution of the TAWS technology, just culture and confidential reporting should enable studies of this sort to be able to be expanded in scope accomplished more easily with the ensuing lessons learnt.

3.8 ACCIDENT STUDY USING CAST DATA

3.8.1 Background

This study is primarily an accident analysis focusing on large commercial jets operated by operators over the last 20 years. Non-western jets are excluded. Standard ICAO accident definitions were used. The accident data was extracted from the CAST database provided to the EBT Data Subgroup. Because the CAST database only contained accidents through 2008, it was supplemented by the NTSB database for the years 2009 and 2010 so as to more consistent time wise with the other accident studies in the meta-analysis. There are 457 accidents used to compile the statistics.

Accidents were analyzed from three perspectives:

1. Accidents normalized by exposure (number of flight cycles) over time (trends)
2. Categories – The analysis of accidents by categories are accomplished using a zero sum methodology meaning that each accident is only assigned a single category such that the percentages for all categories total 100%. (The categories are shown in Figure 3.8.1 below.)
3. Flight Phases

Accident Study by Category (CAST Data)
System Malfunction
Abnormal Runway Contact
Runway Excursion
CFIT
Loss of Control
Undershoot
Fuel Starvation
Ground Collision
Fire (leading to an accident)
Icing
Turbulence
Birds
Air Collision (Mid-air)
Unknown

Figure 3.8.1

3.8.2 Strengths and Weaknesses

There are advantages and disadvantages in using an accident, zero sum methodology. Trending is very clear, but assigning a single cause to an accident with many factors can lead to oversimplification, particularly when trying to isolate areas of crew performance to enhance training. This method also has a tendency to hide certain factors, which can be relevant. When conducting analyses based upon causation, there is a strong dependency on the categories for analysis. These categories must be clearly defined and be determined as true causes, and not simply effects. In some of the categorizing in this study, as is with many similar studies today, the lines between cause and effect are sometimes indistinguishable.

The EBT Data subgroup undertook this study to counterbalance the EBT Accident-Incident Factor analysis, which is its antithesis in terms of source biases.

3.9 TRAINING CRITICALITY SURVEY (TCS)

3.9.1 Background

One of the elements of the EBT methodology is based on a training criticality survey, identifying potential threats and errors in each phase of flight. (See appendix 11 for sample of Survey Worksheet.) Aircraft types included in the survey are listed in figure 3.9.1. Pilots experienced in operations and training were asked to assess threats and errors by phase of flight according to their experiences, projections and their intuitive view of risk. There are 161, 3-part questions asked in each survey concerning 40 threats and errors over all phases of flight. 167 pilots completed a Training Criticality worksheet over most of the aircraft generations and 51 aircraft types/variants. There were no respondents for Generation 1 (Jet). Figure 3 represents a list of aircraft that is representative of the 6 generations of aircraft.

Aircraft Generations Analyzed Criticality Survey	
Generation	**Aircraft Type**
Generation 4	A319 A320 A321
	A330 200/300
	A340 200/300
	A340 500/600
	A380
	B777
	EMB 170 190
Generation 3	A300-600
	A310
	CE525A, B, C
	CE 550B, CE 560XL/XLS
	B737 300-500
	B737 600-800
	B747-400
	B757
	BE 40
	CE-680
	CE560XL
	CE560XLS
	CE-550B
	CE750
	CE560
	Cessna Mustang
	Cessna Citation E 60
	DHC 8
	Falcon 900EX
	Falcon DA 2000
	Falcon 200EX EASy
	Gulfstream 450
	Gulftream IV
	Hawker 800/850
Generation 2	MD80
	L-1329 Lockheed JetStar
	Hawker 400
N/A	Simulators
	Enter/Select type

Figure 3.9.1

Aircraft by Generation	
Generation 4 Jet	A318/A319/A320/A321
	A330, A340- 200/300, A340-
	500/600, B777, A380, B787
	A350, Bombardier C Series
	Embraer
	E170/E175/E190/E195
Generation 3 Jet	A310/A300-600
	B737-300/400/500
	B737-600/700/800 (NG), B757
	B767, B747-400, B747-8
	B717, BAE 146, MD11
	MD80, MD90, F70, F100
	Bombardier CRJ Series
	Embraer ERJ 135/145
Generation 3 Turboprop	ATR 42-600, ATR 72-600
	Bombardier Dash 8 Q Series
Generation 2 Jet	A300 (except A300-600)
	BAC111, B727, B737-100/200
	B747-100/200/300
	DC9, DC10, F28, L1011
Generation 2 Turboprop	ATR 42, ATR 72 (all series except -600)
	Embraer EMB-120
Generation 1 Jet	DC8, B707

Figure 3.2.1.1 (duplicate)

The respondents were volunteers from all over the world, multiple organizations, and airlines. It was not always possible to find volunteers for every aircraft listed in the figure 3.2.1.1 (duplicate) but certain volunteers came forward from aircraft that were not in the table. When this occurred, the aircraft involved were grouped with aircraft having similar characteristics as the aircraft in the table.

The threats and errors used in the survey were defined by the EBT Project Group specific to flight phases and considered relevant to training. In addition, the potential threats and errors that could occur in all flight phases are listed separately in a phase, defined as Phase Φ.

TCS Flight Phase Definitions		
Flight Phase	**Numerical Order of Flight Phase**	**Definition**
All	Phase Φ	Potential threats/errors in any or all phases of flight Phase (1-8)
Pre-Flight/Taxi	Phase 1	Pre-flight and taxi – flight preparation to completion of line-up
Take-off	Phase 2	From the application of take-off thrust until the completion of flap and slat retraction
Climb	Phase 3	From the completion of flap and slat retraction until the top of climb
Cruise	Phase 4	From top of climb until top of descent
Descent	Phase 5	From top of descent until the earlier of first slat/flap extension or crossing the initial approach fix
Approach	Phase 6	Form the earlier of first slat/flap extension or crossing the initial approach fix until 15m (50ft) AAL, including go-around
Landing	Phase 7	From 15m (50ft) AAL until reaching taxi speed
Taxi/Post-Flight	Phase 8	From reaching taxi speed until engine shutdown

Figure 3.9.1a

The defined threats and errors were evaluated on a scale of 1 to 5, according to likelihood of occurrence; severity of outcome, and the benefit training could have in mitigating the outcome. These three parameters are more fully described below.

Likelihood describes the probability that over the course of a defined period in time a pilot will experience a threat, requiring intervention. Five levels of likelihood were used as defined by the EBT international working group:

1. Rare – once in a career or less;
2. Unlikely – a few times in a career;
3. Moderately likely – once every 3-5 years;
4. Likely – probably once a year; and
5. Almost certain – more than once a year.

Severity describes the most likely outcome based on the assumption that the pilot has not received training to manage the defined event in five levels as follows:

1. Negligible – insignificant effect not compromising safety;
2. Minor – reduction in safety margin (but not considered a significant reduction);
3. Moderate – safety compromised or significant reduction in safety margin;
4. Major – aircraft damage and/or personal injury; and
5. Catastrophic – significant damage or fatalities.

Training Benefit describes the effect of training to reduce the severity by at least one level, and is assessed in a five level scale as follows:

1. Unimportant − training does not reduce severity;
2. Minor − enhances performance in managing an event;
3. Moderate − having no training compromises safety;
4. Significant − safe outcome is unlikely without effective training;
5. Critical − essential to understanding the event and coping with it.

For the purpose of this survey, the notion of risk is defined as likelihood x severity and is calculated for all threats and errors by phase of flight for each aircraft.

See Appendix 11 for a list of the aircraft involved in the Training Criticality Survey as well as the respondent's ATO or operator. The representation of each generation in terms of the number of surveys completed is displayed in Appendix 11.

Originally when the survey was sorted by threats and errors according to aircraft generation, all the factors in phase ϕ went to the bottom of the sort. This is because the factors in this phase were only assessed once even though they appear in multiple phases, hence their cumulative scoring was artificially small. Since risk is a weighted probability (by severity) and all the phases of flight are mutually exclusive, the risk of any given flight is the sum of the risks for each individual phase. This makes it important to assess a threat or error each time it appears. To compensate for the way the survey was structured, in not always asking the questions in the same way (ϕ phase issue), a rule was made to multiply the risk value times the number of phases where the risk is relevant in the sense that it could well have been a factor in an accident.

There were two other problems in the survey that needed to be corrected:

1. **Questions unanswered by the respondents.** An unanswered question automatically assigns an unwanted 0 risk. In order to correct this, the average risk per factor per phase of flight was calculated and used this value to fill in for unanswered question. (See Appendix 11 Analysis for this calculation)
2. **Outliers.** An outlier is an observation that lies an abnormal distance from other values in a random sample from a population. This definition provides discretion for the analyst to determine the distance.

Trimming of the outliers was done only on the high side of the mean because of the multiplicative effect of the risk formula, the effects of outliers on that side are exaggerated. All outliers were trimmed 1.6 standard deviations greater than the mean consistent with the advice of the statistician in the EBT Data Subgroup. Trimming was done at the finest level (risk per factor per phase per generation). This is because risk varies per factor with the phase of flight; that is another reason that questions regarding each factor should be asked for each phase. The correlations could have been accomplished using the corrected average risk per factor per generation but the cumulative value gives the same results and is one less step. The methodology yields the following results:

1. Average risk for each threat or error per each phase of flight per generation on a scale of 1-25
2. Cumulative risk scoring for each threat or error for a given flight per generation.
3. Corrected (for unanswered questions and outliers) average risk for each threat and error in each phase of flight per generation on a scale of 1-25
4. Corrected cumulative risk scoring per threat and error by generation leading to ranking
5. Training Criticality in the same format as risk values above.
6. Distribution of the risk by factor per phase
7. Distribution of the risk by factor per phase by generation
8. Standard Deviation of risk (generation factor and phase)

3.9.2 Strengths and Weaknesses

The survey is too small to reach an acceptable margin of error. This weakness is amplified by the fact that the interest lies in examining risk and training criticality according to aircraft generation, implying a partition of the data set. The data are heavily biased towards Generation 4, because that is the generation for which most of the surveys were completed. The structure of the questions (i.e., phase Φ) necessitated a rule to compensate for the fact that the threats and errors were not assessed every time they might actually appear. The correction required for the outliers was minimal and turned out not to change the outcome. The response rate to questions was very high requiring only a minor correction for that problem. Because of the problem with the size of the survey as well as the bias towards generation 4, the results were not integrated into any conclusions in this report other than to correlate them with the EBT Accident Incident study (See Appendix 11 for the correlative results.). With the several corrections noted above, the methodology can lead to a robust process, which can be utilized for the next round of investigation. Using expert opinion for a survey like the training criticality analysis is an excellent means for providing perspective, correlation and a continuous spectrum of data that is easily updatable and usually difficult to secure in other domains.

3.10 CORRELATION OF RISK BETWEEN TCS AND ACCIDENT-INCIDENT STUDY

3.10.1 Background

A standard statistical correlation was completed between the rankings of the sum of the corrected risk per factor according to aircraft generation in the TCS and the relative risk rankings by generation in the EBT accident incident analysis.

Data Sample Comparisons – The data sample for Generation 4 was the best for Training Criticality Survey while the data sample for Generation 2 was the best in terms of the Accident-Incident Analysis. Given that this study is intended to identify discriminators between aircraft generations with respect to training, only correlations from the same generation in the TCS to the same generation in Accident/Incident Study were calculated. Because there were no responses in the Training Criticality Survey for Generation 1 aircraft, there were only three correlations calculated i.e., generations 2, 3, and 4. No correlation was calculated from the all-generation ranking of the TCS to the all-generation ranking of the Accident/Incident analysis because of the asymmetric generational sizes of the raw data sets.

It is important to note that only the rankings are correlated. The amplitude of the risks for each factor was not taken into consideration, only its positional relation along the X-axis, as the primary objective of the analysis is only the prioritization of the threats and errors. A graphical presentation of the results of the correlation is available in Appendix 11. Consideration was given to correlating criticality (i.e., need for training) from the two analyses. This was not done for the following reasons:

1. While both analyses considered training effect on a five-point scale, the scales were significantly different and mapping would have been difficult.
2. Training effect in the training criticality survey was measured at the level of the threat and error while in the accident and incident study it was measured at the level of the event (accident–incident).

3.10.2 Strengths and Weaknesses

While the data sets correlate fairly well and with remarkable consistency according to aircraft generation, (see Appendix 11) there are several problems with the process. Firstly, the survey has too few responses to achieve an acceptable margin of error. Secondly, the data samples did not match well in terms of size. The data sample of the TCS for Generation 4 was the best with Generation 2 being the worst. The reverse was true for the Accident-Incident Analysis with Generation 4 the largest and Generation 2 the smallest. No correlations were done for the turbo-props because of the very limited number of respondents available for them. The survey correlations indicate consistency and promise; however, the survey, itself, is too small to use as extensively as had originally been planned. Never the less, the exercise demonstrated its value and it will be developed further in the future. The fact that the generational correlations tend to be quite good, offer additional confidence in the accident-incidence study.

3.11 EVIDENCE TABLE METHODOLOGY

3.11.1 Purpose

Most of the evidence from analyzed data sources is managed by using the Evidence Table. Meaningful outcomes from the individual analyses are phrased as Evidence Statements and recorded there. The only exceptions to this are the EBT Accident-Incident study and the Training Criticality Survey, the management of each being covered in their respective sections.

The purpose of the Evidence Table is to integrate evidence, identify meaningful patterns and enable the grouping of evidence to support key findings and is the major tool for the final analysis in chapter 4. The table also facilitates the prioritization of results. The ET was created as an excel file with columns to accommodate all necessary categorizations as follows:

(See Appendix 12 for representation of the Evidence Table)

1. **Reference Number** – a unique identifier for the statement
2. **Evidence Statement** – statements of evidence that range from a short sentence to a small paragraph or a bulleted list
3. **Objective Relevance** – 3 columns tracking evidence relating to the stated objectives of the study
4. **Flight Phase** – applicability to one or more phases of flight
5. **Applicability to Gen** – applicability to aircraft generation
6. **Source** – origin of the data; each individual source is uniquely named in this column
7. **Keywords** – keywords matching the evidence and allocated to the statements. Each statement may have none, 1 or more keywords.
8. **Context & Remarks** – usually there are several statements with the same context. This column also hosts remarks of any kind that may be relevant to the evidence statement
9. **Training Topic** – linking between the Evidence Statements and Training Topics
10. **Factors** – each evidence statement is linked, where applicable, to one or more relevant factors as defined in EBT Accident Incident Analysis in this column.
11. **Competencies** – Each Evidence Statement is linked with the relevant competencies in this column.

3.11.2 Data Entry

Prior to entry, each evidence statement is reviewed according to a standard process. Several analysts read the report, working collaboratively to draft related evidence statements. The content and detailed wording of the evidence statements are reviewed and edited by the core analysts in the data-analysis working group. Evidence statements are then reviewed and verified independently to ensure accurate reflection of the original source report material.

3.11.3 Evidence Table – Identifying the most Critical Training Topics

Once the Evidence Table (ET) was sufficiently complete, an analysis was performed on its contents. The first step involved doing a cross sectional verification of the finding by individual sources in the Evidence Table. The table is searched and filtered in multiple ways to identify information associated with specific topics and their importance. In assessing the evidence, attention is paid to the number of Evidence Statements supporting the topic, the number of independent sources listed to support the topic, along with the weight and credibility of the Evidence Statements involved.

Training Topics that are highly supported with strong evidence from multiple sources are labeled as the “A” topics. Training Topics that are supported with good credible evidence but not necessarily coming from as many independent sources is labeled as the “B” topics.

The end result of this process is a number of Training Topics, divided into two categories (A and B) with Category A being the more important. Each Training Topic has a specific pane with a Supporting Table listing all relevant Evidence Statements, in addition to an overall summary. The Evidence Statements are also linked to the appropriate factors defined in the EBT Accident-Incident Study as well as the relevant competencies to provide further analytical capability.

The list of A and B topics used in the training prioritization is one of the most important conclusions in the study. (See Chapter 2 Major Findings.)

The content and structure of the Evidence Table serves as a tool for continual analysis. It is a tool that has the capability to evolve and should be continually updated with more and new data.

3.11.4 Evidence Table – Analysis by Source

Chapter 4 begins by providing summaries of all the training topics that resulted from the EBT data study. These are the results of the convergence of all data analyzed to compile this report. This is followed immediately by reverting to the beginning of the analysis process: analyses by source.

After the training topics were identified and ranked (See 3.11.3 – Identifying the most critical Training Topics and 2.6 – Prioritization of Training Topics) an in depth analysis beginning with the sources was undertaken in order to:

1. Integrate and condense the various analyses to synthesize the results in terms of training topics.
2. Provide transparency in the analytical transformation of the information from pre-analysis to conclusions in terms of methods and tools.

3.11.4.1 Filtering and Word Searches to Create Support Tables

Each of the 17 sources (See 1.1, figure 1.1a) was analyzed using the linked evidence statements of the Evidence Table with one notable exception: the EBT Accident-Incident Study. (A discussion of the analysis of this source appears in 3.2). The method primarily used with the Evidence Table was simply filtering by the topic sequentially. In some cases additional searches according to synonym or related issue, were done in order to provide additional information for the topic. The results are tabulated in support tables, which are simply excerpts of the evidence table containing the evidence statements relating to the searches. Figure 3.11.4.1 is an example of a support table for Unstable Approaches in FDA. (Ref: 4.2.3 Unstable Approaches for the actual analysis.)

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Key Words	Training Topics	Factors	Competencies
170	3.5% of approaches are unstable	APR	34	34	FDA	Unstable APR/GA	Unstable APP	Mis A/C Stable	All
171	Only 1.4% of them lead to a Go-Around	APR	34	34	FDA	Unstable APR/GA	Unstable APP Go-Arounds	Mis A/C Stable Compliance	Application of Procedures/Knowledge
178	Frequency of flts having at least one FDA event (all severity levels) is the same for stable and Unstable Approaches (83.63 vs 81.11 stable vs unstable respectively) indicating there are landing problems with stable approaches as well.	APR	34	34	FDA	Unstable APR/GA	Landing Issues	Compliance Mis A/C State Mis-Sys	All
179	Comparing events per flt (all severities) stable vs unstable is 2.24:2:84 or r=1.3 (approx.)	APR	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	All
180	Comparing events rates (high severity stable vs unstable is 8.11% vs 19.53 (approximately 2.4 times) indicating that there are more than double the hi risk events on landing with Unstable Approaches	APR	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	All
181	Comparing event rates stable vs Unstable Approaches (all severities) for the selected 10 serious landing events stable vs unstable is 14.33% to 34.52% or r=2.4 (approx.)	APR	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	All
182	Comparing event rate (high severity) stable vs unstable for the set of 10 serious events is 1.96% vs 5.47% or r=2.8 (approx.) indicating that there are almost 3 times the hi risk events on landing with Unstable Approaches	APR	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	All
183	Unstable Approaches are not the cause of all landing problems. This is particularly concerning if we remember that the ratio of stable approaches over Unstable Approaches is approx. 27:1	APR	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	Manual AC Control
184	But if we drill down we see that when Unstable Approaches occur, there are many more of severe events during landings (things go more wrong when unstable.)	APR	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	Manual AC Control
185	Flights with Unstable Approaches produce more events than flights with Stable Approaches even in phases of flight outside of Approaches and Landings.	All	34	All	FDA	Unstable APR/GA	Unstable APP Error Mgt	Compliance Mis A/C State Mis-Sys	All

Figure 3.11.4.1

Bullets immediately following the topic title (e.g., 4.2.3.1.1 Unstable Approaches) define how each search was accomplished in order to build the particular support table for the specific topic. An example of the terminology used in defining the searches that produced the table in Fig 3.11.4.1 is given below with an explanation appearing in italics:

- **Filter Evidence Table for FDA** *(The evidence table is first filtered for all the rows with evidence statements relating to the source, Flight Data Analysis)*
- **Filter for [Unstable Approaches)(Landing Issues)(Error Management)]** *(This terminology indicates that the results of the previous filtering are then filtered again for Unstable Approaches then combined with filtered results for Landing Issues and lastly combined with filtered results with Error Management. The rows resulting from the filtering processes are combined into a matrix.)*

If any of the evidence statements are not relevant to the topic, unstable approaches, the analyst manually suppresses them from the support table. The technique is to over-search and suppress rather than lose any relevant information.

This type of technique was used to accumulate the data from each source in terms of the individual topics. Three other support tables in addition to the training topics using the same techniques were also built to make sure that no useful information relevant to training was lost. These other related topics are:

- Generational Aspects
- Phase of Flight
- Training Effect

The results from the ensuing support tables of the above three topics were used later in the analysis. (See the Note in 3.11.4.4)

3.11.4.2 Summary Process for Each Topic

The next step in the analysis is a two-part process:

1. The analyst organizes the evidence statements from the support tables into 'result' bullets that better reflect the overall meaning of the evidence statements. This falls under the heading: Results that follow the search definitions.
2. These result-statements are then summarized into brief one or two paragraphs reflecting the implications of the particular training topic per specific source, which are titled summaries.

3.11.4.3 Summary Analysis Matrix

There are 16 sources, 14 training topics and 3 other topics used in the described process. This could yield up to (16X17) individual summaries. Many sources contain little or no information for a given topic. No individual source covers all training topics. In order to aid in further analysis, a matrix was considered useful and constructed with the rows being the sources and the columns being the topics i.e., training topics and other relevant topics. An excerpt of the Summary Analysis Matrix is shown in Fig 4.11.4.3. See Appendix 13 for the entire matrix.

The matrix is a transformation of the data from the sources to the topics. One of the benefits of this informational array is that it shows the density of the data as a function of source and topic. It is easy to see what and how much support exists for a given topic; as well as how many sources contain information relevant to the topic.

EVIDENCE TABLE - SUMMARY ANALYSIS					
	Unstable Approach	**Automation**	**Error Management**	**Manual Aircraft Control**	**Go-Around**
LOSA Study 4.1	Unstable approaches remain a consistent problem at a rate of approximately 4%. They almost always result in an uneventful landing. The crews in most cases have mismanaged the situation but are willing to continue the approach, violate SOPs and/or are unsure of the appropriate stabilized approach criteria. Landings are often performed in the wrong aircraft configuration.	The overarching problem with automation for the flight crews is monitoring and cross checking. 28% of the flights have at least one automation error with almost half of them not detected or acted upon by the crew. In addition there is a basic problem with understanding the system, mode confusion and using the automation and/or flying manually at inappropriate times.	A key strategy for managing flight crew errors is monitoring and crosschecking. The situation is critical as just over 25% of the errors made by the flight crews are detected and rectified. The highest risk is crosschecking errors (e.g. omitted deviations as they result 65% of UAS). The flight phase with the most threats is pre-departure, while the most mismanaged errors occur in DES, APP and LDG. Error detection is generally better in the early phases of flight with automation error captured being the best overall (53%) and procedure (16%) being the poorest. The Captain detects more errors than the First Officer (27% versus 18%) but neither rates highly at detecting their own errors (5-6%).	According to LOSA, manual control errors, while not the most frequent type of error (41% occurrence by flight), are only exceeded by automation errors. Many manual control errors result from the improper technique, flight crews ignoring or "flying through" the indicated flight guidance. Manual control problems are exacerbated in adverse weather. The leading error type is unintentional vertical deviation (32%) followed closely by deviations in landing, lateral, speed and improper thrust.	According to LOSA, go-around from unstable approaches occur only 3% of the time (contrary to SOP's). Landings from unstable approaches rank in the top 5 UAS during the LDG phase and are the number 3 non-compliance item in the LOSA database). When a go-around from an unstable approach is performed it is usually a surprise to the crew and poorly executed.
EBT Flight Data analysis 4.2.1	The FDA unstable approach rate is around 3.5%. This is consistent across aircraft types and geographical regions. There are as many flights that have landing events following stable approaches as there are following unstable approaches. Solving the unstable approach problem will not address all landing issues. The increased risk associated with unstable approaches becomes evident when examining event rates and event severity. Landings from unstable approaches have a higher event rate and as the events themselves become more severe, the event rate becomes even higher. Unstable approaches can be viewed as a barometer of the flight itself; flights with unstable approaches generally have more FDA events all in-flight phases, including phases not associated with the approach.	Intentionall Blank	Intentionall Blank	Intentionall Blank	Only 1.4% of unstable approaches lead to a go-around, with an FDA all event rate of 1.6 occurrences in the immediate phases after go-around (GA, CLB). The high-risk event rate for the same period is 0.24. Both these rates are conservative because the flight recorder cannot capture many of the crew errors that could occur. Go-around initiation heights overwhelmingly occur at heights different from those briefed.
Long body aircraft Studies 4.2.2	Intentionall Blank	Intentionall Blank	Intentionall Blank	Long body aircraft are more prone to high "G" landings. Because of geometric considerations, perspectives from the cockpit are slightly different laterally and vertically and tend to produce steeper approach gradients just prior to flare as well as centreline displacement in crosswinds. To compensate for this crews should be attentive to landings in crosswind, avoid last minute pitch-down and a tendency to under-flare. There is a tendency to under-rotate in long body aircraft, which degrades take-off performance; pilots should make smooth accurate rotations avoiding "pilot induced oscillations.	Intentionall Blank

Figure 3.11.4.3 – A small excerpt of the Evidence Table Summary Analysis

3.11.4.4 Summary Analysis Templates

The next tool to be used in the analytical process is the summary analysis template. (See figure 3.11.4.4. for an example.) There are 14 of these, one for each Training Topic. See Appendix 13 for all of the summary analysis templates.

Summary Analysis - Automation

Sources	Summaries
LOSA	The overarching problem with automation for the flight crews is monitoring and cross checking. 28% of the flights have at least one automation error with almost half of them not detected or acted upon by the crew. In addition there is a basic problem with understanding the system, mode confusion and using the automation and/or flying manually at inappropriate times.
AQP	Automation is an issue of concern regarding assessments in AQP in both the planning and execution phases of flight. The phases most concerned are CRZ and DES.
ATQP	Mismanaged auto-flight is a major factor, contributing to unstable approaches and go-around errors, both in training and line operations. This remains constant, whether in the all engines operating, or engine-out case.
Pilot Survey	The pilot survey was heavily critical of automation training during the initial type rating. Only 25% of the pilots felt prepared to utilize the automation when released to line operations. In reality 61% had multiple encounters on the line during their first 6 months of flying where they reported being involved in uncomfortable situations. Over 60% felt that the operational aspect of FMS training was missing during training requiring them to learn to use the system effectively during the first year after training. When asked how the training could be improved, the majority felt that automation surprises was the most important issue followed by hands on use in operational situations; while about a third recommended better training in transitioning between levels. The prevailing sentiment was that the operational aspect of the FMS was seriously lacking in training, the focus being on the functional, such as basic knowledge and programming
IATA Safety	The IATA accident reports generally support the LOSA finding with regard to automation. Specifically, flight crews were found reluctant to revert to manual flying even when the situation required it. In addition, crosschecking is promoted to be the best countermeasure to mitigate automations errors and further finds that gross error checks should be made when imputing data into the FMS to trap errors easily made with this function
CAA ACCIDENT REPORTS	The ranking of automation as a causal factor is generally low in accident reporting and the CAA accident reporting is no exception at 1.9%. The prevailing opinion by many analysts is that because mismanaged automation is further upstream in the error chain and under reported in causal accident investigation
Skill Decay	The skill decay study shows that skill losses can be substantial and decay without practice. This deterioration is much greater for skilled tasks, such as certain automation skills making it important to assess these skills in training particularly for pilots that do on operate routinely.
FAA HF Report	The FAA automation report found that pilots have various situation awareness issues with automation. They are vulnerable to lack of flight path and energy awareness when using autoflight. In addition they are surprised by the subtleties and complexities of automation and the training courses fail to focus on operation principles of the autoflight architecture. Many pilots use the autoflight when inappropriate and fail to revert to manual flight. The training courses at the time of the study tended to be checking rather than learning oriented and had not kept pace with human factor issues in regard to automation. The report recommends that training enhance mode and position awareness when using automation, particularly with regard to terrain, energy and upset. In addition, the report recommends that there be adequate training content to insure airmanship, CRM, decision-making, workload/task management when utilizing automation especially in demanding situations
AUTO PRACT GUIDE	The Automation Training Practitioners' Guide advocates a new training concept. Specifically it recommends training in blocks, adapting to individual trainees, integrating CRM throughout training, and major emphasis on the "need to know" items. In addition it recommends using multiple assessment techniques, confirming that pilots understand the logic, design purpose and limitations of the automation. Lastly it recommends practice in operational setting of managing automation throughout the various levels including eversion to manual flight

Outline	Excerpts	Narrative
Problem	28% of the flights have at least one automation error with almost half of them not detected or acted upon by the crew. - LOSA	According to LOSA almost 30% of the flights have at least one automation error with almost half of them not detected or acted upon by the crew. Training reports that automation is an issue of concern regarding assessments in both the planning and execution phases of flight. Pilots themselves are heavily critical of automation training during the initial type rating with only 25% of the pilots feeling prepared to utilize the automation when released to line operations. A major accident investigation agency believes that because mismanaged automation is further upstream in the error chain, it is under reported in causal accident investigation. Another authority states that many pilots use the autoflight when inappropriate and fail to revert to manual flight when required. The skill decay study shows that skill losses can be substantial and decay without practice. This deterioration is much greater for skilled tasks, such as certain automation skills making it important to assess these skills in training particularly for pilots that do on operate routinely. All of this points to a need to change the way current training is accomplished. A total of 60% of pilots reported that operational FMS training was not provided during initial training, and that they were left to self-learn during line operations.. Recommendations to improve training include that training enhances mode and position awareness when using automation, particularly with regard to terrain, energy and upset. In addition, there should be adequate training content to ensure airmanship, CRM, decision-making and workload management when utilising automation, especially in demanding situations. Training should also include multiple assessment techniques, confirming that pilots understand the logic, design purpose and limitations of the automation. Practice and reinforcement should be accomplished in an operational setting, managing automation at all levels and including reversions to manual flight.
	Automation is an issue of concern regarding assessments in AQP in both the planning and execution phases of flight - AQP	
	Mismanaged auto-flight is a major factor, contributing to unstable approaches and go-around errors, both in training and line operations. This remains constant, whether in the all engines operating, or engine-out case. - ATQP	
	In reality 61% [of survey pilots] had multiple encounters on the line during their first 6 months of flying where they reported being involved in uncomfortable situations. - Pilot Survey	
	The IATA accident reports generally support the LOSA finding with regard to automation. Specifically, flight crews were found reluctant to revert to manual flying even when the situation required it. - IATA Safety	
	The ranking of automation as a causal factor is generally low in accident reporting and the CAA accident reporting is no exception at 1.9%. - CAA Accident Reports	
	The FAA automation report found that pilots have various situation awareness issues with automation. - FAA HF Report	
	Many pilots use the autoflight when inappropriate and fail to revert to manual flight. - FAA HF Report	
	Input from Evidence Table	
	Input from EBT Accident-Incident Study	
Specifics	The overarching problem with automation for the flight crews is monitoring and cross checking - LOSA	
	The phases most concerned are CRZ and DES. - AQP	
	The prevailing opinion by many analysts is that because mismanaged automation is further upstream in the error chain, it is under reported in causal accident investigation. - CAA Accident Reports	
	They [Flight crews] are vulnerable to lack of flight path and energy awareness when using autoflight. In addition they are surprised by the subtleties and complexities of automation and the training courses fail to focus on operation principles of the autoflight architecture. - FAA HF Report	
	Input from Evidence Table	
	Input from EBT Accident-Incident Study	
Training Effect	When asked how the training could be improved, the majority felt that automation surprises was the most important issue followed by hands on use in operational situations; while about a third recommended better training in transitioning between levels. - Pilot Survey	
	In addition, crosschecking is promoted to be the best countermeasure to mitigate automations errors. - IATA Safety	
	The training courses at the time of the study tended to be checking rather than learning oriented and had not kept pace with human factor issues in regard to automation. - FAA HF Report	
	The Automation Training Practitioners' Guide advocates a new training concept. Specifically it recommends training in blocks, adapting to individual trainees, integrating CRM throughout training, and major emphasis on the "need to know" items. - AUTO PRACT GUIDE	
	Input from Evidence Table	
	Input from EBT Accident-Incident Study	
Criticality	The pilot survey was heavily critical of automation training during the initial type rating. Only 25% of the pilots felt prepared to utilize the automation when released to line operations. - Pilot Survey	
	Over 60% felt that the operational aspect of FMS training was missing during training requiring them to learn to use the system effectively during the first year after training. - Pilot Survey	
	The prevailing sentiment was that the operational aspect of the FMS was seriously lacking in training, the focus being on the functional, such as basic knowledge and programming - Pilot Survey	
	The skill decay study shows that skill losses can be substantial and decay without practice. This deterioration is much greater for skilled tasks, such as certain automation skills making it important to assess these skills in training particularly for pilots that do on operate routinely. - Skill Decay	
	The report recommends that training enhance mode and position awareness when using automation, particularly with regard to terrain, energy and upset. In addition, the report recommends that there be adequate training content to insure airmanship, CRM, decision-making, workload/task management when utilizing automation especially in demanding situations. - FAA HF Report	
	In addition it recommends using multiple assessment techniques, confirming that pilots understand the logic, design purpose and limitations of the automation. Lastly it recommends practice in operational setting of managing automation throughout the various levels including eversion to manual flight. - AUTO PRACT GUIDE	
	Input from Evidence Table	
	Input from EBT Accident-Incident Study	

Figure 3.11.4.4

The synthesis works from left to right with the first two columns depicting the topic summary by source. In the case of the example for Automation in the figure above, there are 8 sources providing summary results for the training topic.

These summaries from the applicable sources were transcribed from the Summary Analysis Matrix i.e., the appropriate column (e.g., Automation) with the empty cells collapsed.

The next step is to excerpt from all the summaries and reorganize these excerpts in terms of the following four constructs:

1. Problem
2. Specifics of the problem
3. The effect of training in mitigating the problem or its ramifications
4. The Training Criticality

Note: There were no templates created for the topics other than the 14 training topics. The other summaries from the other topic classifiers (i.e., Generational Aspects, Phase of flight and Training Effect) are excerpted and added to the outline under the appropriate construct (Problem, Specifics, Training Effect and Training Criticality), as these issues are highly germane to training.

3.11.4.4.1 Assimilating the Results of the EBT Accident-Incident Study

The sections in Chapter 4 (4.2.2.1 – 4.2.2.9) contain the results of the EBT accident-incident analysis in statement form and titled by training topic. The appropriate statements from these sections are added into the respective summary analysis template in the Excerpt column and in the appropriate construct section to augment the body of information that is used to infer the last stage in the argument.

3.11.4.5 Narratives of Training Topics

The final step in the process is to summarize and deduce the conclusions in a short narrative form from all the excerpts in the format of the constructs. These narratives, one for each of the 14 training topics, are in the last column of the associated summary analysis template as well as in the opening section of Chapter 4 – Analysis and Results.

4 ANALYSIS AND RESULTS

INTRODUCTION

This chapter has a pyramidal organization much like the report itself, beginning with the findings and continuing down through the analyses to the data. It commences with the training topics that resulted from the summation of all the various analyses followed by the supporting analyses.

13 topic worksheets integrate the EBT Accident-Incident Study factor analysis with the Evidence Table Summary matrix, providing singular results according to each Training Topic. See Appendix 13 for the worksheets for each of the training topics.

This type of layout provides a clear view of the information from its source and the logic of the analysis. It also demonstrates the results in terms of their relevance to training.

4.1 SUMMARY ANALYSIS BY TOPIC

4.1.1 Unstable Approaches

The rate of unstable approaches remains a consistent problem at approximately between 3 – 4% across aircraft generations and geographical regions. The increased risk that is associated with unstable approaches becomes evident when examining event rates and event severity. Landings from unstable approaches have a higher risk and as the events themselves become more severe, the risk escalates in an accelerated manner.

As pilots continue to make unstable approaches they continue to land from them instead of executing the go-around required by SOP. Pilots admit to this violation, citing many reasons including the fact that they feel less comfortable with the go-around than the subsequent landing. The data support that go-arounds are usually not well executed.

Interestingly, unstable approaches can be viewed as a barometer of the flight itself; flights with unstable approaches generally have more FDA risk events in all flight phases, including phases not associated with the approach.

Training should address this issue, not only for the approach, but the go-around as well. Associated issues of non-compliance and pilot confidence should also be addressed to effectively treat the continuing problem of the unstable approach.

4.1.2 Automation

According to LOSA almost 30% of the flights have at least one automation error with almost half of them not detected or not acted upon by the crew. Training reports that automation is an issue of concern regarding assessments in both the planning and execution phases of flight. Pilots themselves are heavily critical of automation training during the initial type rating with only 25% of the pilots feeling prepared to utilize the automation when released to line operations.

A major accident investigation agency believes that because mismanaged automation is further upstream in the error chain, it is under reported in causal accident investigation. Another authority states that many pilots use the autoflight when inappropriate and fail to revert to manual flight when required. The skill decay study shows that skill losses can be substantial and decay without practice. This deterioration is much greater for skilled tasks, such as certain automation skills making it important to assess these skills in training particularly for pilots that do on operate routinely.

All of this points to a need to change the way current training is accomplished. A total of 60% of pilots reported that operational FMS training was not provided during initial training, and that they were left to self-learn during line operations.

Recommendations to improve training include that training should enhance mode and position awareness when using automation, particularly with regard to terrain, energy and upset. In addition, there should be adequate training content to ensure airmanship, CRM, decision-making and workload management when utilizing automation, especially in demanding situations. Training should also include multiple assessment techniques, confirming that pilots understand the logic, design purpose and limitations of the automation. Practice and reinforcement should be accomplished in an operational setting, managing automation at all levels and including reversions to manual flight.

4.1.3 Error Management

Effective monitoring and error detection are increasingly important when operating highly reliable, automated aircraft. Multiple data sources provide evidence of substantial rates of undetected error. Error management is reported as a very significant countermeasure in current operations with one accident study espousing that it is the most significant tool available to pilots for the prevention of accidents. Multiple sources of data show that there is a high level of intentional non-compliance and so any error management strategy must include greatly reducing its incidence.

Error management skills are subject to decay. Error management currently does not form part of any strategy developed through the regulation of flight crew training, so consequently it is lacking in most training programs. It is a key topic and needs to be incorporated into training strategies in order to raise flight crew situation awareness and further develop the professional capabilities of pilots.

4.1.4 Manual Aircraft Control (Flight Path Management – Manual)

Manual aircraft control is one of the most important topics in operations and training. It ranks very highly as a competency issue in accident reports. Various sources of flight operations data show substantial competency issues associated with manual control. The phases of flight that routinely involve manual aircraft control such as take-off, landing and taxing show a very significant percentage increase in accidents over the last decade. Unintentional deviations and failure to follow flight guidance, plus speed and thrust errors, exacerbated by adverse weather, are some of the issues being observed. Landings with high vertical acceleration, difficulties in crosswinds, long touchdowns and substantial handling errors during go-arounds are amongst the problems revealed by flight data. While training data indicate rapid mastery of manual control especially in Gen 4 jets, this effect can easily be undermined in complex and unexpected situations. Results show that safety while using automation depends on flight crews having the confidence to fly manually.

Data across the EBT study highlight the importance of training to mitigate an obvious deterioration in manual aircraft control skills. Pilots are well aware of the need for manual aircraft control training and clearly expressed this need when responding to the Airline Pilot Perceptions of Training Effectiveness Survey. Training data effectively shows that the trend can be reversed providing the skill is mastered. Skill retention data in two independent reports show that manual aircraft control skills are resistant to decay as long as they are practiced.

Good manual control skills include transitioning in and out of automation, with attendant and realistic distractions and threats from the environment, aircraft systems and ATC. Simply to continue practicing only traditional and rote maneuvers is insufficient for crew confidence and proficiency required for modern aircraft in today’s environment.

4.1.5 Go-Arounds

Despite efforts to eradicate unstable approaches and to mandate go-arounds should an unstable approach occur, the occurrence rate of unstable approaches remains significant as well as the fact that flight crews simply do not go around as mandated. A major concern of unstable approaches is the disregard of the SOP's, in addition to the efficacy of threat and error management during the entire flight. According to the LOSA report, there is a “90% (SOP) violation factor” in terms of not executing a go-around from an unstable approach.

Unstable approaches are often a barometer for the flight itself. If an approach is poorly executed, there are strong indications from the data that the rate of errors and risk events will be higher across the entire flight, according to FDA and LOSA. Data from multiple operational and training sources indicate that crews almost universality have problems with the go-around. This is because it is not usually expected, and may have to be executed under demanding conditions, from altitudes and energy states other than those practiced in training. When unraveling the unstable approach paradox, one issue remained clear throughout; flight crews must acquire the necessary capability to execute a go-around from any situation, utilizing automation and/or manual control skills as appropriate.

The multi-source data are quite compelling on the current state of the go-around in operations and training today. Yet variable Go Around management with all engines operating does not form part of any strategy developed through the regulation of flight crew training. This is a key topic and needs focus to raise awareness and develop pilot capability. A strategy for training should address multiple intersecting issues in addition to providing exposure and building confidence in this area.

4.1.6 Adverse Weather

Despite improvements in aircraft design and automation systems, it is clear from multi-source data that adverse weather is still a very substantial threat to the safety of commercial air transport operations. Accident and serious incident data indicate a strong presence of adverse weather as a factor, and this is corroborated by operations data. The trend is particularly concerning in Gen 2 aircraft where the percentage of fatal accidents in which weather has been a factor has doubled in the last 15 years. Adverse weather increases workload, distracts the crew from normal tasks, including monitoring, and increases the risk of mismanagement of crew error.

The data indicate that operations in adverse weather should be effectively trainable, and that the creation of training scenarios should include dynamic and variable weather conditions, forcing crews to consider and manage, avoid and react, as conditions require. This EBT study is rich with data about adverse weather from many sources offering the opportunity to create realistic training to mitigate the seemingly ever-present threats to flight crews from adverse weather.

4.1.7 System Malfunction

According to EBT accident-incident data, system malfunction has reduced as a factor in accidents and major incidents as design and reliability of modern aircrafts have evolved. This is not the case for Gen 2 Jet aircraft, and system malfunctions are a significant contributor to undesired aircraft states, which are or can be a pre-cursor to incidents and accidents The management of an unexpected malfunction induces crew error, and according to operations data, remains a threat partly due to the distraction from normal duties, intentional noncompliance with procedures and the vulnerability of closed loop tasks.

Improvements in engine reliability are well documented and understood, and the rate of engine failures has reduced substantially. However, training data indicate that handling the aircraft in unexpected engine-out situations still presents difficulty to crews, and there remains a clear need to continue to practice the psychomotor skills based capability to fly the aircraft with an engine inoperative as part of an EBT program.

4.1.8 Terrain

There has been a significant reduction in accidents and incidents with terrain as a factor since the inception of TAWS regulation. However, the data from several sources indicate a decline in flight crew situation awareness with regard to terrain and terrain remains one of the most important mismanaged threats in the cockpit. While advancing technology has provided a very effective alerting system, attention needs to be placed on the need to ensure crews are vigilant and maintain at a high level of SA and not become complacent with regards to terrain.

4.1.9 Surprise

As design and reliability improve, the likelihood of crews facing specific malfunctions and events reduces. Isolated and unexpected events become more problematic as reliability is improved while attending to the overall system becomes more complex. A lack of effective procedural and conceptual knowledge of automation often leads to surprises in operations. Data indicate that cognitive tasks have potential for skills decay and flight path control in dynamic situations is often more demanding especially where there are attendant distractions from the environment, system or ATC.

Pilots reported that they often face operational surprises for which they have not been trained. In modern generation aircraft, the accident and serious incident data show an increase in poor situation awareness when things go wrong.

Despite all the data, current training is driven by highly prescriptive regulatory requirements based on evidence from early jets and training programs containing many elements, most of which are highly predictable. Data from operations and training indicate crews face substantial problems when dealing with unexpected events, for example executing an unanticipated all engine operative go-around, simply because they are unexpected and often performed in conditions not experienced in training.

4.1.10 Landing Issues

According to multiple accident studies the landing phase ranks first or second as the phase with the highest percentage of accidents and this trend is increasing. One study shows that accidents involving a landing short of the runway have doubled in the last decade. Landing problems are complex, as the accident-Incident data rank landing accidents number 1 in the clustering of factors. According to operational data the third most frequent non-compliance item is landing from an unstable approach; the same study also indicated that handling errors on landing are not well detected.

Training data indicates that landing skills take time to develop, while other studies show deterioration in the skills necessary in landing without practice, as well as the need for emphasis on training to better understand environmental and aerodynamic effects associated with landing. Most importantly realistic training should continually emphasize when and how to apply the go–around as a landing escape maneuver.

4.1.11 Compliance

Intentional non-compliance remains a substantial problem, and while the level of crew non-technical competency has shown signs of improvement over the most recent periods examined, non-compliance remains a serious weakness in current operations. It has decreased somewhat in the last 15 years but not at the same rate as has accidents. A notable exception to this is Gen 2 Jet where the rate has actually increased. There are many potential reasons for crews to deviate routinely from SOP's and these include attempts to optimize the operation, particularly in time-constrained situations. Complacency due to familiarity is another factor. However, the data show significant correlation between non – compliance and large increases in risk of undetected errors and undesired aircraft states. Checklist and call-out protocols show substantial signs of weakness. The failure of crews to execute a Go-round under conditions when SOP requires it is a very significant area of intentional non-compliance. Pilots admit to call-out and checklist deviations on a regular basis, as well as the failure to adhere to approach procedures and execute Go-rounds when required.

Crew discipline has always been assumed to be a pillar supporting operational safety and now the data show its breakdown. Crews must understand that intentional non-compliance, correlates highly with errors resulting in undesired aircraft states and that compliance failures also rank highly in accident data.

Crews are currently trained to comply and demonstrate adherence to SOP, but detecting and addressing non-compliance is not a feature of existing training programs. Data indicate that effective training and appropriate focus on areas such as leadership can address non-compliance.

4.1.12 Leadership

Leadership and teamwork as a competency issue has more than doubled in recent years. This is the case for all generations but it is even more pronounced for modern generation aircraft. The prevalence of a non-compliance culture is indicative of lack of appropriate leadership focus. In addition several sources point to a well understood need and desire for better leadership from flight crews. Data from pilots indicate a willingness to demonstrate effective leadership and make decisions enhancing and protecting the level of operational safety.

The absence of effective leadership in the cockpit adds substantially to the risk of mismanaged threats and errors leading to undesired aircraft states. Conversely, leadership when coupled with effective communication proves to be a very effective catalyst for managing threats and both reducing and managing errors.

From a training perspective, data indicate that leadership can be effectively developed, when there is a strong compliance culture, which in turn necessitates the careful design of effective procedures and adherence to them. The fact that leadership and teamwork is not reported as a competency issue in serious incidents indicates the importance of it as a mitigating agent in accidents as well as its importance in training. Strengthening leadership in training improves compliance, hence risk will be reduced and crews should be able to deal more effectively as a team with today's complex environment and function more effectively when faced with unfamiliar situations.

4.1.13 Mismanaged Aircraft State

Mismanaged aircraft state is a leading factor in the accident and serious incident reports in all generations and during all time periods. There is a reported weakness in prevention of mismanaged aircraft states as well as in the skills to recover from them after entry. Examples are landing incidents following unstable approaches and manual aircraft control competency issues. Mismanaged aircraft states occur for many reasons, all of which are of significance from a training perspective.

Aircraft states cited include flight path issues involving potential and actual loss of control, terrain and energy awareness. The flight phases having the most mismanaged aircraft states are descent, approach and landing. Effort needs to focused on detecting the errors that lead to mismanaged states as evidence shows that during these dynamic phases a large percentage are not detected until after the state becomes critical.

Recommendations include regular training to avoid mismanaged aircraft states as well as recovery from inadvertent entries and reinforcement training in basic flying skills such as manual handling, landings and go-arounds. Flight crews are reluctant to revert to manual flight from automation, while basic maneuvers such as landings and go-arounds continue to be a problem. The reports propose that proficiency, discipline and confidence be fostered during training to combat mismanaged aircraft states.

4.1.14 Upset

While upset still ranks as a major cause of accidents when measured as a category in several accident reports, its percentage of total accidents has remained steady in the last two decades. Several reports in the meta-study list this category of accidents as a concern.

Training should prepare pilots for any contingency whether expected or not. Manual aircraft control skills are important as reiterated many times in this report and pilots must have the skills to recognize and execute the recoveries from developing upsets (any time the aeroplane begins to unintentionally diverge from the intended flight path or airspeed). Prevention is key, with a strong focus on the detection and early intervention to prevent upsets from occurring. This is the essential strategy that must become an integral part of training.

4.2 ANALYSIS BY SOURCE

4.2.1 LOSA

Introduction

The LOSA study was specifically targeted to address issues likely to receive effective mitigation by appropriate training. The information that follows in this section illustrates the various areas of risk, as determined by LOSA data from approximately 9,000 observed flights across multiple airlines in various regions of the world when training intervention is considered likely to mitigate risk substantially.

The bullet statements at the beginning of each subsection of a particular source depict the processes used in the analysis of the Evidence Table. The functions (e.g., Filter) used to sort the respective data create specific support tables, shown as associated figures for each training topic per source.

4.2.1.1 Unstable Approaches and Go-Arounds

- Filter Evidence Table – LOSA Reports
- Filter Topic – Unstable Approach
  - See Figure 4.2.1.1
  - **Result – LOSA – Unstable approach**
    - The unstable approach rate is 4%.of all approaches
    - 97% of all the unstable approaches terminate in landing, 90% of which are uneventful.
    - In virtually all cases both pilots are willing to continue to land even though the approach is not stabilized.
    - Missed approaches as a result of unstable approaches are usually a surprise to the crew and rarely well executed.
    - In many cases the pilots act as if they are not aware that the approach is not stabilized or do not know the criteria for a stabilized approach.

  - 97% of unstable approaches are not linked to weather or ATC.
  - Failure to go-around from an unstable approach is the 3rd ranked non-compliance issue.
  - Crews sometimes volunteer to assist ATC, and this compromises a stabilized approach.
  - The effects of unstable approaches are consistently in the top five undesired aircraft states in the LOSA archives.
- Summary – Unstable approaches remain a consistent problem at a rate of approximately 4%. They almost always result in an uneventful landing. The crews in most cases have mismanaged the situation but are willing to continue the approach, violate SOPs and/or are unsure of the appropriate stabilized approach criteria.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicable to Generations	Source	Training Topics	Factors	Competencies
1	Unstable Apprs: 4% of approaches were unstable. 97% continued to landing.1% of such landings were abnormal. Both crew members willing to continue even if unstable.	APR	234	All	LOSA	Unstable APP Go Arounds	CRM Mis A/C State Compliance	Application of Procedures/Knowledge
2	Pilots did not know stable approach criteria.	APR	234	All	LOSA	Unstable APP Go Arounds	CRM	Knowledge
3	3% of Unstable Appes are linked to weather and ATC.	APR	234	All	LOSA	Unstable APP WX	Adverse Weather/Ice ATC	
4	Missed Approaches as result of Unstable Appes are rarely handled well. Risk rises dramatically which is problematic.	APR GA	234	All	LOSA	Unstable APP Go Arounds	Mis A/C State	Application of Procedures/Knowledge
5	Usually a surprise to the crew. None occurred at standard missed approach height briefed.	APR	234	All	LOSA	Go Arounds Surprise	Compliance CRM	SA Problem Solving Decision Making Application of Procedures/Knowledge Manual AC Control
33	Number 3 non-compliance item: Fail to execute missed appr when required	APR	234	All	LOSA	Unstable APP Landing Issues Go Arounds	Compliance CRM Mis A/C State	Leadership and Teamwork Problem Solving Decision Making Application of Procedures/Knowledge
44	Crews often agree to ATC clearances in order to "help".	CLB DES APR	234	All	LOSA	Error Mgt Leadership	ATC Workload Distraction Pressure Mis A/C State Mis-AFS	Communication Flight Management Guidance and Automation Manual AC Control Problem Solving Decision Making
52	In top 5 - UAS in DES/APR/LND: speed too high	DES APR LDG	234	All	LOSA	Unstable APP Landing Issues	ATC Compliance CRM Mis A/C State	SA Workload Management Problem Solving Decision Making Flight Management Guidance and Automation
53	In Top 5 - UAS in DES/APR/LND: Unstable App	DES APR LDG	234	All	LOSA	Unstable APP Landing Issues	ATC Compliance CRM Mis A/C State	SA Workload Management Problem Solving Decision Making Flight Management Guidance and Automation Application of Procedures/Knowledge
54	In top 5 - UAS in DES/APR/LND: incorrect A/C config-Automation	DES APR LDG	234	All	LOSA	Unstable APP	Compliance CRM Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance and Automation Application of Procedures/Knowledge
55	In top 5 - UAS in DES/APR/LND: incorrect A/C config-systems	DES APR LDG	234	All	LOSA	Unstable APP Go Arounds	Compliance CRM Mis A/C State Mis-Sys	Problem Solving Decision Making Application of Procedures/Knowledge
56	In top 5 - UAS in DES/APR/LND: continued landing after Unstable App	DES APR LDG	234	All	LOSA	Unstable APP	Compliance CRM Mis A/C State	Leadership and Teamwork Problem Solving Decision Making

Figure 4.2.1.1 – Unstable Approach/LOSA

4.2.1.2 Automation

- Filter Evidence Table for LOSA 1 or LOSA 2 reports
- Filter Topic [Automation]
  - See Figure 4.2.1.2
  - **Result LOSA – Automation**
    - 28% of flights in the LOSA database have an automation error. Almost 1% of flights have automation errors that lead to consequences, in LOSA terms UAS.
    - 21% of automation UAS result from monitoring and crosschecking errors.
    - Mismanaged flight guidance is the most prevalent automation error, followed by late disengagement of the system in DES, APP and LDG and manual flight at inappropriate times. Failures to cross check SID and STAR is also listed as an automation error.
    - A major reported problem is lack of understanding of the automation systems.
    - Pilots do not communicate mental models of the automation in the cockpit.
    - Automation mode confusion is a significant issue.
    - The overarching problem with automation is monitoring and crosschecking.
    - 47% of all automation errors are not detected or acted upon by the crews.
  - Summary Statement: The overarching problem with automation for the flight crews is monitoring and crosschecking. 28% of the flights have at least one automation error with almost half of them not detected or acted upon by the crew. In addition there is a basic problem with understanding the system, mode confusion and using the automation and/or flying manually at inappropriate times.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicable to Gens	Source	Keywords	Training Topics	Factors	Competencies
7	In terms of mismanaged errors guidance are far more prevalent than programming errors.	All	234	All	LOSA	Error Automation Training	Automation Error Mgt	Mis-AFS	Flight Management Guidance/Automation
8	Technical understanding of the Automation	All	234	All	LOSA	Automation Competencies Training	Automation	Mis-AFS CRM	Flight Management Guidance/Automation Knowledge
9	A lack of "verbalization" by crew to share mental models	All	234	All	LOSA	Competencies Automation Training	Automation Error Mgt	Mis-AFS CRM	Flight Management Guidance/Automation Communication
10	The late engagement of autopilot after takeoff or early disengagement in Descent/Approach/Land,Basically hand flying at an inappropriate time. Common errors include hand flying in a busy Terminal Area.	CLB APP	234	All	LOSA	Automation Competencies	Automation Manual AC Control Error Mgt	Mis-AFS CRM	Flight Management Guidance/Automation Problem Solving Decision Making
11	Control Zone, looking through the FD, not checking modifications to the SID, STAR or Approach profile and relying on the PM to effect FMC/FMGC changes.	CLB APP	234	All	LOSA	Automation Training	Automation Manual AC Control Monitor Xcheck	Mis-AFS CRM	Flight Management Guidance/Automation Workload Management Manual Aircraft Control Application of Procedures/Knowledge
12	The overarching element is Monitoring/Cross-Checking, with little to no dialogue between the pilots during most of the errors.	All	234	All	LOSA	Automation Error MonitoringXchecking Training	Automation Monitor Xcheck Error Mgt	Mis-AFS CRM	Flight Management Guidance/Automation Communication SA
13	21% of the Automation induced undesired aircraft states result from SOP Cross-Verification errors	All	234	All	LOSA	Automation Error MonitoringXchecking UAS	Automation Monitor Xcheck Error Mgt	Mis-AFS CRM Mis A/C State	Flight Management Guidance/Automation SA
14	There are often misunderstandings of autopilot modes.	All	234	All	LOSA	Automation Competencies Training	Automation Error Mgt	Mis-AFS CRM	Flight Management Guidance/Automation Knowledge
42	ATC threat 2: Runway Changes, leading to Automation Issues, Briefing errors, SOP errors, Aircraft configuration issues.	APP GND	234	All	LOSA	Communication Automation Error	Error Mgt Automation	ATC Workload Distraction Mis A/C State Mis-AFS CRM Compliance	Communication Application of Procedures/Knowledge Flight Management Guidance/Automation
112	41% of Aircraft Handling errors are detected and acted upon vs. 16% of Procedural errors Automation has the best rate of all error types. (53%)	All	234	234	LOSA 2	Error ManualACControl MonitoringXchecking	Error Mgt Automation Monitor Xcheck	Compliance CRM Mis A/C State Mis-Sys	SA Leadership and Teamwork Workload Management Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control
132	Automation errors have the best detection with action rates of all error types - 53% of Automation errors are detected and acted upon by flight crews.	All	234	234	LOSA 2	Error MonitoringXchecking	Automation Error Mgt	Mis-AFS	Flight Management Guidance/Automation

Figure 4.2.1.2 – Automation/LOSA

4.2.1.3 Error Management

- Filter Evidence Table for LOSA 1 or LOSA 2 reports
- Filter Topic [Error management]
  - See Figure 4.2.1.3
  - **Result – LOSA – Error Management**
    - LOSA archive shows that 26% of all errors logged by observers are detected and acted upon by flight crews.
    - A key error management strategy is monitoring and crosschecking.
    - Two of the more frequent monitoring and crosschecking errors logged in LOSA are callout and SOP cross verification errors.
    - The highest risks among callout errors are omitted deviations (65% result in UAS).
    - The flight phase with most threats is pre-departure.
    - Flight phases with the most mismanaged errors and UAS are DES, APP, LDG
    - Error management is generally better in the first four flight phases.
    - The rates of error detection and action are much higher for aircraft handling errors than for procedural errors.
    - Automation errors have the best detection/action rates of all error types – 53% of Automation errors are detected and acted upon by flight crews.
    - 41% of aircraft handling errors are detected and acted upon versus 16% of procedural errors.
    - For procedural error types, checklist error detection is better in CRZ and DES/ APP/LDG, while callout error detection is better in TO/CLB.
    - There is little difference in the error detection rate when crewmembers are PM.
    - Once an error has been committed, crews are more capable of detecting other people's errors than their own.
    - Captains detect 27% of the First Officer errors; First Officers detect 18% of the Captain's errors.
    - Both Captains and First Officers detect only 5-6% of the errors that they individually make.
  - Summary Statement: A key strategy for managing flight crew errors is monitoring and crosschecking. The situation is critical as just over 25% of the errors made by the flight crews are detected and rectified. The highest risk is crosschecking errors (e.g., omitted deviations as they result in 65% of UAS). The flight phase with the most threats is pre-departure, while the most mismanaged errors occur in DES, APP and LDG. Error detection is generally better in the early phases of flight with automation error captured being the best overall (53%) and procedure (16%) being the poorest. The Captain detects more errors than the First Officer (27% versus 18%) but neither rates highly at detecting their own errors (5-6%).

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Generations	Source	Training Topics	Factors	Competencies
18	About 4% of all flights are rated poor or marginal on Monitoring/Cross-Checking in at least one phase of flight. Flights with poor or marginal monitoring/Cross-Checking ratings have double the rate of mismanaged threats than those with Good or above.	All	234	All	LOSA	Monitoring Xcheck Error Mgt	CRM Workload Distraction Pressure Compliance	SA Workload Management Application of Procedures/Knowledge
19	Two of the more frequent Monitor/Cross-Checking errors logged in LOSA are Callout and SOP Cross verification errors.	All	234	All	LOSA	Monitoring Xcheck Error Mgt	CRM Workload Distraction Pressure Compliance	SA Workload Management Application of Procedures/Knowledge
20	Among callout errors, the ones for omitted deviation callouts have the highest risk (65% UAS/added error rate).	All	234	All	LOSA	Leadership Error Mgt Monitoring Xcheck	Compliance	Leadership and Teamwork Application of Procedures/Knowledge
23	28% of flights in the LOSA Archive have an SOP Cross-Verification error. 1% of these are mismanaged.	All	234	All	LOSA	Monitor Xchk Error Mgt	Mis-AFS Mis A/C State Mis-Sys	Application of Procedures/Knowledge Flight Management Guidance and Automation Manual AC Control
25	Most Risky cross-verification errors: Failure to cross-verify alt setting, Failure to cross-verify FMS settings (14% UAS/added error rate).	All	234	All	LOSA	Monitor Xchk Error Mgt	Mis-Sys Mis-AFS Compliance	SA Flight Management Guidance and Automation Application of Procedures/Knowledge
26	Most important mismanaged Threat: Terrain. Both omitted callouts and failure to select Terrain feature on Nav Display are a common and risky combination. Airlines that operate in high Terrain areas tend to get too used to this threat.	TO CLB DES APR LDG	234	All	LOSA	Terrain Monitor Xchk Error Mgt	Mis-Sys Compliance	SA Application of Procedures/Knowledge
30	Intentional Noncompliance: significant positive correlation between this and the number of mismanaged threats, unintentional errors, mismanaged errors and UAS.	All	234	All	LOSA	Error Mgt	Compliance CRM Mis-AFS Mis A/C State Mis-Sys	Leadership and Teamwork Application of Procedures/Knowledge
38	If communication is poor, TEM is poor despite good Leadership by captain.	All	234	All	LOSA	Error Mgt	CRM	Communication Leadership and Teamwork
50	Flight phases: most threats in pre-departure.	GRD	234	All	LOSA	Error Mgt	Cabin CRM Workload Distraction Pressure	Leadership and Teamwork Workload Management
51	Flight phases: most mismanaged errors and UAS in DES, APR, LND	DES APR LDG	234	All	LOSA	Error Mgt	CRM Workload Distraction Pressure Mis A/C State Mis-Sys	Leadership and Teamwork Workload Management
58	Predeparture/Taxi-out are extremely important phases from the point of view that they are fertile territory for mitigating threats by training.	GRD	234	All	LOSA	Error Mgt	Ground manoeuvring CRM	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Communication Knowledge Application of Procedures/Knowledge Flight Management Guidance and Automation
110	ManualACControl/Flight Control error detection/action taken is notably stronger in Predeparture/Taxi-Out than in the other phases of flight	GRD	234	All	LOSA 2	Manual AC Control Error Mgt Monitoring Xcheck	Mis-Sys Mis A/C State	SA Problem Solving Decision Making Manual AC Control
111	Callout error detection is better in Takeoff/Climb.	CLB	234	All	LOSA 2	Error Mgt Monitoring Xcheck	Compliance CRM	Communication SA Application of Procedures/Knowledge
112	41% of Aircraft Handling errors are detected and acted upon vs. 16% of Procedural errors Automation has the best rate of all error types. (53%)	All	234	234	LOSA 2	Error Mgt Automation Monitoring Xcheck	Compliance CRM Mis A/C State Mis-Sys	SA Leadership and Teamwork Workload Management Application of Procedures/Knowledge Flight Management Guidance and Automation Manual AC Control
113	Captains detect 27% of the First Officer mistakes; First Officers detect 18% of the Captain's errors.	All	234	234	LOSA 2	Error Mgt Monitoring Xcheck	Compliance Mis-AFS Mis A/C State Mis-Sys	Application of Procedures/Knowledge Flight Management Guidance and Automation Manual AC Control Communication
114	Once an error has been committed, people are more capable of detecting other people's errors than their own.	All	234	All	LOSA 2	Error Mgt Monitoring Xcheck	Compliance Mis-AFS Mis A/C State Mis-Sys	Application of Procedures/Knowledge Flight Management Guidance and Automation Manual AC Control Communication
115	Across all three error groups, the Captain as PF detects/acts on more errors than does the First Officer as PF, particularly for Communication errors. There is little difference in PM rates.	All	234	All	LOSA 2	Error Mgt Monitoring Xcheck	Compliance Mis-AFS Mis A/C State Mis-Sys	Application of Procedures/Knowledge Flight Management Guidance and Automation Manual AC Control Communication
116	As the rate of Intentional Noncompliance increases, the rate of errors detected and acted on decreases.	All	234	All	LOSA 2	Error Mgt	Compliance	Application of Procedures/Knowledge
117	The LOSA Archive shows that 26% of all errors logged by observers are detected and acted upon by flight crews.	All	234	234	LOSA 2	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control
118	Error detection is most closely aligned with the quality of Monitoring/Cross-Checking in all phases of flight and the quality of the Briefing.	All	234	All	LOSA 2	Error Mgt Monitoring Xcheck	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control
119	**One**-quarter of all errors in the cockpit are detected, acted upon and inconsequential.	All	234	234	LOSA 2	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control
120	One-half of all errors in the cockpit go undetected/not acted upon and are also inconsequential.	All	234	234	LOSA 2	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control
121	'taking shortcuts' reinforces over and over that most errors are inconsequential, whether they act on them or not. **PARADOX**	All	234	234	LOSA 2	Error Mgt complaince	CRM Compliance	Application of Procedures/Knowledge leadership and Teamwork
122	An error that is detected and acted upon does not guarantee an inconsequential outcome. In fact, 1% of errors detected and acted upon by a flight crew link to an additional error or undesired aircraft state due to active misManagement.	All	234	234	LOSA 2	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control
123	There is little difference amongst the first four phases of flight in that 25-30% of errors are detected and acted upon.	All	234	All	LOSA 2	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control
124	Taxi/Park has the lowest rate of errors detected and acted upon (17%) because approximately one-half of the errors in Taxi/Park are Intentional Noncompliance errors vs. about one-quarter of errors in the other phases.	GRD	234	All	LOSA 2	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control
126	ManualACControl/Flight Control errors - error detection/action is notably stronger in Predeparture/Taxi-Out than in the other phases of flight (53% of ManualACControl/Flight Control errors are detected and acted upon during Predeparture/Taxi-Out vs. 21-30% of ManualACControl/Flight Control errors being detected and acted upon in later phases of flight	GRD ALL	234	All	LOSA 2	Error Mgt	Mis A/C State	Manual AC Control
127	When compared with the other Aircraft Handling error types, it seems that error detection for ManualACControl/Flight Control errors weakens notably after departure/Taxi-Out, while Automation and System/Instrument/Radio error detection rates stay relatively the same	GRD ALL	234	All	LOSA 2	Error Mgt	Mis A/C State	Manual AC Control

Figure 4.2.1.3 – Error Management/LOSA

128	Procedural error types, Checklist error detection is better in Cruise and Descent/Approach/Land while Callout error detection is better in Takeoff/Climb.	TO CLB CRZ DES LDG	234	All	LOSA 2	Error Mgt	Mis-Sys Compliance	Application of Procedures/Knowledge
129	The rates of error detection and action are much higher for Aircraft Handling errors than for Procedural errors.	All	234	All	LOSA 2	Error Mgt	Mis-Sys Compliance Mis A/C State	Application of Procedures/Knowledge Manual AC Control
130	Specifically, 41% of Aircraft Handling errors are detected and acted upon vs. 34% of Communication errors and 16% of Procedural errors.	All	234	All	LOSA 2	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control
131	The detection and action rates for Procedural errors are shown below: o Briefing 20% o Callout 22% o Checklist 20% o Documentation 30% o General Procedural 7% o PF/PM Duty 5% o SOP Cross-Verification 9%	All	234	All	LOSA 2	Error Mgt Monitoring Xcheck	Compliance	Communication Application of Procedures/Knowledge
132	Automation errors have the best detection with action rates of all error types - 53% of Automation errors are detected and acted upon by flight crews.	All	234	234	LOSA 2	Automation Error Mgt	Mis-AFS	Flight Management Guidance and Automation
133	The Aircraft handling with the lowest rate of detection are: (Many are not detected until UAS) o Unintentional vertical deviation 41% o Wrong speed brakes setting 39% o Incorrect Nav Display setting 35% o Unintentional landing deviation 32% o Wrong radar setting 30% o Unintentional lateral deviation 29% o Unintentional speed deviation 24% o Wrong power/thrust setting 22% o Wrong anti-ice setting 19%	All	234	All	LOSA 2	Landing Issues Manual AC Control Error Mgt	Mis-AFS Mis A/C State Mis-Sys	Problem Solving Decision Making Manual AC Control
135	• Both Captains and First Officers detect only 5-6% of the errors that they make.	All	234	All	LOSA 2	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control
137	• Both Captains and First Officers detect only 5-6% of the errors that they make.	All	234	All	LOSA 2	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control
138	The general pattern is consistent across error types i.e. o Captains can detect 39% of the Aircraft Handling errors made by First Officers but only 9% of their own Aircraft Handling errors o First Officers can detect 12% of the Procedural errors made by Captains, but only 4% of their own Procedural errors.	All	234	All	LOSA 2	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control
139	There is very little difference in error rate detection between the crew member position as PF and PM and very little difference between Capt and F/O as error detectors with the Capt detecting slightly more in either case. o Capt as PF – 7% vs Capt as PM – 7% o F/O as PF – 4% vs F/O as PM – 6%	All	234	All	LOSA 2	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control
140	There is however a difference between Capt's and F/Os when action is combined with detection. The Capt is much more likely to act when detecting own error while pilot flying VS the F/O (23% vs 13%)	All	234	All	LOSA 2	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control
141	When the Capt is PM the rate for detecting own error and taking action is about the same as F/O as PM (25% vs 22% respectively)	All	234	All	LOSA 2	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control
142	25% of all errors are recorded as Intentional Noncompliance errors, of which 96% are not acted upon.	All	234	All	LOSA 2	Error Mgt Leadership	Compliance	Application of Procedures/Knowledge

Figure 4.2.1.3 continued

4.2.1.4 Manual Aircraft Control

- Filter Evidence Table for LOSA 1 or LOSA 2 reports
- Filter Topic [Man A/C Control]
  - See Figure 4.2.1.4
  - **Result – LOSA – Manual Aircraft Control**
    - Failure to follow flight guidance commands, not checking SID, STAR or approach profile and relying on the PM to make FMS changes.
    - Manual aircraft control errors are exacerbated by thunderstorms and adverse weather
    - Many manual aircraft control errors result from crew accepting clearances in order to “assist” ATC.
    - 41% of aircraft handling errors are detected and acted upon.
    - The leading manual aircraft control problem is vertical deviation (41%), followed by landing deviation (32%), followed by lateral deviation (29%) then speed deviation (24%), and finally improper thrust setting (22%).
    - Captains detect 39% of the aircraft handling errors made by First Officers but only 9% of their own.
  - Summary – According to LOSA, manual control errors, while not the most frequent type of error (41% occurrence by flight), are only exceeded by automation errors. Many manual control errors result from the improper technique, flight crews ignoring or “flying through” the indicated flight guidance. Manual control problems are exacerbated in adverse weather. The leading error type is unintentional vertical deviation (32%) followed closely by deviations in landing, lateral, speed and improper thrust.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Generations	Source	Training Topics	Factors	Competencies
11	Control Zone, looking through the FD, not checking modifications to the SID, STAR or Approach profile and relying on the PM to effect FMC/FMGC changes.	CLB APR	234	All	LOSA	Automation Manual AC Control Monitoring Xcheck	Mis-AFS CRM	Flight Management Guidance and Automation Workload Management Manual AC Control Application of Procedures/Knowledge
27	Thunderstorms/Turbulence: Common errors associated are ManualACControl, Flight control and System, Instrument and Radio error. – exacerbate the situation.	TO CLB DES APR	234	All	LOSA	WX Error Mgt Manual AC Control	Adverse Weather/Ice Workload Distraction Pressure Mis A/C State Mis-Sys	Communication SA Workload Management Application of Procedures/Knowledge Manual AC Control
44	Crews often agree to ATC clearances in order to "help".	CLB DES APR	234	All	LOSA	Error Mgt Leadership	ATC Workload Distraction Pressure Mis A/C State Mis-AFS	Communication Flight Management Guidance and Automation Manual AC Control Problem Solving Decision Making
110	ManualACControl/Flight Control error detection/action taken is notably stronger in Predeparture/Taxi-Out than in the other phases of flight	GRD	234	All	LOSA 2	Manual AC Control Error Mgt Monitoring Xcheck	Mis-Sys Mis A/C State	SA Problem Solving Decision Making Manual AC Control
112	41% of Aircraft Handling errors are detected and acted upon vs. 16% of Procedural errors Automation has the best rate of all error types. (53%)	All	234	234	LOSA 2	Error Mgt Automation Monitoring Xcheck	Compliance CRM Mis A/C State Mis-Sys	SA Leadership and Teamwork Workload Management Application of Procedures/Knowledge Flight Management Guidance and Automation Manual AC Control
129	The rates of error detection and action are much higher for Aircraft Handling errors than for Procedural errors.	All	234	All	LOSA 2	Error Mgt	Mis-Sys Compliance Mis A/C State	Application of Procedures/Knowledge Manual AC Control
130	Specifically, 41% of Aircraft Handling errors are detected and acted upon vs. 34% of Communication errors and 16% of Procedural errors.	All	234	All	LOSA 2	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control
133	The Aircraft handling with the lowest rate of detection are: o Unintentional vertical deviation 41% o Unintentional landing deviation 32% o Unintentional lateral deviation 29%	All	234	All	LOSA 2	Landing Issues Manual AC Control Error Mgt	Mis-AFS Mis A/C State Mis-Sys	Problem Solving Decision Making Manual AC Control
138	Captains can detect 39% of the Aircraft Handling errors made by First Officers but only 9% of their own. oerrors.	All	234	All	LOSA 2	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control

Figure 4.2.1.4 – Manual Aircraft Control/LOSA

4.2.1.5 Go-Around

- Filter Evidence Table for LOSA 1 or LOSA 2 reports
- Word search [(GA) (Go-around) (Missed Approach)]
  - See Figure 4.2.1.5
  - **Result – LOSA – Go-Around**
    - Only 3% of unstable approaches resulted in a go-around.
    - Missed Approaches as a result of unstable approaches are usually poorly executed.
    - Missed approaches are usually a surprise to flight crew and none in LOSA database occurred at the altitude briefed during the approach briefing.
    - One of top 5 contributory factors to the unstable approach UAS is incorrect aircraft configuration.
    - One of top 5 UAS after unstable approach is a failure to go-around, which is also and number 3 in non-compliance items.
  - Summary – According to LOSA, go-around from unstable approaches occur only 3% of the time (contrary to SOP's). Landings from unstable approaches rank in the top 5 UAS during the LDG phase and are the number 3 non-compliance item in the LOSA database). When a go-around from an unstable approach is performed it is usually a surprise to the crew and poorly executed.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
1	Unstable Apprs: 4% of approaches were unstable. 97% continued to landing.10% of such landings were abnormal. Both crew members willing to continue even if unstable.	APR	234	All	LOSA	Unstable APR/GA	Unstable APP Go Arounds	CRM Mis A/C State Compliance	Application of Procedures/Knowledge
4	Missed Approaches as result of Unstable Appes are rarely handled well. Risk rises dramatically which is problematic.	APR GA	234	All	LOSA	Competencies Unstable APR/GA	Unstable APP Go Arounds	Mis A/C State	Application of Procedures/Knowledge
5	Usually a surprise to the crew. None occurred at standard missed approach height briefed.	APR	234	All	LOSA	Competencies Unstable APR/GA	Go Arounds Surprise	Compliance CRM	SA Problem Solving Decision Making Application of Procedures/Knowledge Manual AC Control
33	Number 3 non-compliance item: Fail to execute missed appr when required	APR	234	All	LOSA	Unstable APR/GA Compliance	Unstable APP Landing Issues Go Arounds	Compliance CRM Mis A/C State	Leadership and Teamwork Problem Solving Decision Making Application of Procedures/Knowledge
55	In top 5 - UAS in DES/APR/LND: incorrect A/C config-systems	DES APR LDG	234	All	LOSA	Unstable APR/GA UAS	Unstable APP Go Arounds	Compliance CRM Mis A/C State Mis-Sys	Problem Solving Decision Making Application of Procedures/Knowledge
56	In top 5 - UAS in DES/APR/LND: continued landing after Unstable App	DES APR LDG	234	All	LOSA	Unstable APR/GA UAS	Unstable APP	Compliance CRM Mis A/C State	Leadership and Teamwork Problem Solving Decision Making

Figure 4.2.1.5 – Go-Around/LOSA

4.2.1.6 Weather

- Filter Evidence Table for LOSA 1 or LOSA 2 reports
- Word search [(WX) (Adverse Weather)]
  - See Figure 4.2.1.6
  - **Result – LOSA – Weather**
    - Weather is the most common threat in the LOSA database and in the top 3 for all flight phases
    - 3% of unstable approaches are linked to weather and ATC.
    - Thunderstorms and turbulence exacerbate common errors associated with manual aircraft control and instrument/radio errors.
    - The most common error associated with icing conditions is the failure to select the anti-ice system on.
    - 8% of LOSA flights encounter thunderstorms.
    - Over 6% of thunderstorm encounters lead to UAS.
    - 25% of weather avoidance events involve non-compliance of SOPs.
    - The key theme in weather avoidance events is poor planning and late identification.
    - The most important radar errors are failure to select radar on, and use of incorrect "tilt."
  - Summary – Weather is the number 1 threat in the LOSA database and significant in all flight phases. 8% of all flights encounter thunderstorms with over 6% of these encounters resulting in UAS. Less than 3% of unstable approaches are due to weather. Turbulence exacerbates other common errors, specifically manual aircraft control. Weather avoidance errors are associated with SOP non-compliance (25%), poor planning and radar misuse. The number 1 error associated with ice and snow is failure to select the anti-ice system on.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicable to Gen	Source	Keywords	Training Topics	Factors	Competencies
3	3% of Unstable Approaches are linked to weather and ATC.	APR	234	All	LOSA	Unstable APR/GA	Unstable APP WX	Adverse WX ATC	
27	Thunderstorms/Turbulence: Common errors associated are ManualACControl, Flight control and System, Instrument and Radio error. – exacerbate the situation.	TO CLB DES APR	234	All	LOSA	ManualACControl Error	WX Error Mgt Manual AC Control	Adverse WX Workload Distraction Mis A/C State Mis-Sys	Communication SA Workload Management Application of Procedures/Knowledge Manual AC Control
29	Icing and Snow – The most common error associated with this threat is failure to select anti-ice on. That situation leads to a UAS. Usually coupled with poor/marginal monitoring / cross-checking.	All	234	All	LOSA	Error MonitoringXchecking UAS	WX Error Mgt Monitor Xchk	Adverse WX Compliance CRM Workload Distraction Mis-Sys	SA Workload Management Application of Procedures/Knowledge
39	Most common threat type: Adverse weather.	All	234	All	LOSA	WX	WX	Adverse WX Windshear Crosswind Poor Visibility	SA Problem Solving Decision Making Application of Procedures/Knowledge Manual AC Control
46	Weather radar usage: 8% of flights face Thunderstorm, 1% mismanaged; half of errors lead to UAS. Most common linked errors are: Wrong radar settings, Course or heading deviations without ATC clearance, Weather penetration.	All	234	All	LOSA	Compliance Error UAS WX	WX	Adverse WX ATC CRM Mis A/C State Mis-Sys Compliance	Knowledge Communication Application of Procedures/Knowledge
47	About 25% of Weather avoidance events involve intentional non-compliance: deviation without ATC clearance and deliberately penetrating bad weather. Offsets are often less than company requirements.	CLB CRZ DES	234	All	LOSA	Compliance Error WX	WX	Adverse WX ATC CRM Mis A/C State Compliance	Communication Application of Procedures/Knowledge Problem Solving Decision Making
48	Key theme in weather avoidance errors is lack of forward planning. Late identification contributed in all penetration events.	All	234	All	LOSA	Error WX	WX	Adverse WX CRM Mis A/C State	SA Problem Solving Decision Making
49	The two most important radar errors were: radar not switched on and incorrect use of gain and especially tilt.	All	234	All	LOSA	Error WX	WX Error Mgt	Compliance CRM Mis-Sys	Knowledge Workload Management Application of Procedures/Knowledge
57	In all phases, according to LOSA, weather is either the most significant threat or in the top three.	All	234	All	LOSA	Error Management WX	WX	Adverse WX	

Figure 4.2.1.6 – Weather/LOSA

4.2.1.7 System Malfunction

- Filter Evidence Table for LOSA 1 or LOSA 2 reports
- Filter Topics [(Sys Mal]
  - See Figure 4.2.1.7
  - **Result – LOSA – System Malfunction**
    - With respect to predicted or expected system malfunctions, e.g., MEL dispatch, crews are often observed applying engineering shortcuts or workarounds, instead of following defined procedures, which results in a high degree of intentional non-compliance.
    - Unexpected aircraft malfunction is ranked 4th as a threat in the LOSA database.
    - Unexpected aircraft malfunction is ranked 5th in mismanaged threats, from the LOSA database.
    - Aircraft system malfunction is the 3rd ranked contributor to UAS in the LOSA database.
  - Summary – There is a high degree of intentional non-compliance associated with procedures during the management of unexpected system malfunctions. In addition, unexpected system malfunction is in the top 5 threats as well as in the top 5 mismanaged threats in LOSA database. System malfunction ranks 3rd as a contributory factor in UAS.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicable to Gen	Source	Keywords	Training Topics	Factors	Competencies
28	Unexpected aircraft malfunction. Crew applying engineering shortcuts or workarounds instead of following ECAM, QRH, MEL. High degree of intentional non-compliance.	All	234	All	LOSA	Compliance	Error Mgt System Malfunction Surprise	Syst mal Compliance CRM Workload Distraction	Application of Procedures/Knowledge
311	Aircraft malfunction unexpected by crew is number 4 of top five threats in LOSA database	All	234	All	LOSA	Threats malfunction	System Malfunction Surprise	Syst mal	SA Application of Procedures/Knowledge
312	Aircraft malfunction unexpected by crew is number 4 of top five mismanaged threats in LOSA database	All	234	All	LOSA	Mismanaged Threats malfunction	System Malfunction Surprise	Syst mal	SA Workload Management Application of Procedures/Knowledge
313	Aircraft malfunction is number 3 of top five UAS in LOSA database	All	234	All	LOSA	UAS	System Malfunction	Syst mal	SA Workload Management Application of Procedures/Knowledge

Figure 4.2.1.7 – System Malfunction/LOSA

4.2.1.8 Leadership

- Filter Evidence Table for LOSA 1 or LOSA 2 reports
- Filter Topics [Leadership] combine with…
- Word-search for Leadership all columns with editing superfluous or redundant statements.
  - See Figure 4.2.1.8
  - **Result – LOSA – Leadership**
    - Captains display significantly more non-compliance than first officers.
    - Flights with outstanding ratings for "Leadership and Communication Environment" have on average 2.3 errors per flight, versus 7 Errors per flight for poor "Leadership and Communication Environment." Flights with poor Leadership ratings have approximately 3 times the number of mismanaged threats to those without poor ratings.
    - If communication is poor, TEM often rated poor, despite good leadership by the Captain.
  - Summary – Leadership is an effective positive catalyst in terms of reducing errors per flight, provided that it is accompanied by good communications.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicable to Gen	Source	Keywords	Training Topics	Factors	Competencies
36	Captains display significantly more non-compliance than first officers.	All	234	All	LOSA	Compliance	Leadership	Compliance CRM	Leadership and Teamwork Application of Procedures/Knowledge
37	Flights with outstanding ratings for Leadership and Communication Environment have on average 2.3 errors/flight vs 7. errors/flights for poor Leadership and Communication Environment. Flights with poor ratings have approximately 3 times the number of mismanaged threats.	All	234	All	LOSA	Leadership Communication Error	Leadership Error Mgt Surprise	CRM Mis A/C State	Communication Leadership and Teamwork
38	If communication is poor, TEM is poor despite good Leadership by captain.	All	234	All	LOSA	Leadership Communication	Error Mgt	CRM	Communication Leadership and Teamwork

Figure 4.2.1.8 – Leadership/LOSA

4.2.1.9 Terrain

- Filter Evidence Table for LOSA 1 or LOSA 2 reports
- Filter Topics [Terrain]
  - See Figure 4.2.1.9
  - **Result – LOSA – Terrain**
    - Many flights have improperly set secondary altimeters. Proper altimeter use is not re-enforced in training or imbedded in SOPs
    - The most important mismanaged threat is terrain. Omitted callouts and failure to select the “terrain” feature on navigation displays are a common and risky combination.
    - Crews with airlines that operating in high terrain areas show a tendency towards complacency, as they become very used to the threat. This process of “normalization” reduces perception of true level of risk.
  - Summary – LOSA indicates that proper altimeter use should be emphasized during training and that terrain is one of the most important mismanaged threats in LOSA database. In addition, airlines that operate in high terrain environment tend to be complacent to terrain threats.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicable to Gen	Source	Keywords	Training Topics	Factors	Competencies
16	Many flights have improperly set secondary altimeters. Proper use of secondary altimeters does not seem to be taught in training or imbedded in SOPs	All	234	All	LOSA	Error	Error Mgt Terrain	Mis-Sys Mis A/C State Def-Proc's	SA
26	Most important mismanaged Threat: Terrain. Both omitted callouts and failure to select Terrain feature on Nav Display are a common and risky combination. Airlines that operate in high Terrain areas tend to get too used to this threat.	TO CLB DES APR LDG	234	All	LOSA	Terrain MonitoringXchecking	Terrain Monitor Xchk Error Mgt	Mis-Sys Compliance	SA Application of Procedures/Knowledge

Figure 4.2.1.9 – Terrain/LOSA

4.2.1.10 Surprise

- Filter Evidence Table for LOSA 1 or LOSA 2 reports
- Filter Topics [Surprise]
  - See Figure 4.2.1.10
  - **Result – LOSA – Surprise**
    - “Go-around” is usually a surprise to the crew. No “go-arounds” in the LOSA database occurred at the standard missed approach altitude and almost all were poorly executed.
    - Aircraft malfunction unexpected by crew is number 4 of top five threats in LOSA database.
    - Aircraft malfunction unexpected by crew is number 4 of top five mismanaged threats in LOSA database.
  - Summary – Go-around is generally a surprise to crew and not well executed. An unexpected malfunction is number 4 threat as well as number 4-mismanaged threat in LOSA database.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicable to Gen	Source	Keywords	Training Topics	Factors	Competencies
5	Usually a surprise to the crew. None occurred at standard missed approach height briefed.	APR	234	All	LOSA	Competencies Unstable APR/GA	Go Arounds Surprise	Compliance CRM	SA Problem Solving Decision Making Application of Procedures/Knowledge Manual AC Control
311	Aircraft malfunction unexpected by crew is number 4 of top five threats in LOSA database	All	234	All	LOSA	Threats malfunction	System Malfunction Surprise	Syst mal	SA Application of Procedures/Knowledge
312	Aircraft malfunction unexpected by crew is number 4 of top five mismanaged threats in LOSA database	All	234	All	LOSA	Mismanaged Threats malfunction	System Malfunction Surprise	Syst mal	SA Workload Management Application of Procedures/Knowledge

Figure 4.2.1.10 – Surprise/LOSA

4.2.1.11 Landing Issues

- Filter Evidence Table for LOSA 1 or LOSA 2 reports
- Filter Training Topics [Landing Issues] combined with…
- Word search (landing) or (LDG) in Evidence Statement column with suppression of extraneous and/or redundant data.
  - See Figure 4.11
  - **Result – LOSA – Landing Issues**
    - According to LOSA only 1% of unstable approaches to landing resulted in an abnormal landing.
    - The 3rd ranked non-compliance item is an unstable approach continued to landing.
    - The 5th ranked non-compliance item is commencing taxi duties during the landing "roll-out."
    - Aircraft handling errors rank 2nd, and the error least detected is "landing deviation."
  - Summary – 1% of all landings in LOSA database result in an abnormal landing. The number 3 non-compliance item in the database is landing from an unstable approach. Aircraft handling errors on landing are not well detected as they rank 2nd in least detected error during landing phase. The early commencement of after landing and taxi-in during the landing rollout is prevalent and ranked 5 overall in non-compliance.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicable to Gen	Source	Keywords	Training Topics	Factors	Competencies
1	Unstable Apprs: 4% of approaches were unstable. 97% continued to landing.10% of such landings were abnormal. Both crew members willing to continue even if unstable.	APR	234	All	LOSA	Unstable APR/GA	Unstable APP Go Arounds	CRM Mis A/C State Compliance	Application of Procedures/Knowledge
33	Number 3 non-compliance item: Fail to execute missed appr when required	APR	234	All	LOSA	Unstable APR/GA Compliance	Unstable APP Landing Issues Go Arounds	Compliance CRM Mis A/C State	Leadership and Teamwork Problem Solving Decision Making Application of Procedures/Knowledge
35	Number 5 non-compliance item: Taxi duties commence before runway exit	GRD	234	All	LOSA	Compliance	Monitor Xchk Error Mgt Leadership Landing Issues	Compliance CRM Ground manoeuvring	Communication SA Leadership and Teamwork Workload Management Application of Procedures/Knowledge
52	In top 5 - UAS in DES/APR/LND: speed too high	DES APR LDG	234	All	LOSA	Unstable APR/GA UAS	Unstable APP Landing Issues	ATC Compliance CRM Mis A/C State	SA Workload Management Problem Solving Decision Making Flight Management Guidance/Automation
56	In top 5 - UAS in DES/APR/LND: continued landing after Unstable App	DES APR LDG	234	All	LOSA	Unstable APR/GA UAS	Unstable APP	Compliance CRM Mis A/C State	Leadership and Teamwork Problem Solving Decision Making
133	The Aircraft handling with the lowest rate of detection are: o Unintentional vertical deviation 41% o Unintentional landing deviation 32% o Unintentional lateral deviation 29% o Unintentional speed deviation 24% o Wrong power/thrust setting 22%	All	234	All	LOSA 2	Error ManualACControl MonitoringXchecking UAS	Landing Issues Manual AC Control Error Mgt	Mis-AFS Mis A/C State Mis-Sys	Problem Solving Decision Making Manual AC Control

Figure 4.2.1.11 – Landing Issues/LOSA

4.2.1.12 Compliance

- Filter Evidence Table for LOSA 1 or LOSA 2 reports
- Filter Factors [Compliance] combined with…
- Word search [(compliance) or (noncompliance)]
- Suppression of extraneous or redundant data.
  - See Figure 4.2.1.12
  - **Result – LOSA – Compliance**
    - There is a significant correlation of non-compliance and UAS.
    - There is a negative correlation between non-compliance and error rate (exclusive of non-compliance errors)
    - 25% of all errors are non-compliance errors.
    - 20% of omitted callouts are intentional.
    - The 1st ranked non-compliance issue is checklist protocol with 50% occurring on the ground.
    - The 2nd ranked non-compliance issue is omitted call-outs.
    - Omitted call outs of deviations have the highest risk with 65% resulting in UAS.

    - The 3rd ranked noncompliance issue is failure to execute missed approach when required.
    - Both crewmembers regularly continue to land from unstable approaches in violation of SOPs.
    - The 4th ranked non-compliance issue is PF making own changes in violation of SOPs.
    - The 5th ranked non-compliance issue is commencing taxi duties before clearing runway.
    - 25% of weather avoidance errors are associated with deviations without ATC clearances.
    - There is a high degree of non-compliance regarding shortcuts and workarounds associated with abnormal procedures for unexpected malfunctions.
    - Most errors are inconsequential reinforcing crew inaction.
- Summary – There is a significant positive correlation between non-compliance and UAS. 25% of all errors are non-compliance errors. The top ranked non-compliance error is checklist protocol, followed by omitted call-outs. The 3rd ranked non-compliance issue is failure to execute a missed approach when required. The 4th and 5th ranked non-compliances are PF making their own changes and PM commencing taxi duties before leaving runway respectively. With respect to weather avoidance errors, 25% result from deviations without ATC clearances. Paradoxically, the fact that most errors are inconsequential reinforces crew inaction, creating additional non-compliance with associated negative effects.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gen	Source	Keywords	Training Topics	Factors	Competencies
1	Unstable Apprs: 4% of approaches were unstable. 97% continued to landing.10% of such landings were abnormal. Both crew members willing to continue even if unstable.	APR	234	All	LOSA	Unstable APR/GA	Unstable APP Go Arounds	CRM Mis A/C State Compliance	Application of Procedures/Knowledge
19	Two of the more frequent Monitor/Cross-Checking errors logged in LOSA are Callout and SOP Cross verification errors.	All	234	All	LOSA	MonitoringXchecking	Monitoring Xcheck Error Mgt	CRM Workload Distraction Compliance	SA Workload Management Application of Procedures/Knowledge
20	Among callout errors, the ones for omitted deviation callouts have the highest risk (65% UAS/added error rate).	All	234	All	LOSA	MonitoringXchecking UAS	Leadership Error Mgt Monitoring Xcheck	Compliance	Leadership and Teamwork Application of Procedures/Knowledge
21	2% of omitted callouts are intentional.	All	234	All	LOSA	MonitoringXchecking Compliance	Leadership Error Mgt	Compliance	Communication SA Leadership and Teamwork Application of Procedures/Knowledge
22	There is a strong association between non compliance and poor TEM performance.	All	234	All	LOSA	Compliance	Error Mgt	Compliance CRM	Communication SA Leadership and Teamwork Workload Management Problem Solving Decision Making Knowledge Application of Procedures/Knowledge Flight Management Guidance/Automation Manual AC Control
28	Unexpected aircraft malfunction. Crew applying engineering shortcuts or workarounds instead of following ECAM, QRH, MEL. High degree of intentional non-compliance.	All	234	All	LOSA	Compliance	Error Mgt System Malfunctiof Surprise	Syst mal Compliance CRM Workload Distraction	Application of Procedures/Knowledge
30	Intentional Noncompliance: significant positive correlation between this and the number of mismanaged threats, unintentional errors, mismanaged errors and UAS.	All	234	All	LOSA	Compliance UAS	Error Mgt	Compliance CRM Mis-AFS Mis A/C State Mis-Sys	Leadership and Teamwork Application of Procedures/Knowledge
31	Number 1 non-compliance item: Non standard checklist protocol. Almost half during ground/taxi out.	All	234	All	LOSA	Compliance	Error Mgt Leadership	Ground manoeuvring CRM Compliance	Application of Procedures/Knowledge
32	Number 2 non-compliance item: Omitted altitude callouts	All	234	All	LOSA	Compliance Error	Monitor Xchk Error Mgt	Compliance CRM Workload Distraction	Communication SA Application of Procedures/Knowledge
33	Number 3 non-compliance item: Fail to execute missed appr when required	APR	234	All	LOSA	Unstable APR/GA Compliance	Unstable APP Landing Issues Go Arounds	Compliance CRM Mis A/C State	Leadership and Teamwork Problem Solving Decision Making Application of Procedures/Knowledge
34	Number 4 non-compliance item: PF makes own changes	All	234	All	LOSA	Compliance	Leadership Error Mgt Monitor Xchk	Compliance CRM	Communication SA Leadership and Teamwork Application of Procedures/Knowledge
35	Number 5 non-compliance item: Taxi duties commence before runway exit	GRD	234	All	LOSA	Compliance	Monitor Xchk Error Mgt Leadership Landing Issues	Compliance CRM Ground manoeuvring	Communication SA Leadership and Teamwork Workload Management Application of Procedures/Knowledge
36	Captains display significantly more non-compliance than first officers.	All	234	All	LOSA	Compliance	Leadership	Compliance CRM	Leadership and Teamwork Application of Procedures/Knowledge
47	About 25% of Weather avoidance events involve intentional non-compliance: deviation without ATC clearance and deliberately penetrating bad weather. Offsets are often less than company requirements.	CLB CRZ DES	234	All	LOSA	Compliance Error WX	WX	Adverse WX ATC CRM Mis A/C State Compliance	Communication Application of Procedures/Knowledge Problem Solving Decision Making
121	'taking shortcuts' reinforces over and over that most errors are inconsequential, whether they act on them or not. **PARADOX**	All	234	234	LOSA 2	Error MonitoringXchecking	Error Mgt Compliance	CRM Compliance	Application of Procedures/Knowledge Leadership and Teamwork
142	25% of all errors are recorded as Intentional Noncompliance errors, of which 96% are not acted upon.	All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt Leadership	Compliance	Application of Procedures/Knowledge
143	There is a negative correlation between the rate of noncompliance and the rate of errors, other than noncompliance, detected and acted upon. That is to say that noncompliance is an inhibitor to detection and correction. (multiplier in a negative sense) This is true across all error types	All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt	Compliance	Application of Procedures/Knowledge

Figure 4.2.1.12 – Compliance/LOSA

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
20	Among callout errors, the ones for omitted deviation callouts have the highest risk (65% UAS/added error rate).	All	234	All	LOSA	MonitoringXchecking UAS	Leadership Error Mgt Monitoring Xcheck	Compliance	Leadership and Teamwork Application of Procedures/Knowledge
25	Most Risky cross-verification errors: Failure to cross-verify alt setting, Failure to cross-verify FMS settings (14% UAS/added error rate).	All	234	All	LOSA	MonitoringXchecking UAS	Monitor Xchk Error Mgt	Mis-Sys Mis-AFS Compliance	SA Flight Management, Guidance/Automation Application of Procedures & Knowledge
29	Icing and Snow – The most common error associated with this threat is failure to select anti-ice on. That situation leads to a UAS. Usually coupled with poor/marginal monitoring / cross-checking.	All	234	All	LOSA	Error MonitoringXchecking UAS	WX Error Mgt Monitor Xchk	Adverse WX Compliance CRM Workload Distraction Mis-Sys	SA Workload Management Application of Procedure/Knowledge
30	Intentional Noncompliance: significant positive correlation between this and the number of mismanaged threats, unintentional errors, mismanaged errors and UAS.	All	234	All	LOSA	Compliance UAS	Error Mgt	Compliance CRM Mis-AFS Mis A/C State Mis-Sys	Leadership and Teamwork Application of Procedure/Knowledge
46	Weather radar usage: 8% of flights face Thunderstorm, 1% mismanaged; half of errors lead to UAS. Most common linked errors are: Wrong radar settings, Course or heading deviations without ATC clearance, Weather penetration.	All	234	All	LOSA	Compliance Error UAS WX	WX	Adverse WX ATC CRM Mis A/C State Mis-Sys Compliance	Knowledge Communication Application of Procedures/Knowledge
51	Flight phases: most mismanaged errors and UAS in DES, APR, LND	DES APR LDG	234	All	LOSA	Error Mgt UAS	Error Mgt	CRM Workload Distraction Pressure Mis A/C State Mis-Sys	Leadership and Teamwork Workload Management
52	In top 5 - UAS in DES/APR/LND: speed too high	DES APR LDG	234	All	LOSA	Unstable APR/Go Arounds UAS	Unstable APP Landing Issues	ATC Compliance CRM Mis A/C State	SA Workload Management Problem Solving Decision Making Flight Management, Guidance/Automation
53	In Top 5 - UAS in DES/APR/LND: Unstable App	DES APR LDG	234	All	LOSA	Unstable APR/Go Arounds UAS	Unstable APP Landing Issues	ATC Compliance CRM Mis A/C State	SA Workload Management Problem Solving Decision Making Flight Management, Guidance/Automation Application of Procedures/Knowledge
54	In top 5 - UAS in DES/APR/LND: incorrect A/C config-Automation	DES APR LDG	234	All	LOSA	Unstable APR/Go Arounds UAS	Unstable APP	Compliance CRM Mis A/C State Mis-AFS Mis-Sys	Flight Management, Guidance and Automation Application of Procedures & Knowledge
55	In top 5 - UAS in DES/APR/LND: incorrect A/C config-systems	DES APR LDG	234	All	LOSA	Unstable APR/Go Arounds UAS	Unstable APP Go Arounds	Compliance CRM Mis A/C State Mis-Sys	Problem Solving Decision Making Application of Procedures/Knowledge
56	In top 5 - UAS in DES/APR/LND: continued landing after Unstable App	DES APR LDG	234	All	LOSA	Unstable APR/Go Arounds UAS	Unstable APP	Compliance CRM Mis A/C State	Leadership and Teamwork Problem Solving Decision Making
133	The Aircraft handling with the lowest rate of detection are: (Many are not detected until UAS) o Unintentional vertical deviation 41% o Wrong speed brakes setting 39% o Incorrect Nav Display setting 35% o Unintentional landing deviation 32% o Wrong radar setting 30% o Unintentional lateral deviation 29% o Unintentional speed deviation 24% o Wrong power/thrust setting 22% o Wrong anti-ice setting 19%	All	234	All	LOSA 2	Error Manual AC Control MonitoringXchecking UAS	Landing Issues Manual AC Control Error Mgt	Mis-AFS Mis A/C State Mis-Sys	Problem Solving Decision Making Manual Aircraft Control

Figure 4.2.1.12a – Compliance cont.

4.2.1.13 Phase of Flight

- Filter Evidence Table for LOSA 1 or LOSA 2 reports
- Search all columns [Phase]
- Filter Flight Phase [(TAXI)U(TO)U(CLB)U(CRZ)U(DES)U(APP)U(LDG)]
- Suppression of extraneous and/or redundant data.
  - See Figure 4.2.1.13
  - **Result LOSA – Phase of Flight**
    - Weather is in the top three threats in all phases of flight.
    - TAXI
      - The majority of threats are revealed pre-departure.
      - Pre-departure taxi is an extremely important phase for training mitigation.
      - Detection of manual aircraft control errors is notably stronger in taxi out than any other phase, but also notably weakens after this phase.
      - A runway change is major threat.
      - The lowest rate of error detection is reported as taxi-in and parking phase after landing.
    - TO/CLB
      - Late engagement of the autopilot is a major automation error as well as ignoring or "flying through" the flight guidance.
      - Callout error detection is best in TO/CLB.
    - CRZ
      - Procedural error detection is best in CRZ
    - DES/APP
      - Late disengagement of autopilot is a major automation error as well as "flying through" the flight guidance.
      - There are frequent mismanaged errors and UAS.
      - Speed too high is a frequent error
      - The most frequent non-compliance error is the failure to execute a go-around when appropriate.
      - Another frequent error is incorrect aircraft configuration.
    - LDG
      - Speed control is frequent error.
      - Continuation of a landing from an unstable approach is a frequent error.
      - Commencing after landing and taxi items before clearing the runway is frequent procedural error.
  - Summary – Weather is considered a major threat in all flight phases. LOSA data shows that it is in the top three threats for all flight phases. Flight phases have different characteristics in terms of threats, errors, error detection rates and undesired aircraft states.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
10	The late engagement of autopilot after takeoff or early disengagement in Descent/Approach/Land,Basically hand flying at an inappropriate time. Common errors include hand flying in a busy Terminal Area.	CLB APR	234	All	LOSA	Automation Competencies	Automation Manual AC Control Error Mgt	Mis-AFS CRM	Flight Management Guidance/Automation Problem Solving Decision Making
11	Control Zone, looking through the FD, not checking modifications to the SID, STAR or Approach profile and relying on the PM to effect FMC/FMGC changes.	CLB APR	234	All	LOSA	Automation	Automation Manual AC Control Monitoring Xcheck	Mis-AFS CRM	Flight Management Guidance/Automation Workload Management Manual Aircraft Control Application of Procedures/Knowledge
33	Number 3 non-compliance item: Fail to execute missed appr when required	APR	234	All	LOSA	Unstable APR/GA Compliance	Unstable APP Landing Issues Go Arounds	Compliance CRM Mis A/C State	Leadership and Teamwork Problem Solving Decision Making Application of Procedures/Knowledge
35	Number 5 non-compliance item: Taxi duties commence before runway exit	GRD	234	All	LOSA	Compliance	Monitor Xchk Error Mgt Leadership Landing Issues	Compliance CRM Ground manoeuvring	Communication SA Leadership and Teamwork Workload Management Application of Procedures/Knowledge
42	ATC threat 2: Runway Changes, leading to Automation Issues, Briefing errors, SOP errors, Aircraft configuration issues.	APR GRD	234	All	LOSA	Communication Automation Error Mgt	Error Mgt Automation	ATC Workload Distraction Mis A/C State Mis-AFS CRM Compliance	Communication Application of Procedures/Knowledge Flight Management Guidance/Automation
50	Flight phases: most threats in pre-departure.	GRD	234	All	LOSA	Error Mgt	Error Mgt	Cabin CRM Workload Distraction	Leadership and Teamwork Workload Management
51	Flight phases: most mismanaged errors and UAS in DES, APR, LND	DES APR LDG	234	All	LOSA	Error Mgt UAS	Error Mgt	CRM Workload Distraction Mis A/C State Mis-Sys	Leadership and Teamwork Workload Management
52	In top 5 - UAS in DES/APR/LND: speed too high	DES APR LDG	234	All	LOSA	Unstable APR/GA UAS	Unstable APP Landing Issues	ATC Compliance CRM Mis A/C State	SA Workload Management Problem Solving Decision Making Flight Management Guidance/Automation
53	In Top 5 - UAS in DES/APR/LND: Unstable App	DES APR LDG	234	All	LOSA	Unstable APR/GA UAS	Unstable APP Landing Issues	ATC Compliance CRM Mis A/C State	SA Workload Management Problem Solving Decision Making Flight Management Guidance/Automation Application of Procedures/Knowledge
54	In top 5 - UAS in DES/APR/LND: incorrect A/C config-Automation	DES APR LDG	234	All	LOSA	Unstable APR/GA UAS	Unstable APP	Compliance CRM Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance/Automation Application of Procedures/Knowledge
55	In top 5 - UAS in DES/APR/LND: incorrect A/C config-systems	DES APR LDG	234	All	LOSA	Unstable APR/GA UAS	Unstable APP Go Arounds	Compliance CRM Mis A/C State Mis-Sys	Problem Solving Decision Making Application of Procedures/Knowledge
56	In top 5 - UAS in DES/APR/LND: continued landing after Unstable App	DES APR LDG	234	All	LOSA	Unstable APR/GA UAS	Unstable APP Landing Issues	Compliance CRM Mis A/C State	Leadership and Teamwork Problem Solving Decision Making
57	In all phases, according to LOSA, weather is either the most significant threat or in the top three.	All	234	All	LOSA	Error Mgt WX	WX	Adverse WX	
58	Predeparture/Taxi-out are extremely important phases from the point of view that they are fertile territory for mitigating threats by training. 4	GRD	234	All	LOSA	Error Mgt	Error Mgt	Ground manoeuvring CRM	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Communication Knowledge Application of Procedures/Knowledge Flight Management Guidance/Automation
##	ManualACControl/Flight Control error detection/action taken is notably stronger in Predeparture/Taxi-Out than in the other phases of flight	GRD	234	All	LOSA 2	ManualACControl Error Mgt	Manual AC Control Error Mgt Monitoring Xcheck	Mis-Sys Mis A/C State	SA Problem Solving Decision Making Manual AC Control
111	Callout error detection is better in Takeoff/Climb.	CLB	234	All	LOSA 2	Error Mgt MonitoringXcheck	Error Mgt Monitoring Xcheck	Compliance CRM	Communication SA Application of Procedures/Knowledge
##	Taxi/Park has the lowest rate of errors detected and acted upon (17%) because approximately one-half of the errors in Taxi/Park are Intentional Noncompliance errors vs. about one-quarter of errors in the other phases.	GRD	234	All	LOSA 2	Error Mgt MonitoringXcheck	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual AC Control
##	ManualACControl/Flight Control errors - error detection/action is notably stronger in Predeparture/Taxi-Out than in the other phases of flight (53% of ManualACControl/Flight Control errors are detected and acted upon during Predeparture/Taxi-Out vs. 21-30% of ManualACControl/Flight Control errors being detected and acted upon in later phases of flight	GRD All	234	All	LOSA 2	ManualACControl Error Mgt MonitoringXcheck	Error Mgt	Mis A/C State	Manual AC Control
##	When compared with the other Aircraft Handling error types, it seems that error detection for ManualACControl/Flight Control errors weakens notably after departure/Taxi-Out, while Automation and System/Instrument/Radio error detection rates stay relatively the same	GRD All	234	All	LOSA 2	Error Mgt ManualACControl MonitoringXcheck	Error Mgt	Mis A/C State	Manual AC Control
##	Procedural error types, Checklist error detection is better in Cruise and Descent/Approach/Land while Callout error detection is better in Takeoff/Climb.	GRD All	234	All	LOSA 2	Error Mgt MonitoringXcheck	Error Mgt	Mis-Sys Compliance	Application of Procedures/Knowledge

Figure 4.2.1.13 – Phase of Flight/LOSA

4.2.1.14 Training Effect

- Filter Evidence Table for LOSA 1 or LOSA 2 reports
- Filter Keywords [Training]
  - See Figure 4.2.1.14
  - **Result LOSA – Training Effect**
    - LOSA data highlights the unstable approach and go-around problem that is not addressed in training, placing particular emphasis on SOP knowledge and discipline as well as citing difficulties in go-around execution.
    - Automation needs to be addressed; automation errors occur on 28% of LOSA archive flights. Issues cited are as follows:
      - Guidance errors
      - Technical understanding and poor grasp of the “mental model.”
      - Poor monitoring and crosschecking.
    - Threat and error management in terms of:
      - SOP Cross-verification
      - Altimeter crosschecking
      - Intentional non-compliance.
      - Low error detection rates relating to specific aircraft handling issues.
    - LOSA cites the pre-departure and taxi phase as “fertile territory for mitigating threats by training”.
    - Communication, particularly with ATC, remains a frequent threat and is often linked with poor TEM.
  - Summary – The LOSA study was specifically targeted to address issues likely to receive effective mitigation in training. Some of the more important findings in the report highlight automation problems, specifically in terms of operational performance as well as conceptual understanding and procedural knowledge. Monitoring and crosschecking is the overarching element that needs to be improved according to the LOSA report and this is emphasized repetitively in the data. Communication, particularly with ATC, remains a frequent threat and is often linked with poor TEM. Findings in most cases are presented in terms of TEM and show specific operational areas such as, the pre-departure/taxi that in the words of the report: “are fertile territory for mitigating threats by training”.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
2	Pilots did not know stable approach criteria.	APR	234	All	LOSA	Unstable APR/GA	Unstable APP G0 Arounds	CRM	Knowledge
4	Missed Approaches as result of Unstable Appes are rarely handled well. Risk rises dramatically which is problematic.	APR GA	234	All	LOSA	Competencies Unstable APR/GA	Unstable APP G0 Arounds	Mis A/C State	Application of Procedures/Knowledge
6	28% of flights in the LOSA Archive have an Automation error. Almost 1% of total flights have Automation errors that have consequential results.	All	234	All	LOSA	Automation Error Mgt	Automation Error Mgt	Mis-AFS Mis A/C State	Flight Management Guidance/Automation
7	In terms of mismanaged errors guidance are far more prevalent than programming errors.	All	234	All	LOSA	Error Mgt Automation	Automation Error Mgt	Mis-AFS	Flight Management Guidance/Automation
8	Technical understanding of the Automation	All	234	All	LOSA	Automation Competencies	Automation	Mis-AFS CRM	Flight Management Guidance/Automation Knowledge
9	A lack of “verbalization” by crew to share mental models	All	234	All	LOSA	Competencies Automation	Automation Error Mgt	Mis-AFS CRM	Flight Management Guidance/Automation Communication
11	Control Zone, looking through the FD, not checking modifications to the SID, STAR or Approach profile and relying on the PM to effect FMC/FMGC changes.	CLB APR	234	All	LOSA	Automation	Automation Manual AC Control Monitoring Xcheck	Mis-AFS CRM	Flight Management Guidance/Automation Workload Management Manual Aircraft Control Application of Procedures/Knowledge
12	The overarching element is Monitoring/Cross-Checking, with little to no dialogue between the pilots during most of the errors.	All	234	All	LOSA	Automation Error Mgt MonitoringXcheck	Automation Monitoring Xcheck Communication Error Mgt	Mis-AFS CRM	Flight Management Guidance/Automation Communication SA
13	21% of the Automation induced undesired aircraft states result from SOP Cross-Verification errors	All	234	All	LOSA	Automation MonitorXchk Error Mgt UAS	Automation Monitoring Xcheck Error Mgt	Mis-AFS CRM Mis A/C State	Flight Management Guidance/Automation SA
14	There are often misunderstandings of autopilot modes.	All	234	All	LOSA	Automation Competencies	Automation Error Mgt	Mis-AFS CRM	Flight Management Guidance/Automation Knowledge
23	28% of flights in the LOSA Archive have an SOP Cross-Verification error. 1% of these are mismanaged.	All	234	All	LOSA	MonitoringXcheck	Monitoring Xcheck Error Mgt	Mis-AFS Mis A/C State Mis-Sys	Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control
24	Most Frequent cross-verification errors: Omitted flight mode verification – 2%, Failure to cross-verify alt setting – 18%, Failure to cross-verify FMS settings – 16%, Failure to cross verify documentation and performance – 9%	All	234	All	LOSA	MonitoringXcheck	Monitoring Xcheck Error Mgt	Mis-Sys Mis-AFS Compliance	SA Flight Management Guidance/Automation Application of Procedures/Knowledge
25	Most Risky cross-verification errors: Failure to cross-verify alt setting, Failure to cross-verify FMS settings (14% UAS/added error rate).	All	234	All	LOSA	MonitoringXcheck UAS	Monitoring Xcheck Error Mgt	Mis-Sys Mis-AFS Compliance	SA Flight Management Guidance/Automation Application of Procedures/Knowledge
26	Most important mismanaged Threat: Terrain. Both omitted callouts and failure to select Terrain feature on Nav Display are a common and risky combination. Airlines that operate in high Terrain areas tend to get too used to this threat.	TO CLB DES APR LDG	234	All	LOSA	Terrain MonitoringXcheck	Terrain Monitoring Xchk Error Mgt	Mis-Sys Compliance	SA Application of Procedures/Knowledge
30	Intentional Noncompliance: significant positive correlation between this and the number of mismanaged threats, unintentional errors, mismanaged errors and UAS.	All	234	All	LOSA	Compliance UAS	Error Mgt	Compliance CRM Mis-AFS Mis A/C State Mis-Sys	Leadership and Teamwork Application of Procedures/Knowledge
38	If communication is poor, TEM is poor despite good Leadership by captain.	All	234	All	LOSA	Leadership Communication	Error Mgt	CRM	Communication Leadership and Teamwork
40	ATC threats are the second most common threat type observed in the LOSA Archive.	All	234	All	LOSA	Communication		ATC	Communication
45	ATC induced problems often linked with poor communication and cross-checking in the cockpit.	TO CLB DES APR	234	All	LOSA	Communication MonitoringXcheck	Error Mgt Monitoring Xcheck	ATC CRM	Communication SA Application of Procedures/Knowledge
50	Flight phases: most threats in pre-departure.	GRD	234	All	LOSA	Error Mgt	Error Mgt	Cabin CRM Workload Distraction	Leadership and Teamwork Workload Management
58	Predeparture/Taxi-out are extremely important phases from the point of view that they are fertile territory for mitigating threats by training. 4	GRD	234	All	LOSA	Error Mgtt Training	Error Mgt	Ground manoeuvring CRM	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Communication Knowledge Application of Procedures/Knowledge Flight Management Guidance/Automation
118	Error detection is most closely aligned with the quality of Monitoring/Cross-Checking in all phases of flight and the quality of the Briefing.	All	234	All	LOSA 2	Error MonitoringXcheck	Error Mgt Monitoring Xcheck	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
133	The Aircraft handling with the lowest rate of detection are: (Many are not detected until UAS) o Unintentional vertical deviation 41% o Wrong speed brakes setting 39% o Incorrect Nav Display setting 35% o Unintentional landing deviation 32% o Wrong radar setting 30% o Unintentional lateral deviation 29% o Unintentional speed deviation 24% o Wrong power/thrust setting 22% o Wrong anti-ice setting 19%	All	234	All	LOSA 2	Error ManualACControl MonitoringXcheck UAS	Landing Issues Man Handling Error management	Mis-AFS Mis A/C State Mis-Sys	Problem Solving Decision Making Manual Aircraft Control

Figure 4.2.1.14 – Training Effect/LOSA

4.2.2 Accident Incident Analysis

The following statements are listed under relevant topics, in some cases considered as factors in the analysis, and in other cases the competencies analyzed. The graphics relating to the information listed are referenced in Appendix 2.

4.2.2.1 Adverse Weather

- **Gen4 Jet**
  - As the overall accident rate has reduced, exposure to weather related accidents has reduced from 0.8 to 0.65 per million take-offs.
  - When comparing the last 11 years compared to the previous era, adverse weather is a greater factor in accidents and incidents, rising from 37% to 46%
  - Adverse weather is the number 1 factor in accidents over the last in last 11 years for all accidents
  - Adverse weather is ranked 3rd after non-compliance and CRM, as a factor in accidents with high training effect. It has increased by a factor of 2 when comparing the previous 11-years data.

- **Gen3 Jet**
  - Adverse weather has reduced slightly as a factor, in comparison to the period prior to the last 15-years. Over the last 15-years, adverse weather remains the number 1 ranked factor in accidents and serious incidents, evident in 40% of events.
  - When considering fatal accidents only, adverse weather is ranked 3rd after CRM and system malfunction, at 20% of all fatal accidents over the last 15 years.
  - Adverse weather is currently ranked 3rd as a factor in accidents with high training effect, at 30% overall, implying substantial benefit from mitigation through training.

- **Gen2 Jet**
  - Adverse weather is ranked 2nd as a factor in accidents, and has increased in the most recent 15-year period from 30% to 35%.
  - Adverse weather is now the number 1 ranked factor by percentage of occurrence in fatal accidents, having doubled in the most recent 15-year period to 60%.
  - Exposure data indicates adverse weather as a factor in fatal accidents at the rate of 1 per million take-offs, over the most recent 15-year period.
  - For accidents with high training effect, adverse weather is ranked 3rd after CRM and poor visibility, at 40% with no significant change over the last 15-year period and before, implying substantial benefit from mitigation through training.

- **Gen3 Turboprop**
  Note, there was no available exposure data
  - Adverse weather has increased as a factor in accidents from 25% to 40% when comparing the most recent 15-year period to the previous period.
  - Adverse weather is now the number 1 ranked factor by percentage of occurrence in accidents, having risen from a previous ranking of 3rd.
  - For accidents with high training effect, adverse weather is now ranked 2nd at 60% after CRM. Prior to the last 15 years it was a factor in 65% of accidents.

- **Gen2 Turboprop**
  Note, there was no available exposure data
  - Prior to the last 15-years, adverse weather was ranked 2nd with a 40% rate of reported occurrence in accidents.
  - There was insufficient data to draw further conclusions over the most recent 15-year period.

4.2.2.2 Competencies – General

Manual Aircraft Control is the most important competency expressed in all accidents, followed by Situation Awareness, and Application of Procedures and Knowledge.

With respect to the most critical flight phases, TO/LDG/APP, patterns are consistent with the statements above, except that the peaks with respect to Manual Aircraft Control, Situation Awareness and Application of Procedures and knowledge, are much more pronounced.

In less critical flight phases, the difference is very small, except in GND, where Situation Awareness is predominant.

- **Gen4 Jet**
  - Competency issues most prevalent are:in
    - Manual Aircraft Control
    - Situation Awareness
    - Application of Procedures and knowledge
  - In the APP phase over the last 21 years, the competency issues most prevalent are:
    - Manual Aircraft Control
    - Situation Awareness
    - Application of Procedures and knowledge
  - In the LDG phase over the last 21 years, the competency issues most prevalent are
    - Manual Aircraft Control
    - Situation Awareness
    - Application of Procedures and knowledge
  - This pattern remains consistent when combining the APP and LDG phases
    - Manual Aircraft Control
    - Application of Procedures and knowledge
    - Situation Awareness
- **Gen3 Jet**
  - Competency issues most prevalent are:
    - Manual Aircraft Control
    - Situation Awareness
    - Application of Procedures and knowledge
- **Gen2 Jet**
  - Competency issues most prevalent are:
    - Manual Aircraft Control (which is very dominant)
    - Problem Solving and decision-making
    - Situation Awareness
    - Application of Procedures and knowledge
- **Gen3 Turboprop**
  - Competencies most prevalent are:
    - Manual Aircraft Control
    - Application of Procedures and knowledge
    - Knowledge
    - Situation Awareness

- **Gen2 Turboprop**
  - Competencies most prevalent are:
    - Manual Aircraft Control
    - Problem Solving and decision-making
    - Situation Awareness

4.2.2.3 Compliance

- **Gen4 Jet**
  - During the last 11-year period, compliance as factor has decreased from being ranked 3rd at 36%, to 23%.
  - For accidents with a high training effect, compliance is a substantial factor, at 75% having risen from 63%

- **Gen3 Jet**
  - During the last 15-year period, compliance as factor has reduced from being ranked 5th at 24% to 14%.
  - For fatal accidents, the rate of occurrence of this factor has reduced from 50% to 21%.
  - For accidents with a high training effect, compliance is a substantial factor, at 50% overall and ranked 2nd.

- **Gen2 Jet**
  - The rate of accidents involving compliance has increased slightly over the most recent 15-year period considered, but other factors have increased much more.
  - Compliance is now ranked 9th at 13%, having decreased from 22%.
  - For fatal accidents, the rate of occurrence of compliance has decreased from 33% to 7%.
  - For accidents with a high training effect, compliance is a substantial factor, at 39% overall and ranked 5th.

- **Gen3 Turboprop**
  Note, there was no available exposure data
  - During the last 15-year period, compliance as factor has decreased from 25% to 11% when compared to the previous period.
  - For accidents with a high training effect, compliance remains is a substantial factor, at 50% overall and ranked 3rd.

- **Gen2 Turboprop**
  Note, there was no available exposure data
  - During the last 15-year period, compliance as factor has risen from 28% to 38% when compared to the previous period.
  - For accidents with a high training effect, compliance is a substantial factor, at 78% having risen from 65% overall and ranked 2nd.

4.2.2.4 Landing

- **Gen4 Jet**
  - The highest total numbers of accidents occur in the LDG & GND phases. In the period considered before 2000, LDG was the flight phase with the largest number of accidents, twice as many as any other phase. Over the most recent 11-year period considered, the trend has decreased with the APP phase becoming predominant.
  - The APP phase is now considered as the number 1 flight phase in terms of the number of accidents.
  - The factors which contribute to accidents in the LDG phase are:
  - Compliance/CRM/Adverse Weather/Adverse Wind (These factors occur in 50% of accidents)

- When considering the sum of all factors in all accidents, there are more factors occurring in accidents in the LDG phase than in any other phase.
- For fatal accidents, the LDG phase is ranked 3rd after APP and TO
- When considering the sum of all factors in fatal accidents, there are more factors occurring in accidents in the LDG phase than in any other phase.
- The factors, which are most prevalent in fatal accidents during LDG over the most recent 11-year period are:
  - Adverse weather/CRM/Compliance

- **Gen3 Jet**
  - The LDG phase which was previously ranked 3rd in accidents, has now climbed to number 1, over the last 15-years.
  - When considering the sum of all factors in all accidents, there are more factors occurring in accidents in the LDG phase than in any other phase.
  - The factors which are most prevalent in accidents in the LDG phase are:
  - CRM/Adverse Weather/System Malfunction/Poor visibility/Compliance
  - The LDG phase is not the highest ranked phases for fatal accidents.
  - When considering the sum of all factors in fatal accidents, there are more factors occurring in accidents in the LDG phase than during any other phase.
  - The factors which are most prevalent in fatal accidents during LDG over the most recent 15-year period are:
    - CRM/Adverse Weather/Windshear/System Malfunction/Adverse Weather/Mismanaged System

- **Gen2 Jet**
  - The LDG phase which was previously ranked number 1 in accidents has dropped to a ranking of number 2 over the last 15-years.
  - The APP phase is now ranked number 1 over the last 15-year period.
  - For all accidents, the most prevalent factors are:
    - CRM/System Malfunction
  - For fatal accidents in the last 15 years, APP was the predominant phase
  - When considering the sum of all factors in fatal accidents, there are more factors occurring in accidents during in the APP phase than in any other phase.
  - The factor most prevalent in fatal accidents during LDG over the most recent 15-year period are:
    - Poor visibility/Runway taxiway condition

- **Gen3 Turboprop**
  Note, there was no available exposure data
  - The LDG phase was previously ranked 2nd but has now dropped to 5th overall in the most recent 15-year period.
  - The factors which are most prevalent in all accidents during LDG over the most recent 15-year period are:
    - CRM/Adverse Weather/System Malfunction/Runway taxiway condition/Poor visibility.

- **Gen2 Turboprop**
  Note, there was no available exposure data
  - LDG is ranked number 1 in flight phases for the most accidents for all periods considered.
  - When considering the sum of all factors in all accidents, there are more factors occurring in accidents in the LDG phase than in any other phase.
  - The factors which are most prevalent in accidents during the LDG phase are:
    - System malfunction/Compliance/CRM.

4.2.2.5 Leadership & Teamwork

- **Gen4 Jet**
  - Exposure to an accident or serious incident involving Leadership and teamwork as a competency issue has risen from 0.12 per million take-offs to 0.4 per million take-offs in the most recent 11-year period.
  - Leadership and teamwork is reported as a competency issue in 8% of all accidents, which is a reduction from 18% in the previous 11-year period.
  - When considering serious incidents, Leadership and teamwork is not reported as a competency issue, perhaps indicating that effective Leadership can prevent more serious events.

- **Gen3 Jet**
  - Exposure to an accident or serious incident involving Leadership and teamwork as a competency issue has reduced from 0.23 per million take-offs to 0.08 per million take-offs in the most recent 15-year period.
  - Leadership and teamwork is reported as a competency issue in 5% of all accidents, which is a reduction from 13% in the previous 15-year period.
  - However the trend is reversed for fatal accidents where Leadership and teamwork is reported as a competency issue has risen from 7% to 15% in the most recent 15-year period
  - In serious incidents, where in many cases an accident was prevented by the crew action, Leadership and teamwork is conspicuously not reported as a competency issue providing evidence for research that effective Leadership could well have prevented an accident.

- **Gen2 Jet**
  - Exposure to an accident or serious incident involving Leadership and teamwork as a competency issue has increased from 0.11 per million take-offs to 0.19 per million take-offs in the most recent 15-year period.
  - Leadership and teamwork is reported as a competency issue in 4% of all accidents
  - The percentage of fatal accidents with a Leadership and teamwork as a competency issue has risen from 4% to 7% in the most recent 15-year period.
  - In serious incidents, Leadership and teamwork as a competency issue is only reported at 3%, providing evidence for research that effective Leadership could prevent more serious events.

- **Gen3 Turboprop**
  Note, there was no available exposure data
  - Leadership and teamwork is reported as a competency issue in 8% of all accidents
  - When considering serious incidents, Leadership and teamwork as a competency issue has risen from 3%, to 7% over the last 15-years.

- **Gen2 Turboprop**
  Note, there was no available exposure data
  - Leadership and teamwork is reported as a competency issue in 38% of all accidents, and this has risen from a previous figure of 17%.

4.2.2.6 Manual Aircraft Control (Flight Path Management – Manual)

- **Gen4 Jet**
  - Of the 9 competencies analyzed, the competency most reported as a problem is Manual Aircraft Control; it is a competency issue in 22% of accidents over the most recent period. It does show improvement from the previous 11-year study, where it was at more than 35%
  - For the period up to 2000, more than 0.8 accidents per million take-offs showed manual aircraft control as a competency issue, which then declined to 0.3 in the period 2000-2010.
  - For accident with a high training effect, manual aircraft control remains the highest competency issue from data over the last 11 years as well as in the previous period.
  - There is a significant difference in the rate of manual aircraft control as a competency issue, between fatal accidents and serious incidents, this and the fact that analysts noted that in many cases in serious incidents that crew actions prevented an accident from occurring provides evidence that accidents are avoided through effective manual control strategies.

- **Gen3 Jet**
  - The exposure to accidents with manual aircraft control as a competency issue is stable over time, at approximately 30%. This is more than double the percentages of the other competencies.
  - There is a significant difference in the rate of manual aircraft control as a competency issue, between fatal accidents and serious incidents, this and the fact that analysts noted that in many cases in serious incidents that crew actions prevented an accident from occurring provides evidence that accidents are avoided through effective manual control strategies.
  - For accidents with a high training effect, manual aircraft control remains the highest competency issue from data over the last 15-years as well as in the previous period.
  - Manual aircraft control, as a competency issue stands at 40% in fatal accidents more than 15-years ago, as compared to over 50% in the most recent 15-year period.

- **Gen2 Jet**
  - Of the 9 competencies analyzed, the competency at issue most often is Manual Aircraft Control, a competency issue in 40% of accidents over the period 1995-2010. This has increased by a magnitude of 3 times from the previous 15-year period.
  - There are 4 accidents per million take-offs, 50% of them showing manual aircraft control as a competency issue.
  - Manual aircraft control has always been amongst the top ranked competency issues in fatal accidents, but has risen in the most recent 15-year period to 60%.
  - There is a significant difference in the rate of manual aircraft control as a competency issue, between fatal accidents and serious incidents, this and the fact that analysts noted that in many cases in serious incidents that crew actions prevented an accident from occurring provides evidence that accidents are avoided through effective manual control strategies.
  - For accidents and serious incidents with a high training effect, manual aircraft control is now considered a competency issue in 80% of events, an increase of 100% over the previous 15-yearperiod.
  - Exposure data indicates an increase in manual aircraft control as a competency issue, from of 0.2 to 0.7 for accidents with a high training effect, over the most recent 15-year period.

- **Gen3 Turboprop**
  Note, there was no available exposure data for this generation
  - Manual aircraft control as a competency issue in all accidents has risen from 13% to 16% in the most recent 15-year period.
  - Manual aircraft control is now ranked as the number 1 competency issue in accidents. There is a significant difference in the rate of manual aircraft control as a competency issue, between fatal accidents and serious incidents, this and the fact that analysts noted that in many cases in serious incidents that crew actions prevented an accident from occurring provides evidence that accidents are avoided through effective manual control strategies.

- **Gen2 Turboprop**
  Note, there was no available exposure data for this generation
  - Manual aircraft control shows an increase from 27% to 38% as a competency issue in all aircraft accidents, and is now ranked 2.
  - There is a significant difference in the rate of manual aircraft control as a competency issue, between fatal accidents and serious incidents, this and the fact that analysts noted that in many cases in serious incidents that crew actions prevented an accident from occurring provides evidence that accidents are avoided through effective manual control strategies.

4.2.2.7 Surprise (Situation Awareness)

Little information can be directly inferred from accident and incident reports with respect to unexpected or surprise events being considered as competency issues. Surprise was not considered directly as a competency issue. It can however be indirectly inferred, that when there is a reported breakdown in situation awareness, there is a greater likelihood of unexpected events, and the management of surprises is more difficult. For this reason, situation awareness is considered as a competency issue affecting surprise.

- **Gen4 Jet**
  - For all accident data, Situation Awareness is among the top 3 ranked competency issues, the rate rising from 18% to 22% in the last 11-years, when compared with the previous time period.
  - Situation Awareness is the number 1 competency, alongside Manual Aircraft Control, when analyzing competency issues in accidents and incidents.
  - When analyzing incidents alone, Situation Awareness is the highest ranked competency issue at over 20%.

- **Gen3 Jet**
  - For all accident data, Situation Awareness is among the top 3 ranked competency issues, with the rate rising from 13% to 28% in the last 15-years, when compared with the previous period.
  - Situation Awareness is now ranked 2nd as the most significant competency issue, after Manual Aircraft Control.
  - When considering fatal accidents, Situation Awareness is ranked 2nd, in 29% of fatal accidents.
  - There is a significant difference in the rate of Situation Awareness as a competency issue, between fatal accidents and serious incidents, this and the fact that analysts noted that in many cases in serious incidents that crew actions prevented an accident from occurring provides evidence that accidents are avoided through the maintenance or regaining of Situation Awareness.

- **Gen2 Jet**
  - For all accident data, Situation Awareness is among the top 3 ranked competency issues with, the rate rising from 16% to 24% in the last 15-years, when compared with the previous period.
  - When considering fatal accidents, Situation Awareness is ranked 2nd as a competency, contributory to 21% of fatal accidents, with a slight reduction from 23% in the previous period.

- There is a significant difference in the rate of Situation Awareness as a competency issue, between fatal accidents and serious incidents, this and the fact that analysts noted that in many cases in serious incidents that crew actions prevented an accident from occurring provides evidence that accidents are avoided through the maintenance or regaining of Situation Awareness.

- **Gen3 Turboprop**
  Note, there was no available exposure data for this generation
  - For all accident data, Situation Awareness is ranked among the top 3 competency issues with, the rate decreasing from 17% to 14% in the last 15-years, when compared with the previous period.
  - Situation Awareness is now ranked 3rd after Manual Aircraft Control and Application of Procedures and Knowledge.
  - When considering incidents alone, Situation Awareness is the highest ranked competency issue at 18%.

- **Gen2 Turboprop**
  Note, there was no available exposure data for this generation
  - For all accident data, Situation Awareness is currently ranked 4th, with the rate rising from 15% to 17% in the last 15-years, as compared with the previous period.

4.2.2.8 System Malfunction

- **Gen4 Jet**
  - System malfunction is ranked 5th as a factor and present in 15% of all accidents over the latest 11-year period.
  - As a factor all accidents, system malfunction has increased from below 10% to above 15% from the previous period.
  - For accidents with high training effect, system malfunction has decreased in occurrence from 25% of accidents to 5%. Although the available volume of data is relatively small, it seems reasonable to infer that training is an effective remediation tool.

- **Gen3 Jet**
  - System malfunction is ranked 3rd as a factor and present in 19% of accidents over the latest 15-year period.
  - As a factor system malfunction has increased from 14% to 19% in the last 15-year period.
  - For fatal accidents, system malfunction is ranked 2nd and stable at 30% over the 2 time periods analyzed.
  - For accidents with high training effect, system malfunction is ranked 6th and present in 18% of accidents over the last 15-years. Prior to this the figure was 27%, and therefore it seems reasonable to infer that training is an effective remediation tool.

- **Gen2 Jet**
  - System malfunction is ranked number 1 as a factor and is present in 45% of accidents over the latest 15-year period.
  - As a factor system malfunction has increased from 25% to 45% in the last 15-year period and has gone from 3rd to 1st in ranking.
  - For fatal accidents, system malfunction is ranked 3rd occurring more than 50% of the time compared to the previous time period when it ranked 5th and only occurred at 20%.
  - For accidents with high training effect, system malfunction is ranked 4th and present in over 40% of accidents over the last 15-years. This is up from an occurrence rate of about 20%.

- **Gen3 Turboprop**
  Note, there was no available exposure data
  - System malfunction is ranked 3rd as a factor and is present in 22% of accidents over the latest 15-year period.
  - As a factor system malfunction has decreased as a percentage from 42% to 22% in the last 15-year period with a ranking down from 1st to 3rd.
  - For accidents with high training effect, system malfunction is present in 17% of accidents over the last 15-years.

- **Gen2 Turboprop**
  Note, there was no available exposure data
  - System malfunction is ranked number 1 as a factor and is present in 50% of accidents over the latest 15-year period.
  - As a factor system malfunction is stable at 50% and remains number 1 for all flights analyzed.
  - For accidents with high training effect, system malfunction is ranked 3rd and present in over 70% of accidents over the last 15-years. The rate went from 50% to over 70% in the latest period, although the available data set is small.

4.2.2.9 Terrain

- **Gen4 Jet**
  - Terrain as a threat generally ranks low according to Gen4 Jet accident and incident data.
  - As a contributory factor in accidents, terrain has reduced from 5% to 1% when comparing older data to that from the last 11-year period.
  - When considering accidents with a high training effect, there has been a reduction in accidents including terrain as a factor, from 13% to 5% over the 2 periods analyzed.

- **Gen3 Jet**
  - Terrain as a threat generally ranks low according to Gen3 Jet accident and incident data, currently it is a factor in 2% of all accidents in the most recent 15-year period, compared to 3% previously.
  - When considering fatal accidents, terrain ranks 6th overall but has decreased in the rate of occurrence from 21% to 15%.
  - When considering accidents with a high training effect, the rate is low at 3% overall.

- **Gen2 Jet**
  - Terrain as a threat generally ranks 11th according to Gen2 Jet accident and incident data, but has increased in the most recent 15-year period to 11%, from 3% previously.
  - When considering fatal accidents only, terrain ranks 8th overall but has increased in the rate of occurrence from 16% to 23% in the most recent 15-year period.
  - When considering accidents with a high training effect, the rate of accidents with terrain as a contributory factor is at 14% overall.

- **Gen3 Turboprop**
  Note, there was no available exposure data for this generation
  - Terrain as a threat generally ranks low according to Gen3 Turboprop accident data.

- **Gen2 Turboprop**
  Note, there was no available exposure data for this generation
  - Terrain as a threat generally ranks low according to Gen2 Turboprop accident and incident data.

4.2.3 Flight Data Analysis

4.2.3.1 EBT FDA

4.2.3.1.1 Unstable Approaches

- Filter Evidence Table for FDA
- Filter result for [Unstable Approaches)(Landing Issues)(Error Management)]
  - See Figure 4.2.3.1.1
  - **Result FDA – Unstable Approach**
    - 3.5% of approaches are unstable
    - The frequency of flights having at least one FDA event (all severity levels) during landing is the same for stable and unstable approaches indicating there are landing problems with stable approaches as well as unstable approaches.
    - In order to determine the increased risk associated with unstable approaches the event rate and severity are examined in the relevant subsequent phases of flight after the approach (LDG and GA/CLB).
    - Comparing events rates (all severities) stable versus unstable the ratio is 2.24:2.84 (i.e., ratio≈1.3)

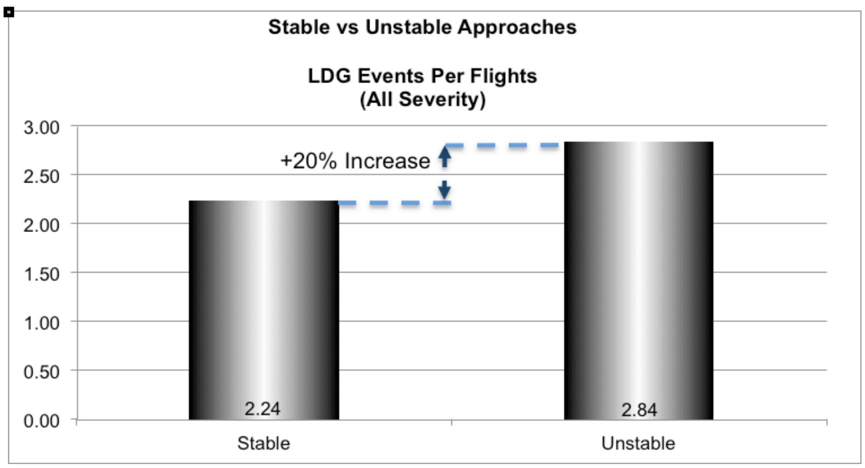

Figure 2.3d (duplicate)

    - Comparing high severity event rates, for stabilized versus unstable approaches, the ratio is 8.11% versus 19.53 (ratio≈2.4) indicating that there are more than double the high risk events during landing from unstable approaches.

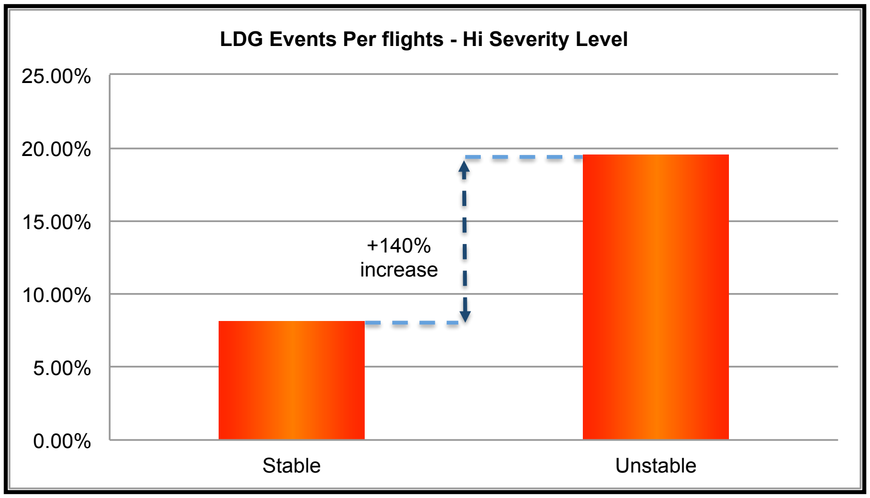

Figure 2.3f (duplicate)

- Comparing high severity event rates for stabilized versus unstable approaches, for a defined set of serious events, the rates are 1.96% versus 5.47% (ratio≈2.8). This indicates that examining events of increasing severity produces a greater differential between risks on landing associated between the two types of approach.

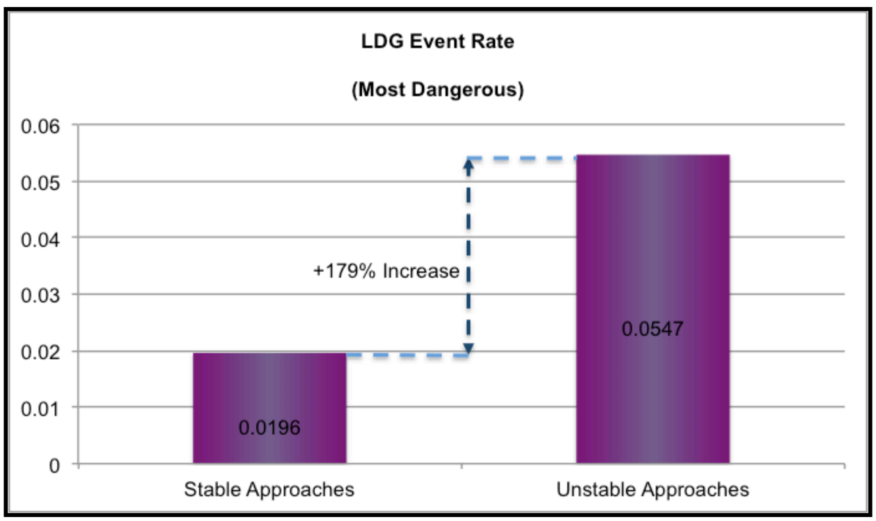

Figure 2.3h (duplicate)

- Flights with unstable approaches generally have more FDA events even in flight phases other than APP and LDG. i.e., ratio ≈1.2 for all event and 1.35 for high severity events.

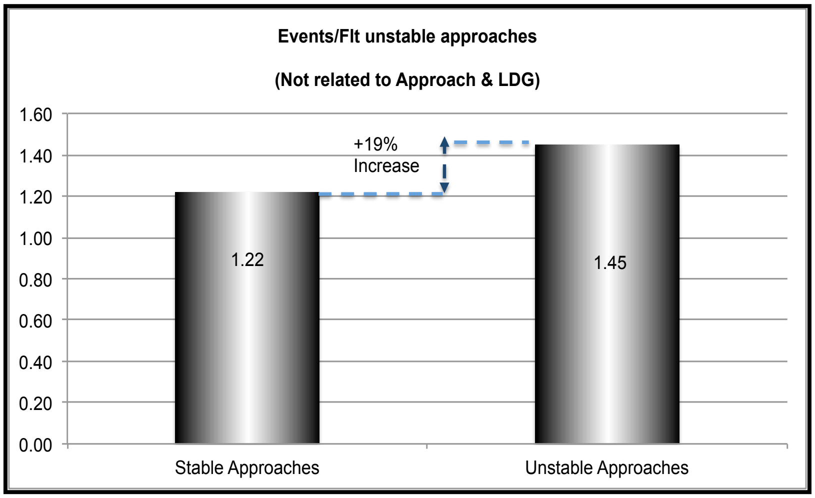

Figure 2.3i (duplicate)

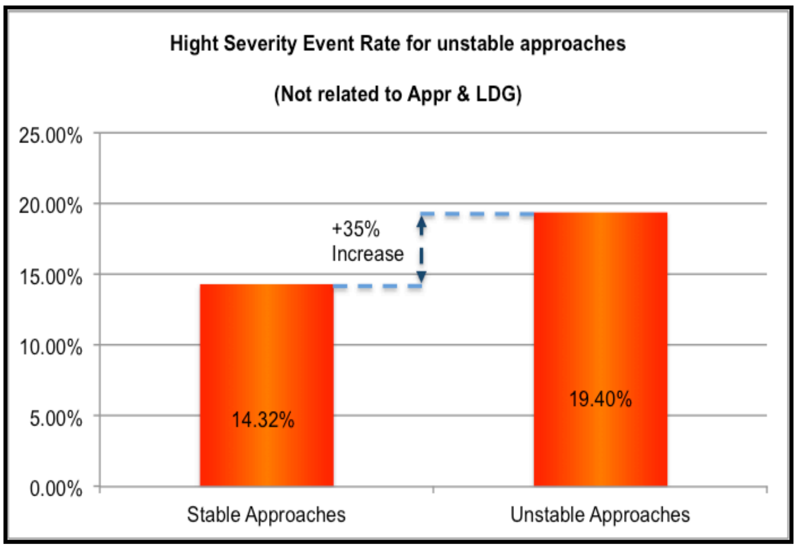

Figure 2.3j (duplicate)

- Summary – The FDA unstable approach rate is around 3.5%. This is consistent across aircraft types and geographical regions. There are as many flights that have landing events following stable approaches as there are following unstable approaches. Solving the unstable approach problem will not address all landing issues. The increased risk associated with unstable approaches becomes evident when examining event rates and event severity. Landings from unstable approaches have a higher event rate and as the events themselves become more severe, the event rate becomes even higher. Unstable approaches can be viewed as a barometer of the flight itself; flights with unstable approaches generally have more FDA events all in-flight phases, including phases not associated with the approach.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Key Words	Training Topics	Factors	Competencies
170	3.5% of approaches are unstable	APR	34	34	FDA	Unstable APR/GA	Unstable APP	Mis A/C Stable	All
171	Only 1.4% of them lead to a Go-Around	APR	34	34	FDA	Unstable APR/GA	Unstable APP Go-Arounds	Mis A/C Stable Compliance	Application of Procedures/Knowledge
178	Frequency of flts having at least one FDA event (all severity levels) is the same for stable and Unstable Approaches (83.63 vs 81.11 stable vs unstable respectively) indicating there are landing problems with stable approaches as well.	APR	34	34	FDA	Unstable APR/GA	Landing Issues	Compliance Mis A/C State Mis-Sys	All
179	Comparing events per flt (all severities) stable vs unstable is 2.24:2:84 or r=1.3 (approx.)	APR	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	All
180	Comparing events rates (high severity stable vs unstable is 8.11% vs 19.53 (approximately 2.4 times) indicating that there are more than double the hi risk events on landing with Unstable Approaches	APR	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	All
181	Comparing event rates stable vs Unstable Approaches (all severities) for the selected 10 serious landing events stable vs unstable is 14.33% to 34.52% or r=2.4 (approx.)	APR	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	All
182	Comparing event rate (high severity) stable vs unstable for the set of 10 serious events is 1.96% vs 5.47% or r=2.8 (approx.) indicating that there are almost 3 times the hi risk events on landing with Unstable Approaches	APR	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	All
183	Unstable Approaches are not the cause of all landing problems. This is particularly concerning if we remember that the ratio of stable approaches over Unstable Approaches is approx. 27:1	APR	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	Manual AC Control
184	But if we drill down we see that when Unstable Approaches occur, there are many more of severe events during landings (things go more wrong when unstable.)	APR	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	Manual AC Control
185	Flights with Unstable Approaches produce more events than flights with Stable Approaches even in phases of flight outside of Approaches and Landings.	All	34	All	FDA	Unstable APR/GA	Unstable APP Error Mgt	Compliance Mis A/C State Mis-Sys	All

Figure 4.2.3.1.1 – Unstable Approach/EBT FDA

4.2.3.1.2 Go-Around

- Filter Evidence Table for FDA
- Filter result for [Unstable Approaches (GA)(Unstable Approaches Surprise)]
  - See Figure 4.2.3.1.2b
  - **Result FDA 2 –** Go-Around (FDA)
    - 1.4% of unstable approaches lead to a go-around.
    - The rate of FDA events for a go-around from an unstable approach is 1.6 events per flight.
    - There is an average increase of 85% in the rate of high-risk events when a go-around is executed from an unstable approach, when compared to go-arounds executed from stabilized approaches.

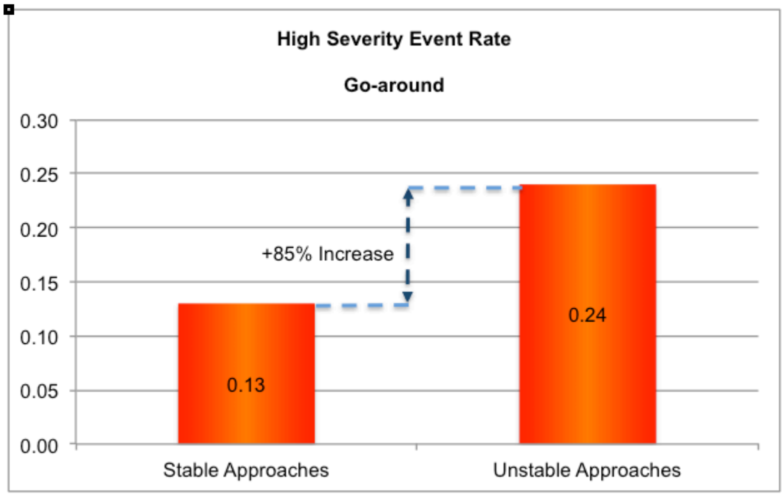

Figure 2.3g (duplicate)

- The FDA event rates are conservative, because many errors are not captured due to technical reasons. (Parameter, software and hardware limitations)
- In the FDA database of 1.6 million flights across multiple types (Gen 3 and 4) the average go-around initiation height above the aerodrome was over 800 ft. with a ratio of over 6:1 of initiation heights > 200 ft. to initiation heights ≤ 200 ft.

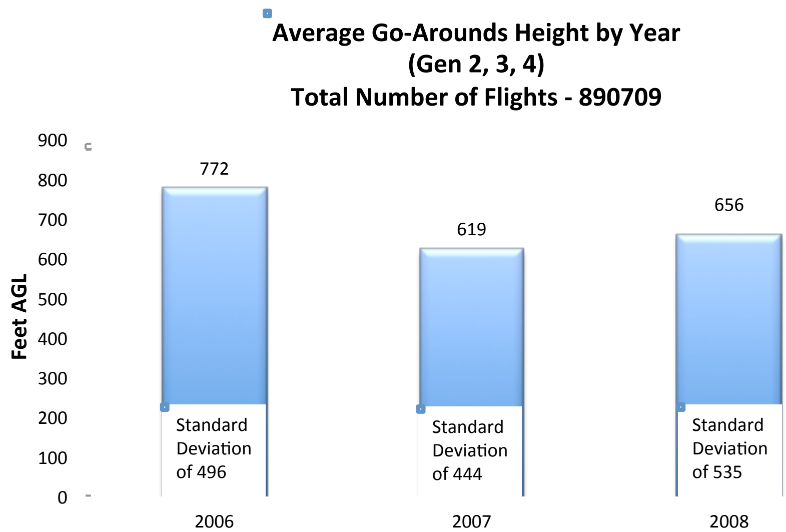

Figure 4.2.3.1.2

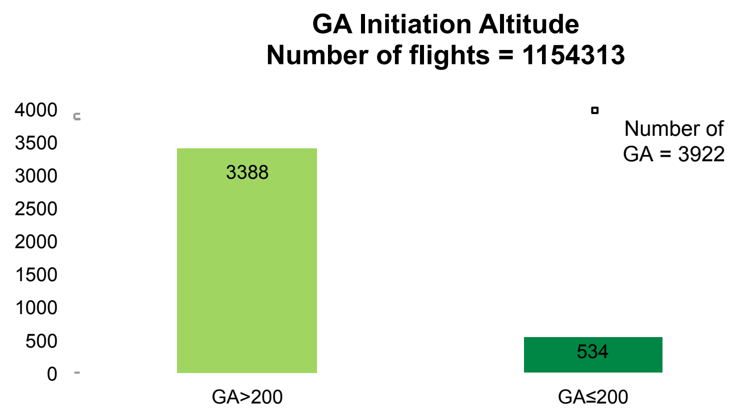

Figure 4.2.3.1.2a

- Summary – Only 1.4% of unstable approaches lead to a go-around, with an FDA all event rates of 1.6 occurrences in the immediate phases after go-around (GA, CLB). The high-risk event rate for the same period is 0.24. Both these rates are conservative because the flight recorder cannot capture many of the crew errors that could occur. Go-around initiation heights overwhelmingly occur at heights different from those briefed.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
171	Only 1.4% of them lead to a Go-Around	APR	34	34	FDA	Unstable APR/GA	Unstable APP Go Arounds	Mis A/C State Compliance	Application of Procedures/Knowledge
172	(0.31% of stable approaches lead to a Go-Around)	APR	34	34	FDA	Unstable APR/GA	Unstable APP Go Arounds		
173	A GA from an Unstable App causes on average 1.6 FDA risk events	APR GA	34	34	FDA	Unstable APR/GA	Unstable APP Go Arounds	Mis A/C State	All
174	24% rate of hi risk events during GA from unstable apprs	APR GA	34	34	FDA	Unstable APR/GA	Unstable APP Go Arounds	Mis A/C State	All
175	FDA cannot detect many errors; e.g. Lat Flight Plan deviations.	APR GA	34	All	FDA	Unstable APR/GA	Go Arounds	Mis A/C State Mis-AFS Mis-Sys	
177	The ratio of GA>200' To GA ≤200' is more than 6:1 The ratio for Stable Approaches is higher	APR GA	34	34	FDA	Unstable APR/GA	Go Arounds Surprise		All
187	Looking at a cross secton of types (5 types and 9 models) over a three year period including 1.6 million flights and approximately 5700 go- arounds) the average height above the field was over 800 at the initiation of the GA. All types in the study had a least one GA from 0 ft agl. Many GAs occured close to 2000 agl.	APR	34	234	FDA	Unstable APR/GA	Go Arounds Surprise		All

Figure 4.2.3.1.2b – Go-Around/EBT FDA

4.2.3.2 Long Body Aircraft Studies

4.2.3.2.1 Manual Aircraft Control

- Filter Evidence Table for Long Aircraft FDA Study
- Filter Topics [Manual Aircraft Control]
  - See Figure 4.2.3.2.1b
  - **Result – Long body aircraft study – manual aircraft control**
    - Long aircraft compared to shorter versions of the same type have a greater frequency of high vertical acceleration landings.

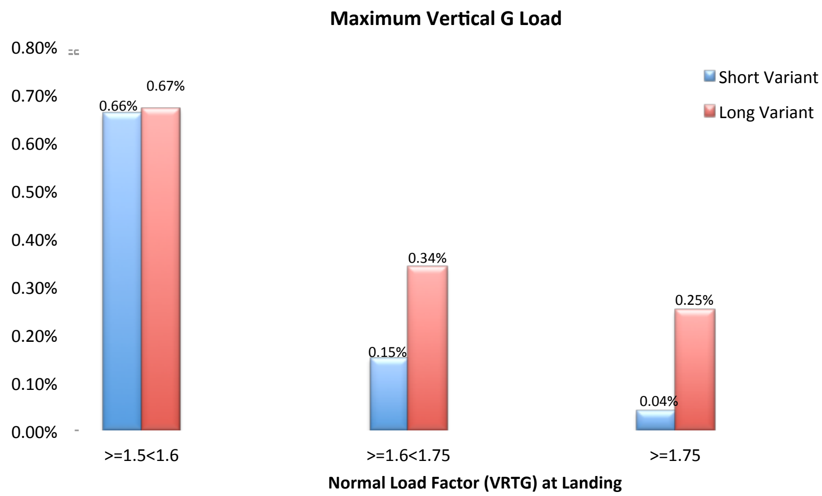

Figure 4.2.3.2.1

- They tend to have steeper approach gradients just prior to flare and a shorter time to touchdown from flare initiation.

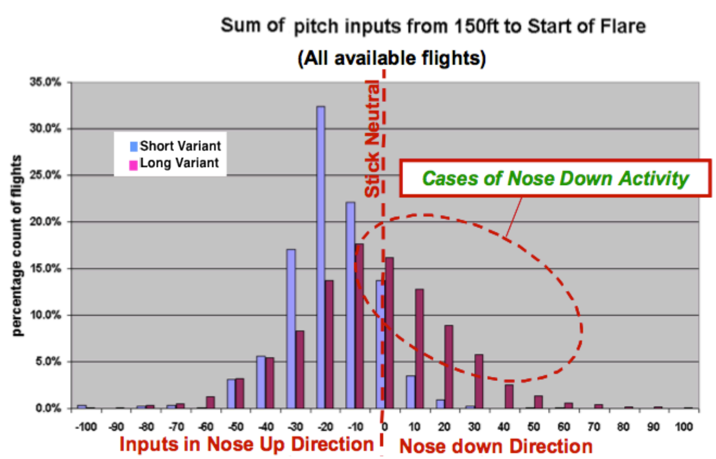

Figure 4.2.3.2.1a

- There is a higher tendency “duck under” the glideslope.
- Greater attention is required during landings in crosswinds, with pitch-down and under-flare as well as the aircraft geometric limits.
- Crews need to be made aware that the tendency to under-rotate in long body aircraft degrades take-off performance; pilots should make smooth accurate rotations avoiding “pilot induced oscillations”.

- Summary – Long body aircraft are more prone to high “G” landings. Because of geometric considerations, perspectives from the cockpit are slightly different laterally and vertically and tend to produce steeper approach gradients just prior to flare as well as centerline displacement in crosswinds. To compensate for this crews should be attentive to landings in crosswind, avoid last minute pitch-down and a tendency to under-flare. There is a tendency to under-rotate in long body aircraft, which degrades take-off performance; pilots should make smooth accurate rotations avoiding “pilot induced oscillations.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
297	Long aircraft type variant landings with vertical acceleration above 1.5g were more frequent compared to the shorter versions resulting in higher scatter of the landing assessment parameters.	LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual Aircraft Control	Knowledge Application of Procedures/Knowledge Manual Aircraft Control
298	for 1.3% of the landings, the long aircraft type variant had a higher rate of high vertical acceleration landings compared to the shorter type variant. From the data - the probability of a landing > 1.75 g was found to be 0.25 % on long aircraft type variant compared to 0.04 % on shorter versions.	LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual Aircraft Control	Manual Aircraft Control
299	it was noted that the obvious difference in inertia implied that in certain circumstances (such as recovery from a steep approach gradient) more anticipation would be needed in the long aircraft type/variant than the shorter versions	APP LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual Aircraft Control	Manual Aircraft Control Knowledge
302	One of the most interesting results is a strong correlation between high Vz at touchdown and a lack of effective pitch stick input. This is either due to insufficient or late aft input and provides a clear implication that pitch control authority is not in question	LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual Aircraft Control	Manual Aircraft Control SA Application of Procedures/Knowledge
303	Compared to the shorter version, statistically the long aircraft type variant shows: – A slightly steeper approach gradient at the start of the flare – More forward stick input below 150 ft – A shorter time from flare to touchdown	APP LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual Aircraft Control	Manual Aircraft Control SA
304	A dedicated examination of all the hard landings* available in the database confirmed that a majority (60%) of these cases involved a late "Duck Under" (pilot action to steepen the slope at or just below 150 feet AFE to bring the touch down point closer to the threshold), followed by an insufficient flare (too low and/or not enough nose up pitch input) * Landings having a maximum vertical acceleration > 1.75g (Note that this is not the AMM definition of hard landing	APP LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual Aircraft Control Mis A/C State	Manual Aircraft Control SA Application of Procedures/Knowledge
305	There is a need for pilots to better anticipate and monitor the final approach and flare on the long aircraft type variant has become evident.	APP LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual Aircraft Control Mis A/C State	Manual Aircraft Control SA
306	To avoid hard landings, handling recommendations include: - Maintaining a stable slope prior to flare (no "duck under") - Avoidance of under flaring - Avoidance of significant nose down inputs during flare - Crosswind landing reminders - Reminder of pitch monitoring and aircraft pitch geometric	APP LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control Monitor xcheck Surprise	Manual Aircraft Control Mis A/C State Compliance	Manual Aircraft Control SA Communication Application of Procedures/Knowledge
307	– It is recommended to highlight differences to pilots receiving training to operate long aircraft type variant either in a mixed fleet or single fleet environment. These differences can be highlighted within the scope of type rating training and recurrent.	APP LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing issues unstable approach Manual AC Controll Compliance Error Mgt	Crosswind Compliance CRM mis A/C state	Knowledge Application of Procedures/Knowledge Manual Aircraft Control
308	On difficult runways, use of dedicated markings in conjunction with a predetermined Auto-brake setting may increase crew confidence to achieve the proper touchdown point without the need to duck under.	APP LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual Aircraft Control Mis A/C State Compliance	Knowledge Application of Procedures/Knowledge Manual Aircraft Control

Figure 4.2.3.2.1b

4.2.3.2.2 Landing Issues

- Filter Evidence Table for Long Aircraft FDA Study
- Filter Topics [Landing Issues]
    - See Figure 4.2.3.2.2a
    - **Result – Long Body Aircraft Study – Landing Issues**
        - The probability of a landing > 1.75 g was found to be 0.25% on long aircraft type variant compared to 0.04% on shorter versions.

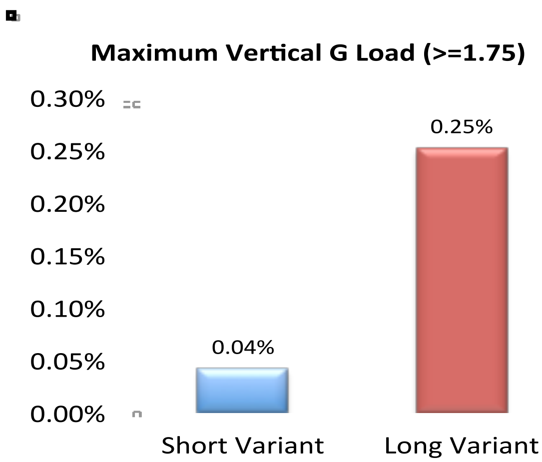

Figure 4.2.3.2.2

        - The difference in inertia implies recovery from a steep approach gradient demands greater anticipation on long body aircraft
        - Compared to shorter versions, long body aircraft show a slightly steeper approach gradient at flare initiation, with greater forward control input below 150 ft and shorter time from flare to touchdown.
        - There is a need for pilots to better anticipate and monitor the final approach and flare on a long body aircraft type.
        - Pilots should maintain a stable slope prior to flare initiation, avoiding the tendency to “duck under” the glideslope.
        - Pilots should avoid “under flaring.”
        - Close attention is required when performing approaches and landing in crosswinds.
    - Summary – Landing events are statistically more likely with long body aircraft, especially with respect to heavy landings. Pilots need to be especially cognizant of not ‘ducking under’ the glideslope. In addition, pilots need to understand the differences in ground speed and momentum as well as perceptual differences both laterally and vertically resulting from the extended length between the main gear and cockpit.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
297	Long aircraft type variant landings with vertical acceleration above 1.5g were more frequent compared to the shorter versions resulting in higher scatter of the landing assessment parameters.	LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual AC Control	Knowledge Application of Procedures/Knowledge Manual AC Control
298	for 1.3% of the landings, the long aircraft type variant had a higher rate of high vertical acceleration landings compared to the shorter type variant. From the data - the probability of a landing > 1.75 g was found to be 0.25 % on long aircraft type variant compared to 0.04 % on shorter versions.	LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual AC Control	Manual AC Control
299	it was noted that the obvious difference in inertia implied that in certain circumstances (such as recovery from a steep approach gradient) more anticipation would be needed in the long aircraft type/variant than the shorter versions	APR LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual AC Control	Manual AC Control knowledge
302	One of the most interesting results is a strong correlation between high Vz at touchdown and a lack of effective pitch stick input. This is either due to insufficient or late aft input.	LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual AC Control	Manual AC Control SA Application of Procedures/Knowledge
303	Compared to the shorter version, statistically the long aircraft type variant shows: – A slightly steeper approach gradient at the start of the flare – More forward stick input below 150 ft – A shorter time from flare to touchdown	APR LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual AC Control	Manual AC Control SA
304	A dedicated examination of all the hard landings* available in the database confirmed that a majority (60%) of these cases involved a late "Duck Under" (pilot action to steepen the slope at or just below 150 feet AFE to bring the touch down point closer to the threshold), followed by an insufficient flare (too low and/or not enough nose up pitch input) * Landings having a maximum vertical acceleration > 1.75g (Note that this is not the AMM definition of hard landing	APR LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual AC Control Mis A/C State	Manual AC Control SA Application of Procedures/Knowledge
305	There is a need for pilots to better anticipate and monitor the final approach and flare on the long aircraft type variant has become evident.	APR LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual AC Control Mis A/C State	Manual AC Control SA
306	To avoid hard landings, handling recommendations include: - Maintaining a stable slope prior to flare (no "duck under") - Avoidance of under flaring - Avoidance of significant nose down inputs during flare - Crosswind landing reminders - Reminder of pitch monitoring and aircraft pitch geometric limits	APR LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control Monitoring Xcheck Surprise	Manual AC Control Mis A/C State Compliance	Manual AC Control SA Communication Application of Procedures/Knowledge
307	It is recommended to highlight differences to pilots receiving training to operate long aircraft type variant either in a mixed fleet or single fleet environment.	APR LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing issues Unstable APP Manual AC Control Compliance Error Mgt	Crosswind Compliance CRM Mis A/C state	Knowledge Application of Procedures/Knowledge Manual AC Control

Figure 4.2.3.2.2a – Landing Issues/EBT FDA

4.2.3.2.3 Crosswind

- Filter Evidence Table for Long Aircraft FDA Study
- Word search [Crosswind]
  - See Figure 4.2.3.2.3
  - **Result – Long Body Aircraft Study – Weather**
    - Avoidance of "duck under" the glideslope.
    - Crosswind landing reminders
  - Summary – In low visibility and/or crosswind conditions common errors such as "duck under" and misalignment with the runway centerline are more critical in long body aircraft.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors
306	To avoid hard landings, handling recommendations include: - Maintaining a stable slope prior to flare (no "duck under") - Avoidance of under flaring - Avoidance of significant nose down inputs during flare - Crosswind landing reminders - Reminder of pitch monitoring and aircraft pitch geometric limits	APR LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control Monitoring Xcheck Surprise	Manual AC Control Mis A/C State Compliance

Figure 4.2.3.2.3 – Crosswind/EBT FDA

4.2.3.2.4 Compliance

- Filter Evidence Table for Long Aircraft FDA Study
- Filter Factors [Compliance]
- Suppress superfluous
  - See Figure 4.2.3.2.4
  - **Result – Long Body Aircraft Study – Compliance**
    - To avoid high "G" landings associated with long body aircraft, it important to follow any specific recommendations provided by the OEM.
    - The phases of flight most affected by the recommendations are TO, APP and LDG.
  - Summary – In long aircraft, following the recommendations of the manufacturer provided in SOP's and training mitigates the tendency toward high "G" landings. Application of take-off procedures is equally important in the prevention of "pilot induced oscillations" during take-off.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Key Words	Training Topics	Factors	Competencies
306	To avoid landings, handling recommendations include: -Maintaining a stable slope prior to flare (no "duck under") -Avoidance of under flaring -Avoidance of significant nose down inputs during flare -Crosswind landing reminders -Reminder of pitch monitoring and aircraft pitch geometric limits	APR LDG	4	4	Long Aircraft FDA Study	Hard Landing	Landing Issues Manual AC Control Monitoring Xcheck Surprise	Manual AC Control Mis A/C State Compliance	Flight Management, Guidance/Automation SA Communication Application of Procedures/Knowledge
307	It is recommended to highlight differences to pilots receiving training to operate long aircraft type variant either in a mixed fleet or single fleet environment. These differences can be highlighted within the scope of type rating training and recurrent.	APR LDG	4	4	Long Aircraft FDA Study	Hard Landing	Landing Issues Unstable APP Manual AC Control Compliance Error Mgt	Crosswind Compliance CRM Mis A/C State	Knowledge Application of Procedures/Knowledge Flight Management Guidance/Automation
308	On difficult runways, use of dedicated markings in conjunction with a predetermined Auto-brake setting may increase crew confidence to achieve the proper touchdown point without the need to duck under.	APR LDG	4	4	Long Aircraft FDA Study	Hard Landing	Landing Issues Manual AC Control	Manual AC Control Mis A/C State Compliance	Knowledge Application of Procedures/Knowledge Flight Management Guidance/Automation
310	Long aircraft with high power tend to have: -Lower rotation rates which could result in degraded TO performance -Require a greater attention to making a smooth rotation to avoid PIO on takeoff.	TO	4	All	Long Aircraft FDA Study	Rotation Technique PIO	Manual AC Control	Mis A/C State Compliance	Flight Management Guidance/Automation SA Application of Procedures/Knowledge

Figure 4.2.3.2.4 – Compliance/EBT FDA

4.2.3.3 A Study of Normal Operational Landing Performance on Subsonic Civil Narrow Body Jet Aircraft during ILS Approaches

4.2.3.3.1 Landing Issues

- Filter Evidence Table NLR
- Filter Topics [Landing Issues]
  - See Figure 4.2.3.3.1
  - **Result – Aircraft during ILS Approaches – Landing Issues**
    - Threshold crossing height has strongest influence on airborne distance over the runway.
    - Speed loss from flare initiation height to touchdown has a significant effect on airborne distance over the runway.
    - Gen 4 jet aircraft have fewer tendencies to over-speed at the runway threshold, compared with other types, due to the use of autothrottle/autothrust during the landing.
    - Autolands have a lower average airborne distance over the runway than manual landings.
  - Summary – FDA statistical analysis on a large sample of Gen 3 and 4 jet aircraft indicated that automation (autoland and autothrottle/autothrust) provide greater touchdown accuracy, with Gen 4 jet aircraft being more accurate than Gen 3 jet aircraft. The two parameters most affecting airborne distance are threshold crossing height and airspeed over-speed at threshold, in that order.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Key Words	Training Topics	Factors	Competencies
188	The influence of the threshold crossing height appears to have the strongest influence on the airborne distance.	LDG	34	All	NLR	Generation Automation Unstable APR/GA	Error Mgt Landing Issues	Compliance Mis A/C State	Application of Procedures/Knowledge Flight Management, Guidance/Automation
189	The speed loss from flare initiation to touchdown has a very significant influence on the airborne distance.	LDG	34	All	NLR	Generation Automation Unstable APR/GA	Error Mgt Landing Issues	Mis A/C State	Manual AC Control
190	The difference in the actual speed and the reference speed over the threshold has a strong influence on the airborne distance.	LDG	34	All	NLR	Generation Automation Unstable APR/GA	Error Mgt Landing Issues	Mis A/C State	Application of Procedures/Knowledge Flight Management, Guidance/Automation
191	The Gen 3 type shows a higher tendency to over speed at the threshold compared to the other types. This is most likely caused by the fact the fly-by-wire aircraft usually fly with the auto thrust (A/THR) engaged during a landing whereas a conventional controlled aircraft with wing mounted engines disengages the A/THR as soon as the auto pilot is disengaged to avoid pitch up tendencies (like on the B737). With A/THR engaged the speed control is more accurate.	LDG	34	34	NLR	Generation Automation Unstable APR/GA	Landing Issues	Mis A/C State	Flight Management, Guidance/Automation
192	The autolands have a lower average airborne distance than manual landings and also show less deviation from the average airborne performance.	LDG	34	34	NLR	Generation Automation Unstable APR/GA	Landing Issues	Mis A/C State	Flight Management, Guidance/Automation

Figure 4.2.3.3.1

4.2.4 Training Data (AQP & ATQP)

4.2.4.1 AQP Study

4.2.4.1.1 Automation

- Filter Evidence Table AQP
- Filter Topic [Automation]
    - See Figure 4.2.4.1.1
    - **Result – AQP Study – Automation**
        - Gen 4 jet has a significantly higher rate of NCGs (non-conforming grades – below company standard) in GND and CRZ phases of flight due to automation issues and international procedures.
        - The descent phase for Gen 3 and Gen 4 jet aircraft has the highest rate of NCGs, automation being a significant area weakness.
    - Summary – Automation is an issue of concern regarding assessments in AQP in both the planning and execution phases of flight. The phases most concerned are CRZ and DES.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Key Words	Training Topics	Factors	Competencies
157	The two flight phases where the GEN IV - TYPE has a significantly higher rate of non-conforming grades are Ground Operations and Cruise, which are preparatory phases. Based on instructor comments, in cruise the high rate is driven by difficulties with international procedures - some problems also related to the use of Automation. For the Ground phase, the instructor comments were not specific enough to determine the types of problems.	GRD CRZ	234	34	AQP	ATQP/AQP Generation Automation phases of flight	Automation	CRM Mis-AFS	Application of Procedures/Knowledge Flight Management Guidance/Automation
165	The descent phase has the highest non-conforming grades. Based on the instructor comments, the three areas of concern are Automation, System Management and Briefings.	DES	234	234	AQP	ATQP/AQP Generation	Automation Compliance	Mis-AFS Mis-Sys	Communication Application of Procedures/Knowledge Flight Management Guidance/Automation

Figure 4.2.4.1.1 – Automation/AQP

4.2.4.1.2 Error Management

- Filter Evidence Table AQP
- Filter Topic [Error management]
  - See Figure 4.2.4.1.2a
  - **Result – AQP Study – Error Management**
    - The largest numbers of errors in all evaluations, both in IQ (Initial Qualification) and in CQ (Continuing Qualification), are policy errors.
    - Policy errors average 50% of the total errors
    - The 2nd ranked error type is procedural.
    - Crews operating Gen 3 jet aircraft show a greater percentage of intentional non-compliance and decision making errors than crews operating Gen 4 jet aircraft. This difference increases as the training cycle progresses. This same phenomenon exists with non-technical skills.

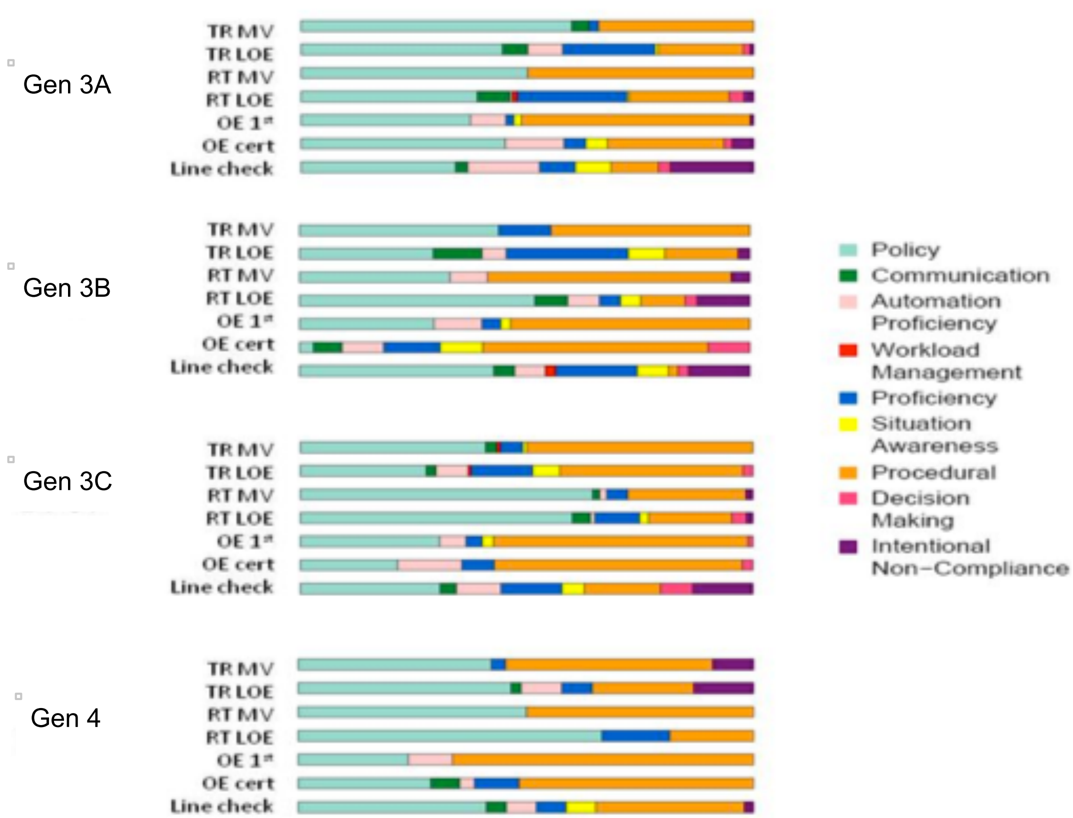

Figure 4.2.4.1.2 – Error Proportionality

  - Summary – In all AQP evaluations, whether type rating courses (IQ) or recurrent training (CQ), policy and procedural error types are ranked 1st and 2nd, accounting for the majority of all errors. Crews operating Gen 3 jet aircraft show a proportionally greater percentage of errors relating to proficiency, situation awareness, non-compliance and decision making when compared with crews operating Gen 4 jets. This trend increases as the training cycle progresses from the type rating to recurrent line checks.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Key Words	Training Topics	Factors	Competencies
166	The biggest error category is Policy. It is equally present for all types and makes about 50% of all errors. The second biggest category is Procedural.	All	234	All	AQP	Competencies Error ATQP/AQP Procedures	Error Mgt	Compliance	Application of Procedures/Knowledge
167	In the OE 1st flight error distribution charts, the Gen III types present errors related to Proficiency and Situational Awareness whle this is not the case for GEN IV - TYPE.	All	234	34	AQP	Competencies Error SA ATQP/AQP Generation	Error Mgt		SA
168	The more the training cycle advances towards the line check, the more the Gen III types present Intentional Non-Compliance and Decision Making errors. This is not the case for GEN IV - TYPE, which on the contrary presents some Intentional Non-Compliance during TR. This difference is noticeable.	All	234	34	AQP	Competencies Error ATQP/AQP Generation Compliance Decision Making	Error Mgt	Compliance	Problem Solving Decision Making Procedures/Knowledge
169	The more the training cycle advances towards the line check, the more the Gen III types present errors related to non-technical skills, compared to the GEN IV - TYPE.	All	234	34	AQP	Competencies Error ATQP/AQP Generation	Error Mgt		Communication SA Leadership and Teamwork Workload Management Problem Solving Decision Making

Figure 4.2.4.1.2a – Error Management/AQP

4.2.4.1.3 Manual Aircraft Control

- Filter Evidence Table AQP
- Filter Topic [Manual Aircraft Control]
  - See Figure 4.2.4.1.3b
  - **Result – AQP Study – Manual Aircraft Control**
    - Gen 4 jet aircraft have best pilot performance results for manual aircraft control maneuvers during type ratings.

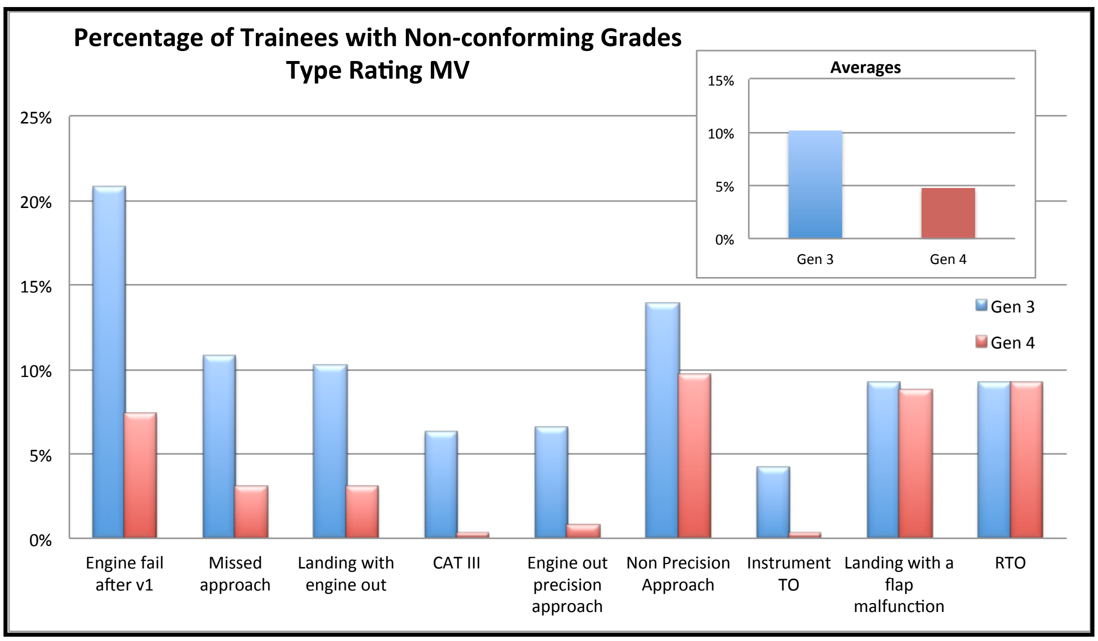

Figure 4.2.4.1.3

- The percentage of NCGs grades for manual aircraft control remains fairly constant from Initial Qualification through to Continuing Qualification especially for Gen 4 jet aircraft. Gen 3 jet aircraft pilot performance improves slightly from Initial to Continuing Qualification but remains consistently poorer than that for Gen 4 jets.

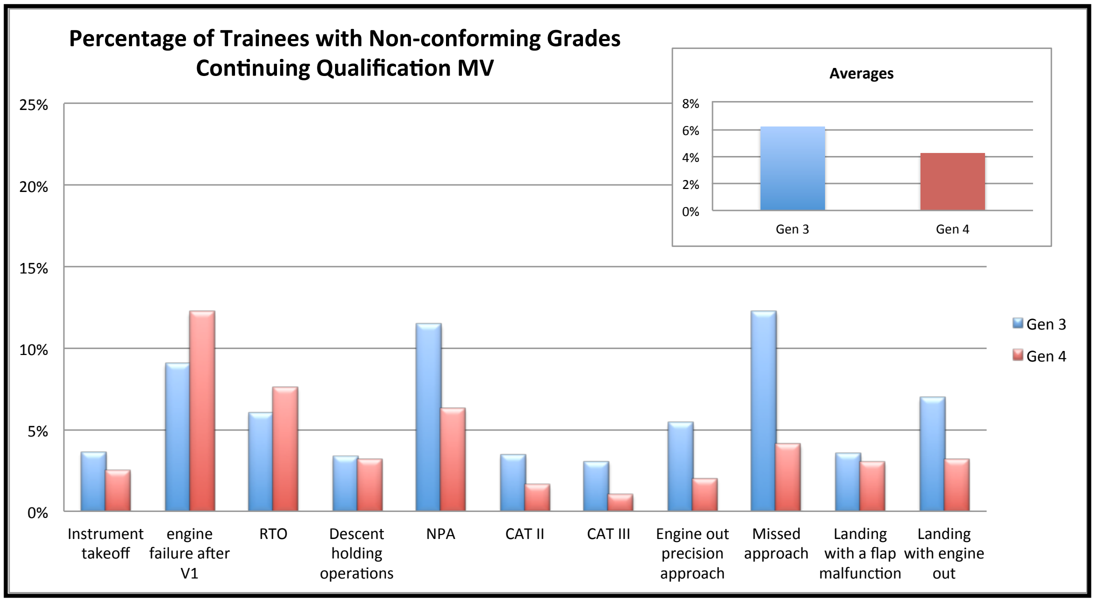

Figure 4.2.4.1.3a

- Summary – Training results from AQP demonstrate that pilots achieve a more rapid mastery of manual aircraft control skills during initial training in Gen 4 jet aircraft. Manual aircraft control skills demonstrated in Gen 3 jet aircraft improve as training progresses, but the assessment level consistently remains below that of the Gen 4 aircraft.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
144	The significant finding is the clear advantage of GenIV-type over the Gen II/III aircraft in Type Rating results.	All	234	34	AQP	ATQP/AQP Generation	Error Mgt Manual AC Control	Mis A/C State Mis-AFS Mis-Sys	All
150	TR/MV validation data indicate that pilots have less difficulty to perform the defined maneuvers in the GEN IV –TYPE (gen.IV) vs. gen III -type – with the exception of the windshear maneuvers.	All	234	34	AQP	ATQP/AQP Generation WX	Manual AC Control	Manual AC Control	Flight Management, Guidance/Automation
151	In the most extreme case (eng failure at V1) the failure rates were 0.208 (Gen III –type) and 0.074 (GEN IV -TYPE) which indicates a significant difference in difficulty.	TO	234	34	AQP	ATQP/AQP Generation	Manual AC Control	Eng Fail Manual AC Control	Flight Management, Guidance/Automation
152	Exceptionally, the only two items in TR/MV where the GEN IV –TYPE proved more difficult were the two windshear items (takeoff and approach). The most extreme case is approach where the failure rates were 0.084 (Gen III -type) and 0.154 (GEN IV -TYPE).	TO APR	234	34	AQP	ATQP/AQP Generation	Manual AC Control	Manual AC Control	Flight Management, Guidance/Automation
162	Overall, the grades in both generations are better than in TR-LOE but for Gen III significantly worse than in OE certification or RT-MV.	All	234	34	AQP	ATQP/AQP Generation	Manual AC Control	Manual AC Control	Flight Management, Guidance/Automation

Figure 4.2.4.1.3b – Manual Aircraft Control/AQP

4.2.4.1.4 Compliance

- Filter Evidence Table AQP
- Filter Topic [Compliance] in Training Topics
  - See Figure 4.2.4.1.4.
  - **Result – AQP Study – Compliance**
    - Instructor comments indicate that non-compliance with international procedures, particularly in CRZ, in addition to non-compliance with navigation procedures, are the most significant issues.
    - The DES phase reveals substantial non-compliance during line checks.
    - The largest error category is non-compliance with company policy, which accounts for 50% of the total errors made by the flight crew.
  - Summary – The biggest problem with NCGs (non-conforming grades) throughout all operational evaluations is non-compliance with airline policy, amounting to 50% of errors committed. In addition, non-compliance with international procedures is also substantial. The flight phase where the crews have the most difficulty in following procedures is DES. Data from international flights show that the CRZ phase has significantly more NCGs than domestic flights.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
157	The two flight phases where the GEN IV –TYPE has a significantly higher rate of non-conforming grades are Ground Operations and Cruise, which are preparatory phases. Based on instructor comments, in cruise the high rate is driven by difficulties with international procedures – some problems also related to the use of Automation. For the Ground phase, the instructor comments were not specific enough to determine the types of problems.	GRD CRZ	234	34	AQP	ATQP/AQP Generation Automation phases of flight	Automation Compliance	CRM Mis-AFS	Application of Procedures/Knowledge Flight Management Guidance/ Automation
159	In the OE cert profiles, the only significant variation across types is the rate for GEN IV –TYPE in cruise, which is around 10% whereas the other types are in the range 2%-3%. Based on instructor comments, the reason for the high GEN IV –TYPE rate is international procedures related to navigation.	CRZ	234	34	AQP	ATQP/AQP Generation phase	Compliance	Compliance	Application of Procedures/Knowledge
165	The descent phase has the highest non-confirming grades. Based on the instructor comments, the three areas of concern are Automation, system Management and briefings. Line check	DES	234	234	AQP	ATQP/AQP Generation Trainability	Automation Compliance	Mis-AFS Mis-Sys	Communication Application of Procedures/Knowledge Flight Management Guidance/Automation
166	The biggest error category is Policy. It is equally present for all types and makes about 50% of all errors. The second biggest category is Procedural.	ALL	234	All	AQP	Competencies Error ATQP/AQP Procedures	Error Mgt Compliance	Compliance	Application of Procedures/Knowledge

Figure 4.2.4.1.4 – Compliance/AQP

4.2.4.1.5 Generational Aspects

- Filter Evidence Table AQP
- Filter Keywords [Generations]
- Suppress superfluous.
  - See Figure 4.2.4.1.5d
  - **Result – AQP Study – Generations**
    - Evaluation data for type ratings shows a marked difference in the rate of NCGs (non-conforming grades) between pilots under training on Gen 4 jet aircraft, and Gen 3 jet aircraft, with the Gen 4 jet pilots demonstrating higher performance.
    - There is a very significant peak in NCGs during the first flight, OE (Operational Evaluation) on all types, the most pronounced being for Gen 4 jet. The negative slope following the peak reflects learning during IOE, and this indicates a training gap; the type-rating course does not sufficiently prepare the crew for line operations.

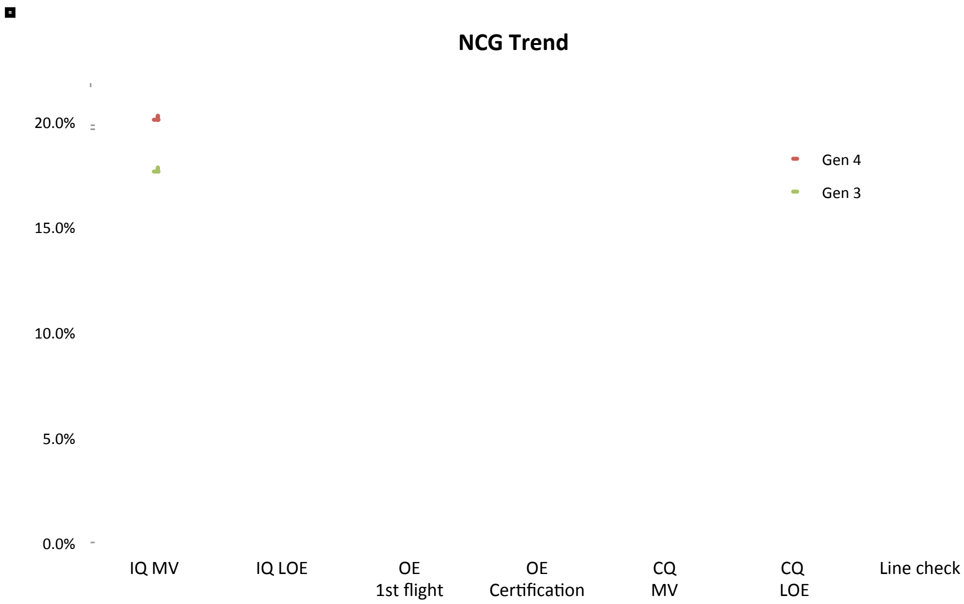

Figure 4.2.4.1.5

- After the first flight (OE) Gen 3 jet NCGs increase during recurrent training and MV (Maneuvers Validation) and forms a secondary peak for the recurrent training Line Orientated Evaluation (LOE), indicating possible skill decay which is not evident in the Gen 4 jet data.
- Gen 4 jet aircraft have a significantly lower rate of NCGs (better pilot performance grades) for flight maneuvers. The most significant difference is seen with “engine failure between V1 and V2”, NCG rates are 21% (Gen 3 jet) and 7.4% (Gen 4 jet).

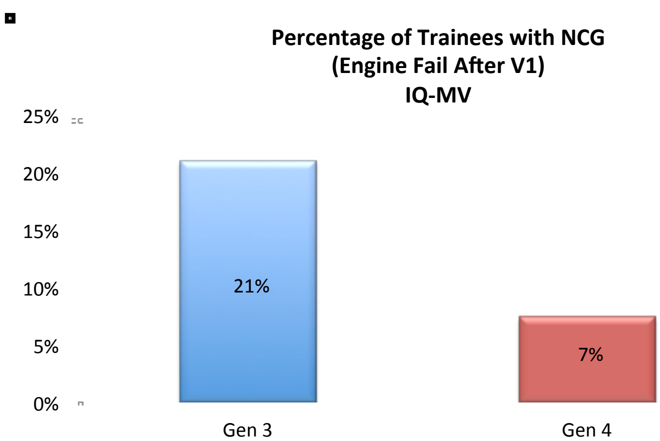

Figure 4.2.4.1.5a

- The first flight (OE) performances vary considerably by type with differences of 20 percentage points, indicating a need to vary training according to type and generation. See Fig 4.2.4.1.5c.
- Two flight phases where Gen 4 jet shows a higher rate of NCGs are GND and CRZ, which are preparatory phases.

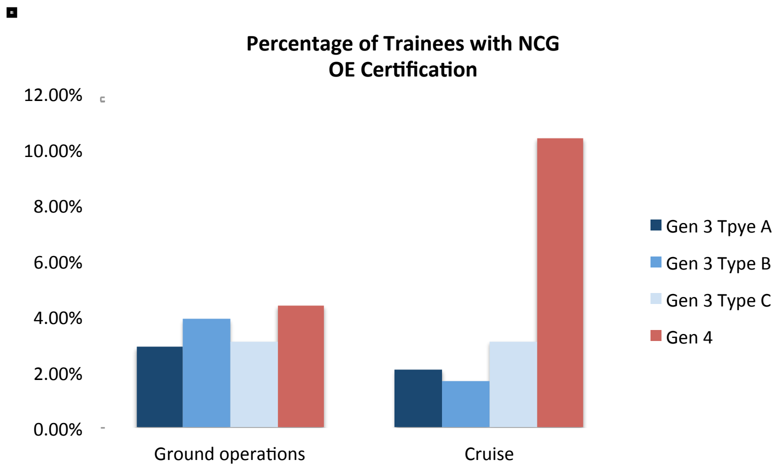

Figure 4.2.4.1.5b

- Gen 4 jet data shows a significantly higher rate of NCG than Gen 3 jet (10% versus 2-3%). This is explained by instructor comments and pertains more to international procedures rather than generational differences.
- The overall advantage of Gen 4 aircraft in NCG rate gradually disappears in recurrent training (CQ) but the grade distribution by phase of flight remains different.

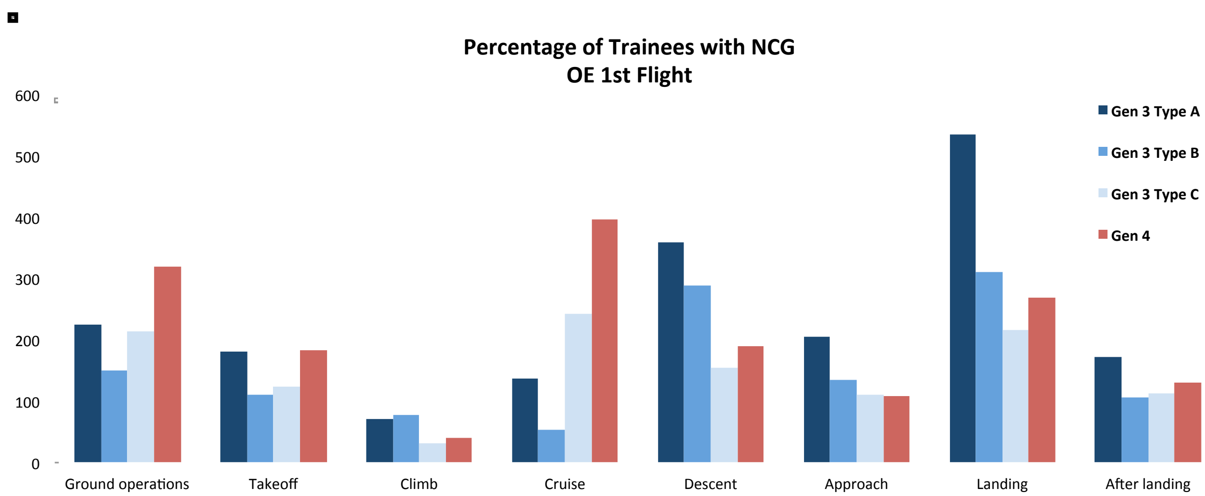

Figure 4.2.4.1.5c

- During line checks, the generational differences are much smaller than in other phases of the training cycle. While the overall rate is lower, some areas remain a problem indicating that recurrent training is not addressing certain issues.

○ Summary – Certain manual aircraft control maneuver skills are demonstrably easier to acquire in Gen 4 jet aircraft, when compared to Gen 3 jets, and performance data indicates a lower level of skill decay. This advantage is minimized in recurrent training (CQ) but training challenges remain different across generations with certain phases of flight, certain issues being more problematic for different types. This clearly makes a case for the regulation of training being adapted to aircraft generation, and for the focus of assessments to be aligned with overall competency, rather than pure maneuver based skills.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
144	The significant finding is the clear advantage of GenIV-type over the Gen III aircraft in Type Rating results.	All	234	34	AQP	ATQP/AQP Generation	Error Mgt Manual AC Control	Mis A/C State Mis-AFS Mis-Sys	All
145	There is a very significant peak in NCG in the 1st flight (OE) on all types. The peak is most pronounced on the GEN IV -TYPE. The *downhill* after the peak reflects the huge amount of learning and training on the aircraft during IOE. Such significant learning at this stage of the training program is not desirable. It reflects that the training does not really prepare the trainees for the real operation	All	234	4	AQP	ATQP/AQP Generation Learning on Line. Trainability			All
146	Post-first flight, the Gen IV –type continues at the same low level as in TR, but the curve for Gen III increases for RT-MV and forms a secondary peak for RT-LOE.	All	234	34	AQP	ATQP/AQP Generation Learing on line. Trainability			All
147	Compared to the significant advantage of the GEN IV –TYPE in TR, this advantage has to a large extent disappeared post-first flight.	All	234	4	AQP	ATQP/AQP Generation Trainability			All
148	Generally, the data supports the notion that generation IV aircraft are easier to train. However, the training challenge on GEN IV –TYPE for windshear scenarios illustrates that training data needs to be analysed to optimize the training program.	All	234	4	AQP	ATQP/AQP Generation WX. Trainability			All
150	Post-first flight, the Gen IV –type continues at the same low level as in TR, but the curve for Gen III increases for RT-MV and forms a secondary peak for RT-LOE.	All	234	43	AQP	ATQP/AQP Generation WX. Trainability	Manual AC Control	Manual AC Control	Flight Management, Guidance/Automation
151	In the most extreme case (eng failure at V1) the failure rates were 0.208 (Gen III –type) and 0.074 (GEN IV -TYPE) which indicates a significant difference in difficulty.	All	234	34	AQP	ATQP/AQP Generation Trainability	Manual AC Control	Eng Fail Manual AC Control	Flight Management, Guidance/Automation
156	The 1st flight *profiles* are still different across all types, with differences exceeding 20 percentage points.	All	234	All	AQP	ATQP/AQP Generation Trainability			All
157	The two flight phases where the GEN IV –TYPE has a significantly higher rate of non-conforming grades are Ground Operations and Cruise, which are preparatory phases. Based on instructor comments, in cruise the high rate is driven by difficulties with international procedures – some problems also related to the use of Automation. For the Ground phase, the instructor comments were not specific enough to determine the types of problems.	GRD CRZ	234	34	AQP	ATQP/AQP Generation Automation generation phases of flight	Automation Compliance	CRM Mis-AFS	Application of Procedures/Knowledge Flight Management Guidance/Automation
159	In the OE cert profiles, the only significant variation across types is the rate for GEN IV –TYPE in cruise, which is around 10% whereas the other types are in the range 2%-3%. Based on instructor comments, the reason for the high GEN IV –TYPE rate is international procedures related to navigation.	CRZ	234	34	AQP	ATQP/AQP Generation phase	Compliance	Compliance	Application of Procedures/Knowledge
160	The advantage of the GEN IV –TYPE has disappeared to the point that the Type A (Gen III) now shows less non-conforming grades (average 3.6%).	All	234	234	AQP	ATQP/AQP Generation Trainability			
161	Even though the overall performance is similar between these two best performing types (Type A (Gen III) and GEN IV -TYPE), their *profiles* are very different, indicating that what needs to be emphasized in training is very different.	All	234	34	AQP	ATQP/AQP Generation Trainability			
162	Overall, the grades in both generations are better than in TR-LOE but for Gen III significantly worse than in OE certification or RT-MV.	All	234	34	AQP	ATQP/AQP Generation Trainability	Manual AC Control	Manual AC Control	Flight Management, Guidance/Automation
163	In RT-LOE, the GEN IV –TYPE performs generally better than the gen III types, but not to the extent it does in TR. The main changes are in ground and approach phases where the advantage of the GEN IV –TYPE has disappeared (otherwise its profile is similar to TRLOE). The GEN IV –TYPE is significantly better than Gen III in takeoff, climb and cruise phases – by a factor of three to one or more.	GRD APR	234	34	AQP	ATQP/AQP Generation Trainability			All
164	At line check, the rates are quite similar for all types. In cruise, descent, approach and landing, the Type A (Gen III) and GEN IV –TYPE both have higher rates of non-confirming grades than the other two types. Paradoxically, these two were the best performers during training. This is an indicator that the initial training performance does not necessarily correlate well with the actual operational performance.	CRZ DES APR LDG	234	234	AQP	ATQP/AQP Generation Trainability			All

Figure 4.2.4.1.5d – Generational Aspects/AQP

4.2.4.1.6 Phase of Flight

- Filter Evidence Table AQP
- Filter Keywords [Generations] combine with
- Word search all columns [phase]
- Suppress superfluous.
  - See Figure 4.2.4.1.6b
  - **Result – AQP Study – Generations**
    - During Initial Qualification (IQ), Gen 4 jet data shows a significantly lower rate of NCGs than Gen 3 jet (the only exception is the slightly better performance after landing phase for one type). The effect is even greater in TO, CLB and CRZ by 1:2 ratio (i.e., 6.4% to 13.3%).

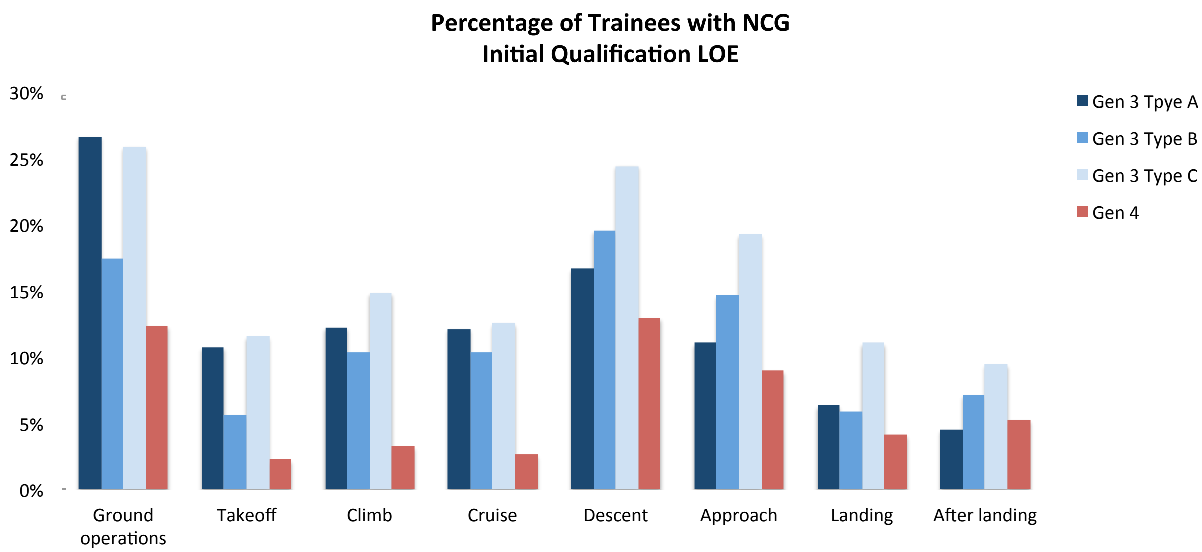

Figure 4.2.4.1.6

- The two flight phases with the greatest rate of NCGs in the IQ Line Orientated Evaluation (LOE) are the GND and DES, which could be considered planning or preparatory phases. (See Fig 4.2.4.1.6)
- In the CQ (Continuing Qualification) LOE Gen 4 jet data indicate a lower rate of NCGs, but not in all phases. In GND and APP the there is little difference. In TO, CLB and CRZ Gen 4 jet data show the lower rates of NCGs, by a factor of 3 to 1.
- During line checks, NCGs are similar for all types. The phases with most predominant NCG rates are CRZ, DES, APP and LDG. Interestingly the Gen 3 jet types with the lowest rates of NCGs during IQ have the highest rate in line checks. This is an indicator that the initial training performance does not correlate well with the actual operational performance for Gen 3 jets.
- In line checks DES has the highest NCGs. Based on the instructor comments, the areas of concern are automation, system management and briefings.

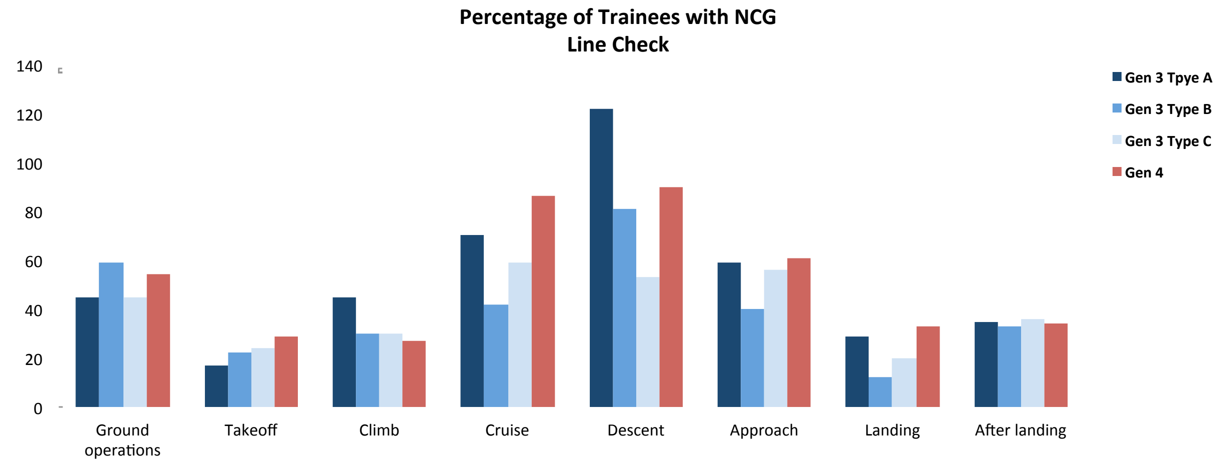

Figure 4.2.4.1.6a

- Summary – During the type-rating course (IQ) the crews of Gen 4 jet aircraft performed considerably better than those operating Gen 3 jet aircraft in all evaluations. For recurrent training (CQ) Gen 4 jet crews maintained this advantage but to a lesser degree, and not in all phases of flight. GND and DES become equally problematic, especially with regard to flight preparation and automation issues. During line checks the Gen 4 jet advantage was less significant, except that there was a marked deterioration with certain Gen 3 jet types. This could indicate a lack of relevancy for the training courses, and consequent preparedness for line operations.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
153	The two flight phases with the highest non-conforming grades in TR/LOE were the Ground and Descent phases, which could be considered planning or preparatory phases.	GRD DES	234	All	AQP	ATQP/AQP Trainability		CRM Mis-AFS	Problem Solving Decision Making Application of Procedures/Knowledge Flight Management Guidance/Automation
154	In every phase the GEN 4 –TYPE (gen 4) has a significantly lower rate of non-conforming grades than types A, B and C (all gen III). (the only exception is the slightly better performance of type A in the After landing phase). The effect is even greater in Takeoff, Climb and Cruise. The average over all flight phases for GEN 4 –TYPE is 6.4% and for the other types 13.3%, in other words the ratio is about 1:2.	TO CLB CRZ ALL	234	34	AQP	ATQP/AQP Generation. Trainability Phase			All
163	In RT-LOE, the GEN IV –TYPE performs generally better than the gen III types, but not to the extent it does in TR. The main changes are in ground and approach phases where the advantage of the GEN IV –TYPE has disappeared (otherwise its profile is similar to TRLOE). The GEN IV –TYPE is significantly better than Gen III in takeoff, climb and cruise phases – by a factor of three to one or more.	GRD APR ALL	234	34	AQP	ATQP/AQP Generation Trainability			All
164	At line check, the rates are quite similar for all types. In cruise, descent, approach and landing, the Type A (Gen III) and GEN IV –TYPE both have higher rates of non-confirming grades than the other two types. Paradoxically, these two were the best performers during training. This is an indicator that the initial training performance does not necessarily correlate well with the actual operational performance.	CRZ DES APR LDG	234	234	AQP	ATQP/AQP Generation Trainability			All
165	The descent phase has the highest non-confirming grades. Based on the instructor comments, the three areas of concern are Automation, system Management and briefings. Line check	DES	234	234	AQP	ATQP/AQP Generation Trainability	Automation Compliance	Mis-AFS Mis-Sys	Communication Application of Procedures/Knowledge Flight Management Guidance/Automation

Figure 4.2.4.1.6b – Phase of Flight/AQP

4.2.4.1.7 AQP – Trainability

- Filter Evidence Table AQP
- Filter result for [Trainability] in Keywords, Suppress superfluous.
- See Figure 4.2.4.1.7b
  - **Result – AQP Study – Trainability**
    - Generally, the data support the notion that pilots acquire certain skills more easily during training in Gen 4 jets, when compared with gen 3 jets
    - In the most significant case, “engine failure between V1 and V2”, the NCGs were: 0.208 (Gen 3) and 0.074 (Gen 4). See Fig 4.2.4.1.5a
    - The two flight phases with the highest NCGs in IQ were the GND and DES phases (preparatory phases). See Figure 4.2.4.1.6
    - The training efficiency is even greater for Gen 4 in TO, CLB and CRZ with Gen 3 aircraft as indicated by significantly higher percentages of NCGs.

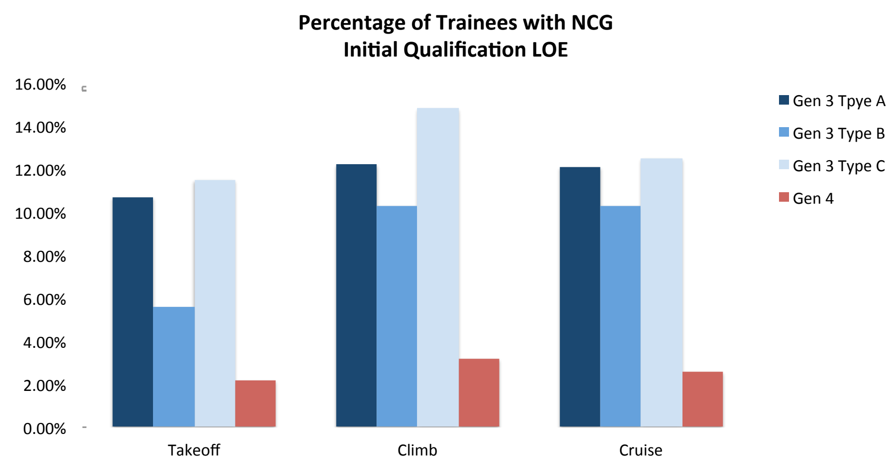

Figure 4.2.4.1.7

- For the line check, the NCG rates are similar for the generations.

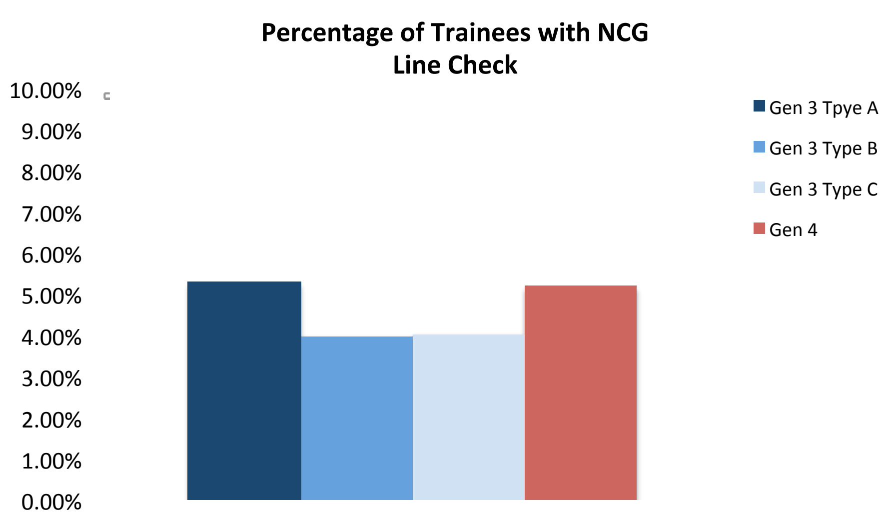

Figure 4.2.4.1.7a

- Paradoxically, the two best performers during IQ turn out to be worst performers in IQ/Line checks indicating that IQ does not well prepare the crews for line operations.
- In the first flight (OE) error distribution charts, Gen 3 jet has a higher rate of errors related to proficiency and situation awareness than Gen 4 jet.
- As the training cycle advances towards the line check, data indicate a higher rate of Gen 3 jet pilot errors related to non-technical skills, when compared to Gen 4 jets.

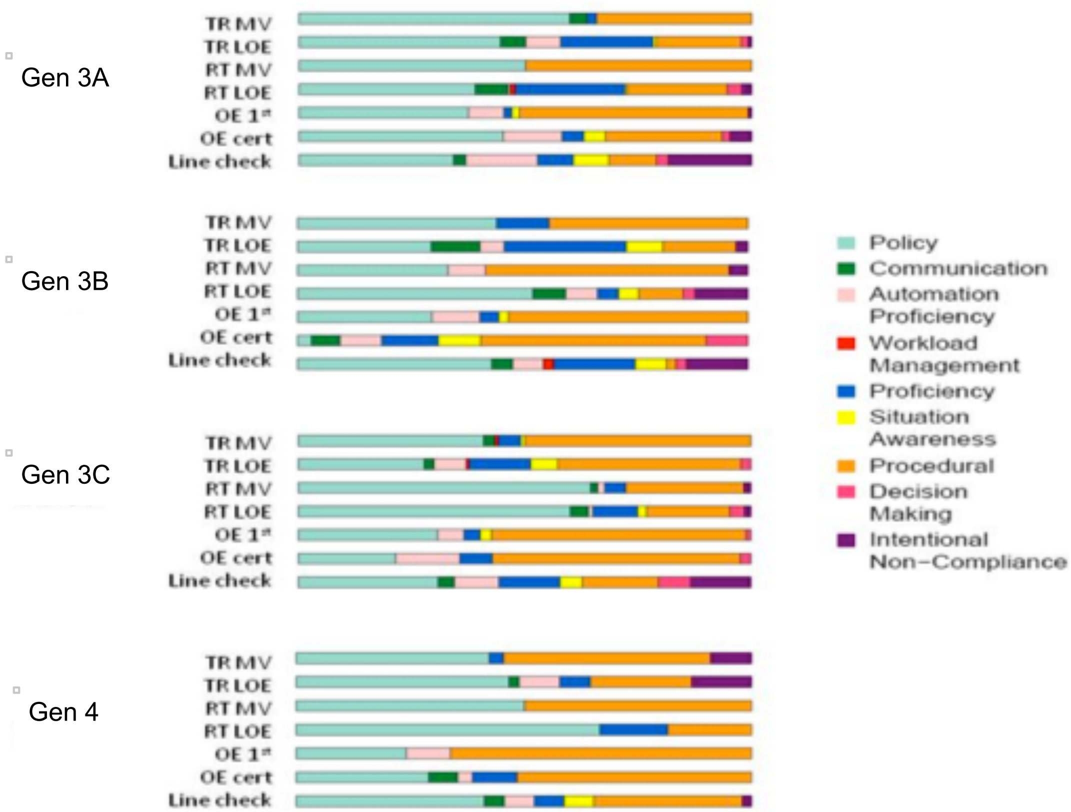

Figure 4.2.4.1.2 (duplicate) – Error Proportionality

- Summary – Training results from AQP demonstrate that pilots achieve a more rapid mastery of certain skills during initial training in Gen 4 jet aircraft. As the training cycle progresses, the difference between Gen3 Jet and Gen4 Jet becomes smaller. Conversely, data show that non-technical skills improve more readily during training for Gen 3 versus Gen 4. In addition, the skills most easily acquired during initial training appear to most problematic during line-checks. The maneuvers showing the highest rate of NCGs in both IQ and CQ is “engine failure between V1 and V2” and this effect is most pronounced in Gen 3 jet, IQ by a factor of more than 3 to 1 (Gen3 Jet versus Gen4 Jet). At the end of type rating course (IQ) Gen3 Jet evaluations show the highest deficiencies in situation awareness and maneuver proficiency. The phases of flight with highest NCGs are GND and DES (preparatory phases) while the phases where training effect is highest are CLB and CRZ.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
145	There is a very significant peak in NCG in the 1st flight (OE) on all types. The peak is most pronounced on the GEN 4 TYPE. The *downhill* after the peak reflects the huge amount of learning and training on the aircraft during IOE. Such significant learning at this stage of the training program is not desirable. It reflects that the training does not really prepare the trainees for the real operation	All	234	4	AQP	ATQP/AQP Generation Learning on Line. Trainability			All
147	Compared to the significant advantage of the GEN 4 –TYPE in TR, this advantage has to a large extent disappeared post-first flight.	All	234	4	AQP	ATQP/AQP Generation Trainability			All
151	In the most extreme case (eng failure at V1) the failure rates were 0.208 (Gen 3 –type) and 0.074 (GEN 4 -TYPE) which indicates a significant difference in difficulty.	TO	234	34	AQP	ATQP/AQP Generation Trainability	Manual AC Control	Eng Fail Manual Aircraft Control	Manual Aircraft Control
153	The two flight phases with the highest non-conforming grades in TR/LOE were the Ground and Descent phases, which could be considered planning or preparatory phases.	GRD DES	234	All	AQP	ATQP/AQP Trainability		CRM Mis-AFS	Problem Solving Decision Making Application of Procedures/Knowledge Flight Management Guidance/Automation
154	In every phase the GEN 4 –TYPE (gen 4) has a significantly lower rate of non-conforming grades than types A, B and C (all gen 3). (the only exception is the slightly better performance of type A in the After landing phase). The effect is even greater in Takeoff, Climb and Cruise. The average over all flight phases for GEN 4 –TYPE is 6.4% and for the other types 13.3%, in other words the ratio is about 1:2.	TO CLB CRZ ALL	234	34	AQP	ATQP/AQP Generation. Trainability Phase			All
155	There is a very significant overall increase in the non-confirming grades compared to LOEs in TR and RT. The values have roughly doubled. This appears to be an indication that the type rating course is not adequately preparing the pilots for IOE.	All	234	All	AQP	ATQP/AQP. Trainability			All
156	The 1st flight *profiles* are still different across all types, with differences exceeding 20 percentage points.	All	234	All	AQP	ATQP/AQP Generation Trainability			All
160	The advantage of the GEN 4 –TYPE has disappeared to the point that the Type A (Gen 3) now shows less non-conforming grades (average 3.6%).	All	234	234	AQP	ATQP/AQP Generation Trainability			
161	Even though the overall performance is similar between these two best performing types (Type A (Gen 3) and GEN 4 -TYPE), their profiles are very different, indicating that what needs to be emphasized in training is very different.	All	234	34	AQP	ATQP/AQP Generation Trainability			
162	Overall, the grades in both generations are better than in TR-LOE but for Gen 3 significantly worse than in OE certification or RT-MV.	All	234	34	AQP	ATQP/AQP Generation Trainability	Manual AC Control	Manual Aircraft Control	Manual Aircraft Control
163	In RT-LOE, the GEN 4 –TYPE performs generally better than the gen 3 types, but not to the extent it does in TR. The main changes are in ground and approach phases where the advantage of the GEN 4 –TYPE has disappeared (otherwise its profile is similar to TRLOE). The GEN 4 –TYPE is significantly better than Gen 3 in takeoff, climb and cruise phases – by a factor of three to one or more.	GRD APP ALL	234	34	AQP	ATQP/AQP Generation Trainability			All
164	At line check, the rates are quite similar for all types. In cruise, descent, approach and landing, the Type A (Gen 3) and GEN 4 –TYPE both have higher rates of non-confirming grades than the other two types. Paradoxically, these two were the best performers during training. This is an indicator that the initial training performance does not necessarily correlate well with the actual operational performance.	CRZ DES APP LDG	234	234	AQP	ATQP/AQP Generation Trainability			All
165	The descent phase has the highest non-confirming grades. Based on the instructor comments, the three areas of concern are Automation, system Management and briefings. Line check	DES	234	234	AQP	ATQP/AQP Generation Trainability	Automation Compliance	Mis-AFS Mis-Sys	Communication Application of Procedures/Knowledge Flight Management Guidance/Automation
169	The more the training cycle advances towards the line check, the more the Gen 3 types present errors related to non-technical skills, compared to the GEN 4 -TYPE	All	234	34	AQP	Competencies Error ATQP/AQP Generation trainability	Error Mgt	CRM	Communication SA Leadership and Teamwork Workload Management Problem Solving Decision Making

Figure 4.2.4.1.7b – Trainability/AQP

4.2.4.2 ATQP Study

4.2.4.2.1 Unstable Approaches

- Filter Evidence Table ATQP
- Filter result for [Unstable Approaches]
  - See Figure 4.2.4.2.1
  - **Result – ATQP Study – Unstable Approaches**
    - During transition from a conventional course to ATQP the operational rate of unstable approaches remained unchanged
    - Approximately 50% of go-arounds resulted from unstable approaches
    - Factors affecting unstable approaches in order of importance are:
      - Accepting constraining ATC clearances
      - Mismanaged visual approaches
      - Mismanaged auto-flight
      - Energy mismanagement
      - Manual aircraft control
  - Summary – Unstable approaches were closely monitored during the transition to ATQP and the rate of unstable approach remained constant, indicating that a major change in training can be performed without increasing risk as far as approaches are concerned. Approximately 50% of go-arounds during this transition resulted from unstable approaches. The causes of unstable approaches in order of importance were poor decisions in accepting ATC clearances, mismanaged visual approaches, mismanaged energy, and poor manual aircraft control.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
91	During ATQP implementation period Stability remaining static at 1000' and 500'.	APR	3 4	34	ATQP airline	Unstable APR	Unstable APP	Mis A/C State	Application of Procedures/Knowledge
92	During ATQP implementation period G/A's from Unstable Appes account for approximately 1/2 of all G/A's	APR GA	3 4	34	ATQP airline	Unstable APR/GA Compliance	Go Arounds Unstable APP	Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge
93	Factors contributing to Unstable Appes are: 1. Accepting ATC vectors or speed control. 2. Turning too tight when visual, 3. FMGS mis-selections, 4. Energy Management 5. Lack of proficiency when manually flying instrument approaches.	APR	3 4	34	ATQP airline	Unstable APR/GA	Unstable APP	ATC Mis A/C State Mis-AFS	SA Problem Solving Decision Making Flight Management Guidance/Automation Manual Aircraft Control

Figure 4.2.4.2.1 – Unstable Approaches/ATQP

4.2.4.2.2 Automation

- Filter Evidence Table ATQP
- Filter Competencies [Automation]
  - See Figure 4.2.4.2.2
  - **Result – ATQP Study – Automation**
    - FMS miss-selection is ranked 3rd as cause for unstable approaches
    - Flight management (auto-flight) is the biggest factor in mismanaged go-arounds.
    - Mismanaged auto-flight is a major factor during engine-out non-precision approaches conducted in training.
    - Mismanaged auto-flight is a major factor in engine-out go-arounds during training.
  - Summary – Mismanaged auto-flight is a major factor, contributing to unstable approaches and go-around errors, both in training and line operations. This remains constant, whether in the all engines operating, or engine-out case.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
93	Factors contributing to Unstable Appes are: 1. Accepting ATC vectors or speed control. 2. Turning too tight when visual, 3. FMGS mis-selections, 4. Energy Management 5. Lack of proficiency when manually flying instrument approaches.	APR	3 4	34	ATQP airline	Unstable APR/GA	Unstable APP	ATC Mis A/C State Mis-AFS	SA Problem Solving Decision Making Flight Management Guidance/Automation Manual Aircraft Control
95	During ATQP implementation period (Missed Approach 1. Approximately 1/10 G/A's failed to comply with SOP's and just over 1/10 G/A's resulted in a flap over speed. 2. There has been no significant change in G/A rates3. Flight Management remains the biggest cause	APR GA	3 4	34	ATQP airline	GA	Go Arounds	Compliance CRM Mis-AFS Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge Flight Management Guidance/Automation
101	vi. Single Engine NPA 1. Just over 1% failed 2. 5% were procedural errors, 3. 2% Automation, 4. 2% situational awareness. 5. 5% were handling errors	APR	3 4	34	ATQP airline	Manual A/C Control Automation	System Malfunction Manual AC Control Automation	Eng Fail Syst mal Compliance CRM Mis-Sys Mis A/C State	SA Problem Solving Decision Making Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control
102	vii. SE Go-Around 1. Approximately 2% failed or only passed after a repeat 2. Of the repeats a. just over 4% were procedural errors, b. just over 4% handling 3. Of the failed a. 2% Automation and a 2% situational awareness. b. Approx 1/3 were procedural errors and ½ handling.	GA	3 4	34	ATQP airline	Manual A/C Control Automation GA	Go Arounds Automation Error Mgt	Eng Fail Compliance CRM Mis-AFS Mis A/C State	SA Application of Procedures/Knowledge Flight Management GuidanceAutomation Manual Aircraft Control
106	2 Eng G/A should be scheduled into recurrent training.	GA	3 4	34	ATQP airline	GA Manual AC Control	Go Arounds	Mis A/C State	Application of Procedures/Knowledge Flight Management GuidanceAutomation Manual Aircraft Control
108	Innovative training solutions should be sought for crew to maintain currency with FMGS and technical / procedural Knowledge.	all	3 4	34	ATQP airline	Automation	Automation	Compliance CRM Mis-AFS	Knowledge Application of Procedures/Knowledge Flight Management GuidanceAutomation

Figure 4.2.4.2.2 – Automation/ATQP

4.2.4.2.3 Error Management

- Filter Evidence Table ATQP
- Filter result for [Automation]
  - See Figure 4.2.4.2.3c
  - **Result – ATQP Study – Error Management**
    - Inadvertent selections occur during operations not routinely practiced, in particular all engines go-around, "engine failure between V1 and V2", engine out non-precision approach, and engine out go-around.
    - By far the two biggest categories of errors were procedural and manual aircraft control. (Note. The data set is predominantly related to Gen 4 jets)

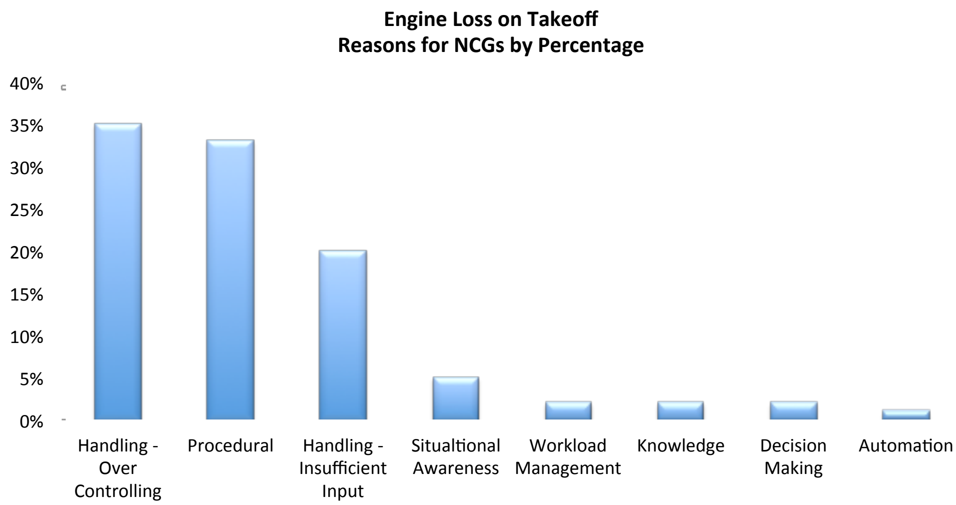

Figure 4.2.4.2.3

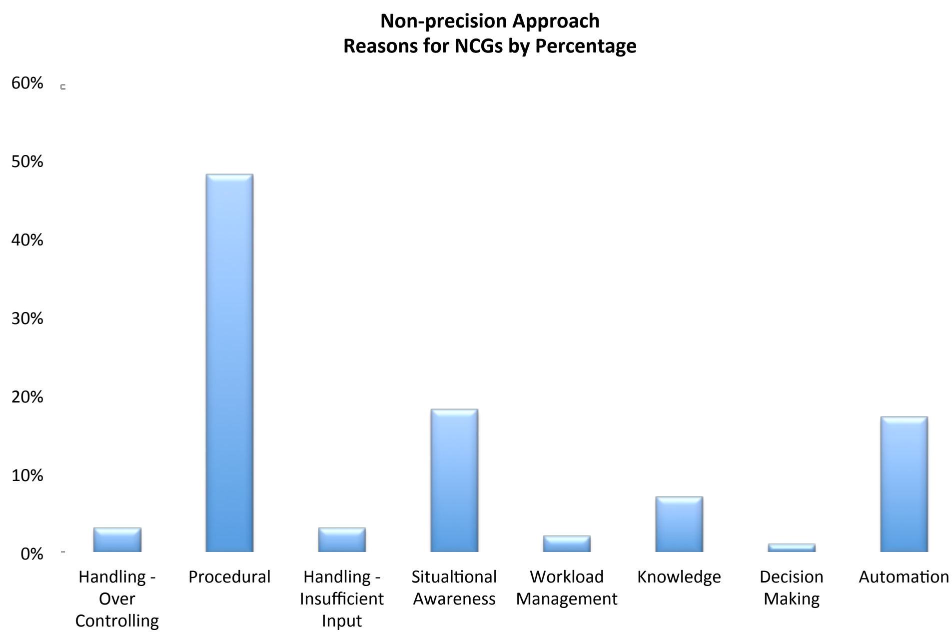

Figure 4.2.4.2.3a

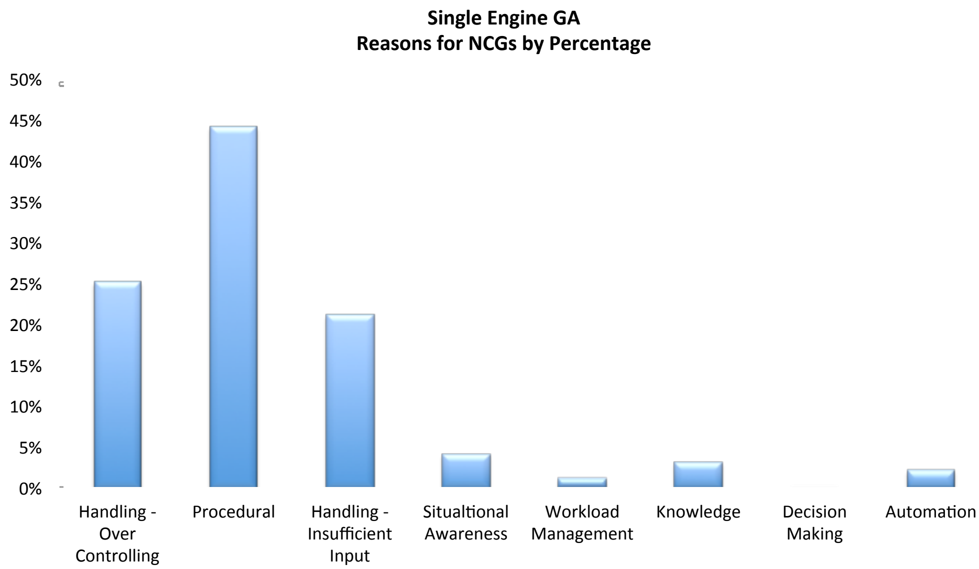

Figure 4.2.4.2.3b

  - Training in descent planning and energy management during the descent and approach, is not adequate.
- Summary – Both operational and training data confirm that crews have problems with maneuvers that are not routinely practiced. Procedural and manual control skills need reinforcement, as these areas are where most of the errors occur. In addition, descent planning and energy management also need specific training.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
98	During ATQP implementation period, inadvertent mis-selections appear to occur most during operations that are not routinely practised	All	3 4	34	ATQP airline	Error	Error Mgt Surprise	Mis-Sys Mis-AFS	Problem Solving Decision Making Application of Procedures/Knowledge
99	During ATQP implementation period, dual Inputs have reduced but need to be carefully monitored.	All	3 4	34	ATQP airline	ManualACControl Monitoring Xchecking	Error Mgt Manual AC Control	Mis-Sys Ops/Type Spec Compliance	SA Manual AC Control Application of Procedures/Knowledge
102	vii. SE Go-Around 1. Approximately 2% failed or only passed after a repeat 2. Of the repeats a. just over 4% were procedural errors, b. just over 4% handling 3. Of the failed a. 2% Automation and a 2% situational awareness. b. Approx 1/3 were procedural errors and ½ handling.	GA	3 4	34	ATQP airline	ManualACControl Automation GA	Go Arounds Automation Error Mgt	Eng Fail Compliance CRM Mis-AFS Mis A/C State	SA Application of Procedures/Knowledge Flight Management Guidance and Automation Manual AC Control
103	ii. Procedures not routinely flown, 2 Eng G/A, EFATO, SE NPA and SE G/A appear to present the greatest difficulty to crew, with procedural error and ManualACControl being the biggest factors.	TO GA	3 4	34	ATQP airline	ManualACControl GA	Go Arounds System Malfunctionf Error Mgt Surprise	Eng Fail Syst mal Compliance CRM Mis A/C State	Application of Procedures/Knowledge Manual AC Control
107	Training in energy Management and environmental descent planning needs to be more specific.	DES	3 4	34	ATQP airline	Unstable APR	Error Mgt Unstable APP	Mis A/C State	Problem Solving Decision Making SA

Figure 4.2.4.2.3c – Error Management/ATQP

4.2.4.2.4 Manual Aircraft Control

- Filter Evidence Table Source ATQP
- Filter Topics for [(Manual)(Man)] combine with
- Filter Competencies [Manual Aircraft Control]
  - See Figure 4.2.4.2.4
  - **Result – ATQP Study – Manual Aircraft Control**
    - Manual control issues remained stable or improved slightly during ATQP implementation
    - Handling problems remain one of the biggest concerns particularly with maneuvers not using the autopilot and not routinely practiced. See Fig 4.2.4.2.3 and Fig 4.2.4.2.3b
  - Summary – The evidence gathered during ATQP shows that manual aircraft control is a problem on modern aircraft and more practice in training is needed.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
94	During ATQP implementation period There has been an increase in the number of fast touchdowns. AND There has been a reduction in landing events	LDG	3 4	34	ATQP airline	ATQP/AQP	Landing Issues	Mis A/C State	Manual AC Control
99	During ATQP implementation period, dual Inputs have reduced but need to be carefully monitored.	All	3 4	34	ATQP airline	Manual AC Control Monitoring Xchecking	Error Mgt Manual AC Control	Mis-Sys Ops/Type Spec Compliance	SA Manual Aircraft Control Application of Procedures/Knowledge
101	vi. Single Engine NPA 1. Just over 1% failed 2. 5% were procedural errors, 3. 2% Automation, 4. 2% situational awareness. 5. 5% were handling errors	APR	3 4	34	ATQP airline	Manual AC Control Automation	System Malfunction Manual AC Control Automation	Eng Fail Syst mal Compliance CRM Mis-Sys Mis A/C State	SA Problem Solving Decision Making Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control
104	Procedures not routinely flown, 2 Eng G/A, EFATO, SE NPA and SE G/A flown with Automation the error rate is reduced.	TO GA	3 4	34	ATQP airline	Manual AC Control Automation GA	Manual AC Control	Workload Distraction	Problem Solving Decision Making Manual Aircraft Control

Figure 4.2.4.2.4 – Manual Aircraft Control/ATQP

4.2.4.2.5 Go-Around

- Filter Evidence Table Source ATQP
- Filter Topics for [GA]
  - See Figure 4.2.4.2.5a
  - **Result – ATQP Study – Go-Around**
    - Mismanaged auto-flight remains the biggest contributory factor in go-arounds
    - 10% of go-arounds failed to comply with SOP.
    - 10% of go-arounds had flap over-speeds.
    - Procedural and handling errors are the biggest factors in engine-out go-arounds.
    - Data indicates that all-engine go-arounds are a problem not dealt with in training.
  - Summary – Mismanagement of auto-flight systems, resulting in unstable approaches, are the biggest cause for go-arounds in operations. A significant percentage of go-arounds result in flap over-speeds and violations of SOP. Engine out go-arounds form part of the regulated training program, but still result in a significant percentage of unacceptable performance grades. Surprise go-arounds do not form part of the training program, and are not well executed by crews in line operations. Consequently, the all-engines go-around from various altitudes is a target for improvement in ATQP.

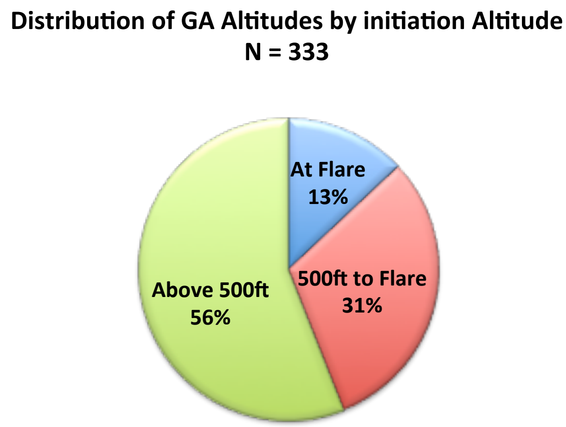

Figure 4.2.4.2.5

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
95	During ATQP implementation period (Missed Approach 1. Approximately 1/10 G/A's failed to comply with SOP's and just over 1/10 G/A's resulted in a flap over speed. 2.There has been no significant change in G/A rates3. Flight Management remains the biggest cause	APR GA	3 4	34	ATQP airline	GA	Go Arounds	Compliance CRM Mis-AFS Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge Flight Management Guidance/ Automation
96	During ATQP implementation period, the number of APProaches not meeting company criteria at 1000 ft has significantly reduced.	APR	3 4	34	ATQP airline	Unstable APR	Go Arounds	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge
102	vii. SE Go-Around 1. Approximately 2% failed or only passed after a repeat 2. Of the repeats a. just over 4% were procedural errors, b. just over 4% handling 3. Of the failed a. 2% Automation and a 2% situational awareness. b. Approx 1/3 were procedural errors and ½ handling.	GA	3 4	34	ATQP airline	Manual AC Control Automation GA	Go Arounds Automation Error Mgt	Eng Fail Compliance CRM Mis-AFS Mis A/C State	SA Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control
103	ii. Procedures not routinely flown, 2 Eng G/A, EFATO, SE NPA and SE G/A appear to present the greatest difficulty to crew, with procedural error and ManualACControl being the biggest factors.	TO GA	3 4	34	ATQP airline	Manual AC Control GA	Go Arounds System Malfunction Error Mgt Surprise	Eng Fail Syst mal Compliance CRM Mis A/C State	Application of Procedures/Knowledge Manual Aircraft Control
106	2 Eng G/A should be scheduled into recurrent training.	GA	3 4	34	ATQP airline	GA Manual AC Control	Go Arounds	Mis A/C State	Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control

Figure 4.2.4.2.5a – Go-Around/ATQP

4.2.4.2.6 System Malfunction

- Filter Evidence Table Source ATQP
- Filter Topics for [Sys Mal]
  - See Figure 4.2.4.2.6
  - **Result – ATQP Study – System Malfunction**
    - "Engine failures between V1 and V2" is the maneuver with the highest rate of unacceptable performance, almost 50% of failures involving procedural errors.
    - The 2nd ranked maneuver in terms of unacceptable performance is the engine-out go-around, with procedural and handling errors most prevalent.
    - The 3rd ranked maneuver in terms of unacceptable performance is the engine out non-precision approach, with procedures and handling being the biggest issues, followed by situation awareness and automation errors.
  - Summary – Procedures and handling associated with maneuvers after engine failure result in the highest rates of unacceptable performance in training. Despite the emphasis in training on engine failure, its effects continue to be problematic to crews in terms of procedures and manual aircraft control.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
100	Engine Failure on TO: 1. Approximately a 1/5 failed or only passed with a repeat 2. Almost ½ were procedural errors. 3. 1% related to Situational awareness or Decisions Making	TO	3 4	3 4	ATQP airline	Manual AC Control	System Malfunction	Eng Fail Syst mal Compliance CRM Mis-Sys	SA Problem Solving Decision Making Application of Procedures/Knowledge
101	vi. Single Engine NPA 1. Just over 1% failed 2. 5% were procedural errors, 3. 2% Automation, 4. 2% situational awareness. 5. 5% were handling errors	APR	3 4	3 4	ATQP airline	Manual AC Control Automation	System Malfunction Manual AC Control Automation	Eng Fail Syst mal Compliance CRM Mis-Sys Mis A/C State	SA Problem Solving Decision Making Application of Procedures/Knowledge Flight Management Guidance/ Automation Manual Aircraft Control
102	vii. SE Go-Around 1. Approximately 2% failed or only passed after a repeat 2. Of the repeats a. just over 4% were procedural errors, b. just over 4% handling 3. Of the failed a. 2% Automation and a 2% situational awareness. b. Approx 1/3 were procedural errors and ½ handling.	GA	3 4	3 4	ATQP airline	Manual AC Control Automation GA	Go Arounds Automation Error Mgt System Malfunction	Eng Fail Compliance CRM Mis-AFS Mis A/C State	SA Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control
103	Procedures not routinely flown, 2 Eng G/A, EFATO, SE NPA and SE G/A appear to present the greatest difficulty to crew, with procedural error and Manual AC Control being the biggest factors.	TO GA	3 4	3 4	ATQP airline	Manual AC Control GA	Go Arounds System Malfunctionf Error Mgt Surprise	Eng Fail Syst mal Compliance CRM Mis A/C State	Application of Procedures/Knowledge Manual Aircraft Control
105	EFATO, SE NPA and SE GA should be retained in the ISS.	TO APR GA	3 4	3 4	ATQP airline	Manual AC Control GA	System Malfunctionf Go Arounds	Eng Fail Syst mal	Manual Aircraft Control

Figure 4.2.4.2.6 – System Malfunction/ATQP

4.2.4.2.7 Surprise

- Filter Evidence Table Source ATQP
- Filter Topics for [Surprise]
- Word search all columns [SA and/or Situation Awareness]
- Suppress superfluous
  - See Figure 4.2.4.2.7
  - **Result – ATQP Study – Surprise**
    - Inadvertent system and automation selections occur when not sufficiently practiced
    - In engine-out situations, situation awareness is an issue resulting in a high rate of unacceptable performance.
    - Surprise all engine go-arounds are a problem and should be incorporated into training situations.
    - Descent and automation planning are problematic and precipitate unanticipated situations.
  - Summary – Surprises need to be incorporated in training particularly with respect to automation and engine failure situations both from a proactive and reactive perspective.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
98	During ATQP implementation period, inadvertent mis-selections appear to occur most during operations that are not routinely practised	All	3 4	34	ATQP airline	Error	Error Mgt Surprise	Mis-Sys Mis-AFS	Problem Solving Decision Making Application of Procedures/Knowledge
101	vi. Single Engine NPA 1. Just over 1% failed 2. 5% were procedural errors, 3. 2% Automation, 4. 2% situational awareness. 5. 5% were handling errors	APR	3 4	34	ATQP airline	Manual AC Control Automation	System Malfunction Manual AC Control Automation	Eng Fail Syst mal Compliance CRM Mis-Sys Mis A/C State	SA Problem Solving Decisio Making Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control
102	vii. SE Go-Around 1. Approximately 2% failed or only passed after a repeat 2. Of the repeats a. just over 4% were procedural errors, b. just over 4% handling 3. Of the failed a. 2% Automation and a 2% situational awareness. b. Approx 1/3 were procedural errors and ½ handling.	GA	3 4	34	ATQP airline	Manual AC Control Automation GA	Go Arounds Automation Error Mgt	Eng Fail Compliance CRM Mis-AFS Mis A/C State	SA Application of Procedures/Knowledge Flight Management and Guidance Manual Aircraft Control
103	ii. Procedures not routinely flown, 2 Eng G/A, EFATO, SE NPA and SE G/A appear to present the greatest difficulty to crew, with procedural error and ManualACControl being the biggest factors.	TO GA	3 4	34	ATQP airline	Manual AC Control GA	Go Arounds System Malfunction Error Mgt Surprise	Eng Fail Syst mal Compliance CRM Mis A/C State	Application of Procedures/Knowledge Manual Aircraft Control
106	2 Eng G/A should be scheduled into recurrent training.	GA	3 4	34	ATQP airline	GA Manual AC Control	Go Arounds Surprise	Mis A/C State	Application of Procedures/Knowledge Flight Management Guidance and Automation Manual Aircraft Control
107	Training in energy Management and environmental descent planning needs to be more specific.	DES	3 4	34	ATQP airline	Unstable APR	Error Mgt Unstable APP	Mis A/C State	Problem Solving Decision Making SA

Figure 4.2.4.2.7 – Surprise/ATQP

4.2.4.2.8 Leadership

- Filter Evidence Table Source ATQP
- Filter Topics for [Leadership] combine with
- Filter Competencies [Decision Making]
- Suppress superfluous
  - See Figure 4.2.4.2.8
  - **Result – ATQP Study – Leadership**
    - Many unstable approaches result from accepting inappropriate ATC clearances.
    - Effective training encourages and enhances leadership, and this is demonstrated by improved leadership and workload management performance grades data in training, in addition to better adherence to company criteria in operations.
  - Summary – ATQP training and operational data provide encouraging results showing that leadership showed remarkable improvement in training as well as better performance on the line.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
93	1. Accepting ATC vectors or speed control. 2.Turning too tight when visual, 3. FMGS mis-selections, 4. Energy Management 5. Lack of proficiency when manually flying instrument	APR	3 4	34	ATQP airline	Unstable APR/GA	Unstable APP	ATC Mis A/C State Mis-AFS	SA Problem Solving Decision Making Flight Management Guidance/Automation Manual Aircraft Control
96	During ATQP implementation period, the number of APProaches not meeting company criteria at 1000 ft has significantly reduced.	APR	3 4	34	ATQP airline	Unstable APR	Go Arounds	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge
109	Data shows that leadership and workload mgt can be taught / learned. 7% to 2%.	All	3 4	34	ATQP airline	Leadership	Leadership	Workload Distraction	Leadership and Teamwork Workload Management

Figure 4.2.4.2.8 – Leadership/ATQP

4.2.4.2.9 Mismanaged Aircraft State

- Filter Evidence Table Source ATQP
- Filter Factors [Mis A/C State]
- Suppress superfluous
  - See Figure 4.2.4.2.9
  - **Result – ATQP Study – Mismanaged Aircraft State**
    - Unstable approaches accounted for 50% of go-arounds in operations
    - 10% of go-arounds resulted in flap over-speed.
    - 10% of go-arounds resulted in SOP violations.
    - Mismanaged autoflight is cited as cause of most problems during go-around execution.
    - Implementation of ATQP reduced the rate of unstable approaches in operations.
    - Training in descent planning and energy management are needed to reduce mismanaged aircraft states.
  - Summary – Studies during ATQP highlight the need for specific training in planning and energy management to reduce mismanaged aircraft states. Go-arounds continue to be mismanaged and 50% of them result from mismanaged approaches. During the go-around, mismanaged autoflight continues to result in mismanaged aircraft states including flap over-speeds and SOP violations.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
92	During ATQP implementation period G/A's from Unstable Appes account for approximately 1/2 of all G/A's	APR GA	3 4	34	ATQP airline	Unstable APR/GA Compliance	Go Arounds Unstable APP	Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge
95	During ATQP implementation period (Missed Approach) 1. Approximately 1/10 G/A's failed to comply with SOP's and just over 1/10 G/A's resulted in a flap over speed. 2. There has been no significant change in G/A rates 3. Flight Management remains the biggest cause	APR GA	3 4	34	ATQP airline	GA	Go Arounds	Compliance CRM Mis-AFS Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge Flight Management Guidance/Automation
96	During ATQP implementation period, the number of APProaches not meeting company criteria at 1000 ft has significantly reduced.	APR	3 4	34	ATQP airline	Unstable APR	Go Arounds	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge
##	Engine Failure on TO: 1. Approx 1/5 failed or only passed with a repeat 2. Almost ½ were procedural errors 3. 1% related to SA or Decisions making.	TO	3 4	34	ATQP airline	ManualACControl	System Malfunction	Eng Fail System Malfunction Compliance CRM Mis-Sys	SA Problem Solving Decision Making Application of Procedures/Knowledge
##	Training in energy Management and environmental descent planning needs to be more specific.	DES	3 4	34	ATQP airline	Unstable APR	Error Mgt Unstable APP	Mis A/C State	Problem Solving Decision Making SA

Figure 4.2.4.2.9 – Mismanaged Aircraft State/ATQP

4.2.4.2.10 Phase of Flight

- Filter Evidence Table Source ATQP
- Suppress Flight Phase [All]
  - See Figure 4.2.4.2.10
  - **Result – ATQP Study – Phases of Flight**
    - Unstable approaches accounted for 50% of go-arounds in operations
    - 10% of go-arounds resulted in flap over-speed.
    - 10% of go-arounds resulted in SOP violations.
    - Mismanaged autoflight is cited as cause of most problems during go-around execution.
    - Implementation of ATQP reduced the rate of unstable approaches in operations.
    - Training in descent planning and energy management is needed to reduce mismanaged aircraft states.
    - The descent phase is often mismanaged.
    - "Engine failures between V1 and V2" is the maneuver with the highest rate of unacceptable performance, 50% of failures involving procedural errors.
  - Summary – APP, TO and GA appear most in the ATQP data as expected in training courses. DES is noted because of planning and energy management problems. Autoflight accounts for most of the problems in the go-around because of the dynamic nature of the phase.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Key Words	Training Topics	Factors	Competencies
92	During ATQP implementation period G/As frm Unstable Apprs acount for approximately 1/2 of all G/As	APR GA	34	34	ATQP airline	Unstable APR/GA Compliance	Go Arounds Unstable APP	Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge
93	Factors contributing to Unstable Apprs are: 1 Accepting ATC vectors or speed control 2 Turning too tight when visual 3 FMGS mis-selections 4 Energy Management 5 Lack of proficiency when manually flying instrument approaches	APR	34	34	ATQP airline	Unstable APR/GA	Unstable APP	ATC Mis A/C State Mis-AFS	SA Problem Solving Decision Making Flight Management Guidance/Automation Manual Aircraft Control
95	During ATQP implementation period (Missed Approach): 1 Approximately 1/10 G/As failed to comply with SOPs and just over 1/10 G/As resulted in a flap over speed 2 There has been no significant change in G/A rates 3 Flight Management remains the biggest cause	APR GA	34	34	ATQP airline	GA	Go-Arounds	Compliance CRM Mis-AFS Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge Flight Management Guidance/Automation
96	During ATQP implementation period, the number of Approaches not meeting company criteria at 1000ft has significantly reduced.	APR	34	34	ATQP airline	Unstable APR	Go-Arounds	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge
100	Engine Failure on TO: 1 Approximately 1/5 failed or only passed with a repeat 2 Almost 1/2 were procedural errors 3 1% related to SA or Decision Making	TO	34	34	ATQP airline	Manual AC Control	System Malfunction	Eng Fail Syst mal Compliance CRM Mis-Sys	SA Problem Solving Decision Making Application of Procedures/Knowledge
101	vi. Single Engine NPA: 1 Ajust over 1% failed 2 5% were procedural errors 3 2% Automation 4 2% Situational Awareness 5 5% were handling errors	APR	34	34	ATQP airline	Manual AC Control Automation	System Malfunction Manual AC Control Automation	Eng Fail Syst mal Compliance CRM Mis-Sys Mis A/C State	SA Problem Solving Decision Making Application of Procedures/Knowledge Flight Management Guidance Automation Manual Aircraft Control
104	Procedures not routinely flown, 2 Eng G/A, EFATO, SE NPA and SE G/A flown with Automation the error rate is reduced.	TO GA	34	34	ATQP airline	Manual AC Control Automation GA	Manual AC Control	Workload Distraction	Problem Solving Decision Making Manual Aircraft Control
107	Training in energy Management and environmental descent planning needs to be more specific.	DES	34	34	ATQP airline	Unstable APR	Error Mgt Unstable APP	Mis A/C State	Problem Solving Decision Making SA

Figure 4.2.4.2.10 – Phase of Flight/ATQP

4.2.4.2.11 Training Effect

- Filter Evidence Table Source ATQP
- Filter Keyword [Training]
  - See Figure 4.2.4.2.11
  - **Result – ATQP Study – Training Effect**
    - Training in dynamic use of autoflight (mode transitions) will improve go-around performance.
    - ATQP type course implementation reduces unstable approaches.
    - Mismanaged autoflight is cited as cause of most problems during go-around execution.
    - Training in descent planning and energy management are needed to reduce mismanaged aircraft states.
    - ATQP data show that leadership can be effectively be improved through training.
    - "Engine failures between V1 and V2" is the maneuver with the highest rate of unacceptable performance, 50% of failures involving procedural errors.
  - Summary – Data gathered from operations and training show that ATQP type training is effective in improving crew performance, reducing the rate of unstable approaches in addition to improving leadership. It also shows a need for specific training dedicated to planning and energy management, as well as autoflight training in highly dynamic and unexpected situations.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
95	During ATQP implementation period (Missed Approach) 1. Approximately 1/10 G/A's failed to comply with SOP's and just over 1/10 G/A's resulted in a flap over speed. 2. There has been no significant change in G/A rates 3. Flight Management remains the biggest cause	APR GA	3 4	34	ATQP airline	GA Training	Go Arounds	Compliance CRM Mis-AFS Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge Flight Management Guidance/Automation
96	During ATQP implementation period, the number of APProaches not meeting company criteria at 1000 ft has significantly reduced.	APR	3 4	34	ATQP airline	Unstable APR Training	Go Arounds	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge
98	During ATQP implementation period, inadvertent mis-selections appear to occur most during operations that are not routinely practised	All	3 4	34	ATQP airline	Error management Training	Error Mgt Surprise	Mis-Sys Mis-AFS	Problem Solving Decision Making Application of Procedures/Knowledge
##	Procedures not routinely flown, 2 Eng G/A, EFATO, SE NPA and SE G/A flown with Automation the error rate is reduced.	TO GA	3 4	34	ATQP airline	Manual AC Control Automation GA Training	Manual AC Control	Workload Distraction	Problem Solving Decision Making Manual Aircraft Control
##	Training in energy Management and environmental descent planning needs to be more specific.	DES	3 4	34	ATQP airline	Unstable APR Training	Error Mgt Unstable APP	Mis A/C State	Problem Solving Decision Making SA
##	Data shows that leadership and workload mgt can be taught / learned. 7% to 2%.	All	3 4	34	ATQP airline	Leadership Training	Leadership	Workload Distraction	Leadership and Teamwork Workload Management

Figure 4.2.4.2.11 – Training Effect/ATQP

4.2.5 Pilot Survey

4.2.5.1 Unstable Approaches

- Filter Evidence Table Pilot Survey
- Filter Topics [Unstable Approach]
  - See Figure 4.2.5.1
  - **Result – Pilot Survey – Unstable Approach**
    - The major reason pilots do not execute go-arounds from unstable approaches is that they believe that it is safe to land. [82%].
    - 37% of respondents admit to a psychological barrier, as go-arounds are rare. This is a self-perpetuating effect.
    - 35% of respondents cite operational inconvenience while 24% admit that a go-around is professionally embarrassing.
    - 17% of respondents admit to being unfamiliar with the SOP criteria for stable approaches.
    - According to the survey results, unstable approach rates are less than 5%. This is consistent with LOSA and FDA results.
  - Summary – The pilot survey shows that unstable approaches are a consistent problem, with rates similar to those from LOSA and FDA data. The fact that pilots believe that they can and in most case do make a successful landing when unstable reinforces the continuation of this problem. (82% cite belief that landing can be safely made even though approach is not stable.) Other reasons that pilots continue to land are that they admit to a psychological barrier inhibiting a go-around (37%); it is operationally inconvenient (35%); it is professionally embarrassing (24%); 17% admit that they are unfamiliar with the stable approach criteria and others simply do not want to write the mandatory report. From this information it is clear that there are issues of knowledge, skills and particularly attitudes that foster an unstable approach culture, which needs to be treated on several levels, one certainly being training.

E ref	Evidence Statement	Flight Phas	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
257	Neither pilot suggesting a go-around implies pilots are making it work by applying judgment.	APR	234	All	Survey		Go Arounds Unstable APP	Compliance CRM Mis A/C State	Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
258	Reasons pilots give for not going-around from an Unstable App: 1. Pilot judgment that landing is still safe even though the approach is unstable (82%) 2. There is a psychological barrier because go-arounds are rare (37%) 3. Operational inconvenience (35%) 4. Embarrassment (24%) 5. Unfamiliar with criteria (17%) 6. Mandates a report	APR LDG GA	234	All	Survey	GA	Go Arounds Leadership Unstable APP	Compliance CRM Mis A/C State	Knowledge Flight Management Guidance/Automation Problem Solving Decision Making Application of Procedures/Knowledge Leadership and Teamwork
268	Unstalble approach deviations are infrequent but consistent	ALL	234	All	Survey	Unstable APR/GA Error	Unstable APP	Mis A/C State	SA Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
269	Unstable approach rate calculated from Pilot Survey Reponse is consistent with LOSA and FDA rates and Survey.	APR	234	All	Survey	Unstable APR	Unstable APP	Mis A/C State	All

Figure 4.2.5.1 – Unstable Approaches/Pilot Survey

4.2.5.2 Automation

- Filter Evidence Table Pilot Survey
- Filter Topics [Automation]
  - See Figure 4.2.5.2b
  - **Result – Pilot Survey – Automation**
    - Pilots were asked about whether they had difficulty on type after initial training. They responded accordingly:
      - 25% felt prepared
      - 14% had one encounter where they felt unprepared
      - 61% had multiple encounters where they felt unprepared.

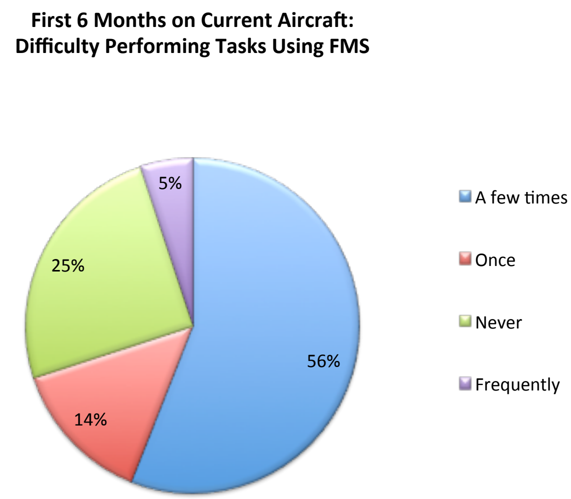

Figure 4.2.5.2

- Only about 50% felt the FMS training adequate during initial training.
- Only 15% felt comfortable operating the FMS after the type rating course.
- 62% felt that operational training of the FMS was insufficient, the acquisition of operational capability and comfort with the FMS typically being achieved only after 1 year of line experience.

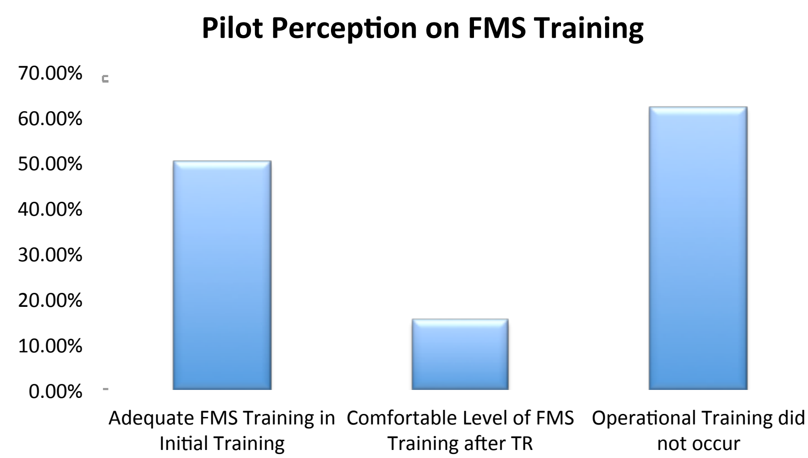

Figure 4.2.5.2a

- When surveying pilots regarding how FMS training could be improved, the majority felt that automation surprises were the most important followed by hands on use in operational situations.
- One third felt that training needed to be improved in transitioning between the various modes of autoflight.
- The only part of automation training not heavily criticized was the functional aspect, such as basic knowledge of the system and programming.
- An analysis of survey comments ranked flight management 3rd in pilot discomfort in line operations

- Summary – The pilot survey was heavily critical of automation training during the initial type rating. Only 25% of the pilots felt prepared to utilize the automation when released to line operations. In reality 61% had multiple encounters on the line during their first 6 months of flying where they reported being involved in uncomfortable situations. Over 60% felt that the operational aspect of FMS training was missing during training requiring them to learn to use the system effectively during the first year after training. When asked how the training could be improved, the majority felt that automation surprises was the most important issue followed by hands on use in operational situations; while about a third recommended better training in transitioning between levels. The prevailing sentiment was that the operational aspect of the FMS was seriously lacking in training, the focus being on the functional, such as basic knowledge and programming.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
246	Difficulty with Automation in first 6 mos on type • 25% were prepared • 14% had one encounter • 61% had multiple encounters	All	234	34	Survey	Automation	Automation Surprise	Mis-AFS	Flight Management Guidance/Automation Knowledge
247	• 42 % of the Pilots believe that the training of the FMS on the type they are currently flying needs to be improved • Only 51% believed it was adequate • 32% believed it was minimal	All	234	34	Survey	Automation	Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge
248	Only 15% of pilots felt "comfortable" operating the FMS After type rating course, 41% acquired comfort after 3 months of operation 21% acquired comfort after 6 to 12 months of operation	All	234	34	Survey	Automation	Automation	Mis-AFS	Flight Managemen Guidance/Automation Knowledge
249	Distribution of learning the operational use of the FMS : • In training: 38% • On the line: 42% • Self study: 20%	All	234	34	Survey	Automation	Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge
250	62% acquired comfort during 3-12 months of line experience. The results suggest that comfort in using the FMS develops over time with 3 months of line experience being the critical learning period for the respondents followed by 6 months, then one year.	All	234	34	Survey		Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge
251	The results suggest that 41% of the respondents felt comfortable operating the FMS after completion of their initial operating experience (IOE). The remaining 59% acquired comfort during the 3 to 12 month period following completion of training	All	234	34	Survey		Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge
252	Pilots often report that the learning of the flight management system (FMS) occurs over time. FMS learning on the line—42%. • FMS learning from training—38%. • FMS learning through self---study—20%.	All	234	34	Survey		Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge
253	Areas where FMS training can be improved in order of importance per surveyed pilot opinion: 1. Automation surprises - 57.1% 2. Hands on use in the operational situation – 52% 3. Transitions between modes – 32.8% 4. Basic Knowledge of the system – 26.7% 5. Programming – 21%	All	234	34	Survey	Automation Criticality	Automation Surprise	Mis-AFS	Knowledge Flight Management Guidance/Automation Problem Solving Decision Making
277	Training needs (per analyzed survey comments) in terms of pilot-operational discomfort by order of priority: 1. Adverse weather 30% 2. Crew Resource Management 23% 3. Non-normal checklists 16% 3. Flight management 15% 4. Airplane handling 13% 5. Systems 12% 6. Maneuvers 10%	All	234	All	Survey	Criticality	WX Automation Man A/C Ctl	Syst mal CRM Adverse WX Manual AC Control Mis AFS	All

Figure 4.2.5.2b – Automation/Pilot Survey

4.2.5.3 Error Management

- Filter Evidence Table Pilot Survey
- Filtered Topic [Error Mgt] combined with
- Filtered results Keywords [MonitorXchk]
- Suppress superfluous
  - See Figure 4.2.5.3b
  - **Result – Pilot Survey – Error Management**
    - Over 90% of pilots believe that detecting and managing errors is the most effective strategy concerning errors in the cockpit.
    - When asked, most pilots responded that monitoring and crosschecking is taught in training.
    - Survey shows that monitoring and crosschecking is poorest in the CLB phase because of complacency (48%) and too many secondary duties (30%).

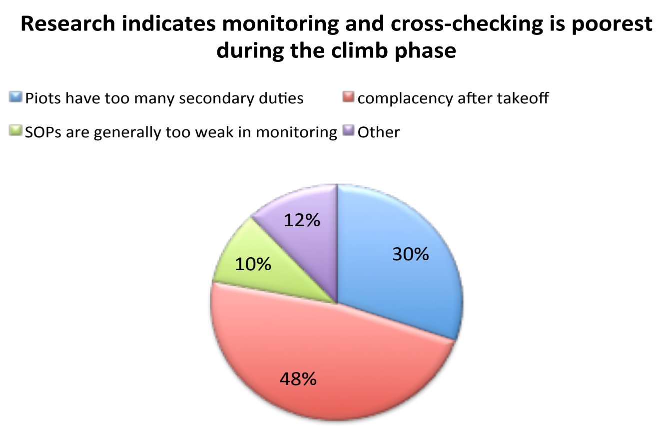

Figure 4.2.5.3

- Noncompliance is major problem in error management:
  - 21% of pilots admit to call out deviations on every flight.
  - 18% admit to checklist deviations frequently while 13% admit to deviations that are intentional.
- The level of assertiveness seems to be related to the level of the resulting intervention. Routine issues such as identifying a deviation in the flight path or proposing a checklist occur at a high percentage of the time while demanding a GA in an appropriate situation is considerably less likely to occur.

Response Categories	Distribution
Tell the pilot flying about a deviation	92%
Take control from the pilot flying	49%
Propose a checklist if the pilot flying delays asking for it	91%
Propose a go-around during an unstable approach	83%
Verbally demand a go-around if you think it is required	80%

Figure 4.2.5.3a

- Summary – Almost all pilots believe that the most important strategy in error management is monitoring and crosschecking and that it is emphasized most of the time in training and taught explicitly about half of the time. There are, however, problems in error management that are not so well addressed. Non-compliance with procedures is too high, for example 21% of pilots admit to call out deviations on virtually every flight; cross checking is particularly bad in the CLB phase because of complacency and too many secondary duties. Intentional non-compliance on a fairly regular basis was reported by 13% of those surveyed. The issue of assertiveness was questioned and while the monitoring pilot almost always speaks up if there is a flight path deviation (90%), but less than half of the respondents (49%) reported that they would be willing to take control from the flying pilot.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
259	Pilot response to the question of whether monitoring and cross checking is taught in training: • 47% explicitly • 34% include it implicitly • 15% marginally • 4% not at all	All	234	All	Survey	MonitorXchk	Monitoring Xcheck	CRM	SA Application of Procedures/Knowledge
261	Survey implies that pilots believe that monitoring and cross-checking is the poorest during the CLIMB phase because of complanency (57%) and too many secondary duties (36%).	All	234	All	Survey	MonitorXchk	Monitoring Xcheck	CRM Workload Distraction	SA Application of Procedures/Knowledge Workload Management
262	90% of surveyed pilots believe that detecting and managiung errors is the most effective strategy concerning errors on the flight deck	All	234	All	Survey	Error Mgt	Error Mgt Monitoring Xcheck	CRM	SA Problem Solving Decision Making Knowledge
263	More than 2/3 of pilots report that they get a chance to practice approach briefings during training	CRZ APR	234	All	Survey	Error Mgt	Error Mgt	CRM	SA Application of Procedures/Knowledge Workload Management
266	18% if pilots admit to deviating from checklists frequently	All	234	All	Survey	Error Mgt Compliance	Error Mgt Leadership	Compliance CRM	Application of Procedures/Knowledge
267	Approximately 21% of the pilot respondents admit to call out deviations on virtually every flight. Approximately 28% of the pilot respondents admit to call out deviation on about every 10 flights.	All	234	All	Survey	Error Mgt Compliance	Error Mgt	Compliance CRM Workload Distraction	Leadership and Teamwork Application of Procedures/Knowledge
312	Pilots report high levels of assertiveness in 4 of 5 categories, with taking control from the pilot flying registering the lowest at 49%. The level of assertiveness appears to be linked to the level of resulting intervention. Tasks such as identifying a deviation (92%) or proposing a checklist (91%) are more likely to be asserted than tasks such as proposing a GA (83%) or demanding a GA (80%).	APR LDG GA	All	All	Survey	GA Descision Making Assertiveness	Leadership Error Mgt Monitoring Xcheck Go Arounds	Compliance CRM	Communication Leadership and Teamwork Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
314	Most pilots (93%) believe detecting and managing errors is the most effective strategy for error management (Figure). A small percentage of pilots (7%) believe that errors should not be committed.	All	All	All	Survey	MonitoringXchecking Error Mgt	Monitoring Xcheck		Leadership and Teamwork Application of Procedures/Knowledge
316	Intentional deviations from checklists occurred a reported every ten flights by 13% of the respondents, a few times a year by 30% of the respondents, and once a year by 36% of the respondents. Very few (4%) reported a deviation on every flight. Checklist deviations occurring at this high of a rate suggest other factors may be involved not related to compliance.	All	All	All	Survey	Compliance Error Mgt	Error Mgt Leadership	Compliance CRM	Application of Procedures/Knowledge

Figure 4.2.5.3b – Error Management/Pilot Survey

4.2.5.4 Manual Aircraft Control

- Filter Evidence Table Pilot Survey
- Filtered result for Topics [Man A/C Ctl]
  - See Figure 4.2.5.4a
  - **Result – Pilot Survey – Manual A/C Control**
    - Aircraft handling ranked 5th (13%) and maneuver training ranked 7th (10%) in the comments regarding training needs.

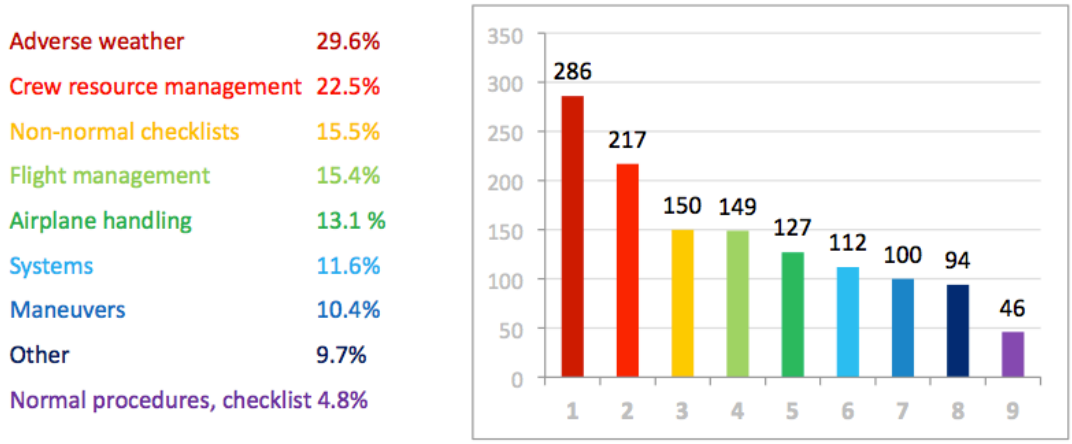

Figure 4.2.5.4 – Training Needs per Pilot Survey

  - Summary – The pilots were allowed to make whatever comments on any training subject and these comments were subsequently analyzed and added to the results from the formal survey questions. There were a significant number of comments on training needs and these needs were prioritized according to the analysis of the comments. Two categories referred to manual aircraft control, manual handling and maneuvers. Together they indicated that pilots feel quite strongly that manual aircraft control is a high priority item in training.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
277	Training needs (per analyzed survey comments) in terms of pilot-operational discomfort by order of priority: 1. Adverse weather 30% 2. Crew Resource Management 23% 3. Non-normal checklists 16% 4. Flight management 15% 5. Airplane handling 13% 6. Systems 12% 7. Maneuvers 10%	All	234	All	Survey	Criticality	WX Automation Man A/C Control	Syst mal CRM Adverse WX Manual AC Control Mis AFS	All

Figure 4.2.5.4a – Manual Aircraft Control/Pilot Survey

4.2.5.5 Go Around

- Filter Evidence Table Pilot Survey
- Filter Topic [GA]
  - See Figure 4.2.5.5
  - **Result – Pilot Survey – Go-Around**
    - In over 70% of the cases where a go-around should have been performed neither pilot even suggested a go around.
    - When a go-around was suggested by the PM, in 30% of the cases the PF continued to land; in most of these cases the PF was the captain.
    - The reasons that pilots gave in the survey for not going around in order of importance are:
      - Pilot judged landing would be safe (82%).
      - Psychological barrier because go-around's are rare (37%).
      - Operationally inconvenient (35%).
      - Embarrassing (24%).
      - Not familiar with SOP criteria requiring a go-around (17%).
      - Mandates a report (10%).
    - While pilots tend to report high levels of assertiveness in the survey, taking over control in a situation such as when the PF does not go-around appropriately is judged the least likely to occur.
  - Summary – The survey shows as pilots readily admit that they are not going around per the airline SOP. The reason most often cited is a feeling that the landing can be successful despite the unstable condition. In the majority of the cases the prospect of a go-around is not discussed during an unstable approach. Pilots report a psychological barrier to performing a go-around.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
254	In cases where Go-arounds should have been performed: • 71% of the cases neither pilot suggested a go-around	All	234	All	Survey	GA	Go Arounds Leadership Compliance	Compliance CRM Mis A/C State	Flight Management Guidance/Automation Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
255	In almost 30% of the cases when a Go-around was suggested the other pilot disagreed (Influenced by rank)	APR	234	All	Survey		Go Arounds Leadership	Compliance CRM Mis A/C State	Problem Solvin Decision Making Knowledge Application of Procedures/Knowledge
256	Psychological barriers to a go around suggests more practice in training may be beneficial, especially for all engine scenarios	APR	234	All	Survey	Criticality	Go Arounds Leadership	Compliance CRM Mis A/C State	All
257	Neither pilot suggesting a go-around implies pilots are making it work by applying judgment.	APR	234	All	Survey		Go Arounds Unstable APP	Compliance CRM	Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
258	Reasons pilots give for not going-around from an Unstable App: 1. Pilot judgment that landing is still safe even though the approach is unstable (82%) 2. There is a psychological barrier because go-arounds are rare (37%) 3. Operational inconvenience (35%) 4. Embarrassment (24%) 5. Unfamiliar with criteria (17%) 6. Mandates a report	APR LDG GA	234	All	Survey	GA Descision making Complaince	Go Arounds Leadership Unstable APP	Compliance CRM Mis A/C State	Flight Management Guidance/Automation Problem Solving Decision Making Knowledge Application of Procedures/Knowledge Leadership and Teamwork
311	Go-Around Maneuvers: 1. I suggested a go-around, but the other pilot disagreed (20%). 2. The other pilot suggested a go-around, but I disagreed (8%). 3. Neither pilot suggested a go-around (72%).	APR LDG GA	All	All	Survey	GA Descision making Compliance	Go Arounds Surprise	Compliance CRM	Communication Leadership
312	Pilots report high levels of assertiveness in 4 of the 5 categories, with taking control from the pilot flying registering the lowest at 49%. The level of assertiveness appears to be linked to the level of resulting intervention. Tasks such as identifying a deviation (92%) or proposing a checklist (91%) are more likely to be asserted than tasks such as proposing a GA (83%) or demanding a GA (80%).	APR LDG GA	All	All	Survey	GA Descision making Assertiveness	Leadership Error Mgt MonitorXcheck Go Arounds	Compliance CRM	Communication Leadership Problem Solving Decision Making Knowledge Application of Procedures/Knowledge

Figure 4.2.5.5 – Go Around/Pilot Survey

4.2.5.6 Weather

- Filter Evidence Table Pilot Survey
- Filter Topic [WX]
  - See Figure 4.2.5.6
  - **Result – Pilot Survey – WX**
    - In the analysis of training needs conducted from the voluntary comments by the pilots, WX ranked as the number 1 training need (30% of the comments). (See Fig 4.2.5.4)
  - Summary – The survey showed that in the opinion of the pilots, WX is the most important training need. This result came from the analysis of voluntary comments made by the pilots.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
277	Training needs (per analyzed survey comments) in terms of pilot-operational discomfort by order of priority: 1. Adverse weather 30% 2. Crew Resource Management 23% 3. Non-normal checklists 16% 4. Flight management 15% 5. Airplane handling 13% 6. Systems 12% 7. Maneuvers 10%	All	234	All	Survey	Criticality	WX Automation Manual AC Control	System Malfunction CRM Adverse WX Manual AC Control Mis AFS	All

Figure 4.2.5.6 – Weather/Pilot Survey

4.2.5.7 System Malfunction

- Filter Evidence Table Pilot Survey
- Filter Factor [Sys Mal]
  - See Figure 4.2.5.6
  - **Result – Pilot Survey – Sys Mal**
    - In the analysis of training needs conducted from the voluntary comments by the pilots, Non-Normal checklists for system malfunctions ranked as the number 3 training need (16% of the comments). (See Graphic 4.2.5.4)
  - Summary – The survey showed that in the opinion of the pilots, Sys Mal is an important training need in terms of the non-normal checklists (ranked 3rd). This result came from the analysis of voluntary comments made by the pilots.

4.2.5.8 Surprise

- Filter Evidence Table Pilot Survey
- Filter Topic [Surprise]
  - See Figure 4.2.5.8b
  - **Result – Pilot Survey – Surprise**
    - 75% of the survey respondents said that they had one or more FMS encounters in their first six months for which they were unprepared.

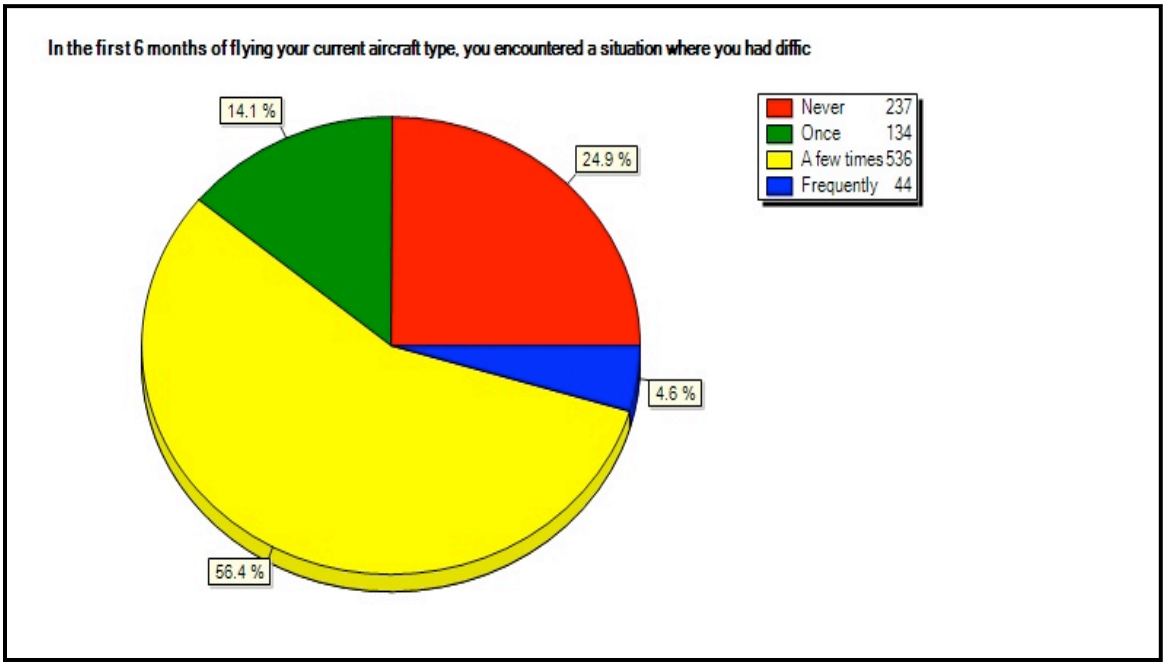

Figure 4.2.5.8

- When asked about areas for FMS training improvement, the number one issue reported was Automation Surprises (57.1%).
- 54% of the pilots (includes experienced pilots) said that they had at least one operational situation for which they were unprepared.

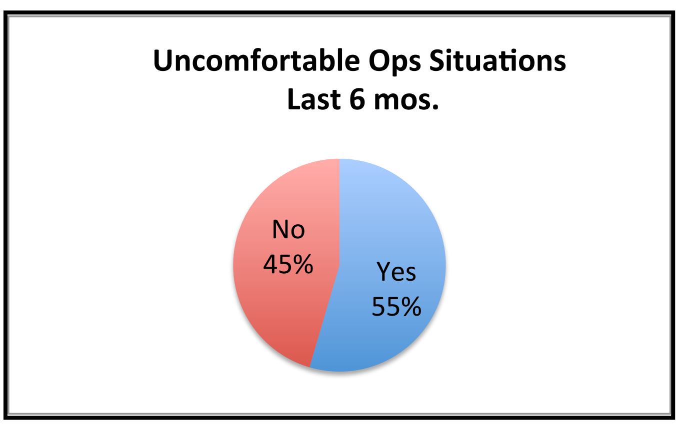

Figure 4.2.5.8a

- Summary – A high percentage of pilots found themselves in a 'surprise' situation after initial training. These uncomfortable situations continued despite experience on type. Automation surprises are particularly problematic as the majority of respondents report this issue as the number 1 topic for automation training improvement. It is clear from what the pilots are saying that current training does not deal adequately with unexpected operational situations.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Key Words	Training Topics	Factors	Competencies
246	Difficulty with Automation in first 6 months on type: - 25% were prepared - 14% had one encounter - 61% had multiple encounters	All	234	34	Survey	Automation	Automation Surprise	Mis-AFS	Flight Management Guidance/Automation Knowledge
253	Areas where FMS training can be improved in order of importance per surveyed pilot opinion: 1 Automation surprises - 57.1% 2 Hands on use in the operational situation - 52% 3 Transitions between modes - 32.8% 4 Basic knowledge of the system - 26.7% 5 Programing - 21%	All	234	34	Survey	Automation Criticality	Automation Surprise	Mis-AFS	Knowledge Flight Management Guidance/Automation Problem Solving Decision Making
271	54% of pilots encountered an operational situation in the past 6 months in which they were not comfortable - of the Yes category: - 57% are Captains - 43% are FOs	All	234	34	Survey	Criticality	Surprise	Mis-AFS Mis A/C State Mis-Sys	Knowledge Problem Solving Decision Making

Figure 4.2.5.8b – Surprise/Pilot Survey

4.2.5.9 Compliance

- Filter Evidence Table Pilot Survey
- Filtered Topic [Compliance] combined with
- Filtered Keyword [Compliance]
  - See Figure 4.2.5.9
  - **Result – Pilot Survey – Compliance**
    - In cases where pilots admit that a go-around should have been performed, 71% of the respondents advised that neither pilot mentioned a go-around.
    - 18% of pilots admit that they deviate from checklists frequently.
    - 21% of pilots admit to call out Intentional deviations on virtually every flight.
    - 13% of pilots admit to intentional deviations on a frequent basis.
  - Summary – The pilot survey is probably most revealing in the subject of compliance. If what LOSA postulates is true i.e., that the error rate is multiplicative when noncompliance is involved, then the following statistics speak for themselves:
    - 21% of pilots admit to call out Intentional deviations on virtually every flight.
    - 13% if pilots admit to intentional deviations from checklists on a frequent basis.
    - In a go around situation 71% of time neither pilot mentioned a go-around.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
254	In cases where Go-arounds should have been performed: • 71% of the cases neither pilot suggested a go-around	All	234	All	Survey	GA	Go Arounds Leadership Compliance	Compliance CRM Mis A/C State	Flight Management Guidance/Automation Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
266	18% if pilots admit to deviating from checklists frequently	All	234	All	Survey	Error Mgt Compliance	Error Mgt Leadership	Compliance CRM	Application of Procedures/Knowledge
267	Approximately 21% of the pilot respondents admit to call out deviations on virtually every flight. Approximately 28% of the pilot respondents admit to call out deviation on about every 10 flights.	All	234	All	Survey	Error Compliance	Error Mgt	Compliance CRM Workload	Leadership and Teamwork Application of Procedures/Knowledge
311	Go-Around Maneuvers: 1. I suggested a go-around, but the other pilot disagreed (20%). 2. The other pilot suggested a go-around, but I disagreed (8%). 3. Neither pilot suggested a go-around (72%).	APR LDG GA	All	All	Survey	GA Descision making Compliance	Go Arounds Surprise	Compliance CRM Workload	Communication Leadership and Teamwork
315	Intentional deviations from checklists occurred a reported every ten flights by 13% of the respondents, a few times a year by 30% of the respondents, and once a year by 36% of the respondents. Very few (4%) reported a deviation on every flight. Checklist deviations occurring at this high of a rate suggest other factors may be involved not related to compliance.	All	All	All	Survey	Compliance Error Mgt	Error Mgt Leadership	Compliance CRM Workload	Application of Procedures/Knowledge

Figure 4.2.5.9 – Compliance/Pilot Survey

4.2.5.10 Leadership

- Filter Evidence Table Pilot Survey
- Filtered result for Topic [Leadership]
  - See Figure 4.2.5.10
  - **Result – Pilot Survey – leadership**
    - In cases where a GA should have been performed, 71% of the times neither pilot mentioned GA.
    - Approach briefings is concluded and conducted in training but an analysis of pilot comments indicate that content is not well understood and practiced.
    - Pilots deviate frequently (18% of the time) from checklists and most often the deviation is intentional.
    - A majority of respondent would deviate from SOPs if it would improve safety.
  - Summary – The pilot survey provided both encouraging and discouraging results with regard to leadership. On the one hand most pilots are willing to make appropriate decisions to promote safety. However, there is too often a casual attitude indicated by significant intentional disregard for procedural compliance.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
254	In cases where Go-arounds should have been performed: • 71% of the cases neither pilot suggested a go-around	All	234	All	Survey	GA	Go Arounds Leadership Compliance	Compliance CRM Mis A/C State	Flight Management Guidance/Automation Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
264	The approach briefing is included and conducted in training. However based on comments, appropriate briefing content may not be known or practiced.	APR	234	All	Survey		Leadership	CRM	Communication Application of Procedures/Knowledge
266	18% if pilots admit to deviating from checklists frequently	All	234	All	Survey	Error Compliance	Error Mgt Leadership	Compliance CRM	Application of Procedures/Knowledge
312	Pilots report high levels of assertiveness in 4 of the 5 categories, with taking control from the pilot flying registering the lowest at 49%. The level of assertiveness appears to be linked to the level of resulting intervention. Tasks such as identifying a deviation (92%) or proposing a checklist (91%) are more likely to be asserted than tasks such as proposing a GA (83%) or demanding a GA (80%).	APR LDG GA	All	All	Survey	GA Descision making Assertiveness	Leadership Error Mgt MonitorXcheck Go Arounds	Compliance CRM	Communication Leadership Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
314	A majority of the respondents (53%) would deviate if they believe it increases safety and twenty--- nine percent would deviate if it resulted in no reduction in safety. Overall, most (83%) pilots would exercise judgment to intentionally deviate from company SOPs with their judgment being the pilot's assessment of safety. Another seven percent reported they would never deviate.	All	All	All	Survey	Compliance Error	Error Mgt Leadership	Compliance CRM	SA Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
315	Intentional deviations from checklists occurred a reported every ten flights by 13% of the respondents, a few times a year by 30% of the respondents, and once a year by 36% of the respondents. Very few (4%) reported a deviation on every flight. Checklist deviations occurring at this high of a rate suggest other factors may be involved not related to compliance.	All	All	All	Survey	Compliance Error	Error Mgt Leadership	Compliance CRM	Application of Procedures/Knowledge

Figure 4.2.5.10 – Leadership/Pilot Survey

4.2.5.11 Mismanaged Aircraft State

- Filter Evidence Table Pilot Survey
- Filtered result for Factors [Mis A/C State]
  - See Figure 4.2.5.11
  - **Result – Pilot Survey – Mismanaged Aircraft State**
    - Pilots rarely go around from a mismanaged approach and most often the reason is that they believe and do perform a successful landing.
    - Unstable approaches seem to remain consistent over time as indicated by various data sources.
    - The majority of pilot respondents in the survey indicated that they encountered an aircraft-operating situation in which they were not comfortable.
  - Summary – The survey asked questions regarding a specific mismanaged aircraft state, the unstable approach. This provided considerable reinforcement of results from other data sources. In the 6 months prior to responding, pilots detailed other situations they found uncomfortable and had difficulty managing.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
258	Reasons pilots give for not going-around from an Unstable App: 1. Pilot judgment that landing is still safe even though the approach is unstable (82%) 2. There is a psychological barrier because go-arounds are rare (37%) 3. Operational inconvenience (35%) 4. Embarrassment (24%) 5. Unfamiliar with criteria (17%) 6. Mandates a report	APP LDG GA	234	All	Survey	GA Descision making Complaince	Go Around Leadership Unstable APP	Compliance CRM Mis A/C State	Knowledge Flight Management Guidance/Automation Problem Solving Decision Making Knowledge Application of Procedures/Knowledge Leadership and Teamwork
268	Unstalble approach deviations are infrequent but consistent	ALL	234	All	Survey	Unstable APR/GA Error	Unstable APP	Mis A/C State	SA Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
269	Unstable approach rate calculated from Pilot Survey Reponse is consistent with LOSA and FDA rates and Survey.	APR	234	All	Survey	unstable apr	Unstable APP	Mis A/C State	All
271	Unstable approach rate calculated from Pilot Survey Reponse is consistent with LOSA and FDA rates and Survey.	APR	234	All	Survey	unstable apr	Unstable APP	Mis A/C State	All

Figure 4.2.5.11 – Mismanaged Aircraft State/Pilot Survey

4.2.5.12 Training Effect

- Filter Evidence Table Pilot Survey
- Filtered Keywords [Criticality]
  - See Figure 4.2.5.12
  - **Result – Pilot Survey – Training Effect**
    - Psychological barriers to a go around suggest more practice in training may be beneficial, especially for all engine scenarios.
    - Training must address the operational as well as the functional as such need is exemplified by the fact that the majority of pilots face operational situations on a frequent basis that they feel ill equipped to address.
    - According to pilot comments the topics in priority that need to be addressed in training is similar to the rankings found in other data sources e.g., weather, system malfunctions, automation and manual aircraft control.
  - Summary – The pilot survey highlighted some important topics for which training is needed. Pilots indicated the need for more training in go-arounds from various altitudes especially with all engines operating. Training also needs to be more operational in nature to deal with the shortfalls commented on by the survey respondents. In addition, the ranking of topics where effective training is needed parallels the priorities established by other data analyses in the EBT data study.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
253	Areas where FMS training can be improved in order of importance per surveyed pilot opinion: 1. Automation surprises - 57.1% 2. Hands on use in the operational situation – 52% 3. Transitions between modes – 32.8% 4. Basic Knowledge of the system – 26.7% 5. Programming – 21%	ALL	234	34	Survey	Automation Criticality	Automation Surprise	Mis-AFS	Knowledge Flight Management Guidance/Automation Problem Solving Decision Making Knowledge
256	Psychological barriers to a go around suggests more practice in training may be beneficial, especially for all engine scenarios	APP	234	All	Survey	Criticality	Go Around Leadership	Compliance CRM Mis A/C State	All
271	Unstable approach rate calculated from Pilot Survey Reponse is consistent with LOSA and FDA rates and Survey.	APP	234	All	Survey	Unstable APR/GA Criticality	Unstable APP	Mis A/C State	All
272	54% had a negative experience in training in the last 5 years	ALL	234	All	Survey	Criticality			
276	Training is multi-dimensional. All dimensions must be addressed for improvement to be successful and sustainable: • Content (operational and functional) • Delivery methods and tools • Airline Culture	ALL	234	All	Survey	Criticality			
277	Training needs (per analyzed survey comments) in terms of pilot-operational discomfort by order of priority: 1. Adverse weather 30% 2. Crew Resource Management 23% 3. Non-normal checklists 16% 4. Flight management 15% 5. Airplane handling 13% 6. Systems 12% 7. Maneuvers 10%	ALL	234	All	Survey	Criticality	WX Automation Manual AC Control	Syst mal CRM WX Manual AC Ccontrol Mis AFS	All

Figure 4.2.5.12 – raining Effect/Pilot Survey

4.2.6 IATA Accident Reports 2008/2009

4.2.6.1 Unstable Approaches

- Filter Evidence Table IATA Reports
- Filter Topics [Unstable Approaches]
  - See Figure 4.2.6.1
  - **Result – IATA Reports – Unstable Approaches**
    - Failure to go-around is number 3 error at 11% in 2009 report.
    - IATA Accident Reports recommend introducing special training to reduce Unstable Approaches
  - Summary – The IATA Accident Reports find unstable approaches to be a concern and a frequent error. The report recommends FTSD training in order to reduce the problem.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
74	Top errors Manual Handling (33%), SOP 30%, Fail to GA 11%	All	All	All	ACC IATA	Error	Manual AC Control Error Mgt Unstable APP Go Arounds	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control
85	Introduce Unstable App training in simulators	APR	All	All	ACC IATA Comments	Unstable APR/GA	Unstable APP	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge

Figure 4.2.6.1 – Unstable Approaches/IATA Accident Reports

4.2.6.2 Automation

- Filter Evidence Table IATA Reports
- Filter Keywords for [Automation]
  - See Figure 4.2.6.2
  - **Result – IATA Reports – Automation**
    - IATA Accident reports fully support LOSA findings regarding Automation
    - Automation error countermeasure involves crosschecking.
    - Crews are reluctant to revert to manual aircraft control.
    - Gross error checks are necessary when imputing data into FMS.
  - Summary – The IATA accident reports generally support the LOSA finding with regard to automation. Specifically, flight crews were found reluctant to revert to manual flying even when the situation required it. In addition, crosschecking is promoted to be the best countermeasure to mitigate automations errors and further finds that gross error checks should be made when imputing data into the FMS to trap errors easily made with this function.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
72	IATA 29 ACC statistics: Flight Crew Errors fully in support of LOSA results (ManualACControl, compliance, failure to go-around, Automation)	All	All	All	ACC IATA	Manual AC Control Compliance Automation	Manual AC Control Go Arounds Automation	Compliance CRM Mis A/C State Mis-AFS	Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control Flight Management Guidance/Automation
77	Countermeasures include monitoring / cross-checking and Automation mgt	All	All	All	ACC IATA	Monitoring Xcheck Automation	Error Mgt Automation Monitor Xchk	Mis-AFS CRM	SA Flight Management Guidance/Automation
79	Flight Crews are becoming more reluctant to revert to manual flying when Automation fails.	All	All	34	ACC IATA Comments	Automation Manual AC Control	Manual AC Control Error Mgt Automation	CRM Mis-AFS Syst mal Mis A/C State	Problem Solving Decision Making Flight Management Guidance/Automation Manual Aircraft Control
80	Gross error checks are required when inputting data in FMS.	All	All	34	ACC IATA Comments	Automation Error Management	Automation Error Mgt	CRM Mis-AFS	SA Flight Management Guidance/Automation

Figure 4.2.6.2 – Automation/IATA Accident Reports

4.2.6.3 Error Management

- Filter Evidence Table IATA Reports
- Filter Topics [Error Management]
  - See Figure 4.2.6.3
  - **Result – IATA Reports – Error management**
    - Top errors are Manual Aircraft Control followed by failure to GA.
    - Improved training could have prevented 23% of the accidents in IATA 2009 Accident Report.
    - Most important countermeasure in accident prevention is monitoring and crosschecking.
    - Specifically, gross error checks must be incorporated in imputing data into the FMS.
    - GA decision must be reinforced in training
    - Briefing must be adapted to the particular situation.
  - Summary – Error management results from the IATA studies echo the LOSA findings. Error management is listed as being the most important countermeasure to accident prevention. In addition, training is recommended to reinforce go-around in appropriate situations. Manual aircraft handling is also cited as an area to be improved by training in addition to automation management i.e., flight path management. Other specific areas noted are gross error checks when inputting FMS data as well as dealing with pilot reluctance to revert to manual flying when appropriate.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
74	Top errors Manual Handling (33%), SOP 3%, Fail to GA 11%	All	All	All	ACC IATA	Error Management Training Effect	Manual AC Control Error Mgt Unstable APP Go Arounds	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control
76	For 23% of 29 accidents, training could have been effective in reducing the likelihood	All	All	All	ACC IATA	Error Management Training Effect	Error Mgt		
77	Countermeasures include monitoring / cross-checking and Automation mgt	All	All	All	ACC IATA	MonitoringXchecking Automation	Error Mgt Automation Monitoring Xcheck	Mis-AFS CRM	SA Flight Management Guidance/Automation
79	Flight Crews are becoming more reluctant to revert to manual flying when Automation fails.	All	All	34	ACC IATA Comments	Automation ManualACControl	Manual AC Control Error Mgt Automation	CRM Mis-AFS Syst mal Mis A/C State	Problem Solving Decision Making Flight Management Guidance/ Automation Manual Aircraft Control
80	Gross error checks are required when inputting data in FMS.	All	All	34	ACC IATA Comments	Automation Error Management	Automation Error Mgt	CRM Mis-AFS	SA Flight Management Guidance/Automation
81	Decision to GA needs to be reinforced in training for abnormal landings (existing training counterproductive to this objective 4)	LDG	All	All	ACC IATA Comments	Unstable APR/GA Compliance Training Effect	Go Arounds Landing Issues Error Mgt	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge
84	g. Briefing should be adapted to the situation.	All	All	All	ACC IATA Comments	Error Management	Error Mgt	CRM	Communication SA

Figure 4.2.6.3 – Error management/IATA Accident Reports

4.2.6.4 Manual Aircraft Control

- Filter Evidence Table Sources IATA Reports
- Filter Topics [Manual Aircraft Control] combined with
- Filter Competencies [Manual Aircraft Control]
  - See Figure 4.2.6.4
  - **Result – IATA Reports – Manual Aircraft Control**
    - The IATA accident reports support LOSA's conclusion that manual aircraft control skills are critical, and is the top reported error at 33%.
    - The top UAS is improper landing.
    - The report recommends the reinforcement of manual aircraft control skills in training.
    - Pilots of highly automated aircraft are reluctant to revert to manual flight.
    - Go-arounds are problematic, a contributory factor being poor manual aircraft control.
  - Summary – The IATA report recommends reinforcing manual aircraft control skills through training and notes that crews are reluctant to revert to manual flying from automation. Poor manual aircraft control ranks as the number 1 error in their accident reports. The report cites problems during landing in addition to go-arounds.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
72	IATA 29 ACC statistics: Flight Crew Errors fully in support of LOSA results (ManualACControl, compliance, failure to go-around, Automation)	All	All	All	ACC IATA	ManualACControl Compliance Automation	Manual AC Control Go Arounds Automation	Compliance CRM Mis A/C State Mis-AFS	Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control Flight Management Guidance/Automation
74	Top errors Manual Handling (33%), SOP 3%, Fail to GA 11%	All	All	All	ACC IATA	Error Management	Manual AC Control Error Mgt Unstable/ Approaches Go Arounds	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control
75	Top UAS: improper landing 21%	LDG	All	All	ACC IATA	Error Management ManualACControl UAS	Landing Issues	Rwy/Taxi condition Mis A/C State	Problem Solving Decision Making Manual Aircraft Control
78	ManualACControl needs to be reinforced in Training	All	All		ACC IATA Comments	ManualACControl	Manual AC Control	Mis A/C State	Manual AC Control
79	Flight Crews are becoming more reluctant to revert to manual flying when Automation fails.	All	All	34	ACC IATA Comments	Automation ManualACControl	Manual AC Control Error Mgt Automation	CRM Mis-AFS Syst mal Mis A/C State	Problem Solving Decision Making Flight Management Guidance/Automation Manual Aircraft Control
86	b. Go-Arounds need training in terms of Decision making, surprise, execution, two engine, any point during the approach and landing	APR LDG GA	All	All	ACC IATA Comments	GA	Go Arounds Surprise	CRM Mis A/C State	SA Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control

Figure 4.2.6.4 – Manual Aircraft Control/IATA Accident Reports

4.2.6.5 Go-around

- Filter Evidence Table Sources IATA Reports
- Filter Topics [GA]
  - See Figure 4.2.6.5
  - **Result – IATA Reports – Go-Around**
    - IATA statistics support LOSA results regarding failure to go-around from unstable approaches.
    - Failure to go-around ranks number 2 in percentage of errors in accidents.
    - The go-around decision needs to be reinforced in training as well as the execution (all engine and engine out).
    - Coping with surprise and proficiency established in go-around at any point during the approach.
  - Summary – The results from IATA accident statistics support the LOSA findings in terms of the high degree of failure to go-around when the approach is unstable. This crew error is ranked high in IATA accident analysis and the report recommends training in go-arounds with regard to decision-making and execution of any type of go-around, at any point during the approach.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
72	IATA 29 ACC statistics: Flight Crew Errors fully in support of LOSA results (ManualACControl, compliance, failure to go-around, Automation)	All	All	All	ACC IATA	ManualACControl Compliance Automation	Manual AC Control Go Arounds Automation	Compliance CRM Mis A/C State Mis-AFS	Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control Flight Management Guidance/Automation
74	Top errors Manual Handling (33%), SOP 3%, Fail to GA 11%	All	All	All	ACC IATA	Error Management	Manual AC Control Error Mgt Unstable APP Go Arounds	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control
81	Decision to GA needs to be reinforced in training for abnormal landings (existing training counterproductive to this objective 4)	LDG	All	All	ACC IATA Comments	Unstable APR/GA Compliance	Go Arounds Landing Issues Error Mgt	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge
86	Go-Arounds need training in terms of Decision making, surprise, execution, two engine, any point during the approach and landing	APR LDG GA	All	All	ACC IATA Comments	GA	Go Arounds Surprise	CRM Mis A/C State	SA Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control

Figure 4.2.6.5 – Go Around/IATA Accident Reports

4.2.6.6 Weather

- Filter Evidence Table Sources IATA Reports
  - Filter Topics [WX]
  - See Figure 4.2.6.6
  - **Result – IATA Reports – WX**
    - The top threat in the IATA accident reports is weather.
  - Summary – The top threat in the IATA accident reports is weather.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
73	Top threat weather 29%	All	All	All	ACC IATA	Error Management WX	WX	Adverse WX Windshear Crosswind Poor Visibility	SA Problem Solving Decision Making Application of Procedures/Knowledge

Figure 4.2.6.6 – Weather/IATA Accident Reports

4.2.6.7 Surprise

- Filter Evidence Table Sources IATA Reports
- Filter Topics [Surprise] combined with
- Filter Competencies [SA]
- Suppress superfluous.
  - See Figure 4.2.6.7
  - **Result – IATA Reports – Surprise**
    - Important countermeasures to enhance situation awareness include monitoring and crosschecking.
    - Many abnormal situations that crews encounter are not covered in training.
    - Briefings to cover the specific situations that crews are encountering enhance awareness.
    - Training should be designed to go to the "edge of the envelope."
    - The IATA report specifically recommends training to cope with surprise go-around situations.
  - Summary – Maintaining situation awareness by specific briefings as well as monitoring and cross checking are effective countermeasures for dealing with all operational situations, including surprises. The IATA accident reports recommend training to deal with unusual "edge of the envelope" situations as well as specific training to cope with surprise go-arounds.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
77	Countermeasures include monitoring / cross-checking and Automation mgt	All	All	All	ACC IATA	MonitoringXchecking Automation	Error Mgt Automation Monitoring Xcheck	Mis-AFS CRM	SA Flight Management/Guidance/Automation
82	Many abnormal events that crews face are not covered in training.	All	All	34	ACC IATA Comments	Surprise	Surprise		SA
83	Training should be designed to take pilots to the edge of the envelope. (black/grey Surprise)	All	All	All	ACC IATA Comments	Surprise	Surprise		SA Problem Solving Decision Making Application of Procedures/Knowledge
84	Briefing should be adapted to the situation.	All	All	All	ACC IATA Comments	Error Management	Error Mgt	CRM	Communication SA
86	Go-Arounds need training in terms of Decision making, surprise, execution, two engine, any point during the approach and landing	APR LDG GA	All	All	ACC IATA Comments	GA	Go Arounds Surprise	CRM Mis A/C State	SA Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control

Figure 4.2.6.7 – Surprise/IATA Accident Reports

4.2.6.8 Landing Issues

- Filter Evidence Table Sources IATA Reports
- Filter Topics [Landing Issues]
  - See Figure 4.2.6.8
  - **Result – IATA Reports – Landing Issues**
    - The top UAS in the IATA accident reports is improper landings at 21%.
    - Training should reinforce go-around in appropriate situations.
  - Summary – According to the IATA accident reports, the number 1 UAS is improper landing. Training should reinforce go-around from abnormal landings.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Key Words	Training Topics	Factors	Competencies
75	Top UAS: improper landing 21%	LDG	All	All	ACC IATA	Error Management Manual AC Control UAS	Landing Issues	Runway Taxi Condition Mis A/C State	Problem Solving Decision Making Manual AC Control
81	Decision to GA needs to be reinforced in training for abnormal landings (existing training counterproductive to this objective 4)	LDG	All	All	ACC IATA Comments	Unstable APR/GA Compliance	Go-Arounds Landing Issues Error Mgt	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge

Figure 4.2.6.8 – Landing Issues/IATA Accident Reports

4.2.6.9 Compliance

- Filter Evidence Table Sources IATA Reports
- Filter Factors [Compliance]
  - See Figure 4.2.6.9
  - **Result – IATA Reports – Compliance**
    - IATA accident reports support compliance findings in LOSA.
    - SOP issues are rated in the top 3 category of errors.
    - Training to reinforce SOP in approach and landings should be included in an FSTD-based program.
  - Summary – The IATA reports echo LOSA findings. Compliance is rated as one of the top errors and specific training is recommended particularly with respect to following SOPs (i.e., to go-around) when an approach is not stable, and when the landing is improper.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
72	IATA 29 ACC statistics: Flight Crew Errors fully in support of LOSA results (ManualACControl, compliance, failure to go-around, Automation)	All	All	All	ACC IATA	ManualACControl Compliance Automation	Manual AC Control Go Arounds Automation	Compliance CRM Mis A/C State Mis-AFS	Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control Flight Management Guidance/Automation
74	Top errors Manual Handling (33%), SOP 3%, Fail to GA 11%	All	All	All	ACC IATA	Error Management	Manual AC Control Error Mgt Unstable APP Go Arounds	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control
81	Decision to GA needs to be reinforced in training for abnormal landings (existing training counterproductive to this objective 4)	LDG	All	All	ACC IATA Comments	Unstable APR/GA Compliance	Go Arounds Landing Issues Error Mgt	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge
85	a. Introduce Unstable App training in simulators	APR	All	All	ACC IATA Comments	Unstable APR/GA	Unstable APP	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge

Figure 4.2.6.9 – Compliance/IATA Accident Reports

4.2.6.10 Mismanaged Aircraft State

- Filter Evidence Table Sources IATA Reports
- Filter Factors [Mis A/C State]
  - See Figure 4.2.6.10
  - **Result – IATA Reports – Mismanaged Aircraft State**
    - Improper landing is the top UAS.
    - Manual aircraft control is a problem and should be reinforced during training.
    - Pilots are reluctant to revert to manual flight.
    - IATA reports recommend training for landings and go-around.
  - Summary – Mismanaged aircraft states occur for many reasons. The IATA report recommends reinforcement training in basic flying skills such as manual handling, landings and go-arounds. Flight crews are reluctant to revert to manual flight from automation, while basic maneuvers such as landings and go-arounds continue to be a problem. The reports propose that proficiency and confidence be fostered during training.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
74	Top errors Manual Handling (33%), SOP 3%, Fail to GA 11%	All	All	All	ACC IATA	Error Management	Manual AC Control Error Mgt Unstable APP Go Arounds	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control
75	Top UAS: improper landing 21%	LDG	All	All	ACC IATA	Error ManualACControl UAS	Landing Issues	Runway/Taxi condition Mis A/C State	Problem Solving Decision Making Manual Aircraft Control
78	ManualACControl needs to be reinforced in Training	All	All		ACC IATA Comments	ManualACControl	Manual AC Control	Mis A/C State	Manual Aircraft Control
79	Flight Crews are becoming more reluctant to revert to manual flying when Automation fails.	All	All	34	ACC IATA Comments	Automation ManualACControl	Manual AC Control Error Mgt Automation	CRM Mis-AFS Syst mal Mis A/C State	Problem Solving Decision Making Flight Management Guidance/Automation Manual Aircraft Control
81	Decision to GA needs to be reinforced in training for abnormal landings (existing training counterproductive to this objective 4)	LDG	All	All	ACC IATA Comments	Unstable APR/GA Compliance	Go Arounds Landing Issues Error Mgt	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge
85	Introduce Unstable App training in simulators	APR	All	All	ACC IATA Comments	Unstable APR/GA	Unstable APP	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge
86	Go-Arounds need training in terms of Decision making, surprise, execution, two engine, any point during the approach and landing	APR LDG GA	All	All	ACC IATA Comments	GA	Go Arounds Surprise	CRM Mis A/C State	SA Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control

Figure 4.2.6.10 – Mismanaged Aircraft State/IATA Accident Reports

4.2.6.11 Upset

- Filter Evidence Table Sources IATA Reports
- Filter Factors [Upset]
  - See Figure 4.2.6.11
  - **Result – IATA Reports – Upset**
    - Training should be designed to take pilots to the edge of the envelope (Black/grey Surprise)
  - Summary – Training should enable pilots to respond to unexpected events throughout the flight regime at various levels of difficulties.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
83	Training should be designed to take pilots to the edge of the envelope. (black/grey Surprise)	All	All	All	ACC IATA Comments	Surprise	Surprise Upset		SA Problem Solving Decision Making Application of Procedures/Knowledge

Figure 4.2.6.11 – Upset/IATA Accident Reports

4.2.6.12 Training Effect

- Filter Evidence Table Sources IATA Reports
  - Filter Keywords [Training Effect]
  - See Figure 4.2.6.12
  - **Result – IATA Reports – Training Effect**
    - Unstable approach training should be introduced as part of an FSTD based program.
    - Decision to go-around should be reinforced in training as well as the execution of the maneuver from any point on the approach.
    - Training should be designed to maximize pilot exposure to potentially challenging events.
  - Summary – As evidenced by the recommendations in the IATA accident reports, the analysts and authors believe that FSTD training would be effective to mitigate unstable approaches, reinforce the decision to go-around when appropriate as well as improve the performance of the go-around maneuver itself.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
81	Decision to GA needs to be reinforced in training for abnormal landings (existing training counterproductive to this objective 4)	LDG	All	All	ACC IATA Comments	Unstable APR/GA Compliance Training effect	Go Arounds Landing Issues Error Mgt	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/ Knowledge
83	f. Training should be designed to take pilots to the edge of the envelope. (black/grey Surprise)	All	All	All	ACC IATA Comments	Training effect	Surprise Upset		SA Problem Solving Decision Making Application of Procedures/ Knowledge
85	a. Introduce Unstable App training in simulators	APR	All	All	ACC IATA Comments	Unstable APR/GA Training Effect	Unstable APP	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/ Knowledge
86	b. Go-Arounds need training in terms of Decision making, surprise, execution, two engine, any point during the approach and landing	APR LDG GA	All	All	ACC IATA Comments	GA Training Effect	Go Arounds Surprise	CRM Mis A/C State	SA Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control

Figure 4.2.6.12 – Training Effect/IATA Accident Reports

4.2.7 Incidents during Training

4.2.7.1 Unstable Approaches

- Filter Evidence Table Incidents During Training
- Filter Topics [Unstable APP]
  - See Figure 4.2.7.1 and Fig 4.2.7.1a
  - **Result – Incidents during Training – Unstable Approaches**
    - Unstable approaches are the number 1 reported event in the STEADES database for training flights at 16.7%.
    - Unstable approaches are the number 2 reported event in the STEADES database for all-flights at 8.3%.
    - There is twice the percentage of ASRs for unstable approaches during training flights compared to the all-flights ASR database.

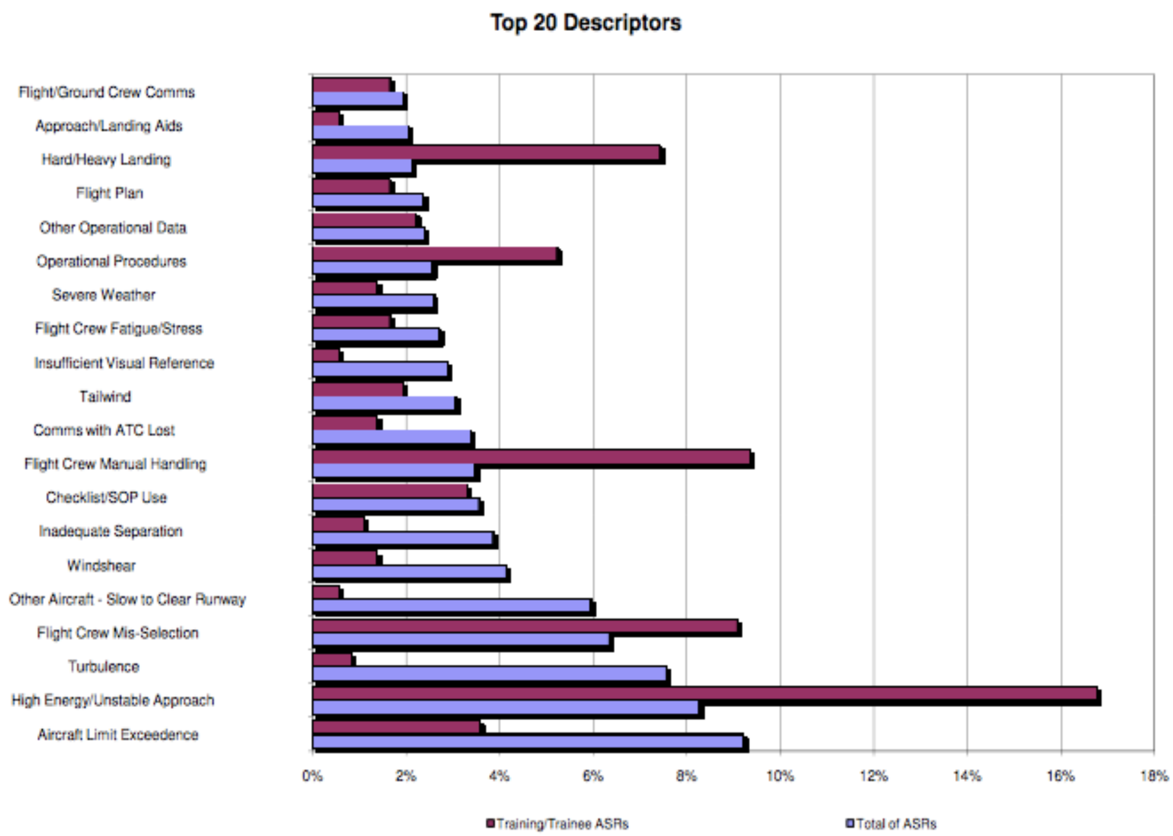

Figure 4.2.7.1

  - Summary – According to pilot reporting, not only do the unstable approaches rank high in reported incidents; but also the percentage of reports is twice as high during training flights.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
333	Top 10 ASR's in operations in percentage of reports o Aircraft limit exceedance 9.2% o Unstable approach 8.3% o Turbulence 7.6% o Flight crew missed selection 6.3% o Traffic on runway during short final 5.9% o Windshear 4.2% o ATC traffic separation 3.8% o Checklist/S0P use 3.5% o Manual handling 3.4% o ATC communication lost 3.1%	All	All	All	Incid Anal STEADES		Manual AC Control Automation WX Unstable APP Compliance	Adverse WX ATC Loss of comms Traffic Windshear Compliance Mis A/C State Mis-Sys Manual AC Control	Communication Application of Procedures/Knowledge Workload Management SA
337	Manual handling is number 2 in percentage of ASRs for training flights (9.2%) but number 9 for normal ops at 3,5%.	All	All	All	Incid Anal STEADES		Manual AC Control	Mis A/C State	Manual AC Control

Figure 4.2.7.1a – Unstable Approaches/Training Incidents

4.2.7.2 Error Management

- Filter Evidence Table Incidents During Training
- Filter Topics [Error Mgt]
  - See Figure 4.2.7.2
  - **Result – Incidents during Training – Error Management**
    - The majority of incidents reported on training flights are errors while in the majority of incidents in the database for all flights refer to threats.
    - Flight crew mis-selection is ranked similarly in both databases but generates twice the percentage of reports during training flights as compared to normal operations.
    - Problems with checklist use and SOPs is ranked 8th in percentage of ASRs reported in the main database and ranked 9th for training flights. The percentage of occurrence for both is nearly the same at approximately 3.5%.
  - Summary – Comparing the subjects of the incident reports for the training flights with the main ASR database provides some insight into the evolution of pilots as they acquire more experience on the line. The training flight database is heavily populated with errors, rather than threats, but not the case for the main database. This is not only true for the rankings of the incidents, but also for the percentages of actual reports with similar rankings across the two groupings of flights.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
334	Top 10 ASR's in training flights o Unstable approach 16.7% o Manual handling 9.4% o Flight crew missed selection 9.2% o Heavy/hard Landings 7.5% o Deep (long) Landings 5.5% o Procedures (operational) 5.2% o EGPWS G/S Alert 4.3% o Aircraft limit exceedance 3.6% o Checklist/S0P use 3.3% o Aircraft anti/de-ice 3.1%	All	All	All	Incid Anal STEADES		Unstable APP Manual AC Control Error Mgt Landing Issues Compliance WX	Adverse WX Compliance Mis-AFS Mis A/C State Mis-Sys Manual AC Control	Leadership and Teamwork Application of Procedures/Knowledge Manual Aircraft Control Workload Management
338	Flight crew mis-selection is ranked 4th in both databases but generates twice the percentage of reports during training flights as compared to normal operations.	All	All	All	Incid Anal STEADES		Error Mgt	Mis-Sys Mis A/C State Mis-AFS	Leadership and Teamwork Workload Management
339	Problems with checklist use and SOPs is ranked 8th in ASR percentage in the main database and ranked 9th for training flights. The percentage of occurrence for both is nearly the same at approximately 3.5%.	All	All	All	Incid Anal STEADES	Criticality	Compliance Error Mgt	Compliance Workload distraction	Application of Procedures/Knowledge Workload Management

Figure 4.2.7.2 – Error management/Training Incidents

4.2.7.3 Manual Aircraft Control

- Filter Evidence Table Incidents During Training
- Filter Topics [Manual A/C Control]
  - See Figure 4.2.7.3b
  - **Result – Incidents during Training – Manual Aircraft Control**
    - Manual handling accounts for 9.4% of the reported incidents for training flights in the ASR database.

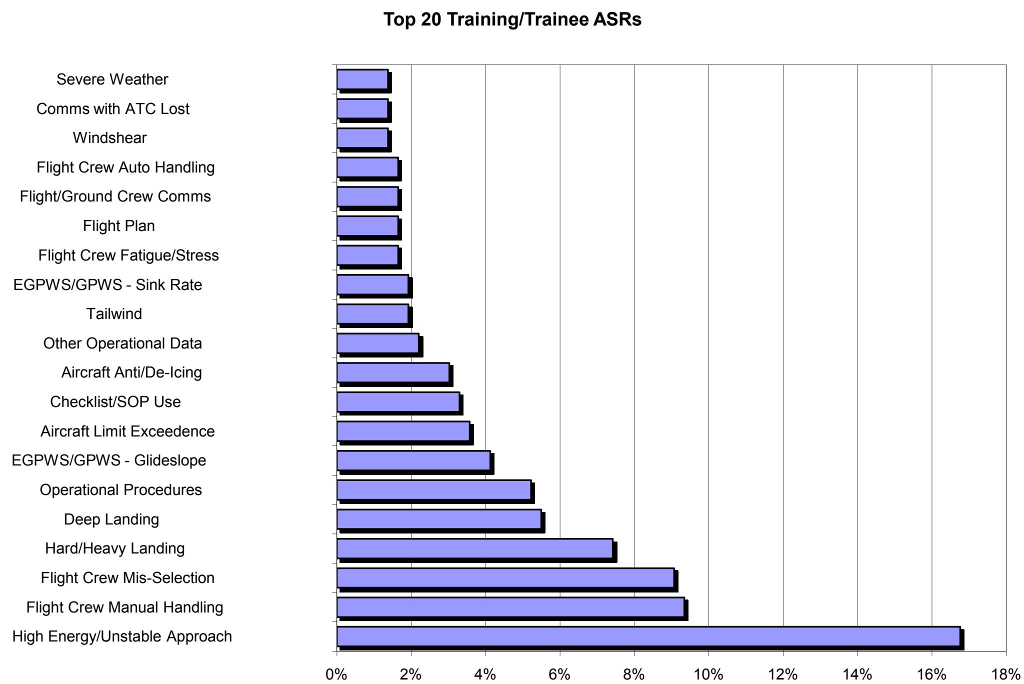

Figure 4.2.7.3

- Manual handling accounts for 3.4% of the reported incidents for all flights in the ASR database.

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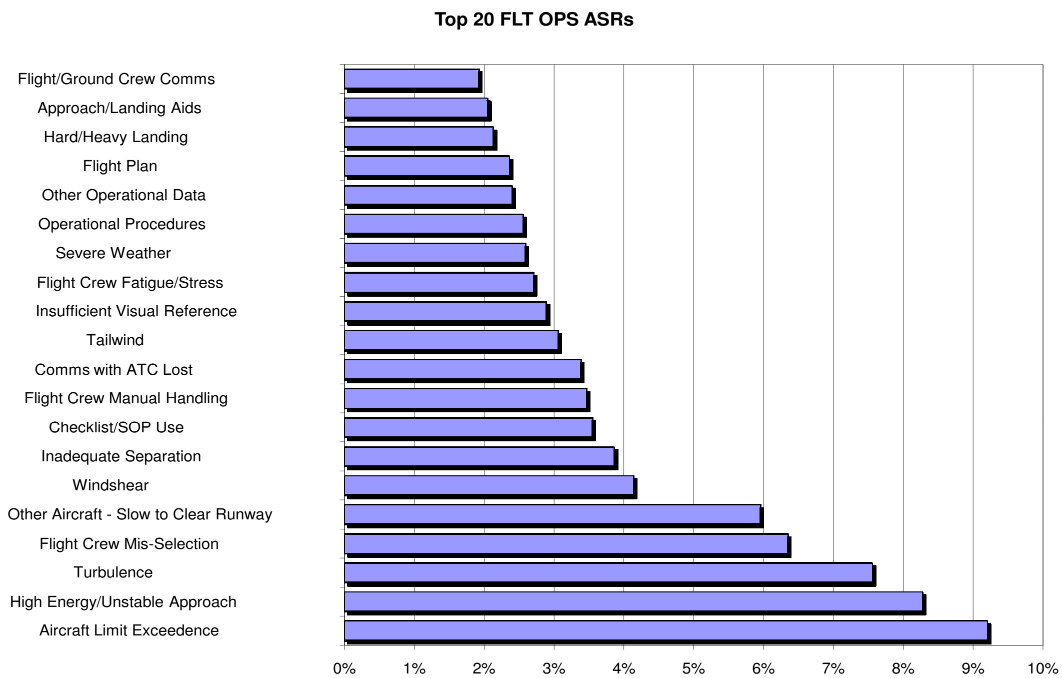

Figure 4.2.7.3a

- Manual handling is ranked 2nd in percentage of reported incidents for training flights while it is ranked 9th overall.

o Summary – Reported incidents show manual aircraft control is a concern, as it is 3.4% of the total incidents reported. However it is three times more likely to be reported when the flight is a training flight and it is the 2nd most reported incident for the set of training flights.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
333	Top 10 ASR's in operations in percentage of reports o Aircraft limit exceedance 9.2% o Unstable approach 8.3% o Turbulence 7.6% o Flight crew missed selection 6.3% o Traffic on runway during short final 5.9% o Windshear 4.2% o ATC traffic separation 3.8% o Checklist/SOP use 3.5% o Manual handling 3.4% o ATC communication lost 3.1%	All	All	All	Incid Anal STEADES		Manual AC Control Automation WX Unstable APP Compliance	Adverse WX ATC Loss of comms Traffic Windshear Compliance Mis A/C State Mis-Sys Manual AC Control	Communication Application of Procedures/Knowledge Workload Management SA
337	Manual handling is number 2 in percentage of ASRs for training flights (9.2%) but number 9 for normal ops at 3,5%.	All	All	All	Incid Anal STEADES		Manual AC Control	Mis A/C State	Manual AC Control

Figure 4.2.7.3b – Manual Aircraft Control/Training Incidents

4.2.7.4 Weather

- Filter Evidence Table Pilot Survey
- Filter Topics [WX]
  - o See Figure 4.2.7.4
  - o **Result – Incidents during Training – Weather**
    - ▪ Weather threats are reported at 17.8% in the all-flight database, while only at 4.8% rate for training flights. See figures above in Section 4.2.7.3.
    - ▪ The majority of incidents reported during training flights are errors, while the overall majority of incidents refer to threats in the database for all flights
  - o Summary – Weather is a major threat for flight crews, and this source continues to corroborate the threat. The fact that it is ranked so low according to the training flight ASR data (4.8% versus 17,8% in all-flight database), indicates that new pilots are absorbed with other concerns, related to errors.

E ref	Evidence Statement	Flight Phase	Gen Specifi	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
333	Top 10 ASR's in operations in percentage of reports o Aircraft limit exceedance 9.2% o Unstable approach 8.3% o Turbulence 7.6% o Flight crew missed selection 6.3% o Traffic on runway during short final 5.9% o Windshear 4.2% o ATC traffic separation 3.8% o Checklist/S0P use 3.5% o Manual handling 3.4% o ATC communication lost 3.1%	All	All	All	Incid Anal STEADES		Manual AC Control Automation WX Unstable APP Compliance	Adverse WX ATC Loss of comms Traffic Windshear Compliance Mis A/C State Mis-Sys Manual Aircraft Control	Communication Application of Procedures/Knowledge Workload Managementt SA
334	Top 10 ASR's in training flights o Unstable approach 16.7% o Manual handling 9.4% o Flight crew missed selection 9.2% o Heavy/hard Landings 7.5% o Deep (long) Landings 5.5% o Procedures (operational) 5.2% o EGPWS G/S Alert 4.3% o Aircraft limit exceedance 3.6% o Checklist/S0P use 3.3% o Aircraft anti/de-ice 3.1%	All	All	All	Incid Anal STEADES		Unstable APP Manual AC Control Error Mgt Landing Issues Compliance WX	Adverse WX Compliance Mis-AFS Mis A/C State Mis-Sys Manual Aircraft Control	Leadership and Teamwork Application of Procedures/Knowledge Manual Aircraft Control Workload Management

Figure 4.2.7.4 – Weather/Training Incidents

4.2.7.5 Landing Issues

- Filter Evidence Table Incidents During Training
- Filter Topics [Landing Issues]
  - See Figure 4.2.7.5
  - See figures above in Section 4.2.7.3
  - **Result – Incidents during Training – Landing Issues**
    - Manual handling accounts for 9.4% of the reported incidents for training flights in the ASR database.
    - Heavy or hard landings account for 7.5% of the reported incidents for training flights.
    - Deep (long) landings account for 5.5% of the reported incidents for training flights.
    - Manual handling accounts for 3.4% of the reported incidents for all flights in the ASR database.
    - Heavy or hard landings account for 2.3% of the reported incidents for all flights.
  - Summary – Reported landing incidents account for 13% of reports for training flights. This coupled with the fact that manual handling is ranked 2nd imply that there is still a considerable amount of learning skills are not fully acquired prior to IOE.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Key Words	Training Topics	Factors	Competencies
334	Top 10 ASR's in training flights -Unstable approach 16.7% -Manual handling 9.4% -Flight crew missed selection 9.2% -Heavy/hard landings 7.5% -Deep (long) landings 5.5% -Procedures (operations) 5.2% -EGPWS G/S alert 4.3% -Aircraft limit exceedance 3.6% -Checklist/SOP use 3.3% -Aircraft anti/de-ice 3.1%	All	All	All	Incid Anal STEADES		Unstable APP Manual AC Control Error Mgt Landing Issues Compliance WX	Adverse WX Compliance Mis-AFS Mis A/C State Mis-Sys Manual AC Control	Leadership and Teamwork Application of Procedures/Knowledge Manual Aircraft Control Workload Management
336	Heavy/hard landings is number 4 in terms of percentage of reports during training flights but outside of the top twenty for normal ops.	All	All	All	Incid Anal STEADES	Criticality	Landing Issues	Mis A/C State	Manual AC Control

Figure 4.2.7.5 – Landing Issues/Training Incidents

4.2.7.6 Compliance

- Filter Evidence Table Incidents During Training
- Filter Topics [Compliance]
  - See Figure 4. 4.2.7.6
  - **Result – Incidents during Training – Compliance**
    - Checklist use is cited in 3.3% of reported incidents for training flights in the ASR database, and ranked 9th overall.
    - Checklist use is cited in 3.4% of the reported incidents for all flights in the ASR database, and ranked 8th overall.
  - Summary – STEADES data draws little distinction between the two groupings of flights (training and all flights). Most of the training flights are for the purpose of IOE, and data indicates issues with checklists and SOPs, which are similar despite varying experience levels.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
333	Top 10 ASR's in operations in percentage of reports o Aircraft limit exceedance 9.2% o Unstable approach 8.3% o Turbulence 7.6% o Flight crew missed selection 6.3% o Traffic on runway during short final 5.9% o Windshear 4.2% o ATC traffic separation 3.8% o Checklist/S0P use 3.5% o Manual handling 3.4% o ATC communication lost 3.1%	All	All	All	Incid Anal STEADES		Manual AC Control Automation WX Unstable APP Compliance	Adverse WX ATC Loss of comms Traffic Windshear Compliance Mis A/C State Mis-Sys Manual AC Control	Communication Application of Procedures/Knowledge Workload Management SA
334	Top 10 ASR's in training flights o Unstable approach 16.7% o Manual handling 9.4% o Flight crew missed selection 9.2% o Heavy/hard Landings 7.5% o Deep (long) Landings 5.5% o Procedures (operational) 5.2% o EGPWS G/S Alert 4.3% o Aircraft limit exceedance 3.6% o Checklist/S0P use 3.3% o Aircraft anti/de-ice 3.1%	All	All	All	Incid Anal STEADES		Unstable APP Manual AC Control Error Mgt Landing Issues Compliance WX	Adverse WX Compliance Mis-AFS Mis A/C State Mis-Sys Manual AC Control	Leadership and Teamwork Application of Procedures/Knowledge Manual Aircraft Control Workload Management

Figure 4.2.7.6 – Compliance/Training Incidents

4.2.7.7 Mismanaged Aircraft State

- Filter Evidence Table Incidents During Training
- Filter Factors [Mis A/C State]
  - See Figure 4.2.7.7
  - See figures above in Section 4.2.7.3
  - **Result – Incidents during Training – Mismanaged Aircraft State**
    - There is twice the percentage of ASRs (Air Safety Reports) for unstable approaches during training flights when compared to the all flight ASR database.
    - “Heavy or hard” landing is ranked 4th in terms of percentage of reports during training flights, but outside of the top twenty for normal operations.
    - Looking at the top ten incidents in each grouping, there are twice as many incident types classified as mismanaged aircraft states in the grouping of training flights as opposed to the database of all flights.
  - Summary – The training flight database is heavily populated with incidents that are classified as mismanaged aircraft states while this is not nearly the case for the database of all flights. This fact is not only true for the rankings of the incidents, but also true for the percentages of actual reports with similar rankings across the two groupings of flights. Examples of this are unstable approaches (16.7% versus 8.3%), landing with incident, EGPWS and manual handling.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
333	Top 10 ASR's in operations in percentage of reports o Aircraft limit exceedance 9.2% o Unstable approach 8.3% o Turbulence 7.6% o Flight crew missed selection 6.3% o Traffic on runway during short final 5.9% o Windshear 4.2% o ATC traffic separation 3.8% o Checklist/S0P use 3.5% o Manual handling 3.4% o ATC communication lost 3.1%	All	All	All	Incid Anal STEADES		Manual AC Control Automation WX Unstable APP Compliance	Adverse WX ATC Loss of comms Traffic Windshear Compliance Mis A/C State Mis-Sys Manual AC Control	Communication Application of Procedures/Knowledge Workload Management SA
334	Top 10 ASR's in training flights o Unstable approach 16.7% o Manual handling 9.4% o Flight crew missed selection 9.2% o Heavy/hard Landings 7.5% o Deep (long) Landings 5.5% o Procedures (operational) 5.2% o EGPWS G/S Alert 4.3% o Aircraft limit exceedance 3.6% o Checklist/S0P use 3.3% o Aircraft anti/de-ice 3.1%	All	All	All	Incid Anal STEADES		Unstable APP Manual AC Control Error Mgt Landing Issues Compliance WX	Adverse WX Compliance Mis-AFS Mis A/C State Mis-Sys Manual AC Control	Leadership and Teamwork Application of Procedures/Knowledge Manual Aircraft Control Workload Management
335	There are twice the percentage of ASRs for unstable approaches during training flights compared to the main ASR database	All	All	All	Incid Anal STEADES	Criticality	Unstable APP	Mis A/C State Compliance	Leadership and Teamwork Application of Procedures/Knowledge Manual Aircraft Control Workload Management
336	Heavy/hard landings is number 4 in terms of percentage of reports during training flights but outside of the top twenty for normal ops.	All	All	All	Incid Anal STEADES	Criticality	Landing Issues	Mis A/C State	Manual Aircraft Control
337	Manual handling is number 2 in percentage of ASRs for training flights (9.2%) but number 9 for normal ops at 3,5%.	All	All	All	Incid Anal STEADES		Manual AC Control	Mis A/C State	Manual Aircraft Control
338	Flight crew mis-selection is ranked approximately the same in both databases but generates a 50% higher the percentage figure of reports during training flights as compared to normal operations.	All	All	All	Incid Anal STEADES		Error Mgt	Mis-Sys Mis A/C State Mis-AFS	Leadership and Teamwork Workload Management

Figure 4.2.7.7 – Mismanaged Aircraft State/Training Incidents

4.2.8 UK CAA Accident Studies

4.2.8.1 Automation

- Filter Evidence Table UK CAA
- Filter Topics [Automation]
  - See Figure 4.2.8.1
  - **Result – UK Accident Reports – Automation**
    - The UK accident analysis ranked accidents by cause, ranking "mishandled autoflight" 10th in order of priority at a 1.9% rate of occurrence.
  - Summary – The ranking of automation as a causal factor is generally low in accident reporting and the CAA accident reporting is no exception at 1.9%. The prevailing opinion by many analysts is that because mismanaged automation is further upstream in the error chain it is under reported in causal accident investigation.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
325	General Operational Threats by Rank - (TEM Phase) a. Human Factors – 32.3% b. Compliance failure – 19.1% c. Mishandled Aircraft – 13% d. Mismanaged Aircraft State - 7.8% e. Procedures – 6.9% f. Performance – 4.2% g. Mishandled systems (other than FMS) – 3.8% h. Workload Distribution – 3.4% i. Fatigue – 3.4% j. Mishandled Auto-Flight – 1.9% k. Performance Miscalculation – 1.7% l. Deficiencies in Manuals – 0.8% m. Physiological – 0.8% n. Cabin – 0.6% o. Deficiencies in Charts – 0.4%	All	All	All	ACC CAA	Threats & Errors TEM	Automation Compliance Error Mgt	Compliance Def Manuals Def-Charts Fatique CRM Workload Distraction Mis-AFS Mis-A/C State Mis-Sys Manual AC Control	Workload Management Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control

Figure 4.2.8.1 – Automation/UK CAA Accident Studies

4.2.8.2 Error Management

- Filter Evidence Table UK CAA
- Filter Topics [Error Mgt]
  - See Figure 4.2.8.2
  - **Result – UK Accident Reports – Error Management**
    - CAA reports main TEM issues are compliance human factors, CRM, mishandling aircraft and SOP compliance issues.
    - Top five accident causes are:
      - Omissions/inappropriate actions 38%.
      - Flight mishandling 28%.
      - Lack of positional awareness 25%.
      - Failure of CRM 22%.
      - Major concern for accident causation is the category of human factors.
  - Summary – The CAA accident reports (CAP 776 & CAP 780) cite human factors as the major concern in accident causation. The top five HF issues with their percentage rate of occurrence in accidents are inappropriate actions or omissions (38%), flight mishandling (28%), lack of positional awareness (25%) and failure of CRM (22%).

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
87	CAA report supports main threats (compliance, HF/CRM, mishandling a/c, SOP's). Compared to LOSA, bigger bars in CRZ and APR.	All	All	All	ACC CAA	Compliance ManualACControl	Error Mgt	CRM Mis A/C State Compliance	Communication SA Leadership and Teamwork Workload Management Problem Solving Decision Making Flight Management Guidance/Automation Manual Aircraft Control
326	Five most common causal factor groups (CAP 780) a. Omission/inappropriate Action – 36% b. Flight Handling – 28% c. Lack of Positional awareness – 25% d. Failure of CRM – 22%	All	All	All	ACC CAA	Causes Criticality Errors SA	Manual AC Control Error Mgt Leadership	CRM Manual AC Control	Application of Procedures/Knowledge Leadership and Teamwork Manual Aircraft Control
329	Further analysis to determine the areas of general operational threat it is clear that the major threat is that of the non-technical area of human factors	All	All	All	ACC CAA	Criticality CRM	Manual AC Control Error Mgt Leadership	CRM Workload Distraction Compliance Mis-AFS Mis A/C State Mis-Sys Manual AC Control	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Application of Procedures/Knowledge
330	The UK Civil Aviation Authority publications CAP 776 Global Fatal Accident Review 1997 – 2006 and CAP 780 Aviation Safety Review 2008 both suggest that the main areas of concern are non technical ones by nature	All	All	All	ACC CAA	Criticality CRM	Manual AC Control Error Mgt Leadership	CRM Workload Distraction Compliance Mis-AFS Mis A/C State Mis-Sys Manual AC Control	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Application of Procedures/Knowledge
331	(CAP 776) demonstrates that the top two primary causal factors, accounting for 36.4% of accidents, are non technical in nature. This is further reinforced by data from the CAP 780 which shows that the top five most common causal factors groups contain a significant component of non-technical elements (Human Factors).	All	All	All	ACC CAA	Criticality CRM	Manual AC Control Error Mgt Leadership	CRM Workload Distraction Compliance Mis-AFS Mis A/C State Mis-Sys Manual AC Control	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Application of Procedures/Knowledge
332	(CAP 780) again demonstrates that the most frequently occurring causal factors are crew related	All	All	All	ACC CAA	Criticality CRM	Error Mgt Leadership Compliance Manual AC Control	CRM Workload Distraction Compliance Mis-AFS Mis A/C State Mis-Sys	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Application of Procedures/Knowledge

Figure 4.2.8.2 – Error Management/UK CAA Accident Studies

4.2.8.3 Manual Aircraft Control

- Filter Evidence Table UK CAA
- Filter Topics [Manual AC Control]
  - See Figure 4.2.8.3a
  - **Result – UK Accident Reports – Manual Aircraft Control**
    - Top five accident causes are:
      - Omissions/inappropriate actions 38%.
      - Flight mishandling 28%.
      - Lack of positional awareness 25%.
      - Failure of CRM 22%.

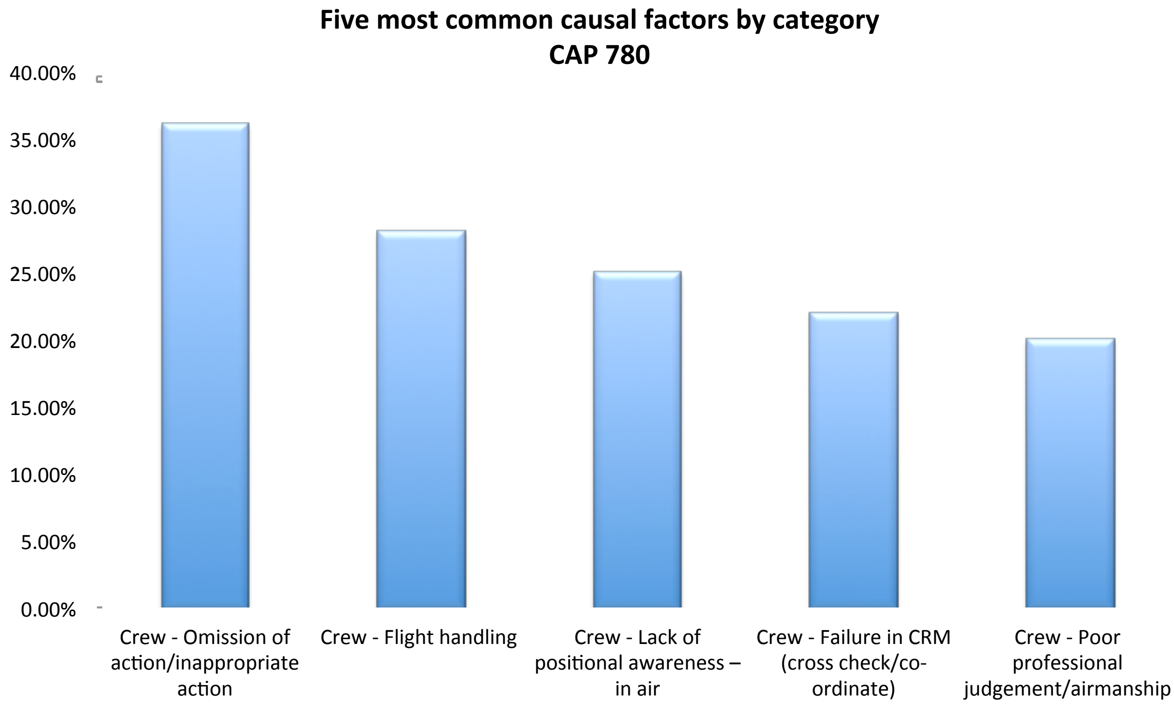

Figure 4.2.8.3

      - CAP 780 reports that the most frequent causal factors are crew related.
  - Summary – Flight mishandling is ranked second in percentage of occurrence in accidents (28%) by the UK Accident Report CAP 780.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
326	Five most common causal factor groups (CAP 780) a. Omission/inappropriate Action – 36% b. Flight Handling – 28% c. Lack of Positional awareness – 25% d. Failure of CRM – 22% e. Poor Judgment/Airmanship – 20%	All	All	All	ACC CAA	Causes Criticality Errors SA	Manual AC Control Error Mgt Leadership	CRM Manual AC Control	Application of Procedures/Knowledge Leadership and Teamwork Manual AC Control
332	(CAP 780) again demonstrates that the most frequently occurring causal factors are crew related	All	All	All	ACC CAA	Criticality CRM	Error Mgt Leadership Compliance Manual AC Control	CRM Workload Distraction Compliance Mis-AFS Mis A/C State Mis-Sys Manual AC Control	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Application of Procedures/Knowledge

Figure 4.2.8.3a – Manual Aircraft Control/UK CAA Accident Studies

4.2.8.4 Compliance

- Filter Evidence Table UK CAA
- Filter Topics [Compliance]
  - See Figure 4.2.8.4a
  - **Result – UK Accident Reports – Compliance**
    - Compliance failure is ranked number 2 in terms of TEM by the UK accident investigation team at 19.1% occurrence rate.

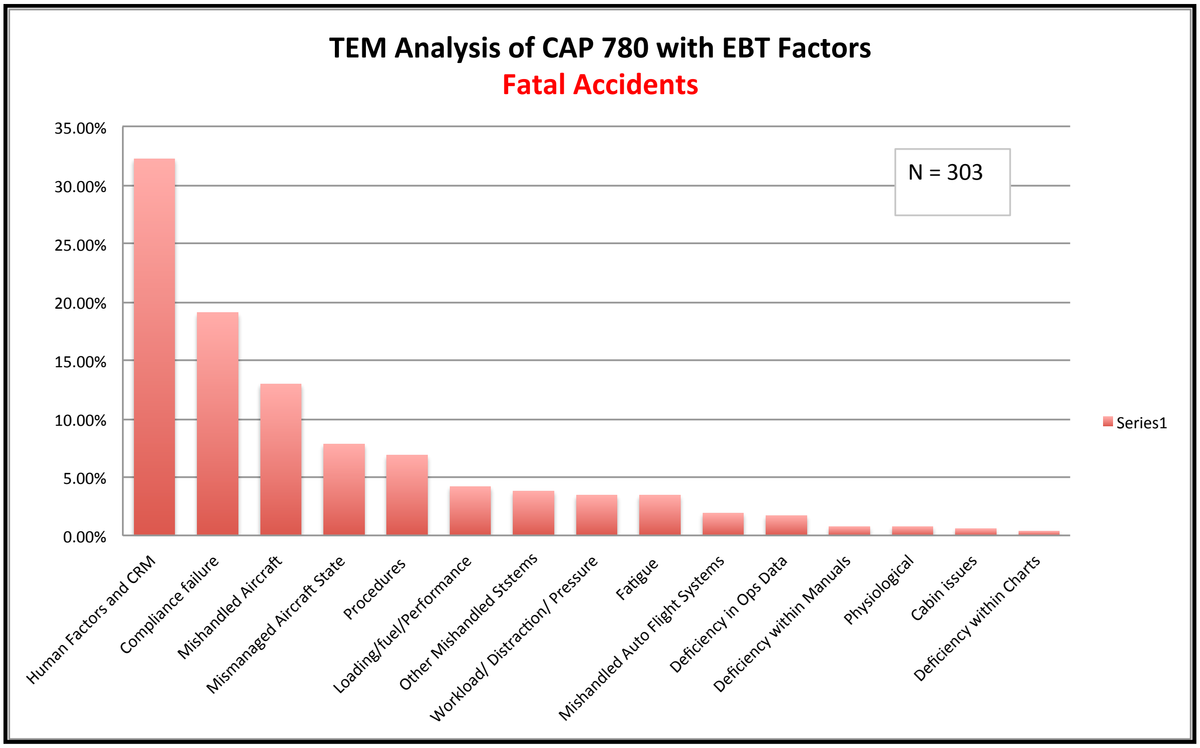

Figure 4.2.8.4

  - Summary – Part of the team that authored CAA CAP 780 Report analyzed the fatal accidents set used in the CAP 780 Report (i.e., occurring during the period between 1 January 1997 and 31 December 2008 (inclusive)) for the EBT Data Report. The analysis was made in terms of the threats and errors defined in the EBT Training Criticality Survey (TCS) and the study determined that compliance failure ranked number 2 at a 19.1% rate of occurrence.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
325	General Operational Threats by Rank - (TEM Phase) a. Human Factors – 32.3% b. Compliance failure – 19.1% c. Mishandled Aircraft – 13% d. Mismanaged Aircraft State - 7.8% e. Procedures – 6.9% f. Performance – 4.2% g. Mishandled systems (other than FMS) – 3.8% h. Workload Distribution – 3.4% i. Fatigue – 3.4% j. Mishandled Auto-Flight – 1.9% k. Performance Miscalculation – 1.7% l. Deficiencies in Manuals – 0.8% m. Physiological – 0.8% n. Cabin – 0.6% o. Deficiencies in Charts – 0.4%	All	All	All	ACC CAA	Threats and Errors TEM	Automation Compliance Error Mgt	Compliance Def Manuals Def-Charts Fatique CRM Workload Distraction Mis-AFS Mis A/C State Mis-Sys Manual AC Control	Workload Management Application of Procedures/Knowledge Flight Management Guidance/ Automation Manual Aircraft Control
331	(CAP 776) demonstrates that the top two primary causal factors, accounting for 36.4% of accidents, are non technical in nature. This is further reinforced by data from the CAP 780 which shows that the top five most common causal factors groups contain a significant component of non-technical elements (Human Factors).	All	All	All	ACC CAA	Criticality CRM	Error Mgt Leadership Compliance	CRM Workload Distraction Compliance Mis-AFS Mis A/C State Mis-Sys Manual AC Control	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Application of Procedures/Knowledge

Figure 4.2.8.4a – Compliance/UK CAA Accident Studies

4.2.8.5 Phase of Flight

- Filter Evidence Table UK CAA
- Filter Keyword [Phase]
  - See Fig 4.2.8.5
  - **Result – UK Accident Reports – Phase of Flight**
    - Accidents by Phase of Flight
      - Pre-Flight and Taxi-Out – 0.7%
      - Take-Off – 11.9%
      - Climb – 19.1%
      - Cruise – 15.8%
      - Descent – 4.3%
      - Approach – 35.6%
      - Land – 11.9%
      - Post-Flight and Taxi-In – 0.7%

Phase of Flight	All Fatal Accidents	Passenger Flights Only	Cargo Flights Only	Western-Built Jets Only	Western-Built Jets on Passenger Flights Only
Pre-Flight and Taxi-Out	2	1	1	1	1
Take-Off	36	23	13	12	10
Climb	58	32	26	16	11
Cruise	48	33	15	13	12
Descent	13	8	5	4	3
Approach	108	74	34	32	25
Landing	36	30	6	18	18
Post-Flight	2	2	0	2	2
Total	**303**	**203**	**100**	**98**	**82**

Figure 4.2.8.5 – Accidents by Phase of Flight

  - Summary – According to the UK Fatal Accident Report CAP 780, the APP phase of flight hosts the most accidents (35.6%) followed by the CLB phase at 19.1%. The rankings change significantly if all accidents are considered.

4.2.9 Skill Retention after Training/Skill Decay

4.2.9.1 Unstable Approaches

- Filter Evidence Table Pilot Survey
- Filter Topics [Unstable APP]
  - See Figure 4.2.9.1
  - **Result – Skill Decay/Skill Retention Studies – Unstable Approaches**
    - Skill loss can be substantial and increases over time without practice.
  - Summary – The skill decay study shows that skill losses can be substantial and decay without practice, making the case for including energy management and recoveries from unstable approaches as part of a training curriculum.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
317	Skill loss can be substantial and generally increases with the duration of non-use / non-practice	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Manual AC Control Unstable APP Go Arounds Automation Landing Issues		All

Figure 4.2.9.1 – Unstable Approaches/Skill Decay

4.2.9.2 Automation

- Filter Evidence Table Pilot Survey
- Filter Topics [Automation]
  - See Figure 4.2.9.2
  - **Result – Skill Decay/Skill Retention Studies – Automation**
    - There is less decay for physical versus cognitive skills.
    - Skill loss can be substantial and increases over time without practice.
    - Skill decay for accuracy is 3 times higher if it is necessary to perform the action quickly.
  - Summary – The skill decay study shows that skill losses can be substantial and decay without practice. This deterioration is much greater for skilled tasks, such as certain automation skills making it important to assess these skills in training particularly for pilots that do on operate routinely.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
70	There is less skill decay for physical tasks compared to cognitive tasks.	All	All	All	Skill Decay & Skill Retention Studies	Skill Decay	Automation Surprise Error Mgt	Manual AC Control	Communication SA Problem Solving Decision Making Knowledge
317	Skill loss can be substantial and generally increases with the duration of non-use / non-practice	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Manual AC Control Unstable APP Go Arounds Automation Landing Issues		All
319	Skill decay for “accuracy” tasks was three times higher than for “speed” tasks, i.e. for tasks where it was necessary to perform the trained skill fast.	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Automation		All

Figure 4.2.9.2 – Automation/Skill Decay

4.2.9.3 Error Management

- Filter Evidence Table Pilot Survey
- Filter Topics [Error Mgt]
  - See Figure 4.2.9.3
  - **Result – Skill Decay/Skill Retention Studies – Error Management**
    - There is less decay for physical versus cognitive skills.
    - Skill retention for open loop tasks is better than for closed loop tasks.
  - Summary – Error management is cognitive in nature implying that its rate of decay is greater than for many other the tasks that pilot perform. This decay aspect makes it important that error management be assessed and reinforced as necessary.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
70	There is less skill decay for physical tasks compared to cognitive tasks.	All	All	All	Skill Decay & Skill Retention Studies	Skill Decay	Automation Surprise Error Mgt	Manual AC Control	Communication SA Problem Solving Decision Making Knowledge
318	Retention of open-loop tasks was better than of closed-loop tasks.	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Error Mgt Leadership		All

Figure 4.2.9.3 – Error Management/Skill Decay

4.2.9.4 Manual Aircraft Control

- Filter Evidence Table Pilot Survey
- Filter Topics [Manual A/C Control]
  - See Figure 4.2.9.4
  - **Result – Skill Decay/Skill Retention Studies – Manual Aircraft control**
    - Skill loss can be substantial and increases over time without practice.
    - There is no evidence that levels of maneuver-based skill decay among pilots in 12-month training cycles are worse than pilots in 6-month cycles. This is derived from the AQP Maneuver Validation (MV) and the subsequent "First Look" data.
    - There is no evidence of significant skill decay differential between normal and abnormal maneuvers.
  - Summary – Manual aircraft control shows greater resistance to skill decay over time than other competencies. This is supported by two skill studies, (see appendix 5). The first is a meta study published by Texas A&M and the second was provided by the FAA, which ran for almost 10 years and included over 2 million training sessions across multiple types of aircraft.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
317	Skill loss can be substantial and generally increases with the duration of non-use / non-practice	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Manual AC Control Go Arounds Automation Unstable APP Landing Issues		All
320	There was no evidence of significant skill decay among pilots in 12-month training cycle (Maneuver Validation vs. First Look grades).	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Manual AC Control	Manual AC Control	Manual AC Control Application of Procedures/ Knowledge
321	There were no detectable trends in the MV-FL difference within the 2000 -2008 period.	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Manual AC Control Landing Issues	Manual AC Control	Manual AC Control Application of Procedures/ Knowledge
322	There was no significant difference between normal vs. abnormal maneuvers; except for the takeoff flight phase, where the "normal" got significantly better grades at all times during the 12-month retention interval.	All	All	All	Skill Decay & Skill Retention Studies	Criticality	System Malfunction Compliance Manual AC Control	Manual AC Control	Manual AC Control Application of Procedures/ Knowledge

Figure 4.2.9.4 – Manual Aircraft Control/Skill Decay

4.2.9.5 System Malfunction

- Filter Evidence Table Pilot Survey
- Filter Topics [Sys Mal]
    - See Figure 4.2.9.5
    - **Result – Skill Decay/Skill Retention Studies – System Malfunction**
        - There is less skill decay for physical tasks when compared with cognitive tasks.
        - There is no significant difference in data when comparing normal and abnormal maneuvers for skill decay measured in a 6-month versus 12-month training intervals.
        - There is no evidence that levels of maneuver-based skill decay among pilots in 12-month training cycles are worse than pilots in 6-month cycles. This is derived from the AQP Maneuver Validation (MV) and the subsequent "First Look" data.
    - Summary – The FAA skill decay study tends to support the notion that system malfunction proficiency is resistant to skill decay over time. The skill retention study conclusions are consistent with this finding. Management of the majority of malfunctions involves following defined procedures and checklists, the exception being a malfunction not anticipated by procedure and checklist design, or one with unexpected consequences. It is likely that skills required in dealing with a less defined problem or malfunction will be more vulnerable to decay.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
70	There is less skill decay for physical tasks compared to cognitive tasks.	All		All	Skill Decay & Skill Retention Studies	Skill Decay	Automation Surprise Error Mgt Manual AC Control System Malfunction	Manual AC Control	Communication SA Problem Solving Decision Making Knowledge Manaul Aircraft Ccontrol
317	Skill loss can be substantial and generally increases with the duration of non-use / non-practice	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Manual AC Control Go Arounds Automation Unstable APP Landing Issues		All
320	There was no evidence of significant skill decay among pilots in 12-month training cycle (Maneuver Validation vs. First Look grades).	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Manual AC Control	Manual AC Control	Manual AC Control Application of Procedures/ Knowledge
321	There were no detectable trends in the MV-FL difference within the 2000 -2008 period.	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Manual AC Control Landing Issues	Manual AC Control	Manual AC Control Application of Procedures/ Knowledge
322	There was no significant difference between normal vs. abnormal maneuvers; except for the takeoff flight phase, where the "normal" got significantly better grades at all times during the 12-month retention interval.	All	All	All	Skill Decay & Skill Retention Studies	Criticality	System Malfunction Compliance Manual AC Control	Manual AC Control	Manual AC Control Application of Procedures/ Knowledge

Figure 4.2.9.5 – System Malfunction/Skill Decay

4.2.9.6 Landing Issues

- Filter Evidence Table Pilot Survey
- Filter Topics [Landing Issues]
  - See Figure 4.2.9.6
  - **Result – Skill Decay/Skill Retention Studies – Landing Issues**
    - Skill loss can be substantial and increases over time without practice.
    - There is no evidence that levels of maneuver-based skill decay among pilots in 12-month training cycles are worse than pilots in 6-month cycles. This is derived from the AQP Maneuver Validation (MV) and the subsequent "First Look" data.
  - Summary – Landings are generally practiced in the interval between training cycles and so not generally a problem for skill decay. This is indicated in the FAA skill decay study. Skill decay is a problem for pilots without landing practice, and this may affect those involved in ultra-long haul operations.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
317	Skill loss can be substantial and generally increases with the duration of non-use / non-practice	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Manual AC Control Go Arounds Automation Unstable APP Landing Issues		All
320	There was no evidence of significant skill decay among pilots in 12-month training cycle (Maneuver Validation vs. First Look grades).	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Manual AC Control	Manual AC Control	Manual AC Control Application of Procedures/ Knowledge
321	There were no detectable trends in the MV-FL difference within the 2000 -2008 period.	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Manual AC Control Landing Issues	Manual AC Control	Manual AC Control Application of Procedures/ Knowledge
323	The results suggest pilots maintain their proficiency across the 12-month re-training interval	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Go Arounds System Malfunction Landing Issues	System Malfunction Compliance	Manual Aircraft Control Application of Procedures/Knowledge

Figure 4.2.9.6 – Landing Issues/Skill Decay

4.2.9.7 Training Effect

- Filter Evidence Table Pilot Survey
- Filter Keywords [Criticality]
    - See Figure 4.2.9.7
    - **Result – Skill Decay/Skill Retention Studies – Training Effect**
        - Skill loss can be substantial and increases over time without practice.
        - There is no evidence that levels of maneuver-based skill decay among pilots in 12-month training cycles are worse than pilots in 6-month cycles. This is derived from the AQP Maneuver Validation (MV) and the subsequent “First Look” data.
        - There is no significant difference in data when comparing normal and abnormal maneuvers for skill decay measured in a 6-month versus 12-month training intervals.
    - Summary – The FAA skill decay study tends to support the notion that system malfunction proficiency is resistant to skill decay over time. The skill retention study conclusions are consistent with this finding. Management of the majority of malfunctions involves following defined procedures and checklists, the exception being a malfunction not anticipated by procedure and checklist design, or one with unexpected consequences. It is likely that skills required in dealing with a less defined problem or malfunction will be more vulnerable to decay.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
317	Skill loss can be substantial and generally increases with the duration of non-use / non-practice	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Manual AC Control Go Arounds Automation Unstable APP Landing Issues		All
318	Retention of open-loop tasks was better than of closed-loop tasks.	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Error Mgt Leadership System Malfunction		All
319	Retention of open-loop tasks was better than of closed-loop tasks.	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Automation		All
320	There was no evidence of significant skill decay among pilots in 12-month training cycle (Maneuver Validation vs. First Look grades).	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Manual AC Control	Manual AC Control	Manual AC Control Application of Procedures/ Knowledge
321	There were no detectable trends in the MV-FL difference within the 2000 -2008 period.	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Manual AC Control Landing Issues	Manual AC Control	Manual AC Control Application of Procedures/ Knowledge
322	There was no significant difference between normal vs. abnormal maneuvers; except for the takeoff flight phase, where the “normal” got significantly better grades at all times during the 12-month retention interval.	All	All	All	Skill Decay & Skill Retention Studies	Criticality	System Malfunction Compliance Manual AC Control	System Malfunction Compliance	Manual Aircraft Control Application of Procedures/Knowledge
323	The results suggest pilots maintain their proficiency across the 12-month re-training interval	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Go Arounds System Malfunction Landing Issues	System Malfunction Compliance	Manual Aircraft Control Application of Procedures/Knowledge

Figure 4.2.9.7 – Training Effect/Skill Decay

4.2.10 FAA Human Factors Team Report 1996

4.2.10.1 Automation

- Filter Evidence Table FAA 1996 Automation Report
- Filter Topics [Automation]
  - See Figure 4.2.10.1
  - **Result – FAA 1996 Automation Report – Automation**
    - Pilot SA automation awareness issues are understanding of capabilities, limitations and modes along with nonstandard levels of use.
    - Pilot vulnerabilities are: flight path, terrain and energy awareness.
    - Pilot training needs to address that pilots are surprised by subtle behavior and complexities of the automation.
    - The training course should focus on design principles that have operational consequences.
    - Existing methods are inadequate to evaluate human performance issues.
    - Current regulations have not kept pace with technical and human factors issues flight crew training needs to be re-balanced to cover automation issues.
    - The report recommends training to enhance mode and position awareness as well as potential causes, detection and recovery regarding hazardous conditions concerning traffic, terrain and upset while using the autoflight system.
    - The report recommends reassessing requirements of initial and recurrent training course to ensure that there is adequate content to cover mode and automation awareness regarding basic airmanship, CRM, decision- making including unanticipated events and workload/task management.
    - The report recommends that airman certification criteria be amended so that pilots have the appropriate automation skills.
    - Pilots have inappropriately used automation instead of reverting to manual flight.
    - The emphasis should be on learning instead of checking.
  - Summary – The FAA automation report found that pilots have various situation awareness issues with automation. They are vulnerable to lack of flight path and energy awareness when using autoflight. In addition they are surprised by the subtleties and complexities of automation and the training courses fail to focus on operation principles of the autoflight architecture. Many pilots use the autoflight when inappropriate and fail to revert to manual flight. The training courses at the time of the study tended to be checking rather than learning oriented and had not kept pace with human factor issues in regard to automation. The report recommends that training enhance mode and position awareness when using automation, particularly with regard to terrain, energy and upset. In addition, the report recommends that there be adequate training content to insure airmanship, CRM, decision-making, workload/task management when utilizing automation especially in demanding situations.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
193	Identified issues show vulnerabilities in flightcrew Management of Automation and situation awareness are: • Pilot understanding of the Automation's capabilities, limitations, modes, and operating principles and techniques. • Differing pilot Decisions about the appropriate Automation level to use.	All	34	34	FAA 1996 Automation Report	Automation Generation Error Mgt	Automation	Mis-AFS	SA Problem Solving Decision Making Knowledge Flight Management/ Guidance/Automation
194	Flightcrew SA issues included vulnerabilities in: • Automation/mode awareness. • Flight path awareness: • including insufficient Terrain awareness sometimes involving loss of control or controlled flight into Terrain) and energy awareness (especially low energy state).	All	34	34	FAA 1996 Automation Report	Automation Generation SA Error Mgt UAS Competencies	Automation Terrain Error Mgt	Mis-AFS Mis A/C State Terrain	SA Flight Management Guidance/Automation
195	Processes for design, training, and regulatory functions inadequately address human performance issues: • users can be surprised by subtle behavior • overwhelmed by the complexity embedded in current systems operated within the current operating environment	All	34	34	FAA 1996 Automation Report	Automation Generation Error Mgt	Surprise Automation	Ops/Type Spec Mis-AFS	SA Flight Management Guidance/Automation
197	Existing methods, data, and tools are inadequate to evaluate and resolve many of the important human performance issues	All	34	All	FAA 1996 Automation Report	Automation Generation Error Mgt	Automation		Flight Management Guidance/Automation
199	Two-thirds to three-quarters of all accidents have flightcrew error cited as a major factor. Flightcrew training investments should be re-balanced to ensure appropriate coverage of Automation issues.	All	34	34	FAA 1996 Automation Report	Automation Error Mgt	Error Mgt Automation	Mis-AFS	Flight Management Guidance/Automation
200	Current Regulatory standards for type certification and operations have not kept pace with changes in technology and increased Knowledge about human performance.	All	34	34	FAA 1996 Automation Report	Automation Generation Error Mgt	Automation		Flight Management Guidance/Automation
201	Recommendation SA-1: The FAA should require operators to increase flightcrews' understanding of and sensitivity to maintaining situation awareness, particularly: • Mode and airplane energy awareness issues associated with autoflight systems (i.e., autopilot, autothrottle, flight Mgt system, and fly-by-wire flight control systems); • Position awareness with respect to the intended flight path and proximity to Terrain, obstacles, or traffic; and • Potential causes, flight crew detection, and recovery from hazardous pitch or bank angle Upsets while under autopilot control (e.g., wake vortex, subtle autopilot failures, engine failure in cruise, atmospheric turbulence).	All	34	34	FAA 1996 Automation Report	Automation Upset Generation Error Mgt	Error Mgt Automation Terrain	Mis-AFS Terrain	SA Flight Management Guidance/Automation Knowledge
202	Recommendation SA-2: The FAA should require operators' initial and recurrent training programs as well as appropriate operating manuals to: • Explicitly address autoflight mode and airplane energy awareness hazards; • Provide information on the characteristics and principles of the autoflight system's design that have operational safety consequences; and • Provide training to proficiency of the flight Management system capabilities to be used in operations.	All	34	34	FAA 1996 Automation Report	Automation Generation	Error Mgt Automation	Mis-AFS	SA Flight Management/Guidance/Automation Knowledge
	Continued on next page								

Figure 4.2.10.1 – Automation/FAA HF Report

	Continued from previous page							
207	Recommendation Knowledge-2: The FAA should reassess the requirements that determine the content, length, and type of initial and recurrent flightcrew training. Ensure that the content appropriately includes: • Management and use of Automation, including mental models of the Automation and moving between levels of Automation; • Flightcrew situation awareness, including mode and Automation awareness; • Basic airmanship; • Crew Resource Management; • Decision making, including unanticipated event training; • Examples of specific difficulties encountered either in service or in training; and • Workload Management (task Management).	All	34	All	FAA 1996 Automation Report	Automation Competencies Generation SA	Leadership Automation	Compliance CRM	SA Problem Solving Decision Making Workload Management
209	Recommendation Knowledge-5: The FAA should reassess the airman certification criteria to ensure that pilots are released with a satisfactory level of skills for managing and using Automation. Since current training is often oriented toward preparing pilots for checkrides, the airman certification criteria should be reassessed to ensure appropriate coverage of the topics listed in Recommendation Knowledge-2.	All	34	34	FAA 1996 Automation Report	Automation	Automation	Mis-AFS	Flight Management Guidance/Automation
219	There have been situations where flightcrews have either inappropriately continued to use the Automation when they found themselves in an abnormal situation.	All	34	34	FAA 1996 Automation Report	Automation Error Mgt	Automation Surprise	Mis-AFS	Problem Solving Decision Making Knowledge Flight Management Guidance/Automation
220	Flightcrews should be given sufficient training on using the FMS to ensure proficiency at least for those capabilities used in normal day-to-day operations. The HF Team considers the practice of expecting flightcrews to acquire these basic skills while flying the line to be inappropriate.	All	34	34	FAA 1996 Automation Report	Automation Competencies	Automation Terrain Error Mgt	Mis-AFS	Flight Management Guidance/Automation
221	The flightcrew must be able to understand the Automation's status and behavior, especially during unusual or demanding situations.	All	34	34	FAA 1996 Automation Report	Automation Error Mgt SA	Automation Surprise	Mis-AFS Workload Distraction	Flight Management Guidance/Automation Knowledge
227	Invest in more coaching and less pass/fail testing.: • Improve the debriefing of flightcrew performance after simulator sessions, IOE, proficiency checks, etc. (e.g., standardization of instructor debriefs, video replays). • Focus more on practicing how to manage the different automated systems in different circumstances, especially the judgments that have to be made on transitioning between different levels of Automation (e.g., when to turn it off or on, or to change to a different level or mode). • Encourage initial/recurrent assessments or checks to be more "learning oriented." Emphasis should be focused so that learning becomes the primary objective rather than passing or failing.	All	34	All	FAA 1996 Automation Report	Automation	Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge
238	Initial and recurrent training should provide a clear understanding of operationally relevant Automation principles and ensure user proficiency for the cockpit automated systems	All	34	34	FAA 1996 Automation Report	Automation	Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge Problem Solving Decision Making

Figure 4.2.10.1 (continued)

4.2.10.2 Error Management

- Filter Evidence Table FAA 1996 Automation Report
- Filter Topics [Error Management]
  - See Figure 4.2.10.2
  - **Result – FAA 1996 Automation Report – Error Management**
    - The report recommends educating crews as to hazardous states of awareness and the need for countermeasures to maintain vigilance.
    - Share operational information.
    - At the time of the report the writers acknowledged insufficient countermeasures to address human factor performance issues.
    - Identify and correct pilot insufficient mental models of automation to prevent operational errors.
    - Current evaluation criteria do not address the skills in areas such as automation.
  - Summary – The report recognized that monitoring and awareness skills were lacking in the automation environment at the time the report was issued. It begins by recommending education of the "hazardous states of awareness", a term it uses to denote a certain phenomenon with respect to situation awareness. Next it recommends sharing operational information to learn from crew errors, followed by proposing to improve the training of operational understanding of the automated systems in order to improve performance. Finally the report recognizes that the evaluation process simply does not address automation skill and should be modified

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
205	Recommendation SA-8: The FAA should ensure that flightcrews are educated about hazardous states of awareness and the need for countermeasures to maintain vigilance. The FAA should encourage operators to: Develop operational procedures and strategies to foster attention Management skills with the objective of avoiding hazardous states of awareness; and Develop techniques to apply during training to identify and minimize hazardous states of awareness.	All	34	All	FAA 1996 Automation Report	MonitoringXchecking Error SA UAS	Error Mgt	Compliance CRM	SA
206	Recommendation Comm/ Coord-3: The FAA should lead an industry-wide effort to share safety information obtained from in-service data and from difficulties encountered in training. This effort should be capable of assisting in the identification and resolution of problems attributed to flight crew error.	All	34	All	FAA 1996 Automation Report	Criticality	Error Mgt	Mis A/C State Compliance Mis Sys Mis-AFS	All
214	Insufficient criteria, methods, and tools for design, training, and evaluation. Existing methods, data, and tools are inadequate to evaluate and resolve many of the important human performance issues. It is relatively easy to get agreement that Automation should be human-centered, or that potentially hazardous situations should be avoided; it is much more difficult to get agreement on how to accomplish these objectives.	All	34	All	FAA 1996 Automation Report	Competencies	Automation Error Mgt	Mis-AFS Mis-Sys	SA Problem Solving Decision Making Knowledge Flight Management Guidance/Automation
233	Identify and correct oversimplifications in pilots' mental models of system functions.	All	34	All	FAA 1996 Automation Report	Criticality Competencies Knowledge	Automation Error Mgt	Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance/Automation Knowledge
243	Checkride criteria do not include or emphasize some of the skill areas mentioned above, such as Management of Automation or other known problem areas of line operation.	All	34	34	FAA 1996 Automation Report	Generation Automation Competencies	Automation Error Mgt	Mis-AFS	Flight Management Guidance/Automation Knowledge Problem Solving Decision Making

Figure 4.2.10.2 – Error Management/FAA HF Report

4.2.10.3 Manual Aircraft Control

- Filter Evidence Table FAA 1996 Automation Report
- Filter Topics [Manual Aircraft Control]
- Suppress superfluous.
  - See Figure 4.2.10.3
  - **Result – FAA 1996 Automation Report – Manual Aircraft Control**
    - Report found that pilots who used automation frequently and/or flew long haul flights experience degradation in manual handling skills.
    - Report recommends that flight crews receive explicit instruction and practice in reverting to manual flight.
  - Summary – The FAA 1996 automation report found that pilots who utilized automation frequently and/or flew long haul flights experienced degradation in manual aircraft control skill and recommended explicit instruction and practice in reverting to manual flight path control.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
240	Based on the incident data, accident data, and pilot and operator input evaluated by the HF team the following concerns surfaced: • degradation of manual flying skills of pilots who use Automation frequently, or who participate in long-haul operations, • A second area of concern is in the skills needed to perform recovery from unusual aircraft attitudes.	All	34	All	FAA 1996 Automation Report	Generation Automation Competencies Upset ManualACControl	Manual AC Control Automation	Upset Mis A/C State	Flight Management Guidance/Automation Manual Aviation Control
241	Flightcrews should explicitly receive instruction and practice in when and how to: (1) appropriately use Automation; (2) transition between various levels of Automation,; and (3) revert to manual flight.	All	34	34	FAA 1996 Automation Report	Generation Automation Competencies	Manual AC Control Automation	Compliance CRM Mis-AFS	Flight Management Guidance/Automation Manual Aviation Control Application of Procedures/Knowledge

Figure 4.2.10.3 – Manual Aircraft Control/FAA HF Report

4.2.10.4 Terrain

- Filter Evidence Table FAA 1996 Automation Report
- Filter Topics [Terrain]
  - See Figure 4.2.10.4
  - **Result – FAA 1996 Automation Report – Terrain**
    - Report found insufficient terrain awareness sometimes involving loss of control and energy awareness.
    - Recommends increasing flight crew understanding and awareness of the hazards involved in maintaining situation awareness in regards flight path proximity to terrain.
  - Summary – The FAA Automation report found disturbing occurrences of lack of situation awareness in regards to flight path proximity to terrain. It recommends increasing the understanding of the crews with regard to this deficiency and the potential risks involved.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
194	Flightcrew situation awareness issues included vulnerabilities in: • Automation/mode awareness. • Flight path awareness: involving loss of control or controlled flight into Terrain) and energy awareness (especially low energy state).	All	34	34	FAA 1996 Automation Report	Automation Generation SA Error Mgt UAS Competencies	Automation Terrain Error Mgt	Mis-AFS Mis A/C State Terrain	SA Flight Management Guidance/Automation
201	Recommendation SA-1: The FAA should require operators to increase flightcrews' understanding of and sensitivity to maintaining situation awareness, particularly: • Mode and airplane energy awareness issues associated with autoflight systems (i.e., autopilot, autothrottle, flight Management system, and fly-by-wire flight control systems); • Position awareness with respect to the intended flight path and proximity to Terrain, obstacles, or traffic; and • Potential causes, flight crew detection, and recovery from hazardous pitch or bank angle Upsets while under autopilot control (e.g., wake vortex, subtle autopilot failures, engine failure in cruise, atmospheric turbulence).	All	34	34	FAA 1996 Automation Report	Automation Upset Generation Error Mgt	Error Mgt Automation Terrain	Mis-AFS Terrain	SA Flight Management Guidance/Automation
203	Recommendation SA-3: The FAA should encourage the aviation industry to develop and implement new concepts to provide better Terrain awareness.	All	34	ALL	FAA 1996 Automation Report	MonitoringXchecking Terrain SA	Terrain	Terrain	SA
212	Flightcrew situation awareness issues included vulnerabilities in, for example: • Automation/mode awareness. This was an area where we heard a universal message of concern about each of the aircraft in our charter. • Flight path awareness, including insufficient Terrain awareness (sometimes involving loss of control or controlled flight into Terrain) and energy awareness (especially low energy state).	All	34	34	FAA 1996 Automation Report	Terrain SA Automation UAS Competencies	Automation Terrain	Terrain Mis-AFS Mis A/C State	SA Flight Management Guidance/Automation

Figure 4.2.10.4 – Terrain/FAA HF Report

4.2.10.5 Surprise

- Filter Evidence Table FAA 1996 Automation Report
- Filter Topics [Surprise]
  - See Figure 4.2.10.5
  - **Result – FAA 1996 Automation Report – Surprise**
    - Pilots can be surprised by subtle behavior, overwhelmed by complexity of current systems operated in current environment.
    - Evidence shows vulnerabilities in pilots' understanding of system behavior creating 'automation surprises' resulting in differing nonstandard set of decisions regarding levels of automation to use and various inappropriate responses.
    - Current training not effectively dealing with flight crew vulnerabilities in above areas.

- Report writers believe that training need better prepare pilots for automation surprises as opposed to trial and error on the line.
- Use feedback from line operations in training to better train for surprises.
- Dedicated LOFT type simulator training needs to be developed and implemented to respond to above problems.
- Provide more opportunities to learn and practice as well as promote understanding rather than rote exercises.

o Summary – The report found that pilots could be surprised by subtle behavior and overwhelmed by complexity of current systems operated in current flight environment. The evidence shows vulnerabilities to surprise because of incomplete system understanding as well as the lack of appropriate responses in terms of utilizing the appropriate responses in dealing with the situations. The report recommends dedicated LOFT type training to give pilots practice in responding to system surprises, promoting better system understanding through training and developing good decisions and proper execution regarding reversion to appropriate levels of automation when surprises occur.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
195	Processes used for design, training, and regulatory functions inadequately address human performance issues: • users can be surprised by subtle behavior • overwhelmed by the complexity embedded in current systems operated within the current operating environment	ALL	34	34	FAA 1996 Automation Report	Automation Generation Error Mgt	Surprise Automation	Ops/Type Spec Mis-AFS	SA Flight Management Guidance/Automation
211	From the evidence, the HF Team identified issues that show vulnerabilities in flightcrew Management of Automation and situation awareness. Issues associated with flightcrew Management of Automation include concerns about: • Pilot understanding of the Automation's capabilities, limitations, modes, and operating principles and techniques. The HF Team frequently heard about Automation "surprises," where the Automation behaved in ways the flightcrew did not expect. "Why did it do that?" "What is it doing now?" and "What will it do next?" were common questions expressed by flightcrews from operational experience. • Differing pilot Decisions about the appropriate Automation level to use or whether to turn the Automation on or off when they get into unusual or non-normal situations.	ALL	34	34	FAA 1996 Automation Report	Automation SA Generation Error Mgt	Automation Surprise	Mis-AFS	Flight Management Guidance/Automation Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
213	Processes used for design, training, and regulatory functions inadequately address human performance issues. As a result, users can be surprised by subtle behavior or overwhelmed by the complexity embedded in current systems operated within the current operating environment. Process improvements are needed to provide the framework for consistent application of principles and methods for eliminating vulnerabilities in design, training, and operations.	ALL	34	ALL	FAA 1996 Automation Report	Automation Competencies	Surprise	Mis A/C State Mis-AFS Mis-Sys	SA Problem Solving Decision Making Knowledge
219	There have been situations where flightcrews have either inappropriately continued to use the Automation when they found themselves in an abnormal situation.	ALL	34	34	FAA 1996 Automation Report	Automation Error Mgt	Automation Surprise	Mis-AFS	Problem Solving Decision Making Knowledge Flight Management Guidance/Automation
221	The flightcrew must be able to understand the Automation's status and behavior, especially during unusual or demanding situations.	ALL	34	34	FAA 1996 Automation Report	Automation Error SA	Automation Surprise	Mis-AFS Workload Distraction	Flight Management Guidance/Automation Knowledge
225	The HF Team believes it is important for flightcrews to be prepared by their training (as opposed to "picking it up on the line"), so that they will be prepared to successfully cope with probable, but unusual situations.	ALL	34		FAA 1996 Automation Report	Competencies Surprise	Automation Surprise	Mis-AFS	Flight Management Guidance/Automation Knowledge
230	Use Automation surprises that occur on the line as subsequent training opportunities to learn more about the Automation and how to manage it.	ALL	34	34	FAA 1996 Automation Report	Criticality Competencies	Automation Surprise	Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance/Automation Knowledge
231	Support follow-up of Automation surprises in a simulator environment in LOFT scenarios or line operational evaluations.	ALL	34	34	FAA 1996 Automation Report	Criticality Competencies	Automation Surprise	Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance/Automation Knowledge
232	Provide more opportunities to learn and practice, especially how to handle surprising situations.	ALL	34	All	FAA 1996 Automation Report	Criticality Competencies Surprise	Automation Surprise	Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance/Automation Knowledge
234	Promote understanding rather than using rote training.	ALL	34	All	FAA 1996 Automation Report	Criticality Competencies Knowledge	Automation Surprise	Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance/Automation Knowledge
237	Continuous learning is one way to help ensure that pilots have the Knowledge they will need in order to effectively manage and use the Automation in a wide range of situations.	ALL	34	All	FAA 1996 Automation Report	Automation Knowledge Criticality Competencies	Automation Surprise	Mis-AFS	Flight Management Guidance/Automation Knowledge

Figure 4.2.10.5 – Surprise/FAA HF Report

4.2.10.6 Leadership

- Filter Evidence Table FAA 1996 Automation Report
- Filter Competencies [Leadership]
  - See Figure 4.2.10.6
  - Result – FAA 1996 Automation Report – Leadership
    - Important knowledge and skills required in modern automated aircraft include understanding the decision-making process especially in regards to unexpected events; workload and attention management; familiarity with the cognitive processes, especially as they relate to flight crew problem solving in airline operations.
  - Summary – The report found that leadership in the complex automated airline environment is especially important. The traits involved relate to understanding the process as well as making good decisions as a team, particularly in unfamiliar situations.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
242	Other important Knowledge and skill areas for flightcrews are: • understanding of Decision making processes (including team Decision making and handling unanticipated events), • workload and attention Management, and • understanding of other human cognitive processes (especially cognitive biases and limitations as they apply to flightcrew problem solving in airline operations).	All	34	All	FAA 1996 Automation Report	Competencies	Surprise Leadership	Workload Distraction	Leadership and Teamwork Problem Solving Decision Making Knowledge

Figure 4.2.10.6 – Leadership/FAA HF Report

4.2.10.7 Mismanaged Aircraft State

- Filter Evidence Table FAA 1996 Automation Report
- Filter Factors [Mis AC State]
- Suppress superfluous.
  - See Figure 4.2.10.7
  - **Result – FAA 1996 Automation Report – Mismanaged Aircraft State**
    - Vulnerabilities lie in flight path awareness sometimes involving LOC, terrain and energy awareness.
    - Flight crews are sometimes overwhelmed by subtleties and complexities of automated systems.
    - Based on incident, accident and operational data, recovery skills, (including manual handling) from mismanaged aircraft are not sufficient.
    - The report goes on to recommend regular training to minimize identified vulnerabilities.
  - Summary – The report found weakness in prevention of mismanaged aircraft states as well as in the skills to recover from them after entry. The states cited include flight path issues involving loss of control, terrain and energy awareness. Recommendations include regular training to avoid mismanage aircraft states as well as recovery from inadvertent entries.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
208	Recommendation Knowledge-3: The FAA should strongly encourage or provide incentives to make advanced maneuvers training an integral part of the training curriculum, especially in recurrent training.	All	34	ALL	FAA 1996 Automation Report	Competencies Generation ManualACControl Upset		Upset Adverse WX Mis A/C State	Manual Aircraft Control
212	Flightcrew situation awareness issues included vulnerabilities in, for example: • Automation/mode awareness. This was an area where we heard a universal message of concern about each of the aircraft in our charter. • Flight path awareness, including insufficient Terrain awareness (sometimes involving loss of control or controlled flight into Terrain) and energy awareness (especially low energy state).	All	34	34	FAA 1996 Automation Report	Terrain SA Automation UAS Competencies	Automation Terrain	Terrain Mis-AFS Mis A/C State	SA Flight Management Guidance/Automation Manual Aircraft Control
213	Processes used for design, training, and regulatory functions inadequately address human performance issues. As a result, users can be surprised by subtle behavior or overwhelmed by the complexity embedded in current systems operated within the current operating environment. Process improvements are needed to provide the framework for consistent application of principles and methods for eliminating vulnerabilities in design, training, and operations.	All	34	All	FAA 1996 Automation Report	Automation Competencies	Surprise	Mis A/C State Mis-AFS Mis-Sys	SA Problem Solving Decision Making Knowledge
240	Based on the incident data, accident data, and pilot and operator input evaluated by the HF team the following concerns surfaced: • degradation of manual flying skills of pilots who use Automation frequently, or who participate in long-haul operations, • A second area of concern is in the skills needed to perform recovery from unusual aircraft attitudes.	All	34	All	FAA 1996 Automation Report	Generation Automation Competencies Upset ManualACControl	Manual AC Control Automation	Upset Mis A/C State	Flight Management Guidance/Automation Manual Aircraft Control

Figure 4.2.10.7 – Mismanaged Aircraft State/FAA HF Report

4.2.10.8 Upset

- Filter Evidence Table FAA 1996 Automation Report
- Filter Keywords [Upset]
- Suppress superfluous.
  - See Figure 4.2.10.8
  - **Result – FAA 1996 Automation Report – Upset**
    - An area of concern is in the skills to detect and recover from unusual attitudes
    - Pilots could benefit from unusual attitude training
    - Recommend increase flight crew understanding and sensitivity in maintaining situation awareness regarding potential causes and detection of upsets from wake vortex, autopilot failures, engine failures and atmospheric disturbances.
    - Further recommend making advance maneuvers a part of training.
  - Summary – The FAA automation report cited detection and recovery from unusual attitudes as an area of concern. It went on to recommend increasing flight crew understanding and sensitivity in maintaining situation awareness regarding potential causes and detection of upsets from wake vortex, autopilot failures, engine failures and atmospheric disturbances as well as recommending advance maneuver training an integral part of training.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
201	Recommendation SA-1: The FAA should require operators to increase flightcrews' understanding of and sensitivity to maintaining situation awareness, particularly: • Potential causes, flight crew detection, and recovery from hazardous pitch or bank angle Upsets while under autopilot control (e.g., wake vortex, subtle autopilot failures, engine failure in cruise, atmospheric turbulence).	ALL	34	34	FAA 1996 Automation Report	Automation Upset Generation Error Mgt	Error Mgt Automation Terrain	Mis-AFS Terrain	SA Flight Management Guidance/Automation Knowledge
208	Recommendation Knowledge-3: The FAA should strongly encourage or provide incentives to make advanced maneuvers training an integral part of the training curriculum, especially in recurrent training.	ALL	34	ALL	FAA 1996 Automation Report	Competencies Generation ManualACControl Upset		Upset Adverse WX Mis A/C State	Manual Aircraft Control
239	Pilots benefit from increased: Basic airmanship, unusual attitude recovery, CRM, team Decision making, awareness of operational aspects of aircraft design philosophy, Automation and mode Management;	ALL	34	ALL	FAA 1996 Automation Report	Automation Upset Criticality Competencies	Manual AC Control Monitoring Xcheck Error Mgt Leadership	Upset Compliance CRM	SA Leadership and Teamwork Problem Solving Decision Making Flight Management Guidance/Automation Manual Aircraft Control
240	Based on the incident data, accident data, and pilot and operator input evaluated by the HF team the following concerns surfaced: • degradation of manual flying skills of pilots who use Automation frequently, or who participate in long-haul operations, • A second area of concern is in the skills needed to perform recovery from unusual aircraft attitudes.	ALL	34	ALL	FAA 1996 Automation Report	Generation Automation Competencies Upset ManualACControl	Manual AC Control Automation	Upset Mis A/C State	Flight Management Guidance/Automation Manual Aircraft Control

Figure 4.2.10.8 – Upset/FAA HF Report

4.2.10.9 Generational Aspects

- Filter Evidence Table FAA 1996 Automation Report
- Filter Keywords [Generation] combine with…
- Filter Topics [Automation]
- Suppress superfluous.
    - See Figure 4.2.10.9
    - **Result – FAA 1996 Automation Report – Generation**
        - Situation awareness and automation issues include a general understanding of capabilities, limitations and modes, in addition to hazards of non-standard utilization.
        - Pilot vulnerabilities are flight path, terrain and energy awareness.
        - Pilot training needs to address the fact that pilots are surprised by subtle behavior and complexities of automation.
        - Training should focus on design principles that have operational consequences.
        - Existing methods of assessment are inadequate to evaluate human performance issues.
        - Current regulations have not kept pace with technical and human factors issues. Flight crew training needs to be re-balanced to cover automation issues.
        - The report recommends training to enhance mode and position awareness. In addition, training in the detection and recovery from hazardous conditions concerning traffic, terrain and upset is needed while using autoflight systems.
        - The report recommends reassessing requirements of initial and recurrent training to ensure that there is adequate content addressing mode and automation awareness, basic airmanship, CRM, and decision-making Training should include exposure to unanticipated events and workload/task management.
        - The report recommends that airman certification criteria be amended so that pilots have appropriate automation skills.
        - Pilots use automation when the situation requires a reversion to manual flight.
        - The emphasis in training should be on learning, instead of checking.
        - Regulated training and checking maneuvers should be evaluated for relevance and phased out if not appropriate.
        - Training should be adapted to background of trainees.
    - Summary – The FAA automation report found that pilots have various situation awareness issues with automation. Pilots need a general understanding of capabilities, limitations and modes, in addition to hazards of non-standard utilization. They are vulnerable to lack of flight path and energy awareness when using autoflight. In addition they are surprised by the subtleties and complexities of automation and the training courses fail to focus on operational principles of the autoflight architecture. Many pilots use the autoflight when inappropriate and fail to revert to manual flight. The training courses at the time of the study tended to be checking rather than learning oriented and had not kept pace with human factor issues in regard to automation. The report recommends that training enhance mode and position awareness when using automation, particularly with regard to terrain, energy and upset. In addition, the report recommends that there be adequate training content to ensure airmanship, CRM, decision-making, workload/task management when utilizing automation especially in demanding situations. Care should be taken to adapt training to the background of trainees. On the other hand, maneuvers not relevant to Gen 3 and 4 should be eliminated from checking. While using automation pilots continue to have difficulties detecting deviations from desired energy states and trajectories.

Note: Fig 4.2.10.1 and Fig 4.2.10.9 are the support tables for Generational Aspects (See fig 4.2.10.1 above) as these two tables contain the same evidence statements when filtering by generation + automation.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Key Words	Training Topics	Factors	Competencies
208	Recommendation Knowlege-3: The FAA should strongly encourage or provide incentives to make advanced maneuvers training an integral part of the training curriculum, especially in recurrent training.	All	34	All	FAA 1996 Automation Report	Competencies Generation Manual AC Control Upset		Upset Adverse WX Mis A/C State	Manual Aircraft Control
244	Maneuvers included in checkrides should be evaluated for continued relevance, be phased out.	All	34	All	FAA 1996 Automation Report	Competencies Generation			All
245	Training should also be adapted to the background of the pilot.	All	34	All	FAA 1996 Automation Report	Competencies Generation			

Figure 4.2.10.9 – Generational Aspects/FAA HF Report

4.2.10.10 Training Effect

- Filter Evidence Table FAA 1996 Automation Report
- Filter result for Keywords [Criticality]
- Combine with Search [Train]
- Suppress superfluous.
  - See Figure 4.2.10.10
  - **Result – FAA 1996 Automation Report – Training Effect**
    - Ensure flight crews are educated about hazardous states of awareness in terms of identification of them and need for countermeasures to maintain vigilance.
    - Ensure content of training courses contain automation management including transitioning between levels of automation, basic airmanship, CRM, decision making including unexpected events, and workload and task management.
    - Training courses should be rebalanced to ensure proper coverage of automation.
    - Pilots should practice what they lean in LOFT type training.
    - Training should include 'automation surprises' that occur in line operations.
    - Provide an accurate and operational mental model of automation.
    - Emphasize understanding rather than rote memorization.
  - Summary – The FAA 1996 automation report strongly emphasizes the effect of training and recommends major changes quite specifically in order to enhance operational safety. The report firstly promotes education regarding what it calls hazardous states of awareness in automated aircraft and promotes training to identify these states and stresses countermeasures to maintain vigilance. Training should include automation management including transitioning between levels of automation, basic airmanship, CRM, decision making including unexpected events, and workload and task management. The elements learned should also be practiced in LOFT type scenarios including unanticipated events taken from actual operational situations. The report goes on to recommend that training provide and accurate operational model of the automation for pilots so as to be able to cope with its management particularly in terms of levels of appropriate usage.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
205	Recommendation SA-8: The FAA should ensure that flightcrews are educated about hazardous states of awareness and the need for countermeasures to maintain vigilance. The FAA should encourage operators to: • Develop operational procedures and strategies to foster attention Management skills with the objective of avoiding hazardous states of awareness; and • Develop techniques to apply during training to identify and minimize hazardous states of awareness.	ALL	34	All	FAA 1996 Automation Report	MonitoringXchecking Error SA UAS	Error Mgt	Compliance CRM	SA
207	Recommendation Knowledge-2: The FAA should reassess the requirements that determine the content, length, and type of initial and recurrent flightcrew training. Ensure that the content appropriately includes: • Management and use of Automation, including mental models of the Automation and moving between levels of Automation; • Flightcrew situation awareness, including mode and Automation awareness; • Basic airmanship; • Crew Resource Management; • Decision making, including unanticipated event training; • Examples of specific difficulties encountered either in service or in training; and • Workload Management (task Management).	ALL	34	All	FAA 1996 Automation Report	Automation Competencies Generation SA	Leadership Automation	Compliance CRM	SA Problem Solving Decision Making Workload Management
208	Recommendation Knowledge-3: The FAA should strongly encourage or provide incentives to make advanced maneuvers training an integral part of the training curriculum, especially in recurrent training.	ALL	34	All	FAA 1996 Automation Report	Competencies Generation ManualACControl Upset		Upset Adverse WX Mis A/C State	Manual AC Control
216	Flightcrew training investments should be re-balanced to ensure appropriate coverage of Automation issues.	ALL	34	34	FAA 1996 Automation Report	Automation	Automation	Mis-AFS	Flight Management Guidance/Automation
220	Flightcrews should be given sufficient training on using the FMS to ensure proficiency at least for those capabilities used in normal day-to-day operations. The HF Team considers the practice of expecting flightcrews to acquire these basic skills while flying the line to be inappropriate.	ALL	34	34	FAA 1996 Automation Report	Automation Competencies	Automation Terrain Error Mgt	Mis-AFS	Flight Management Guidance/Automation
226	Pilots must have the opportunities to practice what they have learned in realistic operational settings through Line Operational Simulations (LOS) and LOFT scenarios: • Create a larger set of line-oriented scenarios to practice • Update these scenarios regularly to reflect the latest information about vulnerabilities from incident reporting systems or other sources. • Expand scenarios to focus more on unique error-vulnerable situations.	ALL	34	ALL	FAA 1996 Automation Report	Error	Automation Surprise	Mis-AFS Workload Distraction	Flight Management Guidance/Automation Knowledge Problem Solving Decision Making
230	Use Automation surprises that occur on the line as subsequent training opportunities to learn more about the Automation and how to manage it.	ALL	34	34	FAA 1996 Automation Report	Criticality Competencies	Automation Surprise	Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance/Automation Knowledge
232	Provide more opportunities to learn and practice, especially how to handle surprising situations.	ALL	34	ALL	FAA 1996 Automation Report	Criticality Competencies Surprise	Automation Surprise	Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance/Automation Knowledge
233	Identify and correct oversimplifications in pilots' mental models of system functions.	ALL	34	ALL	FAA 1996 Automation Report	Criticality Competencies Knowledge	Automation Error Mgt ManACControl	Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance/Automation Knowledge
234	Promote understanding rather than using rote training.	ALL	34	ALL	FAA 1996 Automation Report	Criticality Competencies Knowledge	Automation Surprise	Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance/Automation Knowledge
238	Initial and recurrent training should provide a clear understanding of operationally relevant Automation principles and ensure user proficiency for the cockpit automated systems	ALL	34	34	FAA 1996 Automation Report	Automation	Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge Problem Solving Decision Making
239	Pilots benefit from increased: Basic airmanship, unusual attitude recovery, CRM, team Decision making, awareness of operational aspects of aircraft design philosophy, Automation and mode Management;	ALL	34	ALL	FAA 1996 Automation Report	Automation Upset Criticality Competencies	Manual AC Control Monitoring Xcheck Error Mgt Leadership	Upset Compliance CRM	SA Leadership and Teamwork Problem Solving Decision Making Flight Management Guidance/Automation Manual AC Control

Figure 4.2.10.10 – Training Effect/FAA HF Report

4.2.11 Automation Training Practitioners' Guide

4.2.11.1 Automation

- Filter Evidence Table Automation Training Practitioners' Guide
- Filter Keywords [Automation]
  - See Figure 4.2.11.1
  - **Result – Automation Training Practitioners' Guide – Automation**
    - There is strong support for a new training concept
    - Training should be adapted to the individual.
    - Trainees need to understand why the automation system behaves and not just what the expected outcome is
    - CRM should be integrated throughout training.
    - Trainees should be taught all critical information, what they "need to know"
    - Automation monitoring should be a facet of all training programs.
    - Multiple assessment techniques are required to ascertain the acquisition of knowledge and competency.
    - Pilots need to understand the logic, design function and limitations of automation.
    - Pilots need to practice appropriate use of automation, transition between levels of automation and reversion to manual flight.
  - Summary – The Automation Training Practitioners' Guide advocates a new training concept. Specifically it recommends training in blocks, adapting to individual trainees, integrating CRM throughout training, and major emphasis on the "need to know" items. In addition it recommends using multiple assessment techniques, confirming that pilots understand the logic, design purpose and limitations of the automation. Lastly it recommends practice in operational setting of managing automation throughout the various levels including eversion to manual flight.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
59	Strong support for a new kind of training concept: Scenario-based, matter brought in blocks, gradually, adapted individually. Teach Automation Knowledge, the why's. Teach and test the conceptual Knowledge.	All	All	All	Automation Lyall	Automation		Mis-AFS	Knowledge Flight Management Guidance/Automation
61	Good CRM is especially important in automated aircraft; CRM should be integrated and used throughout the training.	All	All	34	Automation Lyall	Automation	Automation	CRM Workload Distraction Mis A/C State	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Communication Knowledge Application of Procedures/Knowledge Flight Management Guidance/Automation
62	Decide what pilots really need to learn about the Automation. (don't try to teach everything).	All	All	34	Automation Lyall	Automation Error MonitoringXchecking	Automation	CRM	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Communication Knowledge Application of Procedures/Knowledge Flight Management/Guidance Automation
63	Train also to monitor Automation. (This point is strongly underlined by the LOSA data	All	All	34	Automation Lyall	Automation	Automation Monitoring Xcheck	Compliance CRM Workload Distraction	SA Communication Flight Management Guidance/Automation
64	Use multiple assessment techniques to evaluate Automation Knowledge.	All	All	34	Automation Lyall	Automation	Automation		Knowledge Flight Management Guidance/Automation
65	Pilots need to be taught how the components of Automation work together in the overall system.	All	All	34	Automation Lyall	Automation	Automation		Knowledge Flight Management Guidance/Automation
66	Provide as much hands-on experience with the Automation as possible. (One cannot learn by just watching).	All	All	34	Automation Lyall	Automation	Automation		Flight Management Guidance/Automation
68	Teach the logic underlying the Automation and cover its limitations	All	All	34	Automation Lyall	Automation	Automation		Knowledge Flight Management Guidance/Automation
69	Flight crews should explicitly receive instruction and practice in when and how to:a. Appropriately use Automation;b. Transition between levels of Automation.Revert to manual flight."	All	All	34	Automation Lyall	Automation ManualACControl	Automation	Mis-AFS	Knowledge SA Problem Solving Decision Making Manual Aircraft Control Flight Management Guidance/Automation

Figure 4.2.11.1 – Automation/Automation Guide

4.2.11.2 Error Management

- Filter Evidence Table Automation Training Practitioners' Guide
- Filter Topics [Error Management] combine with
- Filter Factors [CRM]
    - See Figure 4.2.11.2
    - **Result – Automation Training Practitioners' Guide – Error Management**
        - Good CRM is especially important in automated aircraft.
        - Training should address the monitoring and cross-checking of tasks where automation systems are involved
        - In order to manage automation errors in is important to know how and when to transition levels of automation, in addition to reversions to manual flight.
    - Summary – The Automation Training Practitioners' Guide stresses that good CRM is particularly important with automation. It espouses monitoring of automation and notes that this skill must be taught and practiced. Finally it points that in order to deal with unexpected situations, including crew errors, pilots must be skilled in managing the transition between the various levels of automation including reversion to manual flight.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
61	Good CRM is especially important in automated aircraft; CRM should be integrated and used throughout the training.	All	All	34	Automation Lyall	Automation	Automation	CRM Workload Distraction Mis A/C State	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Communication Knowledge Application of Procedures/Knowledge Flight Management Guidance/Automation
63	Train also to monitor Automation. (This point is strongly underlined by the LOSA data	All	All	34	Automation Lyall	Automation	Automation Monitoring Xcheck Error Mgt	Compliance CRM Workload Distraction	SA Communication Flight Management Guidance/Automation
69	Flight crews should explicitly receive instruction and practice in when and how to:a. Appropriately use Automation;b. Transition between levels of Automation.Revert to manual flight."	All	All	34	Automation Lyall	Automation ManualACControl	Automation	Mis-AFS	Knowledge SA Problem Solving Decision Making Manual Aircraft Control Flight Management Guidance/Automation

Figure 4.2.11.2 – Error Management/Automation Guide

4.2.11.3 Manual Aircraft Control

- Filter Evidence Table Automation Training Practitioners' Guide
- Filter result for Topics [Manual Aircraft Control]
  - See Figure 4.2.11.3
  - **Result – Automation Training Practitioners' Guide – Manual Aircraft Control**
    - Ensure flights crew can fly manually without automation.
    - Flight crews need instruction, practice and assessment on being able to revert to manual flight.
  - Summary – The Automation Training Practitioners' Guide explicitly states that flight crews need to be able to fly manually in automated aircraft. It continues by saying that trainees should receive instruction on when and how to revert to manual flight and practice accordingly in training.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
60	Make sure flight crews learn to fly manually without the Automation.	All	All	34	Automation Lyall	ManualACControl Automation	Manual AC Control Automation	Mis-AFS Pilot Incap	Manual Aircraft Control Flight Management Guidance/Automation
69	Flight crews should explicitly receive instruction and practice in when and how to: a. Appropriately use Automation; b. Transition between levels of Automation.Revert to manual flight."	All	All	34	Automation Lyall	Automation ManualACControl	Automation Error Mgt Manual AC Control	Mis-AFS	Knowledge SA Problem Solving Decision Making Manual Aircraft Control Flight Management Guidance/ Automation

Figure 4.2.11.3 – Manual Aircraft Control/Automation Guide

4.2.11.4 Generational Aspects

- Filter Evidence Table Automation Training Practitioners' Guide
- Filter Applicability to Gens [34]
- Suppress Superfluous.
  - See Figure 4.2.11.4
  - **Result – Automation Training Practitioners' Guide – Generational Aspects**
    - There is strong support for a new training concept
    - Training should be adapted to the individual.
    - Trainees need to understand why the automation system behaves and not just what the expected outcome is
    - CRM should be integrated throughout training.
    - Trainees should be taught all critical information, what they "need to know"
    - Automation monitoring should be a facet of all training programs.
    - Multiple assessment techniques are required to ascertain the acquisition of knowledge and competency.
    - Pilots need to understand the logic, design function and limitations of automation.
    - Pilots need to practice appropriate use of automation, transition between levels of automation and reversion to manual flight.
  - Summary – The Automation Training Practitioners' Guide advocates a new training concept, adapted to Gen 3 and gen 4 aircraft. Specifically it recommends training in blocks, adapting to individual trainees, integrating CRM throughout training, and major emphasis on the "need to know" items. In addition it recommends using multiple assessment techniques, confirming that pilots understand the logic, design purpose and limitations of the automation. Lastly it recommends practice in operational setting of managing automation throughout the various levels including eversion to manual flight.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Training Topics	Factors	Competencies
59	Strong support for a new kind of training concept: Scenario-based, matter brought in blocks, gradually, adapted individually. Teach Automation Knowledge, the why's. Teach and test the conceptual Knowledge. [details: see Lyall]	All	All	All	Automation Lyall	Automation Generation	Manual AC Control Automation		Mis-AFS	Knowledge Flight Management Guidance/Automation
60	Make sure flight crews learn to fly manually without the Automation.	All	All	34	Automation Lyall	ManualACControl Automation Generation	Automation Error Mgt	Manual AC Control Automation	Mis-AFS Pilot Incap	Manual AC Control Flight Management Guidance/ Automation
61	Good CRM is especially important in automated aircraft; CRM should be integrated and used throughout the training.	All	All	34	Automation Lyall	Automation Generation	Automation Monitoring Xcheck Error Mgt	Automation Error Mgt	CRM Workload Distraction Mis A/C State	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Communication Knowledge Application of Procedures/Knowledge Flight Management Guidance/ Automation
62	Decide what pilots really need to learn about the Automation. (don't try to teach everything).	All	All	34	Automation Lyall	Automation Error MonitoringXcheck Generation	Automation	Automation	CRM	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Communication Knowledge Application of Procedures/Knowledge Flight Management Guidance/Automation
63	Train also to monitor Automation. (This point is strongly underlined by the LOSA data	All	All	34	Automation Lyall	Automation Generation	Automation	Automation Monitoring Xcheck Error Mgt	Compliance CRM Workload Distraction	SA Communication Flight Management Guidance/Automation
65	Pilots need to be taught how the components of Automation work together in the overall system.	All	All	34	Automation Lyall	Automation Generation	Automation	Automation		Knowledge Flight Management Guidance/Automation
68	Teach the logic underlying the Automation and cover its limitations	All	All	34	Automation Lyall	Automation Generation	Automation Error Mgt Manual AC Control	Automation		Knowledge Flight Management Guidance/Automation
69	Flight crews should explicitly receive instruction and practice in when and how to: a. Appropriately use Automation;b. Transition between levels of Automation.Revert to manual flight."	All	All	34	Automation Lyall	Automation ManualACControl generation	Automation Error Mgt Manual AC Control	Automation Error Mgt Manual AC Control	Mis-AFS	Knowledge SA Problem Solving Decision Making Manual Aircraft Control Flight Management Guidance/Automation

Figure 4.2.11.4 – Generational Aspects/Automation Guide

4.2.11.5 Training Effect

- Filter Evidence Table Automation Training Practitioners' Guide
- Filter result for Key Words [Training]
    - See Figure 4.2.11.5
    - **Result – Automation Training Practitioners' Guide – Training Effect**
        - Ensure that flight crews learn to fly manually without the automation.
        - CRM is integrated throughout training.
        - Train monitoring of the automation.
        - Pilots need to understand the logic, design function and limitations of automation.
        - Pilots need to practice appropriate use of automation, transition between levels of automation and reversion to manual flight
    - Summary – The Automation Training Practitioners' Guide specifies certain training to effect improved operational safety with regard to automation. The guide states that automation safety depends on teaching flight crews to effectively fly manually. CRM should be integrated throughout training and monitoring of the automation does not come automatically, it must be taught. Pilots need to have hands on experience using the autoflight and should be given practice, particularly in mode transitions and reversions. Finally the pilots must understand the logic, design and the limitations of the automation in order to respond appropriately in various situations.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
60	Make sure flight crews learn to fly manually without the Automation.	All	All	34	Automation Lyall	ManualACControl Automation Generation Training	Manual AC Control Automation	Mis-AFS Pilot Incap	Manual Aircraft Control Flight Managemen/Guidance/Automation
61	Good CRM is especially important in automated aircraft; CRM should be integrated and used throughout the training.	All	All	34	Automation Lyall	Automation Generation Training	Automation Error Mgt	CRM Workload Distraction Mis A/C State	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Communication Knowledge Application of Procedures/Knowledge Flight Management Guidance/Automation
63	Train also to monitor Automation. (This point is strongly underlined by the LOSA data	All	All	34	Automation Lyall	Automation Generation Training	Automation Monitoring Xcheck Error Mgt	Compliance CRM Workload Distraction	SA Communication Flight Management Guidance/Automation
65	Pilots need to be taught how the components of Automation work together in the overall system.	All	All	34	Automation Lyall	Automation Generation Training	Automation		Knowledge Flight Management Guidance/Automation
66	Provide as much hands-on experience with the Automation as possible. (One cannot learn by just watching).	All	All	34	Automation Lyall	Automation Generation Training	Automation		Flight Management Guidance/Automation
68	Teach the logic underlying the Automation and cover its limitations	All	All	34	Automation Lyall	Automation Generation Training	Automation		Knowledge Flight Management Guidance/Automation
69	Flight crews should explicitly receive instruction and practice in when and how to:a. Appropriately use Automation;b. Transition between levels of Automation.Revert to manual flight."	All	All	34	Automation Lyall	Automation ManualACControl Generation Training	Automation Error Mgt Manual AC Control	Mis-AFS	Knowledge SA Problem Solving Decision Making Manual Aircraft Control Flight Management Guidance/Automation Manual Aircraft Control

Figure 4.2.11.5

4.2.12 TAWS Saves

4.2.12.1 Terrain

- Filter Evidence Table TAWS Saves
- Filter Topics [Terrain]
  - See Figure 4.2.12.1
  - **Result – TAWS Saves – Terrain**
    - EGPWS has entered commercial aviation in the last decade and to a great extent has minimized CFIT accidents.
    - The TAWS Saves confirms that it is and effective safety tool but it still depends on trained crew actions to pull up when the warning occurs.
  - Summary – The TAWS Saves report is essentially an accident report without an accident. Five incidents that the writers of the report felt would probably have resulted in accidents are studied in an accident-investigation format. Two major points emerge from this report. Firstly, a proper EGPWS is an effective tool in reducing CFIT accidents and secondly, that no matter how good the warning system is, terrain avoidance still depends on a properly trained reaction of the flight crew.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
294	EGPWS / TAWS technology has entered airline and corporate operations during the last five years; to date no aircraft fitted with such a system has been involved in a CFIT accident.	All	All	All	TAWS Saves	Terrain	Landing Issues Terrain	Mis A/C State	
295	The 'saves' confirm that TAWS is a very effective safety tool yet it still depends on crew action for the last defence; always pull up when a warning is given.	APR	All	All	TAWS Saves	Terrain	Terrain	Terrain Compliance	SA Application of Procedures/Knowledge

Figure 4.2.12.1 – Terrain/TAWS Saves

4.2.13 Accident Data Using Augmented Cast Data

4.2.13.1 Manual Aircraft Control

- Filter Evidence Table Pilot Survey
- Filter Keywords [Manual Aircraft Control]
  - See Figure 4.2.13.1c
  - **Result – Augmented CAST Data – Manual Aircraft Control**
    - In the decades 2000 and 2010, runway excursions accounted for around 23% of total accidents.
    - In the decade from 2000 to 2010, landing short accidents or undershoots tripled from the previous decade and accounted for 8% of total accidents.

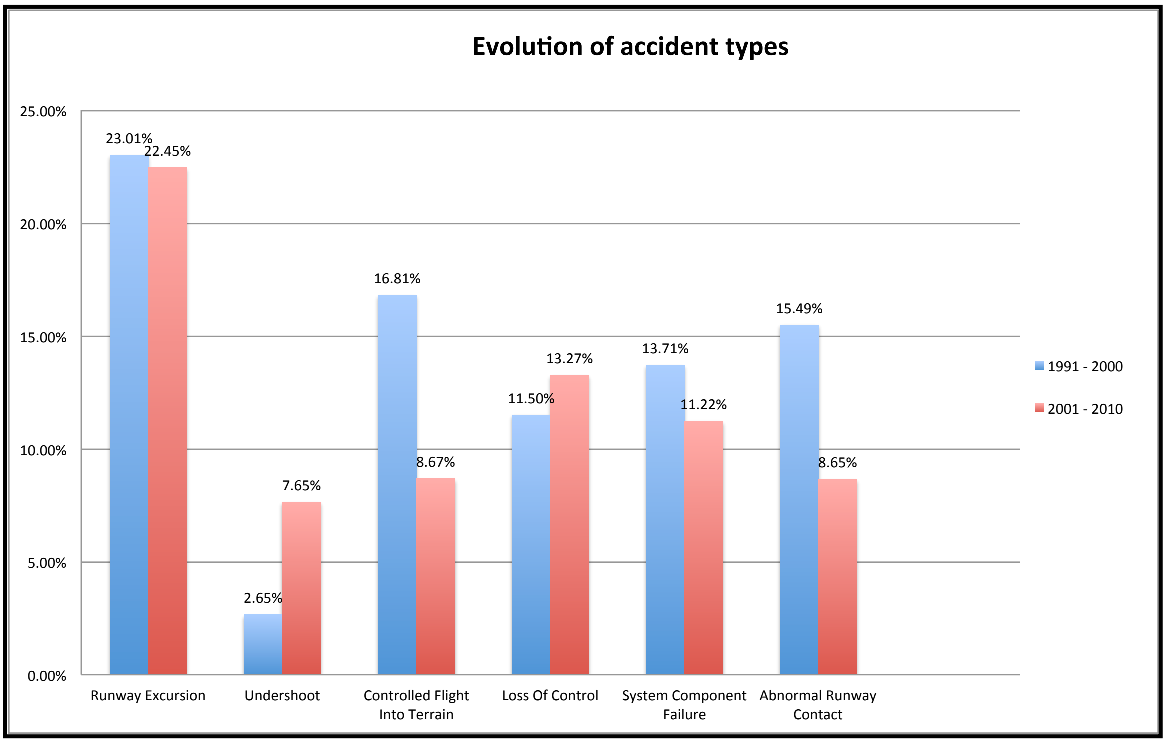

Figure 4.2.13.1

- Runway accidents in general have increased significantly to almost 50% of all accidents in the last 10 years.

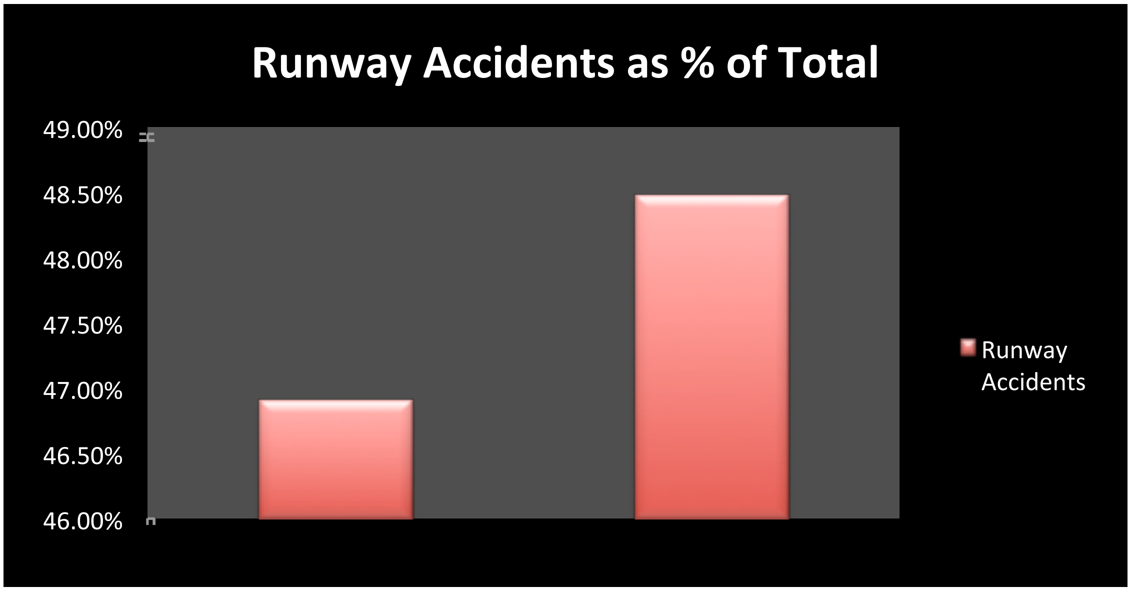

Figure 4.2.13.1a

- Summary – A review of accident data over the last 20 years from the CAST archives, augmented with NTSB data from 2009 and 2010, indicates a significant rise in events during flight phases where, pilots always or usually often fly the aircraft manually (take-off, landing and taxying). While a definitive conclusion relating to the deterioration of manual control skills cannot be made directly, the trend is consistent with this hypothesis and supported by many other sources.

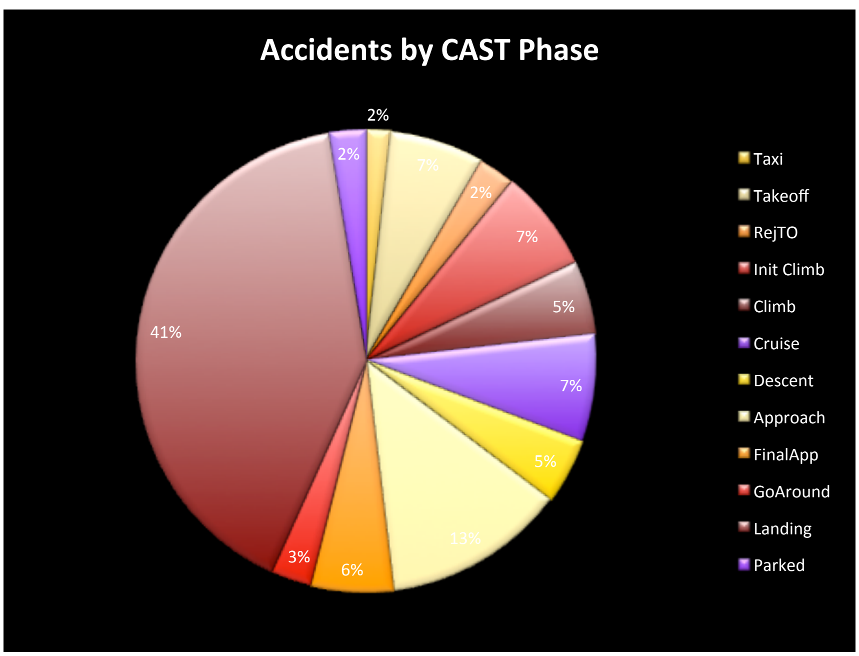

Figure 4.2.13.1b

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
283	Runway Excursion, together with Controlled Flight Into Terrain (CFIT), Loss Of Control (LOC), System/Component Failure (SCF) and Abnormal Runway Contact (ARC) accounted for 78% of all accidents.	All	All	All	CAST+	ManualACControl	Manual AC Control Runway Issues Landing Issues System Malfunction	Upset Syst mal Mis A/C State	ALL
284	Runway excursion (RE), which accounted for 26% of all accidents between 1991 and 2000, increased by almost 10% in the 2001- 2010 period	TO LDG	All	All	CAST+	ManualACControl	Manual AC Control Landing Issues	Mis A/C State	
285	Between the 90 decade and 2000 decade CFIT decreased 17% to 9%	All	All	All	CAST+	Terrain	Manual AC Control Runway Issues Landing Issues	Terrain	SA
289	Between the 90 decade and 2000 decade Land Short or Undershoot Runway Excursions doubled from 3% to 7% (Manual Handling)	APP LDG	All	All	CAST+	ManualACControl	Manual AC Control Runway Issues	Mis A/C State	Manual Aircraft Control SA
290	Looking at Runway Issues comparing the 90 decade and the 2000 decade, the percentage of accidents for wihich runway issues were considered causal was almost 50% (47% and 49%)	TO LDG	All	All	CAST+	ManualACControl	Manual AC Control Landing Issues	Mis A/C State	Manual Aircraft Control SA
291	Undershoot emerged as important categories (ie > 5%) during the 2000 decade a 8%	TAXI	All	All	CAST+	ManualACControl	Manual AC Control Landing Issues	Mis A/C State	Manual Aircraft Control SA
292	Over the last 20 years, 84% of all accidents happened during the approach/ landing or takeoff/climb phases. The approach/landing is by far the most critical of the flight phases, accounting for 63% of all occurrences. The takeoff/climb phase is the second most hazardous phase, accounting for 21% of all events.	APP LDG TO CLB	All	All	CAST+	Phase	Manual AC Control Landing Issues	Mis A/C State	Manual Aircraft Control SA

Figure 4.2.13.1c – Manual Aircraft Control/CAST+Data

4.2.13.2 System Malfunction

- Filter Evidence Table Pilot Survey
- Filter Topics [Sys Mal]
    - See Figure 4.2.13.2
    - **Result – Augmented CAST Data – System Malfunction**
        - System Malfunction ranks as a major accident category.
        - System malfunctions as an accident category remains significant but has decreased somewhat from 14% and 11% in the last 20 years. (See Fig 4.2.13.1)
    - Summary – While system malfunctions still rank as a major cause of accidents at around 11% to 14%.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
283	Runway Excursion, together with Controlled Flight Into Terrain (CFIT), Loss Of Control (LOC), System/Component Failure (SCF) and Abnormal Runway Contact (ARC) accounted for 78% of all accidents.	ALL	All	All	CAST+	ManualACControl	Manual Handling Runway Issues Landing Issues System Malfunction	Upset System Malfunction Mis A/C State	All
287	Between the 90 decade and 2000 decade System Malfunction accidents decreased (14% to 11%)	ALL	All	All	CAST+		System Malfunction	System Malfunction	

Figure 4.2.13.2 – System Malfunction/CAST+Data

4.2.13.3 Upset

- Filter Evidence Table Pilot Survey
- Filter Factors [Upset]
  - See Figure 4.2.13.3
  - **Result – Augmented CAST Data – Upset**
    - Upset ranks as a major accident category.
    - Upset as an accident category has on average shown a slight increase in the last 20 years.
  - Summary – Upset still ranks as a major cause of accidents. its percentage of total accidents has remained steady at around 13% in the last two decades.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
286	Between the 90 decade and 2000 decade Loss or Control accidents remained steady at around 13%.	ALL	All	All	CAST+		Terrain	Upset Mis A/C State	All

Figure 4.2.13.3 – Upset/CAST+Data

4.2.13.4 Landing Issues

- Filter Evidence Table Pilot Survey
- Filter result for Topics [Landing Issues]
  - See Figure 4.2.13.4a
  - **Result – Augmented CAST Data – Landing Issues**
    - Runway Excursions (majority on landing) accounted for 26% of all accidents in the last decade and increase of 10% over the previous decade.
    - In the last decade landing short (undershoots) were 7%, more than double the previous decade.
    - Runway issues (majority on landing) accounted for almost 50% of all accidents. (See Fig 4.2.13.1)
    - The phase with the highest percentage of accidents is the landing phase at 41%.

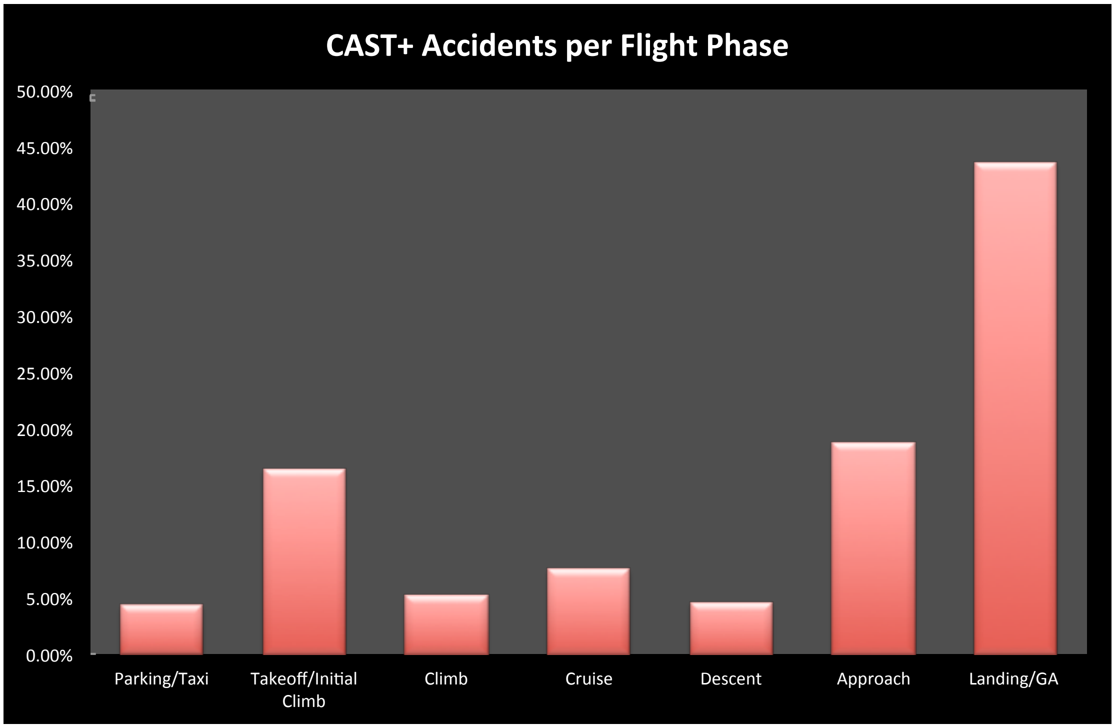

Figure 4.2.13.4

- Summary – Landing issues are a major component of all aircraft accidents and are increasing, according to the data from the last 2 decades. 41% of all accidents happen in the landing phase, by far the leading phase in which accidents occur. In the last two decades the statistics show a significant increase in the proportion of accidents related to various landing issues, particularly with regard to runway excursions and landing short.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
283	Runway Excursion, together with Controlled Flight Into Terrain (CFIT), Loss Of Control (LOC), System/Component Failure (SCF) and Abnormal Runway Contact (ARC) accounted for 78% of all accidents.	ALL	All	All	CAST+	ManualACControl	Manual Handling Runway Issues Landing Issues System Malfunction	Upset System Malfunction Mis A/C State	All
284	Runway excursion (RE), which accounted for 26% of all accidents between 1991 and 2000, increased by almost 10% in the 2001- 2010 period	TO LDG	All	All	CAST+	ManualACControl	Manual Handling Landing Issues	Mis A/C State	Manual AC Control SA
289	Between the 90 decade and 2000 decade Land Short or Undershoot Runway Excursions doubled from 3% to 7% (Manual Handling)	APR LDG	All	All	CAST+	ManualACControl	Manual Handling Runway Issues	Mis A/C State	Manual AC Control SA
290	Looking at Runway Issues comparing the 90 decade and the 2000 decade, the percentage of accidents for wihich runway issues were considered causal was almost 50% (47% and 49%)	TO LDG	All	All	CAST+	ManualACControl	Manual Handling Landing Issues	Mis A/C State	Manual AC Control SA
291	Undershoot emerged as important categories (ie > 5%) during the 2000 decade a 8%	TAXI	All	All	CAST+	ManualACControl	Manual Handling Landing Issues	Mis A/C State	Manual AC Control SA
293	Accidents by Phase: o Parking/Taxi 4% o Takeoff/Initial Climb 16% o Climb 5% o Cruise 7% o Descent 5% o Approach & GA 22% (GA 3%) o Landing 41%	ALL	All	All	CAST+	Phase	Landing Issues Unstable APP	Mis A/C State	All

Figure 4.2.13.4a – Landing Issues/CAST+Data

4.2.13.5 Mismanaged Aircraft State

- Filter Evidence Table Pilot Survey
- Filter result for Factors [Mis A/C State]
  - See Figure 4.2.13.5
  - **Result – Augmented CAST Data – Mismanaged Aircraft State**
    - In the last 10 years runway excursions accounted for 26% of all accidents
    - In the last decade landing short (undershoots) were 7%, more than double the previous decade and emerged as a major accident category.
    - Runway issues (majority on landing) accounted for almost 50% of all accidents.
  - Summary – Even though the accident rate has decreased in the last 20 years, the rate of accidents due to a “mismanaged aircraft state” has increased. Runway excursions, landing short and ground collision are all up and exemplify this trend.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
282	From 1991 to 2010, Runway Excursion (RE) represented by far the main accident category, accounting for 28% of all events.	TO LDG	All	All	CAST+	ManualACControl	Landing Issues	Mis A/C State	
283	Runway Excursion, together with Controlled Flight Into Terrain (CFIT), Loss Of Control (LOC), System/Component Failure (SCF) and Abnormal Runway Contact (ARC) accounted for 78% of all accidents.	ALL	All	All	CAST+	ManualACControl	Manual Handling Landing Issues System Malfunction	Landing problems Upset System Malfunction Mis A/C State	All
284	Runway excursion (RE), which accounted for 26% of all accidents between 1991 and 2000, increased by almost 10% in the 2001- 2010 period	TO LDG	All	All	CAST+	ManualACControl	Manual Handling Landing Issues	Mis A/C State	
289	Between the 90 decade and 2000 decade Land Short or Undershoot Runway Excursions doubled from 3% to 7% (Manual Handling)	APR LDG	All	All	CAST+	ManualACControl	Manual Handling Runway Issues	Mis A/C State	Manual AC Control SA
290	Looking at Runway Issues comparing the 90 decade and the 2000 decade, the percentage of accidents for wihich runway issues were considered causal was almost 50% (47% and 49%)	TO LDG	All	All	CAST+	ManualACControl	Manual Handling Landing Issues	Mis A/C State	Manual AC Control SA
291	Undershoot emerged as important categories (ie > 5%) during the 2000 decade a 8%	TAXI	All	All	CAST+	ManualACControl	Manual Handling Landing Issues	Mis A/C State	Manual AC Control SA

Figure 4.2.13.5 – Mismanaged Aircraft State/CAST+Data

4.2.13.6 Phases of Flight

- Filter Evidence Table Pilot Survey
- Filter Keywords [Phase]
  - See Figure 4.2.13.6
  - **Result – Augmented CAST Data – Phases of Flight**
    - In the last 20 years over 84% of all accidents during the approach/landing or the take-off/climb phases. (See Fig 4.12.4a)
    - The approach/landing accounted for more than 63% of all accidents.
    - The landing phase has by far the most accidents at 41%
    - The take-off/climb phase is second with 21% of all accidents.
    - 4% of all accidents take place in taxi phases of flight.
  - Summary – 84% of all accidents occur in the APP/LDG phases of flight or in the TO/CLB with the leading phase being LDG at 41%. The phases of flight, which show an increasing trend in terms of percentage of total accidents, are LDG and TAXI.

E ref	Evidence Statement	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
292	Over the last 20 years, 84% of all accidents happened during the approach/ landing or takeoff/climb phases. The approach/landing is by far the most critical of the flight phases, accounting for 63% of all occurrences. The takeoff/climb phase is the second most hazardous phase, accounting for 21% of all events.	APR LDG TO CLB	All	All	CAST	Phase	Manual AC Control Landing Issues	Mis A/C State	Manual AC Control SA
293	Accidents by Phase: o Parking/Taxi 4% o Takeoff/Initial Climb 16% o Climb 5% o Cruise 7% o Descent 5% o Approach & GA 22% (GA 3%) o Landing 41%	ALL	All	All	CAST	Phase	Landing Issues Unstable APP	Mis A/C State	All

Figure 4.2.13.6 – Phases of Flight/CAST+Data

GLOSSARY OF TERMS

ACRONYMS

A/C	Aircraft
ACAS	Airborne Collision Avoidance System
AirFASE	EBT Flight Data Analysis tool used in this report
AQP	Advanced Qualification Program
ATA	Air Transport Association
ATC	Air Traffic Control
ATO	Approved Training Organization
ATQP	Alternative Training and Qualification Program
CAA	Civil Aviation Authority
CRM	Crew Resource Management
EBT	Evidence-Based Training
FDA	Flight Data Analysis
FMS	Flight Management System
FOQA	Flight Operations Quality Assurance
FSTD	Flight Simulation Training Device
IOE	Initial Operating Experience
LOFS	Line Orientated Flight Scenario
LOFT	Line Oriented Flight Training
LOSA	Line Operational Safety Audit
PF	Pilot Flying
PIC	Pilot-in-Command
PM	Pilot Monitoring
PNF	Pilot Not Flying (former term for PM)
QAR	Quick Access Recorder
SOP	Standard Operating Procedure
STEADES	IATA Safety Trend Evaluation, Analysis and Data Exchange System
TEM	Threat and Error Management
TCS	Training Criticality Survey
UAS	Undesired Aircraft State

FLIGHT PHASE ABBREVIATIONS

The following abbreviations are used in this document. For full details see ICAO Doc 9995 3.3.3

GND	Pre-flight, taxi, post-flight
TO	Take-off
CLB	Climb
CRZ	Cruise
DES	Descent
APP	Approach
LDG	Landing

DEFINITIONS

Assessment. The determination as to whether a candidate meets the requirements of the competency standard.

ATA Chapters. The chapter numbering system controlled and published by the Air Transport Association, which provides a common referencing standard for all commercial aircraft documentation.

Behavior. The way a person responds, either overtly or covertly, to a specific set of conditions, which is capable of being measured.

Behavioral indicator. An overt action performed or statement made by any flight crewmember that indicates how the crew is handling the event.

Competency. A combination of skills, knowledge and attitudes required to perform a task to the prescribed standard.

Competency-based training. Training and assessment that are characterized by a performance orientation, emphasis on standards of performance and their measurement and the development of training to the specified performance standards.

Core competencies. A group of related behaviors, based on job requirements, which describe how to effectively perform a job. They describe what proficient performance looks like. They include the name of the competency, a description, and a list of behavioral indicators.

Closed loop task. A Task that has a definite beginning and end.

Critical flight maneuvers. Maneuvers that place significant demand on a proficient crew.

Critical system malfunctions. Aircraft system malfunctions that place significant demand on a proficient crew. These malfunctions should be determined in isolation from any environmental or operational context.

Developed upset. A condition meeting the definition of an aeroplane upset.

Developing upset. Any time the aeroplane begins to unintentionally diverge from the intended flight path or airspeed.

Evidence-based training (EBT). Training and assessment that is characterized by developing and assessing the overall capability of a trainee across a range of competencies rather than by measuring the performance of individual events or maneuvers.

EBT instructor. A person who has undergone a screening and selection process, successfully completed an approved course in delivering competency-based training, and is subsequently authorized to conduct recurrent assessment and training within an approved EBT program.

EBT module. A session or combination of sessions in a qualified FSTD as part of the 3-year cycle of recurrent assessment and training.

EBT session. A single defined period of training in a qualified FSTD that normally forms part of an EBT module.

EBT scenario. Part of an EBT session encompassing one or more scenario elements, constructed in to facilitate real time assessment or training.

EBT scenario element. Part of an EBT session designed to address a specific training topic

Error. An action or inaction by the flight crew that leads to deviations from organizational or flight crew intentions or expectations.

Error management. The process of detecting and responding to errors with countermeasures that reduce or eliminate the consequences of errors, and mitigate the probability of further errors or undesired aircraft states.

Exposure. The historical rate of occurrence i.e., the number of flights with a given condition, (factor, threat, error, etc.) divided by the number of flights (in this case take-offs) for a given grouping of aircraft. Note: In this report, the only grouping used was the aircraft generation.

Facilitation technique. An active training method, which uses effective questioning, listening and a non-judgmental approach and is particularly effective in developing skills and attitudes, assisting trainees to develop insight and their own solutions and resulting in better understanding, retention and commitment.

Factor. A reported condition affecting an accident or incident.

Flight crew member. A licensed crew member charged with duties essential to the operation of an aircraft during a flight duty period.

Inter-rater reliability. The consistency or stability of scores between different raters.

Line orientated flight scenario (LOFS). LOFS refers to training and assessment involving a realistic, 'real time', full mission simulation of scenarios that are representative of line operations.
Note: Special emphasis should be given to scenarios involving a broad set of competencies that simulate the total line operational environment, for the purpose of training and assessing flight crew members.

Maneuvers. A sequence of deliberate actions to achieve a desired flight path. Flight path control may be accomplished by a variety of means including manual aircraft control and the use of auto flight systems.

Meta analysis. Synthesizing research results by using various statistical methods to retrieve, select and combine results from previous separate but related studies.

Open loop task. Tasks involving continuous responses that are repeated and do not have a definite beginning and end

Outcome Grading. Assessment using a grading scale with two or more grades describing the overall outcome in relation to a defined outcome (not assessing the individual competencies in depth).

Phase of flight. A defined period within a flight.

Scenario. Part of a training module that consists of predetermined maneuvers and training events.

Threat. Events or errors that occur beyond the influence of the flight crew, increase operational complexity and must be managed to maintain the margin of safety.

Threat management. The process of detecting and responding to threats with countermeasures that reduce or eliminate the consequences of threats and mitigate the probability of errors or undesired aircraft states.

Training Criticality. The need for training

Training criticality survey. Pilot survey of training criticality in terms of threats and errors by aircraft per flight phase

Training effect. The potential effect of FSTD training in preventing or reducing the severity of an accident or incident.

Training event. Part of a training scenario that enables a set of competencies to be exercised.

Training objective. A clear statement that is comprised of three parts, i.e., the desired performance or what the trainee is expected to be able to do at the end of training (or at the end of particular stages of training), the performance standard that must be attained to confirm the trainee's level of competence and the conditions under which the trainee will demonstrate competence.

Undesired aircraft state. A position, condition, or attitude of an aircraft that clearly reduces safety margins and is a result of actions by the flight crew. It is a safety-compromising state that results from ineffective error management. Examples include unstable approaches, lateral deviations, firm landings, and proceeding towards wrong taxiway/runway. Events such as equipment malfunctions or ATC command errors can also place the aircraft in a compromised position, but these would be considered threats.

Unsafe situation. A situation, which has led to an unacceptable reduction in safety margin.

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Jari Nisula	HF/Engineer	EBT Accident Incident Analysis, sorting and classification of data, translation of results into training topics
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Dr Ashleigh Merritt	Statistician	Analysis, development and authoring of LOSA reports
Professor Patrick Murray	Pilot/Instructor/Scientist	Assistance with authoring elements of the report, in addition to guiding its construction and editing
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APPENDICES

APPENDIX 1
LOSA REPORTS

LOSA Archive Report: 10 Target Areas for Evidence Based Training

IATA ITQI EBT Working Group Report

April 2010

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Introduction

The IATA Evidence Based Training (EBT) study group, as part of IATA's Training Quality Initiative (ITQI), contacted The LOSA Collaborative seeking Line Operations Safety Audit (LOSA) information that could help shape future EBT curriculum for commercial airline pilots and instructors. The primary objective was for The LOSA Collaborative to mine the LOSA Archive and provide a list of systemic and/or pilot performance issues that could be used to direct and validate current EBT risk analyses, training products, and pilot skill sets.

Executive Summary

This report highlights 10 performance targets that The LOSA Collaborative recommends for further investigation by the ITQI/EBT study group. These recommendations are based on content analyses of LOSA observers' narratives and statistical analyses of the aggregated data in the LOSA Archive. The evidence for each target is provided in the report sections that follow.

1. Unstable Approach
2. Automation
3. Primary/Secondary Altimeters
4. Monitor/Cross-Check
5. Frequently Mismanaged Threats
6. Intentional Noncompliance
7. Captain Leadership / Communication Environment
8. ATC Threat Management
9. TEM by Phase of Flight
10. Weather Radar

The next few pages outline The LOSA Collaborative's Quality Assurance Process and introduce the reader to the LOSA Archive, the Threat and Error Management Framework, and the terms used in the report. The body of the report is then taken up with statistical evidence and narrative examples to support the above targets.

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LOSA Quality Assurance Process

To ensure LOSA data quality, airlines are required to participate in a five-part quality assurance process in order for the data to meet The LOSA Collaborative standard. This process is outlined below.

1. An agreement is reached between airline management and the pilots' association or representatives of the pilot group. This agreement ensures that all data will be de-identified, confidential, and sent directly to The LOSA Collaborative for analysis. It also states that once the LOSA results are presented, both parties have an obligation to use the data to improve safety.

2. The airline is assisted in selecting a diverse and motivated group of observers. A typical observer team will have representatives from a number of different airline departments, such as flight operations (all fleets), training, safety, and the flight crew association.

3. The observers receive training in the TEM framework, the observation methodology, and the LOSA software tool, which organizes data input. The LOSA Collaborative software also provides data security through automatic encryption. After the initial observer training, observers conduct at least two sample observations and then reconvene for recalibration sessions. During this time, observers are given one-on-one feedback on the quality of their observations and authorized to continue as observers on the project. The observer training and recalibration are considered essential for a standardized LOSA dataset.

4. When the encrypted observations are sent to The LOSA Collaborative, analysts read the observers' flight narratives and check that every threat and error has been coded accurately. This data integrity check ensures the airline's data are of the same standard and quality as other airlines in the LOSA Archive.

5. Once the initial data integrity check is complete, airline representatives who are fleet experts attend a data-verification roundtable with The LOSA Collaborative analysts. Together, they review the data against the airline's procedures, manuals, and policies to ensure that events and errors are valid and have been correctly coded. After the roundtable is completed, airline representatives are required to sign off on the data set as being an accurate rendering of threats and errors. Only then does analysis for an airline's final report begin.

The LOSA Archive

The LOSA Archive currently houses over 10,000 observations and more than 50 LOSA projects. The statistics in this document are drawn from a slightly smaller dataset: 8,375 flight observations from 42 LOSA Projects conducted during the years 2003 – 2010. The LOSAs conducted prior to 2003 (when the coding system was still being refined and before the data collection tool was introduced) are excluded from these analyses to enhance the stability and reliability of the findings.

- AeroMexico
- Air Canada
- Air Freight New Zealand
- Air Hong Kong
- Air New Zealand
- Air Nelson
- Air Transat
- Alaska Airlines
- All Nippon Airways
- Asiana Airlines
- Braathens ASA
- Cathay Pacific
- China Airlines
- Continental Airlines
- Continental Express
- Continental Micronesia
- Delta Air Lines
- DHL Air
- Emirates
- EVA Air / UNI Air
- Frontier Airlines
- Horizon Air
- Japan Airlines
- JetBlue
- LACSA
- Malaysia Airlines
- Mount Cook Airlines
- Qantas
- Regional Express Airline
- Saudi Arabian Airlines
- SilkAir
- Singapore Airlines
- Singapore Airlines Cargo
- TACA International
- TACA Peru
- TAP Portugal
- Thomas Cook
- US Airways
- WestJet

Threat and Error Management Framework

The data collected during a LOSA allow an airline to understand the safety and flight crew performance issues that arise during daily flight operations before an incident or accident. To best facilitate this understanding, all LOSA data are collected and analyzed with the Threat and Error Management (TEM) framework.

The Threat and Error Management (TEM) framework conceptualizes operational activity as a series of ongoing threats and errors that flight crews must manage to maintain adequate safety margins. Threats are external events or errors outside the influence of the flight crew that increase the operational complexity of a flight. Threats are everywhere in flight operations (thunderstorms, terrain, poorly signed runways, late changes from ATC, inoperable NAVAIDS events at the gate, ground crew not ready, mistakes in Dispatch paperwork, etc.) and flight crews have to divert their attention from normal duties to manage them. The more complex, challenging, and/or distracting the threat environment, the greater is the crew's workload.

Crew errors can vary from minor deviations, such as entering the wrong altitude but quickly catching the mistake, to something more severe, such as failing to set flaps before airplane takeoff. Regardless of cause or severity, the outcome of an error depends on whether the crew detects and manages the error before it leads to an unsafe outcome. This is why the foundation of TEM lies in understanding error management rather than focusing solely on error avoidance or error commission.

The Threat and Error Management (TEM) framework has been adopted by ICAO and the FAA:

- As of November 2006, TEM and LOSA concepts were added to several of the Annexes to the Convention on International Civil Aviation (Chicago Convention). In Annex 1 (Personnel Licensing), TEM is now a requirement for all pilot and ATCO licenses (standard). Annex 6 was amended to require TEM for all initial and recurrent flight crew training. In Annex 14 (Aerodromes), the new Safety Management System standards highlight LOSA as a recommended practice for normal operations monitoring.

- LOSA is officially recognized as an FAA Voluntary Safety Project. The current FAA Advisory Circular on LOSA (120.90) was drafted by members of The LOSA Collaborative in partnership with The University of Texas at Austin.

Glossary of Terms Used in this Report

Threat & Error Management (TEM): A framework for understanding operational performance in complex environments. It is designed to capture performance in its "natural" operating context by quantifying the specifics of the environment and the effectiveness of performance in that environment.

Threat

Threat: An event or error that occurs outside the influence of the flight crew, but which requires crew attention and management if safety margins are to be maintained. There are Environmental and Airline threats.

Environmental Threat: Threats that are outside the direct control of the flight crew and the airline. Four types – Weather, ATC, Airport and Terrain/Traffic/Communication.

Airline Threat: Threats that are outside the direct control of the flight crew but within the management purview of the airline. Seven types –Airline Operational Pressure, Aircraft, Cabin, Dispatch/Paperwork, Ground Maintenance, Ground/Ramp and Charts and Manuals.

Mismanaged Threat: A threat that is linked to or induces flight crew error.

Threat Prevalence Index: The percentage of flights with one or more threats.

Threat Mismanagement Index: The percentage of threats that are mismanaged.

Error

Flight Crew Error: An observed flight crew deviation from organizational expectations or crew intentions. There are Handling errors, Procedural errors, and Communication errors.

Aircraft Handling Error: Five types – Manual Handling, Automation, Flight Controls, System/Instrument/Radio and Ground Taxi.

Procedural Error: Seven types –Checklist, Callout, Briefing, SOP Cross-Verification, Documentation, PF/PM duty and "Other".

Communication Error: Pilot-to-Pilot Communication and Crew-External Communication.

Mismanaged Error: An error that is linked to or induces additional error or an undesired aircraft state.

Error Prevalence Index: The percentage of flights with one or more errors.

Error Mismanagement Index: The percentage of errors that are mismanaged.

Undesired Aircraft State

Undesired Aircraft State (UAS): A flight-crew-induced aircraft state that clearly reduces safety margins (i.e., a safety-compromised situation resulting from ineffective threat and error management).

Mismanaged UAS: A UAS that is linked to or induces additional error.

UAS Prevalence Index: The percentage of flights with one or more UAS.

UAS Mismanagement Index: The percentage of UAS that are mismanaged.

Statistical and Content Analyses

Section 1 Unstable Approach

4% of flights in the LOSA Archive have an unstable approach. The evidence indicates that when the aircraft is unstable at the airline mandatory go around point, the crew elected to continue the approach 97% of the time.

Unstable Approach Outcomes

Event	Outcome of the Event
4% of flights in LOSA Archive have an Unstable Approach	87% continued the approach and landed without issue
	10% continued the approach and landed long, short, or significantly off centerline
	3% executed a missed approach (9 of 337 unstable approaches observed)

It is The LOSA Collaborative's experience that the majority of airline observers attending training courses are unsure or slow to recall the criteria and equally unsure of the "bottom line" where a mandatory missed approach is required for their airline. Lengthy discussion always occurs as to the definition of IMC and VMC and the applicability to the 1000ft or 500ft minimum stabilization heights. Very rarely is the mandatory missed approach point fully understood. It seems that all crew start with the aim of being stabilized at 1,000ft, unless on a visual circuit, but when this is not achieved there is much confusion. In fact, few airline manuals define what needs to happen if the approach becomes unstable below the mandatory missed approach point.

Visual meteorological conditions are usually defined by certain visibility minimums, cloud ceilings for landing, and cloud clearances. The exact requirements vary by type of airspace, whether it is day or night, and from country to country. Typical visibility requirements vary from one statute mile to five statute miles (many countries define these in metric units as 1,500m to 8km). Typical cloud clearance requirements vary from merely remaining clear of clouds to remaining at least one mile away (1,500m in some countries) from clouds horizontally and one thousand feet away from clouds vertically. Some observers say VMC is being able to continuously see the approach lights and touchdown zone, some just want to see approach lights and some just the ground. Frequently Managers, Instructors and Pilots cannot agree. Again, airline SOP tends to be confusing, often with differing definitions of VMC in Operating and Training Manuals.

Despite clear parameters for deviation alert calls, these are also flexible depending on the size of the excess and the recovery trend. By experience and report, required deviation callout figures are not readily recalled by crew. When under pressure, it can be difficult to apply a limit of +10 knots to an approach speed that is just a bug or electronic line, not a figure. It becomes a matter of visual judgment and not mathematics. The event list to be recalled at stressful times is large. Most crew regard close to a limit as "good enough" or "acceptable deviation", especially if it "looks OK".

The typical CRM mitigation for an unstable approach is Monitoring/Cross-Checking by the PM, designed to bring attention to the event with a deviation callout. However, if the PF considers that the situation can be recovered in time to make a landing, there frequently appears to be unspoken agreement between the crew that the approach will continue. In 95% of the recorded occurrences the observer selected "All Crew Members" as causing the event and 45-50% of the flights were rated poor or marginal by the observers for Monitoring/Cross-Checking and Inquiry during Descent/Approach/Land. It is clear that the decision to continue is consciously and evidently made by both crew members, even if it is unspoken.

Threat-Linked Unstable Approaches

The LOSA Archive indicates approximately 30% of unstable approaches are linked to a discernable threat as defined by The LOSA Collaborative. It would be possible to argue that good technical and commercial judgment on behalf of the crew makes the airline definition highly flexible. In some cases the observer appears to agree with the decision of the crew, as evidenced by the words “technically unstabilized” or “unstabilized by the definition of SOP”.

Of the unstable approaches that are linked to a threat, the LOSA Archive suggests there are only two significant threat types: ATC and Weather. These threats are typically in one of three categories:

- Controller-induced circumstances resulting in insufficient time to plan, prepare, and execute a safe approach. This includes accepting requests from ATC for flying higher and/or faster than desired or flying shorter routings than desired.
- ATC instructions that result in flying too high and/or too fast during the initial or final approach (e.g., request for maintaining high speed down to the [outer] marker or for GS capture from above – slam-dunk approach).
- Insufficient management of wind conditions:
  - Tailwind component;
  - Low altitude wind shear;
  - Local wind gradient and turbulence (e.g., caused by terrain, forest or buildings).

There is the evidence from the observers’ narratives that the following is happening:

- Failure to recognize deviations or to remember stabilized approach criteria.
- Belief that the aircraft will be stabilized shortly after the stabilization height.
- Excessive confidence by the PM that the PF will achieve a timely stabilization before landing.
- PF/PM over reliance on each other to call excessive deviations or to call for a go-around.

35% of the flights with threat-linked unstable approaches were rated poor or marginal for Inquiry vs. 45% of the flights with unstable approaches that were not linked to threats. These results suggest the PM is somewhat more likely to speak up if the PF has maneuvered an unstable approach in response to a threat vs. an unstable approach due to the PF’s own flying, i.e., without a contributing threat.

Missed Approach Performance after an Unstable Approach

Evidence from the LOSA Archive indicates a missed approach is rarely handled well by the crew. The event is uncommon and, as illustrated below in the narrative excerpts, the level of safety risk rises dramatically. Below are the most common characteristics of missed approach events in the LOSA Archive:

- The event is a surprise to the crew.
- None occur at the standard missed approach point, which had in all cases been briefed.
- A crew error usually precedes the event (e.g., having the incorrect missed approach altitude in the MCP/FCU).

Section 2 Automation

28% of flights in the LOSA Archive have an Automation error. Two-thirds of Automation errors are usually well-managed or remain inconsequential. The table below lists the most mismanaged Automation errors. The 10 errors listed below in descending order of frequency account for three-quarters of all the mismanaged Automation errors that are observed in the LOSA Archive.

Top 10 Mismanaged Automation Errors

Error Codes	% of all Mismanaged Automation Errors
1. Wrong flight guidance altitude entered	21%
2. Failure to execute an MCP/FCU/Flt guidance mode when needed	13%
3. Omitted/wrong waypoint or route settings put in FMGC/FMS	9%
4. Wrong MCP/FCU/flight guidance mode executed	8%
5. Wrong flight guidance speed setting dialed	6%
6. Wrong speed entered into the FMC/FMGC	5%
7. Other wrong FMC/FMGC/FMS entries	5%
8. Wrong flight guidance heading set or dialed	5%
9. (Intentional) Nonstandard automation usage	3%
10. Wrong MCP/FCU/flight guidance mode left engaged	3%

Various training issues arise from an examination of the database and narratives on automation errors. The principal issues are:

- Technical understanding of the automation
- A lack of "verbalization" by crew to share mental models
- The late engagement of autopilot after takeoff or early disengagement in Descent/Approach/Land, basically hand flying at an inappropriate time. Common errors include hand flying in a busy Terminal Control Zone, looking through the FD, not checking modifications to the SID, STAR or Approach profile and relying on the PM to effect FMC/FMGC changes.
- The overarching element is Monitoring/Cross-Checking, with little to no dialogue between the pilots during most of the errors. Monitoring/Cross-Checking is treated as a separate target later in this report.

Automation and SOP Cross-Verification

The LOSA Archive shows that 21% of the Automation induced undesired aircraft states result from SOP Cross-Verification errors, i.e., an Automation error is committed and the crew fails to detect it on procedural cross-check.

Automation and the Autopilot

The LOSA Archive indicates there is often a misunderstanding of the various autopilot modes and how they should be used to achieve the desired path. This was evident on all types of aircraft and manufacturer.

Section 3 Primary/Secondary Altimeters

In the age of RVSM, precise altimeter settings are critical. Unfortunately, the LOSA Archive shows a high prevalence of altimeter errors compared to other aircraft systems and instruments.

Primary Altimeter Setting Errors

"Wrong primary altimeter setting" errors occur on about 3-4% of flights in the LOSA Archive. In addition, 46% of these errors are mismanaged to an additional error or an undesired aircraft state making it one of the most often mismanaged System/Instrument/Radio errors observed in the LOSA Archive. Of particular note, 25% of the mismanaged primary altimeter errors occur below 8,000 ft.

Secondary Altimeter Usage

The secondary or standby altimeter has a function to provide backup in case of primary failure. It needs to be cross-checked for accuracy during predeparture, but its use thereafter varies across airlines. Some airlines successfully use it as a tool to provide increased situational awareness with regard to terrain during climb and descent. In such cases the secondary altimeter is set at a different time to the primary in order to display a height reference to critical terrain. More frequently among airlines, the secondary altimeter setting is simply changed together with the primary. This results in a climb or descent while below MSA with no height reference.

The following general comments are drawn from The LOSA Collaborative observers' experience and link altimeter setting with general terrain awareness. Setting can involve using the 'preset' function of barometric display on the PFD to provide a local QNH.

- Takeoff/Climb

  LOSA observers have noted that many operators set all three altimeters to QNE above transition altitude, even when below area or en route climb MSA. There is no height reference for the pilots in the climb to assist situational awareness in the event of engine failure, oxygen failure or pressurization failure.

- Cruise:

  A regional or local QNH is rarely obtained or preset when overflying terrain above 10,000ft in preparation for emergency descent or drift-down.

  Temperature corrections for any altimeter setting are rarely considered.

  Radius of turn is rarely considered for turn back on terrain critical route segments. Often the radius will take an aircraft outside the flight plan MSA into an area with a higher figure.

  On "Direct to" clearances, where the new routing is outside the flight plan "corridor" for the MSA figures, a revised MSA is rarely sought from charts.

- Descent/Approach/Land:

  In some cases, when operating near areas of high terrain during descent, no altimeter is set to QNH below the descent en-route MSA. In briefing, only the 25 mile airfield MSA is considered, not that for the descent corridor.

Section 4 Monitor/Cross-Check

Across all the TEM countermeasures, Monitoring/Cross-Checking consistently emerges as the weakest at every airline. About 40% of all flights are rated poor or marginal on Monitoring/Cross-Checking in at least one phase of flight, be it Predeparture/Taxi-out, Takeoff/Climb or Descent/Approach/Land.

Scale used by LOSA Observers

Poor	Marginal	Good	Outstanding
Observed performance had an impact on safety	Observed performance was barely adequate	Observed performance was effective	Observed performance was truly noteworthy

MONITOR / CROSS-CHECK	Crew members actively monitored and cross-checked systems and other crew members	*Aircraft position, settings, and crew actions were verified*

LOSA Archive statistics show flights with poor or marginal Monitoring/Cross-Checking ratings have more mismanaged threats, more Handling and Procedural errors, more mismanaged errors, and more undesired aircraft states than flights with standard or outstanding Monitoring/Cross-Checking ratings. In fact, the rates are almost double, i.e., the flights with sub-standard ratings for Monitoring/Cross-Checking have twice as many errors, mismanaged threats, mismanaged errors, and undesired aircraft states.

Two of the more frequent Monitor/Cross-Checking errors logged in LOSA are Callout and SOP Cross-verification errors. Some LOSA Archive results for these error types are shown below:

Callout Errors

The table below lists the most frequent Callout errors in the LOSA Archive and compares their relative occurrence and how often they are consequential.

A Comparison of Omitted Callouts and Their Outcomes

Omitted Callout	% of all Observed Callout Errors	% of these errors that were Inconsequential	% of these errors leading to Added Error or UAS
Altitude Callouts (e.g., 1000 to level off calls)	55%	99%	1%
Descent/Approach Callouts (e.g., FAF call)	17%	92%	8%
Transition Callouts	2%	58%	42%
Deviation Callouts (Speed and Vertical)	2%	35%	65%

The first point to make is that more than half of all Callout errors are omitted altitude callouts (1,000 to go calls). Yet, as the table above shows, only 1% of these omitted calls have been consequential. [To be precise: There are 1,741 instances of omitted altitude callouts in the LOSA Archive presently, and 17 of them have led to additional error.] In fact, omitted altitude callouts are the most frequently logged error in the LOSA Archive by a factor of two, i.e., there are twice as many omitted altitude callouts as the next most frequently observed error in the LOSA Archive.

A concern related to this error is the high rate of Intentional Noncompliance. 20% of these calls are intentional (meaning the altitude calls are omitted systematically and multiple times). As the section on Intentional Noncompliance will show, there is a strong association between Intentional Noncompliance and poor TEM performance.

SOP Cross-Verification Errors

28% of flights in the LOSA Archive have an SOP Cross-Verification error; one in ten of these errors are mismanaged to a UAS or additional error.

SOP Cross-Verification Error	% of all SOP Cross-Verification Errors	% of these errors leading to Added Error or UAS
1. Omitted flight mode verification	20%	4%
2. Failure to cross-verify MCP/FCU/altitude alerter setting	18%	14%
3. Failure to cross-verify FMC/FMGC entries	16%	14%
4. Failure to cross-verify documentation/paperwork/takeoff figures/calculations	9%	7%

Section 5 Frequently Mismanaged Threats

Using the LOSA/TEM coding scheme, almost every flight in the LOSA Archive has a threat. In fact, the average is 4 or 5 threats per flight. Hence, threat management is a core pilot skill. 90% of threats are successfully managed by flight crews; however, about 10% of all threats contribute or link to a crew error, some of which continue on through mismanagement to become an undesired aircraft state.

The table below shows the most frequently encountered threats in the left column and the most common of the mismanaged threats in the right column. As the lists are very similar, it is clear these are the threats to focus on first.

Top 5 Threats Encountered & Top 5 Mismanaged Threats

ALL THREATS Threat Code in Descending Order of Frequency	ALL MISMANAGED THREATS Threat Code in Descending Order of Frequency
1. Terrain	1. ATC challenging clearances or tough to meet restrictions
2. Thunderstorms/turbulence	2. Terrain
3. ATC Challenging clearances or tough to meet restrictions	3. Thunderstorms/turbulence
4. Aircraft Malfunction unexpected by the crew	4. Aircraft Malfunction unexpected by the crew
5. Icing or snow	5. Icing or snow

1. Mismanaged Threat: ATC Challenging Clearances or Tough to Meet Restrictions

As one might expect, the key factors in ATC threat mismanagement are:

- Accepting a visual while high on profile and/or fast
- ATC request for high speed to the OM or Final fix
- Being left high on the FMS/FMGC generated profile by ATC

2. Mismanaged Threat: Terrain

In the LOSA Archive, the most common errors associated with Terrain mismanagement are Briefings, Callouts, and System/Instrument/Radio errors. Failing to mention terrain as part of the briefing was the most common Briefing error, and it occurred about equally in Pre-departure/Taxi-out and Takeoff/Climb as it did in Descent/Approach/Land. Of the Callout errors, omitting the MSA or safe justification call was the most common.

The most common System/Instrument/Radio error was failing to select terrain on the Nav. Display. Terrain poses a further problem when

- No terrain briefing is coupled with
- No selection of terrain on the Nav. Display and
- The flight is in terrain critical environment.

This combination produces a high severity of risk and leaves a crew severely exposed to a CFIT, with only GPWS to protect the aircraft. These events tend to occur in ‘pockets’, i.e., in areas where there is extensive terrain and the threat becomes normalized within an airline and so is not recognized as such.

3. Mismanaged Threat: Thunderstorms/Turbulence

As might be expected, thunderstorms with turbulence are most problematic during Takeoff/Climb and Descent/Approach/Land. In the LOSA Archive, the 2 most common errors associated with this threat are Manual Handling/Flight Control and System/Instrument/Radio errors.

4. Mismanaged Threat: Aircraft Malfunction Unexpected by Crew

The errors associated with aircraft malfunctions mainly focus on crews applying engineering shortcuts or workarounds rather than following ECAM, QRH or MEL procedures and most occur pre-flight or on start up. Rarely do these errors have a consequence. However, there was a high degree of intentional non-compliance in all actions and there are training implications if divergence from SOP is encouraged during route or line training.

5. Mismanaged Threat: Icing and Snow

The most common error associated with icing and snow is the failure to select anti-ice protection ON. In the majority of cases, this situation persists for a significant amount of time and is thereby coded as an undesired aircraft state (Incorrect Aircraft Configuration-Systems UAS). These flights are usually rated poor or marginal for Monitoring/Cross-Checking due to the time it takes the crew to detect the error, if at all.

Section 6 Intentional Noncompliance

All Intentional Noncompliance errors observed in LOSA must meet one of four conditions:

1. The error is committed multiple times during one phase of flight, e.g., missing multiple altitude callouts during descent (if this condition is met, the error is coded as one Intentional Noncompliance error);
2. The crew openly discusses that they are intentionally committing an action that is against published SOP;
3. The observer determines that the crew is time-optimizing SOP when time is otherwise available (i.e., performing a checklist from memory); or
4. An aircraft handling error is determined by the observer to involve an increase in risk when more conservative options were available (e.g., intentionally ducking under a glideslope).

The observer decides that it is an intentional noncompliance, not The LOSA Collaborative, and this judgment is confirmed by the airline representatives at the data cleaning roundtable.

To understand the relationship between Intentional Noncompliance and Threat and Error Management (TEM), a number of statistical analyses were conducted on data in the LOSA Archive. While there is no correlation between the number of threats on a flight and the number of Intentional Noncompliance errors, i.e., the level of threat complexity is the same, there is a significant positive correlation between the number of Intentional Noncompliance errors observed on a flight and the number of mismanaged threats, unintentional errors, mismanaged errors, and undesired aircraft states. In other words, *the more Intentional Noncompliance that occurs on a flight, the less effective is the flight crew's TEM performance*.

To see these relationships more clearly, the 8,000+ flights in the LOSA Archive were divided into three groups – those with zero noncompliance errors (56% of flights), those with one Intentional Noncompliance error (24%), and those with two or more Intentional Noncompliance errors (20%). The table below highlights the notable findings that underscore the above conclusion.

Intentional Noncompliance & TEM Indexes

TEM Indicator	Flights with zero Intentional Noncompliance errors	Flights with one Intentional Noncompliance error	Flights with two or more Intentional Noncompliance errors
% of Flights in LOSA Archive	56%	24%	20%
Average number of threats per flight	4.4	4.7	4.8
Average number of errors per flight	1.9	3.7	6.6
% of flights with a mismanaged threat	23%	37%	50%
% of flights with a mismanaged error	27%	45%	65%
% of flights with an undesired aircraft state	25%	42%	59%

The first table below shows Intentional Noncompliance varies by Error Type with higher rates generally but not always observed with the Procedural errors. The most frequent Intentional Noncompliance Error Codes are shown in the second table below.

Intentional Noncompliance by Error Type

Error Type	% of these Error Types that are Intentional Noncompliance
PF/PM Duty	100%
Checklist	55%
Briefings	26%
Documentation	23%
Ground Taxi	23%
Callouts	18%
SOP Cross-Verification	18%
Manual Handling/Flight Control	15%
Communication	10%
Automation	7%
System/Instrument/Radio	5%

Top 5 Intentional Noncompliance Error Codes

Error Code
1. (Intentional) Checklist performed from memory / Use of nonstandard checklist protocol
2. (Intentional) Omitted altitude callouts
3. (Intentional) Failure to execute a mandatory missed approach
4. (Intentional) PF makes own changes
5. (Intentional) Taxi duties performed before leaving runway

Note: Errors #2 and #3 are discussed in other parts of this report.

It would be easy to draw the conclusion that noncompliance is just experienced pilots taking optimizing shortcuts. Pilots think of it as “using common sense” to get the job done and no big deal. This is reinforced by the fact that Captains display significantly more noncompliance than First Officers. However, as stated earlier, the relationship between noncompliance and TEM performance is more complex.

Intentional Noncompliance: Checklists

Checklists are the backbone of the SOP structure and compliance is a central tenet of training techniques. Yet, over half of all Checklist errors involve some form of noncompliance.

- The vast majority of these noncompliance Checklist errors are attributable to the crew alone – less than 10% of them are prompted by a threat such as Airline Operational Pressure, ATC or Aircraft Malfunction.
- Almost half of all noncompliance Checklist errors occur during Predeparture/Taxi-out.
- All showed a willingness by the crew to accept the error.

Intentional Noncompliance: PF Makes their Own Changes

All PF/PM Duty errors are coded as intentional noncompliance since these events are considered by The LOSA Collaborative as purposeful or willful acts to short-cut well-established SOPs. Of the PF/PM Duty errors, the PF making their own changes are the most common. These errors include the PF changing the MCP/FCU/flight guidance, the FMC/FMGCFMS, and system switches and settings.

- The LOSA Archive shows most of these errors occurred when hand flying.
- One-half of them occurred during Takeoff/Climb.
- The Captain committed two-thirds of these errors. (Note: The Captain was the PF for 56% of the flights in the LOSA Archive.)

Intentional Noncompliance: Taxi Duties Performed before Leaving Runway

This is a very common area of noncompliance. There are no threats attached to the errors and the responsibility rests entirely with the crew. The observers' narratives indicate no evidence of short taxi distances that might require urgent commencement of the duties. Many Flight Manuals permit some post-landing items to be actioned, such as stowing spoilers, but there is an observed tendency to complete many of the minor items by memory while still on the active runway.

Section 7 Captain Leadership / Communication Environment

Communication in the cockpit is addressed in this issue; specifically, the Captain's role in matching the appropriate level of direction and consultation to the crew's skills, background and experience level. The information in this section should be of particular interest to CRM instructors and training content providers.

As part of assessing a flight's TEM countermeasure performance, The LOSA Collaborative observers are asked to rate and comment on the perceived qualities of Captain Leadership and the Communication Environment using the following scale and definitions.

Poor Observed performance had an impact on safety	Marginal Observed performance was barely adequate	Good Observed performance was effective	Outstanding Observed performance was truly noteworthy

COMMUNICATION ENVIRONMENT	Environment for open communication was established and maintained.	*Good cross talk – flow of information was fluid, clear, and direct.*
LEADERSHIP	Captain showed leadership and verbally coordinated flight deck activities.	*In command, decisive, and encouraged crew participation.*

As one might hope, the large majority of flights in the LOSA Archive are rated good or outstanding for Captain Leadership and Communication Environment and the TEM statistics bear out the effectiveness of these behaviors.

The table below shows that despite having the same level of threat complexity (i.e., the same number of threats per flight on average), flights that have outstanding ratings for Leadership and Communication Environment have an average 2.3 errors per flight vs. an average 7.0 errors on flights rated poor for Leadership and Communication Environment. In fact, the flights with poor ratings have approximately 3 times the number of mismanaged threats, errors and undesired aircraft states as the flights with outstanding ratings for Leadership and Communication Environment.

Ratings for Leadership, Communication Environment and TEM Indicators

TEM Indicator Average Number per Flight	LOSA Observer Ratings for Captain Leadership and Communication Environment		
	Outstanding Leadership Outstanding Communication	Good/Outstanding Leadership Poor Communication	Poor Leadership Poor Communication
Threats	4.9	4.3	5.0
Mismanaged Threats	0.3	0.7	1.1
Errors	2.3	5.6	7.0
UAS	0.4	1.4	1.8

The center column in the table is particularly informative because it shows that even when the Captain's Leadership is rated good or outstanding, a poor communication environment in the cockpit still produces poor results as evidenced by the TEM indicators – mismanaged threats, errors, and UAS – these being notably higher especially undesired aircraft states.

This result suggests there can be the perception of good leadership with a 'directive' Captain; however, this is really only acceptable in certain circumstances (to be illustrated in narrative below). The Captain can direct the flight in a manner that produces a text book performance. However, the resultant communication environment is not conducive to the First Officer providing effective monitoring/cross-checking or input should it be needed. Hence, *the much needed improvement in Monitoring/Cross-Checking that earlier targets have identified is inextricably linked to the Communication Environment established by the Captain.*

Section 8 ATC Threat Management

ATC threats are the second most common threat type observed in the LOSA Archive (just behind Adverse Weather). About 12% of ATC threats induce or contribute to a crew error such that 10% of flights in the LOSA Archive have a mismanaged ATC threat.

Top 3 ATC Threats & Their Outcomes

ATC Threat	% of all ATC Threats	% of All Mismanaged ATC Threats	Most Common ATC-Linked Errors	% of ATC-Linked UAS	Most Common UAS
Challenging clearances or tough to meet restrictions	39%	44%	Manual Handling /Flight Control Automation	60%	70% are Aircraft Handling Deviations
Runway changes	13%	18%	Automation Briefing SOP Cross-Verification	14%	70% are Incorrect Aircraft Configurations
Difficulty understanding controller accent or language	11%	14%	Communication	5%	50% are Ground Navigation UAS

The table above shows that of all the ATC threats encountered, about 40% involve challenging clearances or tough to meet restrictions, 15% involve runway changes, and 10% involve difficulty understanding the controllers' language (though of course this last threat varies depending on the airline and the routes flown).

The errors prompted by challenging clearances/tough to meet restrictions are predominantly Manual Handling/Flight Control and Automation errors. About 60% of all the undesired aircraft states that are linked to a mismanaged ATC threat via crew error are the result of mismanaged challenging clearances/tough to meet restrictions, and most of the UAS are Aircraft Handling Deviations such as speed, lateral and vertical deviations.

The errors prompted by runway changes tend to be Automation, Briefing, and SOP Cross-Verification errors. Of the undesired aircraft states that result from a mismanaged ATC threat, about 15% of them link back to these runway changes, and most of them involve Incorrect Aircraft Configurations such as wrong settings.

Finally, the errors prompted by difficulty understanding what the controller is saying are usually Communication errors (wrong readbacks or callbacks). Only 5% of the linked undesired aircraft states are due to these threats, and about half of them are Ground Navigation UAS such as a taxiway/ramp incursion.

The conclusion from this analysis is that challenging clearances/tough to meet restrictions pose the greatest risk to the crews. Crews often agree to clearances in order to 'help or 'assist' ATC (this is evident from the observers' narratives). The 'challenge' in the clearance is as a result of subsequent pilot mismanagement and was never the intention of the Controller. Many of the errors could be considered ‘minor’ or ‘nit picking’ by pilots, but they all display a common theme of poor communication and cross-monitor when under operational time pressure.

Section 9 TEM by Phase of Flight

If asked what phase of flight poses the greatest risk to flight crew, most people would say Descent/Approach/Land. And as more than half of all undesired aircraft states occur in Descent/Approach/Land, this intuitive response would appear to be correct. Extrapolating from this finding, one might also assume that Descent/Approach/Land has the most threats; however, the LOSA Archive proves this assumption wrong.

The table below highlights some of the similarities and differences between the two phases of flight in relation to TEM indicators. For example, 41% of all threats occur during Predeparture/Taxi-Out as compared 31% in Descent/Approach/Land, while the majority of undesired aircraft states (54%) occur in Descent/Approach/Land vs. 18% in Predeparture/Taxi-Out.

A Comparison of TEM Rates in Predeparture/Taxi-out vs. Descent/Approach/Land

TEM Indicator % occurring in each phase	Phase of Flight	
	Predeparture/Taxi-out	Descent/Approach/Land
Threats	41%	31%
Mismanaged Threats	36%	38%
Errors	29%	39%
Mismanaged Errors	23%	51%
UAS	18%	54%

The tables below list the most common threats, errors and undesired aircraft states in the two busiest phases of flight.

Top 5 Threats, Errors & Undesired Aircraft States in Predeparture/Taxi-out

Threat	Error	Undesired Aircraft State
MEL/CDL with operational implications	Incorrect or incomplete briefing	Incorrect Aircraft Configuration - Systems
On-time performance pressure	Checklist performed from memory	Incorrect Aircraft Configuration - Automation
Aircraft malfunction unexpected by the crew	Wrong readback or callback to ATC	Incorrect Operation with MEL/Malfunction
Flight attendant interruption to pilot duties	Missed checklist item	Incorrect Aircraft Configuration - Engines
Terrain	Failure to cross-verify FMC/FMGC entries	Taxi too Fast

Top 5 Threats, Errors & Undesired Aircraft States in Descent/Approach/Land

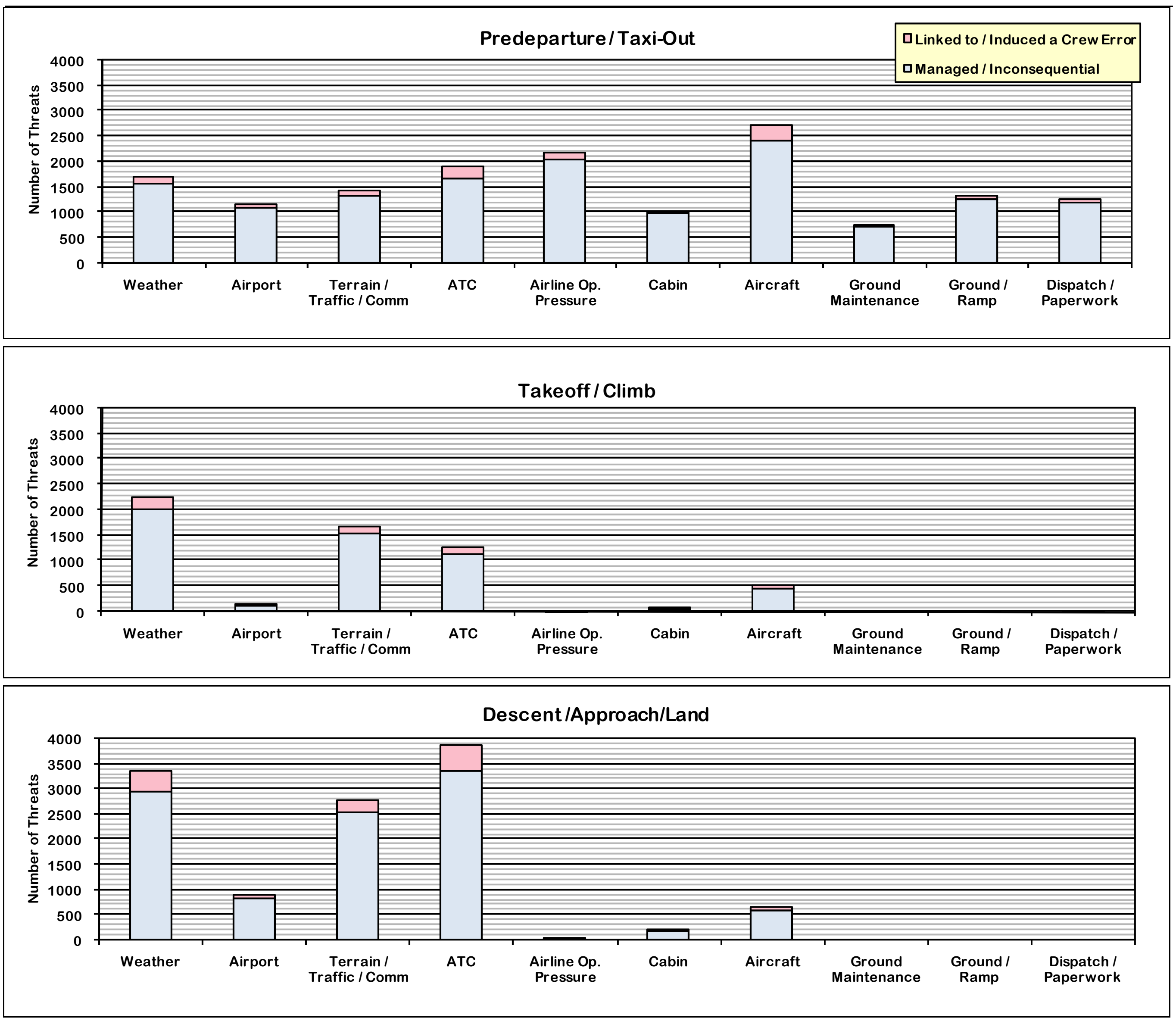
Threat	Error	Undesired Aircraft State
Challenging clearances or tough to meet restrictions	Omitted Altitude Callout	Speed too High
Terrain	Unintentional speed deviation	Unstable Approach
Thunderstorms/turbulence	Incorrect or incomplete briefing	Incorrect Aircraft Configuration - Automation
Icing or snow	Omitted Descent/Approach callouts	Incorrect Aircraft Configuration - Systems
Runway change	Wrong flight guidance altitude entered	Continued Landing after Unstable Approach

Threats by Phase of Flight

Phase of Flight	% of All Threats	% of Environmental Threats	% of Airline Threats	% of Mismanaged Threats
Predeparture/Taxi-out	41%	24%	76%	36%
Takeoff/Climb	16%	20%	5%	17%
Cruise	8%	10%	5%	6%
Descent/Approach/Land	31%	42%	8%	38%
Taxi-in/Park	4%	4%	6%	4%

The three busiest phases of flight are charted below showing the frequency and type of threats that were observed. Each bar represents the total number of threats in each threat type. The blue portion of each bar represents the number of threats that were well-managed or inconsequential while the red portion represents the number of threats that linked to or induced a crew error. All three charts have been drawn to the same scale to visually emphasize the difference in threat profile across phase of flight.

Threats by Phase of Flight

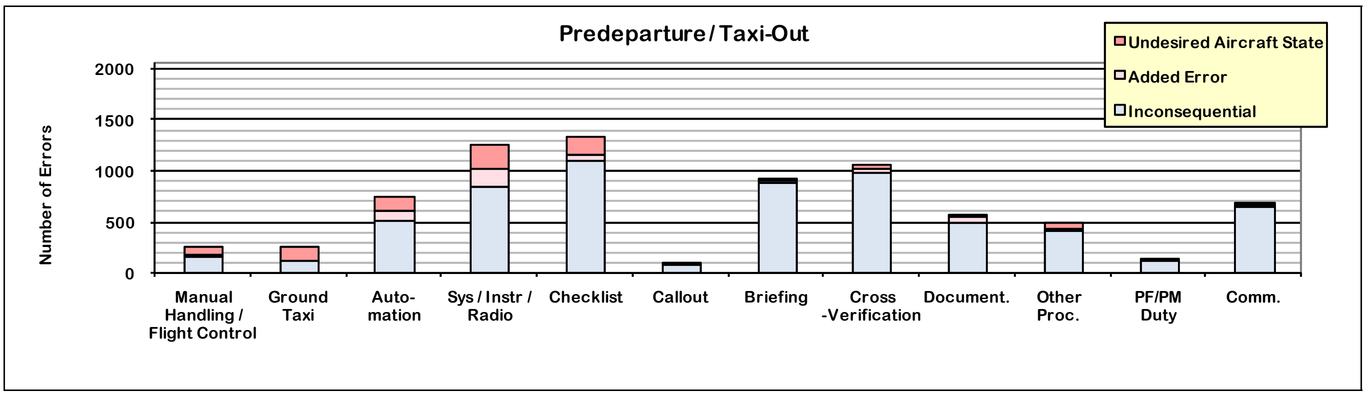


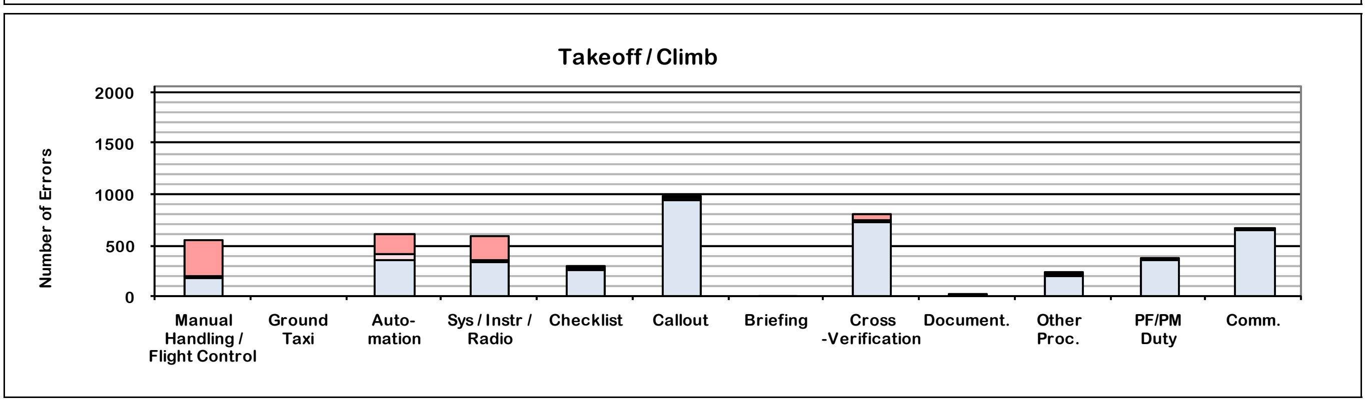
Errors by Phase of Flight

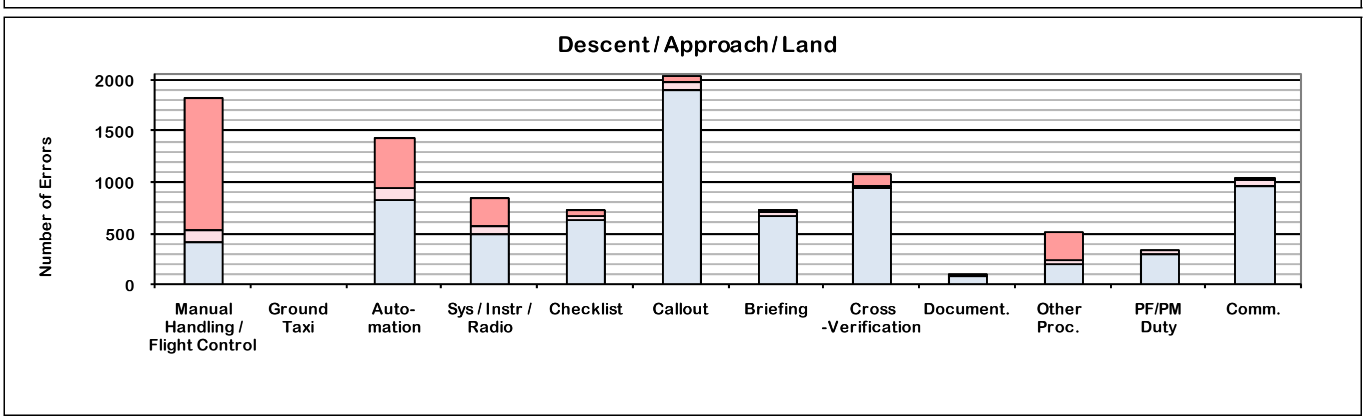
Phase of Flight	% of All Errors	% of Aircraft Handling Errors	% of Procedural Errors	% of All Mismanaged Errors
Predeparture/Taxi-out	29%	26% 31% 23%		
Takeoff/Climb	19%	19%	18%	18%
Cruise	7%	6% 7% 4%		
Descent/Approach/Land	39%	43% 37% 51%		
Taxi-in/Park	6%	6% 7% 4%		

The three busiest phases of flights are charted below. Each bar represents the total number of errors in each error type. The blue portion of each bar represents the number of errors that were well-managed or inconsequential, the pink portion represents the number of errors that were mismanaged to additional error, and the red portion represents the number of errors that were mismanaged to an undesired aircraft state. All three charts have been drawn to the same scale to visually emphasize the difference in error profile across phase of flight.

Errors by Phase of Flight







Section 10 Weather Radar Usage

8% of LOSA Archive flights face a Thunderstorm Threat, and 10% of these threats are mismanaged. The most common linked errors are:

- Wrong radar settings
- Course or heading deviations without ATC clearance
- Weather penetration

About half of these thunderstorm-induced errors result in an undesired aircraft state such as Incorrect Aircraft Configurations, Lateral or Speed Deviations.

The LOSA Collaborative has observed a wide range of effectiveness in weather radar usage and weather avoidance techniques. In most cases the onboard equipment is utilized to provide warning of weather and there is discussion of a suitable track to avoid weather penetration. The fact that the PM is handling the radios ensures the PF has to liaise in order to request a track deviation from ATC.

It is evident from the observers' narratives that the "normal" request for deviation is "up to 10 miles", even when avoiding amber or red radar returns. For many of the airlines there was an operations manual requirement to avoid weather by margins greater than this, especially on the downwind side of a cell. In practice, much closer margins are applied, usually less than 10 miles.

On departure there is sometimes a conflict between display of TERR and Radar, which is not addressed early enough. In the cruise phase radar settings and tilt management is variable but is usually adjusted when first making visual contact with cells during daylight or lightning flashes at night.

The overarching theme in weather avoidance is lack of forward planning. In all of the penetration events, late identification of the threat was a contributory factor.

Wrong Radar Settings

These errors were divided equally between crew members. Two behaviors in particular were significant – weather radar not switched ON when required, and incorrect use of Tilt or Gain functions. It seems one of the least understood aspects of airborne weather radar is the subject of antenna tilt.

Weather Avoidance and Intentional Noncompliance

About a quarter of the Thunderstorm-linked errors involve some form of Intentional Noncompliance, the most common being deviations without ATC clearance and deliberating navigating through known bad weather. As mentioned previously, the overarching theme in weather avoidance is lack of forward planning. In all of the penetration events, late identification of the threat was a contributory factor.

Appendix. Error Detection

LOSA Archive Report: 10 Target Areas for Evidence Based Training

IATA ITQI EBT Working Group Report

September 2010

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Introduction

The LOSA Archive shows that 26% of all errors logged by observers are detected and acted upon by flight crews. This appendix explores some of the underlying factors that give rise to this error detection rate.

In LOSA, there are two primary responses to flight crew error that can be logged by observers. They are:

1. Detected with Action
2. No Action Taken (Undetected or Ignored)

Error responses in LOSA are limited to what an observer can see in the cockpit without querying the flight crew. It is this methodological restriction that explains why error detection is further substantiated by requiring observers to record whether a flight crew attempts to correct an error upon detection. Those errors not acted upon are assumed to be ignored or undetected.

It is also important to note that error responses collected during LOSA are mutually exclusive of error outcome. In other words, an error that is detected and acted upon does not guarantee an inconsequential outcome. In fact, 1% of errors detected and acted upon by a flight crew link to an additional error or undesired aircraft state due active mismanagement.

Summary of Key Findings

- Manual Handling/Flight Control error detection/action taken is notably stronger in Predeparture/Taxi-Out than in the other phases of flight.

- Checklist error detection is better in Cruise and Descent/Approach/Land than in other phases of flight. Callout error detection is better in Takeoff/Climb.

- 41% of Aircraft Handling errors are detected and acted upon vs. 16% of Procedural errors. Automation has the best rate of all error types - 53% of Automation errors are detected and acted upon.

- Captains detect 27% of the First Officer mistakes; First Officers detect 18% of the Captain's errors.

- Once an error has been committed, people are more capable of detecting other people's errors than their own.

- Across all three error groups, the Captain as PF detects/ acts on more errors than does the First Officer as PF, particularly for Communication errors. There is little difference in PM rates.

- As the rate of Intentional Noncompliance increases, the rate of errors detected and acted on decreases.

- Of the TEM Countermeasures, error detection is most closely aligned with the quality of Monitoring/Cross-Checking in *all* phases of flight and the quality of the Briefing in Predeparture/Taxi-Out.

- One-quarter of all errors in the cockpit are detected, acted upon and inconsequential. One-half of all errors in the cockpit go undetected/not acted upon and are *also* inconsequential. This reinforcement for non-action encourages crews to 'take shortcuts' as experience has taught them over and over that most errors are inconsequential, whether they act on them or not.

Phase of Flight

Q. Are there phase of flight differences with error detection and action?

Phase of Flight	% of Errors Detected with Action
Predeparture/Taxi-Out	30%
Takeoff/Climb	25%
Cruise	25%
Descent/Approach/Land	27%
Taxi-in/Park	17%

There is little difference amongst the first four phases of flight in that 25-30% of errors are detected and acted upon. Taxi/Park has the lowest rate of errors detected and acted upon (17%) because approximately one-half of the errors in Taxi/Park are Intentional Noncompliance errors vs. about one-quarter of errors in the other phases. These errors include taxi duties performed before leaving the runway, admin duties performed at inappropriate times, and checklists performed from memory, omitted, or self-initiated. [Using the LOSA definition, Intentional Noncompliance errors are typically not corrected because they are intentionally committed by the crew. See the later section on Intentional Noncompliance and error detection.]

Q. Does error detection vary across phases of flight for different types of errors?

Error Type	% of Errors Detected with Action in each Phase of Flight				
	Predeparture/Taxi-Out	Takeoff/Climb	Cruise	Descent/Approach/Land	Taxi/Park
Manual Handling/Flight Control	53%	21%	25%	30%	27%
Automation	60%	50%	50%	52%	-
System/Instrument/Radio	50%	36%	44%	39%	43%
Checklist	17%	17%	32%	30%	14%
Callout	-	29%	16%	19%	-

Detection rates do differ for some error types across different phases of flight. The largest difference is seen with Manual Handling/Flight Control errors - error detection/action is notably stronger in Predeparture/Taxi-Out than in the other phases of flight (53% of Manual Handling/Flight Control errors are detected and acted upon during Predeparture/Taxi-Out vs. 21-30% of Manual Handling/Flight Control errors being detected and acted upon in later phases of flight). When compared with the other Aircraft Handling error types, it seems that error detection for Manual Handling/Flight Control errors weakens notably after Predeparture/Taxi-Out, while Automation and System/Instrument/Radio error detection rates stay relatively the same.

Of the Procedural error types, Checklist error detection is better in Cruise and Descent/Approach/Land while Callout error detection is better in Takeoff/Climb.

Error Type

Q. Are there errors that are detected and acted upon more than others?

The rates of error detection and action are much higher for Aircraft Handling errors than for Procedural errors. Specifically, 41% of Aircraft Handling errors are detected and acted upon vs. 34% of Communication errors and 16% of Procedural errors.

The detection and action rates for Procedural errors are shown below:

Procedural Errors	% of Errors Detected with Action
Briefing	20%
Callout	22%
Checklist	20%
Documentation	30%
General Procedural	7%
PF/PM Duty	5%
SOP Cross-Verification	9%

Automation errors have the best detection with action rates of all error types - 53% of Automation errors are detected and acted upon by flight crews.

Of the more common Aircraft Handling errors, those with the lowest rates of error detection are listed in the table below. Many of the errors in these categories become undesired aircraft states before the crew becomes aware of the problem.

Aircraft Handling Error Code	% of Errors Detected with Action
Unintentional vertical deviation	41%
Wrong speed brakes setting	39%
Incorrect Nav Display setting	35%
Unintentional landing deviation	32%
Wrong radar setting	30%
Unintentional lateral deviation	29%
Unintentional speed deviation	24%
Wrong power/thrust setting	22%
Wrong anti-ice setting	19%

Error Causation

Q. Does the person who commits the error also detect it or is it more often the other person?

Who Caused the Error	Detected with Action By				
	Captain	First Officer	Both Pilots at the Same Time	Other (e.g., ATC)	Nobody
Captain	6%	18%	28%	5%	43%
First Officer	27%	5%	22%	8%	38%

The LOSA Archive data show that people are not good at detecting their own errors, once they have been committed. Both Captains and First Officers detect only 5-6% of the errors that they make. About one-quarter of the time, the pilots detect the error together. It is informative that First Officers detect 18% of Captain's errors, whereas Captains detect 27% of the First Officer's mistakes.

Q. Does the pattern differ for different types of errors?

Error Type Caused By	Detected with Action By		
	Captain	First Officer	Both Pilots at the Same Time
Aircraft Handling Errors - caused by Captains	9%	24%	17%
Aircraft Handling Errors - caused by First Officers	39%	8%	10%
Procedural Errors - caused by Captains	3%	12%	39%
Procedural Errors - caused by First Officers	17%	4%	34%
Communication Errors - caused by Captains	4%	27%	14%
Communication Errors - caused by First Officers	37%	3%	8%

The general pattern is consistent across error types, i.e., Captains detect more errors than First Officers and people are more capable of detecting other people's errors than their own. For example, Captains can detect 39% of the Aircraft Handling errors made by First Officers but only 9% of their own Aircraft Handling errors. And similarly, First Officers can detect 12% of the Procedural errors made by Captains, but only 4% of their own Procedural errors.

Pilot Flying/Pilot Monitoring

Q. Does the Pilot Monitoring (PM) detect more errors than the Pilot Flying (PF)?

All Errors – Who Detected the Error?					
Captain as PF	First Officer as PF	Captain as PM	First Officer as PM	Both	Other/Nobody
7%	4% 7% 6%			26%	50%

The table above shows very little difference in detection rates – 11% of errors are detected by the PF (Captain and First Officer numbers combined) and 13% of errors are det ected by the PM. A difference starts to emerge when information about response to error is com bined with information about who detected the error, as shown in the table below. Of the errors that are detected and act ed upon, the Captain as PF d etects/acts on more than does the First Officer as the PF (rates for PM are about the same).

Of the Errors Detected with Action - Who Detected the Error?					
Captain as PF	First Officer as PF	Captain as PM	First Officer as PM	Both	Other/Nobody
23%	13%	25%	22%	13%	4%

The table below goes down one more level, to the type of error that is detected and acted upon. Here you can see that across all three error groups, there is little differen ce in PM rates, while the Captain as PF detects/acts on more than does the First Officer as PF, particularly for Communication errors.

Error Type	Of the Errors Detected with Action - Who Detected the Error?					
	Captain as PF	First Officer as PF	Captain as PM	First Officer as PM	Both	Other
Aircraft Handling	20%	11% 29% 24%			14%	2%
Procedural	21%	14% 24% 22%			13%	6%
Communication	45%	20% 15% 12%			7%	1%

Intentional Noncompliance

All Intentional Noncompliance errors observed in LOSA must meet one of four conditions:

- The error is committed multiple times during one phase of flight, e.g., missing multiple altitude callouts during descent (if this condition is met, the error is coded as one Intentional Noncompliance error);
- The crew openly discusses that they are intentionally committing an action that is against published SOP;
- The observer determines that the crew is time-optimizing SOP when time is otherwise available (i.e., performing a checklist from memory); or
- An aircraft handling error is determined by the observer to involve an increase in risk when more conservative options are available (e.g., intentionally ducking under a glideslope).

In the LOSA Archive, one-quarter of all observed errors were rated by the observers (and later verified by airline representatives at the data roundtables) as Intentional Noncompliance using the definitions above. Errors that are committed intentionally are rarely rectified, because they are not seen as errors in the first place but rather as time-optimizing short-cuts or 'pilot knows best' personal procedures. The table below shows that 25% of all errors are recorded as Intentional Noncompliance errors, of which 96% are not acted upon.

Error Type	Detected with Action	No Action Taken	Total
Intentional Noncompliance	4%	96%	100% [25%]
Unintentional error	34%	66%	100% [75%]

To highlight the relationship between Intentional Noncompliance and error detection, the table below shows the percentage of each error type that is Intentional Noncompliance and the percentage of errors detected and acted upon. Note the negative correlation, i.e., as the rate of Intentional Noncompliance increases, the rate of errors detected/acted upon decreases. An obvious challenge for improving error detection rates is to first get pilots to recognize Intentional Noncompliance as another form of error to be detected and corrected.

Error Type	% of Errors that are Intentional Noncompliance	% of Errors Detected with Action
All Aircraft Handling Errors	9%	41%
All Communication Errors	10%	34%
All Procedural Errors	38%	16%

Threat & Error Management Countermeasures

Threat and error countermeasures are techniques used to anticipate threats, avoid errors, and detect and mitigate events/errors that do occur. There are many hardware design and procedural countermeasures employed in aviation to minimize adverse outcomes. The countermeasures observed in a LOSA refer specifically to crew behaviors that have been shown to enhance crew performance. These countermeasures were derived from research performed at The University of Texas at Austin and are grouped into four higher-level activities: Team Climate, Planning, Execution, and Review/Modify.

LOSA Observers rate a countermeasure only when they observe it or if its absence is significant (e.g., a crew fails to evaluate the flight plan in light of new information). A one-time rating is given for Leadership, and Communication Environment; other countermeasures are rated across different phases of flight. Observers rate the crew's performance with the following scale:

1	2	3	4	-
Poor Observed performance had an impact on safety	Marginal Observed performance was barely adequate	Good Observed performance was effective	Outstanding Observed performance was truly noteworthy	Not Observed Behavior was not observed

Q. Which TEM countermeasures are most associated with the ability to detect errors?

To answer this question, flights from the LOSA Archive that had one or more errors were divided into 7 groups - flights where all the errors were detected and acted upon, flights with one error not detected/acted upon, flights with two errors not detected/acted upon, and on up to flights with 6 or more errors not detected and/or acted upon. A multivariate discriminant analysis then employed all of the countermeasure ratings across Predeparture/Taxi-Out, Takeoff/Climb, and Descent/Approach/Land to find the best combination of countermeasures that could predict this grouping of flights.

The answer was statistically stable, simple and sensible. The systematic differences in rates of error detection were due to the quality of Monitoring/Cross-Checking in *all* 3 phases of flight and the quality of the Briefing in Predeparture/Taxi-Out.

While the analysis may seem complex, the results can be interpreted with relative ease. First, a lapse in Monitoring/Cross-Checking in *any* part of the flight is likely to lead to errors being not detected/acted upon. And second, the Briefing in Predeparture sets the tone for the rest of the flight. Recall that errors not detected/acted upon include those Intentional Noncompliance errors that are knowingly committed and ignored. It can be the initial Briefing that directly or indirectly sets the expectation for the acceptable level of noncompliance as well as adherence to procedures and attention to detail.

The Error Detection Dilemma

Q. Why are so many errors not acted upon by flight crews in LOSA?

Of all the errors committed in the cockpit, 26% are detected and acted upon, while 74% are not acted upon by the crew. In such a safety-conscious industry, why is the rate so high?

Error Response	Outcome		Total
	Inconsequential	Additional Error or Undesired Aircraft State	
Detected and acted upon	95%	5%	100%
Undetected and/or not acted upon	71%	29%	100%

95% of all errors that are detected and acted upon are inconsequential and 5% lead to additional error or an undesired aircraft state. By comparison, 71% of all errors that go without action taken are inconsequential with 29% linking to an additional error or an undesired aircraft state. On the surface, it appears obvious that errors that are detected and acted upon have a higher 'success rate' (defined as inconsequential outcome). However, it is important to remember that only 26% of all errors fit this first category of detected/acted upon error and that error detection needs to be understood in the context of all errors.

Error Response	Outcome		Total
	Inconsequential	Additional Error or Undesired Aircraft State	
Detected with Action	25%	1%	26%
No Action Taken	52%	22%	74%
Total	77%	23%	100%

Unlike the first table, this table shows each cell as a percentage of *all observed* errors to highlight the dilemma with error detection. Of all the errors committed in the cockpit, one-quarter are detected and acted upon and are then inconsequential (25%). However, one-half of all errors in the cockpit (52%) go undetected/not acted upon and are *also* inconsequential. This lack of consequential outcome provides powerful reinforcement for not detecting and/or acting upon all errors. It encourages crews to 'take chances' or 'take shortcuts' as experience has taught them over and over that most errors are inconsequential, whether they act on them or not. The fact that three-quarters of all errors (77%) are inconsequential is a testament to the safety measures and redundancies built into the system. And while these checks are clearly a good thing, the unintended consequence has been weakened monitoring and error detection over time.

This then is the dilemma of error detection. On the one hand, pilots learn over time that most errors are inconsequential even when they don't act on them. And on the other hand, they learn (to their surprise) that nearly all the errors that are consequential are the errors they have missed or overlooked.

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APPENDIX 2
ACCIDENT INCIDENT ANALYSIS

INTRODUCTION

This appendix contains statements of results drawn from the EBT Accident-Incident analysis containing information, which follows from factor analyses and relates to the objectives of the study. The statements are organized by topics relative to training and emanate from the rankings of occurrence of the factors and competencies reported in accidents and incidents. The statements are followed by graphical representations of data providing an intuitive demonstration of the results.

2.1 ADVERSE WEATHER

- **Gen4 Jet**
  - As the overall accident rate has reduced, exposure to weather related accidents has reduced from 0.8 to 0.65 per million take-offs.
  - When comparing the last 11years compared to the previous era, adverse weather is a greater factor in accidents and incidents, rising from 37% to 46%.
  - Adverse weather is the number 1 factor in accidents over the last in last 11 years for all accidents
  - Adverse weather is ranked 3rd after non-compliance and CRM, as a factor in accidents with high training effect. It has increased by a factor of 2 when comparing the previous 11-years data.

- **Gen3 Jet**
  - Adverse weather has reduced slightly as a factor, in comparison to the period prior to the last 15-years. Over the last 15-years, adverse weather remains the number 1 ranked factor in accidents and serious incidents, evident in 40% of events.
  - When considering fatal accidents only, adverse weather is ranked 3rd after CRM and system malfunction, at 20% of all fatal accidents over the last 15 years.
  - Adverse weather is currently ranked 3rd as a factor in accidents with high training effect, at 30% overall, implying substantial benefit from mitigation through training.

- **Gen2 Jet**
  - Adverse weather is ranked 2nd as a factor in accidents, and has increased in the most recent 15-year period from 30% to 35%.
  - Adverse weather is now the number 1 ranked factor by percentage of occurrence in fatal accidents, having doubled in the most recent 15-year period to 60%.
  - Exposure data indicates adverse weather as a factor in fatal accidents at the rate of 1 per million take-offs, over the most recent 15-year period.
  - For accidents with high training effect, adverse weather is ranked 3rd after CRM and poor visibility, at 40% with no significant change over the last 15-year period and before, implying substantial benefit from mitigation through training.

- **Gen3 Turboprop**
  Note, there was no available exposure data for this generation
  - Adverse weather has increased as a factor in accidents from 25% to 40% when comparing the most recent 15-year period to the previous period.
  - Adverse weather is now the number 1 ranked factor by percentage of occurrence in accidents, having risen from a previous ranking of 3rd.
  - For accidents with high training effect, adverse weather is now ranked 2nd at 60% after CRM. Prior to the last 15 years it was a factor in 65% of accidents.

- **Gen2 Turboprop**
  Note, there was no available exposure data for this generation
  - Prior to the last 15-years, adverse weather was ranked 2nd with a 40% rate of reported occurrence in accidents.
  - There was insufficient data to draw further conclusions over the most recent 15-year period.

2.2 COMPETENCIES – GENERAL

Combining results from both Gen4 and Gen3 Jets, it is clear that some patterns emerge in respect of competencies.

Manual Aircraft Control is the most noted competency in all accidents, followed by Situation Awareness, and Application of Procedures and Knowledge.

With respect to the most critical flight phases, TO/LDG/APP, patterns are consistent with the statements above, except that the peaks with respect to Manual Aircraft Control, Situation Awareness and Application of Procedures and knowledge, are much more pronounced.

In less critical flight phases, the difference is very small, except in GND, where Situation Awareness is predominant.

- **Gen4 Jet**
  - Competency issues most prevalent are:
    - Manual Aircraft Control
    - Situation Awareness
    - Application of Procedures and knowledge
  - In the APP phase over the last 21 years, the following competency issues most prevalent are:
    - Manual Aircraft Control
    - Situation Awareness
    - Application of Procedures and knowledge
  - In the LDG phase over the last 21 years, the following competency issues most prevalent are:
    - Manual Aircraft Control
    - Situation Awareness
    - Application of Procedures and knowledge
  - This pattern remains consistent when combining the APP and LDG phases
    - Manual Aircraft Control
    - Application of Procedures and knowledge
    - Situation Awareness

- **Gen3 Jet**
  - Competency issues most prevalent are:
    - Manual Aircraft Control
    - Situation Awareness
    - Application of Procedures and knowledge

- **Gen2 Jet**
  - Competency issues most prevalent are:
    - Manual Aircraft Control (which is very dominant)
    - Problem Solving and decision-making
    - Situation Awareness
    - Application of Procedures and knowledge

- **Gen3 Turboprop**
  - Competency issues most prevalent are:
    - Manual Aircraft Control
    - Application of Procedures and knowledge
    - Knowledge
    - Situation Awareness

- **Gen2 Turboprop**
  - Competency issues most prevalent are:
    - Manual Aircraft Control
    - Problem Solving and decision-making
    - Situation Awareness

2.3 COMPLIANCE

- **Gen4 Jet**
  - During the last 11-year period, compliance as factor has decreased from being ranked 3rd at 36%, to 23%.
  - For accidents with a high training effect, compliance is a substantial factor, at 75% having risen from 63%.

- **Gen3 Jet**
  - During the last 15-year period, compliance as factor has reduced from being ranked 5th at 24% to 14%.
  - For fatal accidents, the rate of occurrence of this factor has reduced from 50% to 21%.
  - For accidents with a high training effect, compliance is a substantial factor, at 50% overall and ranked 2nd.

- **Gen2 Jet**
  - The rate of accidents involving compliance has increased slightly over the most recent 15-year period considered, but other factors have increased much more.
  - Compliance is now ranked 9th at 13%, having decreased from 22%.
  - For fatal accidents, the rate of occurrence of compliance has decreased from 33% to 7%.
  - For accidents with a high training effect, compliance is a substantial factor, at 39% overall and ranked 5th.

- **Gen3 Turboprop**
  Note, there was no available exposure data for this generation
  - During the last 15-year period, compliance as factor has decreased from 25% to 11% when compared to the previous period.
  - For accidents with a high training effect, compliance remains is a substantial factor, at 50% overall and ranked 3rd.

- **Gen2 Turboprop**
  Note, there was no available exposure data for this generation
  - During the last 15-year period, compliance as factor has risen from 28% to 38% when compared to the previous period.
  - For accidents with a high training effect, compliance is a substantial factor, at 78% having risen from 65% overall and ranked 2nd.

2.4 LANDING

- **Gen4 Jet**
  - The highest total numbers of accidents occur in the LDG & GND phases. In the period considered before 2000, LDG was the flight phase with the largest number of accidents, twice as many as any other phase. Over the most recent 11-year period considered, the trend has decreased with the APP phase becoming predominant.
  - The APP phase is now considered as the number 1 flight phase in terms of the number of accidents.
  - The factors which contribute to accidents in the LDG phase are:
  - Compliance/CRM/Adverse Weather/Adverse Wind (These factors occur in 50% of accidents)
  - When considering the sum of all factors in all accidents, there are more factors occurring in accidents in the LDG phase than in any other phase.
  - For fatal accidents, the LDG phase is ranked 3rd after APP and TO.
  - When considering the sum of all factors in fatal accidents, there are more factors occurring in accidents in the LDG phase than in any other phase.
  - The factors, which are most prevalent in fatal accidents during LDG over the most recent 11-year period are:
    - Adverse weather/CRM/Compliance

- **Gen3 Jet**
  - The LDG phase which was previously ranked 3rd in accidents, has now climbed to number 1, over the last 15-years.
  - When considering the sum of all factors in all accidents, there are more factors occurring in accidents in the LDG phase than in any other phase.
  - The factors which are most prevalent in accidents in the LDG phase are:
    - CRM/Adverse Weather/System Malfunction/Poor visibility/Compliance.
  - The LDG phase is not the highest ranked phases for fatal accidents.
  - When considering the sum of all factors in fatal accidents, there are more factors occurring in accidents in the LDG phase than during any other phase.
  - The factors which are most prevalent in fatal accidents during LDG over the most recent 15-year period are:
    - CRM/Adverse Weather/Windshear/System Malfunction/Adverse Weather/Mismanaged System

- **Gen2 Jet**
  - The LDG phase which was previously ranked number 1 in accidents has dropped to a ranking of number 2 over the last 15-years.
  - The APP phase is now ranked number 1 over the last 15-year period.
  - For all accidents, the most prevalent factors are:
    - CRM/System Malfunction
  - For fatal accidents in the last 15 years, APP was the predominant phase.
  - When considering the sum of all factors in fatal accidents, there are more factors occurring in accidents during the APP phase than in any other phase.
  - The factor most prevalent in fatal accidents during LDG over the most recent 15-year period are:
    - Poor visibility/Runway taxiway condition.

- **Gen3 Turboprop**
  Note, there was no available exposure data for this generation
  - The LDG phase was previously ranked 2nd but has now dropped to 5th overall in the most recent 15-year period.
  - The factors which are most prevalent in all accidents during LDG over the most recent 15-year period are:
    - CRM/Adverse Weather/System Malfunction/Runway taxiway condition/Poor visibility.

- **Gen2 Turboprop**
  Note, there was no available exposure data for this generation
  - LDG is ranked number 1 in flight phases for the most accidents for all periods considered.
  - When considering the sum of all factors in all accidents, there are more factors occurring in accidents in the LDG phase than in any other phase.
  - The factors which are most prevalent in accidents during the LDG phase are:
    - System malfunction/Compliance/CRM.

2.5 LEADERSHIP & TEAMWORK

- **Gen4 Jet**
  - Exposure to an accident or serious incident involving Leadership and teamwork as a competency issue has risen from 0.12 per million take-offs to 0.4 per million take-offs in the most recent 11-year period.
  - Leadership and teamwork is reported as a competency issue in 8% of all accidents, which is a reduction from 18% in the previous 11-year period.
  - When considering serious incidents, Leadership and teamwork is not reported as a competency issue, implying that effective Leadership can prevent more serious events.

- **Gen3 Jet**
  - Exposure to an accident or serious incident involving Leadership and teamwork as a competency issue has reduced from 0.23 per million take-offs to 0.08 per million take-offs in the most recent 15-year period.
  - Leadership and teamwork is reported as a competency issue in 5% of all accidents, which is a reduction from 13% in the previous 15-year period.
  - However the trend is reversed for fatal accidents where Leadership and teamwork is reported as a competency issue has risen from 7% to 15% in the most recent 15-year period.
  - In serious incidents, where in many cases an accident was prevented by the crew action, Leadership and teamwork is conspicuously not reported as a competency issue providing evidence for research that effective Leadership could well have prevented an accident.

- **Gen2 Jet**
  - Exposure to an accident or serious incident involving Leadership and teamwork as a competency issue has increased from 0.11 per million take-offs to 0.19 per million take-offs in the most recent 15-year period.
  - Leadership and teamwork is reported as a competency issue in 4% of all accidents.
  - The percentage of fatal accidents with a Leadership and teamwork as a competency issue has risen from 4% to 7% in the most recent 15-year period.
  - In serious incidents, Leadership and teamwork as a competency issue is only reported at 3%, providing evidence for research that effective Leadership could prevent more serious events.

- **Gen3 Turboprop**
  Note, there was no available exposure data for this generation
  - Leadership and teamwork is reported as a competency issue in 8% of all accidents.
  - When considering serious incidents, Leadership and teamwork as a competency issue has risen from 3%, to 7% over the last 15-years.

- **Gen2 Turboprop**
  Note, there was no available exposure data for this generation
  - Leadership and teamwork is reported as a competency issue in 38% of all accidents, and this has risen from a previous figure of 17%.

2.6 MANUAL AIRCRAFT CONTROL
(FLIGHT PATH MANAGEMENT – MANUAL)

- **Gen4 Jet**
  - Of the 9 competencies analyzed, the competency most reported as a problem is Manual Aircraft Control, it is a competency issue in 22% of accidents over the most recent period. It does show improvement from the previous 11-year study, where it was at more than 35%.
  - For the period up to 2000, more than 0.8 accidents per million take-offs showed manual aircraft control as a competency issue, which then declined to 0.3 in the period 2000-2010.
  - For accident with a high training effect, manual aircraft control remains the highest competency issue from data over the last 11 years as well as in the previous period.
  - There is a significant difference in the rate of manual aircraft control as a competency issue, between fatal accidents and serious incidents, this and the fact that analysts noted that in many cases in serious incidents that crew actions prevented an accident from occurring provides evidence that accidents are avoided through effective manual control strategies.

- **Gen3 Jet**
  - The exposure to accidents with manual aircraft control as a competency issue is stable over time, at approximately 30%. This is more than double the percentages of the other competencies.
  - There is a significant difference in the rate of manual aircraft control as a competency issue, between fatal accidents and serious incidents, this and the fact that analysts noted that in many cases in serious incidents that crew actions prevented an accident from occurring provides evidence that accidents are avoided through effective manual control strategies.
  - For accidents with a high training effect, manual aircraft control remains the highest competency issue from data over the last 15-years as well as in the previous period.
  - Manual aircraft control, as a competency issue stands at 40% in fatal accidents more than 15-years ago, as compared to over 50% in the most recent 15-year period.

- **Gen2 Jet**
  - Of the 9 competencies analyzed, the competency at issue most often is Manual Aircraft Control, a competency issue in 40% of accidents over the period 1995-2010. This has increased by a magnitude of 3 times from the previous 15-year period.
  - There are 4 accidents per million take-offs, 50% of them showing manual aircraft control as a competency issue.
  - Manual aircraft control has always been amongst the top ranked competency issues in fatal accidents, but has risen in the most recent 15-year period to 60%.
  - There is a significant difference in the rate of manual aircraft control as a competency issue, between fatal accidents and serious incidents, this and the fact that analysts noted that in many cases in serious incidents that crew actions prevented an accident from occurring provides evidence that accidents are avoided through effective manual control strategies.
  - For accidents and serious incidents with a high training effect, manual aircraft control is now considered a competency issue in 80% of events, an increase of 100% over the previous 15-year period.
  - Exposure data indicates an increase in manual aircraft control as a competency issue, from of 0.2 to 0.7 for accidents with a high training effect, over the most recent 15-year period.

- **Gen3 Turboprop**
  Note, there was no available exposure data for this generation
  - Manual aircraft control as a competency issue in all accidents has risen from 13% to 16% in the most recent 15-year period.
  - Manual aircraft control is now ranked as the number 1 competency issue in accidents. There is a significant difference in the rate of manual aircraft control as a competency issue, between fatal accidents and serious incidents, this and the fact that analysts noted that in many cases in serious incidents that crew actions prevented an accident from occurring provides evidence that accidents are avoided through effective manual control strategies.

- **Gen2 Turboprop**
  Note, there was no available exposure data for this generation
  - Manual aircraft control shows an increase from 27% to 38% as a competency issue in all aircraft accidents, and is now ranked 2.
  - There is a significant difference in the rate of manual aircraft control as a competency issue, between fatal accidents and serious incidents, this and the fact that analysts noted that in many cases in serious incidents that crew actions prevented an accident from occurring provides evidence that accidents are avoided through effective manual control strategies.

2.7 SURPRISE
(SITUATION AWARENESS)

Little information can be directly inferred from accident and incident reports with respect to unexpected or surprise events being considered as competency issues. Surprise was not considered directly as a competency issue. It can however be indirectly inferred, that when there is a reported breakdown in situation awareness, there is a greater likelihood of unexpected events, and the management of surprises is more difficult. For this reason, situation awareness is considered as a competency issue affecting surprise.

- **Gen4 Jet**
  - For all accident data, Situation Awareness is among the top 3 ranked competency issues, the rate rising from 18% to 22% in the last 11-years, when compared with the previous time period.
  - Situation Awareness is the number 1 competency, alongside Manual Aircraft Control, when analyzing competency issues in accidents and incidents.
  - When analyzing incidents alone, Situation Awareness is the highest ranked competency issue at over 20%.

- **Gen3 Jet**
  - For all accident data, Situation Awareness is among the top 3 ranked competency issues, with the rate rising from 13% to 28% in the last 15-years, when compared with the previous period.
  - Situation Awareness is now ranked 2nd as the most significant competency issue, after Manual Aircraft Control.
  - When considering fatal accidents, Situation Awareness is ranked 2nd, in 29% of fatal accidents.
  - There is a significant difference in the rate of Situation Awareness as a competency issue, between fatal accidents and serious incidents, this and the fact that analysts noted that in many cases in serious incidents that crew actions prevented an accident from occurring provides evidence that accidents are avoided through the maintenance or regaining of Situation Awareness.

- **Gen2 Jet**
  - For all accident data, Situation Awareness is among the top 3 ranked competency issues with, the rate rising from 16% to 24% in the last 15-years, when compared with the previous period.
  - When considering fatal accidents, Situation Awareness is ranked 2nd as a competency, contributory to 21% of fatal accidents, with a slight reduction from 23% in the previous period.

  - There is a significant difference in the rate of Situation Awareness as a competency issue, between fatal accidents and serious incidents, this and the fact that analysts noted that in many cases in serious incidents that crew actions prevented an accident from occurring provides evidence that accidents are avoided through the maintenance or regaining of Situation Awareness.

- **Gen3 Turboprop**
  Note, there was no available exposure data for this generation
  - For all accident data, Situation Awareness is ranked among the top 3 competency issues with, the rate decreasing from 17% to 14% in the last 15-years, when compared with the previous period.
  - Situation Awareness is now ranked 3rd after Manual Aircraft Control and Application of Procedures and Knowledge.
  - When considering incidents alone, Situation Awareness is the highest ranked competency issue at 18%.

- **Gen2 Turboprop**
  Note, there was no available exposure data for this generation
  - For all accident data, Situation Awareness is currently ranked 4th, with the rate rising from 15% to 17% in the last 15-years, as compared with the previous period.

2.8 SYSTEM MALFUNCTION

- **Gen4 Jet**
  - System malfunction is ranked 5th as a factor and present in 15% of all accidents over the latest 11-year period.
  - As a factor all accidents, system malfunction has increased from below 10% to above 15% from the previous period.
  - For accidents with high training effect, system malfunction has decreased in occurrence from 25% of accidents to 5%. Although the available volume of data is relatively small, it seems reasonable to infer that training is an effective remediation tool.

- **Gen3 Jet**
  - System malfunction is ranked 3rd as a factor and present in 19% of accidents over the latest 15-year period.
  - As a factor system malfunction has increased from 14% to 19% in the last 15-year period.
  - For fatal accidents, system malfunction is ranked 2nd and stable at 30% over the 2 time periods analyzed.
  - For accidents with high training effect, system malfunction is ranked 6th and present in 18% of accidents over the last 15-years. Prior to this the figure was 27%, and therefore it seems reasonable to infer that training is an effective remediation tool.

- **Gen2 Jet**
  - System malfunction is ranked number 1 as a factor and is present in 45% of accidents over the latest 15-year period.
  - As a factor system malfunction has increased from 25% to 45% in the last 15-year period and has gone from 3rd to 1st in ranking.
  - For fatal accidents, system malfunction is ranked 3rd occurring more than 50% of the time compared to the previous time period when it ranked 5th and only occurred at 20%.
  - For accidents with high training effect, system malfunction is ranked 4th and present in over 40% of accidents over the last 15-years. This is up from an occurrence rate of about 20%.

- **Gen3 Turboprop**
  Note, there was no available exposure data for this generation
  - System malfunction is ranked 3rd as a factor and is present in 22% of accidents over the latest 15-year period.
  - As a factor system malfunction has decreased as a percentage from 42% to 22% in the last 15-year period with a ranking down from 1st to 3rd.
  - For accidents with high training effect, system malfunction is present in 17% of accidents over the last 15-years.

- **Gen2 Turboprop**
  Note, there was no available exposure data for this generation
  - System malfunction is ranked number 1 as a factor and is present in 50% of accidents over the latest 15-year period.
  - As a factor system malfunction is stable at 50% and remains number 1 for all flights analyzed.
  - For accidents with high training effect, system malfunction is ranked 3rd and present in over 70% of accidents over the last 15-years. The rate went from 50% to over 70% in the latest period, although the available data set is small.

2.9 TERRAIN

- **Gen4 Jet**
  - Terrain as a threat generally ranks low according to Gen4 Jet accident and incident data.
  - As a contributory factor in accidents, terrain has reduced from 5% to 1% when comparing older data to that from the last 11-year period.
  - When considering accidents with a high training effect, there has been a reduction in accidents including terrain as a factor, from 13% to 5% over the 2 periods analyzed.

- **Gen3 Jet**
  - Terrain as a threat generally ranks low according to Gen3 Jet accident and incident data, currently it is a factor in 2% of all accidents in the most recent 15-year period, compared to 3% previously.
  - When considering fatal accidents, terrain ranks 6th overall but has decreased in the rate of occurrence from 21% to 15%.
  - When considering accidents with a high training effect, the rate is low at 3% overall.

- **Gen2 Jet**
  - Terrain as a threat generally ranks 11th according to Gen2 Jet accident and incident data, but has increased in the most recent 15-year period to 11%, from 3% previously.
  - When considering fatal accidents only, terrain ranks 8th overall but has increased in the rate of occurrence from 16% to 23% in the most recent 15-year period.
  - When considering accidents with a high training effect, the rate of accidents with terrain as a contributory factor is at 14% overall.

- **Gen3 Turboprop**
  Note, there was no available exposure data for this generation
  - Terrain as a threat generally ranks low according to Gen3 Turboprop accident data.

- **Gen2 Turboprop**
  Note, there was no available exposure data for this generation
  - Terrain as a threat generally ranks low according to Gen2 Turboprop accident and incident data.

2.10 TURBOPROP GENERATION 2 ANALYSIS

2.10.1 Data Statistics

2.10.1.1 Demographics

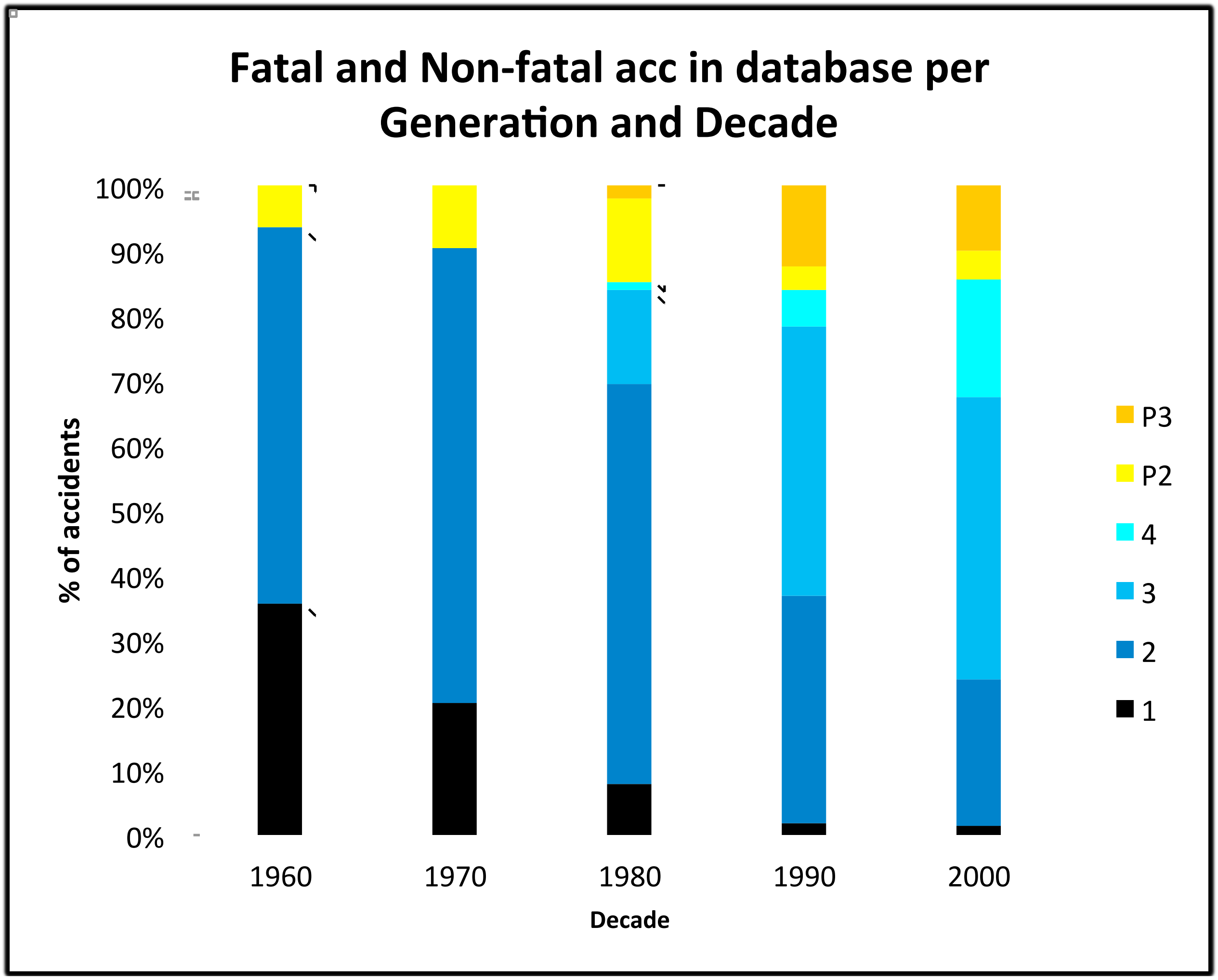


Figure A2.10.1.1

Demographics Continued

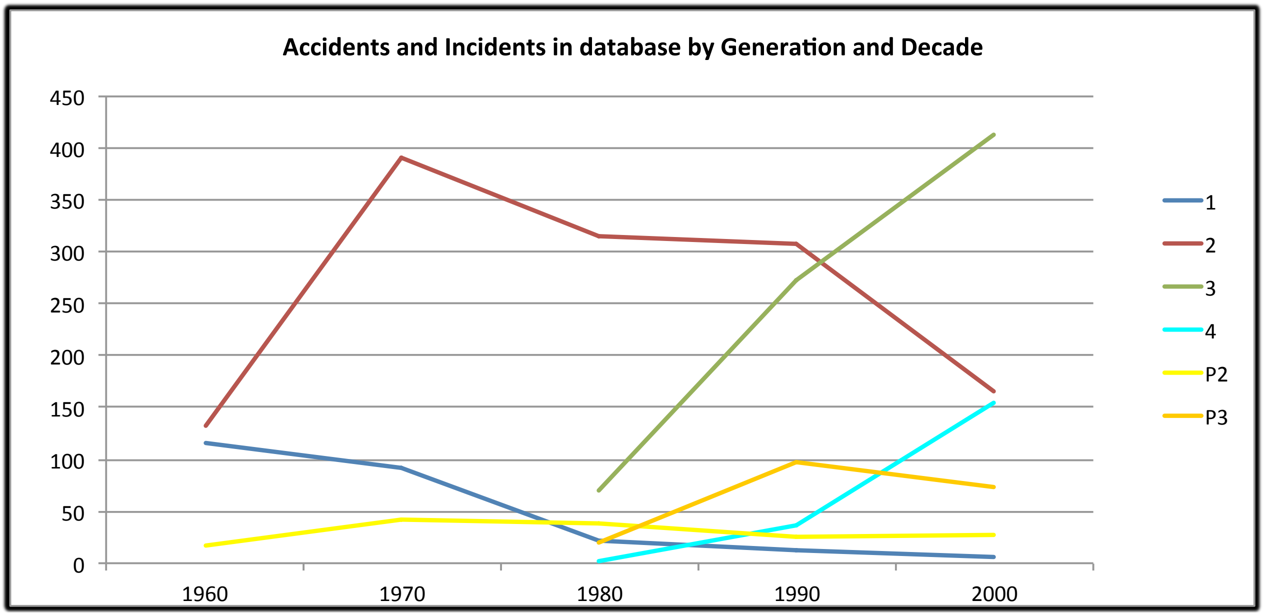


Figure A2.10.1.1a

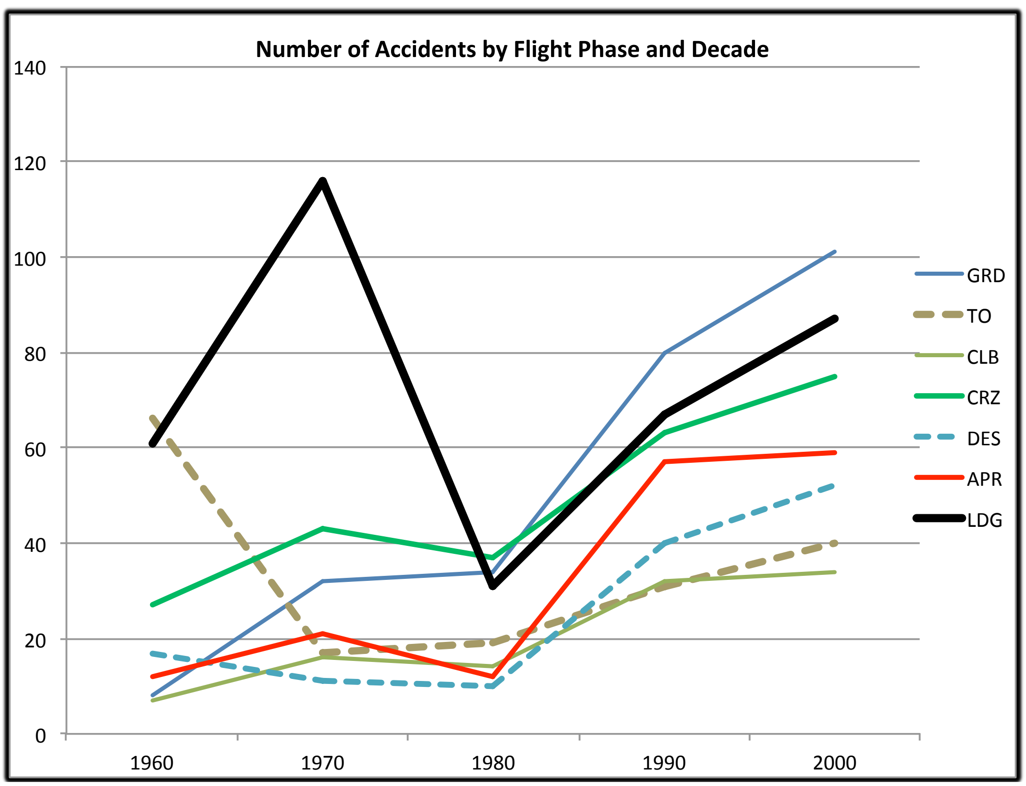


Figure A2.10.1.1b

2.10.2 Global Accidents (Last 15 Years versus Before)

2.10.2.1 Ranking of Factors for All Accidents (Turboprop Generation 2)

Ranking of factors as a percentage of fatal accidents, last 15Y vs. older (last 15 years in blue, earlier times in black).

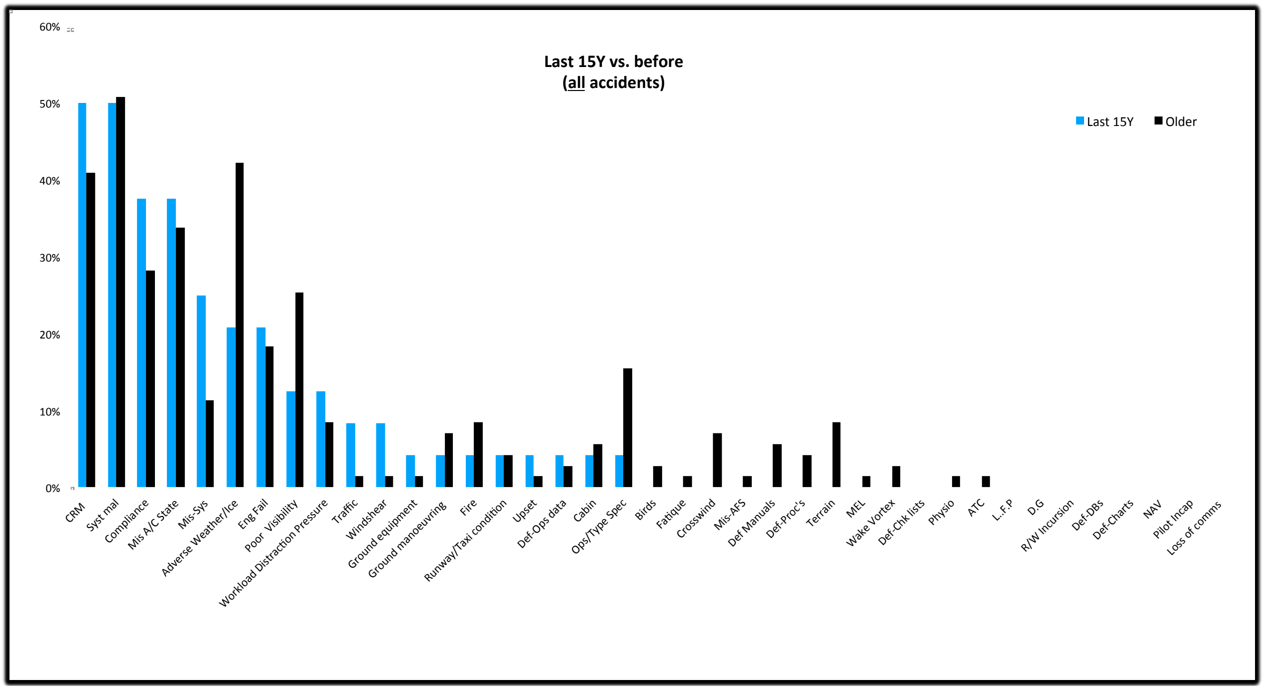


Figure A2.10.2.1

2.10.3 Global Fatal Accidents (Last 15 Years)

2.10.3.1 Ranking of Factors for Fatal Accidents (Turboprop Generation 2)

Ranking of factors as a percentage of fatal accidents, last15Y vs. older

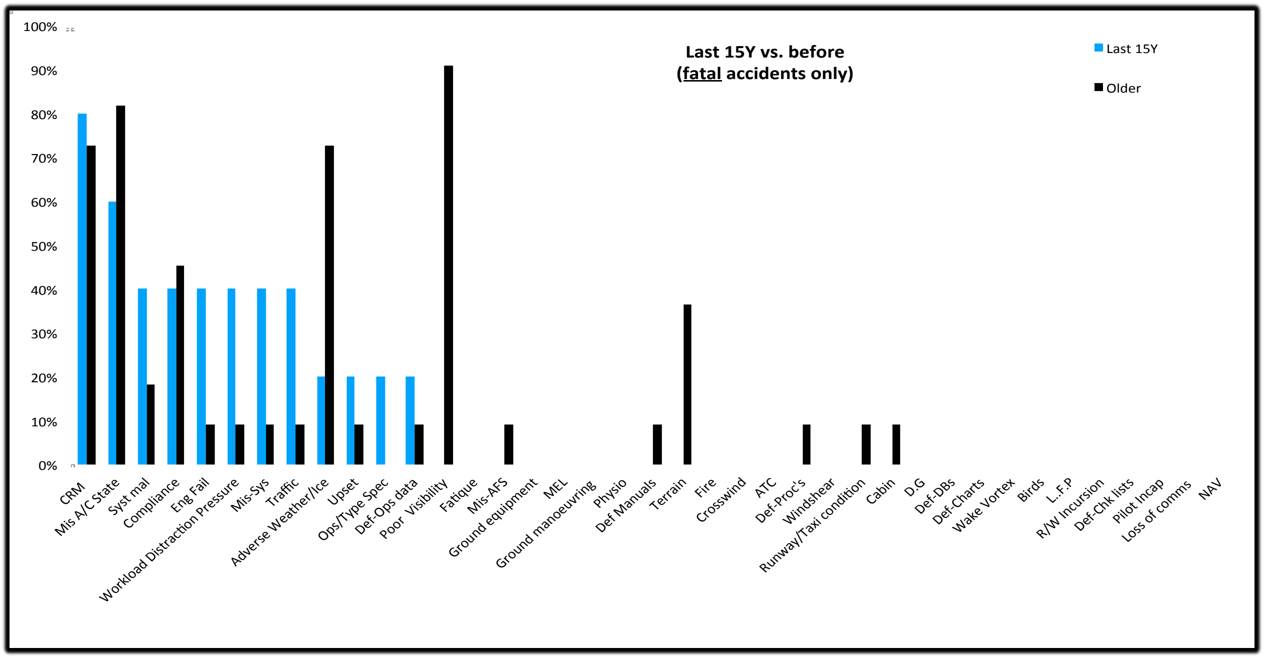


Figure A2.10.3.1

2.10.4 Distribution by Flight Phase

2.10.4.1 Distributions by Flight Phase (Turboprop Generation 2)

Number of accidents per Flight Phase last 15 years.

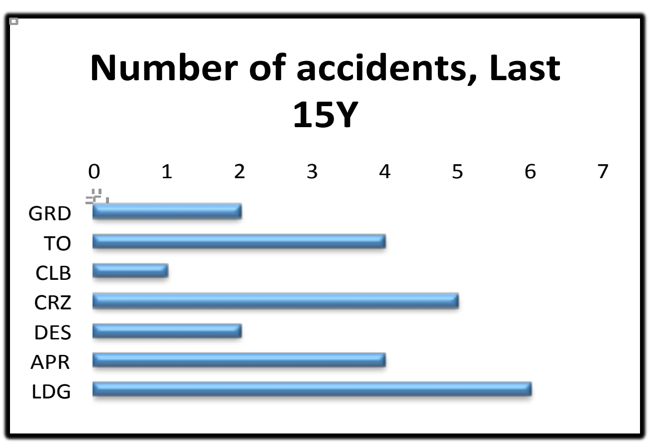
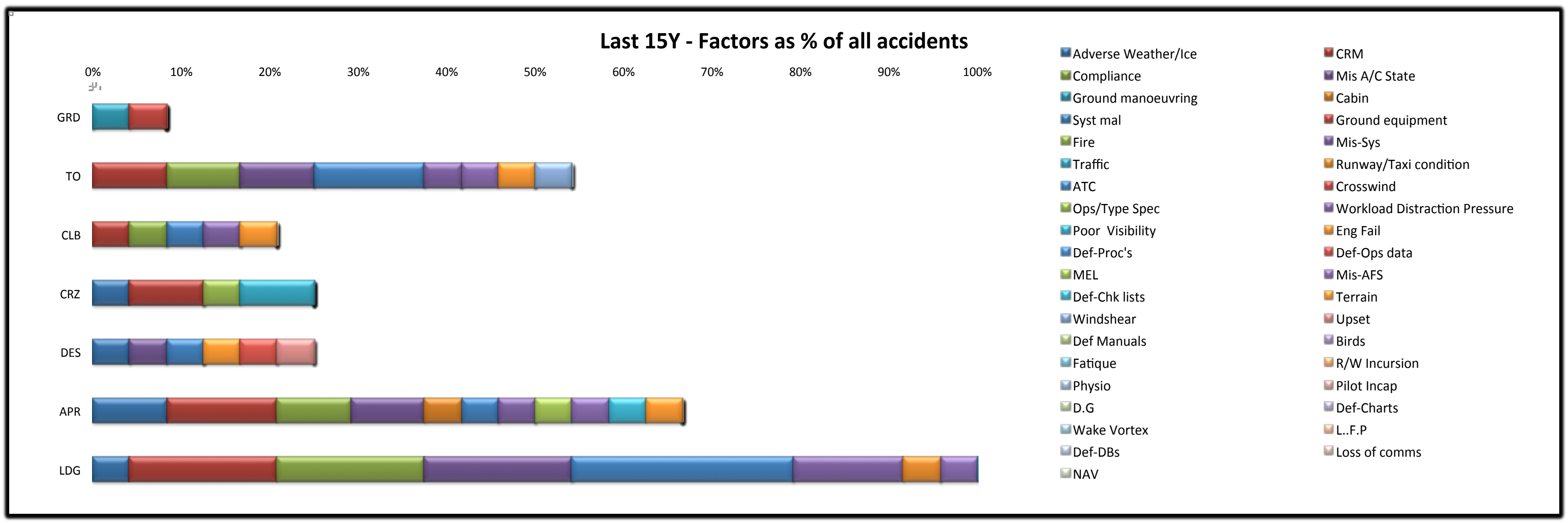


Figure A2.10.4.1

2.10.4.2 Distribution of Specific Factors by Flight Phase (Last 15 Years)

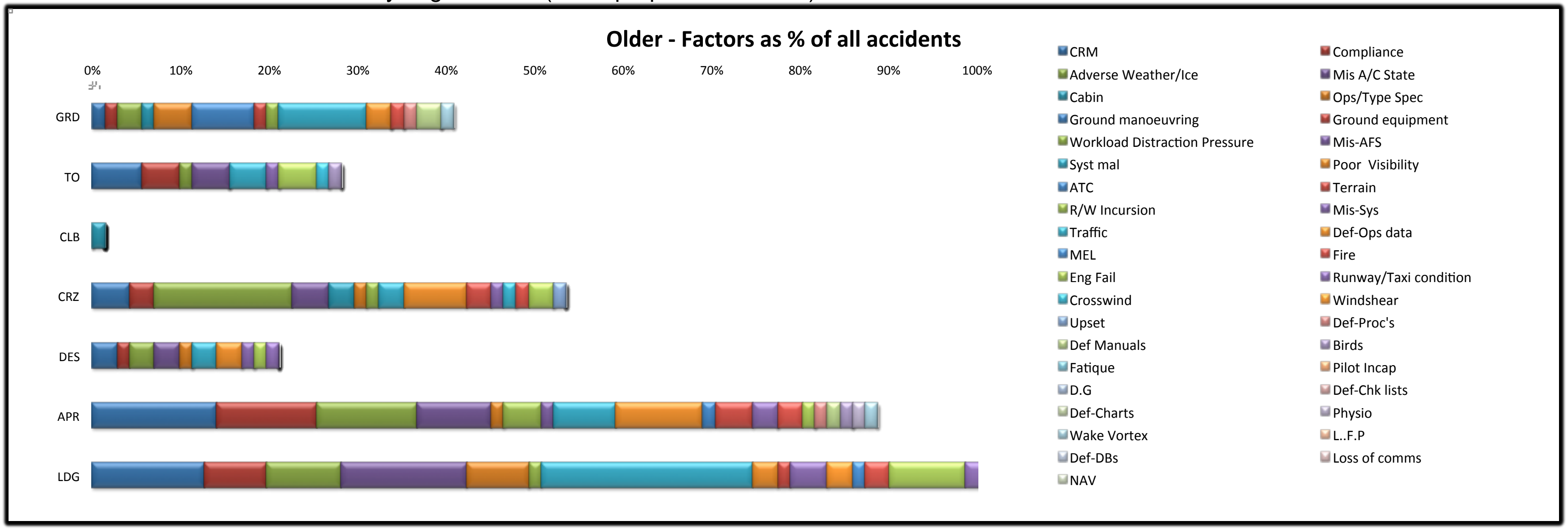
Distribution of factors in accidents by Flight Phase (Turboprop Generation 2)

Figure A2.10.4.2



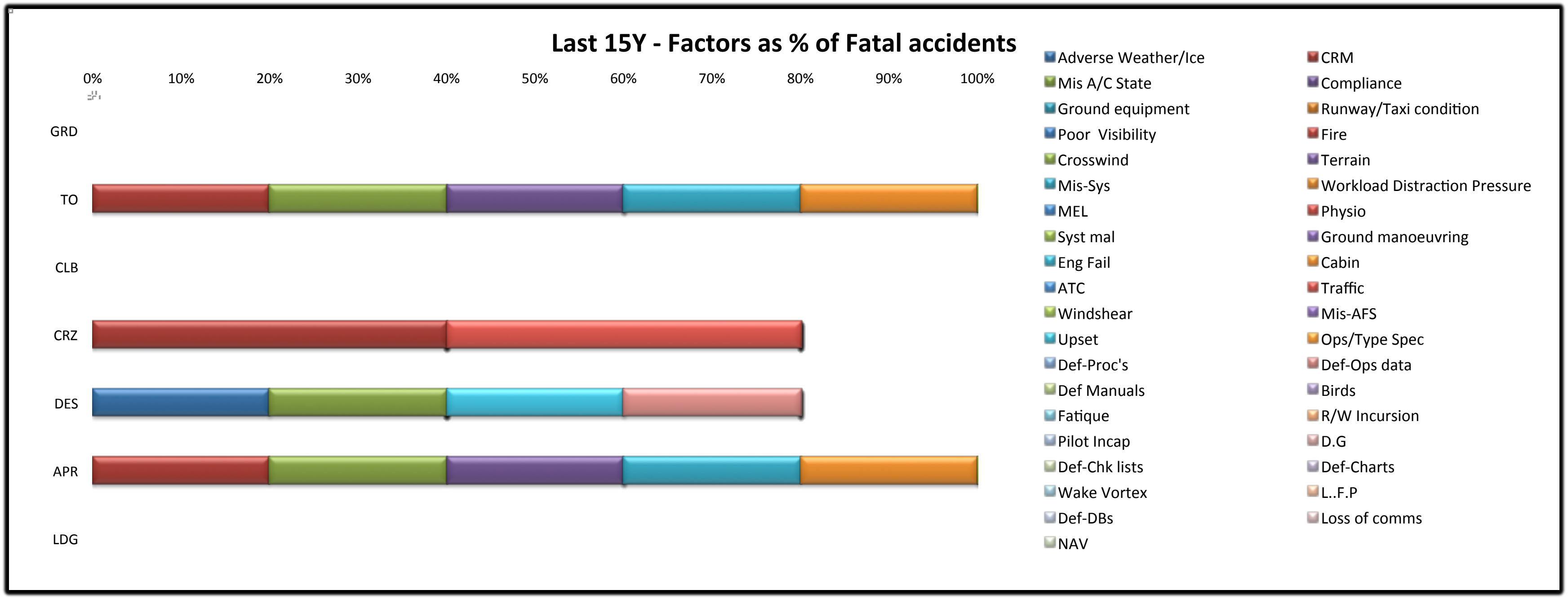
2.10.4.3 Distribution of Specific Factors by Flight Phase (Older)

Distribution of factors in accidents by Flight Phase (Turboprop Generation 2)



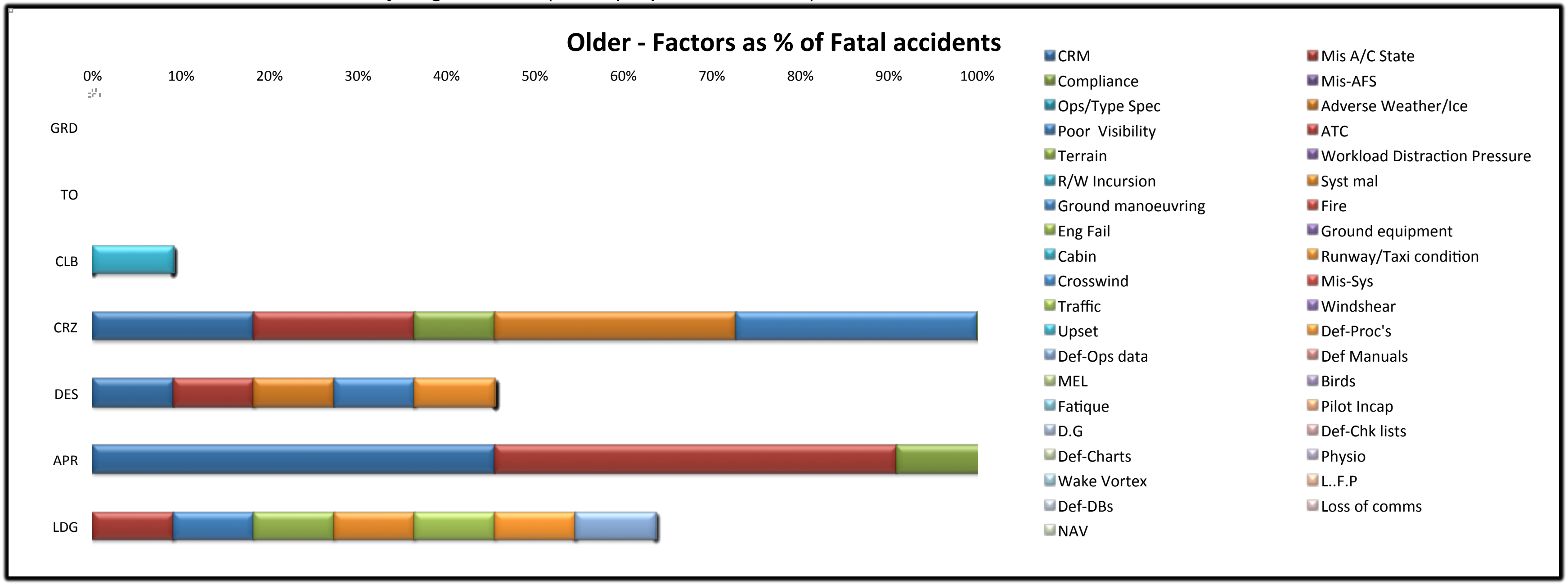
2.10.4.4 Distribution of Specific Factors by Flight Phase (Last 15 Years, Fatal Accidents only)

Distribution of factors in accidents by Flight Phase (Turboprop Generation 2)



2.10.4.5 Distribution of Specific Factors by Flight Phase (Older, Fatal Accidents only)

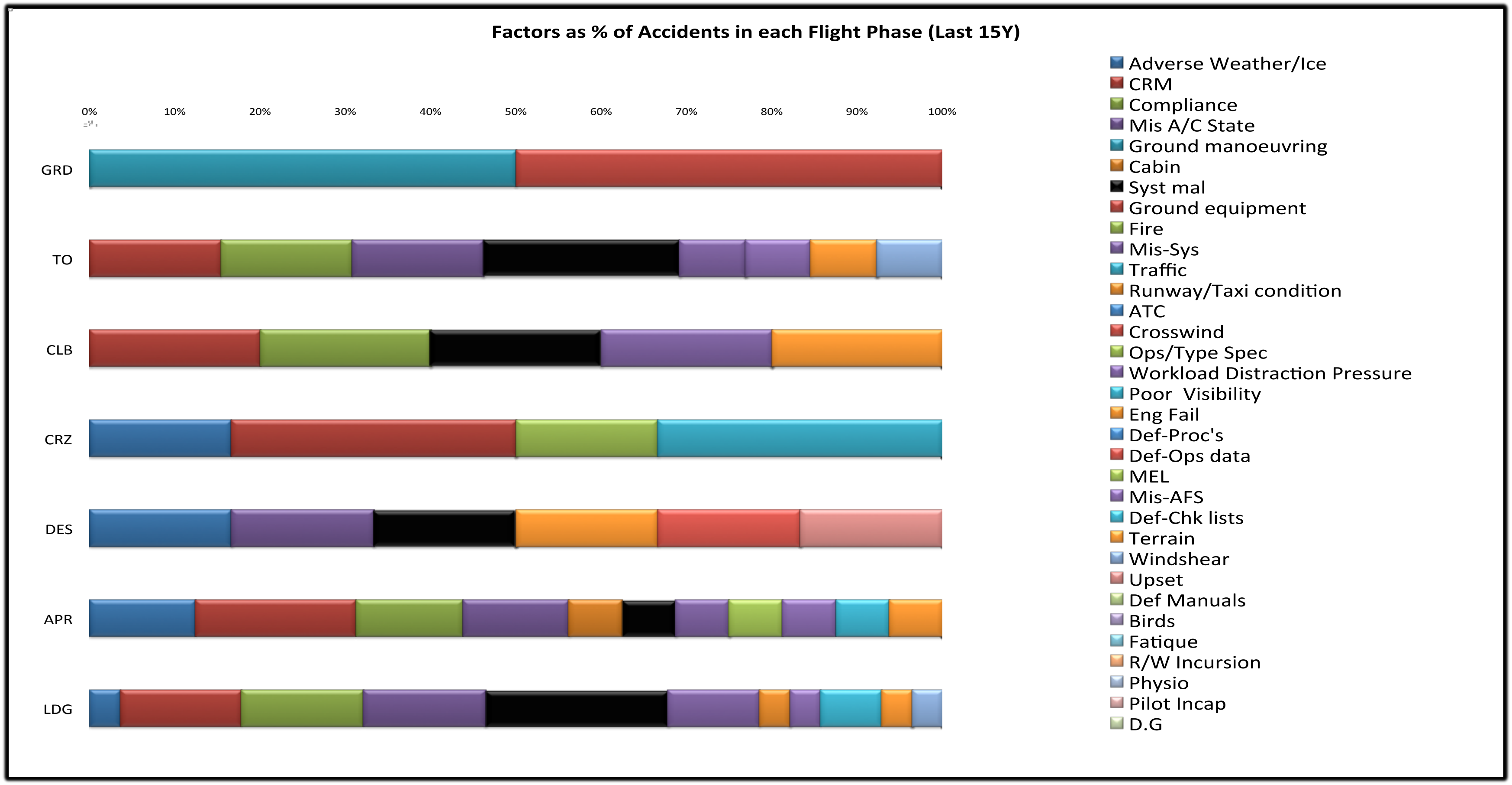
Distribution of factors in accidents by Flight Phase (Turboprop Generation 2)



2.10.4.6 Proportional Distributions of Specific Factors by Flight Phase

Proportional Distributions of Factors by Flight Phase (Last 15 years) (Turboprop Generation 2)

Figure A2.10.4.6



2.10.5 Training Effect

2.10.5.1 Training Effect (Turboprop Generation 2)

Training effect for Turboprop Generation 2 aircraft (All Accidents) by flight phase

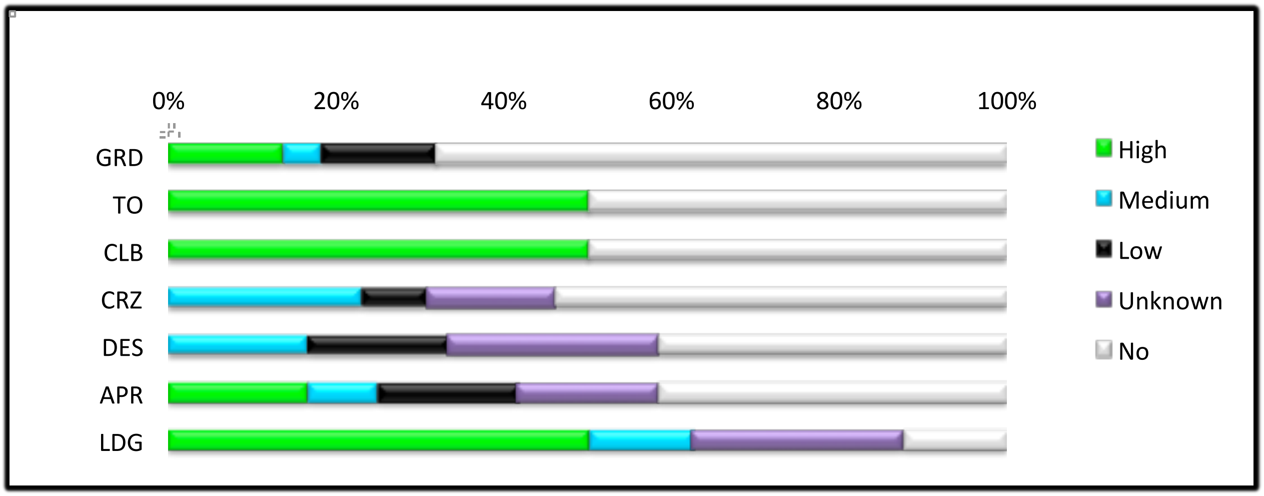


Figure A2.10.5.1

2.10.5.2 Training Effect, All Times (All Generations)

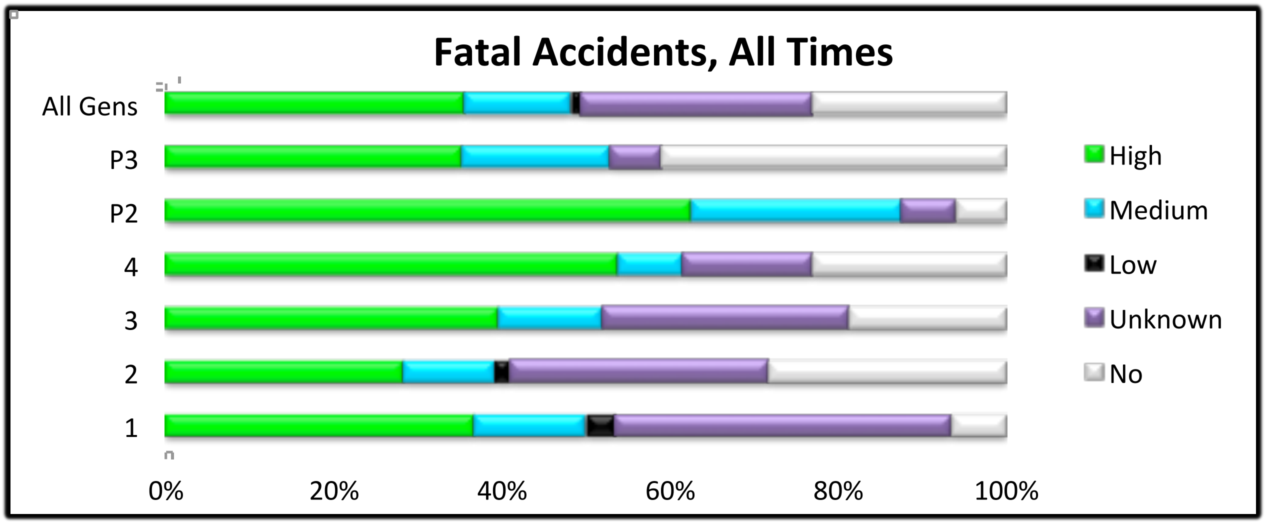


Figure A2.10.5.2

2.10.5.3 Training Effect, Previous Period (All Generations)

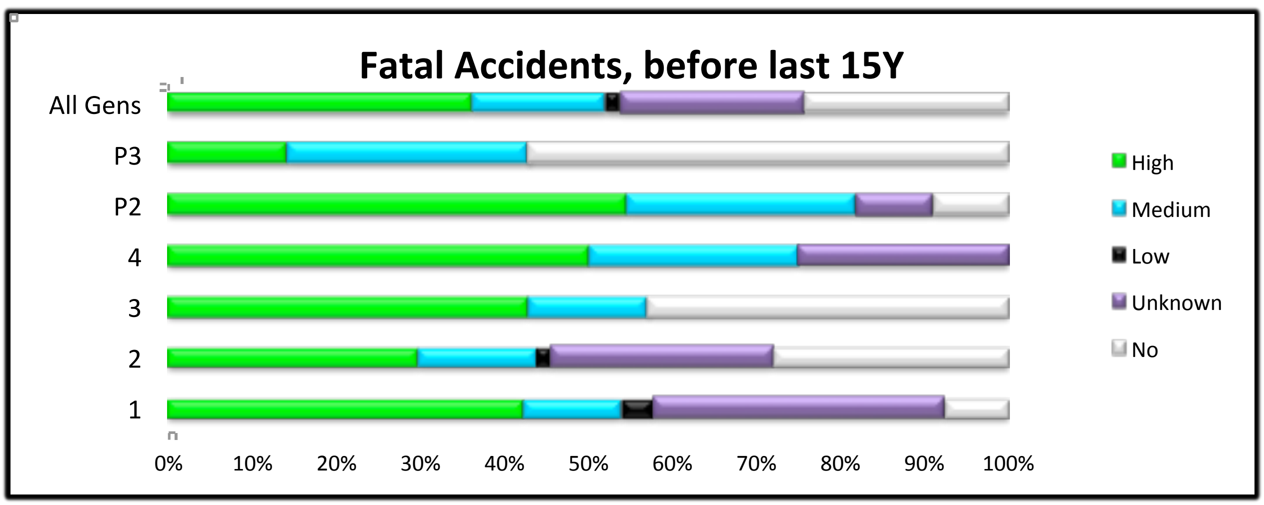


Figure A2.10.5.3

2.10.5.4 Training Effect Most Recent Period (All Generations)

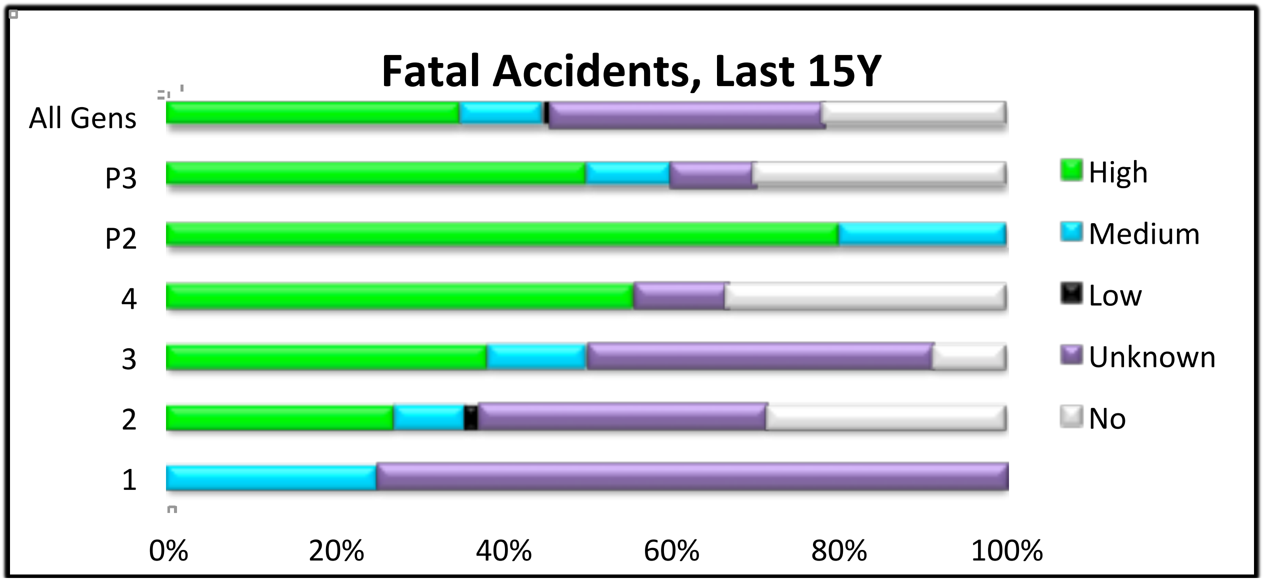


Figure A2.10.5.4

2.10.5.5 Training Effect, All Times (All Generations)

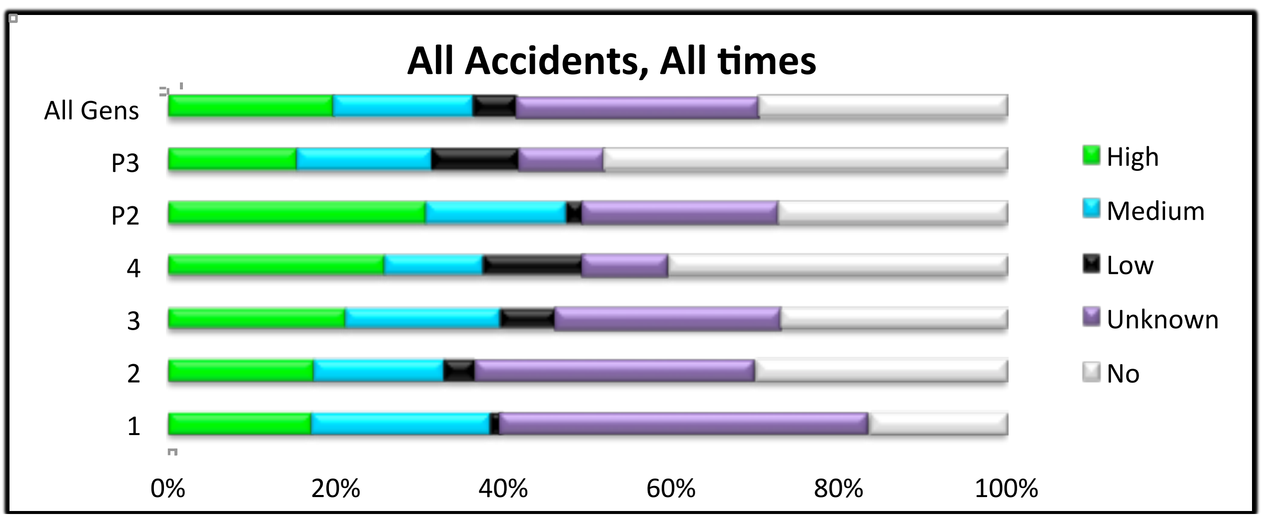


Figure A2.10.5.5

2.10.5.6 Training Effect, Previous Period (All Generations)

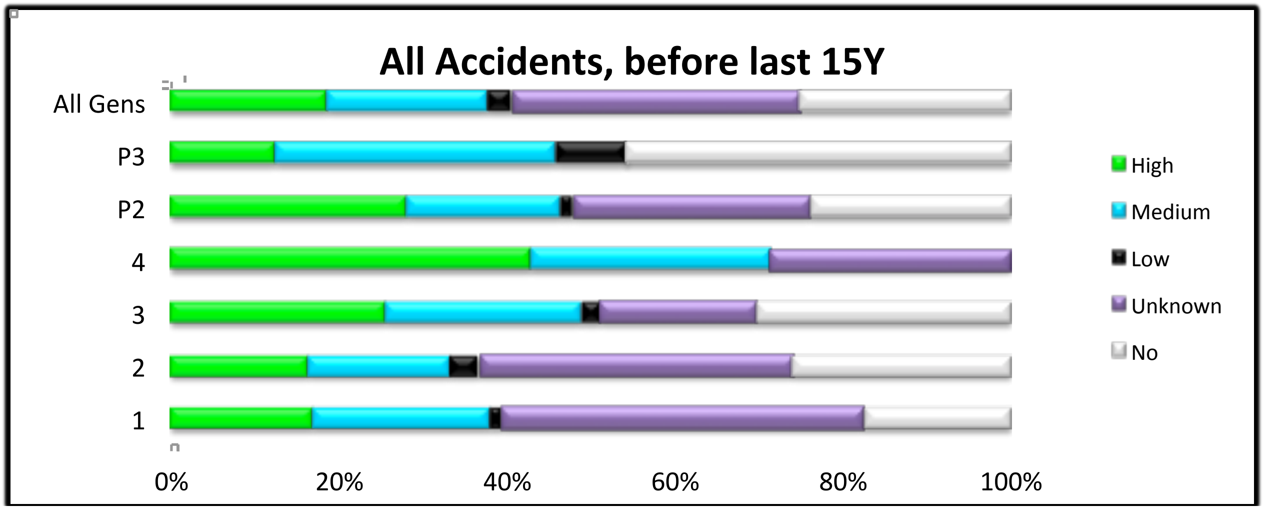


Figure A2.10.5.6

2.10.5.7 Training Effect, Most Recent Period (All Generations)

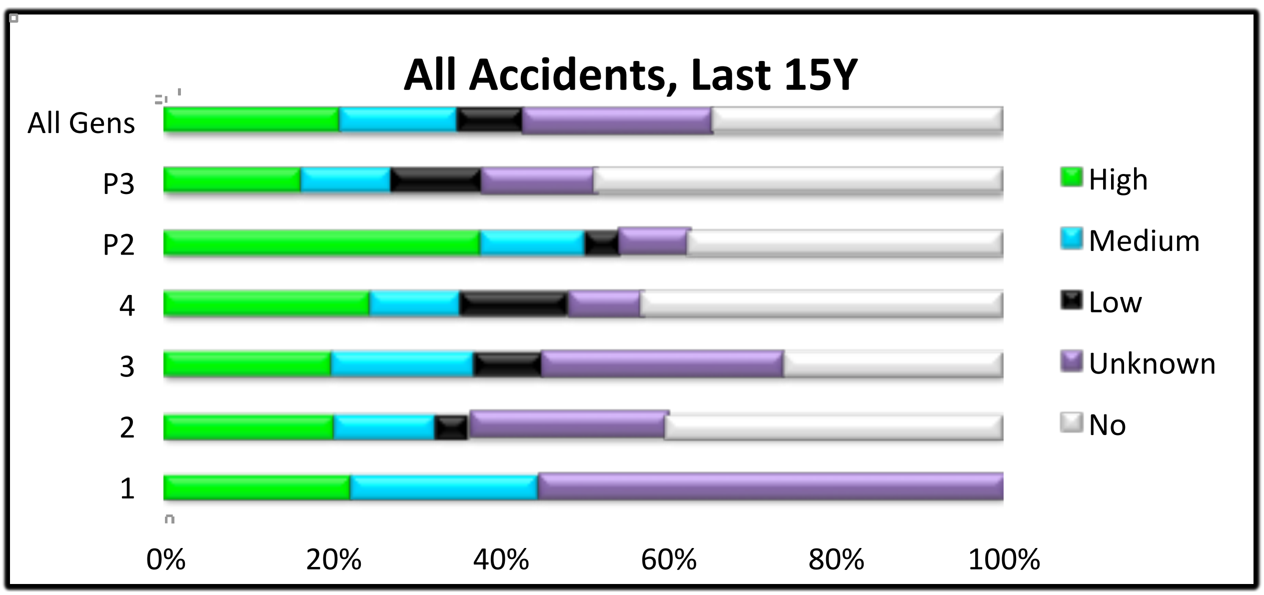


Figure A2.10.5.7

2.10.6 Competencies in Accidents

2.10.6.1 Distributions of Deficient Competencies in Accidents (Turboprop Generation 2)

Deficient competencies in accidents comparing most recent to previous period

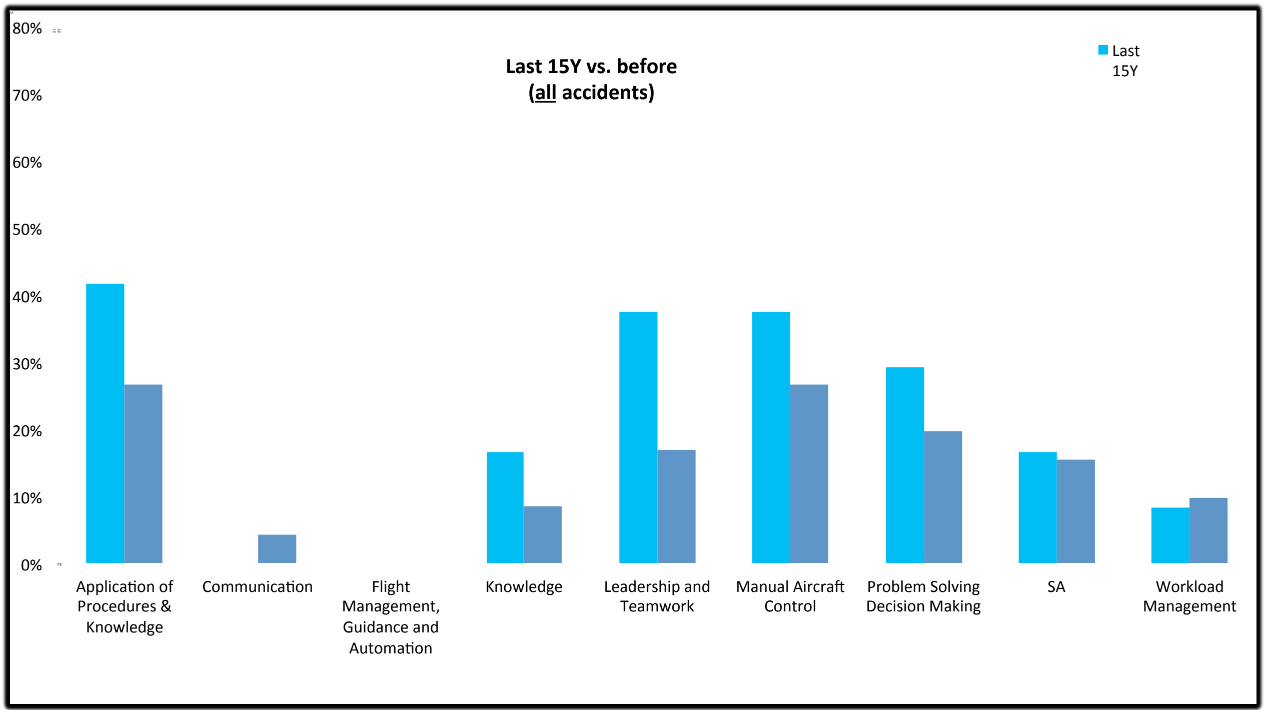


Figure A2.10.6.1

2.10.7 Competencies in Fatal Accidents

2.10.7.1 Distributions of Deficient Competencies in Fatal Accidents (Turboprop Gen 2)

Deficient competencies in fatal accidents comparing most recent to previous period

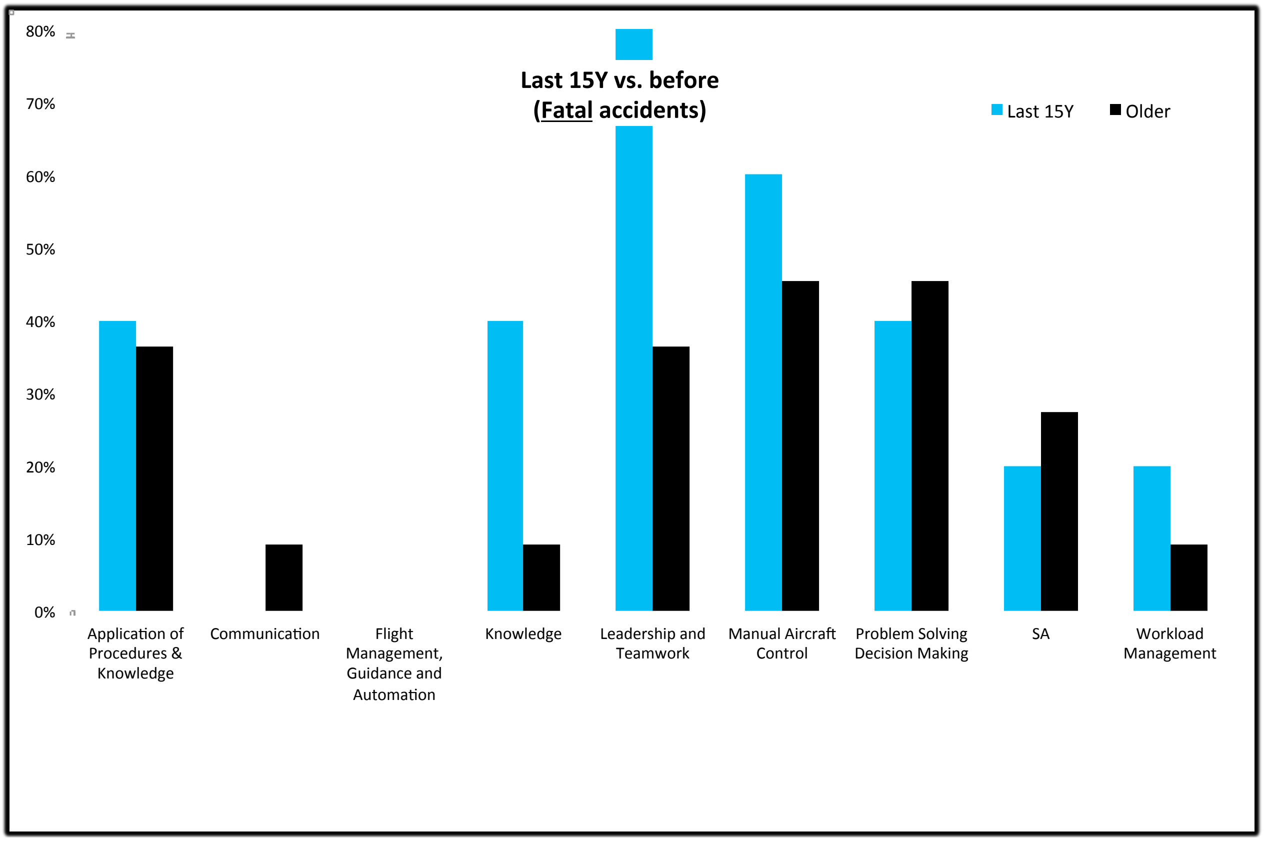


Figure A2.10.7.1

2.10.8 Competencies in Incidents

2.10.8.1 Distributions of Deficient Competencies in Incidents (Turboprop Generation 2)

Deficient competencies in incidents comparing most recent to previous period

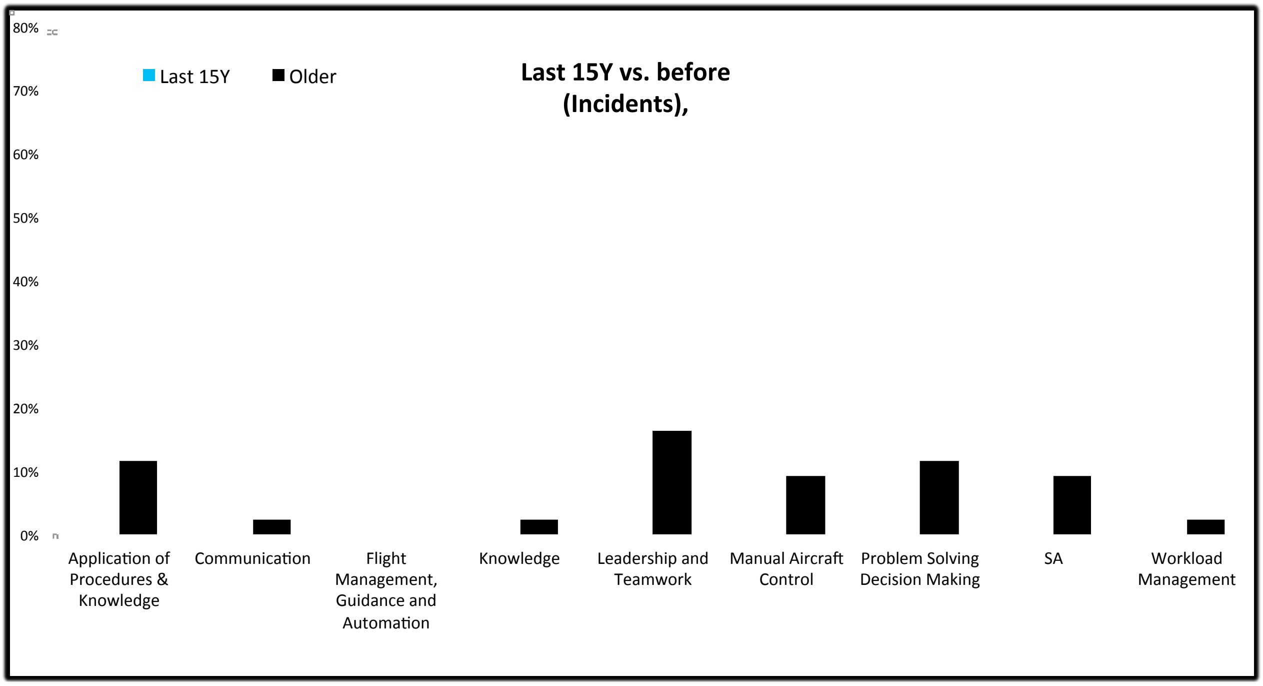


Figure A2.10.8.1

2.10.9 Relative Risk Rank

2.10.9.1 Relative Risk Rank Table (Turboprop Generation 2)

	Frequency						Freq*Sev			
	% of events (all times)			Frequency contribution (% * 5)			Separately at 3 Sev levels			
	% of recent fatal acc	% of recent acc	% of recent inc	F acc	Acc	Inc	F Acc (5)	Acc (3)	Inc (1)	Total risk
CRM	80%	50%	0%	4.00	2.50	0.00	20.00	7.50	0.00	27.50
Adverse Weather/Ice	20%	21%	33%	1.00	1.04	1.67	5.00	3.13	1.67	9.79
Syst mal	40%	50%	83%	2.00	2.50	4.17	10.00	7.50	4.17	21.67
Eng Fail	40%	21%	0%	2.00	1.04	0.00	10.00	3.13	0.00	13.13
Poor Visibility	0%	13%	0%	0.00	0.63	0.00	0.00	1.88	0.00	1.88
Compliance	40%	38%	0%	2.00	1.88	0.00	10.00	5.63	0.00	15.63
Mis A/C State	60%	38%	0%	3.00	1.88	0.00	15.00	5.63	0.00	20.63
Upset	20%	4%	0%	1.00	0.21	0.00	5.00	0.63	0.00	5.63
Fatique	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Workload Distraction Pressure	40%	13%	0%	2.00	0.63	0.00	10.00	1.88	0.00	11.88
Mis-AFS	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ground equipment	0%	4%	0%	0.00	0.21	0.00	0.00	0.63	0.00	0.63
Ground manoeuvring	0%	4%	0%	0.00	0.21	0.00	0.00	0.63	0.00	0.63
Ops/Type Spec	20%	4%	8%	1.00	0.21	0.42	5.00	0.63	0.42	6.04
Def Manuals	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mis-Sys	40%	25%	0%	2.00	1.25	0.00	10.00	3.75	0.00	13.75
Def-Ops data	20%	4%	0%	1.00	0.21	0.00	5.00	0.63	0.00	5.63
MEL	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Physio	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Birds	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fire	0%	4%	0%	0.00	0.21	0.00	0.00	0.63	0.00	0.63
Runway/Taxi condition	0%	4%	0%	0.00	0.21	0.00	0.00	0.63	0.00	0.63
Traffic	40%	8%	0%	2.00	0.42	0.00	10.00	1.25	0.00	11.25

Figure A2.10.9.1

Relative Risk Rank Table (Continued)

	Frequency						Freq*Sev			
	% of events (all times)			Frequency contribution (% * 5)			Separately at 3 Sev levels			
	% of recent fatal acc	% of recent acc	% of recent inc	F acc	Acc	Inc	F Acc (5)	Acc (3)	Inc (1)	Total risk
Def-Proc's	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crosswind	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ATC	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cabin	0%	4%	8%	0.00	0.21	0.42	0.00	0.63	0.42	1.04
Def-Chk lists	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R/W Incursion	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Terrain	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wake Vortex	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Windshear	0%	8%	0%	0.00	0.42	0.00	0.00	1.25	0.00	1.25
D.G	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Def-DBs	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Def-Charts	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
L..F.P	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NAV	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pilot Incap	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Loss of comms	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Communication	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SA	20%	17%	0%	1.00	0.83	0.00	5.00	2.50	0.00	7.50
Leadership and Teamwork	80%	38%	0%	4.00	1.88	0.00	20.00	5.63	0.00	25.63
Workload Management	20%	8%	0%	1.00	0.42	0.00	5.00	1.25	0.00	6.25
Problem Solving Decision Making	40%	29%	0%	2.00	1.46	0.00	10.00	4.38	0.00	14.38
Knowledge	40%	17%	0%	2.00	0.83	0.00	10.00	2.50	0.00	12.50
Application of Procedures & Knowledge	40%	42%	0%	2.00	2.08	0.00	10.00	6.25	0.00	16.25
Flight Management, Guidance and Automation	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Manual Aircraft Control	60%	38%	0%	3.00	1.88	0.00	15.00	5.63	0.00	20.63

Figure A2.10.9.1(cont)

2.10.9.2 Relative Risk Rank Priority

Relative Risk Ranking Priority for Prop Generation 2 (Turboprop Generation 2)

Factor	Priority
CRM	27.50
Syst mal	21.67
Mis A/C State	20.63
Compliance	15.63
Mis-Sys	13.75
Eng Fail	13.13
Workload Distraction Pressure	11.88
Traffic	11.25
Adverse Weather/Ice	9.79
Ops/Type Spec	6.04
Upset	5.63
Def-Ops data	5.63
Poor Visibility	1.88
Windshear	1.25
Cabin	1.04
Ground equipment	0.63
Ground manoeuvring	0.63
Fire	0.63
Runway/Taxi condition	0.63
Fatique	0.00
Mis-AFS	0.00
Def Manuals	0.00
MEL	0.00
Physio	0.00
Birds	0.00
Def-Proc's	0.00
Crosswind	0.00
ATC	0.00
Def-Chk lists	0.00
R/W Incursion	0.00
Terrain	0.00
Wake Vortex	0.00
D.G	0.00
Def-DBs	0.00
Def-Charts	0.00
L..F.P	0.00
NAV	0.00
Pilot Incap	0.00
Loss of comms	0.00

Figure A2.10.9.2

2.10.9.3 Relative Risk Rank Chart

Relative Risk Ranking for Turboprop Generation 2

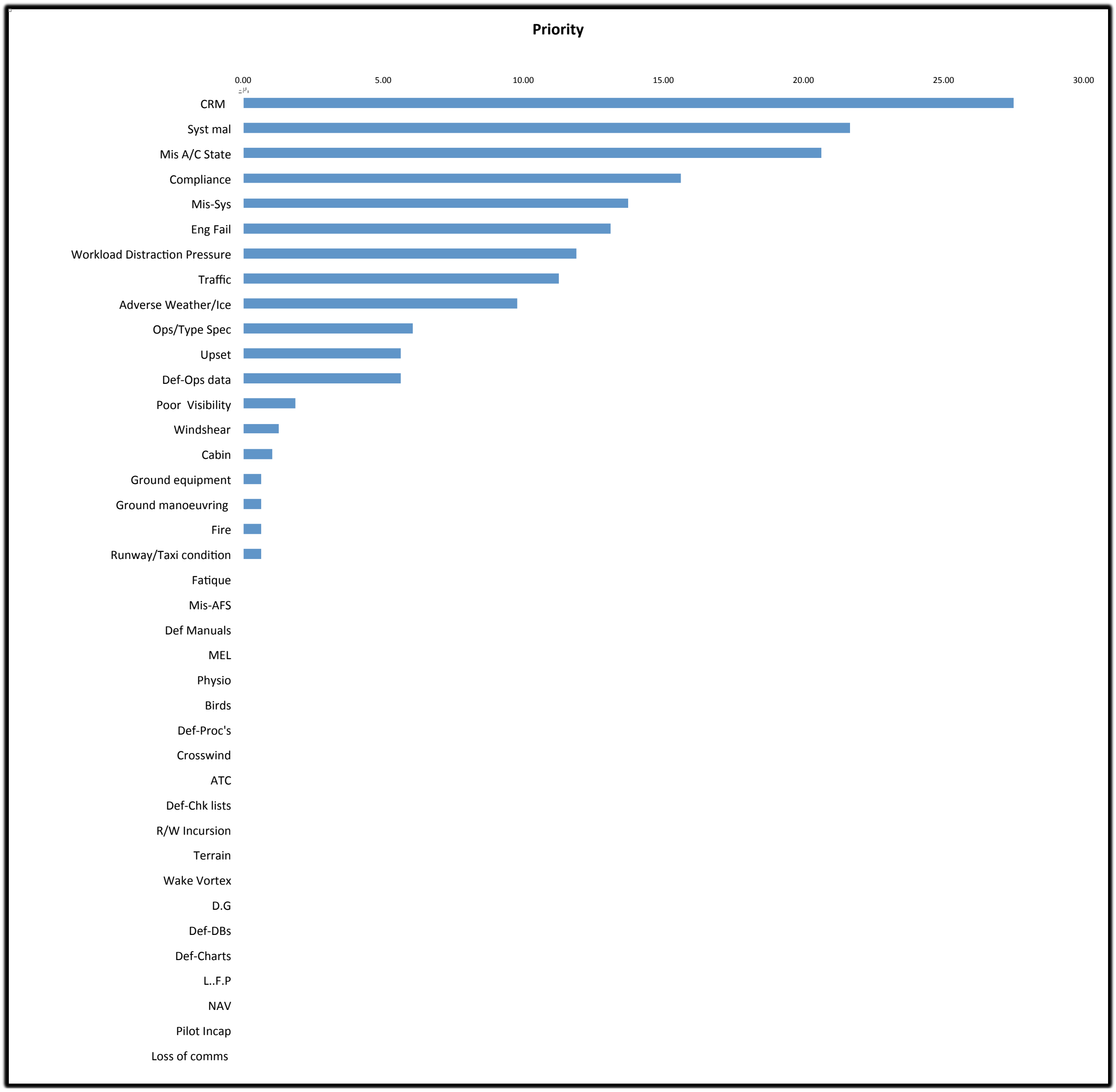


Figure A2.10.9.3

2.10.10 Global Rank Priority for Clustering of Factors for Turboprop Generation 2 (All Accidents)

2.10.10.1 Priority Table

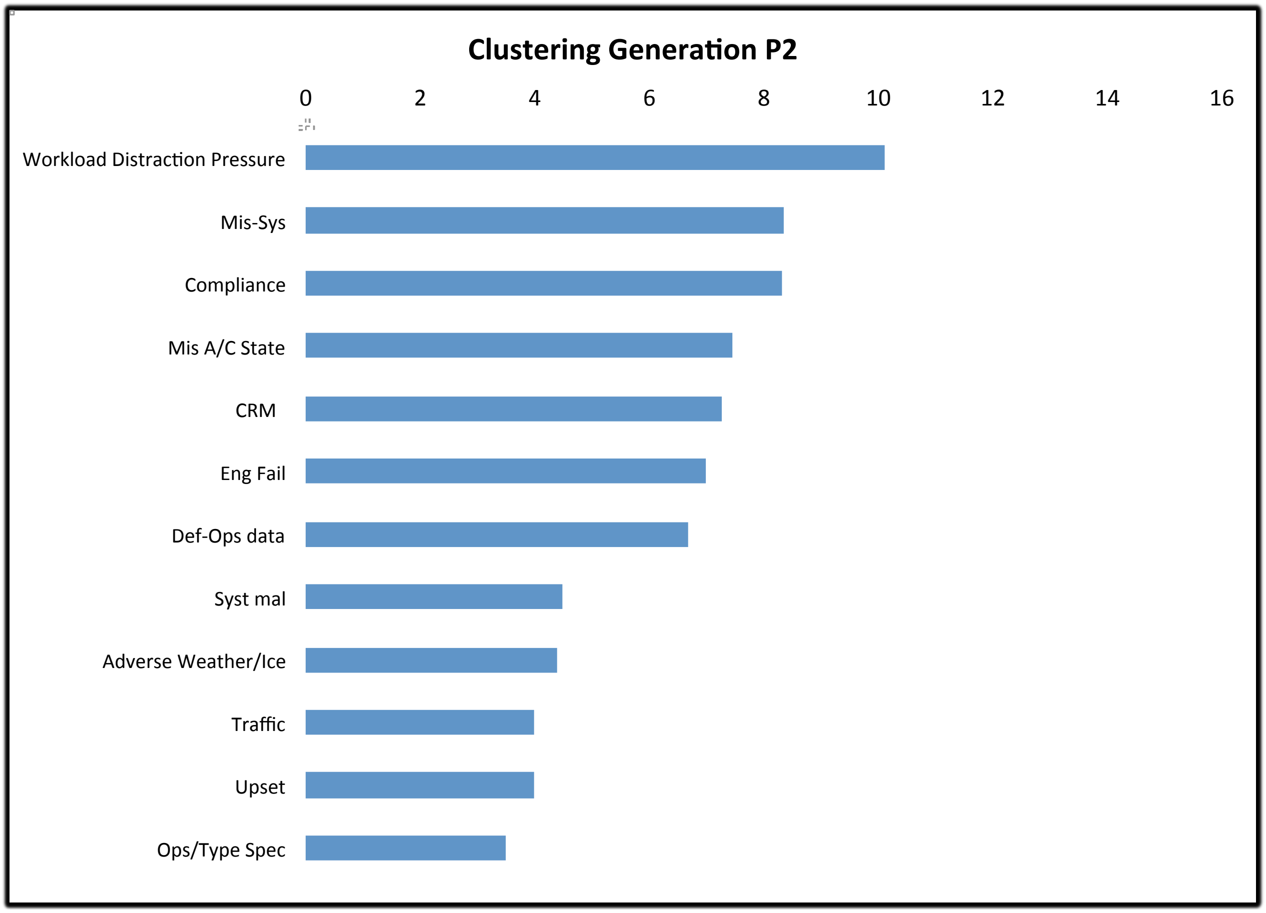


Figure A2.10.10.1

2.10.11 High Training Impact

2.10.11.1 Factors with a High Training Impact (Turboprop Generation 2)

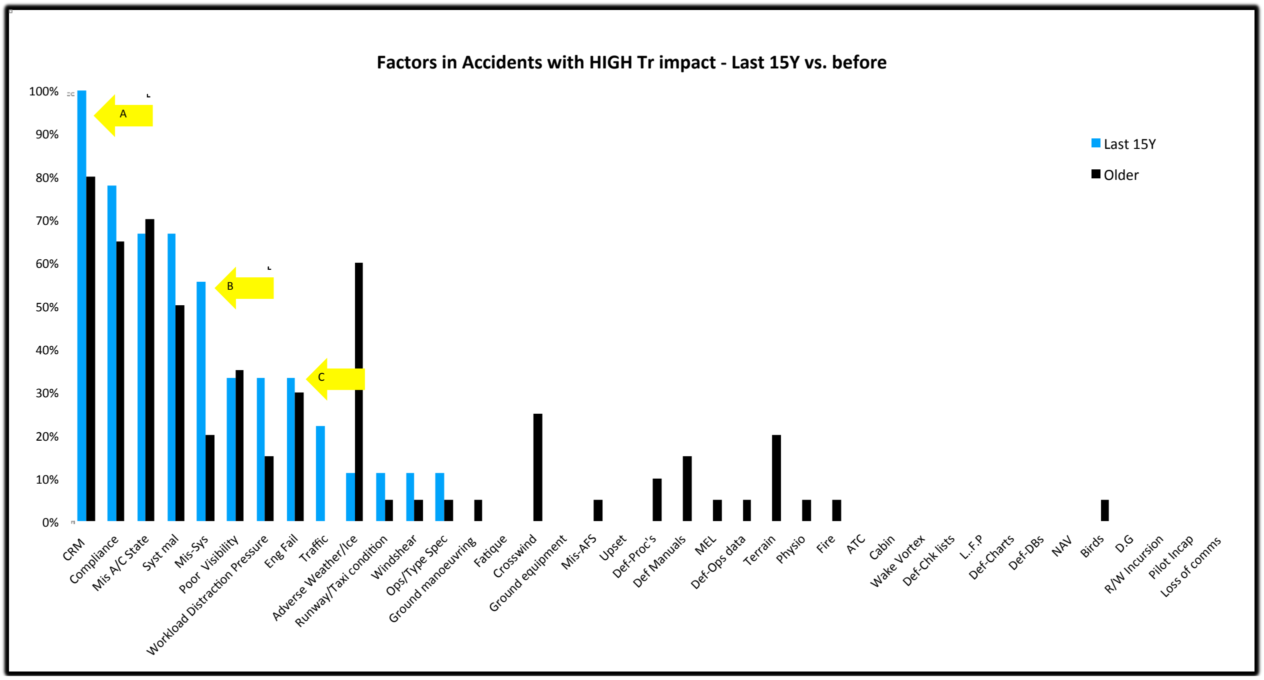


Figure A2.10.11.1

2.10.12 Priority Ranking for Factors Turboprop Generation 2

2.10.12.1 Priority Table

Level	Factor	Rank	Tr
A	CRM	8	A
	Mis A/C State	7	A
	Mis-Sys	7	B
	Compliance	7	C
B	Syst mal	6	A
	Workload Distraction Pressure	6	C
	Eng Fail	5	A
C	Adverse Weather/Ice	3	C
	Traffic	3	C
	Upset	2	C
	Poor Visibility	1	A
	Ops/Type Spec	1	B

Figure A2.10.12.1

2.11 TURBOPROPS GENERATION 3 ANALYSIS

2.11.1 Global Accidents (Last 15 Years)

2.11.1.1 Ranking of Factors for All Accidents (Turboprop Generation 3)

Ranking of factors based on how present they are in accidents (as a percentage of all Prop Generation 3 accidents – last 15 years in blue, earlier times in black)

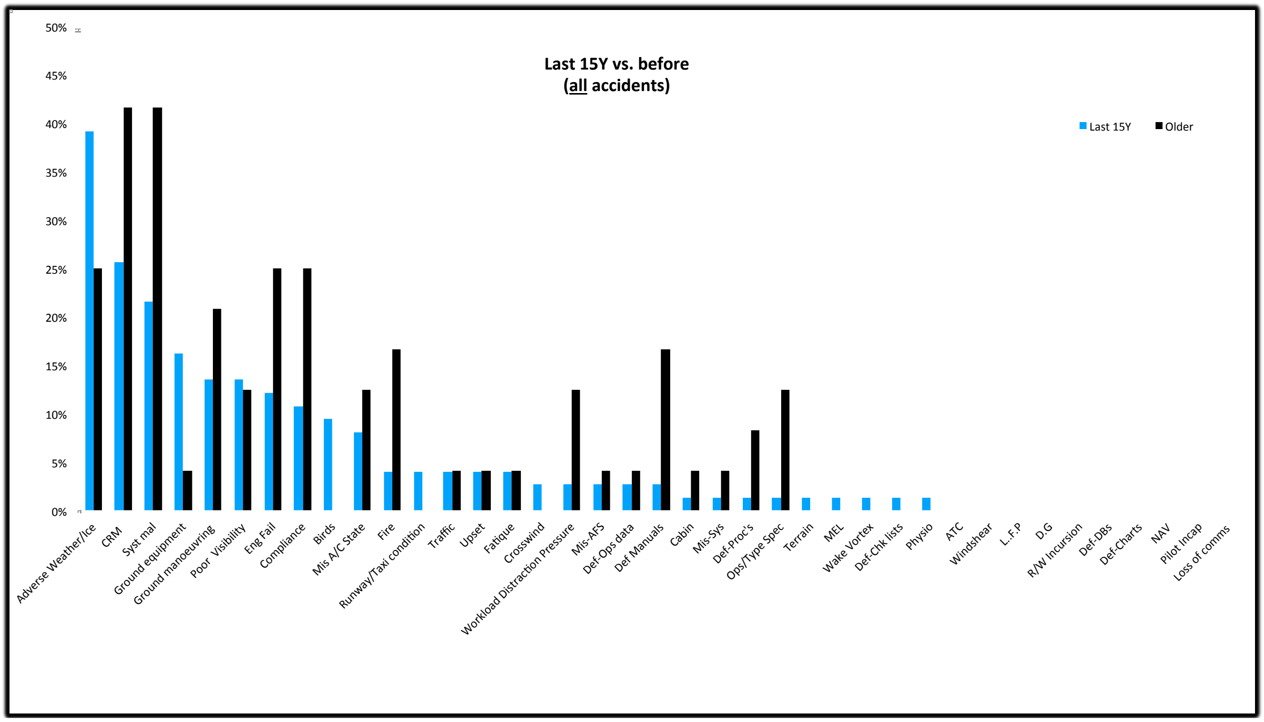


Figure A2.11.1.1

2.11.2 Global Fatal Accidents (Last 15 Years)

2.11.2.1 Ranking of Factors for Fatal Accidents (Turboprop Generation 3)

Ranking of factors as a percentage of fatal accidents, L15Y vs. older

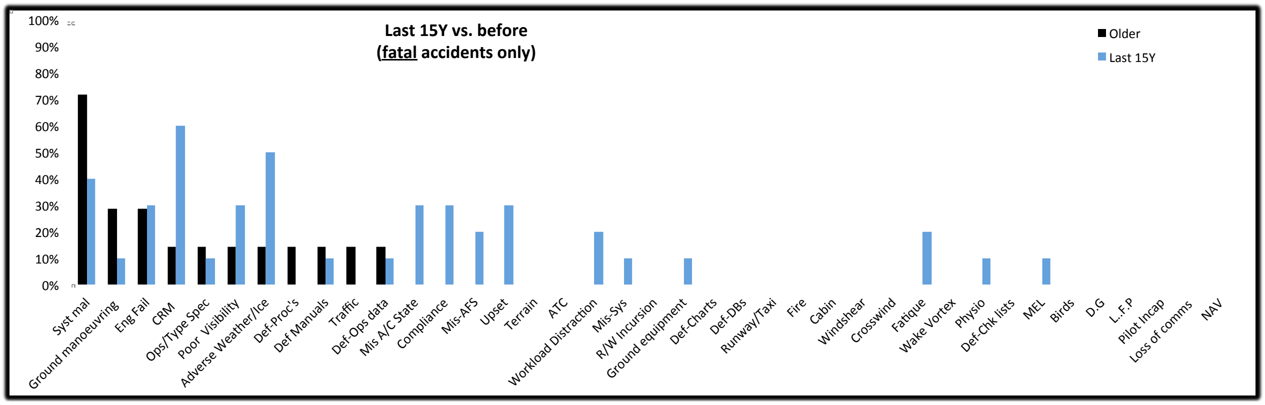


Figure A2.11.2.1

2.11.3 Distribution by Flight Phases

2.11.3.1 Distributions by Flight Phase (Last 15 Years) (Turboprop Generation 3)

Number of accidents per Flight Phase

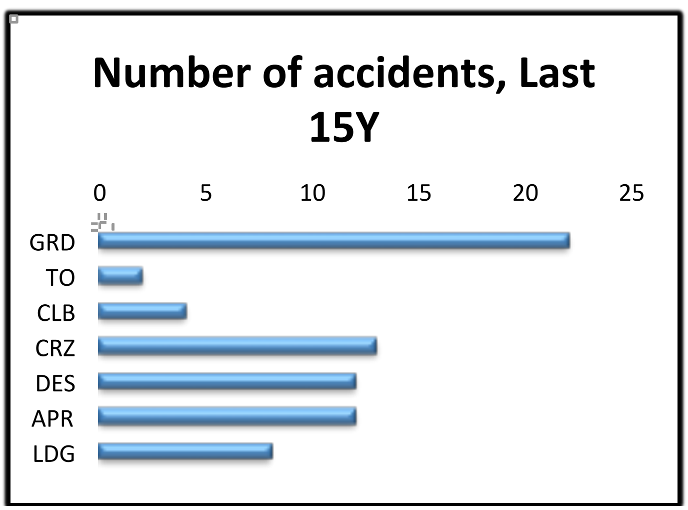


Figure A2.11.3.1

2.11.3.2 Distributions by Flight Phase (Older) (Turboprop Generation 3)

Number of accidents per Flight Phase

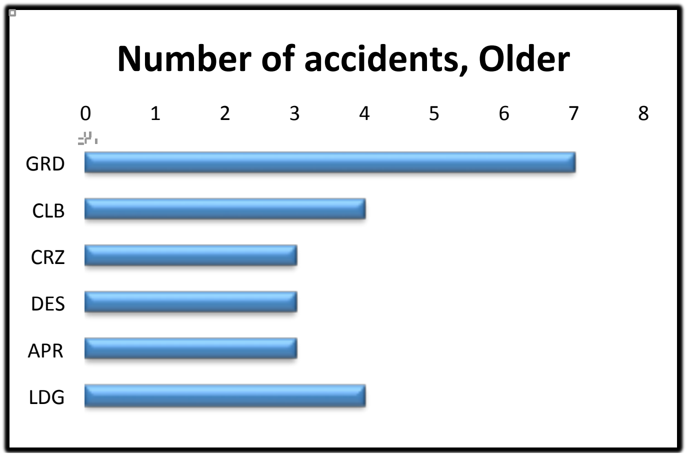
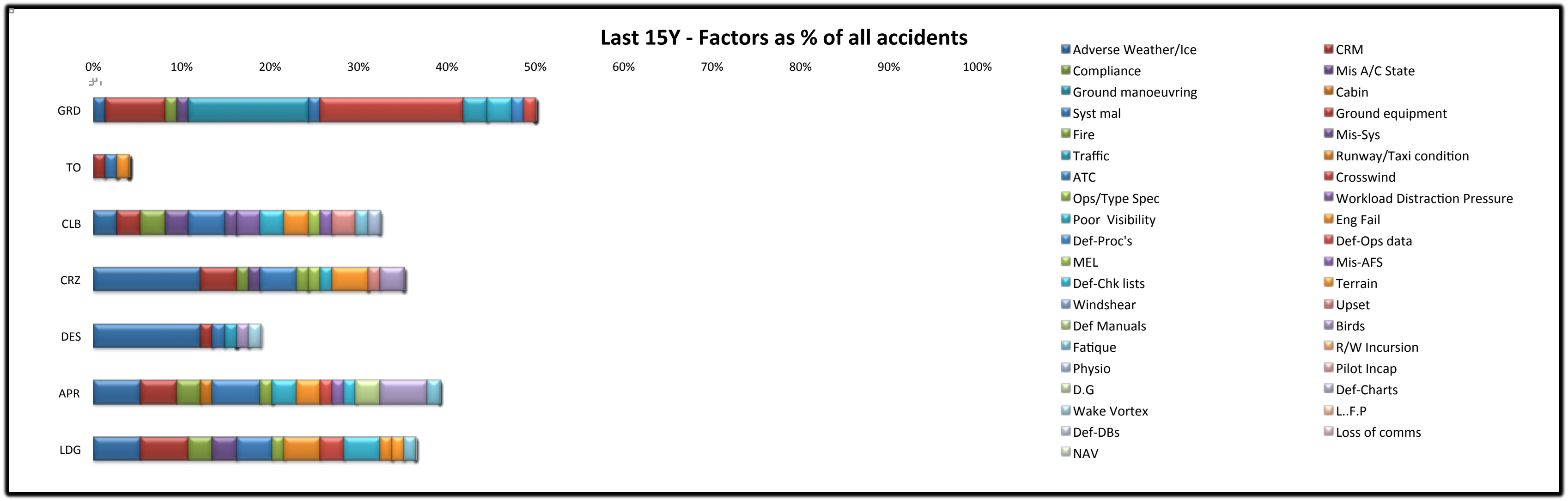


Figure A2.11.3.2

2.11.3.3 Distribution of Specific Factors by Flight Phase (Last 15 Years) (Turboprop Generation 3)

Distribution of factors in accidents by Flight Phase

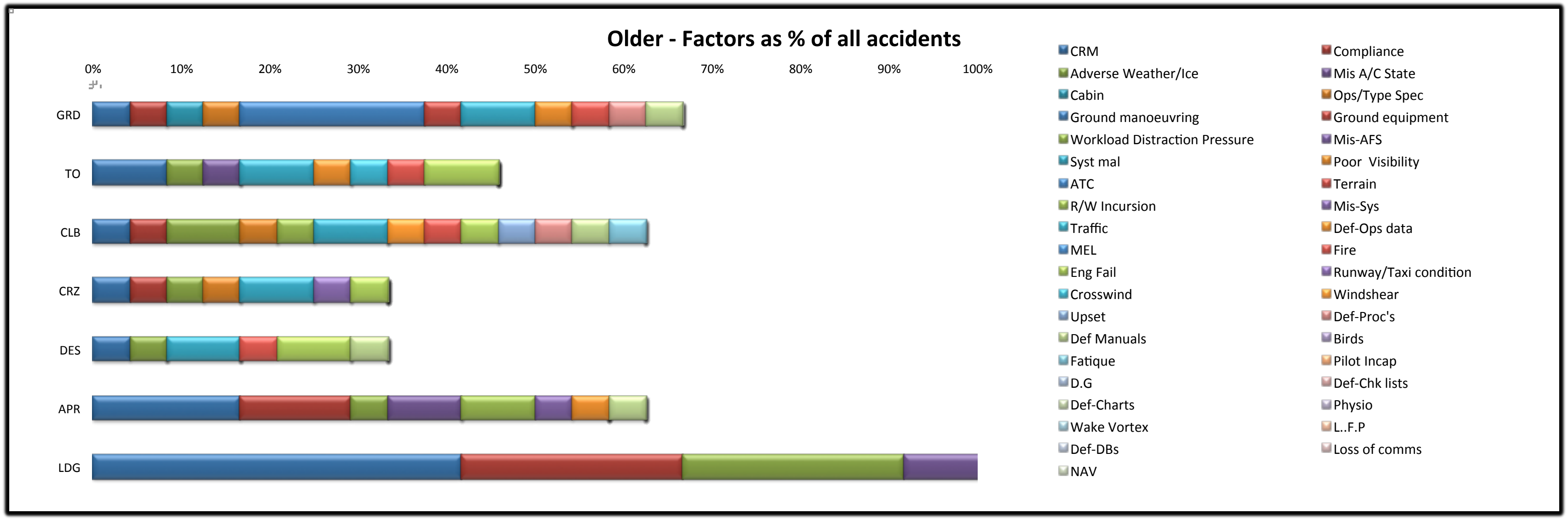
Figure A2.11.3.3



2.11.3.4 Distribution of Specific Factors by Flight Phase (Previous Time Period) (Turboprop Generation 3)

Distribution of factors in accidents by Flight Phase

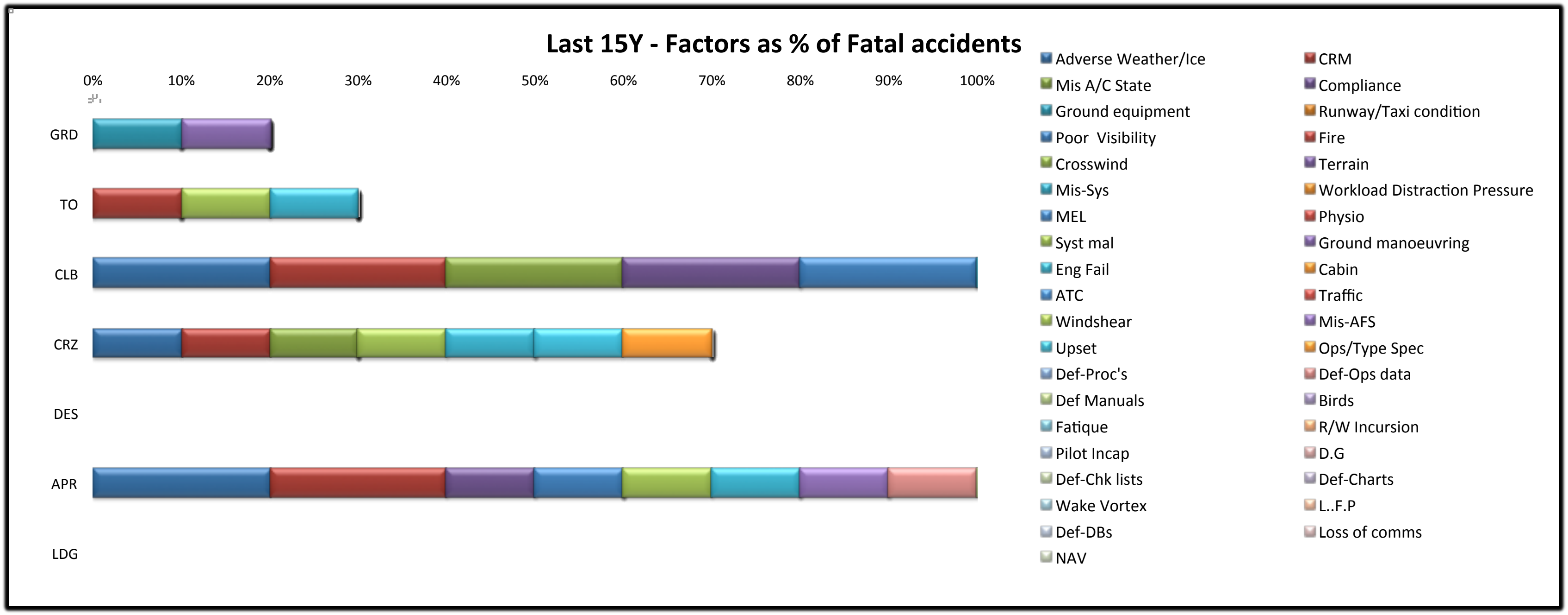
Figure A2.11.3.4



2.11.3.5 Distribution of Specific Factors by Flight Phase (Last 15 Years, Fatal Accidents Only) (Turboprop Generation 3)

Distribution of factors in accidents by Flight Phase

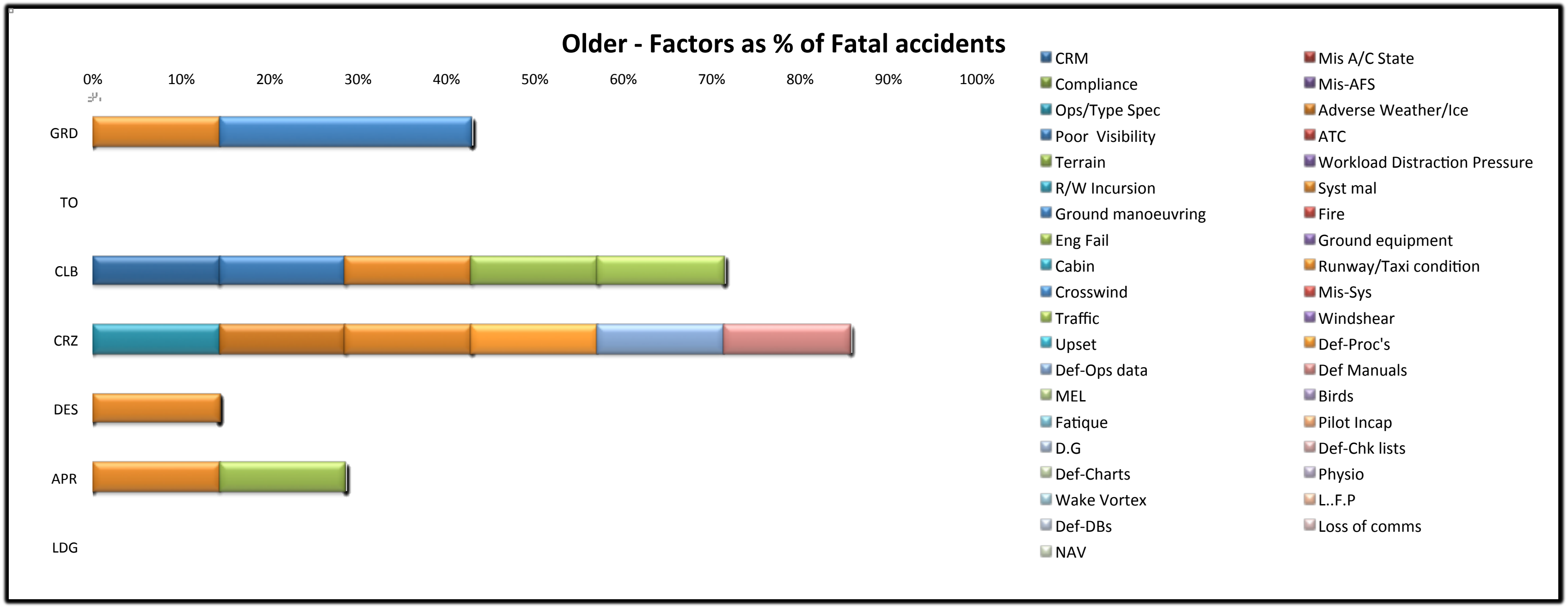
Figure A2.11.3.5



2.11.3.6 Distribution of Specific Factors by Flight Phase (Previous Period, Fatal Accidents Only) (Turboprop Generation 3)

Distribution of factors in accidents by Flight Phase

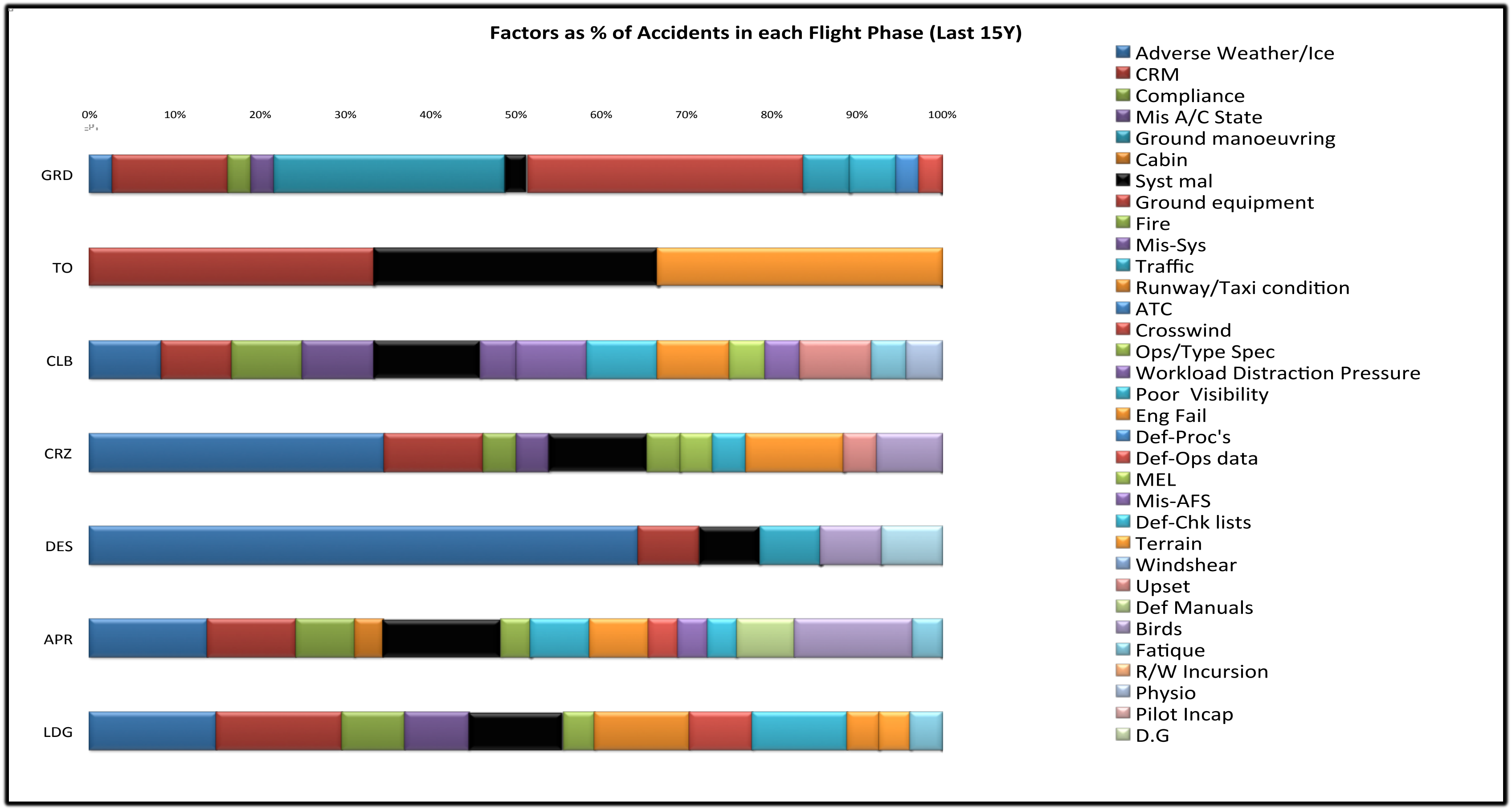
Figure A2.11.3.6



2.11.3.7 Proportional Distributions of Specific Factors by Flight Phase (Last 15 Years) (Turboprop Generation 3)

Proportional distribution of factors by Flight Phase

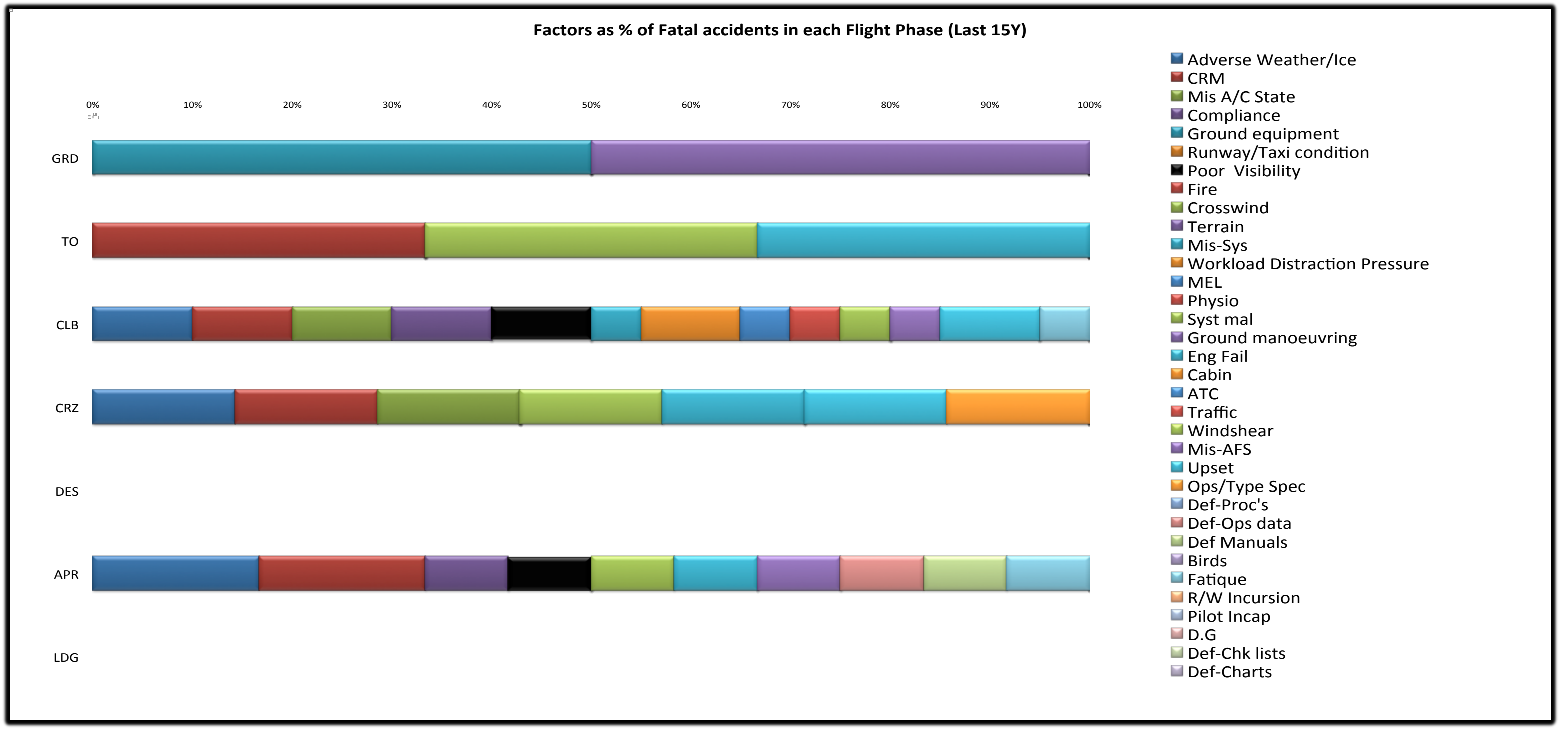
Figure A2.11.3.7



2.11.3.8 Proportional Distributions of Specific Factors by Flight Phase (Last 15 Years) (Turboprop Generation 3)

Proportional distribution of factors by Flight Phase (Fatal Accidents only)

Figure A2.11.3.8



2.11.4 Trainability

2.11.4.1 Training Effect (Turboprop Generation 3)

Training Effect by Flight Phase, all accidents, L15 Years

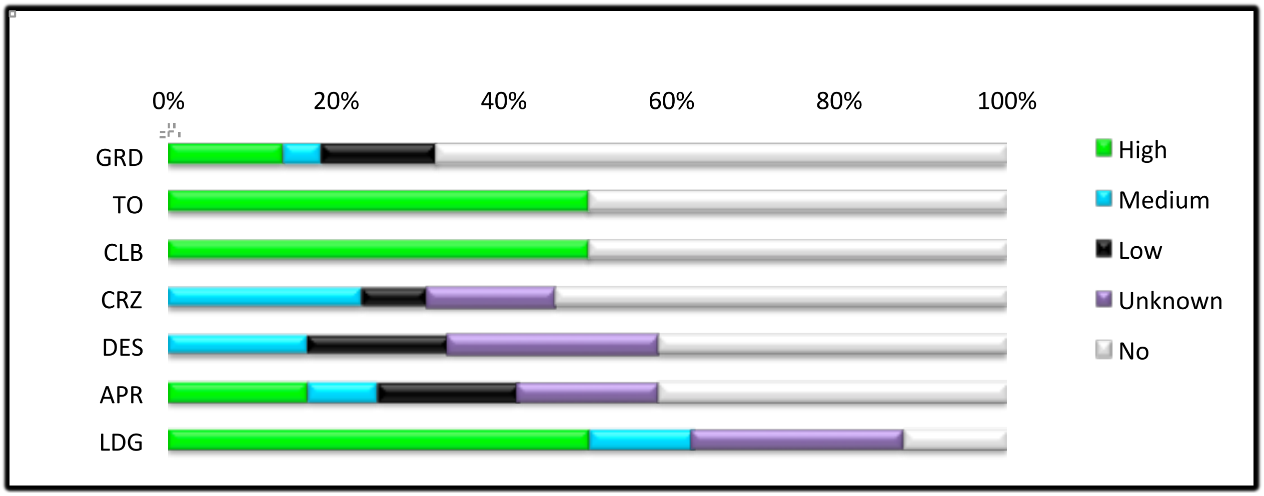


Figure A2.11.4.1

2.11.5 Competencies in All Accidents

2.11.5.1 Comparison of Distributions of Deficient Competencies During Accidents in Current to Previous Period (Turboprop Generation 3)

Deficient competencies in accidents

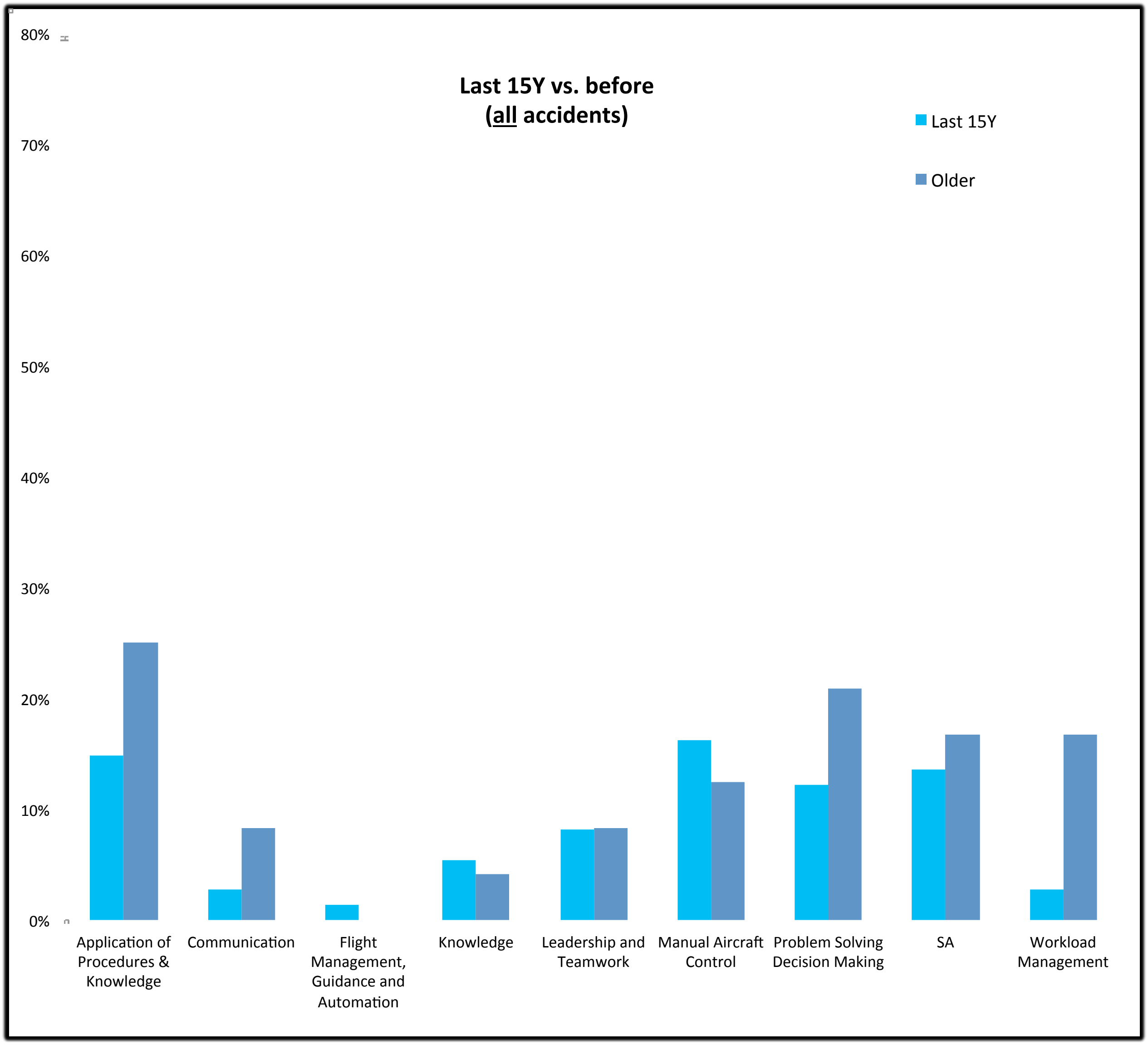


Figure A2.11.5.1

2.11.6 Competencies in Fatal Accidents

2.11.6.1 Comparison of Distributions of Deficient Competencies during Fatal Accidents Current to Previous Period (Turboprop Generation 3)

Deficient competencies in fatal accidents

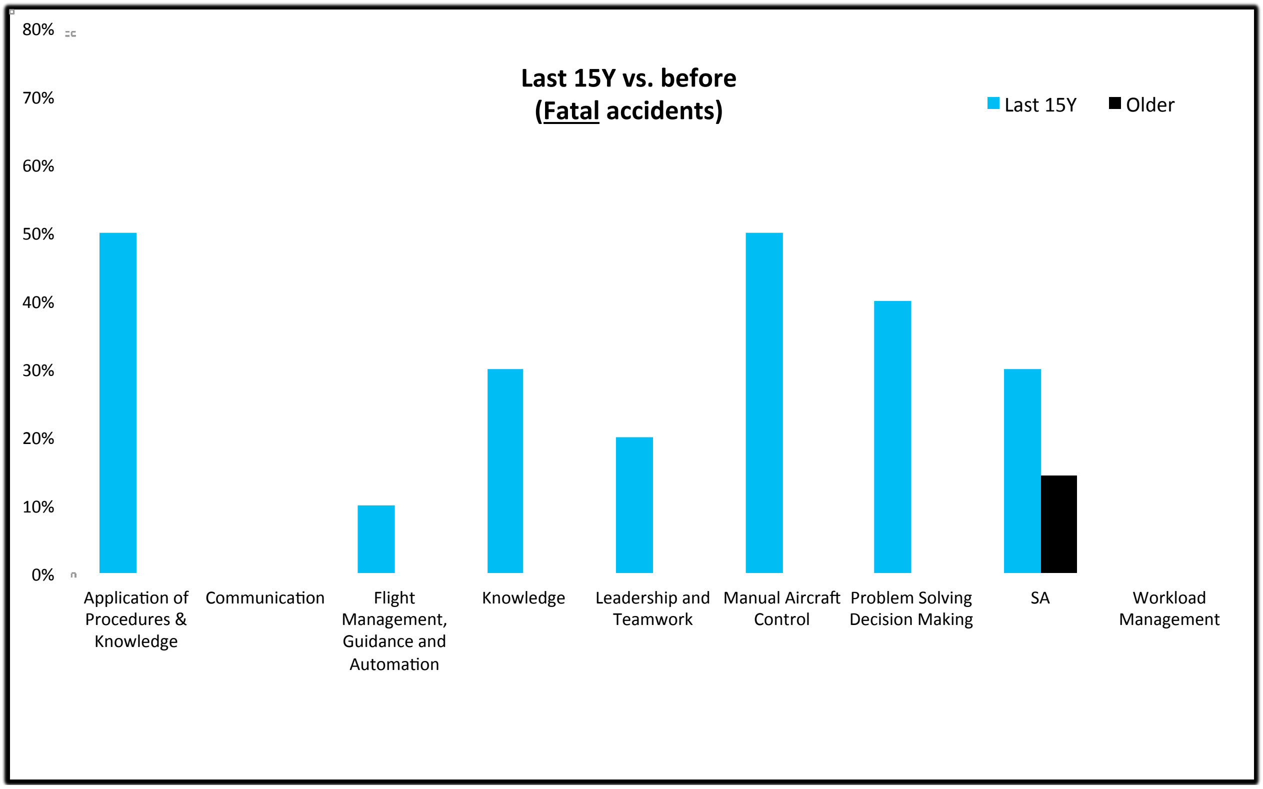


Figure A2.11.6.1

2.11.7 Competencies in Incidents

2.11.7.1 Comparison of Distributions of Deficient Competencies during Incidents in Current to Previous Period (Turboprop Generation 3)

Deficient competencies in incidents

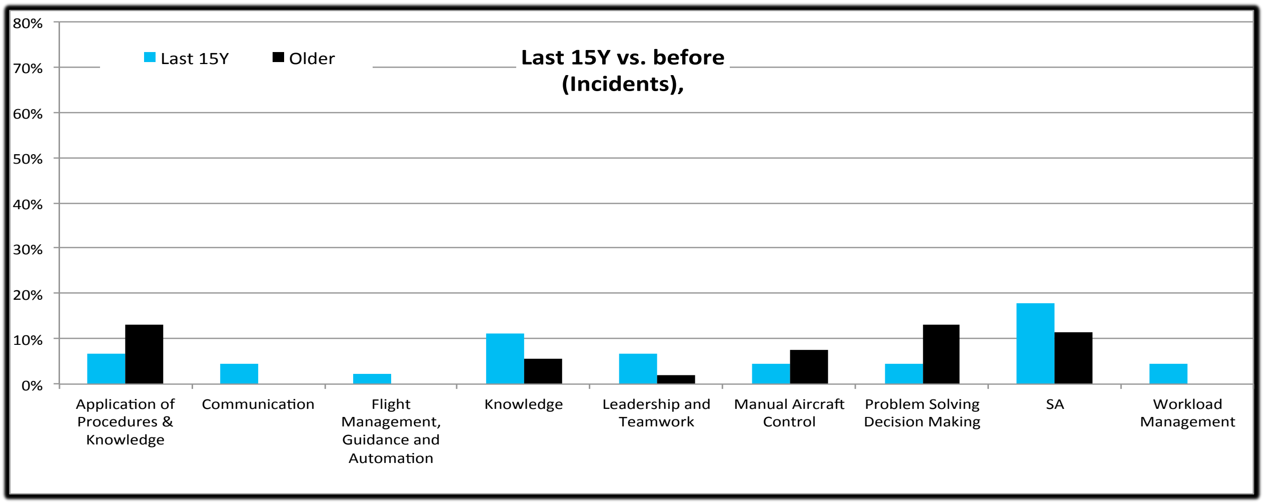


Figure A2.11.7.1

2.11.8 Competency Footprint

2.11.8.1 Distributions of Deficient Competencies in Incidents and Fatal Accidents (Turboprop Generation 3)

Deficient competencies in Incidents vs. Fatal Accidents

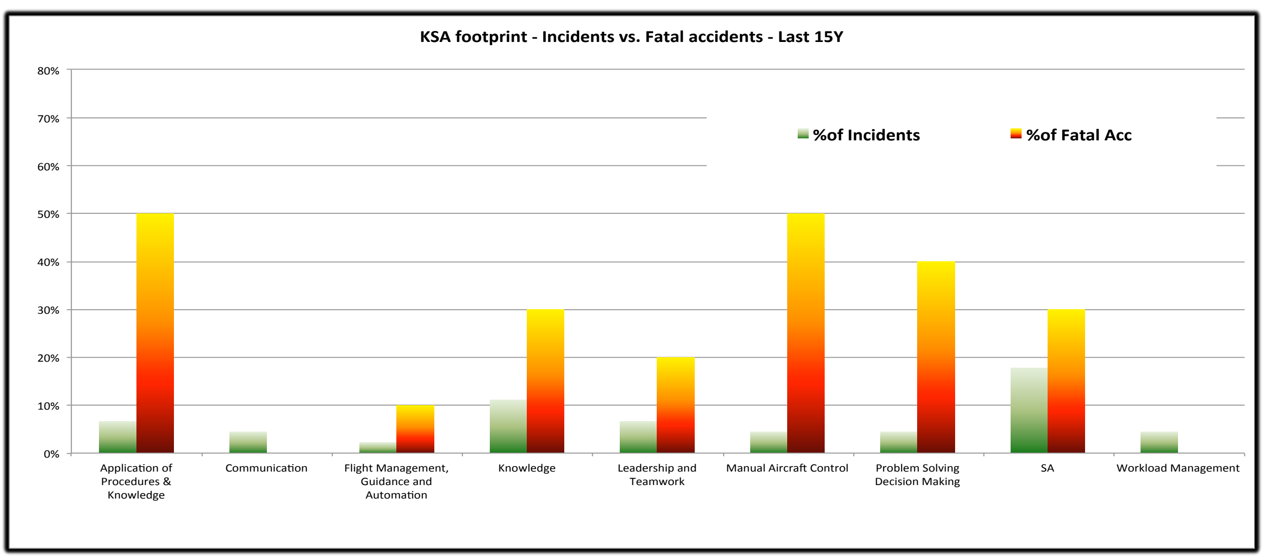


Figure A2.11.8.1

2.11.9 Relative Risk Rank

2.11.9.1 Relative Risk Rank Table for Turboprop Generation 3

	Frequency						Freq*Sev			Total risk
	% of events (all times)			Frequency contribution (% * 5)			Separately at 3 Sev levels			
	% of recent fatal acc	% of recent acc	% of recent inc	F acc	Acc	Inc	F Acc (5)	Acc (3)	Inc (1)	
CRM	60%	26%	20%	3.00	1.28	1.00	15.00	3.85	1.00	19.85
Adverse Weather/Ice	50%	39%	9%	2.50	1.96	0.44	12.50	5.88	0.44	18.82
Syst mal	40%	22%	69%	2.00	1.08	3.44	10.00	3.24	3.44	16.69
Eng Fail	30%	12%	24%	1.50	0.61	1.22	7.50	1.82	1.22	10.55
Poor Visibility	30%	14%	7%	1.50	0.68	0.33	7.50	2.03	0.33	9.86
Compliance	30%	11%	11%	1.50	0.54	0.56	7.50	1.62	0.56	9.68
Mis A/C State	30%	8%	4%	1.50	0.41	0.22	7.50	1.22	0.22	8.94
Upset	30%	4%	4%	1.50	0.20	0.22	7.50	0.61	0.22	8.33
Fatique	20%	4%	0%	1.00	0.20	0.00	5.00	0.61	0.00	5.61
Workload Distraction Pressure	20%	3%	2%	1.00	0.14	0.11	5.00	0.41	0.11	5.52
Mis-AFS	20%	3%	0%	1.00	0.14	0.00	5.00	0.41	0.00	5.41
Ground equipment	10%	16%	9%	0.50	0.81	0.44	2.50	2.43	0.44	5.38
Ground manoeuvring	10%	14%	9%	0.50	0.68	0.44	2.50	2.03	0.44	4.97
Ops/Type Spec	10%	1%	7%	0.50	0.07	0.33	2.50	0.20	0.33	3.04
Def Manuals	10%	3%	2%	0.50	0.14	0.11	2.50	0.41	0.11	3.02
Mis-Sys	10%	1%	4%	0.50	0.07	0.22	2.50	0.20	0.22	2.92
Def-Ops data	10%	3%	0%	0.50	0.14	0.00	2.50	0.41	0.00	2.91
MEL	10%	1%	2%	0.50	0.07	0.11	2.50	0.20	0.11	2.81
Physio	10%	1%	0%	0.50	0.07	0.00	2.50	0.20	0.00	2.70
Birds	0%	9%	0%	0.00	0.47	0.00	0.00	1.42	0.00	1.42
Fire	0%	4%	11%	0.00	0.20	0.56	0.00	0.61	0.56	1.16
Runway/Taxi condition	0%	4%	2%	0.00	0.20	0.11	0.00	0.61	0.11	0.72
Traffic	0%	4%	2%	0.00	0.20	0.11	0.00	0.61	0.11	0.72
Def-Proc's	0%	1%	4%	0.00	0.07	0.22	0.00	0.20	0.22	0.42

Figure A2.11.9.1

Relative Risk Rank Table (Continued)

	Frequency						Freq*Sev			Total risk
	% of events (all times)			Frequency contribution (% * 5)			Separately at 3 Sev levels			
	% of recent fatal acc	% of recent acc	% of recent inc	F acc	Acc	Inc	F Acc (5)	Acc (3)	Inc (1)	
Crosswind	0%	3%	0%	0.00	0.14	0.00	0.00	0.41	0.00	0.41
ATC	0%	0%	7%	0.00	0.00	0.33	0.00	0.00	0.33	0.33
Cabin	0%	1%	2%	0.00	0.07	0.11	0.00	0.20	0.11	0.31
Def-Chk lists	0%	1%	2%	0.00	0.07	0.11	0.00	0.20	0.11	0.31
R/W Incursion	0%	0%	4%	0.00	0.00	0.22	0.00	0.00	0.22	0.22
Terrain	0%	1%	0%	0.00	0.07	0.00	0.00	0.20	0.00	0.20
Wake Vortex	0%	1%	0%	0.00	0.07	0.00	0.00	0.20	0.00	0.20
Windshear	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D.G	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Def-DBs	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Def-Charts	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
L..F.P	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NAV	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pilot Incap	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Loss of comms	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Communication	0%	3%	4%	0.00	0.14	0.22	0.00	0.41	0.22	0.63
SA	30%	14%	18%	1.50	0.68	0.89	7.50	2.03	0.89	10.42
Leadership and Teamwork	20%	8%	7%	1.00	0.41	0.33	5.00	1.22	0.33	6.55
Workload Management	0%	3%	4%	0.00	0.14	0.22	0.00	0.41	0.22	0.63
Problem Solving Decision Making	40%	12%	4%	2.00	0.61	0.22	10.00	1.82	0.22	12.05
Knowledge	30%	5%	11%	1.50	0.27	0.56	7.50	0.81	0.56	8.87
Application of Procedures & Knowledge	50%	15%	7%	2.50	0.74	0.33	12.50	2.23	0.33	15.06
Flight Management, Guidance and Automation	10%	1%	2%	0.50	0.07	0.11	2.50	0.20	0.11	2.81
Manual Aircraft Control	50%	16%	4%	2.50	0.81	0.22	12.50	2.43	0.22	15.15

Figure A2.11.9.1 (cont)

2.11.9.2 Relative Risk Rank Priority

Relative Risk Ranking Priority for Turboprop Generation 3

Factor	Priority
CRM	19.85
Adverse Weather/Ice	18.82
Syst mal	16.69
Eng Fail	10.55
Poor Visibility	9.86
Compliance	9.68
Mis A/C State	8.94
Upset	8.33
Fatique	5.61
Workload Distraction Pressure	5.52
Mis-AFS	5.41
Ground equipment	5.38
Ground manoeuvring	4.97
Ops/Type Spec	3.04
Def Manuals	3.02
Mis-Sys	2.92
Def-Ops data	2.91
MEL	2.81
Physio	2.70
Birds	1.42
Fire	1.16
Runway/Taxi condition	0.72
Traffic	0.72
Def-Proc's	0.42
Crosswind	0.41
ATC	0.33
Cabin	0.31
Def-Chk lists	0.31
R/W Incursion	0.22
Terrain	0.20
Wake Vortex	0.20
Windshear	0.00
D.G	0.00
Def-DBs	0.00
Def-Charts	0.00
L..F.P	0.00
NAV	0.00
Pilot Incap	0.00
Loss of comms	0.00

Figure A2.11.9.2

2.11.9.3 Relative Risk Rank Chart

Relative Risk Ranking for Turboprop Generation 3

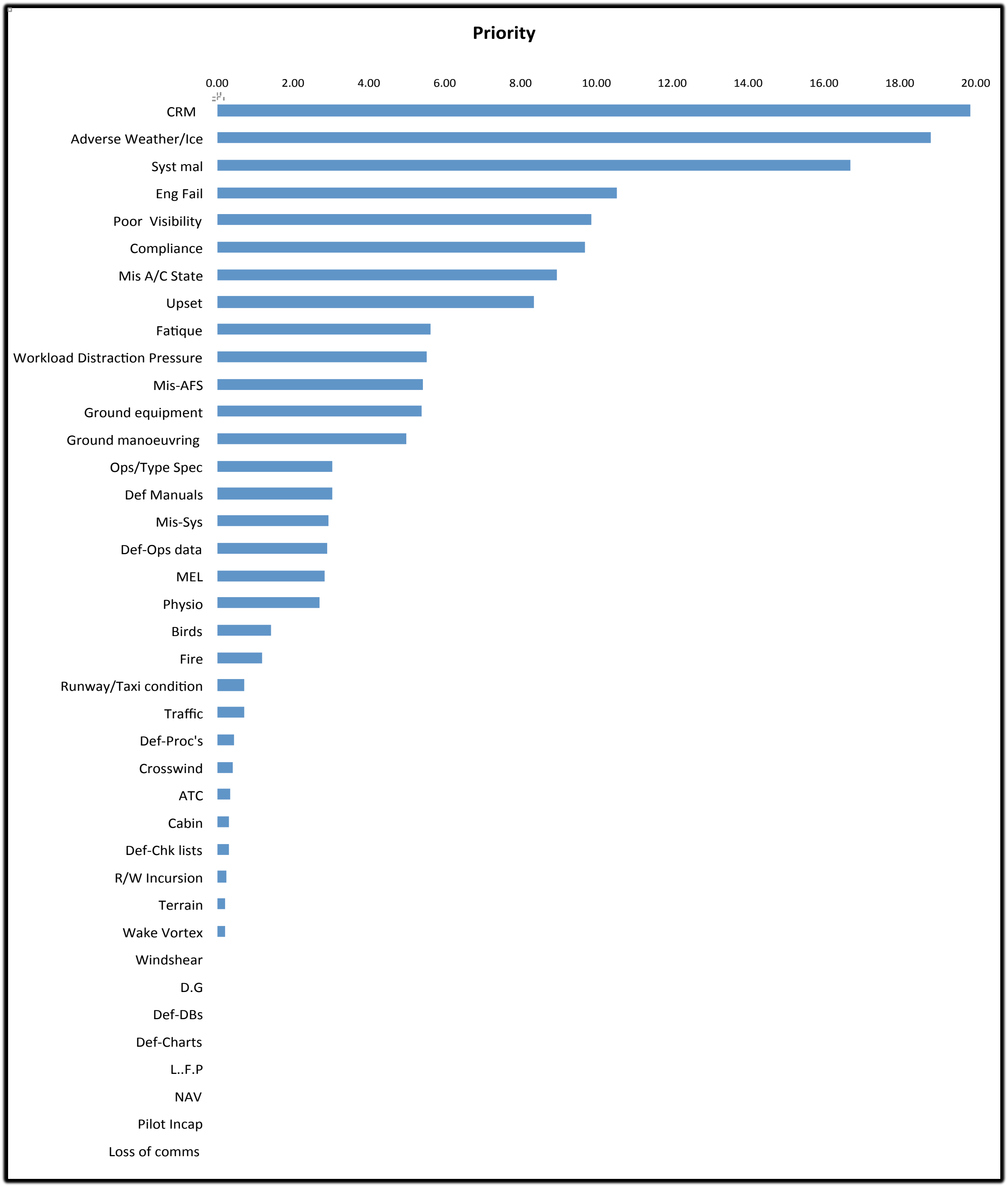


Figure A2.11.9.3

2.11.10 Clustering

2.11.10.1 Global Ranking for Clustering of Factors for Turboprop Generation 3 (All Accidents)

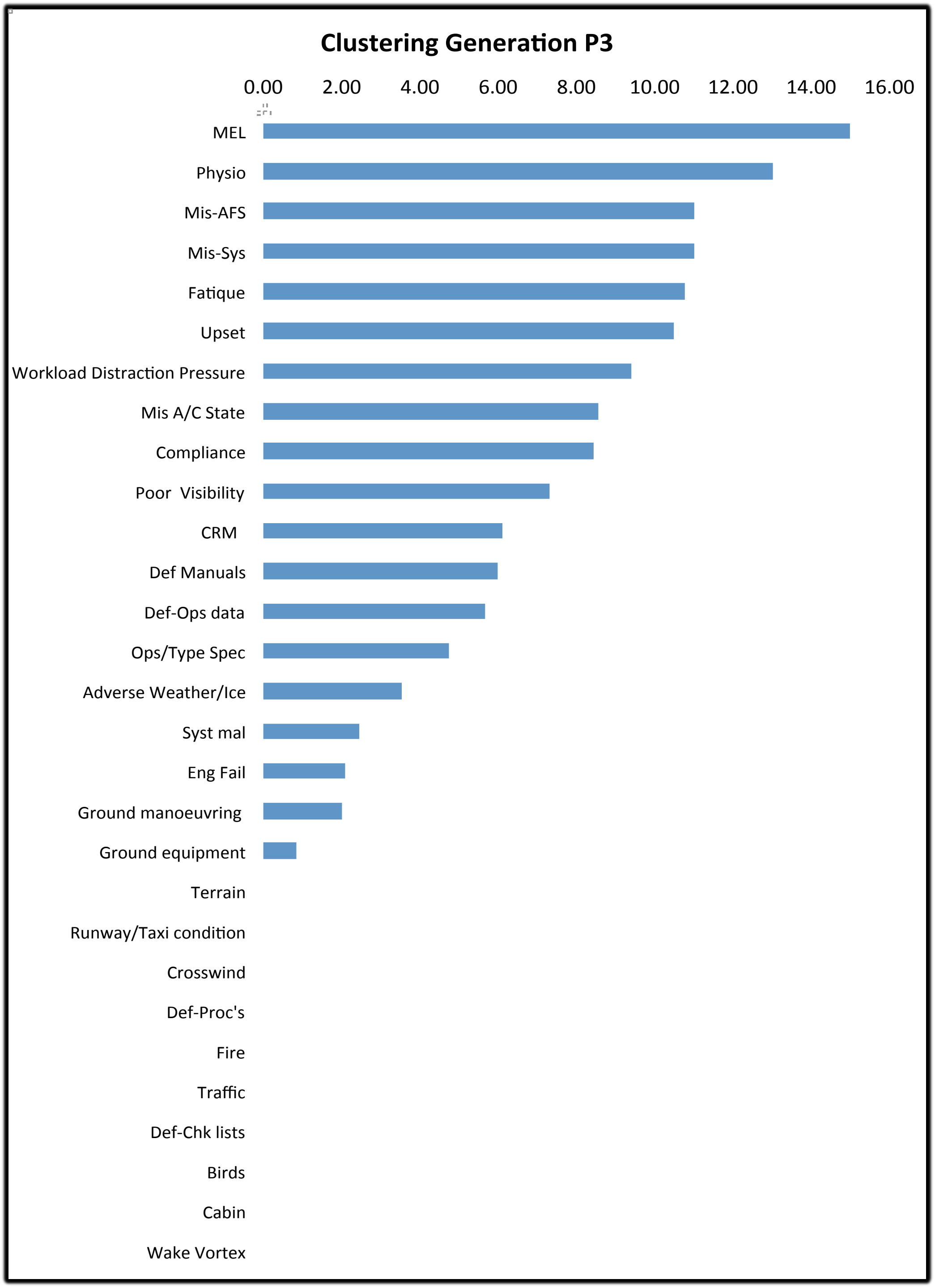


Figure A2.11.10.1

2.11.11 High Training Impact

2.11.11.1 Comparison of Factor Occurrence in Accidents with High Training Effect

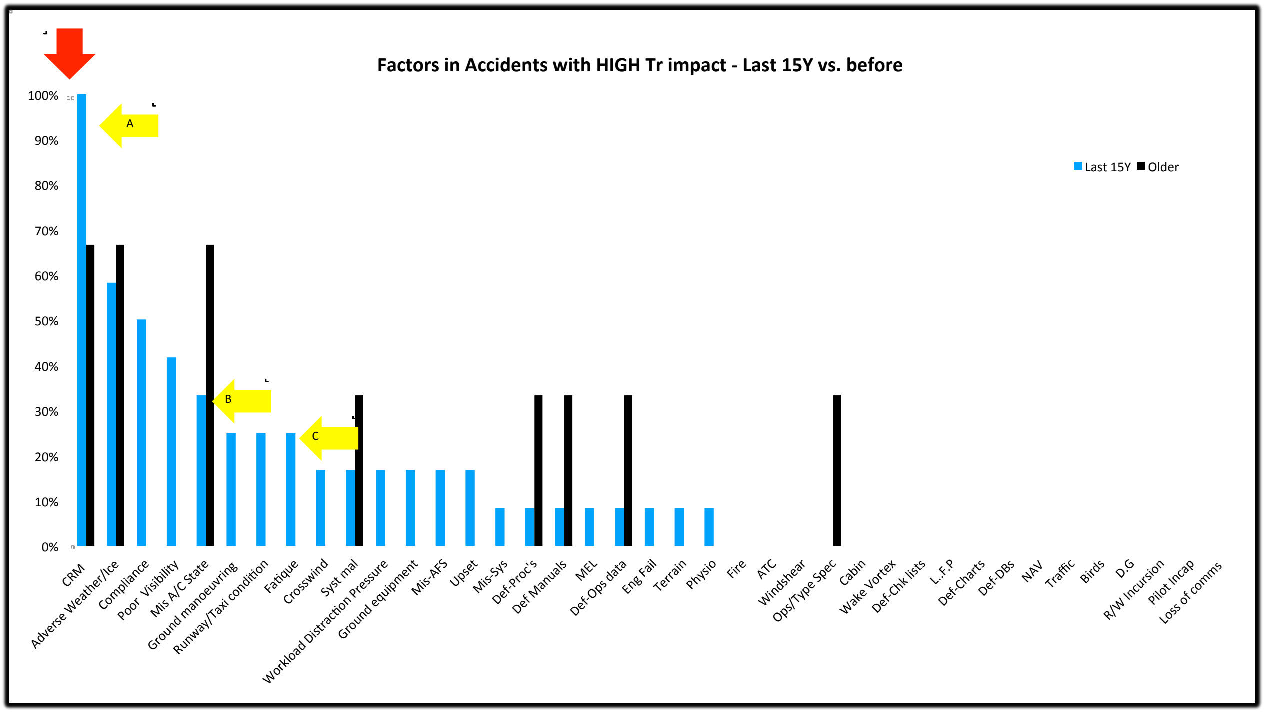


Figure A2.11.11.1

2.11.12 Global Priority Ranking for Factors Turboprop Generation 3

2.11.12.1 Priority Table

Priority table of factors for Turboprop Generation 3

Level	Factor	Rank	Tr
A	CRM	8	A
	Mis A/C State	7	A
	Compliance	7	C
B	Poor Visibility	6	A
	Adverse Weather/Ice	5	C
	Upset	5	C
	MEL	4	B
	Mis-AFS	4	B
	Mis-Sys	4	B
	Workload Distraction Pressure	4	C
C	Syst mal	3	A
	Eng Fail	2	A
	Ops/Type Spec	2	B
	Runway/Taxi condition	1	C

Figure A2.11.12.1

2.12 JET GENERATION 2 ANALYSIS

2.12.1 Global Accidents (Last 15 Years)

2.12.1.1 Ranking of Factors for All Accidents (Generation 2)

Ranking of factors based on how present they are in accidents (as a percentage of all Gen4 accidents – last 15 years in blue, earlier times in black)

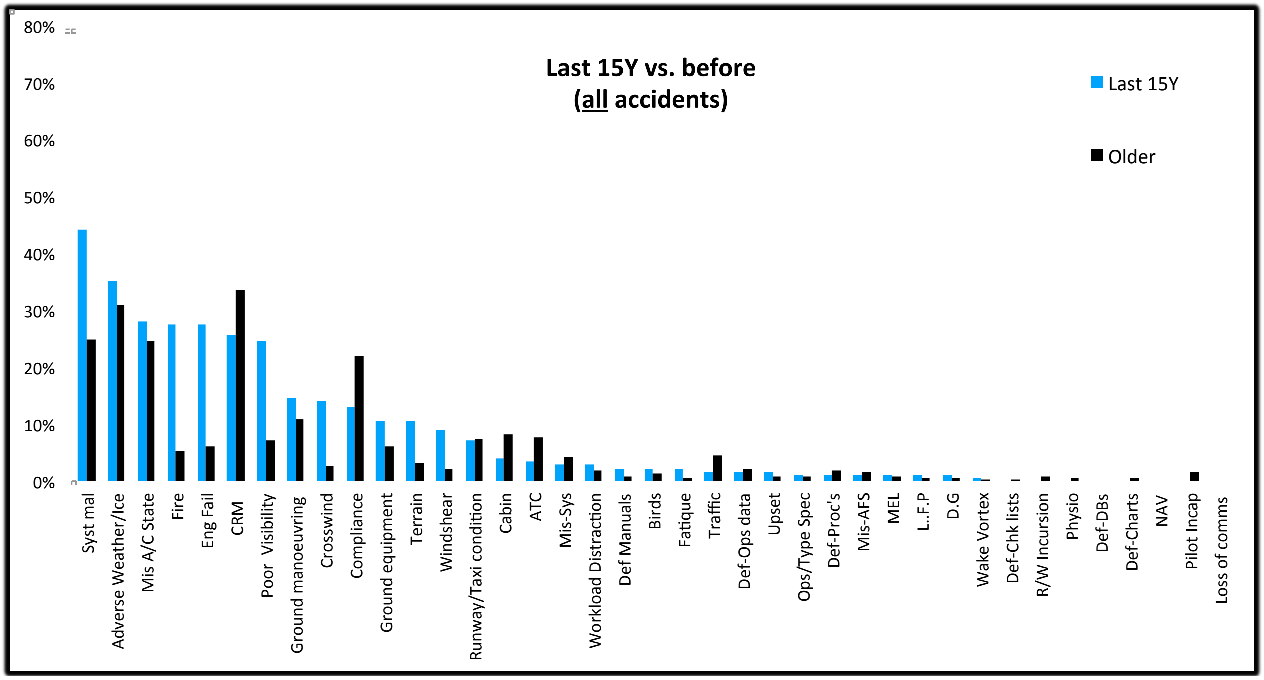


Figure A2.12.1.1

2.12.1.2 Ranking of Factors for All Accidents per One Million Takeoffs (Generation 2)

Comparison of the ranking of factors (normalized by the number of takeoffs) for all accidents in current versus previous time period

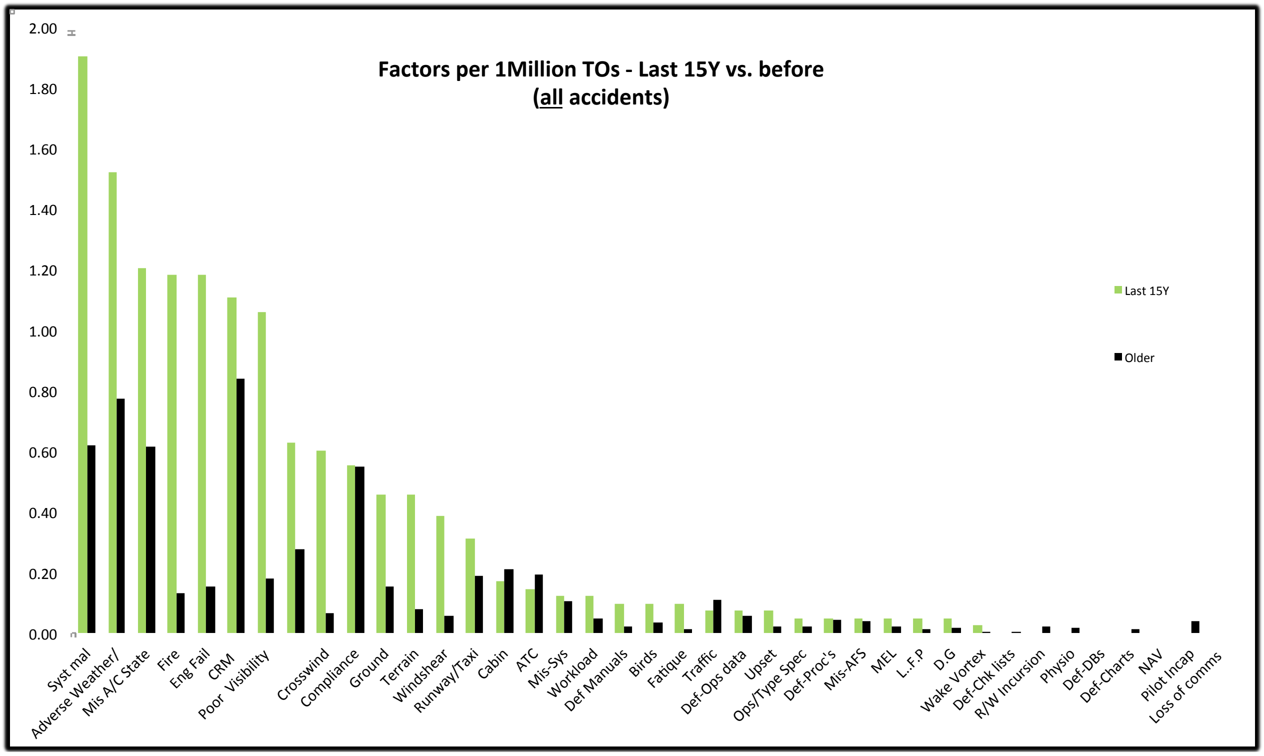


Figure A2.12.1.2

2.12.2 Global Fatal Accidents (Last 15 Years)

2.12.2.1 Ranking of Factors for Fatal Accidents

Ranking of factors as a percentage of fatal accidents, L15Y vs. older

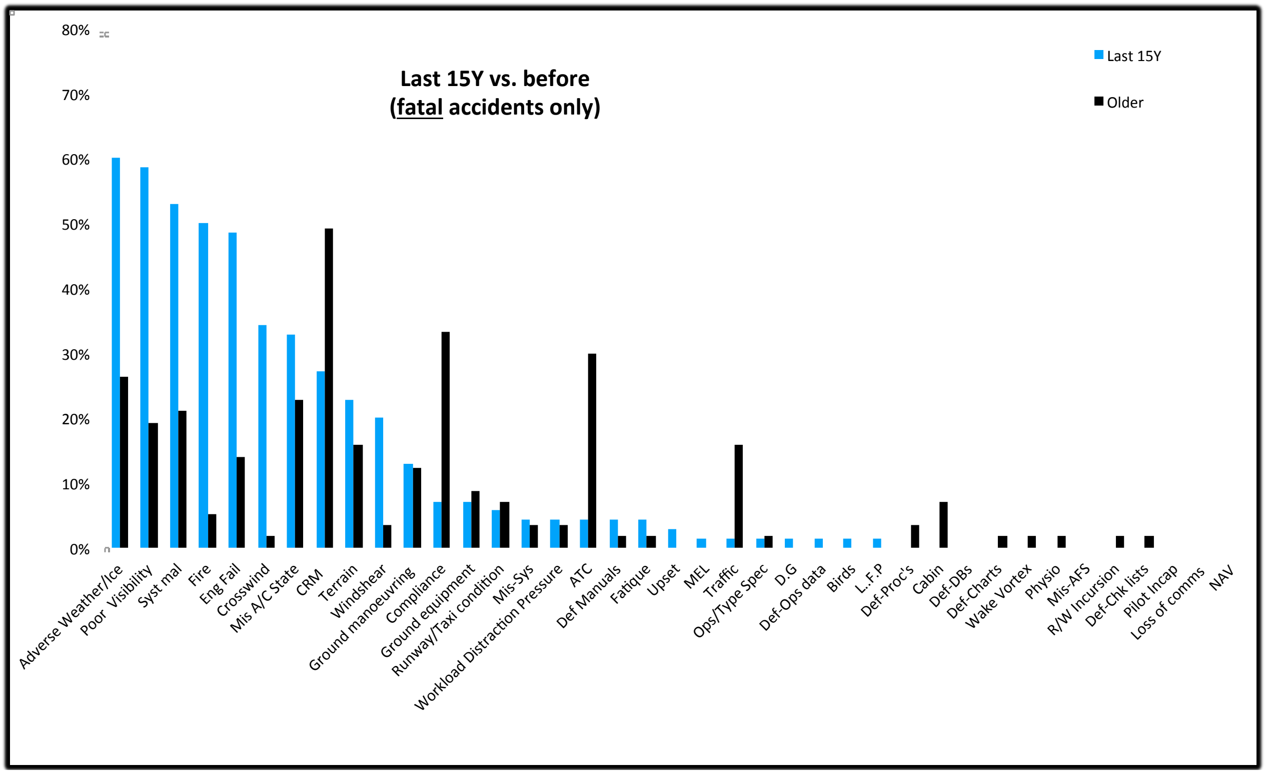


Figure A2.12.2.1

2.12.2.2 Ranking of Factors for Fatal Accidents per One Million Takeoffs (Generation 2)

Comparison of the ranking of factors (normalized by the number of takeoffs) for fatal accidents in the current versus previous time period

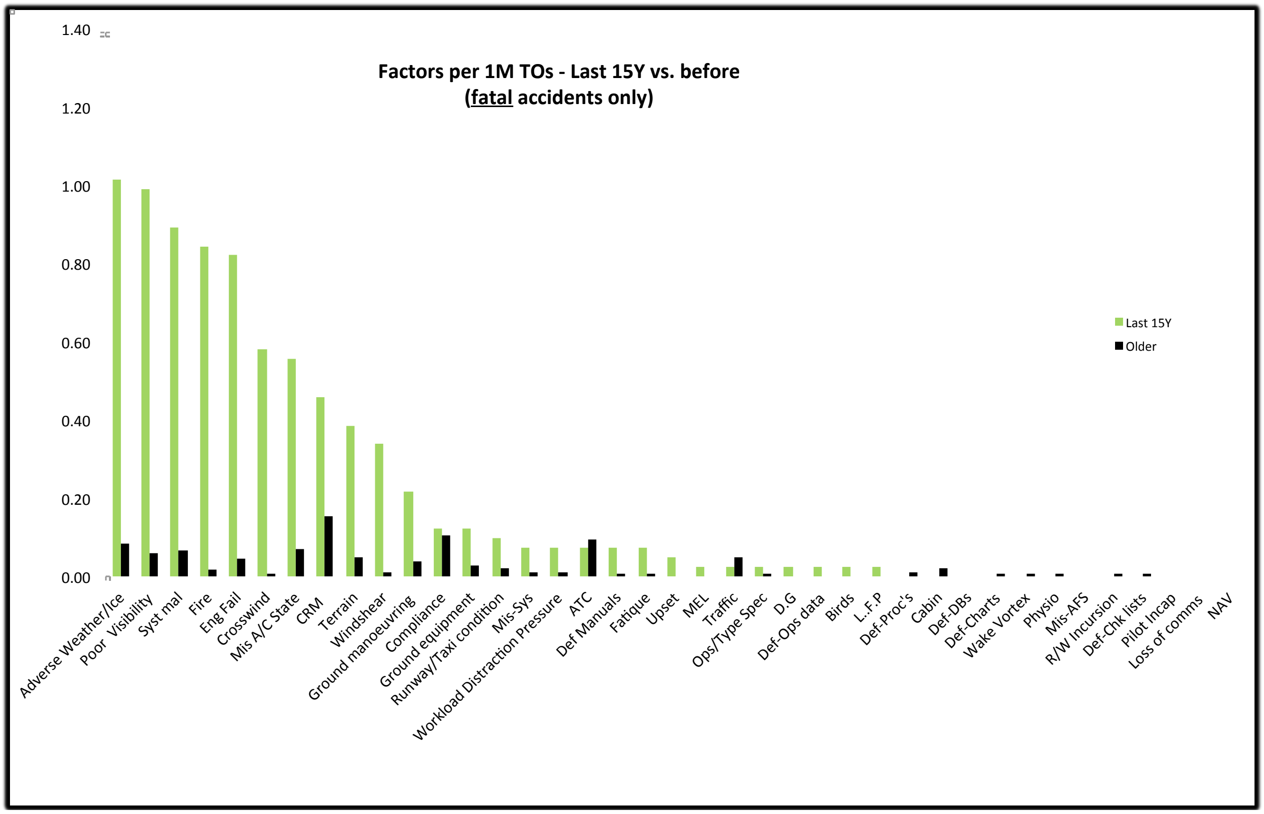


Figure A2.12.2.2

2.12.3 Distribution by Flight Phases (Generation 2)

2.12.3.1 Distributions of accidents by Flight Phase

Number of accidents per Flight Phase (Last 15 Years)

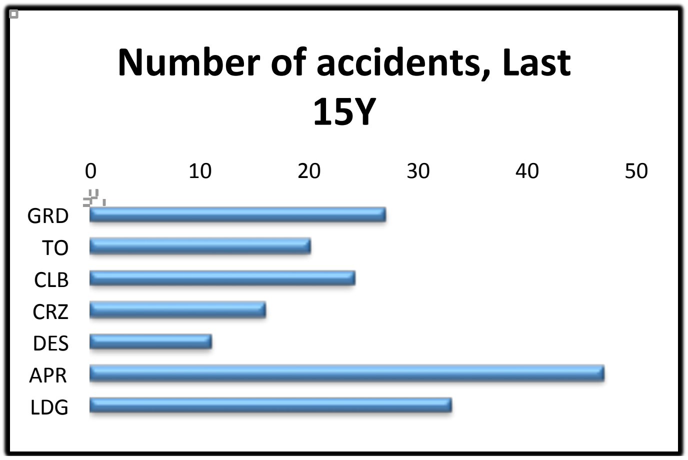


Figure A2.12.3.1

Number of accidents per Flight Phase (Older)

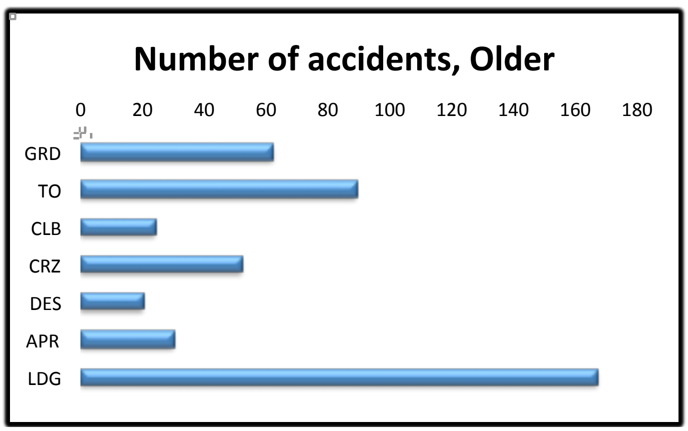
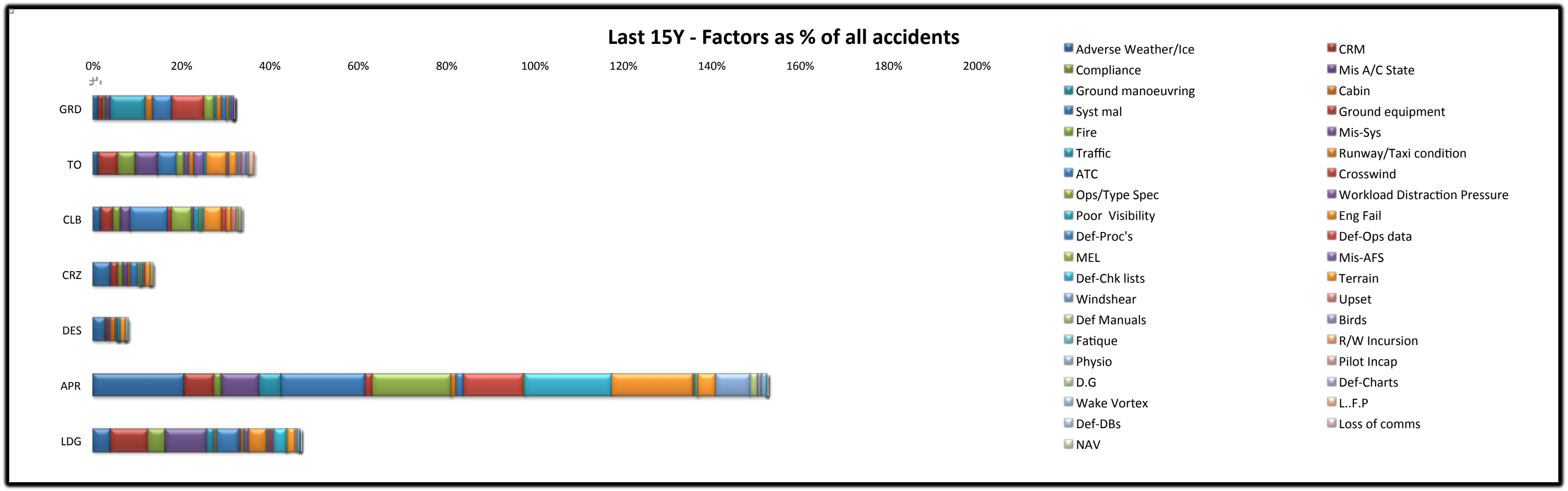


Figure A2.12.3.1a

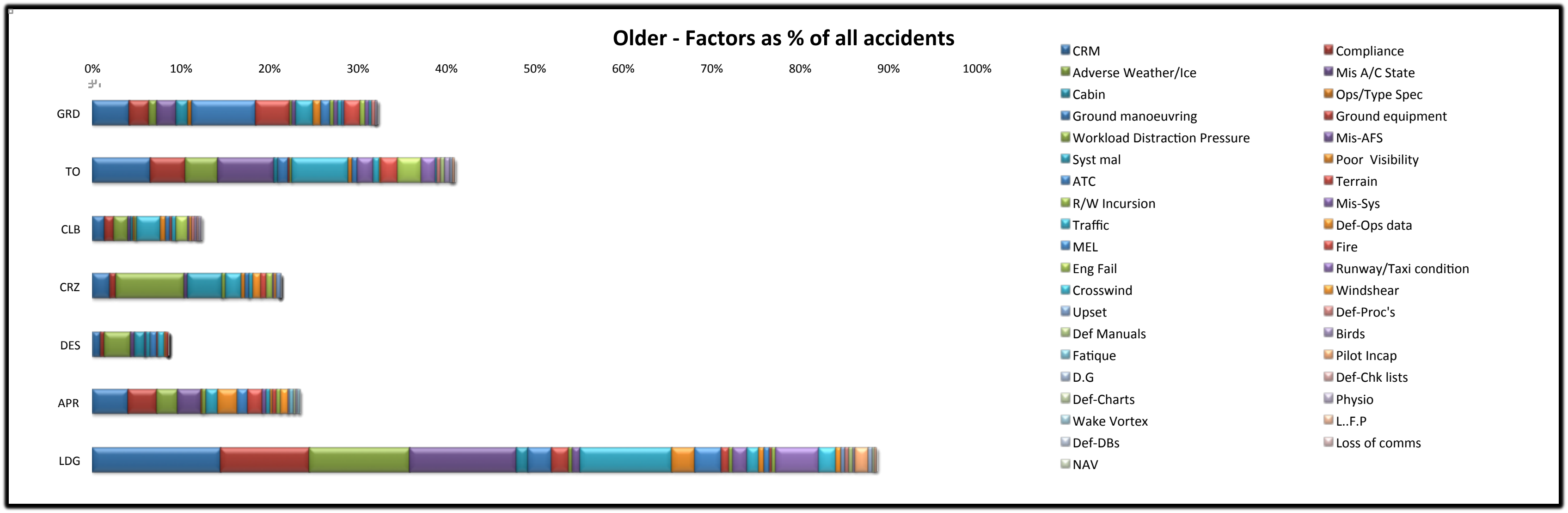
2.12.3.2 Distribution of Specific Factors by Flight Phase (Last 15 Years)

Distribution of factors in all accidents by Flight Phase (Generation 2)



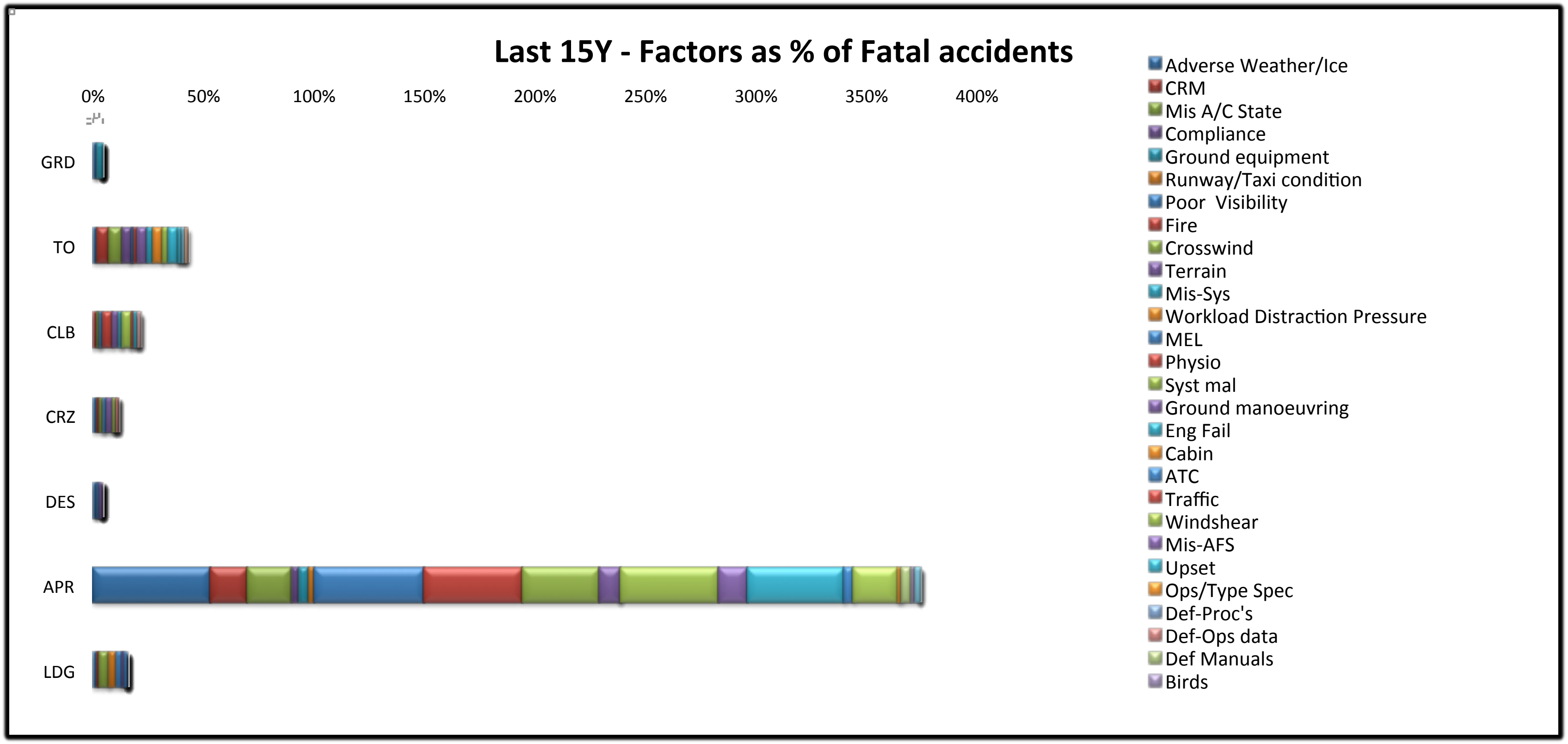
2.12.3.3 Distribution of Specific Factors by Flight Phase (Older)

Distribution of factors in all accidents by Flight Phase (Generation 2)



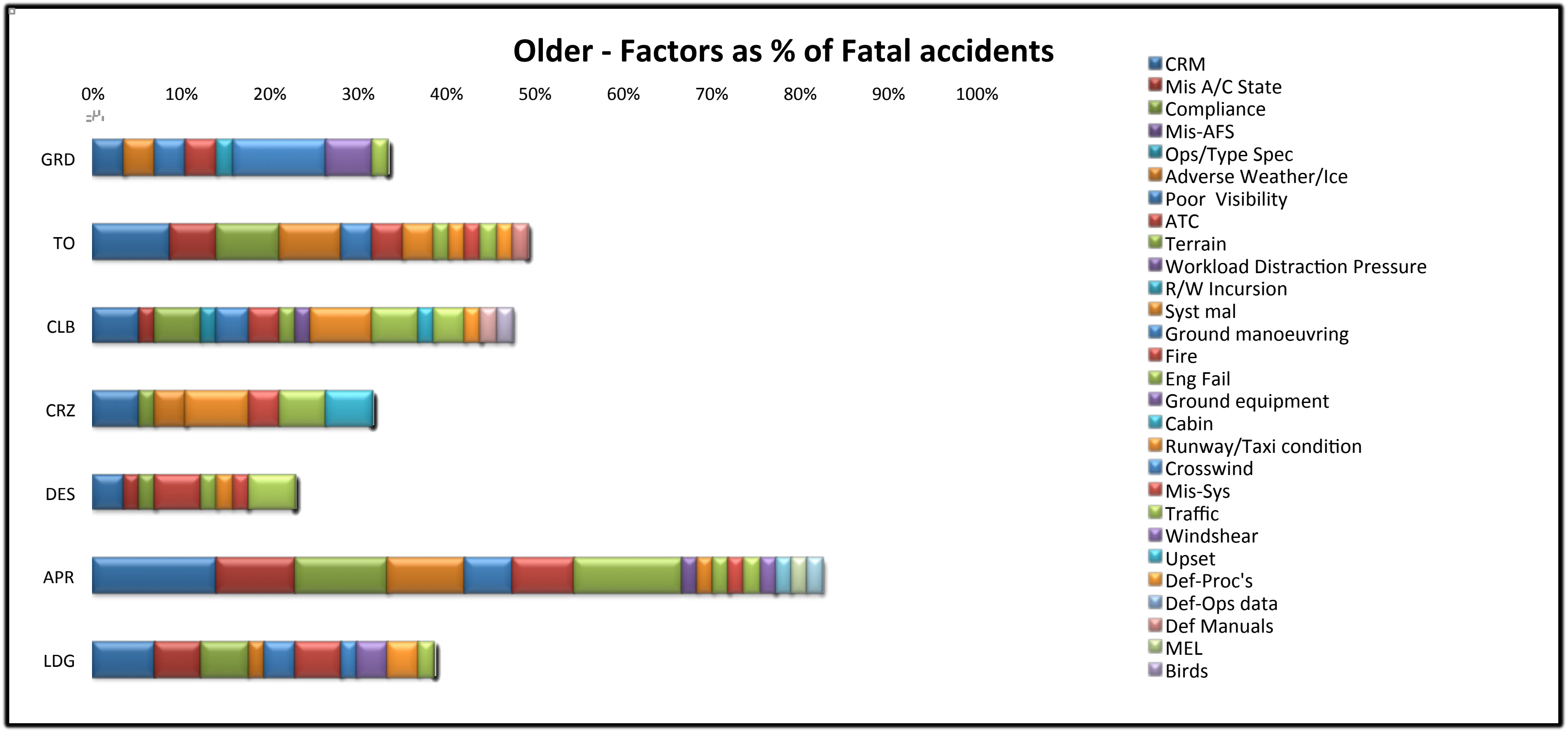
2.12.3.4 Distribution of Specific Factors by Flight Phase (Last 15 Years, Fatal Accidents Only)

Distribution of factors in accidents by Flight Phase (Generation 2)



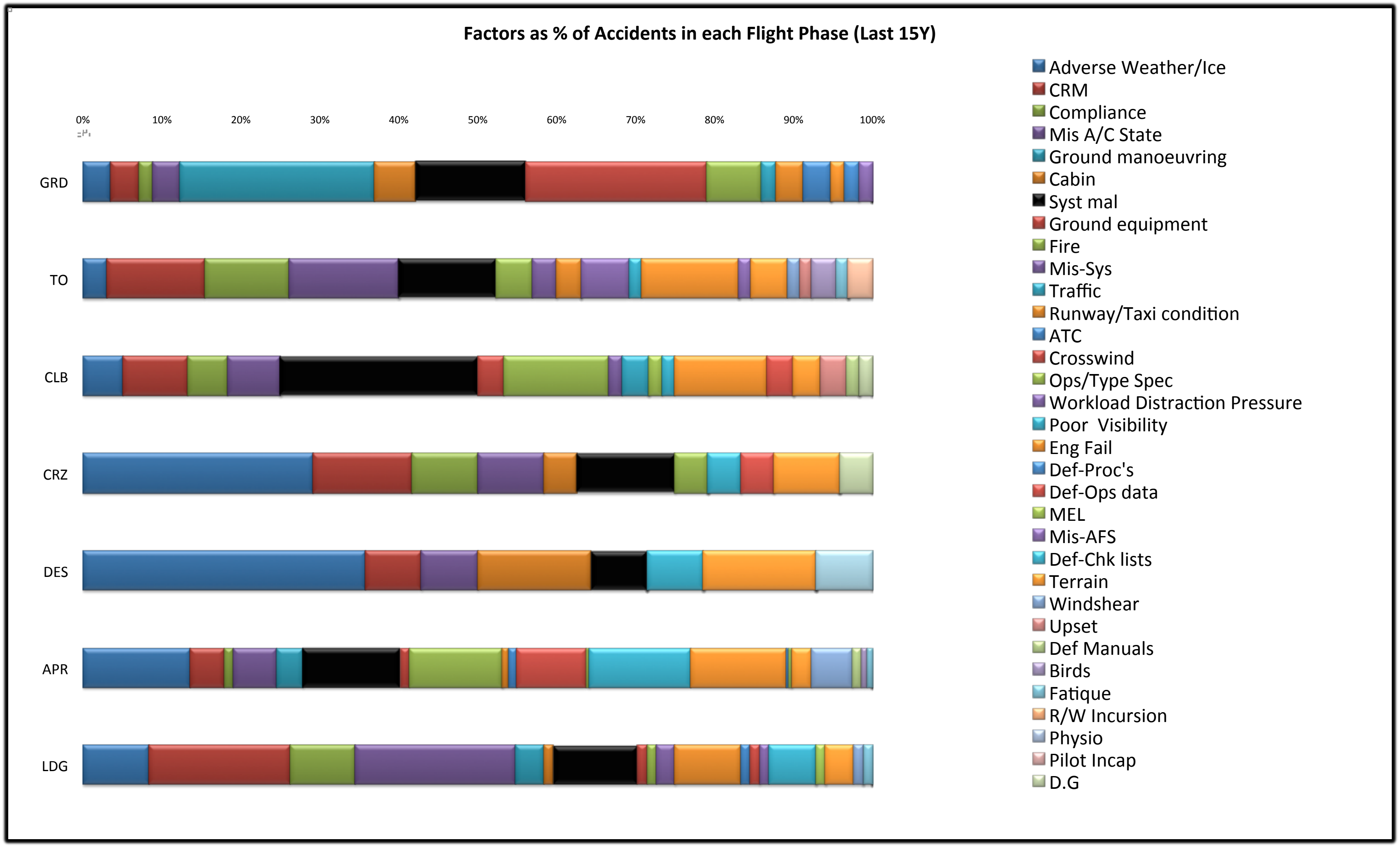
2.12.3.5 Distribution of Specific Factors by Flight Phase (Older, Fatal Accidents Only)

Distribution of factors in accidents by Flight Phase (Generation 2)



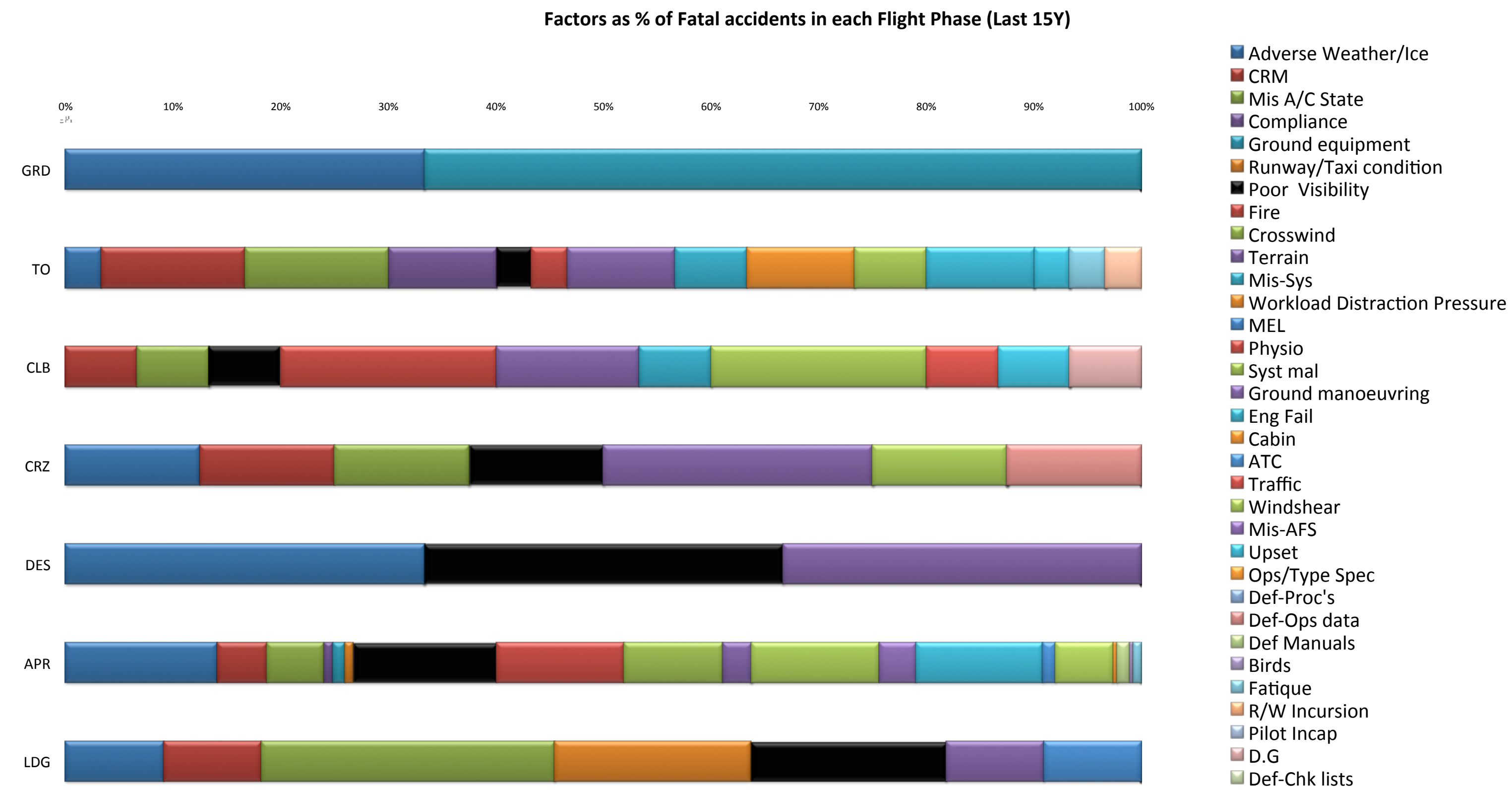
2.12.3.6 Proportional Distributions of Specific Factors by Flight Phase

Distribution of factors in all accidents by Flight Phase (Generation 2)



2.12.3.7 Proportional Distributions of Specific Factors by Flight Phase

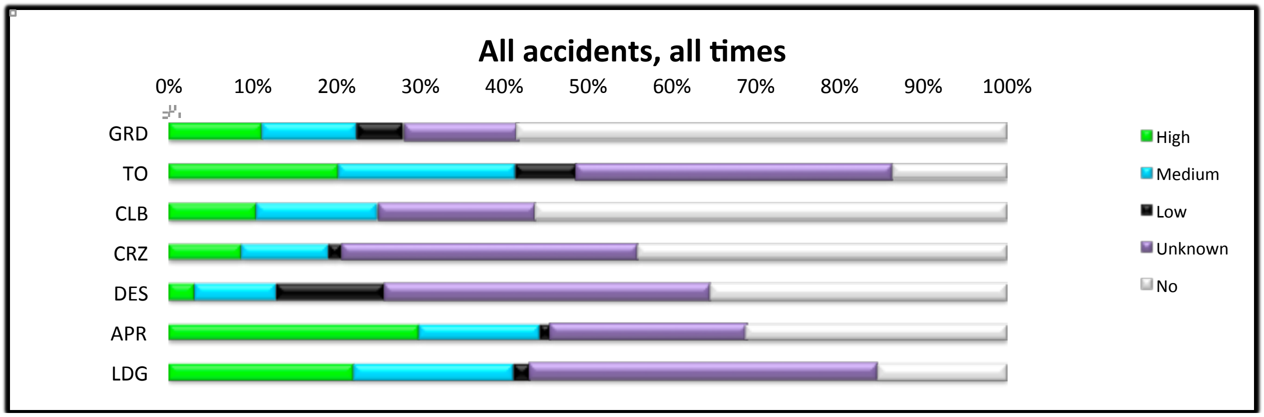
Distribution of factors by Flight Phase (Fatal Accidents only) (Generation 2)



2.12.4 Trainability

2.12.4.1 Training Effect

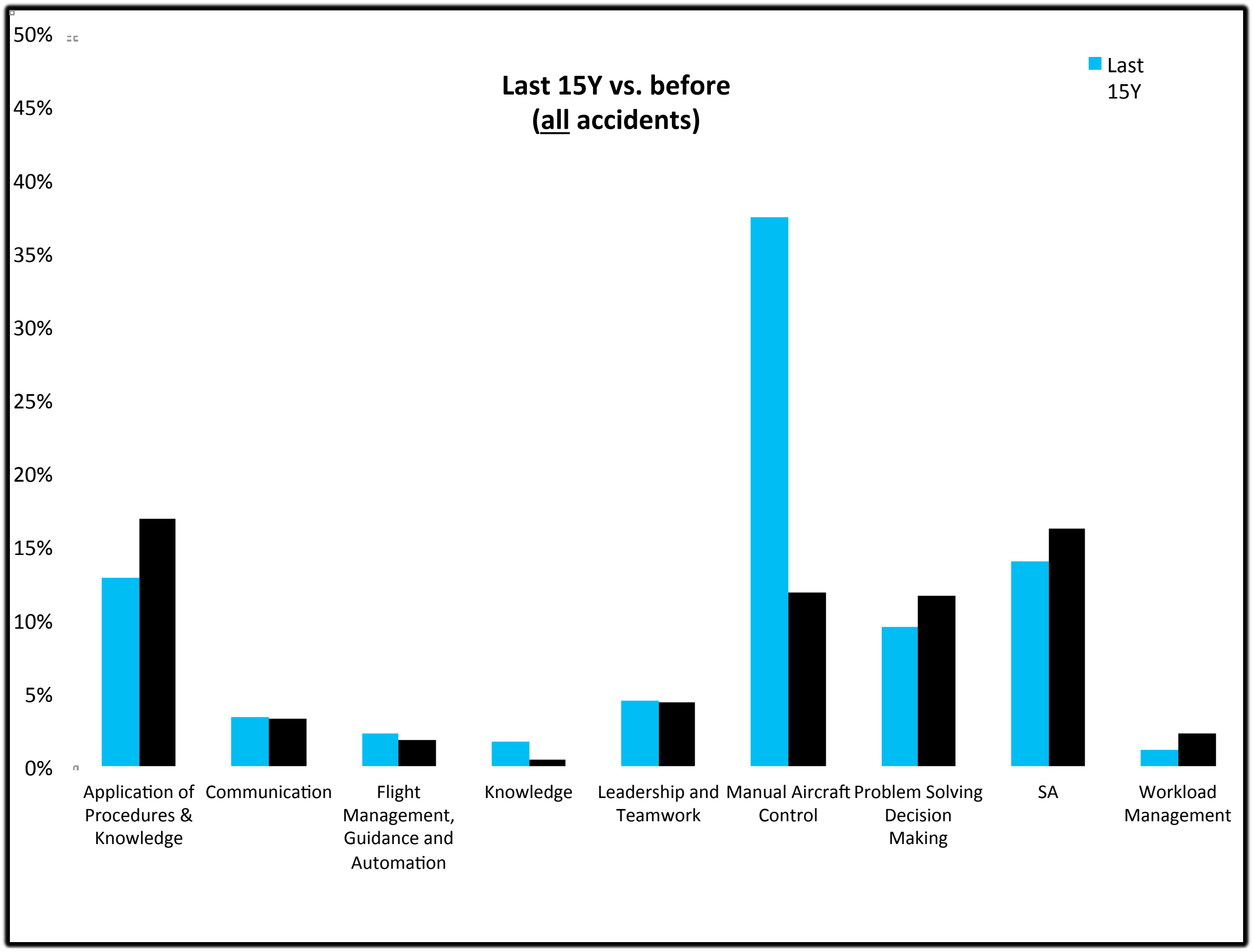
Training Effect by Flight Phase, all accidents, L15 Years (Generation 2)



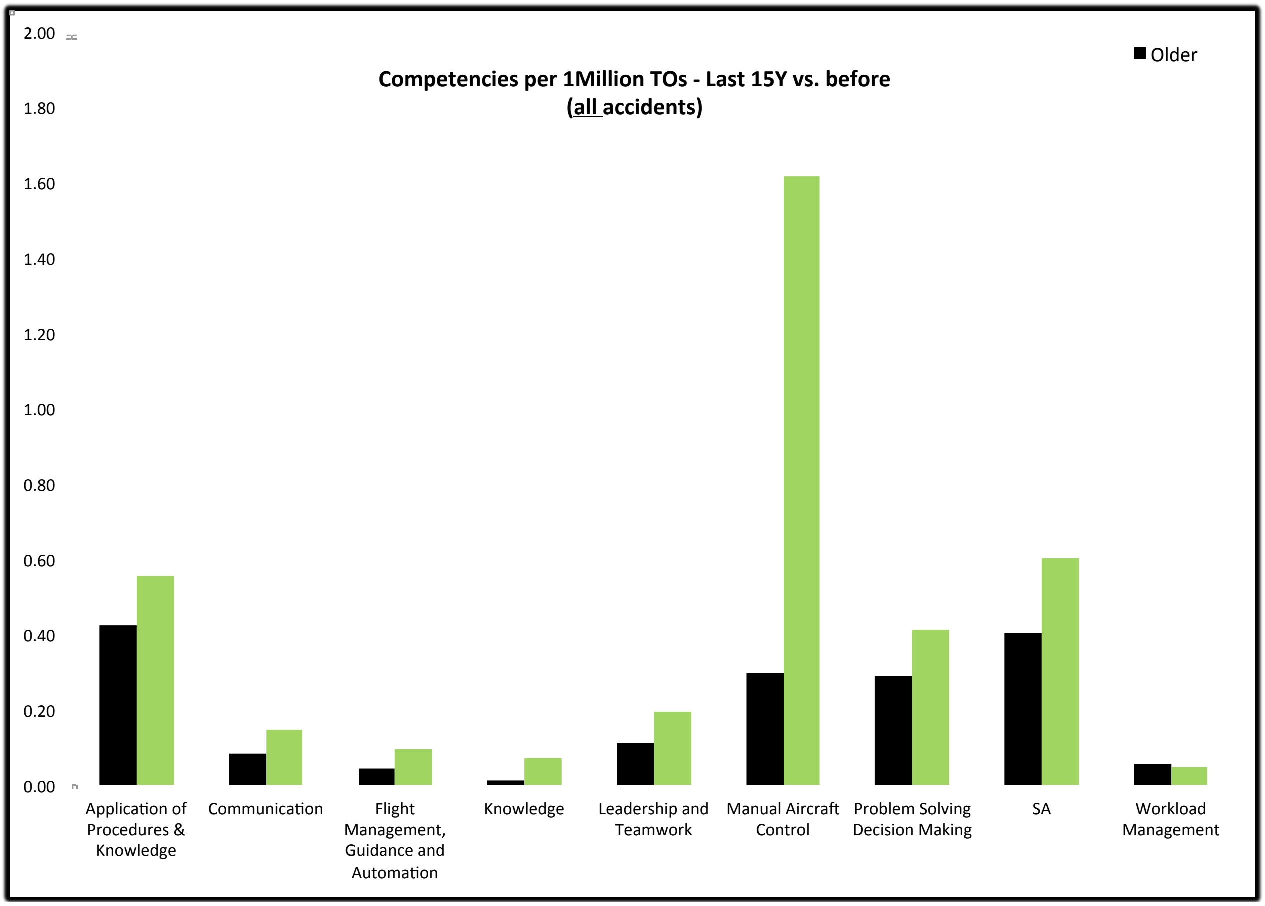
2.12.5 Competencies in Accidents

2.12.5.1 Distributions of Deficient Competencies in Accidents

Deficient competencies in accidents (Generation 2)



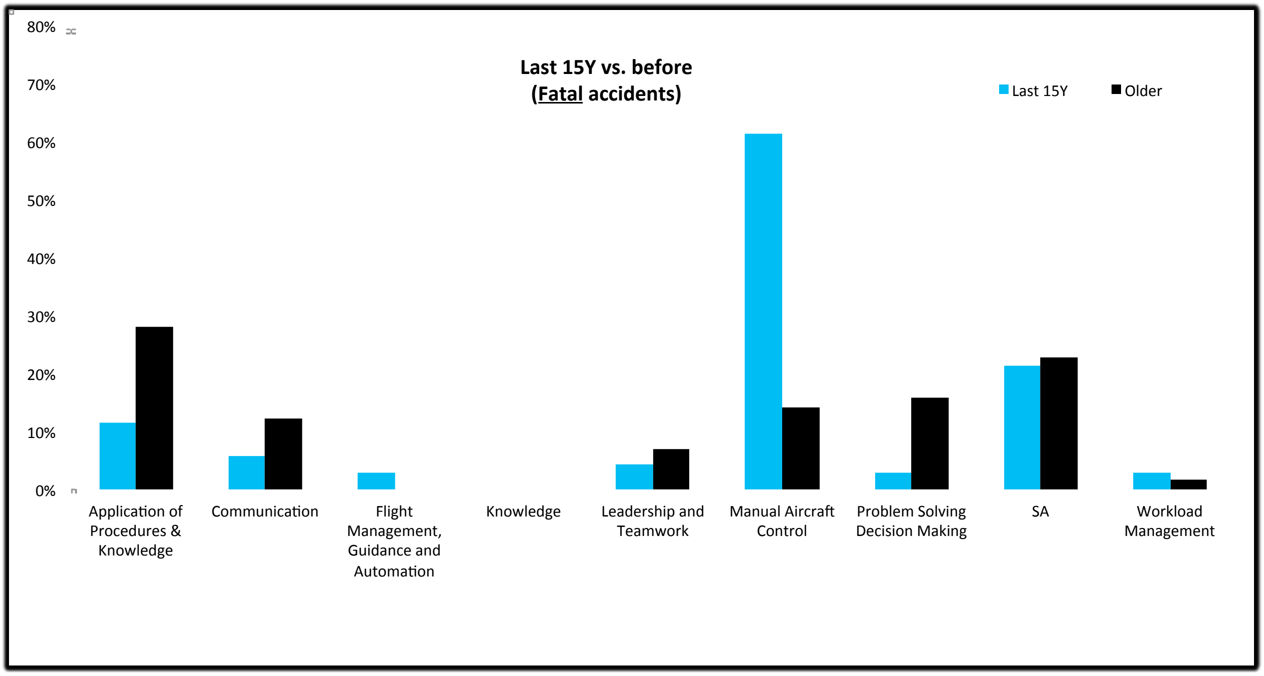
2.12.5.2 Distributions of Deficient Competencies in Accidents per One Million Takeoffs (Generation 2)



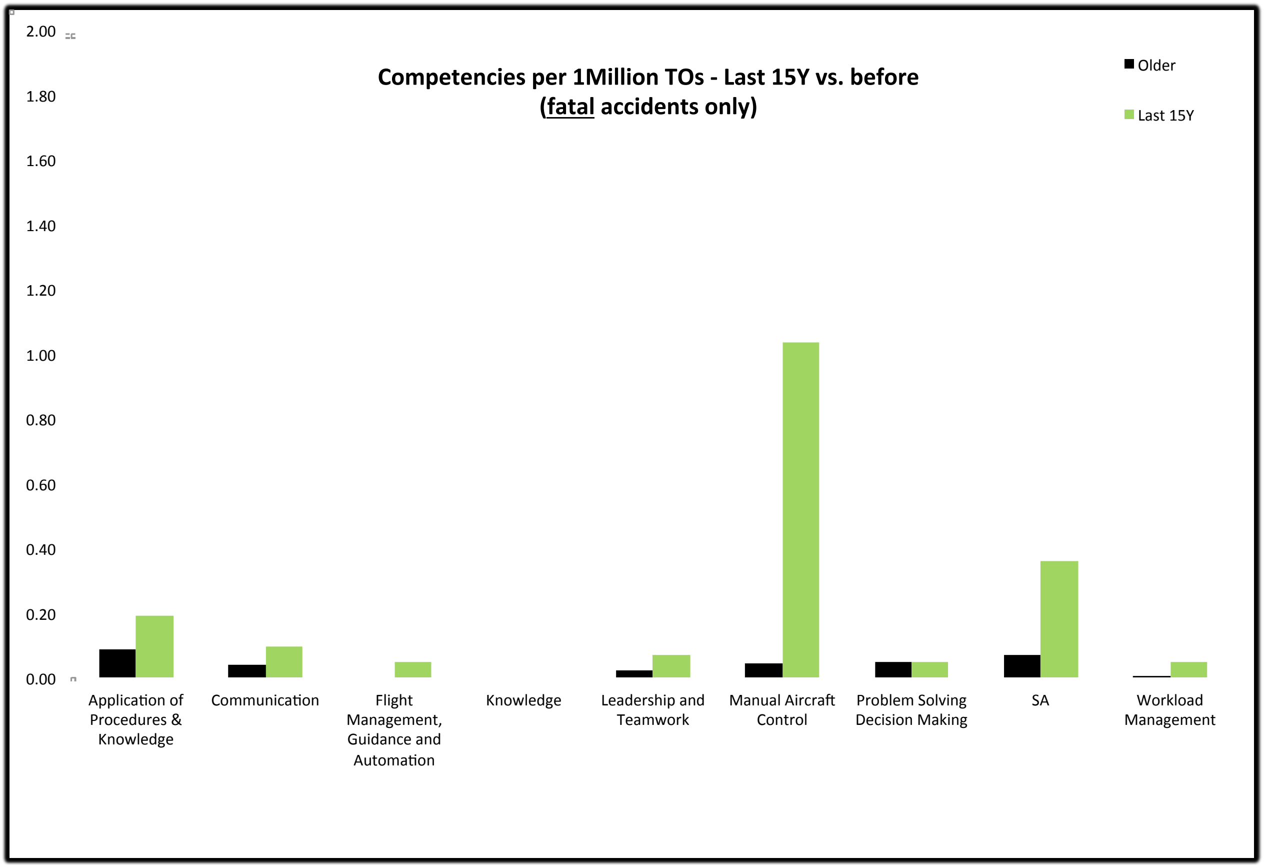
2.12.6 Competencies in Fatal Accidents

2.12.6.1 Distributions of Deficient Competencies in Fatal Accidents

Deficient competencies in fatal accidents (Generation 2)



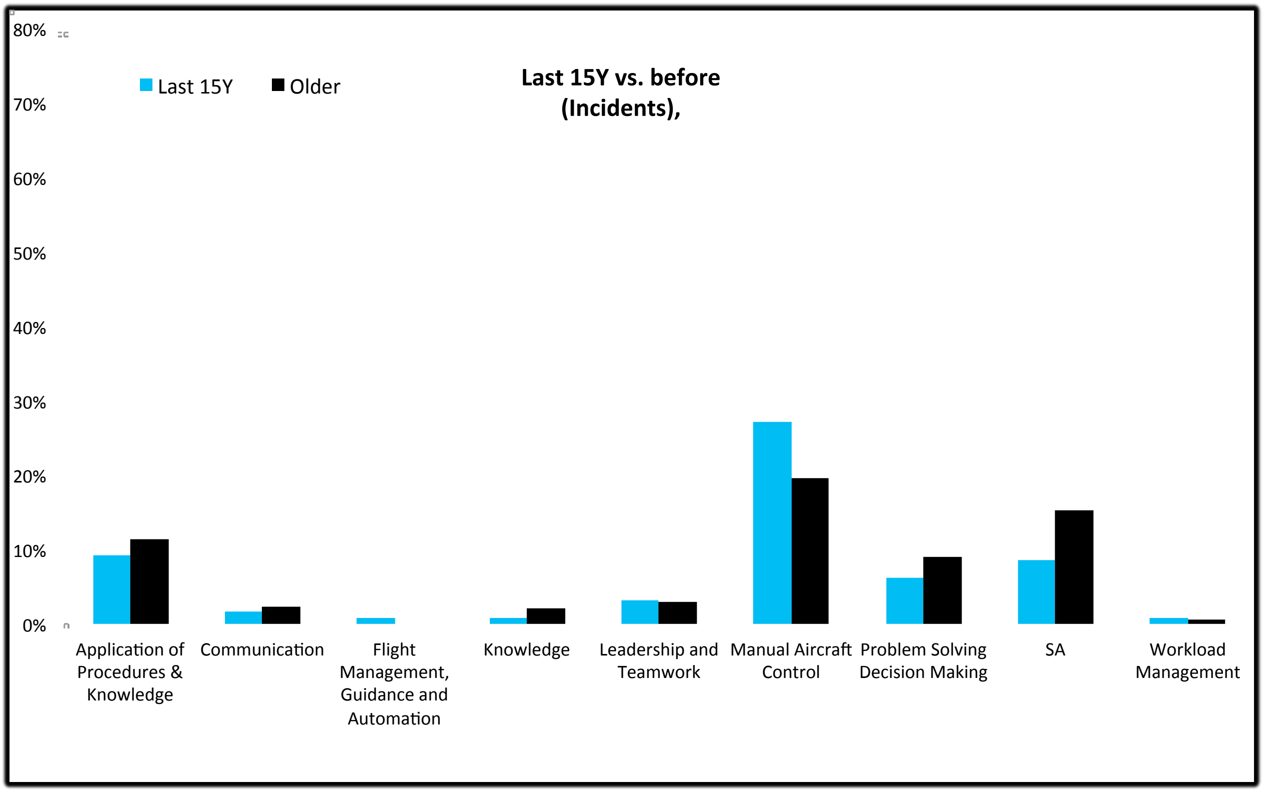
2.12.6.2 Distributions of Deficient Competencies in Fatal Accidents per One Million Takeoffs (Generation 2)



2.12.7 Competencies in Incidents

2.12.7.1 Distributions of Deficient Competencies in Incidents

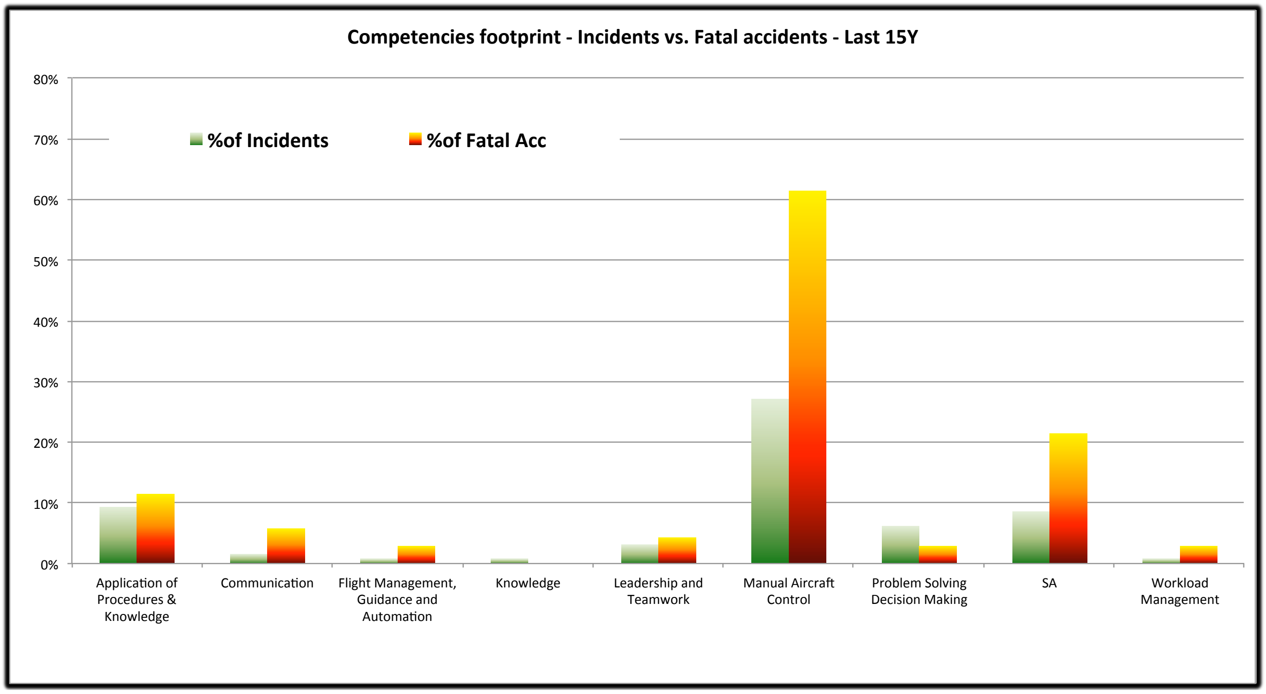
Comparison of deficient competencies in incidents during current versus previous time period (Generation 2)



2.12.8 Competency Footprint

2.12.8.1 Distributions of Deficient Competencies in Incidents and Fatal Accidents

Deficient competencies in Incidents vs. Fatal Accidents (Generation 2)



2.12.9 Relative Risk Rank

2.12.9.1 Relative Risk Rank Table (Generation 2)

	Frequency						Freq*Sev			Total risk
	% of events in the last 15Y			Frequency contribution (% * 5)			Separately at 3 Sev levels			
	% of recent fatal acc	% of recent acc	% of recent inc	F acc	Acc	Inc	F Acc (5)	Acc (3)	Inc (1)	
Syst mal	53%	44%	64%	2.64	2.21	3.18	13.21	6.62	3.18	23.01
Adverse Weather/Ice	60%	35%	20%	3.00	1.76	1.01	15.00	5.28	1.01	21.29
Poor Visibility	59%	25%	12%	2.93	1.23	0.62	14.64	3.69	0.62	18.95
Eng Fail	49%	27%	42%	2.43	1.37	2.09	12.14	4.11	2.09	18.34
Fire	50%	27%	31%	2.50	1.37	1.55	12.50	4.11	1.55	18.16
Mis A/C State	33%	28%	16%	1.64	1.40	0.78	8.21	4.19	0.78	13.18
CRM	27%	26%	16%	1.36	1.28	0.81	6.79	3.85	0.81	11.45
Crosswind	34%	14%	1%	1.71	0.70	0.04	8.57	2.09	0.04	10.71
Terrain	23%	11%	1%	1.14	0.53	0.04	5.71	1.59	0.04	7.35
Windshear	20%	9%	0%	1.00	0.45	0.00	5.00	1.34	0.00	6.34
Ground manoeuvring	13%	15%	11%	0.64	0.73	0.54	3.21	2.18	0.54	5.94
Compliance	7%	13%	5%	0.36	0.64	0.27	1.79	1.93	0.27	3.98
Ground equipment	7%	11%	5%	0.36	0.53	0.27	1.79	1.59	0.27	3.65
Runway/Taxi condition	6%	7%	4%	0.29	0.36	0.19	1.43	1.09	0.19	2.71
ATC	4%	3%	2%	0.21	0.17	0.12	1.07	0.50	0.12	1.69
Mis-Sys	4%	3%	3%	0.21	0.14	0.16	1.07	0.42	0.16	1.65
Workload Distraction Pressure	4%	3%	0%	0.21	0.14	0.00	1.07	0.42	0.00	1.49
Def Manuals	4%	2%	1%	0.21	0.11	0.04	1.07	0.34	0.04	1.45
Fatique	4%	2%	0%	0.21	0.11	0.00	1.07	0.34	0.00	1.41
Upset	3%	2%	2%	0.14	0.08	0.08	0.71	0.25	0.08	1.04
Birds	1%	2%	1%	0.07	0.11	0.04	0.36	0.34	0.04	0.73
Traffic	1%	2%	2%	0.07	0.08	0.08	0.36	0.25	0.08	0.69

Relative Risk Rank Table (Continued)

	Frequency						Freq*Sev			Total risk
	% of events in the last 15Y			Frequency contribution (% * 5)			Separately at 3 Sev levels			
	% of recent fatal acc	% of recent acc	% of recent inc	F acc	Acc	Inc	F Acc (5)	Acc (3)	Inc (1)	
Def-Ops data	1%	2%	1%	0.07	0.08	0.04	0.36	0.25	0.04	0.65
Cabin	0%	4%	1%	0.00	0.20	0.04	0.00	0.59	0.04	0.63
Ops/Type Spec	1%	1%	2%	0.07	0.06	0.08	0.36	0.17	0.08	0.60
L..F.P	1%	1%	1%	0.07	0.06	0.04	0.36	0.17	0.04	0.56
MEL	1%	1%	0%	0.07	0.06	0.00	0.36	0.17	0.00	0.52
D.G	1%	1%	0%	0.07	0.06	0.00	0.36	0.17	0.00	0.52
Def-Proc's	0%	1%	0%	0.00	0.06	0.00	0.00	0.17	0.00	0.17
Mis-AFS	0%	1%	0%	0.00	0.06	0.00	0.00	0.17	0.00	0.17
Wake Vortex	0%	1%	0%	0.00	0.03	0.00	0.00	0.08	0.00	0.08
Def-Chk lists	0%	0%	1%	0.00	0.00	0.04	0.00	0.00	0.04	0.04
Pilot Incap	0%	0%	1%	0.00	0.00	0.04	0.00	0.00	0.04	0.04
Loss of comms	0%	0%	1%	0.00	0.00	0.04	0.00	0.00	0.04	0.04
R/W Incursion	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Physio	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Def-DBs	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Def-Charts	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NAV	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Communication	6%	3%	2%	0.29	0.17	0.08	1.43	0.50	0.08	2.01
SA	21%	14%	9%	1.07	0.70	0.43	5.36	2.09	0.43	7.88
Leadership and Teamwork	4%	4%	3%	0.21	0.22	0.16	1.07	0.67	0.16	1.90
Workload Management	3%	1%	1%	0.14	0.06	0.04	0.71	0.17	0.04	0.92
Problem Solving Decision Making	3%	9%	6%	0.14	0.47	0.31	0.71	1.42	0.31	2.45
Knowledge	0%	2%	1%	0.00	0.08	0.04	0.00	0.25	0.04	0.29
Application of Procedures & Knowledge	11%	13%	9%	0.57	0.64	0.47	2.86	1.93	0.47	5.25
Flight Management, Guidance and Automation	3%	2%	1%	0.14	0.11	0.04	0.71	0.34	0.04	1.09
Manual Aircraft Control	61%	37%	27%	3.07	1.87	1.36	15.36	5.61	1.36	22.33

2.12.9.2 Relative Risk Rank Priority

Relative Risk Ranking Priority for Jet Generation 2

Factor	Priority
Syst mal	23.01
Adverse Weather/Ice	21.29
Poor Visibility	18.95
Eng Fail	18.34
Fire	18.16
Mis A/C State	13.18
CRM	11.45
Crosswind	10.71
Terrain	7.35
Windshear	6.34
Ground manoeuvring	5.94
Compliance	3.98
Ground equipment	3.65
Runway/Taxi condition	2.71
ATC	1.69
Mis-Sys	1.65
Workload Distraction Pressure	1.49
Def Manuals	1.45

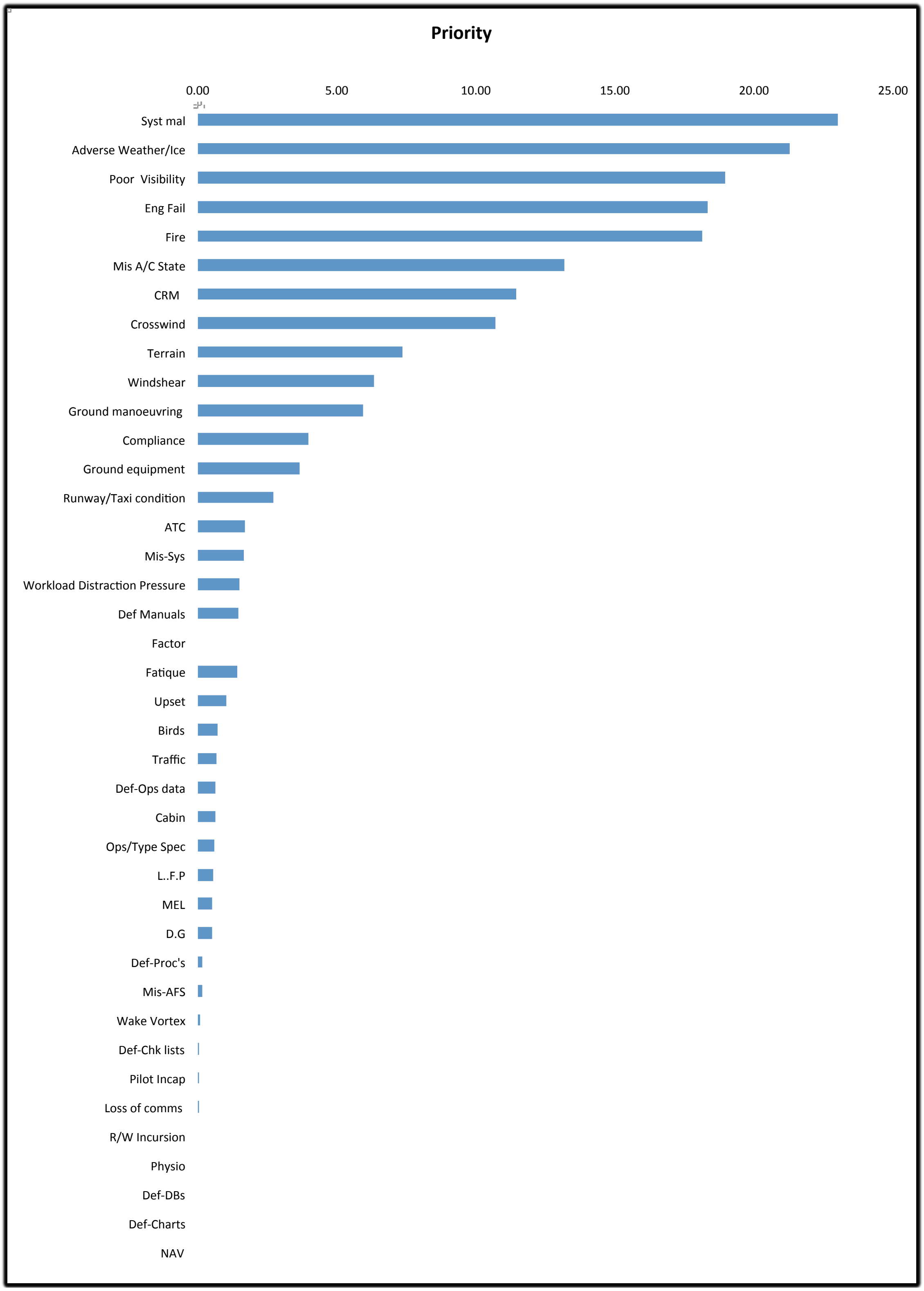
Relative Risk Rank Priority (Continued)

Relative Risk Ranking Priority for Jet Generation 2

Factor	Priority
Fatique	1.41
Upset	1.04
Birds	0.73
Traffic	0.69
Def-Ops data	0.65
Cabin	0.63
Ops/Type Spec	0.60
L..F.P	0.56
MEL	0.52
D.G	0.52
Def-Proc's	0.17
Mis-AFS	0.17
Wake Vortex	0.08
Def-Chk lists	0.04
Pilot Incap	0.04
Loss of comms	0.04
R/W Incursion	0.00
Physio	0.00
Def-DBs	0.00
Def-Charts	0.00
NAV	0.00

2.12.9.3 Relative Risk Rank Chart

Relative Risk Ranking for Jet Generation 2



2.12.10 Takeoff Data

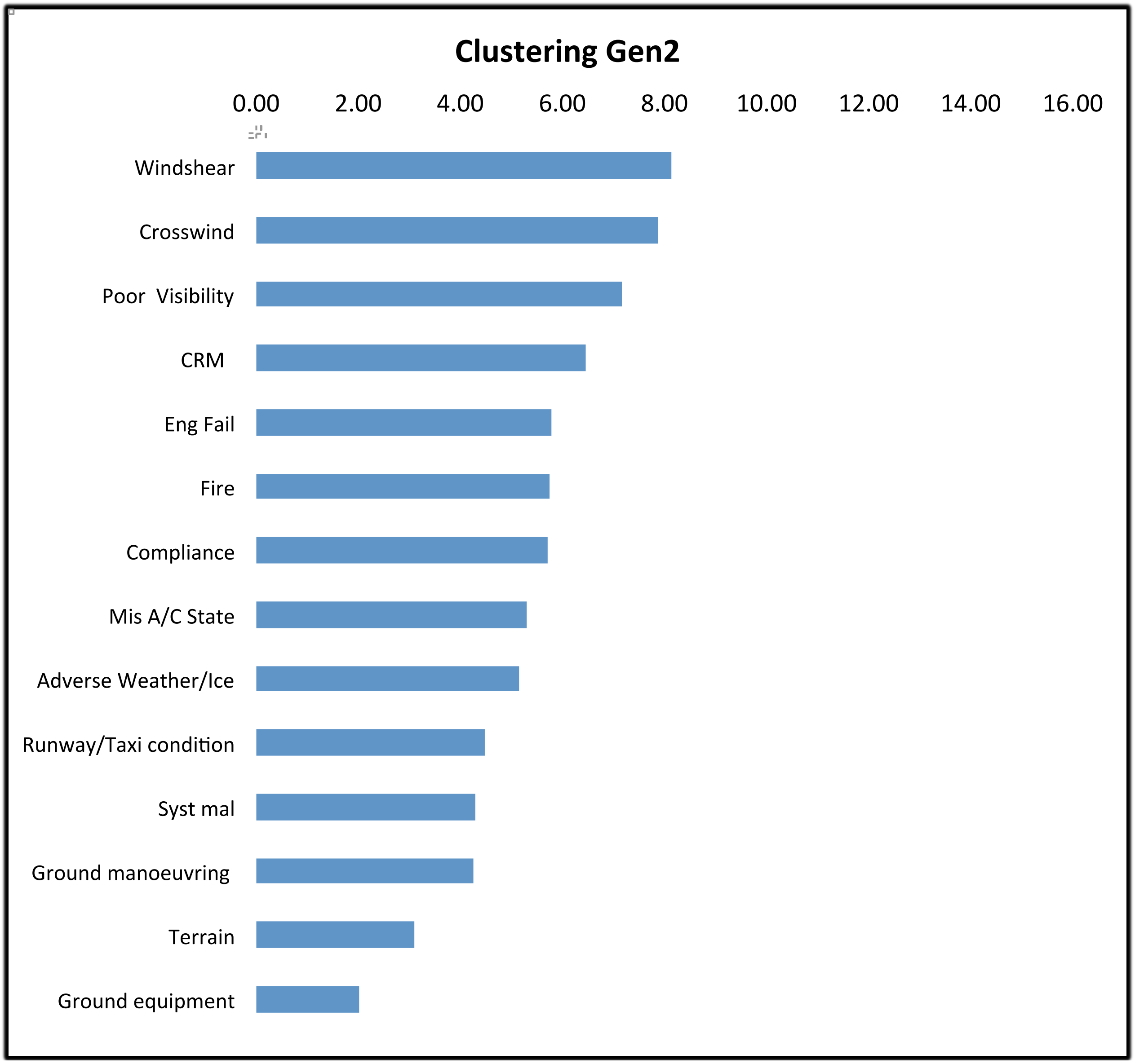
2.12.10.1 Takeoff Data Table

GLOBAL VALUES		1950	1960	1970	1980	1990	2000	2010	Before last 15Y	Last 15Y	Total/Gen
	Gen1	49279	3654782	6978479	2248452	567284	113441	1213	13361467	251463	13612930
	Gen2	0	7685689	55683176	81876860	57656778	20350718	571250	182355441	41469030	223824471
	Gen3	0	0	0	11881889	70034723	127321496	13391504	47286029	175343583	222629612
	Gen4	0	0	0	73214	9455296	50784434	9443295	3266023	66490216	69756239
		9528510					60227729				
	ALL GEN	49279	11340471	62661655	96080415	137714081	198570089	23407262	246268960	283554292	

Grand total	529823252

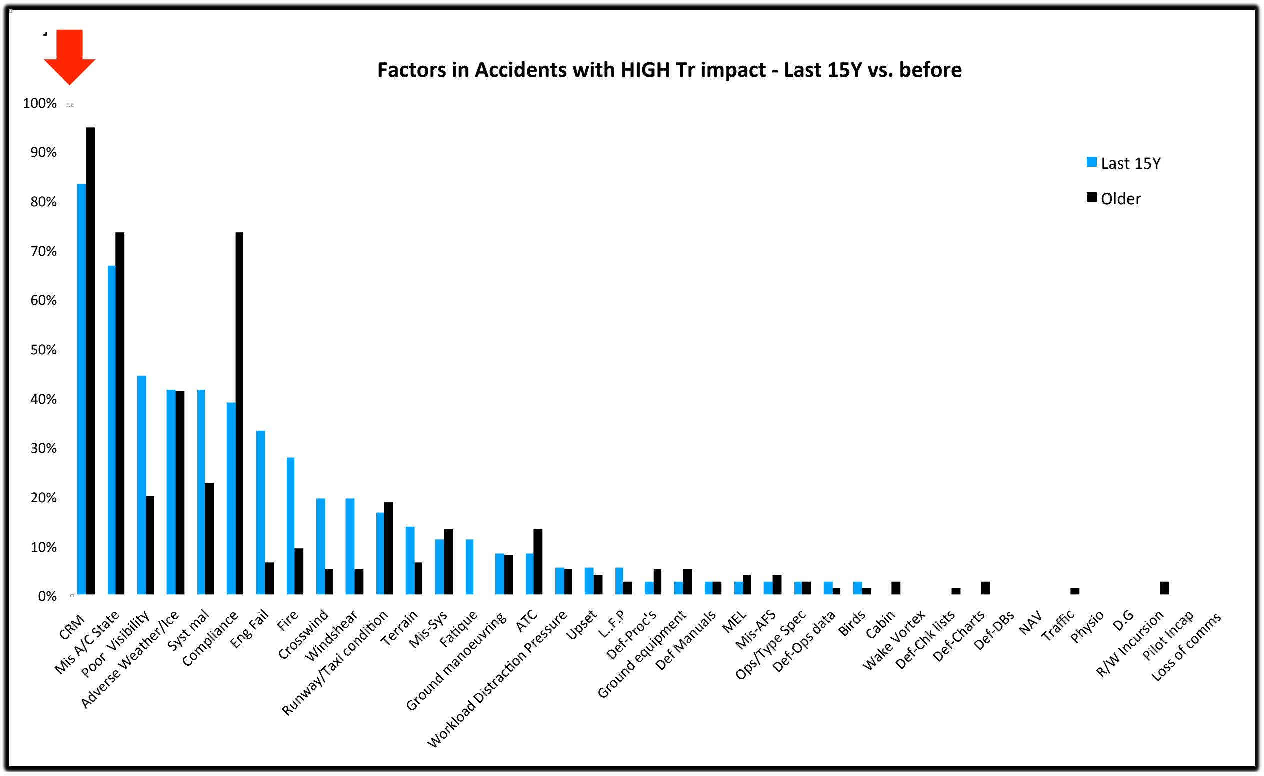
2.12.11 Clustering

2.12.11.1 Clustering of Factors Graph (Generation 2)



2.12.12 HIGH TRAINING EFFECT

2.12.12.1 Comparison of Factors in Accidents with a High Training Impact during Current versus Previous Time Period (Generation 2)



2.12.13 Global Priority Ranking for Factors Jet Generation 2

2.12.13.1 Priority Table

Priority table of factors for Jet Generation 2

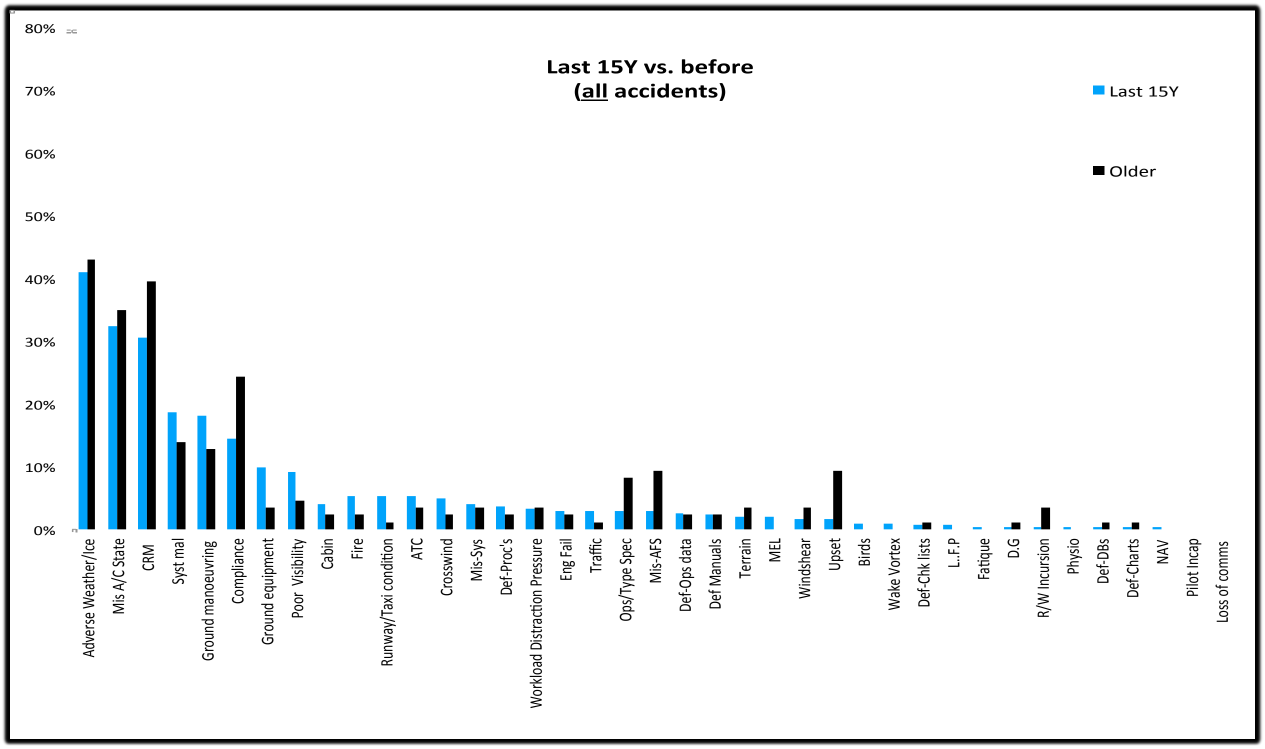
Level	Factors	Rank	Tr
A	CRM	7	A
	Poor Visibility	7	A
B	Mis A/C State	6	A
	Syst mal	6	A
	Adverse Weather/Ice	6	C
	Fire	5	A
	Eng Fail	5	A
	Windshear	5	B
	Crosswind	4	A
	Compliance	4	C
C	Runway/Taxi condition	2	C
	Terrain	2	C

2.13 GENERATION 3 ANALYSIS

2.13.1 Global Accidents (Last 15 Years)

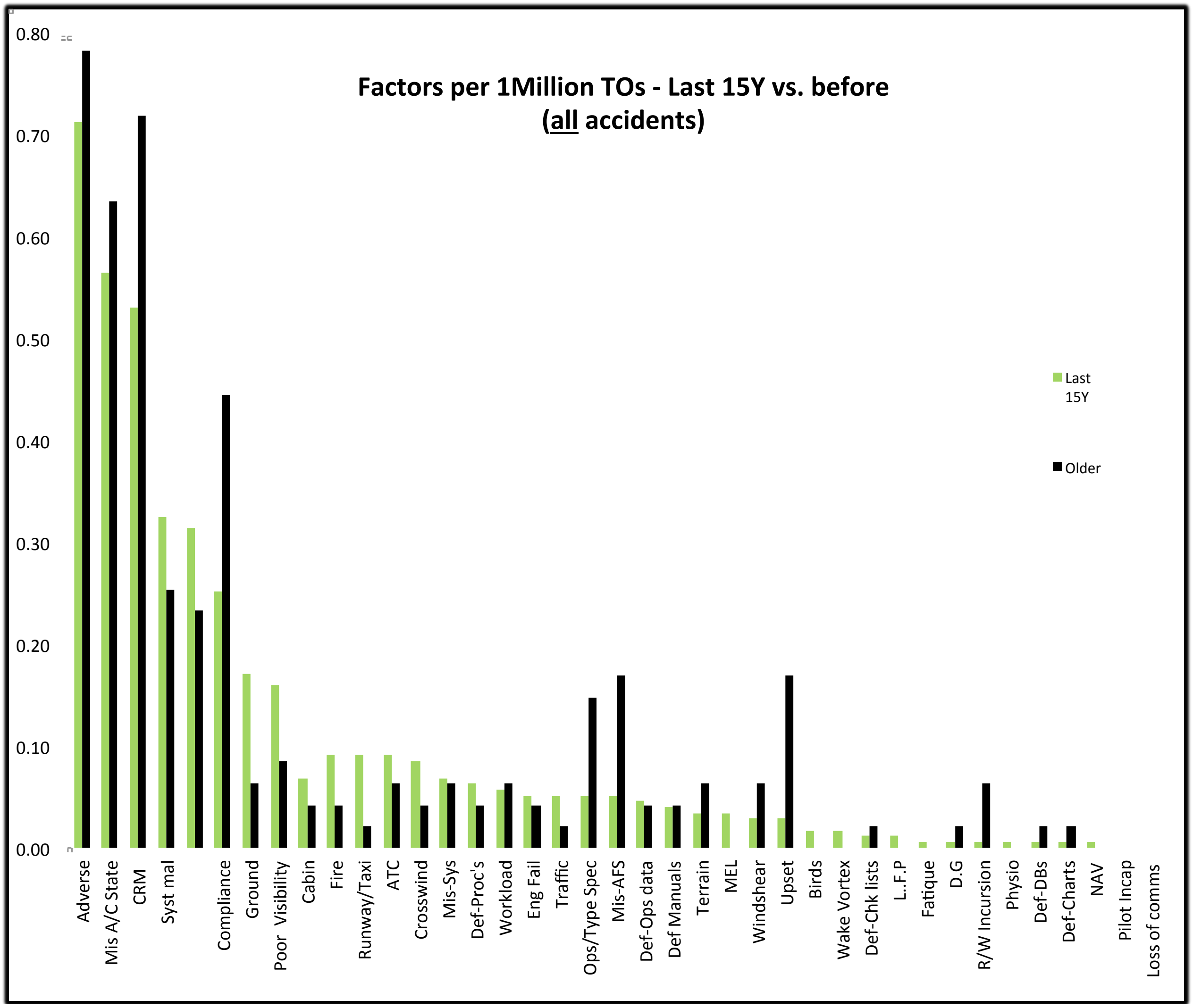
2.13.1.1 Ranking of Factors for All Accidents

Ranking of factors based on how present they are in accidents in Generation 3 (as a percentage of all Gen4 accidents – last 15 years in blue, earlier times in black)



2.13.1.2 Ranking of Factors for All Accidents per One Million Takeoffs (Generation 3)

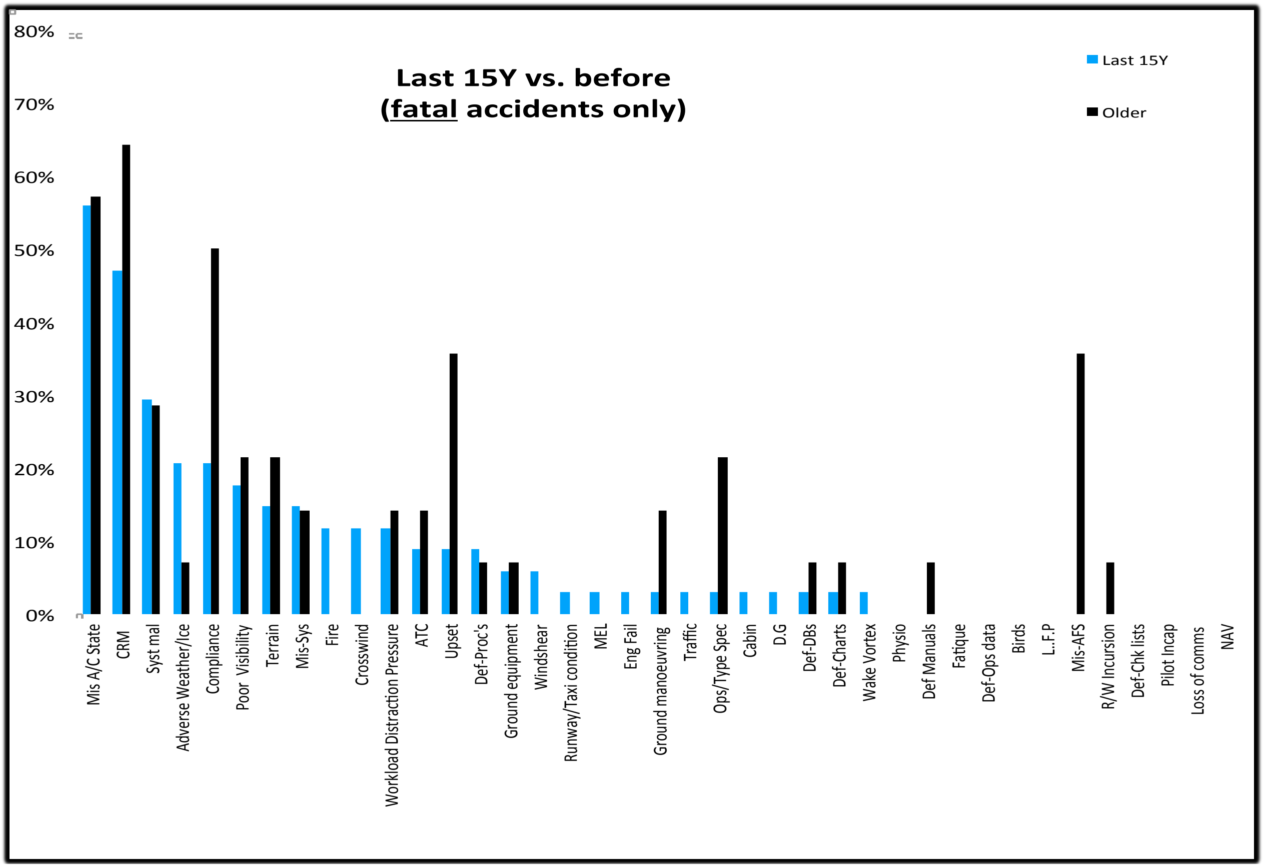
Ranking of factors normalized by the number of takeoffs for all accidents



2.13.2 Global Fatal Accidents (Last 15 Years)

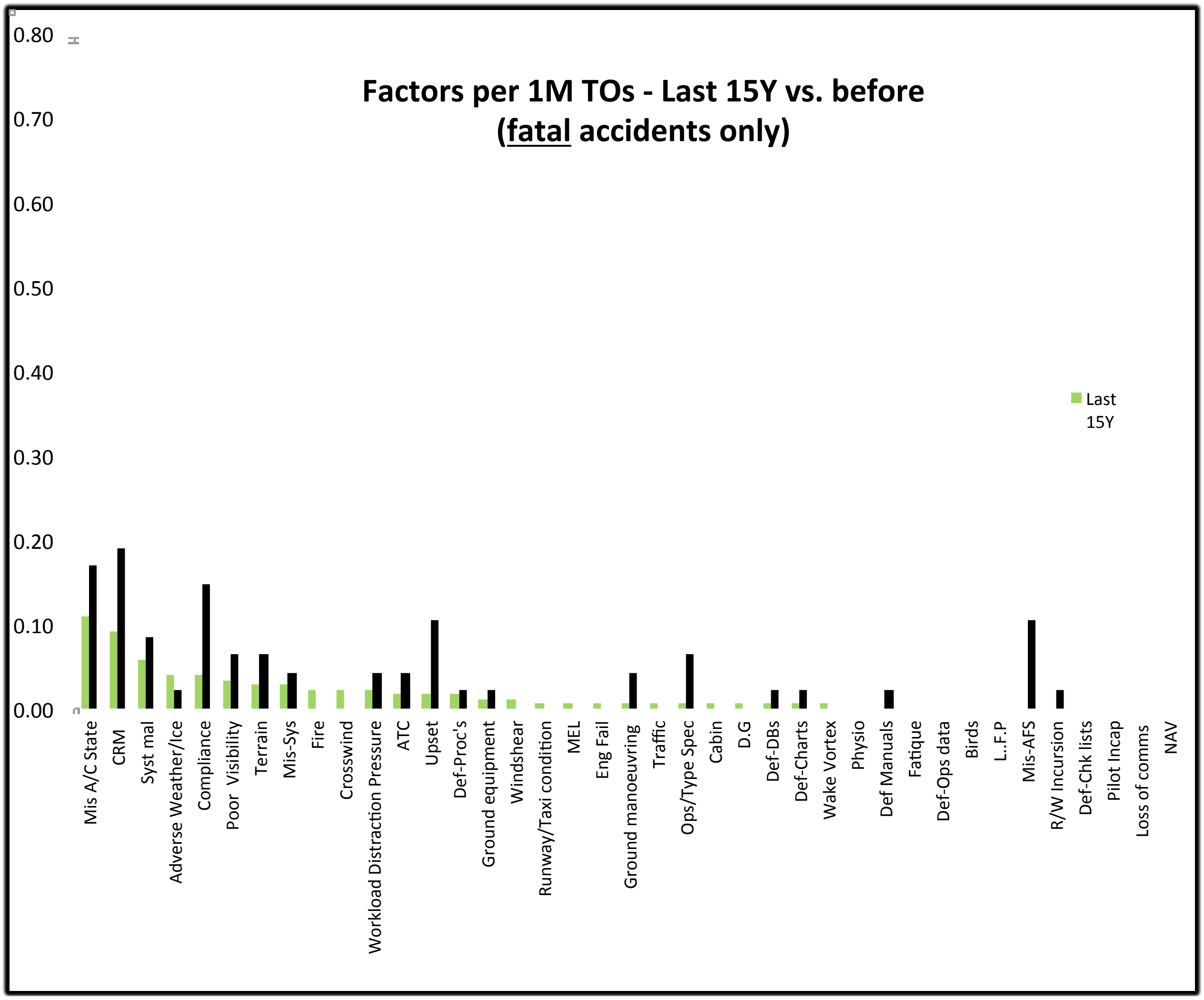
2.13.2.1 Ranking of Factors for Fatal Accidents

Comparison of the ranking of factors as a percentage of fatal accidents, L15Y vs. older (Generation 3)



2.13.2.2 Ranking of Factors for All Fatal Accidents per One Million Takeoffs (Generation 3)

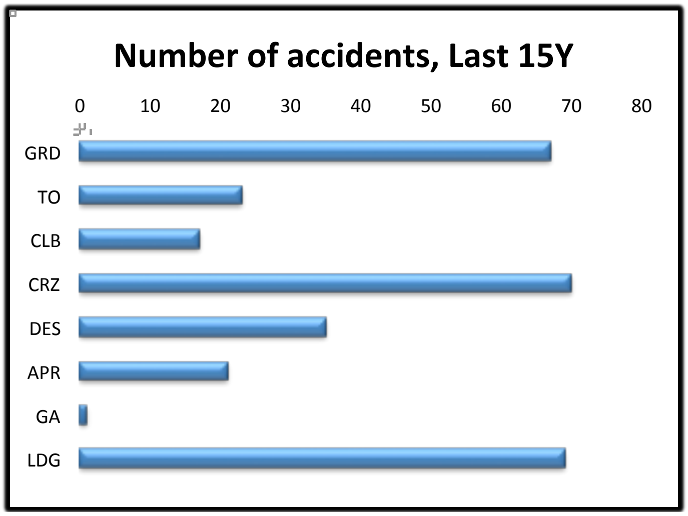
Comparison of factor rankings, normalized by the number of takeoffs. Fatal accidents. (Generation 3)



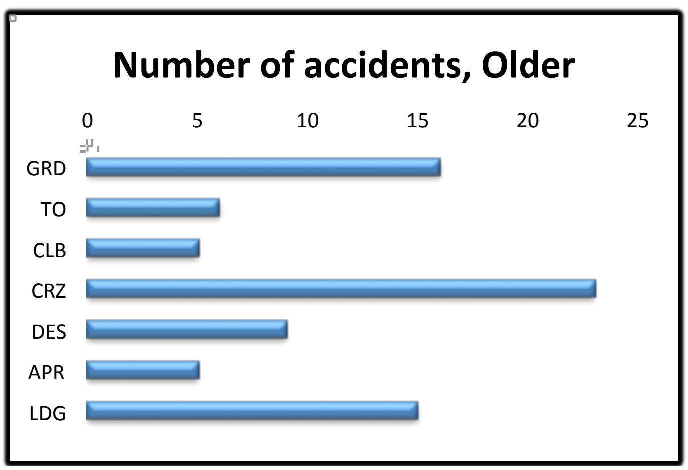
2.13.3 Distribution by Flight Phases

2.13.3.1 Distributions of accidents by Flight Phase

Number of accidents per Flight Phase during the last 15 Years (Generation 3)

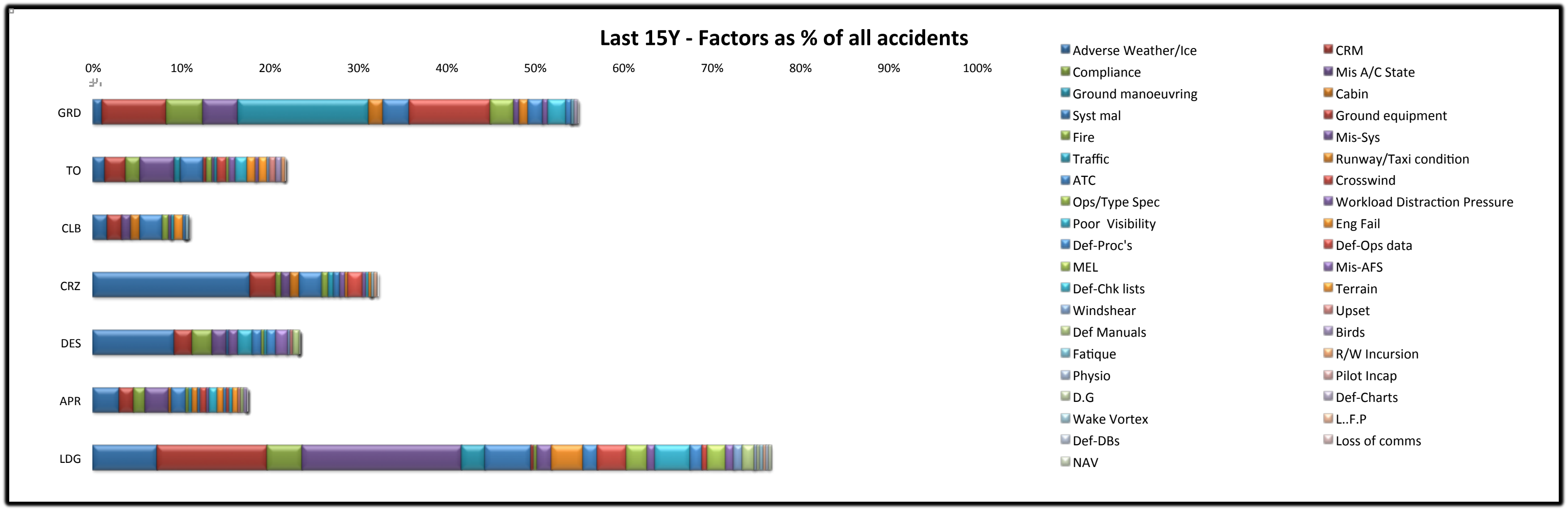


Number of accidents per Flight Phase during previous time period (Generation 3)



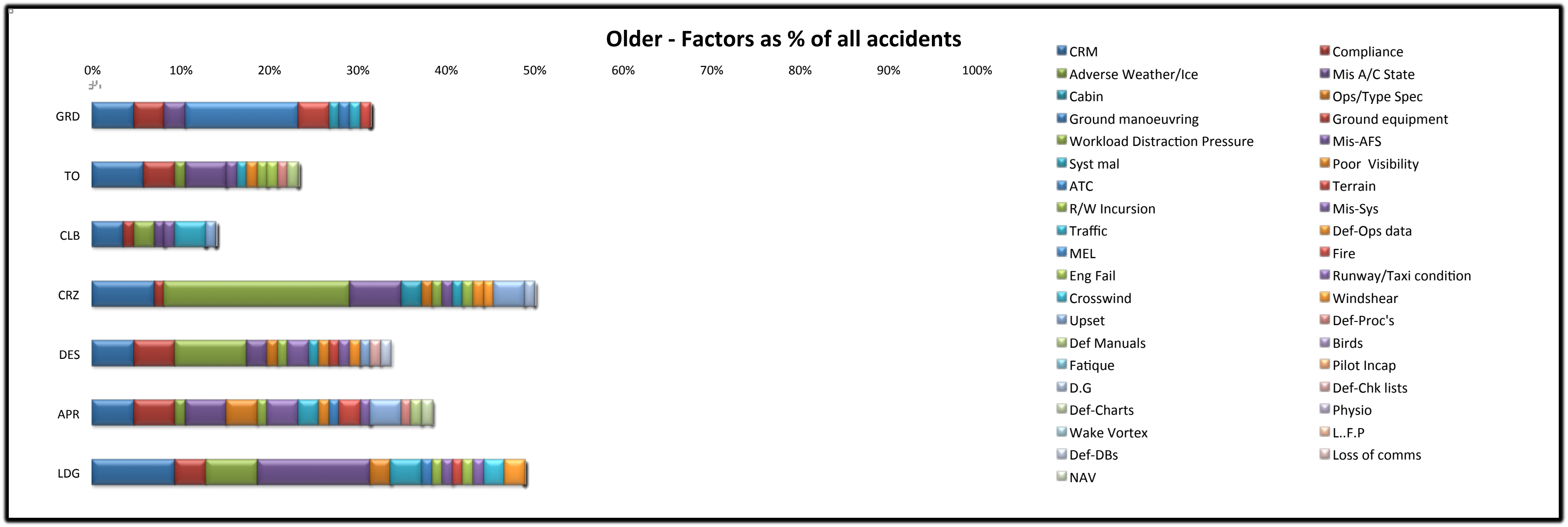
2.13.3.2 Distribution of Specific Factors by Flight Phase (Last 15 Years)

Distribution of factors in all accidents by Flight Phase (Generation 3)



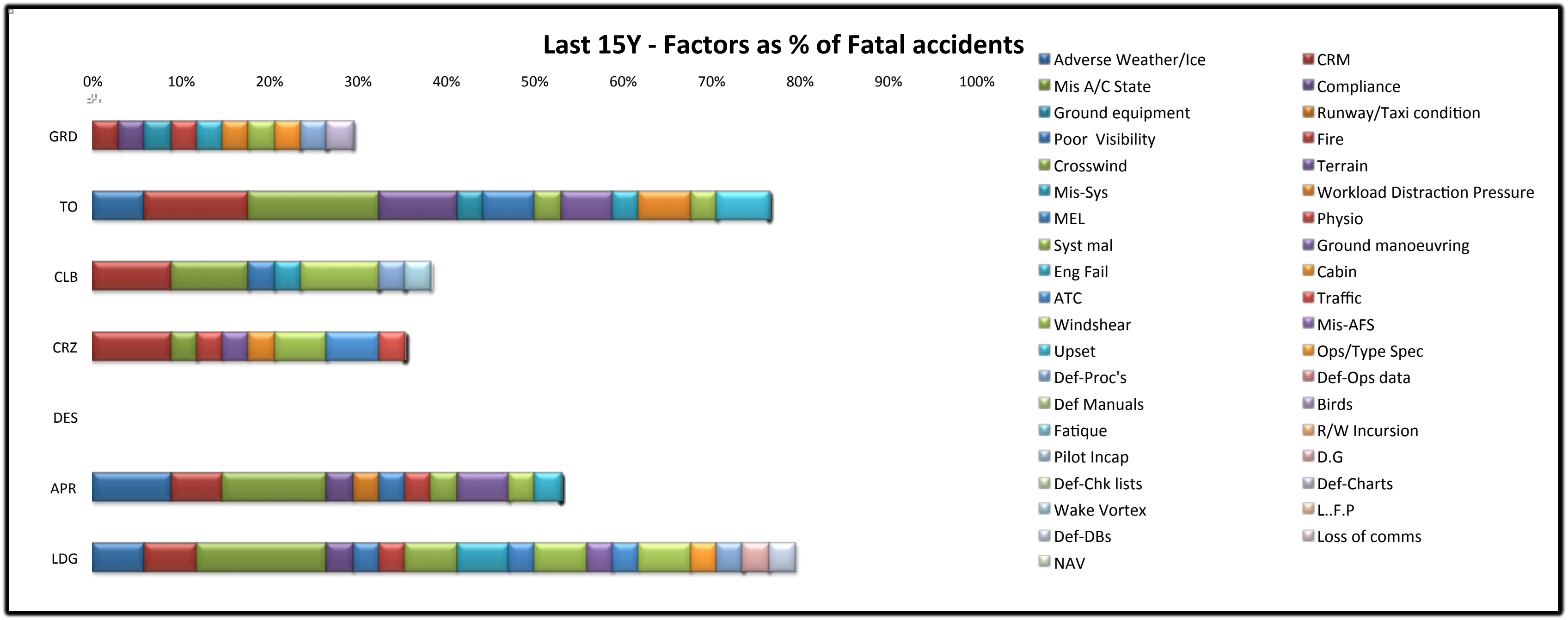
2.13.3.3 Distribution of Specific Factors by Flight Phase (Older)

Distribution of factors in all accidents by Flight Phase (Generation 3)



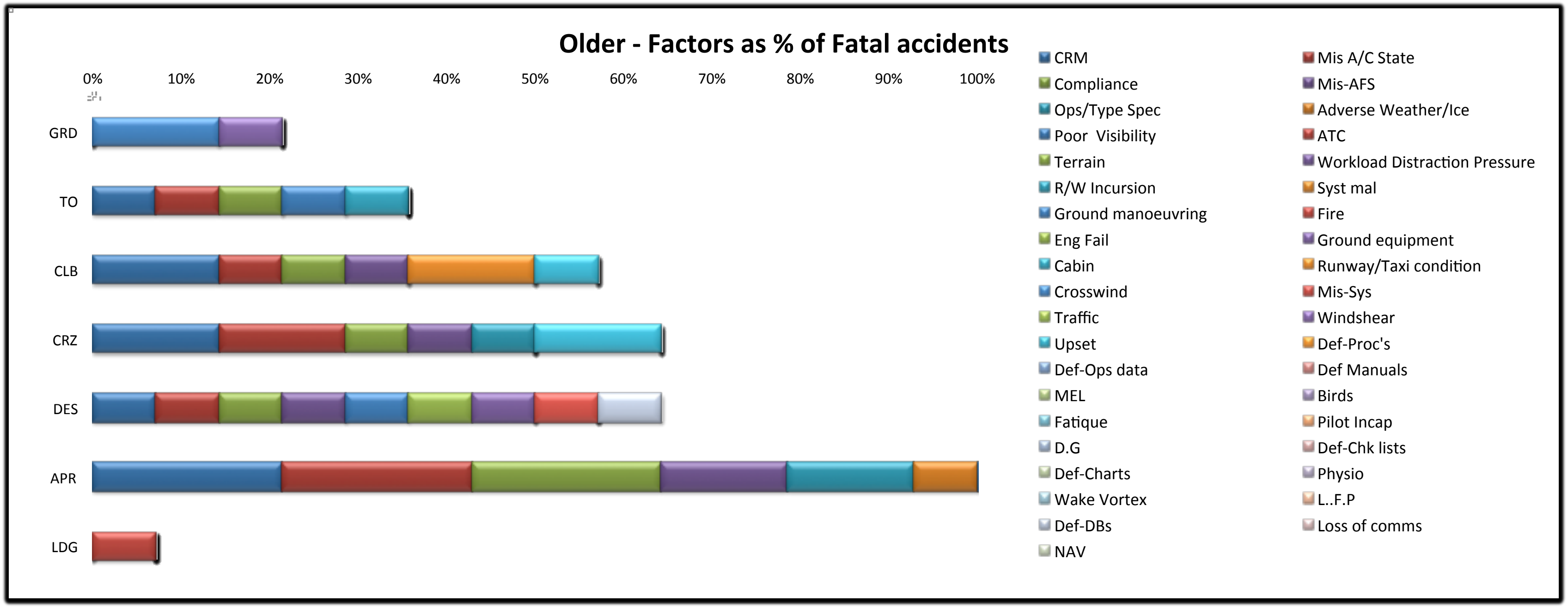
2.13.3.4 Distribution of Specific Factors by Flight Phase (Last 15 Years, Fatal Accidents Only)

Distribution of factors in accidents by Flight Phase (Generation 3)



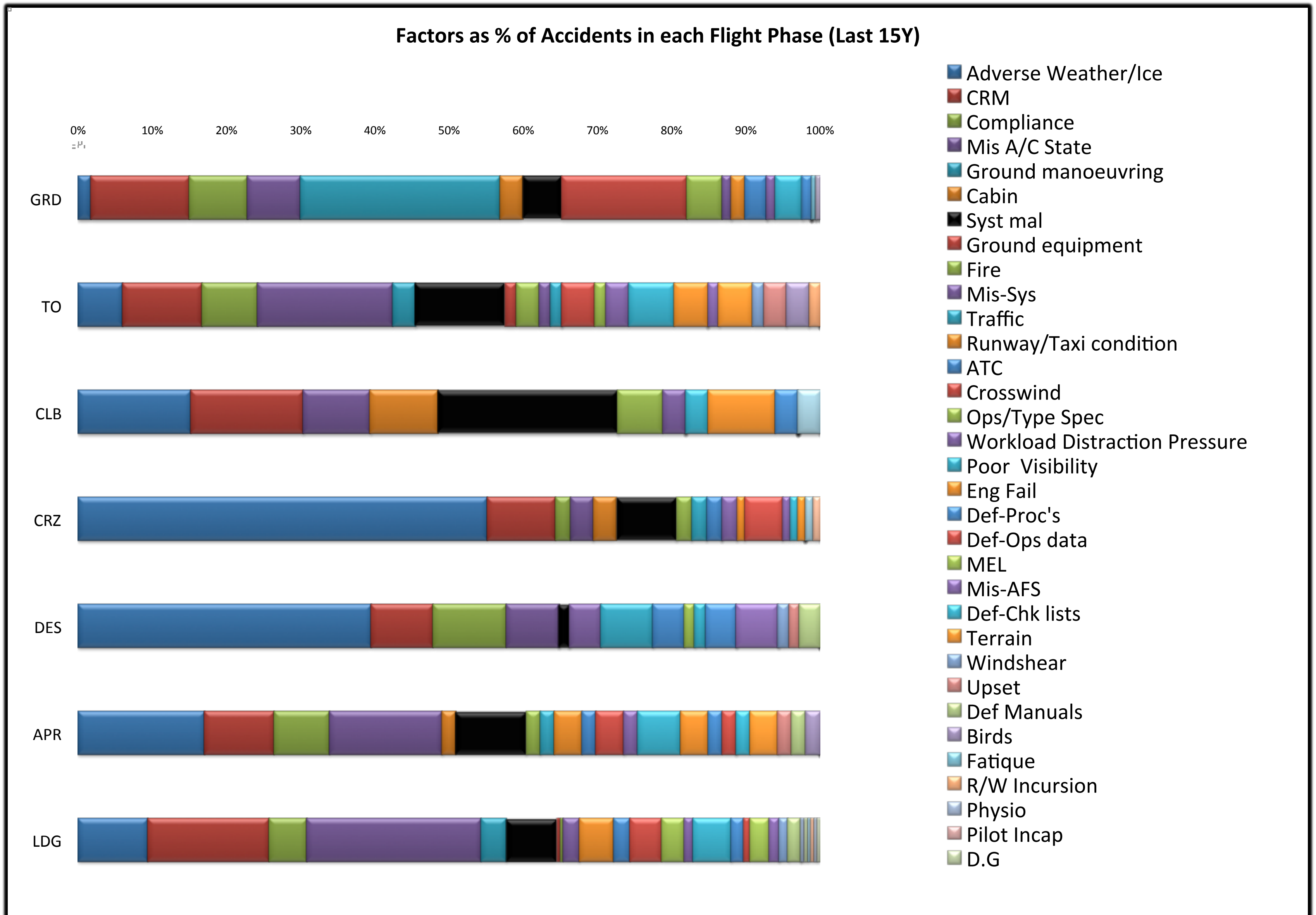
2.13.3.5 Distribution of Specific Factors by Flight Phase (Older, Fatal Accidents Only)

Distribution of factors in accidents by Flight Phase (Generation 3)



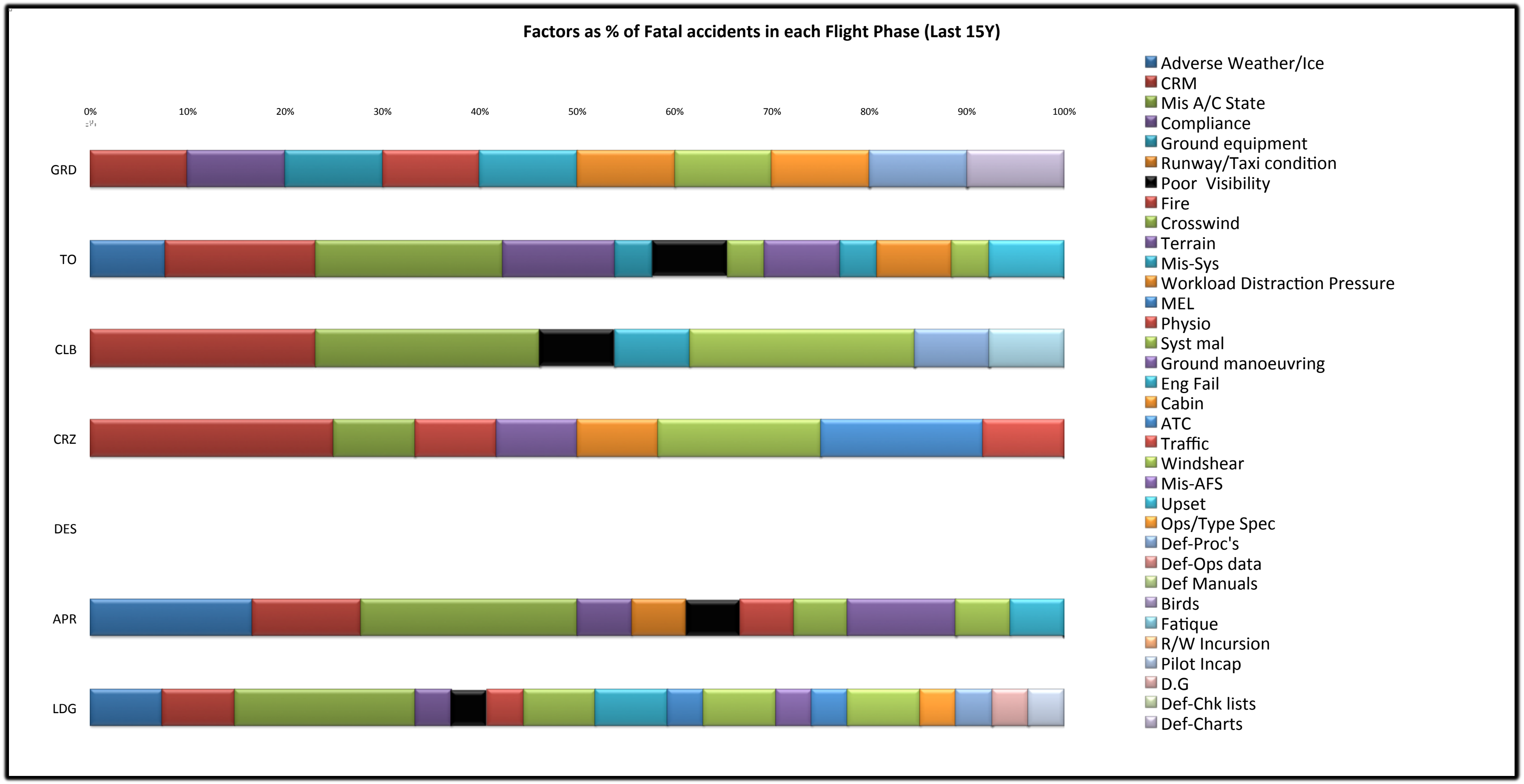
2.13.3.6 Proportional Distributions of Specific Factors by Flight Phase

Distribution of factors by Flight Phase for all accidents (Generation 3)



2.13.3.7 Proportional Distributions of Specific Factors by Flight Phase

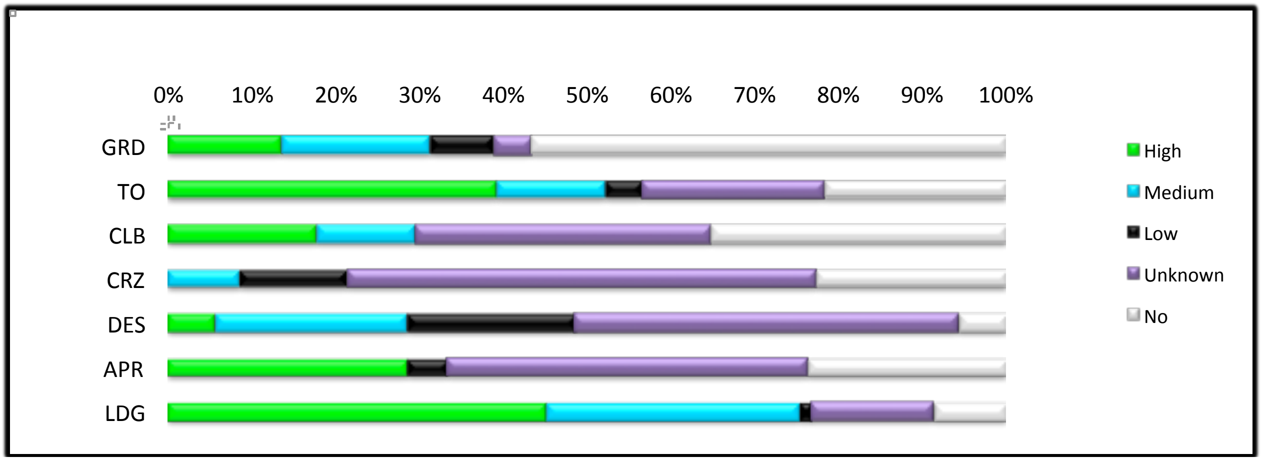
Distribution of factors by Flight Phase for Fatal Accidents only (Generation 3)



2.13.4 Trainability

2.13.4.1 Training Effect

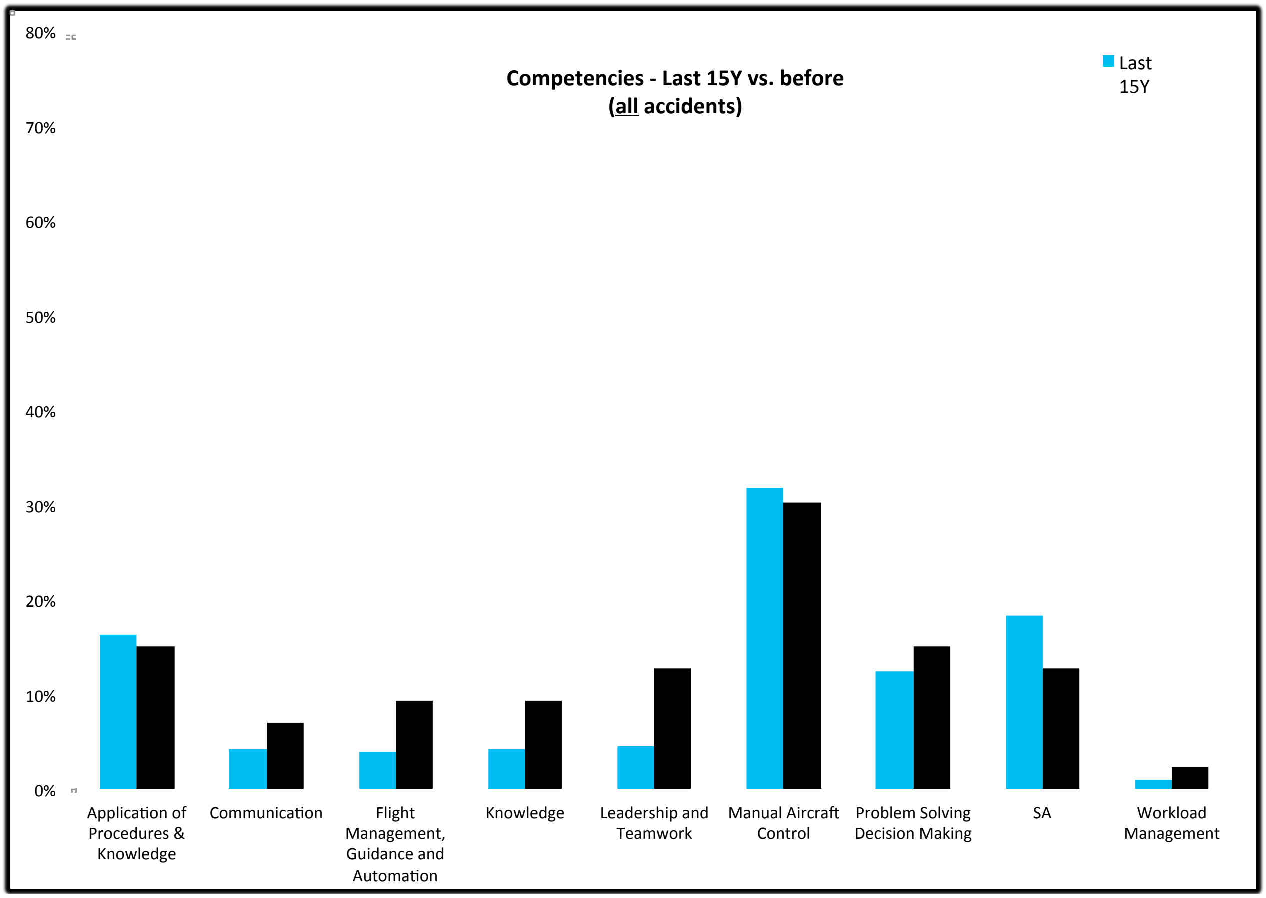
Training Effect by Flight Phase, all accidents, L15 Years (Generation 3)



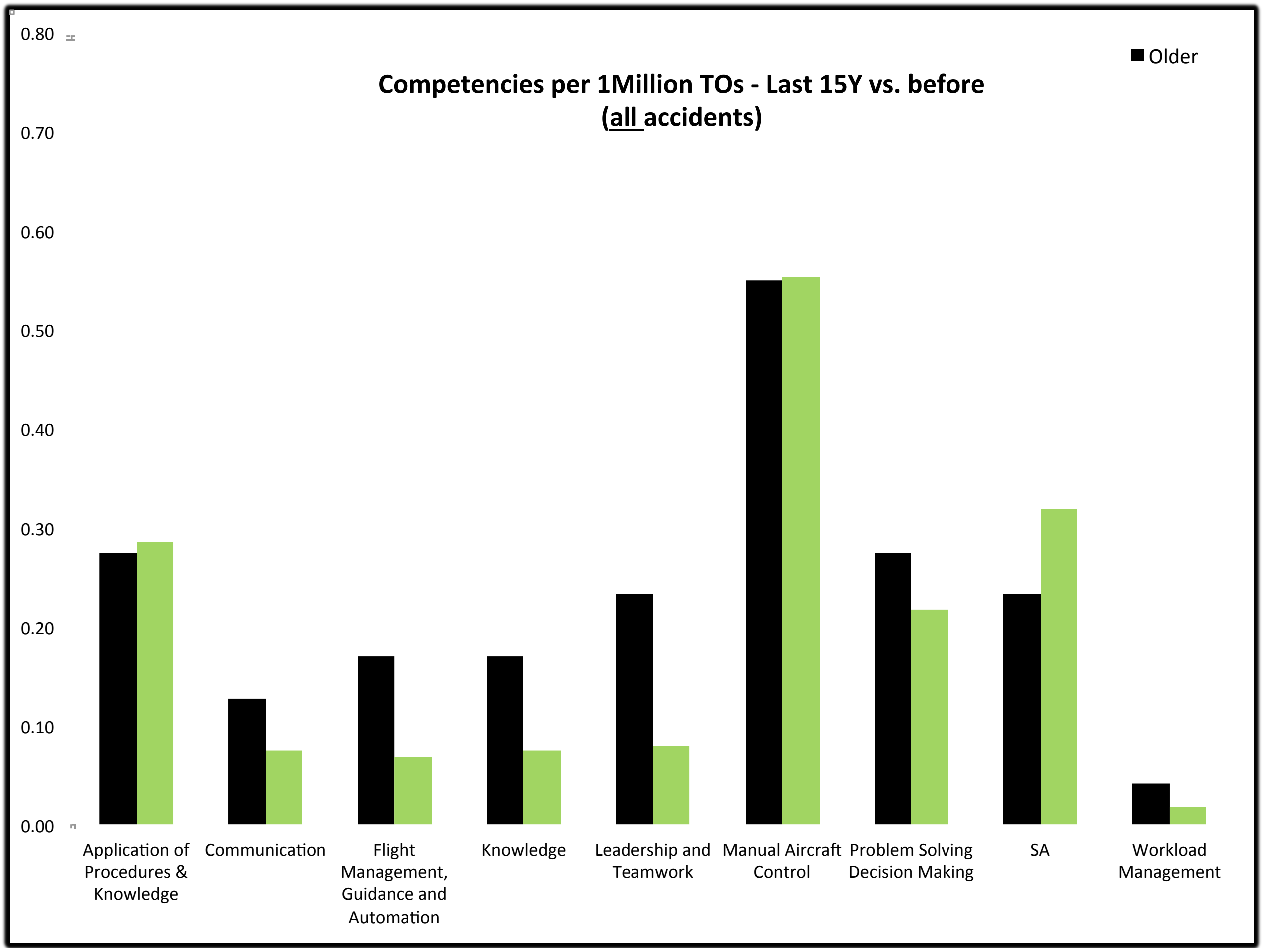
2.13.5 Competencies in Accidents

2.13.5.1 Distributions of Deficient Competencies in Accidents

Comparison of competency issues in accidents during current versus previous time period (Generation 3)



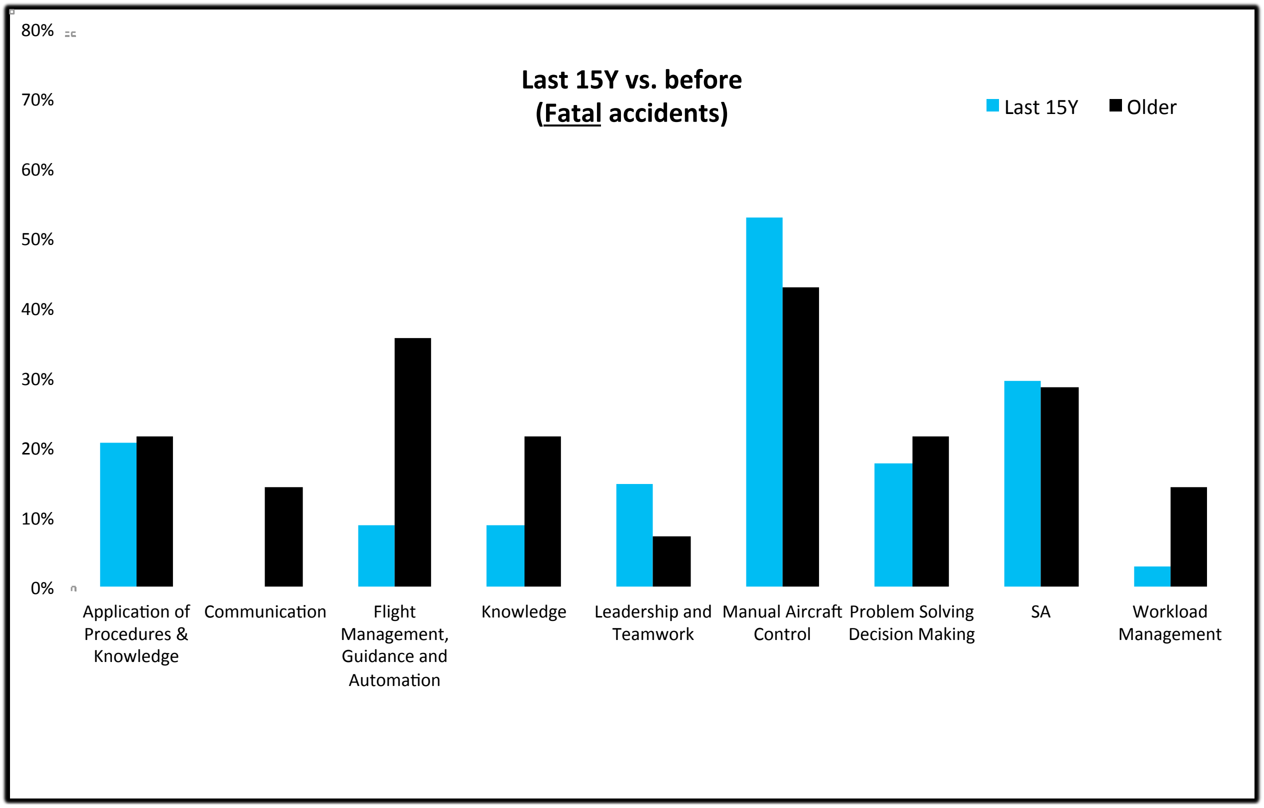
2.13.5.2 Comparison Distributions of Competency Issues in Accidents per One Million Takeoffs during Current versus Previous Time Period (Generation 3)



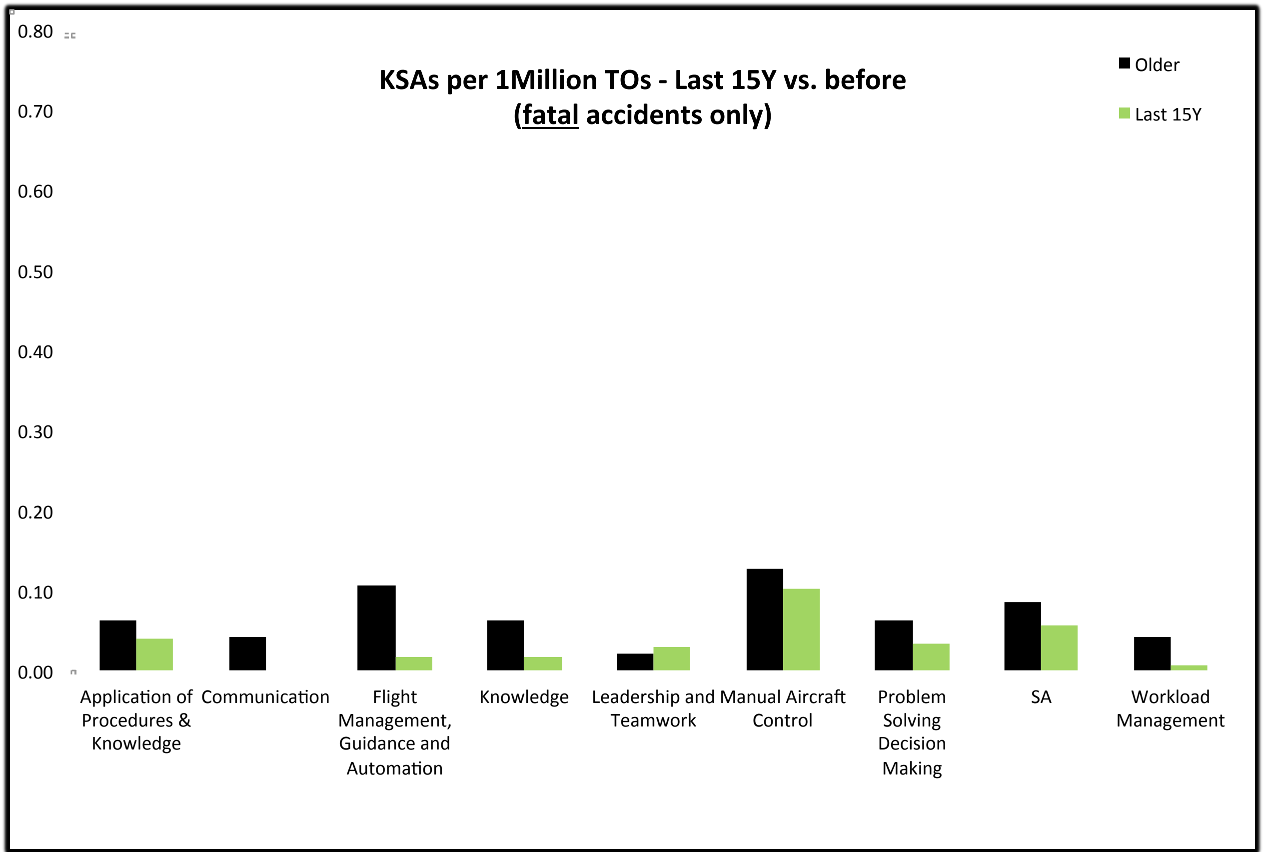
2.13.6 Competencies in Fatal Accidents

2.13.6.1 Distributions of Deficient Competencies in Fatal Accidents

Comparison of competency issues in fatal accidents during current versus previous time period (Generation 3)



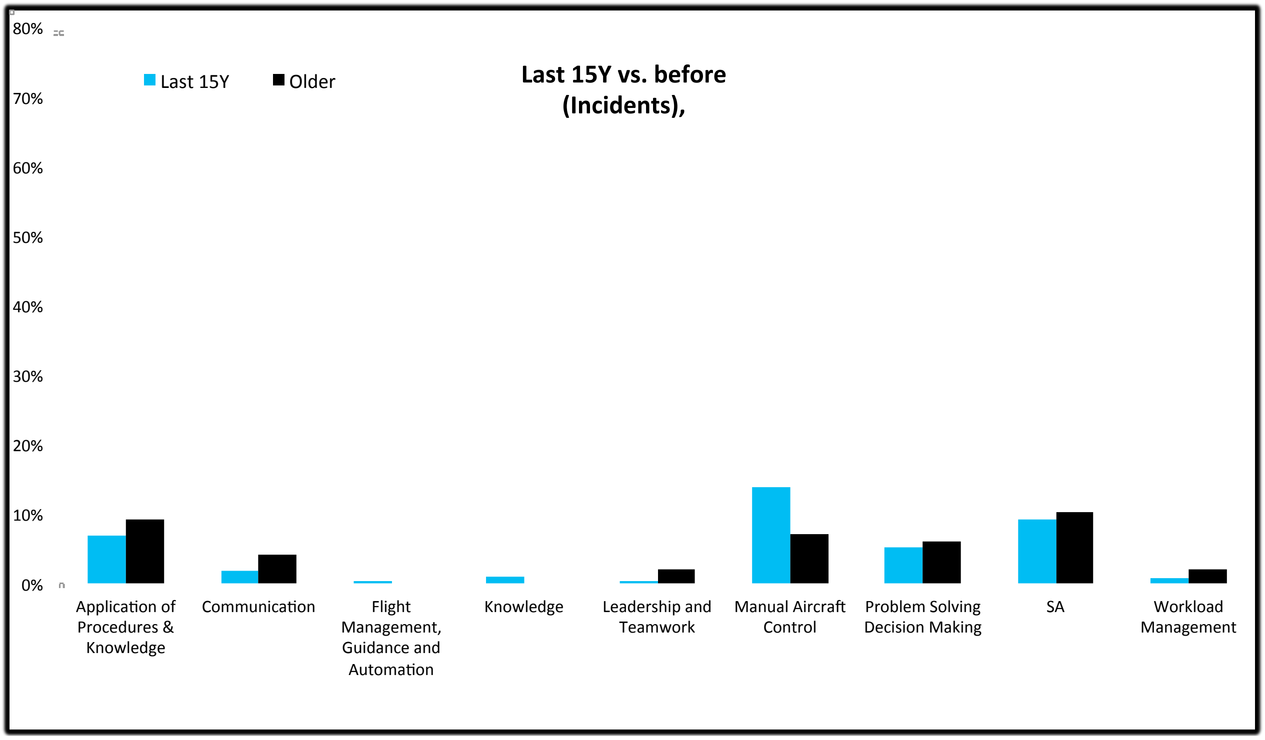
2.13.6.2 Comparison of Distributions of Competency Issues in Fatal Accidents per One Million Takeoffs during Current versus Previous Time Period (Generation 3)



2.13.7 Competencies in Incidents

2.13.7.1 Distributions of Competency Issues in Incidents

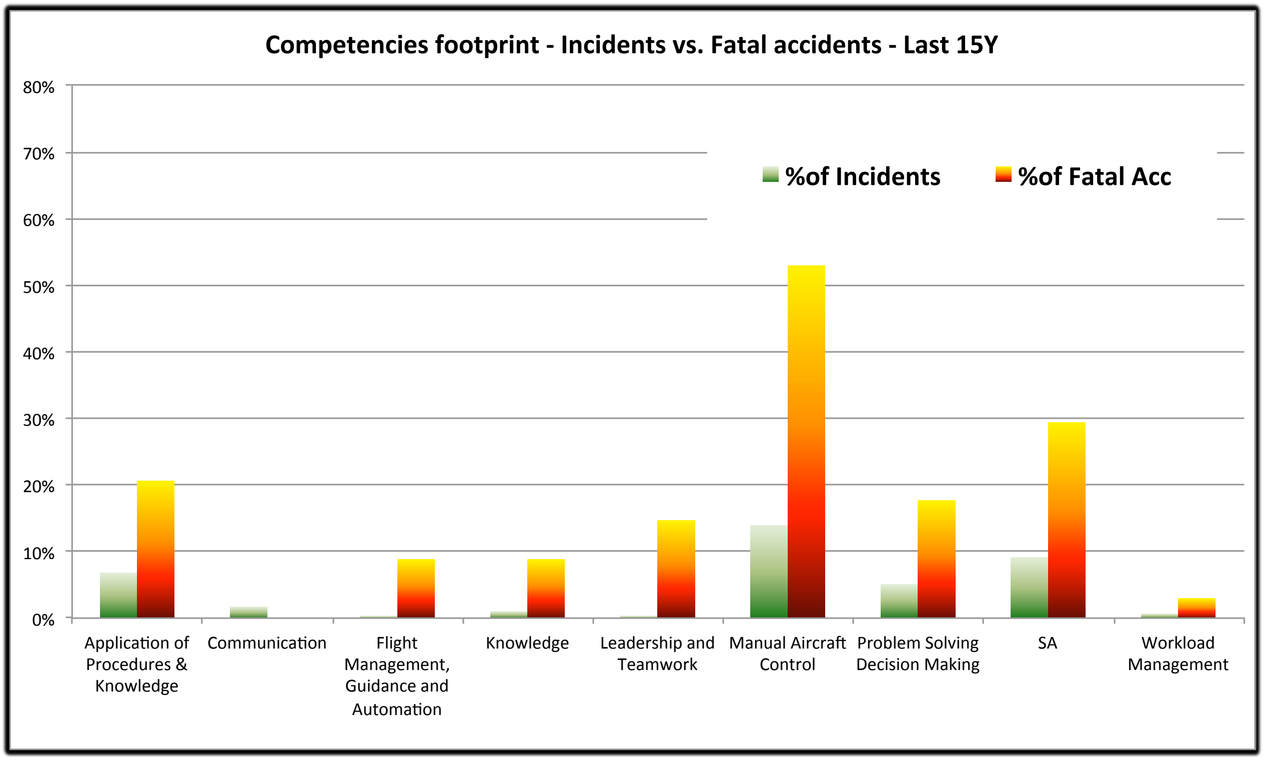
Comparison of deficient competencies in incidents during current versus previous time period (Generation 3)



2.13.8 Competency Footprint

2.13.8.1 Distributions of Competency Issues in Incidents and Fatal Accidents

Comparison of deficient competencies in Incidents vs. Fatal Accidents (Generation 3)



2.13.9 Relative Risk Rank

2.13.9.1 Relative Risk Rank Table (Generation 3)

	Frequency						Freq*Sev			Total risk
	% of events in the last 15Y			Frequency contribution (% * 5)			Separately at 3 Sev levels			
	% of recent fatal acc	% of recent acc	% of recent inc	F acc	Acc	Inc	F Acc (5)	Acc (3)	Inc (1)	
Mis A/C State	56%	32%	17%	2.79	1.62	0.83	13.97	4.87	0.83	19.67
CRM	47%	30%	12%	2.35	1.52	0.59	11.76	4.57	0.59	16.93
Syst mal	29%	19%	55%	1.47	0.93	2.75	7.35	2.80	2.75	12.90
Adverse Weather/Ice	21%	41%	8%	1.03	2.05	0.41	5.15	6.15	0.41	11.70
Compliance	21%	14%	7%	1.03	0.72	0.36	5.15	2.16	0.36	7.67
Poor Visibility	18%	9%	3%	0.88	0.46	0.15	4.41	1.38	0.15	5.94
Fire	12%	5%	18%	0.59	0.26	0.88	2.94	0.79	0.88	4.61
Mis-Sys	15%	4%	1%	0.74	0.20	0.05	3.68	0.59	0.05	4.32
Ground manoeuvring	3%	18%	14%	0.15	0.90	0.69	0.74	2.70	0.69	4.14
Terrain	15%	2%	0%	0.74	0.10	0.02	3.68	0.30	0.02	3.99
Crosswind	12%	5%	2%	0.59	0.25	0.08	2.94	0.74	0.08	3.76
ATC	9%	5%	11%	0.44	0.26	0.54	2.21	0.79	0.54	3.54
Workload Distraction Pressure	12%	3%	1%	0.59	0.16	0.07	2.94	0.49	0.07	3.50
Ground equipment	6%	10%	4%	0.29	0.49	0.22	1.47	1.48	0.22	3.17
Def-Proc's	9%	4%	2%	0.44	0.18	0.08	2.21	0.54	0.08	2.83
Upset	9%	2%	2%	0.44	0.08	0.08	2.21	0.25	0.08	2.54

Relative Risk Rank Table (Continued)

	Frequency						Freq*Sev			Total risk
	% of events in the last 15Y			Frequency contribution (% * 5)			Separately at 3 Sev levels			
	% of recent fatal acc	% of recent acc	% of recent inc	F acc	Acc	Inc	F Acc (5)	Acc (3)	Inc (1)	
Eng Fail	3%	3%	13%	0.15	0.15	0.64	0.74	0.44	0.64	1.82
Cabin	3%	4%	3%	0.15	0.20	0.14	0.74	0.59	0.14	1.46
Windshear	6%	2%	1%	0.29	0.08	0.03	1.47	0.25	0.03	1.75
Runway/Taxi condition	3%	5%	3%	0.15	0.26	0.17	0.74	0.79	0.17	1.69
Traffic	3%	3%	5%	0.15	0.15	0.25	0.74	0.44	0.25	1.43
Ops/Type Spec	3%	3%	4%	0.15	0.15	0.19	0.74	0.44	0.19	1.36
MEL	3%	2%	2%	0.15	0.10	0.08	0.74	0.30	0.08	1.12
Wake Vortex	3%	1%	1%	0.15	0.05	0.07	0.74	0.15	0.07	0.95
D.G	3%	0%	0%	0.15	0.02	0.00	0.74	0.05	0.00	0.78
Def-DBs	3%	0%	0%	0.15	0.02	0.00	0.74	0.05	0.00	0.78
Def-Charts	3%	0%	0%	0.15	0.02	0.00	0.74	0.05	0.00	0.78
Def-Ops data	0%	3%	2%	0.00	0.13	0.08	0.00	0.39	0.08	0.48
Mis-AFS	0%	3%	1%	0.00	0.15	0.03	0.00	0.44	0.03	0.48
Def Manuals	0%	2%	1%	0.00	0.11	0.07	0.00	0.34	0.07	0.41

Relative Risk Rank Table (Continued)

	Frequency						Freq*Sev			Total risk
	% of events in the last 15Y			Frequency contribution (% * 5)			Separately at 3 Sev levels			
	% of recent fatal acc	% of recent acc	% of recent inc	F acc	Acc	Inc	F Acc (5)	Acc (3)	Inc (1)	
R/W Incursion	0%	0%	6%	0.00	0.02	0.32	0.00	0.05	0.32	0.37
Birds	0%	1%	2%	0.00	0.05	0.08	0.00	0.15	0.08	0.23
L..F.P	0%	1%	1%	0.00	0.03	0.03	0.00	0.10	0.03	0.13
Def-Chk lists	0%	1%	0%	0.00	0.03	0.02	0.00	0.10	0.02	0.12
Fatique	0%	0%	0%	0.00	0.02	0.02	0.00	0.05	0.02	0.07
Physio	0%	0%	0%	0.00	0.02	0.02	0.00	0.05	0.02	0.07
NAV	0%	0%	0%	0.00	0.02	0.02	0.00	0.05	0.02	0.07
Pilot Incap	0%	0%	1%	0.00	0.00	0.03	0.00	0.00	0.03	0.03
Loss of comms	0%	0%	1%	0.00	0.00	0.03	0.00	0.00	0.03	0.03
Communication	0%	4%	2%	0.00	0.21	0.08	0.00	0.64	0.08	0.72
SA	29%	18%	9%	1.47	0.92	0.46	7.35	2.75	0.46	10.56
Leadership and Teamwork	15%	5%	0%	0.74	0.23	0.02	3.68	0.69	0.02	4.38
Workload Management	3%	1%	1%	0.15	0.05	0.03	0.74	0.15	0.03	0.92
Problem Solving Decision Making	18%	12%	5%	0.88	0.62	0.25	4.41	1.87	0.25	6.53
Knowledge	9%	4%	1%	0.44	0.21	0.05	2.21	0.64	0.05	2.90
Application of Procedures &	21%	16%	7%	1.03	0.82	0.34	5.15	2.46	0.34	7.95
Flight Management, Guidance and Automation	9%	4%	0%	0.44	0.20	0.02	2.21	0.59	0.02	2.81
Manual Aircraft Control	53%	32%	14%	2.65	1.59	0.69	13.24	4.77	0.69	18.70

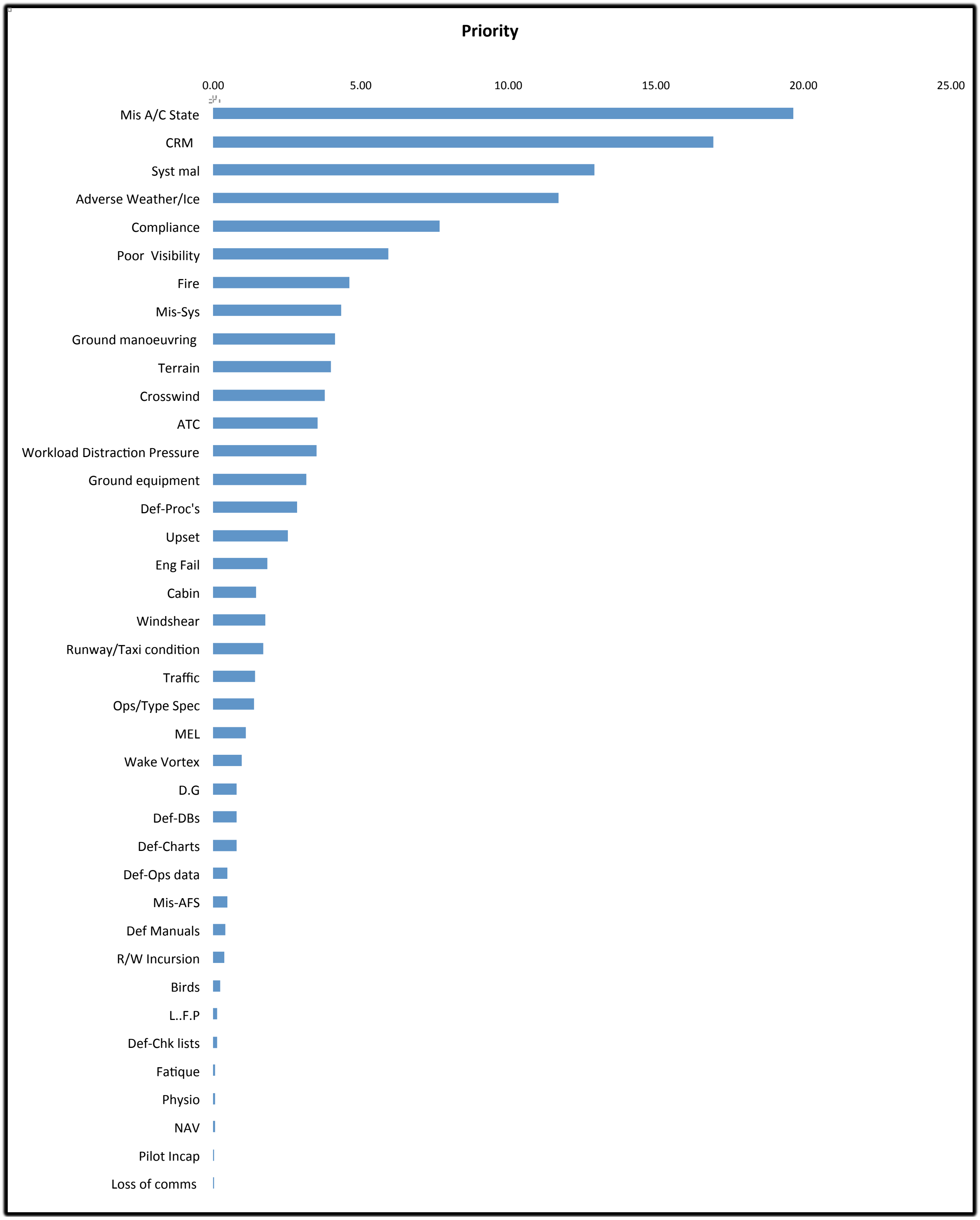
2.13.9.2 Relative Risk Rank Priority

Relative Risk Ranking Priority for Jet Generation 3

Factor	Priority
Mis A/C State	19.67
CRM	16.93
Syst mal	12.90
Adverse Weather/Ice	11.70
Compliance	7.67
Poor Visibility	5.94
Fire	4.61
Mis-Sys	4.32
Ground manoeuvring	4.14
Terrain	3.99
Crosswind	3.76
ATC	3.54
Workload Distraction Pressure	3.50
Ground equipment	3.17
Def-Proc's	2.83
Upset	2.54
Eng Fail	1.82
Cabin	1.46
Windshear	1.75
Runway/Taxi condition	1.69
Traffic	1.43
Ops/Type Spec	1.36
MEL	1.12
Wake Vortex	0.95
D.G	0.78
Def-DBs	0.78
Def-Charts	0.78
Def-Ops data	0.48
Mis-AFS	0.48
Def Manuals	0.41
R/W Incursion	0.37
Birds	0.23
L..F.P	0.13
Def-Chk lists	0.12
Fatique	0.07
Physio	0.07
NAV	0.07
Pilot Incap	0.03
Loss of comms	0.03

2.13.9.3 Relative Risk Rank Chart

Relative Risk Ranking for Jet Generation 3



2.13.10 Takeoff Data

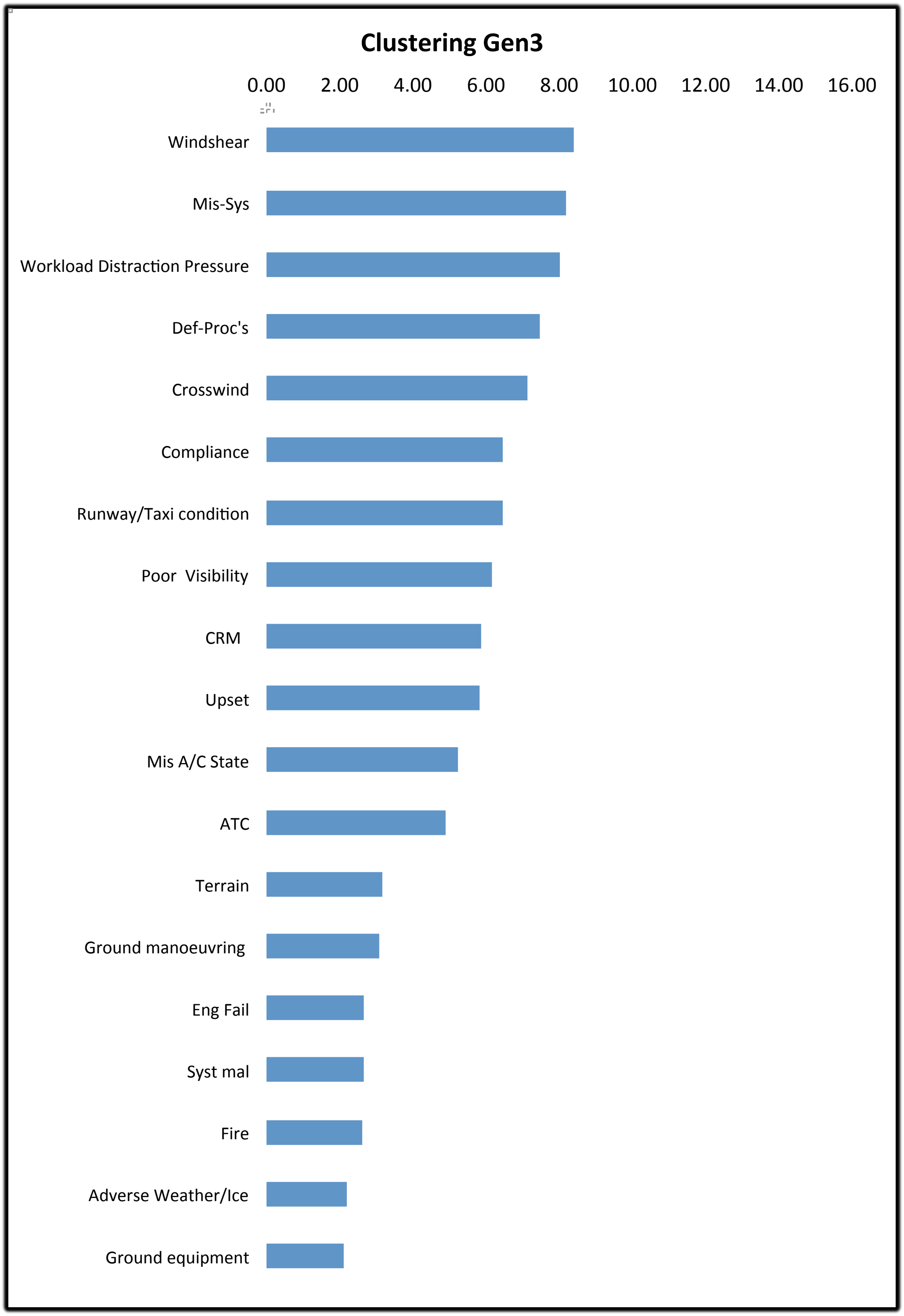
2.13.10.1 Takeoff Data Table

GLOBAL VALUES		1950	1960	1970	1980	1990	2000	2010	Before last 15Y	Last 15Y	Total/Gen
	Gen1	49279	3654782	6978479	2248452	567284	113441	1213	13361467	251463	13612930
	Gen2	0	7685689	55683176	81876860	57656778	20350718	571250	182355441	41469030	223824471
	Gen3	0	0	0	11881889	70034723	127321496	13391504	47286029	175343583	222629612
	Gen4	0	0	0	73214	9455296	50784434	9443295	3266023	66490216	69756239
		9528510					60227729				
	ALL GEN	49279	11340471	62661655	96080415	137714081	198570089	23407262	246268960	283554292	

Grand total	529823252

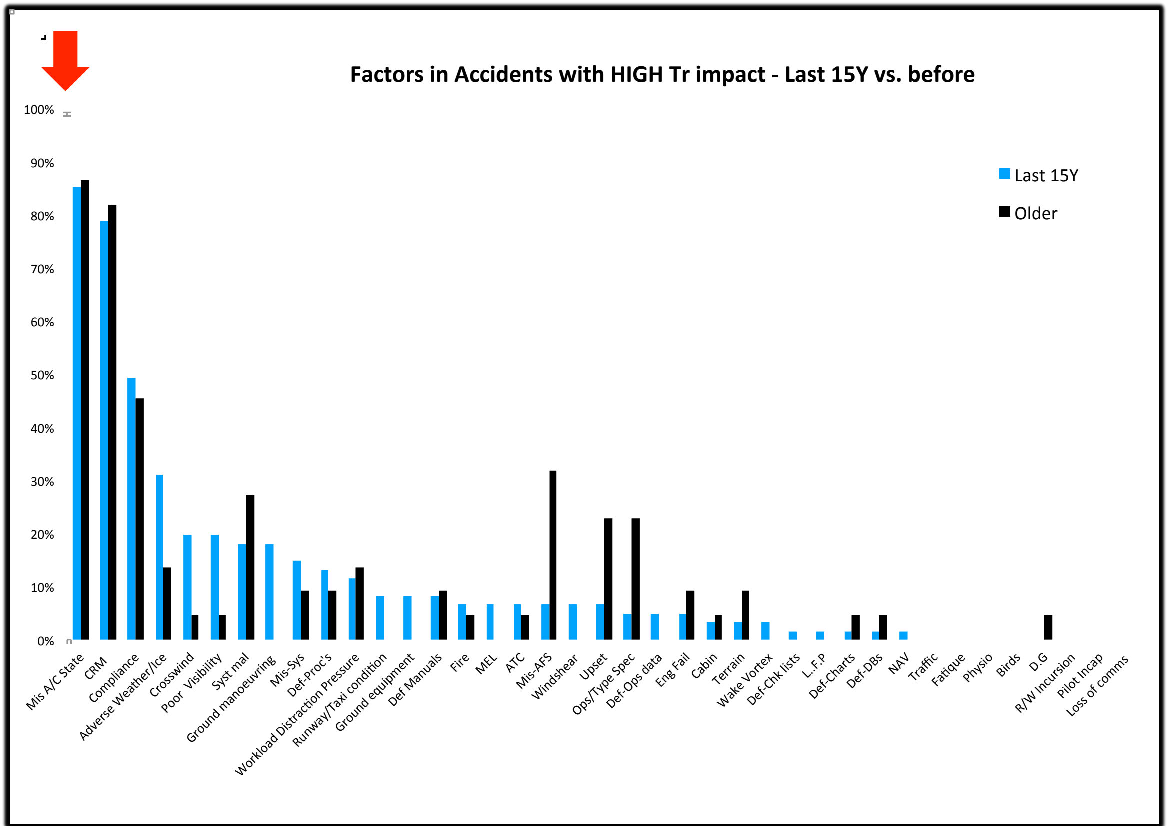
2.13.11 Clustering of Factors

2.13.11.1 Clustering of Factors Graph (Generation 3)



2.13.12 High Training Impact

2.13.12.1 Comparison of Factors with a High Training Impact in All Accidents during Current versus Previous Time Period (Generation 3)



2.13.13 Global Priority Ranking for Factors Jet Generation 3

2.13.13.1 Priority Table

Priority table of factors for Jet Generation 3

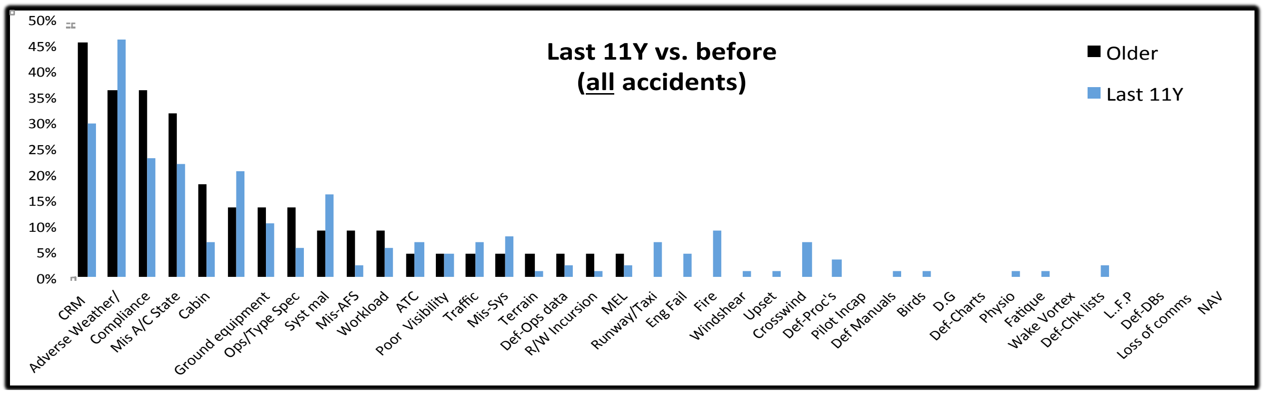
Level	Factors	Rank	Tr
A	CRM	7	A
	Mis A/C State	7	A
	Compliance	7	C
B	Poor Visibility	6	A
	Crosswind	5	A
	Mis-Sys	5	B
	Adverse Weather/Ice	5	C
	Workload Distraction Pressure	5	C
	Syst mal	4	A
	Windshear	4	B
C	Runway/Taxi condition	3	C
	ATC	3	C
	Fire	2	A
	Terrain	2	C
	Upset	2	C
	Eng Fail	1	A

2.14 GENERATION 4 ANALYSIS

2.14.1 Global Accidents (Last 11 Years)

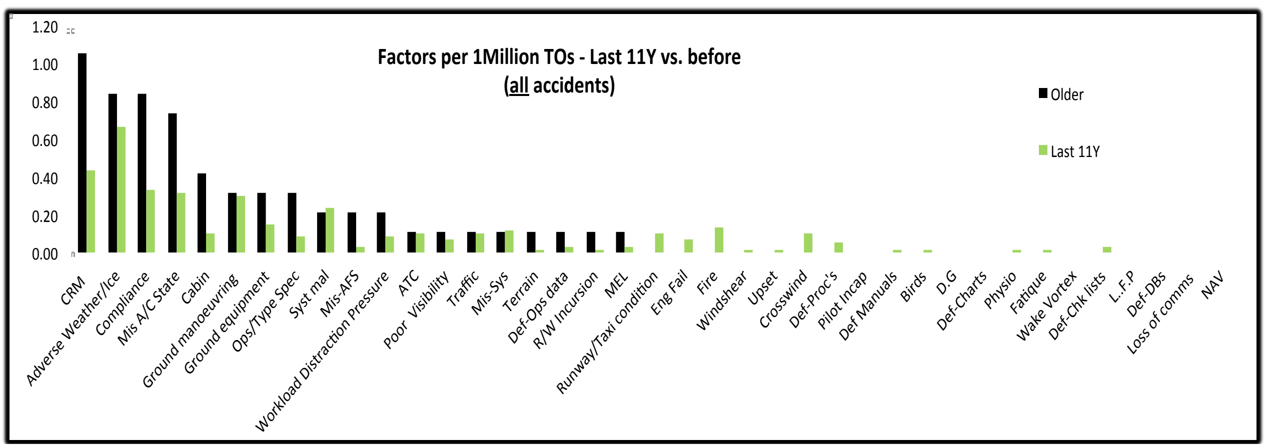
2.14.1.1 Ranking of Factors for All Accidents (Generation 4)

Ranking of factors based on how present they are in accidents (as a percentage of all Gen4 accidents – last 11 years in blue, earlier times in black)



2.14.1.2 Ranking of Factors for All Accidents Per One Million Takeoffs (Generation 4)

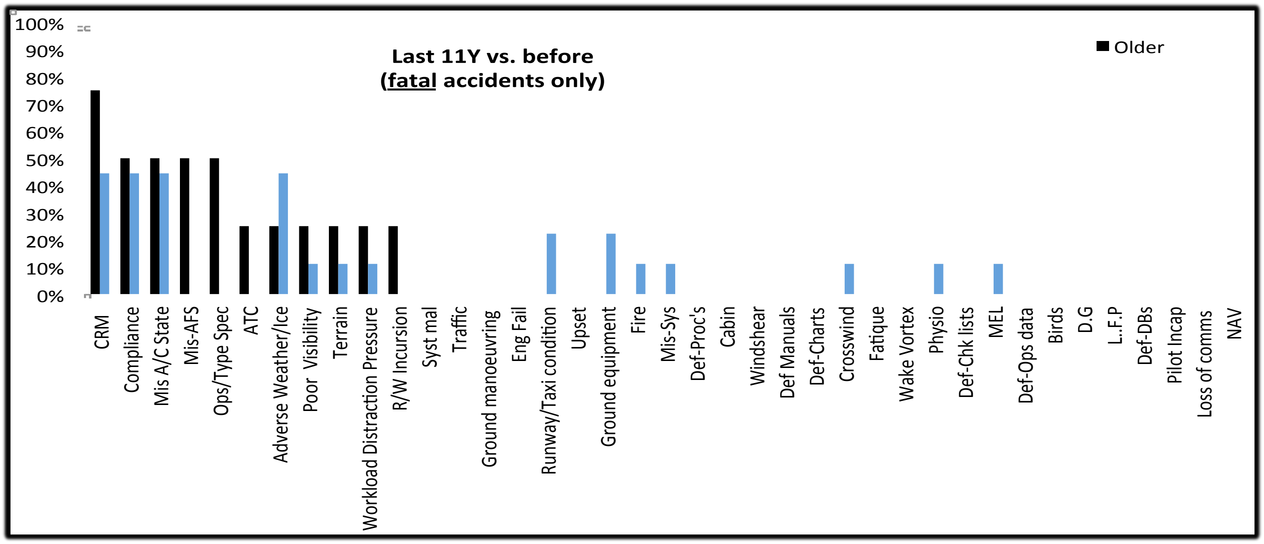
Comparison of ranking of factors normalized by the number of takeoffs for all accidents during current versus previous time period (Generation 3)



2.14.2 Global Fatal Accidents (Last 11 Years)

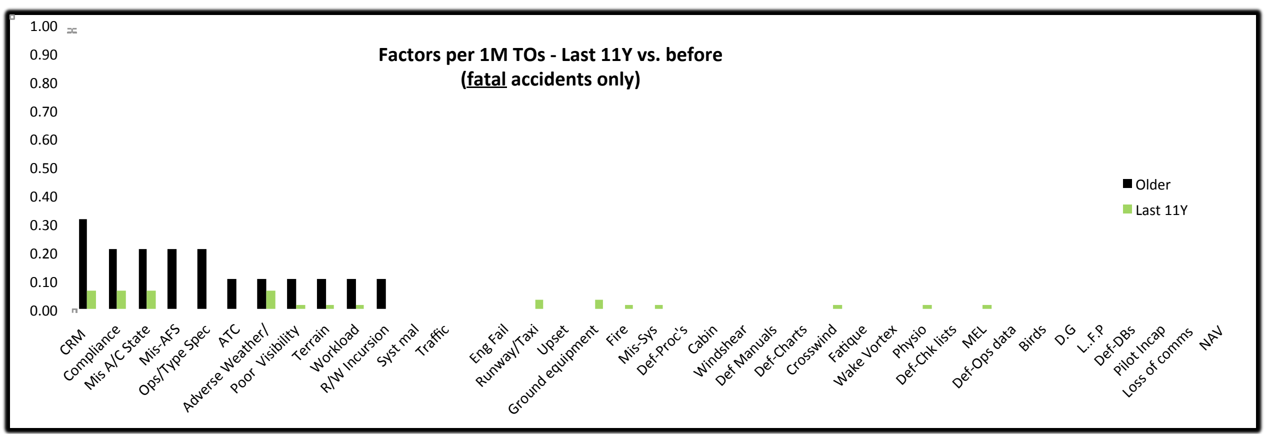
2.14.2.1 Ranking of Factors for Fatal Accidents

Comparison of the ranking of factors as a percentage of fatal accidents, L11Y vs. older (Generation 4)



2.14.2.2 Ranking of Factors for All Fatal Accidents per One Million Takeoffs (Generation 4)

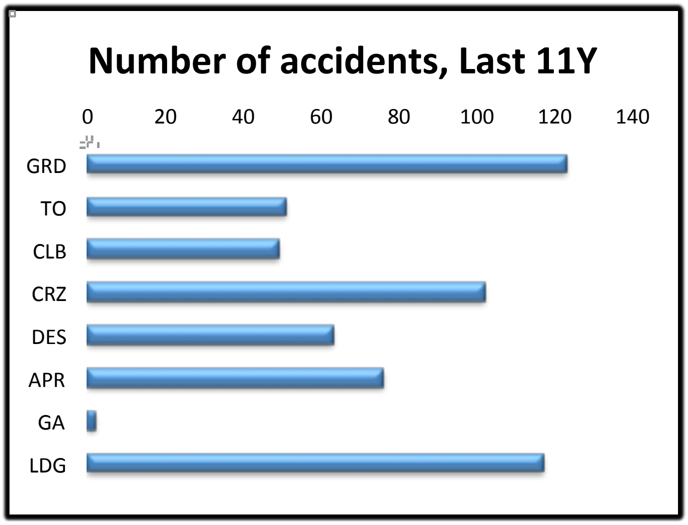
Comparison of the ranking of factors (normalized by the number of takeoffs) for fatal accidents only during current versus previous time period (Generation 4)



2.14.3 Distribution of Factors in Flight Phases

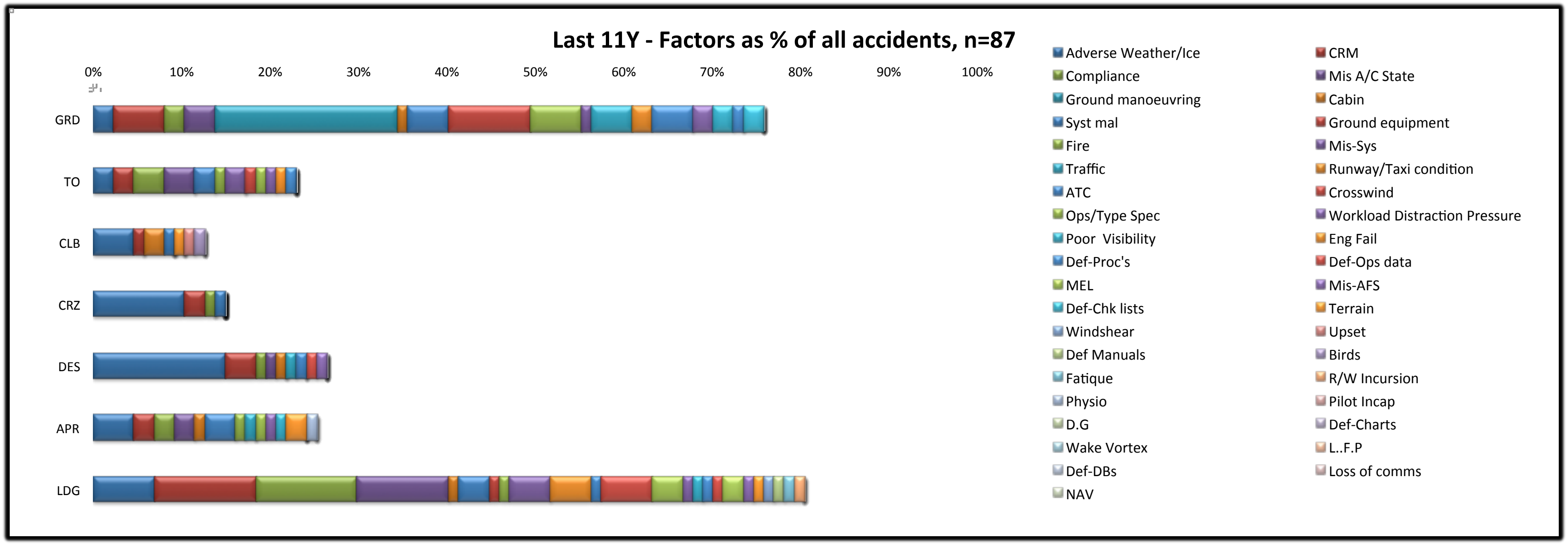
2.14.3.1 Distributions by Flight Phase

Number of accidents per Flight Phase (Generation 4)



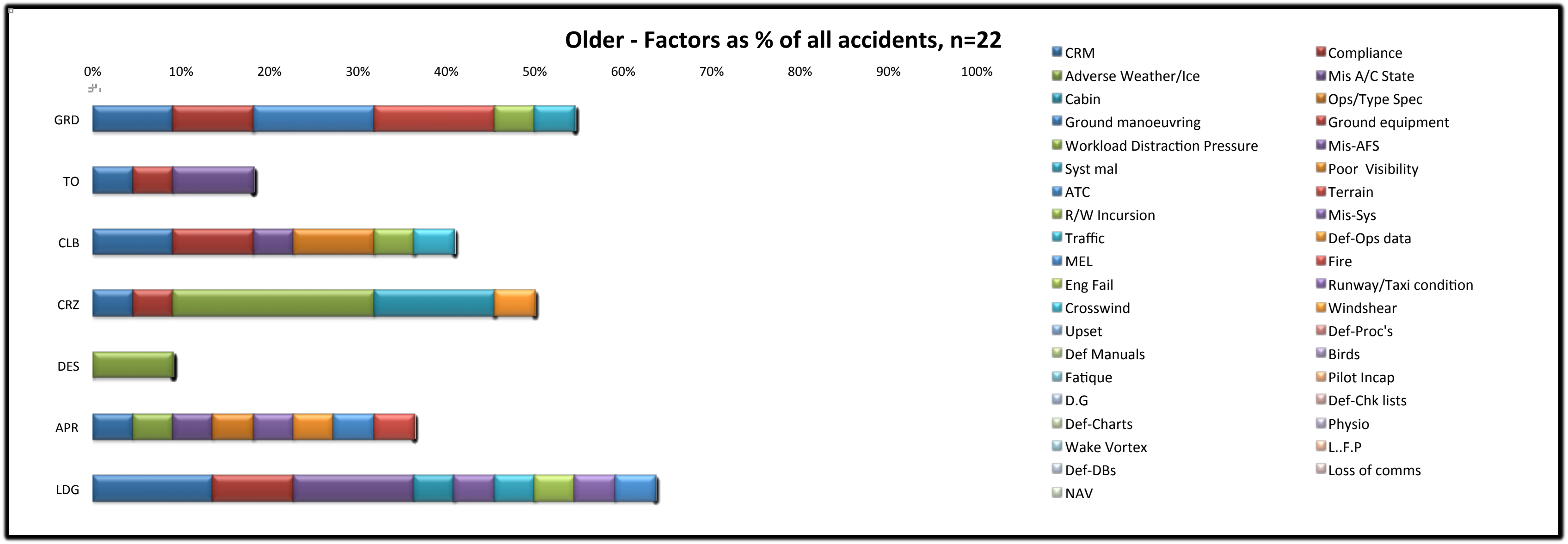
2.14.3.2 Distribution of Specific Factors by Flight Phase (Last 11 Years)

Distribution of all accidents with a specific factor by Flight Phase (Generation 4)



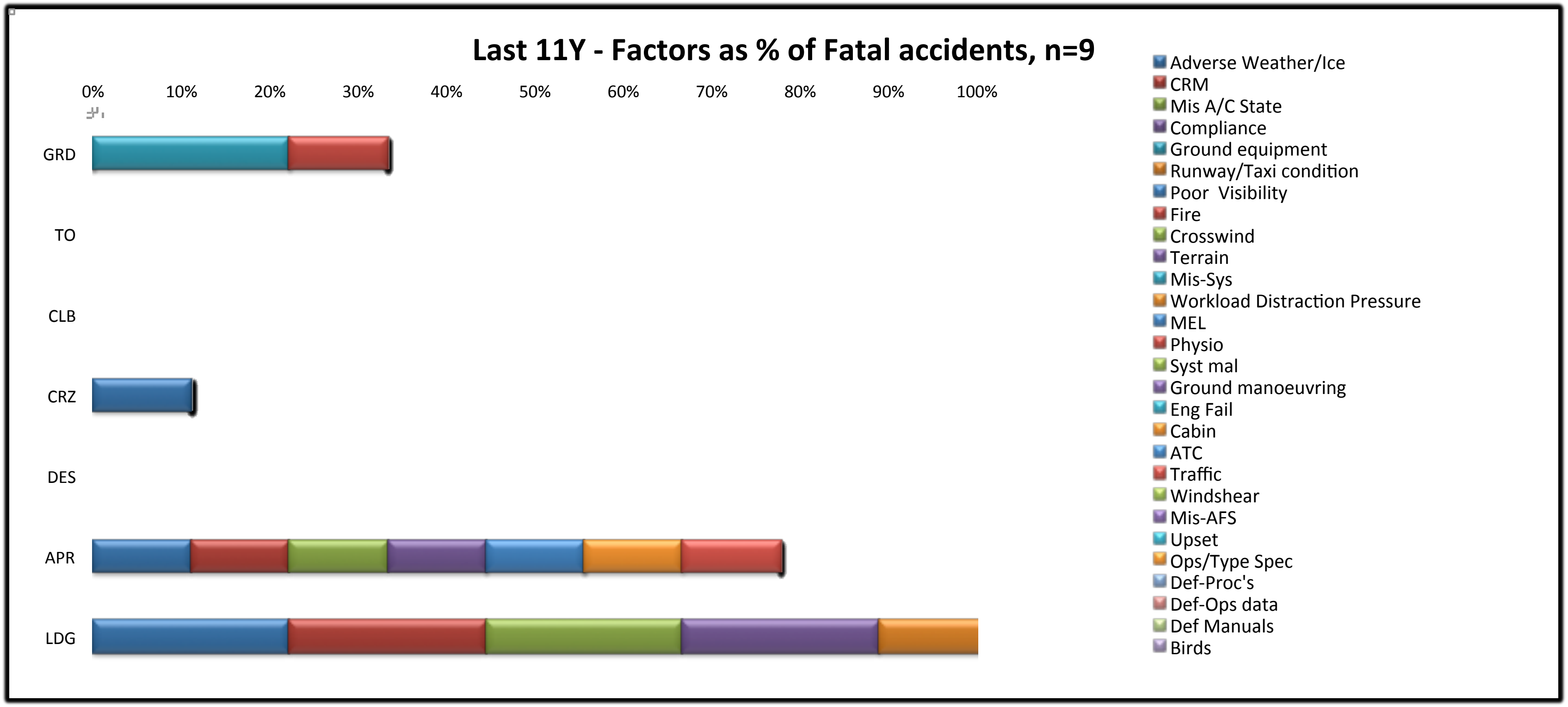
2.14.3.3 Distribution of Specific Factors by Flight Phase (Older)

Distribution of accidents with a specific factor by Flight Phase during previous time period (Generation 4)



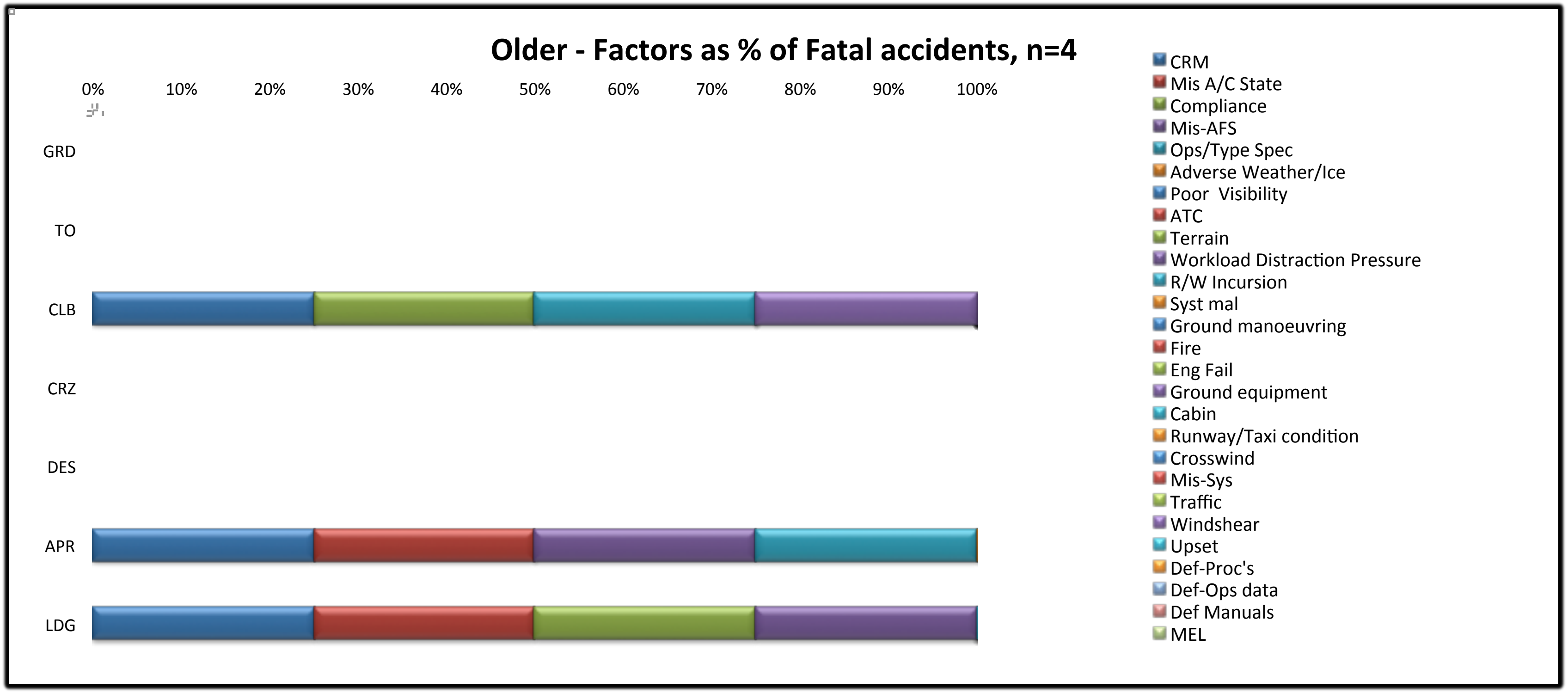
2.14.3.4 Distribution of Specific Factors by Flight Phase (Last 11 Years, Fatal Accidents Only)

Distribution of accidents with a specific factor by Flight Phase in current time period (Generation 4)



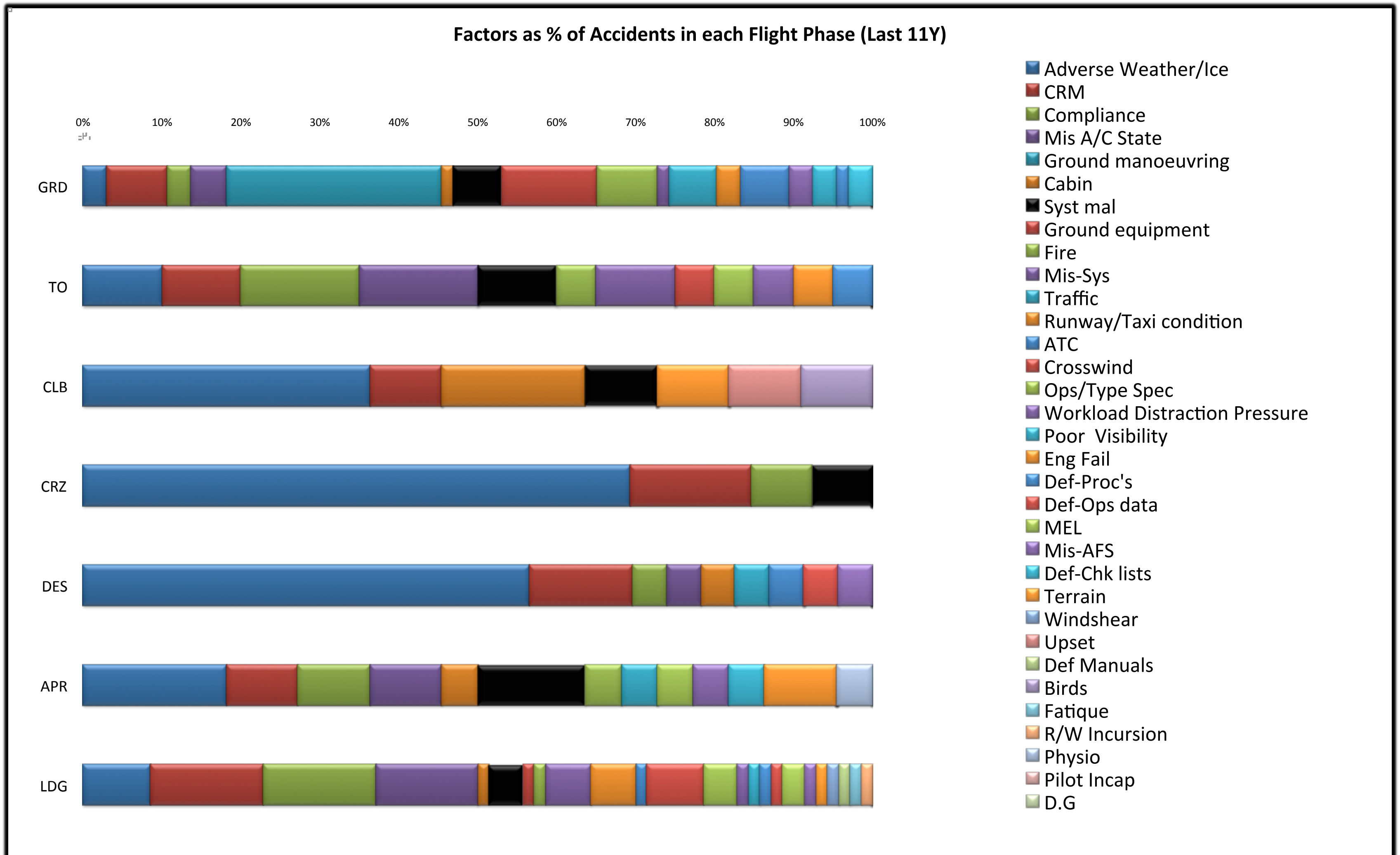
2.14.3.5 Distribution of Specific Factors by Flight Phase (Older, Fatal Accidents Only)

Distribution of accidents with a specific factor by Flight Phase



2.14.3.6 Proportional Distributions of Specific Factors by Flight Phase

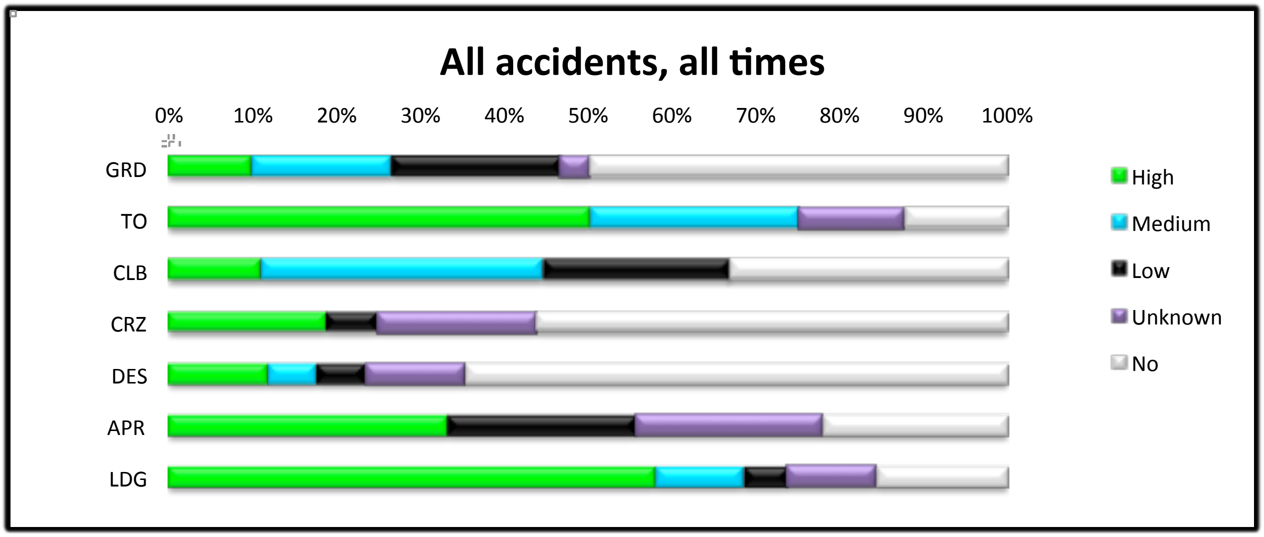
Proportional distribution of factors by Flight Phase (Generation 4)



2.14.4 Trainability

2.14.4.1 Training Effect

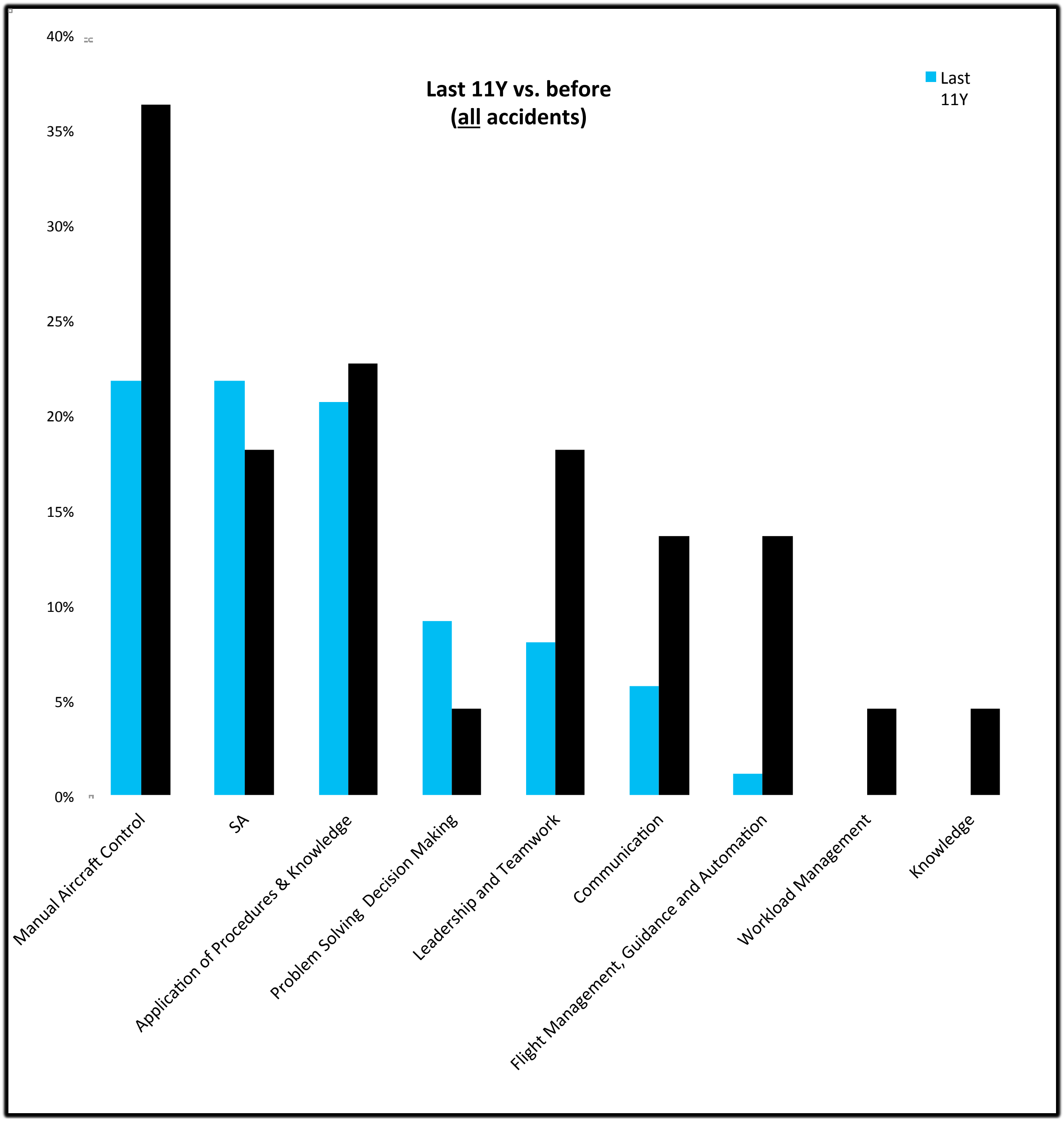
Training Effect by Flight Phase, all accidents, L11 Years (Generation 4)



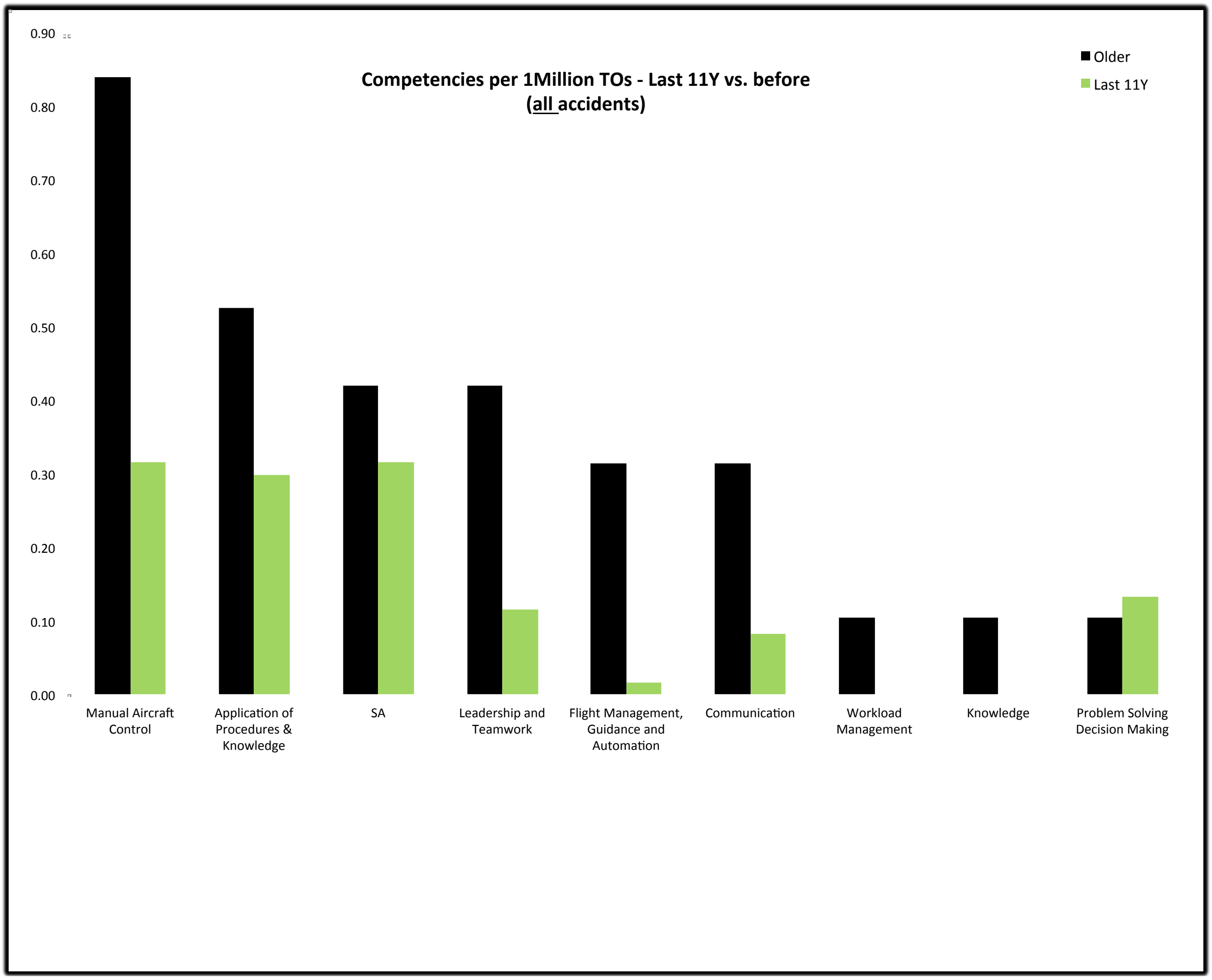
2.14.5 Competencies in Accidents

2.14.5.1 Distributions of Deficient Competencies in Accidents

Comparison of deficient competencies in accidents during current versus previous time period (Generation 4)



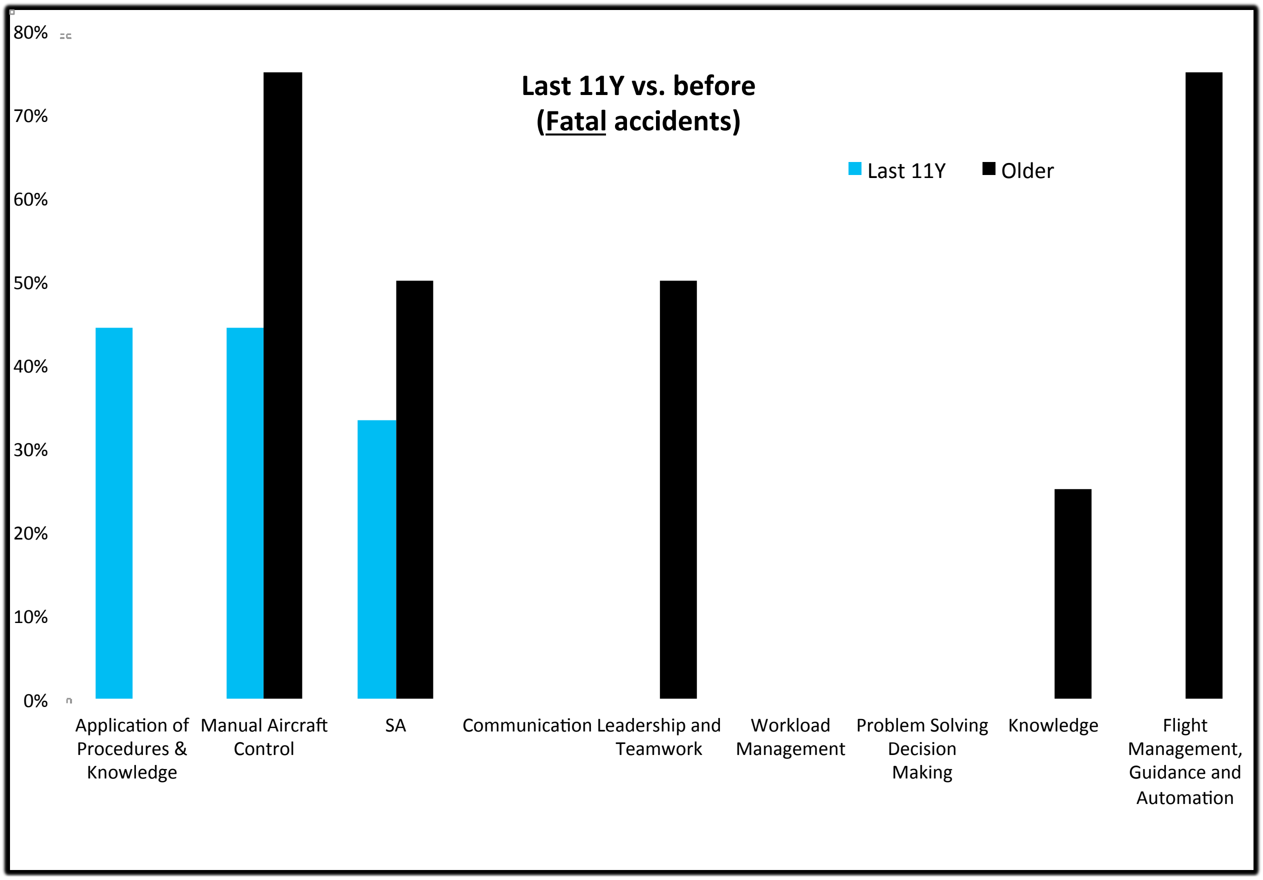
2.14.5.2 Comparison of the Distributions of Deficient Competencies in Accidents (Per One Million Takeoffs) During Current versus Previous Time Period (Generation 4)



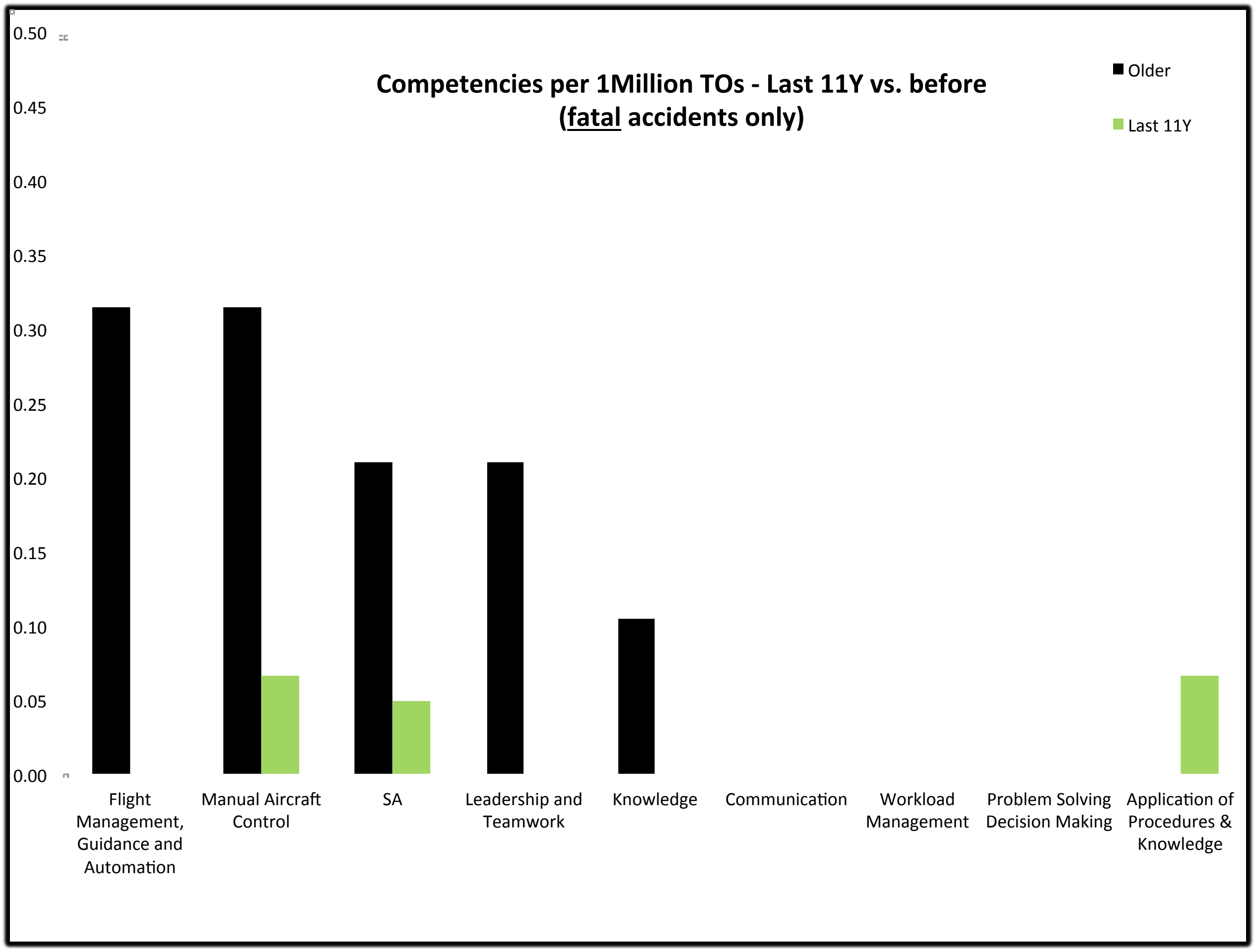
2.14.6 Competencies in Fatal Accidents

2.14.6.1 Distributions of Deficient Competencies in Fatal Accidents

Comparison of deficient competencies in fatal accidents during current versus previous time period (Generation 4)



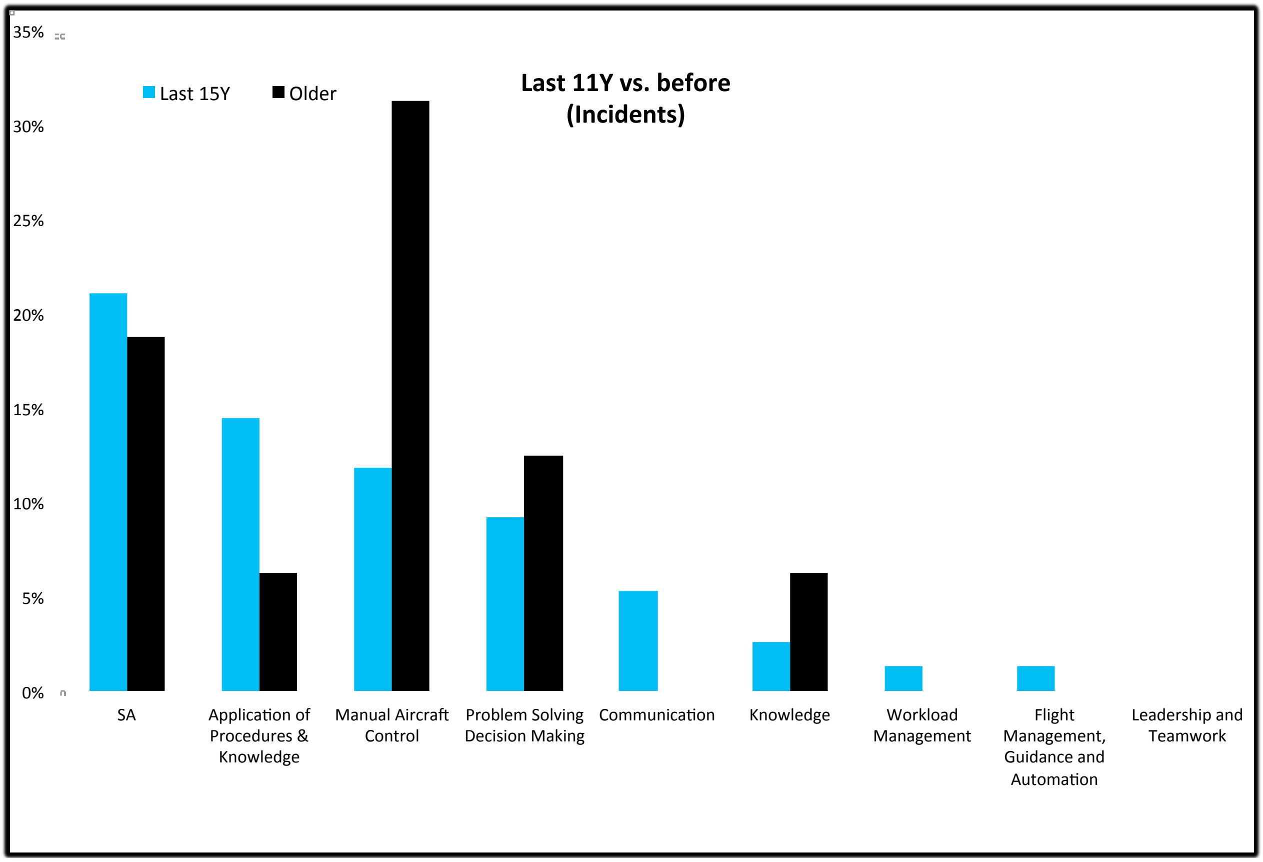
2.14.6.2 Comparison of the Distributions of Deficient Competencies in Fatal Accidents (Per One Million Takeoffs) during Current versus Previous Time Period (Generation 4)



2.14.7 Competencies in Incidents

2.14.7.1 Distributions of Deficient Competencies in Incidents

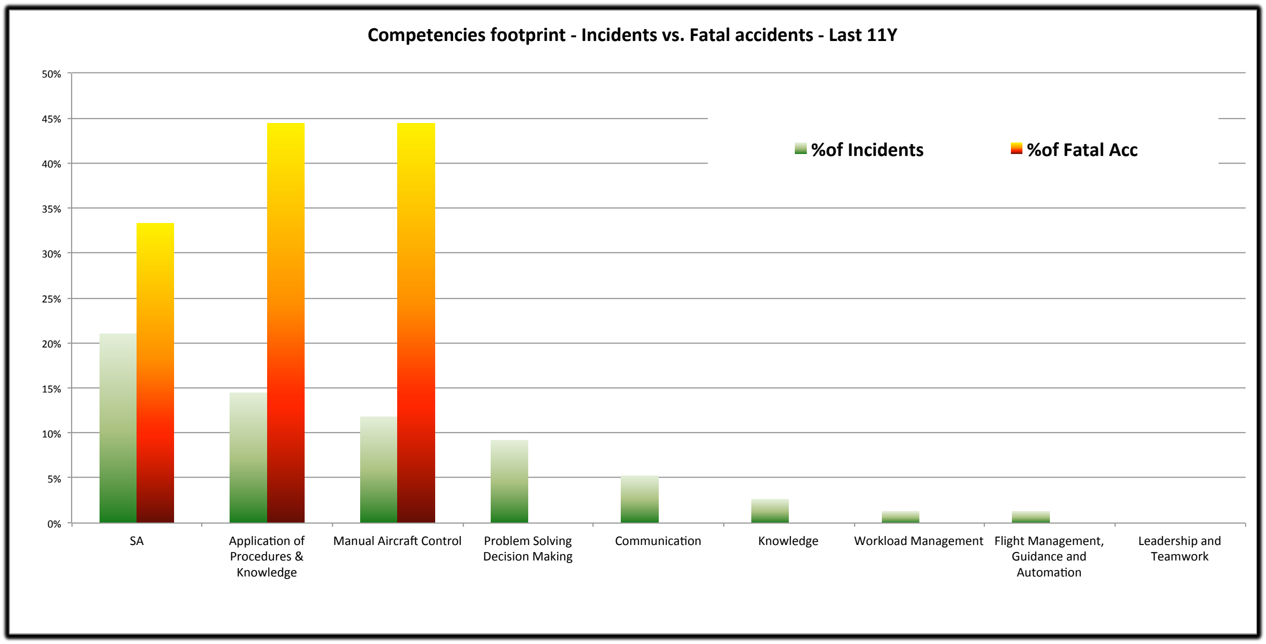
Deficient competencies in incidents (Generation 4)



2.14.8 Competency Footprint

2.14.8.1 Distributions of Deficient Competencies in Incidents and Fatal Accidents

Deficient competencies in Incidents vs. Fatal Accidents (Generation 4)



2.14.9 Relative Risk Rank

2.14.9.1 Relative Risk Rank Table (Generation 4)

	Frequency						Freq*Sev			Total risk
	% of events in the last 11Y			Frequency contribution (% * 5)			Separately at 3 Sev levels			
	% of recent fatal acc	% of recent acc	% of recent inc	F acc	Acc	Inc	F Acc (5)	Acc (3)	Inc (1)	
Adverse Weather/Ice	44%	46%	11%	2.22	2.30	0.53	11.11	6.90	0.53	18.53
CRM	44%	30%	24%	2.22	1.49	1.18	11.11	4.48	1.18	16.78
Compliance	44%	23%	11%	2.22	1.15	0.53	11.11	3.45	0.53	15.09
Mis A/C State	44%	22%	13%	2.22	1.09	0.66	11.11	3.28	0.66	15.04
Ground manoeuvring	0%	21%	12%	0.00	1.03	0.59	0.00	3.10	0.59	3.70
Syst mal	0%	16%	42%	0.00	0.80	2.11	0.00	2.41	2.11	4.52
Cabin	0%	7%	1%	0.00	0.34	0.07	0.00	1.03	0.07	1.10
Ground equipment	22%	10%	5%	1.11	0.52	0.26	5.56	1.55	0.26	7.37
Fire	11%	9%	9%	0.56	0.46	0.46	2.78	1.38	0.46	4.62
Mis-Sys	11%	8%	7%	0.56	0.40	0.33	2.78	1.21	0.33	4.31
Crosswind	11%	7%	3%	0.56	0.34	0.13	2.78	1.03	0.13	3.94
Runway/Taxi condition	22%	7%	7%	1.11	0.34	0.33	5.56	1.03	0.33	6.92
ATC	0%	7%	17%	0.00	0.34	0.86	0.00	1.03	0.86	1.89
Traffic	0%	7%	5%	0.00	0.34	0.26	0.00	1.03	0.26	1.30
Workload Distraction Pressure	11%	6%	9%	0.56	0.29	0.46	2.78	0.86	0.46	4.10
Ops/Type Spec	0%	6%	4%	0.00	0.29	0.20	0.00	0.86	0.20	1.06
Poor Visibility	11%	5%	3%	0.56	0.23	0.13	2.78	0.69	0.13	3.60
Eng Fail	0%	5%	28%	0.00	0.23	1.38	0.00	0.69	1.38	2.07

Relative Risk Rank Table (Continued)

	Frequency						Freq*Sev			Total risk
	% of events in the last 11Y			Frequency contribution (% * 5)			Separately at 3 Sev levels			
	% of recent fatal acc	% of recent	% of recent	F acc	Acc	Inc	F Acc (5)	Acc (3)	Inc (1)	
Def-Proc's	0%	3%	3%	0.00	0.17	0.13	0.00	0.52	0.13	0.65
Def-Ops data	0%	2%	3%	0.00	0.11	0.13	0.00	0.34	0.13	0.48
Mis-AFS	0%	2%	0%	0.00	0.11	0.00	0.00	0.34	0.00	0.34
MEL	11%	2%	1%	0.56	0.11	0.07	2.78	0.34	0.07	3.19
Def-Chk lists	0%	2%	0%	0.00	0.11	0.00	0.00	0.34	0.00	0.34
Terrain	11%	1%	1%	0.56	0.06	0.07	2.78	0.17	0.07	3.02
Windshear	0%	1%	1%	0.00	0.06	0.07	0.00	0.17	0.07	0.24
Def Manuals	0%	1%	0%	0.00	0.06	0.00	0.00	0.17	0.00	0.17
Upset	0%	1%	1%	0.00	0.06	0.07	0.00	0.17	0.07	0.24
Birds	0%	1%	3%	0.00	0.06	0.13	0.00	0.17	0.13	0.30
Fatique	0%	1%	0%	0.00	0.06	0.00	0.00	0.17	0.00	0.17
R/W Incursion	0%	1%	9%	0.00	0.06	0.46	0.00	0.17	0.46	0.63
Physio	11%	1%	1%	0.56	0.06	0.07	2.78	0.17	0.07	3.02
L..F.P	0%	0%	1%	0.00	0.00	0.07	0.00	0.00	0.07	0.07
Wake Vortex	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D.G	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Def-DBs	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Def-Charts	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NAV	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pilot Incap	0%	0%	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Loss of comms	0%	0%	4%	0.00	0.00	0.20	0.00	0.00	0.20	0.20
Communication	0%	6%	5%	0.00	0.29	0.26	0.00	0.86	0.26	1.13
SA	33%	22%	21%	1.67	1.09	1.05	8.33	3.28	1.05	12.66
Leadership and Teamwork	0%	8%	0%	0.00	0.40	0.00	0.00	1.21	0.00	1.21
Workload Management	0%	0%	1%	0.00	0.00	0.07	0.00	0.00	0.07	0.07
Problem Solving Decision Making	0%	9%	9%	0.00	0.46	0.46	0.00	1.38	0.46	1.84
Knowledge	0%	0%	3%	0.00	0.00	0.13	0.00	0.00	0.13	0.13
Application of Procedures & Knowledge	44%	21%	14%	2.22	1.03	0.72	11.11	3.10	0.72	14.94
Flight Management, Guidance and Automation	0%	1%	1%	0.00	0.06	0.07	0.00	0.17	0.07	0.24
Manual Aircraft Control	44%	22%	12%	2.22	1.09	0.59	11.11	3.28	0.59	14.98

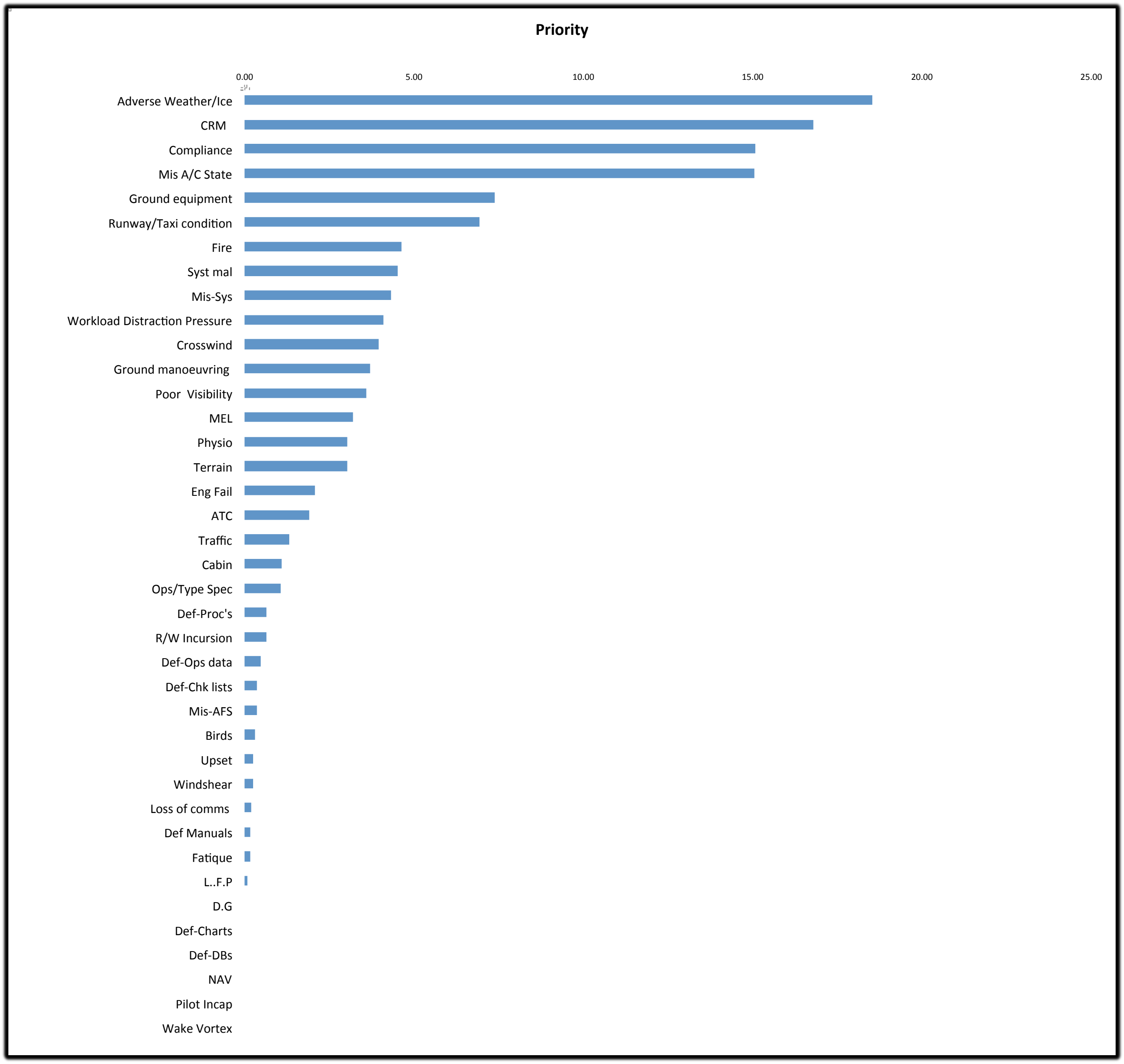
2.14.9.2 Relative Risk Rank Priority

Relative Risk Ranking Priority for Jet Generation 4

Factor	Priority
Adverse Weather/Ice	18.53
CRM	16.78
Compliance	15.09
Mis A/C State	15.04
Ground equipment	7.37
Runway/Taxi condition	6.92
Fire	4.62
Syst mal	4.52
Mis-Sys	4.31
Workload Distraction Pressure	4.10
Crosswind	3.94
Ground manoeuvring	3.70
Poor Visibility	3.60
MEL	3.19
Physio	3.02
Terrain	3.02
Eng Fail	2.07
ATC	1.89
Traffic	1.30
Cabin	1.10
Ops/Type Spec	1.06
Def-Proc's	0.65
R/W Incursion	0.63
Def-Ops data	0.48
Def-Chk lists	0.34
Mis-AFS	0.34
Birds	0.30
Upset	0.24
Windshear	0.24
Loss of comms	0.20
Def Manuals	0.17
Fatique	0.17
L..F.P	0.07
D.G	0.00
Def-Charts	0.00
Def-DBs	0.00
NAV	0.00
Pilot Incap	0.00
Wake Vortex	0.00

2.14.9.3 Relative Risk Rank Chart

Relative Risk Ranking for Jet Generation 4



2.14.10 Takeoff Data

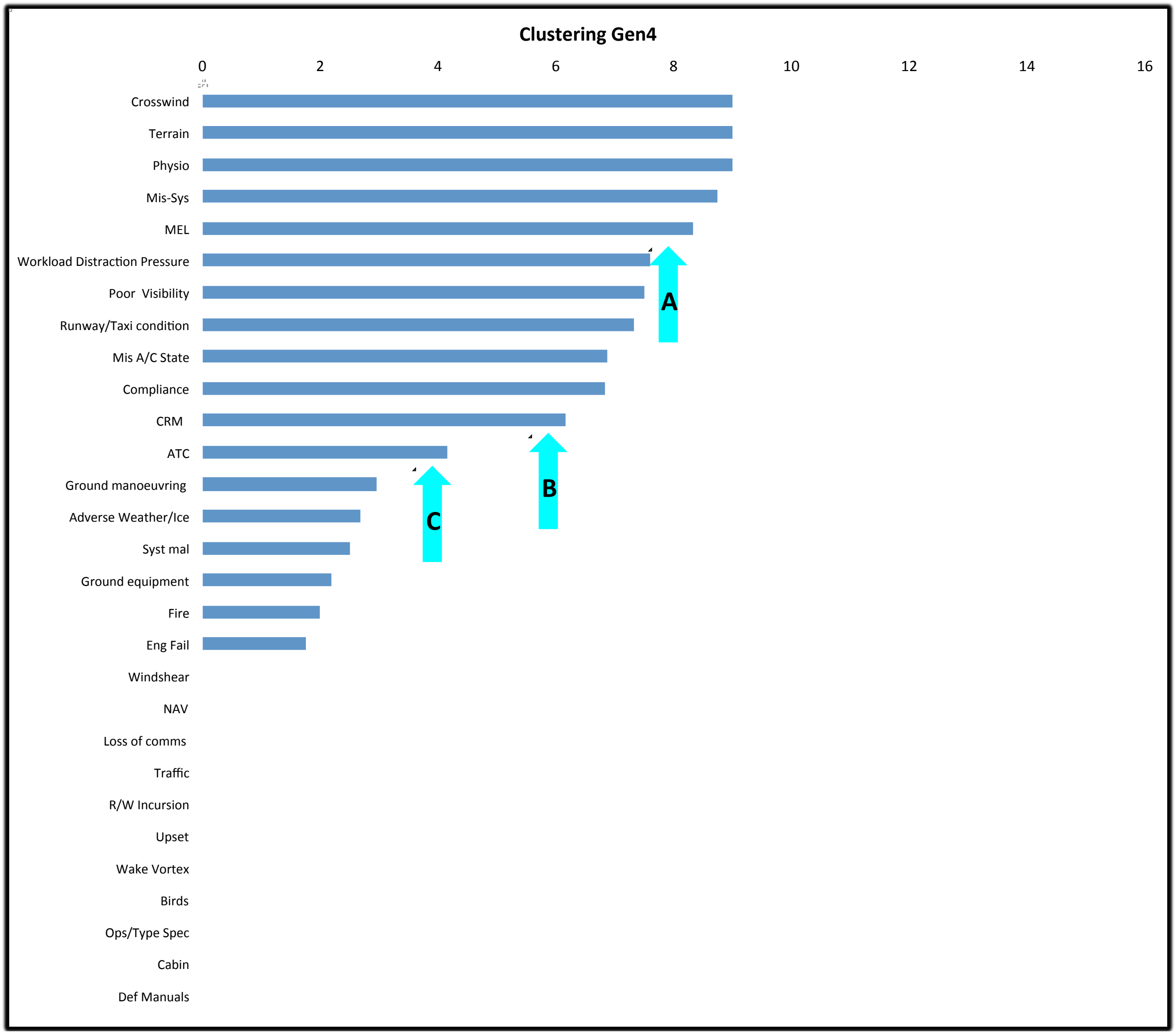
2.14.10.1 Takeoff Data Table

7 GLOBAL VALUES		1950	1960	1970	1980	1990	2000	2010	Before last 11Y	Last 11Y	Total/Gen
	Gen1	0	0	0	0	0	0	0	0	0	0
	Gen2	0	7685689	55683176	81876860	57656778	20350718	571250	182355441	41469030	223824471
	Gen3	0	0	0	11881889	70034723	127321496	13391504	47286029	175343583	222629612
	Gen4	0	0	0	73214	9455296	50784434	9443295	3266023	66490216	69756239
		9528510					60227729				
	ALL GEN	0	7685689	55683176	93831963	137146797	198456648	23406049	232907493	283302829	

Grand total	516210322

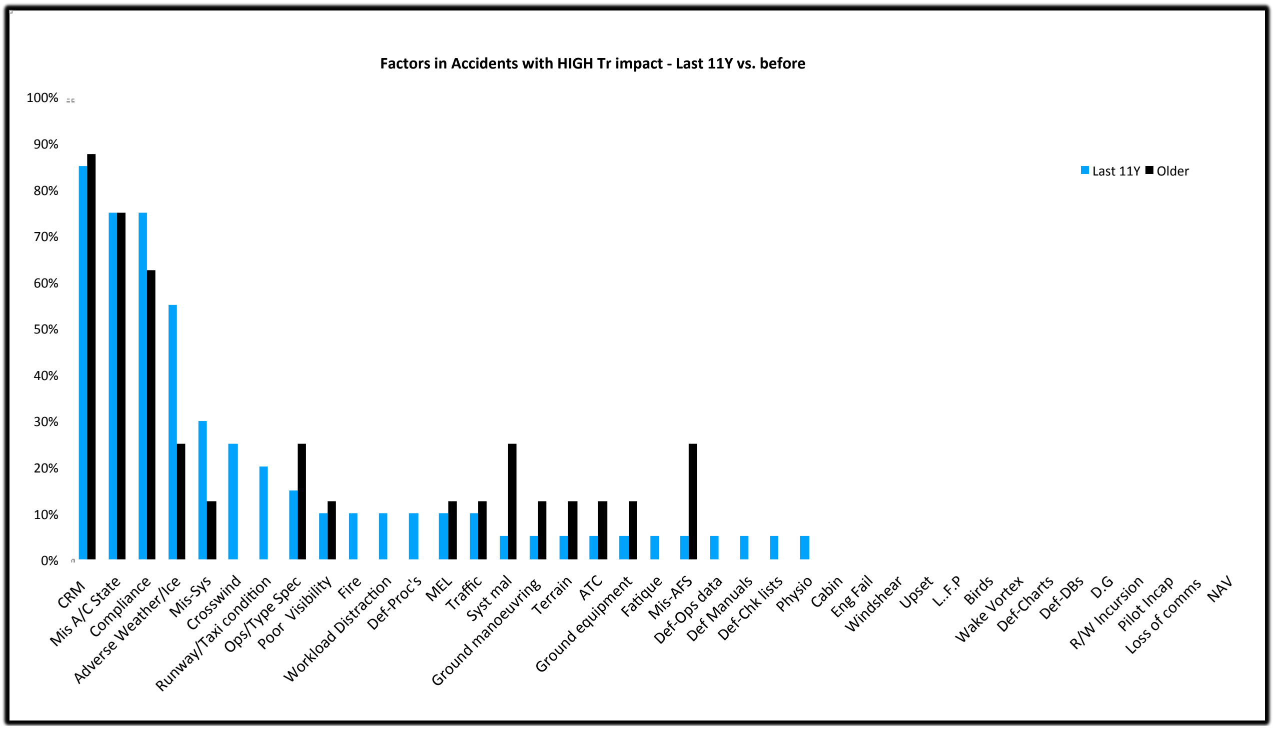
2.14.11 Clustering

2.14.11.1 Clustering of Factors Graph



2.14.12 High Training Impact

2.14.12.1 Comparison of Factors with a High Training Impact During Current Versus Previous Time Period (Generation 4)



2.14.13 Global Priority Ranking for Factors Jet Generation 4

2.14.13.1 Priority Table

Priority table of factors for Jet Generation 4

Level	Updated Gen4 ranking (acc study)	Rank	Tr
A	CRM	8	A
	Mis A/C State	8	A
	Compliance	8	C
B	Crosswind	6	A
	Mis-Sys	6	B
	Runway/Taxi condition	6	C
	Adverse Weather/Ice	5	C
	Poor Visibility	4	A
	MEL	4	B
	Workload Distraction Pressure	4	C
	Terrain	4	C
C	Fire	2	A
	Syst mal	2	A
	ATC	2	C
	Eng Fail	1	A

APPENDIX 3
EVIDENCE-BASED TRAINING MATRIX

INTRODUCTION

This appendix contains the EBT accident-incident matrix stage 1. These are the data that formed the basis for the factor analysis. In addition the exact guidance to the analysts is provided in section 3.2.

3.1 EVIDENCE-BASED TRAINING ACCIDENT-INCIDENT MATRIX

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
11/03/2010	N	http://www.ntsb.g	DES	4	NA	A319				1																	
10/01/2010	N	http://www.ntsb.g	LDG	4	NA	A319																				1	
05/04/2010	I	http://www.ntsb.g	TO	4	NA	A320																				1	
15/06/2010	I	http://www.ntsb.g	TO	4	NA	A330																	1		1	1	
05/06/2010	N	http://www.ntsb.g	GRD	4	NA	A330		1																			
12/05/2010	F	http://www.ntsb.g	LDG	4	AFR	A330																					
13/04/2010	I	http://www.ntsb.g	APR	4	ASIA	A330																	1			1	
03/04/2010	N	http://www.ntsb.g	CRZ	4	NA	EMB-170				1																	
14/11/2009	I	http://www.ntsb.g	CLB	4	NA	A319																1	1			1	
17/09/2009	I	http://www.ntsb.g	CLB	4	EUR	A319																1	1			1	
05/11/2009	I	http://www.ntsb.g	CRZ	4	NA	A320							1		1												
21/10/2009	I	http://www.ntsb.g	CRZ	4	NA	A320									1												
05/08/2009	I	http://www.ntsb.g	GRD	4	EUR	A320		1																	1	1	
10/07/2009	N	http://www.ntsb.g	DES	4	NA	A320				1																	
18/06/2009	I	http://www.ntsb.g	GRD	4	NA	A320	1																				
04/05/2009	N	http://www.ntsb.g	LDG	4	NA	A320				1		1															1
15/01/2009	N	http://www.ntsb.g	CLB	4	NA	A320																1	1				
28/10/2009	I	http://www.ntsb.g	CRZ	4	AUS	A330																				1	
23/06/2009	I	http://www.ntsb.g	CRZ	4	ASIA	A330																				1	
01/06/2009	F	http://www.ntsb.g	CRZ	4	EUR	A330				1																	
21/05/2009	I	http://www.ntsb.g	CRZ	4	NA	A330																				1	
18/11/2009	N	http://www.ntsb.g	CRZ	4	NA	B777				1																	
05/03/2009	N	http://www.ntsb.g	CRZ	4	ASIA	B777				1																	
06/01/2009	I	http://www.ntsb.g	CLB	4	ASIA	B777																	1		1		
27/07/2009	N	http://www.ntsb.g	CLB	4	NA	EMB-170				1																	
11/07/2009	N	http://www.ntsb.g	APR	4	NA	EMB-170				1																	
23/07/2008	I	http://www.ntsb.g	CLB	4	NA	A319																				1	

	Factors (Non-Technical)																	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatigue	CRM	Physio	Workload Distraction Pressure	D.G	L.F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
11/03/2010																		
10/01/2010	1																	
05/04/2010																		
15/06/2010																		
05/06/2010																		
12/05/2010																		
13/04/2010																		
03/04/2010																		
14/11/2009																		
17/09/2009																		
05/11/2009										1								
21/10/2009										1								
05/08/2009																		
10/07/2009																		
18/06/2009																		
04/05/2009		1								1					1	1		
15/01/2009																		
28/10/2009																		
23/06/2009																		
01/06/2009																		
21/05/2009																		
18/11/2009																		
05/03/2009																		
06/01/2009																		
27/07/2009																		
11/07/2009																		
23/07/2008		1										1					1	

	Competencies										Validation		
Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker	YEAR (nb)
11/03/2010										N	JPB	JE	2010
10/01/2010										N	JPB	JE	2010
05/04/2010										N	IG	JE	2010
15/06/2010										N	MN	DS	2010
05/06/2010		1					1			M	MN	DS	2010
12/05/2010										N	MN	DS	2010
13/04/2010										N	MN	DS	2010
03/04/2010										L	MS	ML	2010
14/11/2009										N	JPB	JE	2009
17/09/2009										N	JPB	JE	2009
05/11/2009		1					1			H	IG	JE	2009
21/10/2009		1					1			M	IG	JE	2009
05/08/2009										L	IG	JE	2009
10/07/2009										N	IG	JE	2009
18/06/2009										N	IG	JE	2009
04/05/2009							1	1	1	H	IG	JE	2009
15/01/2009										M	IG	JE	2009
28/10/2009										N	MN	DS	2009
23/06/2009										N	MN	DS	2009
01/06/2009										N	MN	DS	2009
21/05/2009										N	MN	DS	2009
18/11/2009										U	SF	IG	2009
05/03/2009										U	SF	IG	2009
06/01/2009										N	SF	IG	2009
27/07/2009										L	MS	ML	2009
11/07/2009										L	MS	ML	2009
23/07/2008		1					1			M	JPB	JE	2008

Figure A3.1

Evidence-Based Training Accident-Incident Matrix Continued

Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker	YEAR (nb)
17/02/2008	N	http://www.ntsb.g	GRD	4	NA	A319		1								1																																							N	JPB	JE	2008
10/01/2008	N	http://www.ntsb.g	CLB	4	NA	A319													1									1																											L	JPB	JE	2008
09/01/2008	N	http://www.ntsb.g	LDG	4	NA	A319																				1			1										1											1		1			M	JPB	JE	2008
27/11/2008	F	http://www.ntsb.g	APR	4	EUR	A320																																																	U	IG	JE	2008
20/10/2008	N	http://www.ntsb.g	LDG	4	NA	A320																							1								1						1				1					1		1	H	IG	JE	2008
30/05/2008	F	http://aviation-	LDG	4	SA	A320			1	1		1																	1								1						1				1					1		1	H	IG	JE	2008
15/04/2008	I	http://www.ntsb.g	CRZ	4	NA	A320				1																																													L	IG	JE	2008
25/02/2008	I	http://www.ntsb.g	LDG	4	NA	A320			1																	1																													L	IG	JE	2008
25/01/2008	I	http://www.ntsb.g	TO	4	NA	A320									1											1																													M	IG	JE	2008
04/05/2008	I	http://aviation-	LDG	4	ASIA	A321																																					1											1	H	DS	JE	2008
30/03/2008	I	http://www.ntsb.g	CLB	4	ASIA	A321																	1																																N	DS	JE	2008
08/01/2008	I	http://aviation-	LDG	4	EUR	A321																							1								1	1	1				1							1		1		1	H	DS	JE	2008
07/10/2008	N	http://www.ntsb.g	CRZ	4	AUS	A330																				1																													N	MN	DS	2008
02/07/2008	I	http://www.ntsb.g	GRD	4	NA	A330										1	1																																						N	MN	DS	2008
26/11/2008	I	http://www.ntsb.g	CRZ	4	NA	B777																	1				1																												N	SF	IG	2008
16/08/2008	N	http://www.ntsb.g	GRD	4	NA	B777	1	1																																															N	SF	IG	2008
02/07/2008	I	http://www.ntsb.g	DES	4	EUR	B777				1																																													U	SF	IG	2008
29/03/2008	I	http://www.ntsb.g	CRZ	4	EUR	B777																	1																																N	SF	IG	2008
25/02/2008	I	http://www.ntsb.g	GRD	4	NA	B777	1	1																													1										1			1					H	SF	IG	2008
17/01/2008	N	http://www.ntsb.g	APR	4	EUR	B777				1													1			1	1																												L	SF	IG	2008
26/12/2008	N	http://www.ntsb.g	DES	4	NA	EMB-170				1																																													U	MS	ML	2008
17/02/2008	N	http://www.ntsb.g	GRD	4	NA	EMB-170		1																													1						1				1							1	L	MS	ML	2008
22/04/2007	N	http://www.ntsb.g	TO	4	NA	A319																				1			1																							1			M	JPB	JE	2007
16/02/2007	N	http://www.ntsb.g	CLB	4	NA	A319				1																1																													N	JPB	JE	2007
05/01/2007	I	http://www.ntsb.g	LDG	4	NA	A319	1	1	1	1			1			1	1	1											1																	1	1								M	JPB	JE	2007
17/12/2007	I	http://www.ntsb.g	CRZ	4	SA	A320																	1			1																													L	IG	JE	2007
02/12/2007	I	http://www.ntsb.g	LDG	4	NA	A320							1																																										N	IG	JE	2007
26/10/2007	I	http://aviation-	LDG	4	ASIA	A320																																					1											1	M	IG	JE	2007
20/10/2007	I	http://www.ntsb.g	LDG	4	NA	A320																				1											1										1								L	IG	JE	2007
09/10/2007	I	http://www.ntsb.g	LDG	4	NA	A320																				1																													N	IG	JE	2007
16/08/2007	I	http://www.ntsb.g	GRD	4	NA	A320							1																								1															1			N	IG	JE	2007
17/07/2007	F	http://www.ntsb.g	LDG	4	SA	A320			1	1											1			1					1								1						1	1								1		1	H	IG	JE	2007
11/07/2007	I	http://www.ntsb.g	GRD	4	NA	A320											1												1								1										1								M	IG	JE	2007
10/02/2007	I	http://www.ntsb.g	CLB	4	NA	A320																			1			1																											N	IG	JE	2007
25/12/2007	N	http://www.ntsb.g	CRZ	4	NA	A330				1																																													N	MN	DS	2007
04/10/2007	I	http://www.ntsb.g	CLB	4	EUR	A330																	1			1																													N	MN	DS	2007
23/07/2007	I	http://www.ntsb.g	CRZ	4	ASIA	A330																	1			1																													N	MN	DS	2007
14/12/2007	N	http://www.ntsb.g	APR	4	NA	B777																	1			1		1																											U	SF	IG	2007
12/07/2007	N	http://www.ntsb.g	GRD	4	NA	B777		1																																															N	SF	IG	2007
27/06/2007	N	http://www.ntsb.g	GRD	4	NA	B777		1		1								1																			1										1								L	SF	IG	2007
13/05/2007	I	http://www.ntsb.g	TO	4	ASIA	B777																				1																													N	SF	IG	2007
11/03/2007	N	http://www.ntsb.g	TO	4	SA	B777																	1		1																														U	SF	IG	2007
26/02/2007	N	http://www.ntsb.g	GRD	4	EUR	B777																			1	1																													N	SF	IG	2007
23/02/2007	N	http://www.ntsb.g	CRZ	4	NA	B777				1																																													N	SF	IG	2007

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies									Validation		
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
26/05/2007	I	http://www.ntsb.g	TO	4	NA	EMB-170							1				1																																							N	MS	ML
27/03/2007	N	http://www.ntsb.g	DES	4	AFR	EMB-170				1																																	1														L	MS	ML
18/02/2007	N	http://www.ntsb.g	LDG	4	NA	EMB-170			1	1								1											1		1					1	1						1									1		1	H	MS	ML
14/12/2007	N	http://www.ntsb.g	GRD	4	NA	EMB-190		1	1																																														U	MS	ML
23/10/2006	I	http://www.ntsb.g	LDG	4	NA	A319																					1												1					1			1				1				H	JPB	JE
08/09/2006	N	http://www.ntsb.g	GRD	4	NA	A319		1					1			1																					1		1				1				1	1							1	M	JPB	JE
07/07/2006	N	http://www.ntsb.g	DES	4	NA	A319				1																																													N	JPB	JE
21/03/2006	I	http://www.ntsb.g	GRD	4	NA	A319							1			1	1																						1								1		1						N	JPB	JE
29/01/2006	N	http://www.ntsb.g	TO	4	NA	A319																																					1				1								1	H	JPB	JE
07/11/2006	I	http://www.ntsb.g	GRD	4	NA	A320		1					1																								1										1								M	IG	JE
02/08/2006	I	http://www.ntsb.g	CLB	4	ASIA	A320																	1																																N	IG	JE
24/07/2006	I	http://www.ntsb.g	CLB	4	ASIA	A320																	1																																N	IG	JE
05/05/2006	N	http://aviation-	GRD	4	EUR	A320	1																		1																														N	IG	JE
05/05/2006	N	http://aviation-	GRD	4	EUR	A320	1																		1																														N	IG	JE
05/05/2006	N	http://aviation-	GRD	4	EUR	A320	1																		1																														N	IG	JE
03/05/2006	F	http://aviation-	APR	4	ASIA	A320				1								1											1								1	1	1				1				1						1		1	H	IG	JE
23/03/2006	I	http://www.ntsb.g	GRD	4	NA	A320							1				1																																						N	IG	JE
05/03/2006	I	http://www.ntsb.g	LDG	4	EUR	A320																			1	1																													N	IG	JE
25/04/2006	N	http://www.ntsb.g	DES	4	NA	B777				1																					1																								U	SF	IG
19/04/2006	N	http://www.ntsb.g	DES	4	ASIA	B777										1																																							N	SF	IG
19/01/2006	I	http://www.ntsb.g	GRD	4	NA	B777	1																																																U	SF	
08/09/2006	N	http://www.ntsb.g	GRD	4	NA	EMB-170		1					1																																										N	MS	ML
30/05/2006	N	http://www.ntsb.g	GRD	4	NA	EMB-170																				1							1																						N	MS	ML
10/10/2005	N	http://www.ntsb.g	GRD	4	NA	A319	1	1	1	1								1											1										1							1	1								M	JPB	JE
10/06/2005	N	http://www.ntsb.g	DES	4	NA	A319				1																		1	1																										N	JPB	JE
10/05/2005	N	http://www.ntsb.g	GRD	4	NA	A319		1								1										1			1				1		1									1				1			1					H	JPB	JE
21/09/2005	I	http://aviation-	LDG	4	NA	A320																				1																													L	IG	JE
03/08/2005	I	http://www.ntsb.g	GRD	4	NA	A320		1																													1						1				1							1	M	IG	JE
18/09/2005	N	http://www.ntsb.g	LDG	4	NA	A321						1															1		1								1						1	1				1				1		1	H	DS	JE
29/08/2005	N	http://www.ntsb.g	GRD	4	NA	A330		1																													1										1								M	MN	DS
09/06/2005	I	http://www.ntsb.g	TO	4	NA	A330							1			1	1																																						N	MN	DS
06/11/2005	N	http://www.ntsb.g	GRD	4	EUR	A340		1																																							1					1			L	MN	JE
02/08/2005	N	http://www.ntsb.g	LDG	4	NA	A340			1	1		1													1				1								1						1							1		1		1	H	MN	JE
06/11/2005	N	http://www.ntsb.g	GRD	4	EUR	B777		1																																														N	SF	IG
02/08/2005	I	http://www.ntsb.g	CLB	4	AUS	B777													1							1	1																												U	SF	IG
23/06/2005	I	http://www.ntsb.g	CRZ	4	ASIA	B777																	1																																N	SF	IG
03/02/2005	N	http://www.ntsb.g	TO	4	NA	B777				1		1																	1						1		1						1	1			1						1		1	H	SF	IG
03/10/2005	N	http://www.ntsb.g	APR	4	NA	EMB-170										1													1								1						1									1		1	H	MS	ML
07/06/2005	F	http://www.ntsb.g	GRD	4	NA	EMB-170	1																																															N	MS	ML
17/07/2004	N	http://www.ntsb.g	DES	4	NA	A319				1																											1									1		1							H	JPB	JE
30/06/2004	N	http://www.ntsb.g	GRD	4	NA	A319		1								1																															1			1					L	JPB	JE
18/10/2004	I	http://aviation-	LDG	4	ASIA	A320				1	1													1					1								1		1				1	1		1						1		1	H	IG	JE
13/07/2004	I	http://www.ntsb.g	TO	4	NA	A320																							1																						1			H	IG	JE
05/03/2004	I	http://www.ntsb.g	GRD	4	NA	A320		1																					1								1						1			1	1							1	M	IG	JE

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies									Validation		
05/03/2004	I	http://www.ntsb.g	GRD	4	NA	A320		1																						1									1						1			1	1							1	M	IG	JE
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L.F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
22/01/2004	N	http://www.ntsb.g	APR	4	EUR	A320																			1	1																														N	IG	JE
07/06/2004	I	http://www.ntsb.g	GRD	4	NA	A340																																				1															U	MN	JE
11/08/2004	I	http://www.ntsb.g	TO	4	NA	B777																	1		1	1																														N	SF	IG
16/10/2003	N	http://www.ntsb.g	GRD	4	NA	A319		1																		1		1																												L	JPB	JE
02/06/2003	N	http://www.ntsb.g	APR	4	NA	A319				1																																														N	JPB	JE
05/04/2003	N	http://www.ntsb.g	CLB	4	NA	A319				1																																														N	JPB	JE
29/11/2003	I	http://www.ntsb.g	CLB	4	EUR	A320																				1																														N	IG	JE
06/11/2003	I	http://aviation-	LDG	4	SA	A320				1		1																															1												1	M	IG	JE
05/06/2003	N	http://www.ntsb.g	CLB	4	NA	A320				1																										1									1		1							M	IG	JE
26/05/2003	I	http://aviation-	CRZ	4	EUR	A321				1																1									1		1														1					L	JE	MS
21/03/2003	N	http://aviation-	LDG	4	ASIA	A321	1						1				1																				1									1	1								L	JE	MS
05/10/2003	I	http://www.ntsb.g	CLB	4	NA	A330																	1			1																														N	MN	DS
09/08/2003	I	http://www.ntsb.g	CRZ	4	EUR	A330																	1			1																														N	MN	DS
18/08/2003	I	http://www.ntsb.g	TO	4	NA	A340																				1																														U	MN	JE
06/08/2003	N	http://www.ntsb.g	CRZ	4	NA	A340				1																			1								1													1		1			H	MN	JE
07/10/2003	N	http://www.ntsb.g	GRD	4	NA	B777		1					1																																										N	SF	IG
07/10/2003	N	http://www.ntsb.g	GRD	4	NA	B777		1					1																								1						1				1								1	L	SF	IG
28/09/2003	I	http://www.ntsb.g	CRZ	4	ASIA	B777																			1																															N	SF	IG
17/07/2003	N	http://www.ntsb.g	DES	4	NA	B777				1																											1										1								N	SF	IG
25/02/2003	N	http://www.ntsb.g	DES	4	NA	B777				1																																														M	SF	IG
21/11/2002	N	http://www.ntsb.g	LDG	4	NA	A319																				1																														N	JPB	JE
15/04/2002	N	http://www.ntsb.g	DES	4	NA	A319				1																																														N	JPB	JE
28/11/2002	N	http://www.ntsb.g	CLB	4	NA	A320																						1																												N	IG	JE
28/08/2002	N	http://www.ntsb.g	LDG	4	NA	A320																		1						1	1								1							1	1		1		1							1	H	IG	JE
06/07/2002	I	http://www.ntsb.g	TO	4	EUR	A320																	1																																N	IG	JE
17/12/2002	I	http://www.ntsb.g	APR	4	ASIA	A330							1					1			1																1						1				1					1	1		H	MN	DS
25/01/2002	I	http://www.ntsb.g	GRD	4	NA	A340		1	1																										1		1		1								1					1			M	MN	JE
02/11/2001	I	http://www.ntsb.g	CRZ	4	NA	A319																				1																			1						1					M	JPB	JE
20/08/2001	N	http://www.ntsb.g	CRZ	4	NA	A320				1																																														N	IG	JE
15/06/2001	N	http://www.ntsb.g	DES	4	NA	A320							1																								1						1					1		1					1	H	IG	JE
19/04/2001	N	http://www.ntsb.g	CRZ	4	NA	A320				1																											1											1		1					H	IG	JE
20/03/2001	I	http://aviation-	TO	4	EUR	A320				1																1																														N	IG	JE
17/03/2001	N	http://www.ntsb.g	TO	4	NA	A320				1																	1		1									1		1					1	1			1					1		1	H	IG	JE
07/02/2001	N	http://aviation-	LDG	4	EUR	A320				1	1	1															1		1						1		1							1	1						1		1		1	M	IG	JE
21/01/2001	I	http://www.ntsb.g	LDG	4	NA	A320			1	1		1	1																1		1						1							1							1		1		1	M	IG	JE
24/08/2001	I	http://www.ntsb.g	CRZ	4	EUR	A330																	1			1											1							1						1	1	1			H	MN	DS
25/07/2001	I	http://www.ntsb.g	CLB	4	EUR	A330																	1			1																														N	MN	DS
05/09/2001	F	http://www.ntsb.g	GRD	4	NA	B777	1																		1																															H	SF	IG
07/08/2001	I	http://www.ntsb.g	GRD	4	EUR	B777		1																																															U	SF	IG
06/06/2001	I	http://www.ntsb.g	CRZ	4	ASIA	B777																				1																														N	SF	IG
30/01/2001	I	http://aviation-	TO	4	AUS	B777																	1																																N	SF	IG
23/08/2000	F	http://www.ntsb.g	GA	4	ASIA	A320																							1								1						1				1					1		1	H	IG	JE
12/06/2000	N	http://www.ntsb.g	TO	4	NA	A320																				1																														N	IG	JE
11/04/2000	N	http://aviation-	GRD	4	NA	A320	1																																																N	IG	JE

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
13/12/2000	I	http://www.ntsb.g	GRD	4	NA	A340		1	1				1														
26/09/2000	N	http://www.ntsb.g	DES	4	NA	B777				1																	
22/08/2000	N	http://www.ntsb.g	DES	4	NA	B777				1																	
25/04/2000	I	http://www.ntsb.g	TO	4	NA	B777							1														
30/09/1999	N	http://www.ntsb.g	CRZ	4	NA	A319				1																	
26/10/1999	I	http://aviation-	LDG	4	ASIA	A320				1	1																
15/10/1999	N	http://www.ntsb.g	GRD	4	NA	A320	1																				
16/09/1999	N	http://www.ntsb.g	DES	4	NA	A320				1																	
16/02/1999	I	http://www.ntsb.g	LDG	4	NA	A320																				1	
12/02/1999	I	http://aviation-	DES	4	EUR	A320							1			1											
01/02/1999	N	http://www.ntsb.g	CRZ	4	NA	A320				1																	
13/12/1999	N	http://www.ntsb.g	DES	4	EUR	B777				1																	
06/11/1999	N	http://www.ntsb.g	CRZ	4	NA	B777				1																	
05/11/1999	N	http://www.ntsb.g	TO	4	EUR	B777																					
28/08/1998	I	http://www.ntsb.g	TO	4	ASIA	A319																	1			1	
08/08/1998	N	http://www.ntsb.g	GRD	4	NA	A320	1	1																		1	
21/05/1998	I	http://aviation-	LDG	4	EUR	A320																				1	
12/05/1998	N	http://www.ntsb.g	GRD	4	AFR	A320		1																			
22/03/1998	N	http://aviation-	LDG	4	ASIA	A320																		1		1	
16/02/1998	I	http://www.ntsb.g	CRZ	4	NA	A320																				1	
05/12/1998	N	http://www.ntsb.g	CRZ	4	ASIA	A330				1																	
11/11/1998	N	http://www.ntsb.g	CRZ	4	SA	B777																					
07/04/1997	N	http://www.ntsb.g	CRZ	4	NA	A320				1																	
10/03/1997	N	http://aviation-	TO	4	ASIA	A320																					
19/12/1996	I	http://aviation-	LDG	4	NA	A320			1	1								1									
24/11/1996	I	http://www.ntsb.g	LDG	4	NA	A320						1															
14/06/1996	I	http://www.ntsb.g	CLB	4	NA	A320																				1	
18/03/1996	I	http://www.ntsb.g	CRZ	4	NA	A320																				1	
18/09/1996	I	http://www.ntsb.g	CLB	4	NA	A340				1																	
21/06/1996	N	http://www.ntsb.g	CLB	4	NA	A340										1											1
03/06/1995	N	http://www.ntsb.g	GRD	4	NA	A320	1	1																			
28/04/1995	I	http://www.ntsb.g	CRZ	4	NA	A320																				1	1
27/04/1995	I	http://www.ntsb.g	APR	4	NA	A320				1																	1
22/10/1993	I	http://aviation-	CLB	4	EUR	A320																					
14/09/1993	I	http://aviation-	LDG	4	EUR	A320				1	1																1
26/08/1993	I	http://aviation-	TO	4	EUR	A320																				1	
20/01/1992	F	http://www.ntsb.g	APR	4	EUR	A320				1			1					1			1						1
20/09/1991	N	http://www.ntsb.g	LDG	4	NA	A320																					
10/08/1990	N	http://www.ntsb.g	LDG	4	NA	A320																					
14/02/1990	F	http://aviation-	LDG	4	ASIA	A320																					
05/12/1989	F	http://aviation-	LDG	4	EUR	A320											1										
26/06/1988	F	http://aviation-	CLB	4	EUR	A320																					1
16/01/2010	I	http://www.ntsb.gov	TO	3	EUR	A306																	1		1	1	
13/02/2010	N	http://www.ntsb.gov	DES	3	NA	B737G3							1			1											

	Factors (Non-Technical)																	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L.F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
13/12/2000										1		1				1		
26/09/2000																		
22/08/2000																		
25/04/2000				1						1								
30/09/1999	1																	
26/10/1999																1		
15/10/1999																		
16/09/1999																		
16/02/1999																		
12/02/1999																		
01/02/1999	1																	
13/12/1999																		
06/11/1999		1								1								
05/11/1999																1		
28/08/1998		1																
08/08/1998		1								1								
21/05/1998			1					1								1	1	
12/05/1998																		
22/03/1998		1								1						1	1	
16/02/1998																		
05/12/1998																		
11/11/1998																		
07/04/1997	1			1														
10/03/1997		1								1						1		
19/12/1996										1						1		
24/11/1996																		
14/06/1996																		
18/03/1996																		
18/09/1996	1																	
21/06/1996		1								1						1		
03/06/1995		1								1		1						
28/04/1995																		
27/04/1995			1					1		1						1		
22/10/1993		1								1		1					1	
14/09/1993		1								1						1	1	
26/08/1993																		
20/01/1992										1					1	1		
20/09/1991	1																	
10/08/1990										1						1		
14/02/1990		1								1					1	1		
05/12/1989																		
26/06/1988		1								1		1						
16/01/2010																1		
13/02/2010																1		

	Competencies										Validation	
Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
13/12/2000	1				1				1	H	MN	JE
26/09/2000										N	SF	IG
22/08/2000										N	SF	IG
25/04/2000		1								L	SF	IG
30/09/1999	1									N	JPB	JE
26/10/1999									1	M	IG	JE
15/10/1999										N	IG	JE
16/09/1999										N	IG	JE
16/02/1999										N	IG	JE
12/02/1999										L	IG	JE
01/02/1999										N	IG	JE
13/12/1999										N	SF	IG
06/11/1999		1	1							H	SF	IG
05/11/1999									1	H	SF	IG
28/08/1998										H	JPB	JE
08/08/1998	1						1			H	IG	JE
21/05/1998									1	M	IG	JE
12/05/1998										N	IG	JE
22/03/1998		1					1		1	H	IG	JE
16/02/1998										N	IG	JE
05/12/1998										N	MN	DS
11/11/1998										U	SF	IG
07/04/1997										N	IG	JE
10/03/1997					1		1		1	M	IG	JE
19/12/1996					1				1	H	IG	JE
24/11/1996										M	IG	JE
14/06/1996										M	IG	JE
18/03/1996										M	IG	JE
18/09/1996										N	MN	JE
21/06/1996			1				1		1	H	MN	JE
03/06/1995	1			1			1			M	IG	JE
28/04/1995										N	IG	JE
27/04/1995		1				1			1	H	IG	JE
22/10/1993		1					1			N	IG	JE
14/09/1993		1			1				1	H	IG	JE
26/08/1993										N	IG	JE
20/01/1992		1	1					1	1	H	IG	JE
20/09/1991										U	IG	JE
10/08/1990									1	H	IG	JE
14/02/1990		1	1					1	1	H	IG	JE
05/12/1989										U	IG	JE
26/06/1988						1		1	1	M	IG	JE
16/01/2010									1	L	EV	AAD
13/02/2010							1		1	M	DS	SD

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies									Validation		
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
25/01/2010	F	http://www.ntsb.go	TO	3	ME	B737G3															1																																		U	DS	SD
19/01/2010	I	http://www.ntsb.go	LDG	3	ASIA	B737G3		1																																			1											1	U	DS	SD
04/01/2010	I	http://www.ntsb.go	GRD	3	EUR	B737G3	1																		1	1																													N	DS	SD
03/01/2010	I	http://www.ntsb.go	TO	3	EUR	B737G3		1	1	1								1								1																	1											1	M	DS	SD
03/02/2010	I	http://www.ntsb.go	TO	3	ASIA	B747G3																	1		1	1																													N		
31/05/2010	I	http://www.ntsb.go	GRD	3	EUR	B747G3																				1																													U		
21/09/2010	I	http://www.ntsb.go	GRD	3	ASIA	B747G3																				1																													U		
21/01/2010	N	http://www.ntsb.go	LDG	3	EUR	B747G3	1						1					1																																					N		
10/10/2010	N	http://www.ntsb.go	APR	3	NA	B747G3																				1																													N		
08/04/2010	N	http://www.ntsb.go	GRD	3	EUR	B747G3																			1	1																													N		
10/10/2010	I	http://www.ntsb.go	CLB	3	ASIA	B747G3																	1			1																													N		
07/05/2010	I	http://www.ntsb.go	TO	3	AUS	B747G3																																					1											1	M		
11/06/2010	I	http://www.ntsb.go	CLB	3	ASIA	B747G3																	1			1																													N		
30/07/2010	I	http://www.ntsb.go	CLB	3	NA	B747G3																	1			1																													N		
04/03/2010	N	http://www.ntsb.go	TO	3	NA	B747G3																																					1											1	M		
5/16/2010	I	http://www.ntsb.go	CRZ	3	NA	B757																		1	1	1	1										1																		N		
6/12/2010	I	http://www.ntsb.go	CRZ	3	EUR	B757																				1																													N		
2/17/2010	I	http://www.ntsb.go	CLB	3	EUR	B757				1																1																													N		
10/26/2010	N	http://www.ntsb.go	CRZ	3	NA	B757																				1																													N		
8/30/2010	I	http://www.ntsb.go	CLB	3	ASIA	B757				1																1																													N		
6/16/2010	I	http://www.ntsb.go	GRD	3	EUR	B767																			1	1																													U	SF	DB
4/29/2010	N	http://www.ntsb.go	CRZ	3	NA	B767				1																											1									1				1					M		
4/13/2010	I	http://www.ntsb.go	CRZ	3	EUR	B767																			1	1		1																											U		
7/15/2010	N	http://www.ntsb.go	CRZ	3	ASIA	B767				1																																													U		
17/04/2010	N	http://www.ntsb.go	CRZ	3	NA	DC9-8x				1																																													U	ml	MS
28/06/2010	N	http://www.ntsb.go	CRZ	3	NA	EMB-145				1																																													L	MS	ML
16/06/2010	N	http://www.ntsb.go	LDG	3	NA	EMB-145			1																		1																1											1	U	MS	ML
12/03/2010	I	http://www.ntsb.go	APR	3	NA	EMB-145				1																1																													N	MS	ML
9/18/2010	I	http://www.ntsb.go	GRD	3	EUR	MD11							1				1																																						N		
7/27/2010	N	http://www.ntsb.go	LDG	3	AFR	MD11																					1																1											1	M		
3/23/2010	I	http://www.ntsb.go	CRZ	3	EUR	MD11																				1																													N		
29/06/2009	F	http://aviation-safe	APR	3	AFR	A310				1		1																															1											1	H	EV	AAD
22/12/2009	N	http://www.ntsb.go	LDG	3	SA	B737G3		1	1	1								1																																1		1		1	M	DS	SD
30/10/2009	I	http://www.ntsb.go	TO	3	ASIA	B737G3																				1																	1												N	DS	SD
19/10/2009	I	http://www.ntsb.go	LDG	3	AUS	B737G3		1																		1																													N	DS	SD
02/10/2009	I	http://www.ntsb.go	LDG	3	ASIA	B737G3		1																		1																													N	DS	SD
08/09/2009	I	http://www.ntsb.go	LDG	3	NA	B737G3		1																		1																													N	DS	SD
21/08/2009	I	http://www.ntsb.go	TO	3	AUS	B737G3																				1																													N	DS	SD
10/08/2009	N	http://www.ntsb.go	TO	3	ASIA	B737G3		1																																			1									1		1	H	DS	SD
17/07/2009	I	http://www.ntsb.go	GRD	3	EUR	B737G3	1																																																N	DS	SD
15/07/2009	I	http://www.ntsb.go	GRD	3	NA	B737G3																				1																													N	DS	SD
13/07/2009	I	http://www.ntsb.go	CRZ	3	NA	B737G3																				1																													N	DS	SD
14/06/2009	I	http://www.ntsb.go	LDG	3	ME	B737G3																				1																													N	DS	SD
12/06/2009	I	http://www.ntsb.go	LDG	3	ME	B737G3		1																		1																													U	DS	SD

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
12/05/2009	I	http://www.ntsb.gov	LDG	3	NA	B737G3		1																1	1	1																									1				M	DS	SD
02/05/2009	I	http://www.ntsb.gov	CRZ	3	ME	B737G3				1									1																																				U	DS	SD
18/04/2009	N	http://www.ntsb.gov	DES	3	NA	B737G3				1																																													L	DS	SD
27/02/2009	I	http://www.ntsb.gov	CRZ	3	ASIA	B737G3																				1																													N	DS	SD
25/02/2009	F	http://www.ntsb.gov	LDG	3	EUR	B737G3							1					1								1																	1				1				1		1	1	U	DS	SD
12/01/2009	I	http://www.ntsb.gov	CRZ	3	EUR	B737G3				1																1																													N	DS	SD
11/05/2009	I	http://www.ntsb.gov	TO	3	AFR	B747G3																				1																													N		
20/02/2009	N	http://www.ntsb.gov	DES	3	ASIA	B747G3				1																																													U		
5/16/2009	N	http://www.ntsb.gov	CRZ	3	NA	B757				1																																													U		
6/10/2009	I	http://www.ntsb.gov	GRD	3	NA	B757		1																	1	1																													N		
5/1/2009	I	http://www.ntsb.gov	CLB	3	SA	B757																	1			1																													N		
15/06/2009	I	http://www.ntsb.gov	GRD	3	EUR	B757																			1	1																													N		
10/19/2009	I	http://www.ntsb.gov	APR	3	NA	B767			1				1	1				1											1							1	1		1			1	1		1		1		1						H	SF	DB
10/27/2009	N	http://www.ntsb.gov	DES	3	NA	B767				1																																													U		
8/3/2009	I	http://www.ntsb.gov	CRZ	3	NA	B767				1																																													U		
6/1/2009	I	http://www.ntsb.gov	APR	3	NA	B767							1			1																					1						1				1							1	U		
11/4/2009	I	http://www.ntsb.gov	GRD	3	NA	B767	1																																																N		
9/7/2009	I	http://www.ntsb.gov	CRZ	3	NA	B767																			1	1		1																											N		
7/20/2009	I	http://www.ntsb.gov	CRZ	3	EUR	B767																			1	1																													N		
4/20/2009	N	http://www.ntsb.gov	LDG	3	NA	B767				1		1																									1						1			1	1								M		
9/17/2009	I	http://www.ntsb.gov	GRD	3	NA	B767		1																		1																													N		
6/19/2009	I	http://www.ntsb.gov	CRZ	3	NA	B767																				1											1						1				1							1	U		
5/20/2009	N	http://www.ntsb.gov	CRZ	3	NA	B767				1																																													U		
10/5/2009	N	http://www.ntsb.gov	CRZ	3	SA	B767				1																																													U		
6/9/2009	I	Preliminary	CRZ	3	NA	B767																			1			1																											U		
6/5/2009	I	http://www.ntsb.gov	APR	3	ASIA	B767																			1			1																											N		
07/12/2009	N	http://www.ntsb.gov	LDG	3	AFR	EMB-135			1	1																											1						1				1							1	M	MS	ML
21/05/2009	N	http://www.ntsb.gov	GRD	3	NA	EMB-135		1																													1						1				1							1	M	MS	ML
26/06/2009	I	http://www.ntsb.gov	GRD	3	NA	EMB-145		1					1				1																																						N	MS	ML
03/06/2009	I	http://www.ntsb.gov	GRD	3	NA	EMB-145		1					1				1																																						N	MS	ML
4/17/2009	I	http://www.ntsb.gov	APR	3	SA	MD11																				1																													N		
6/9/2009	N	http://www.ntsb.gov	LDG	3	AFR	MD11																																					1											1	M		
10/20/2009	N	http://aviation-safe	LDG	3	SA	MD11																				1																													N		
3/23/2009	F	http://aviation-safet	LDG	3	ASIA	MD11				1	1	1															1													1			1											1	M		
11/28/2009	F	http://www.ntsb.gov	TO	3	ASIA	MD11																																					1											1	M		
31/12/2008	I	http://www.ntsb.gov	TO	3	EUR	B737G3				1									1																																				U	DS	SD
28/12/2008	N	http://www.ntsb.gov	GRD	3	NA	B737G3	1	1																					1																	1	1								N	DS	SD
24/12/2008	I	http://www.ntsb.gov	GRD	3	NA	B737G3	1																						1																	1	1								L	DS	SD
20/12/2008	N	http://www.ntsb.gov	TO	3	NA	B737G3		1				1													1																		1								1			1	H	DS	SD
20/12/2008	I	http://www.ntsb.gov	GRD	3	NA	B737G3	1																					1																											N	DS	SD
07/11/2008	I	http://www.ntsb.gov	GRD	3	NA	B737G3	1	1																																															N	DS	SD
28/10/2008	I	http://www.ntsb.gov	GRD	3	ASIA	B737G3		1																		1																													N	DS	SD
16/10/2008	N	http://www.ntsb.gov	LDG	3	SA	B737G3		1		1																1																													U	DS	SD
01/10/2008	I	http://www.ntsb.gov	GRD	3	NA	B737G3		1																		1																													N	DS	SD

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
28/08/2008	I	http://www.ntsb.go	CRZ	3	SA	B737G3							1			1																														1									N	DS	SD
16/08/2008	I	http://www.ntsb.go	TO	3	EUR	B737G3		1																					1												1						1								H	DS	SD
23/07/2008	I	http://www.ntsb.go	GRD	3	ASIA	B737G3																				1																													N	DS	SD
05/07/2008	I	http://www.ntsb.go	APR	3	NA	B737G3						1				1																																							N	DS	SD
02/07/2008	I	http://www.ntsb.go	GRD	3	NA	B737G3		1									1												1																		1	1							H	DS	SD
06/04/2008	N	http://www.ntsb.go	DES	3	NA	B737G3				1																			1																										L	DS	SD
27/03/2008	I	http://www.ntsb.go	LDG	3	NA	B737G3		1																1																		1									1		1	H	DS	SD
21/03/2008	I	http://www.ntsb.go	LDG	3	EUR	B737G3		1																																															U	DS	SD
10/03/2008	N	http://www.ntsb.go	LDG	3	ASIA	B737G3		1																		1																													U	DS	SD
01/03/2008	I	http://www.ntsb.go	GRD	3	NA	B737G3		1																					1																		1								H	DS	SD
24/02/2008	I	http://www.ntsb.go	DES	3	NA	B737G3				1																																													U	DS	sd
22/02/2008	N	http://www.ntsb.go	DES	3	NA	B737G3				1																																													U	DS	sd
13/02/2008	I	http://www.ntsb.go	LDG	3	EUR	B737G3																																				1											1	U	DS	SD
10/02/2008	N	http://www.ntsb.go	CRZ	3	ASIA	B737G3				1																																													U	DS	SD
31/01/2008	F	http://ntsb.gov/ntsb	GRD	3	NA	B737G3	1																																																N	DS	SD
14/01/2008	F	http://ntsb.gov/ntsb	APR	3	ASIA	B737G3															1																																		U	DS	SD
03/01/2008	I	http://www.ntsb.go	LDG	3	EUR	B737G3		1																				1														1											1	U	DS	SD
02/10/2008	N	http://www.ntsb.go	CRZ	3	ASIA	B747G3				1																																													U		
07/01/2008	I	http://www.ntsb.go	DES	3	ASIA	B747G3																				1																													N		
25/03/2008	I	http://www.ntsb.go	LDG	3	ASIA	B747G3																			1	1																													U		
25/07/2008	N	http://www.ntsb.go	CRZ	3	ASIA	B747G3																				1																													N		
26/08/2008	I	http://www.ntsb.go	LDG	3	NA	B747G3																																				1											1	M		
9/22/2008	I	http://www.ntsb.go	CLB	3	NA	B757									1											1				1					1		1					1								1		1		1	H		
9/18/2008	I	http://www.ntsb.go	CRZ	3	EUR	B757																			1	1																													N		
8/6/2008	I	http://www.ntsb.go	TO	3	NA	B757																	1			1																													N		
3/22/2008	I	http://www.ntsb.go	CRZ	3	NA	B757																				1																													N		
1/13/2008	N	http://www.ntsb.go	GRD	3	NA	B757		1					1																																										N		
12/28/2008	N	http://www.ntsb.go	GRD	3	NA	B757		1																																															N		
1/30/2008	I	http://www.ntsb.go	CRZ	3	NA	B757																			1	1	1																												N		
7/5/2008	I	http://www.ntsb.go	TO	3	NA	B767							1			1	1																																						U		
6/28/2008	N	http://www.ntsb.go	GRD	3	NA	B767																			1	1																													N		
26/12/2008	N	http://www.ntsb.go	GRD	3	NA	DC9-8x		1																					1																										H	ml	MS
11/12/2008	I	http://www.ntsb.go	LDG	3	NA	EMB-145																			1	1																													U	DS	MS
14/08/2008	N	http://www.ntsb.go	LDG	3	NA	EMB-145																							1								1							1							1		1		1	H	DS	MS
21/07/2008	I	http://www.ntsb.go	TO	3	NA	EMB-145							1			1																																							N	DS	MS
27/05/2008	N	http://www.ntsb.go	CRZ	3	NA	EMB-145				1																																													L	MS	ML
15/02/2008	N	http://www.ntsb.go	CLB	3	NA	EMB-145																						1																											N	DS	MS
4/27/2008	I	http://www.ntsb.go	GRD	3	ASIA	MD11																				1																													N		
23/01/2007	I	http://www.ntsb.go	CLB	3	ASIA	A306																	1		1	1																													N	EV	AAD
12/03/2007	N	http://aviation-safe	TO	3	ASIA	A310																				1																													U	EV	AAD
28/01/2007	I	http://www.ntsb.go	CRZ	3	EUR	A310																				1																													U	EV	AAD
25/11/2007	I	http://www.ntsb.go	TO	3	NA	B737G3		1																		1																													N	DS	SD
21/11/2007	I	http://www.ntsb.go	CLB	3	ASIA	B737G3																																																	N	DS	SD
17/11/2007	I	http://www.ntsb.go	CLB	3	NA	B737G3																	1																																N	DS	SD

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
28/10/2007	N	http://www.ntsb.go	APR	3	EUR	B737G3																					
23/09/2007	I	http://www.ntsb.go	APR	3	EUR	B737G3																					
20/09/2007	N	http://www.ntsb.go	GRD	3	ASIA	B737G3																				1	
20/08/2007	N	http://www.ntsb.go	GRD	3	ASIA	B737G3																			1	1	
16/08/2007	I	http://www.ntsb.go	GRD	3	NA	B737G3		1	1				1				1										
02/08/2007	N	http://www.ntsb.go	DES	3	SA	B737G3				1																	
08/07/2007	N	http://www.ntsb.go	CLB	3	NA	B737G3				1																	
05/07/2007	I	http://www.ntsb.go	GRD	3	NA	B737G3							1				1										
25/06/2007	N	http://www.ntsb.go	LDG	3	EUR	B737G3		1																		1	
11/06/2007	N	http://ntsb.gov/ntsb	CLB	3	EUR	B737G3																				1	
05/05/2007	F	http://www.ntsb.go	TO	3	AFR	B737G3															1						
29/04/2007	I	http://www.ntsb.go	CRZ	3	SA	B737G3																				1	
25/04/2007	N	http://www.ntsb.go	DES	3	NA	B737G3				1																	
16/03/2007	I	http://www.ntsb.go	TO	3	NA	B737G3							1				1										
07/03/2007	F	http://www.ntsb.go	LDG	3	ASIA	B737G3		1																	1		
02/02/2007	I	http://www.ntsb.go	LDG	3	NA	B737G3	1	1		1							1										
01/01/2007	F	http://www.ntsb.go	CRZ	3	ASIA	B737G3																					
03/04/2007	I	http://www.ntsb.go	DES	3	ASIA	B747G3																	1			1	
14/04/2007	I	http://www.ntsb.go	CRZ	3	NA	B747G3																	1			1	
29/06/2007	I	http://www.ntsb.go	TO	3	NA	B747G3		1	1																	1	
14/12/2007	N	http://www.ntsb.go	GRD	3	NA	B747G3		1	1									1									
27/06/2007	N	http://www.ntsb.go	CRZ	3	AUS	B747G3				1																	
1/10/2007	I	http://www.ntsb.go	TO	3	NA	B757							1			1											
4/24/2007	N	http://www.ntsb.go	GRD	3	NA	B757		1																			
6/3/2007	N	http://www.ntsb.go	DES	3	NA	B757				1																	
7/11/2007	I	http://www.ntsb.go	LDG	3	NA	B757											1										
4/12/2007	N	http://www.ntsb.go	DES	3	NA	B757				1																	
6/23/2007	I	http://www.ntsb.go	APR	3	SA	B757							1														
3/15/2007	N	http://www.ntsb.go	TO	3	NA	B767												1				1	1			1	
8/20/2007	I	http://www.ntsb.go	CRZ	3	EUR	B767																			1	1	
3/3/2007	I	http://www.ntsb.go	TO	3	EUR	B767																				1	
11/22/2007	I	http://www.ntsb.go	TO	3	EUR	B767																1	1			1	
25/12/2007	N	http://www.ntsb.go	DES	3	NA	DC9-8x				1																	
28/09/2007	N	http://www.ntsb.go	CLB	3	NA	DC9-8x																	1		1	1	
29/03/2007	N	http://www.ntsb.go	CRZ	3	NA	DC9-8x																				1	
20/06/2007	I	http://www.ntsb.go	LDG	3	NA	EMB-135																				1	
17/12/2007	I	http://www.ntsb.go	TO	3	NA	EMB-145																				1	
07/08/2007	N	http://www.ntsb.go	DES	3	NA	EMB-145				1																	
24/02/2007	I	http://www.ntsb.go	LDG	3	NA	EMB-145						1															
1/7/2007	I	http://www.ntsb.go	LDG	3	NA	MD11																				1	
09/07/2006	F	http://aviation-safe	LDG	3	ASIA	A310				1														1		1	
28/12/2006	I	http://www.ntsb.go	LDG	3	ASIA	B737G3																				1	
26/12/2006	N	http://www.ntsb.go	GRD	3	NA	B737G3		1					1														
24/12/2006	N	http://www.ntsb.go	LDG	3	ASIA	B737G3		1																		1	

	Factors (Non-Technical)																		Competencies										Validation	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
28/10/2007																				1					1			U	DS	SD
23/09/2007																1				1					1		1	H	DS	SD
20/09/2007																												N	DS	SD
20/08/2007																												N	DS	SD
16/08/2007																1				1							1	H	DS	SD
02/08/2007																												U	DS	SD
08/07/2007																												N	DS	SD
05/07/2007																												N	DS	SD
25/06/2007																												N	DS	SD
11/06/2007																												U	DS	SD
05/05/2007																												U	DS	SD
29/04/2007																												N	DS	SD
25/04/2007		1																		1					1			U	DS	SD
16/03/2007																												N	DS	SD
07/03/2007																1				1							1	U	DS	SD
02/02/2007																												N	DS	SD
01/01/2007																												U	DS	SD
03/04/2007																												U		
14/04/2007																												N		
29/06/2007		1								1										1			1					H		
14/12/2007										1										1			1					M		
27/06/2007																												U		
1/10/2007																												N		
4/24/2007																												N		
6/3/2007																												U		
7/11/2007																												N		
4/12/2007										1									1									M		
6/23/2007										1						1				1					1			L		
3/15/2007																												N		
8/20/2007																												N		
3/3/2007																												N		
11/22/2007																												N		
25/12/2007																												L	Ben	ml
28/09/2007										1												1						H	ml	ds
29/03/2007		1				1																	1					M	Ben	ml
20/06/2007																												U	MS	ML
17/12/2007																												N	DS	MS
07/08/2007																												L	DS	MS
24/02/2007										1						1							1				1	H	DS	MS
1/7/2007																												N		
09/07/2006		1								1						1	1			1					1		1	H	EV	MS
28/12/2006																												N	DS	SD
26/12/2006		1														1				1							1	H	DS	SD
24/12/2006																1				1							1	H	DS	SD

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
19/10/2006	I	http://www.ntsb.go	CRZ	3	NA	B737G3																			1																													N	DS	SD
29/09/2006	F	http://www.ntsb.go	CRZ	3	SA	B737G3							1																																									U	DS	SD
16/09/2006	N	http://www.ntsb.go	CRZ	3	NA	B737G3				1						1																																						N	DS	SD
12/09/2006	I	http://www.ntsb.go	LDG	3	AUS	B737G3																			1																													N	DS	SD
03/09/2006	I	http://www.ntsb.go	LDG	3	ME	B737G3																				1																												N	DS	SD
31/08/2006	I	http://www.ntsb.go	LDG	3	NA	B737G3		1																		1							1										1											1	H	DS	SD
21/08/2006	I	http://www.ntsb.go	GRD	3	NA	B737G3	1	1																																															N	DS	SD
27/07/2006	N	http://www.ntsb.go	GRD	3	NA	B737G3	1																																																N	DS	SD
23/07/2006	I	http://www.ntsb.go	TO	3	NA	B737G3							1			1	1																																						N	DS	SD
07/07/2006	I	http://www.ntsb.go	CRZ	3	EUR	B737G3																				1																												N	DS	SD
15/06/2006	I	http://www.ntsb.go	LDG	3	EUR	B737G3				1			1					1													1						1					1	1							1		1	1	1	U	DS	SD
08/06/2006	I	http://www.ntsb.go	DES	3	EUR	B737G3														1																																			L	DS	SD
08/06/2006	N	http://www.ntsb.go	GRD	3	NA	B737G3	1																																																N	DS	SD
23/03/2006	I	http://www.ntsb.go	TO	3	NA	B737G3		1					1			1	1																																						N	DS	SD
13/02/2006	I	http://www.ntsb.go	CLB	3	SA	B737G3																	1		1	1																													N	DS	SD
23/07/2006	I	http://www.ntsb.go	TO	3	NA	B747G3							1			1	1																																						N		
23/04/2006	I	http://www.ntsb.go	GRD	3	NA	B747G3	1	1																													1						1				1								1	L		
2/1/2006	I	http://www.ntsb.go	LDG	3	EUR	B747G3																	1																																N		
07/12/2006	I	http://www.ntsb.go	CLB	3	EUR	B747G3																				1																													N		
26/12/2006	I	http://www.ntsb.go	GRD	3	NA	B747G3		1																													1						1				1								1	M		
31/10/2006	N	http://www.ntsb.go	GRD	3	NA	B747G3		1										1																			1						1				1								1	M		
09/10/2006	I	Factual	GRD	3	ASIA	B747G3		1															1		1	1																													N		
12/31/2006	I	http://www.ntsb.go	CLB	3	EUR	B757																				1																													U	SF	DB
2/25/2006	N	http://www.ntsb.go	GRD	3	NA	B757	1																																																N		
1/27/2006	I	http://www.ntsb.go	TO	3	NA	B757							1			1	1																																						N		
10/28/2006	I	http://www.ntsb.go	LDG	3	NA	B757							1					1											1								1		1				1				1					1			M		
3/15/2006	N	http://www.ntsb.go	CRZ	3	NA	B757				1																					1																								U		
5/17/2006	I	http://www.ntsb.go	GRD	3	NA	B757																				1																													N		
9/5/2006	N	http://www.ntsb.go	LDG	3	NA	B757								1																							1						1	1				1				1		1	H		
12/30/2006	I	http://www.ntsb.go	LDG	3	AUS	B767																			1	1																													N		
11/8/2006	I	http://www.ntsb.go	GRD	3	EUR	B767																				1																													N		
7/24/2006	I	http://www.ntsb.go	CRZ	3	NA	B767				1																																													U		
6/17/2006	N	http://www.ntsb.go	GRD	3	NA	B767	1																																																N		
6/2/2006	I	http://www.ntsb.go	GRD	3	NA	B767																	1			1																													N		
9/17/2006	I	http://www.ntsb.go	CRZ	3	SA	B767																			1	1																													N		
20/08/2006	I	http://www.ntsb.go	GRD	3	NA	DC9-8x																			1	1																													N	Ben	ml
20/06/2006	N	http://www.ntsb.go	LDG	3	NA	DC9-8x																				1																													N	Ben	ml
21/03/2006	I	http://www.ntsb.go	LDG	3	NA	DC9-8x																							1								1						1				1								1	M	Ben	ml
24/07/2006	N	http://www.ntsb.go	GRD	3	NA	EMB-145	1	1																					1								1									1						1			M	MS	ML
13/05/2006	N	http://www.ntsb.go	DES	3	NA	EMB-145				1																																													L	MS	ML
12/05/2006	N	http://www.ntsb.go	GRD	3	NA	EMB-145	1											1																																					N	MS	ML
21/03/2006	I	http://www.ntsb.go	GRD	3	NA	EMB-145							1			1	1																																						U	DS	MS
11/7/2006	I	http://www.ntsb.go	LDG	3	EUR	MD11																				1																													N		
9/14/2006	I	http://www.ntsb.go	LDG	3	ASIA	MD11																					1																1											1	M		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents / Factors

Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
21/06/2005	I	http://www.ntsb.gov	CLB	3	ASIA	A306																	1			1	
07/03/2005	N	http://aviation-safet	LDG	3	ASIA	A310																		1		1	
06/03/2005	N	http://aviation-safet	CRZ	3	NA	A310																				1	
13/12/2005	I	http://www.ntsb.gov	GRD	3	NA	B737G3		1								1											
08/12/2005	F	http://www.ntsb.gov	LDG	3	NA	B737G3					1	1															
19/11/2005	N	http://www.ntsb.gov	LDG	3	NA	B737G3		1																			
09/11/2005	I	http://www.ntsb.gov	CRZ	3	AUS	B737G3																				1	
30/10/2005	I	http://www.ntsb.gov	GRD	3	NA	B737G3																			1	1	
22/10/2005	N	http://www.ntsb.gov	CRZ	3	NA	B737G3				1																	
12/10/2005	N	http://www.ntsb.gov	GRD	3	NA	B737G3		1																			
09/09/2005	I	http://www.ntsb.gov	LDG	3	NA	B737G3							1			1											
14/08/2005	F	http://www.ntsb.gov	CRZ	3	EUR	B737G3															1					1	
08/08/2005	N	http://www.ntsb.gov	GRD	3	NA	B737G3		1					1														
08/07/2005	N	http://www.ntsb.gov	GRD	3	NA	B737G3	1	1																			
19/06/2005	I	http://www.ntsb.gov	GRD	3	NA	B737G3	1	1																			
31/05/2005	N	http://www.ntsb.gov	LDG	3	ASIA	B737G3																				1	
17/05/2005	I	http://www.ntsb.gov	GRD	3	NA	B737G3	1	1																			
29/04/2005	N	http://www.ntsb.gov	CRZ	3	NA	B737G3				1																	
16/03/2005	N	http://www.ntsb.gov	GRD	3	NA	B737G3		1																			
30/01/2005	I	http://www.ntsb.gov	APR	3	NA	B737G3																					
08/01/2005	N	http://www.ntsb.gov	GRD	3	NA	B737G3	1	1																			
19/12/2005	N	http://www.ntsb.gov	TO	3	NA	B747G3																				1	
2/20/2005	I	http://www.ntsb.gov	CLB	3	EUR	B747G3																	1				
3/10/2005	N	http://www.ntsb.gov	CLB	3	ASIA	B757																	1			1	
3/6/2005	N	http://www.ntsb.gov	GRD	3	NA	B757		1		1								1									
8/20/2005	N	http://www.ntsb.gov	GRD	3	NA	B757		1																			
5/12/2005	I	http://www.ntsb.gov	TO	3	EUR	B757																					
6/5/2005	N	http://www.ntsb.gov	DES	3	NA	B757				1																	
3/14/2005	I	http://www.ntsb.gov	TO	3	SA	B767																	1			1	
12/15/2005	I	http://www.ntsb.gov	GRD	3	NA	B767		1					1														
12/1/2005	I	http://www.ntsb.gov	TO	3	ASIA	B767																	1		1	1	
11/6/2005	I	http://www.ntsb.gov	LDG	3	EUR	B767																					
1/19/2005	I	http://www.ntsb.gov	CRZ	3	EUR	B767																	1				
7/11/2005	N	http://www.ntsb.gov	CRZ	3	NA	B767				1																	
28/05/2005	I	http://www.ntsb.gov	LDG	3	NA	DC9-8x					1															1	
20/03/2005	N	http://www.ntsb.gov	CLB	3	NA	EMB-135																					
08/08/2005	N	http://www.ntsb.gov	GRD	3	NA	EMB-145		1																			
19/05/2005	I	http://www.ntsb.gov	CRZ	3	NA	EMB-145																	1			1	
4/28/2005	I	http://www.ntsb.gov	CRZ	3	NA	MD11																			1	1	
4/26/2005	I	http://www.ntsb.gov	LDG	3	SA	MD11																				1	
6/7/2005	N	http://www.ntsb.gov	LDG	3	NA	MD11																					
11/03/2004	I	http://www.ntsb.gov	LDG	3	NA	A306																					
07/11/2004	I	http://www.ntsb.gov	GRD	3	EUR	B737G3		1																			
04/11/2004	N	http://www.ntsb.gov	LDG	3	ASIA	B737G3				1														1		1	

Factors (Non-Technical)

Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
21/06/2005																		
07/03/2005		1								1						1	1	
06/03/2005																		
13/12/2005																		
08/12/2005							1	1		1						1	1	
19/11/2005															1			
09/11/2005																		
30/10/2005																		
22/10/2005																		
12/10/2005																		
09/09/2005																		
14/08/2005										1		1						
08/08/2005										1						1		
08/07/2005																		
19/06/2005																		
31/05/2005																		
17/05/2005		1																
29/04/2005																		
16/03/2005										1						1		
30/01/2005										1						1		
08/01/2005																		
19/12/2005																		
2/20/2005																		
3/10/2005																		
3/6/2005										1								
8/20/2005										1						1		
5/12/2005																1		
6/5/2005																		
3/14/2005																		
12/15/2005																		
12/1/2005																		
11/6/2005		1																
1/19/2005																		
7/11/2005																		
28/05/2005																		
20/03/2005	1																	
08/08/2005																		
19/05/2005																		
4/28/2005								1										
4/26/2005																		
6/7/2005										1						1		
11/03/2004		1						1									1	
07/11/2004																		
04/11/2004										1						1		

Competencies / Validation

Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
21/06/2005										N	EV	AAD
07/03/2005		1					1		1	H	EV	AAD
06/03/2005										N	EV	AAD
13/12/2005		1					1			M	DS	SD
08/12/2005						1			1	H	DS	SD
19/11/2005						1	1			H	DS	SD
09/11/2005										U	DS	SD
30/10/2005										N	DS	SD
22/10/2005										L	DS	SD
12/10/2005		1					1			M	DS	SD
09/09/2005										N	DS	SD
14/08/2005			1	1			1			U	DS	SD
08/08/2005		1					1		1	L	DS	ML
08/07/2005										N	DS	ML
19/06/2005										N	DS	ML
31/05/2005										U	DS	ML
17/05/2005		1					1			M	DS	ML
29/04/2005										N	DS	ML
16/03/2005		1					1		1	H	DS	ML
30/01/2005		1							1	L	DS	ML
08/01/2005										N	DS	ML
19/12/2005										U		
2/20/2005										U		
3/10/2005										N		
3/6/2005	1	1								L		
8/20/2005		1					1		1	M		
5/12/2005										M		
6/5/2005										U		
3/14/2005										U		
12/15/2005										U		
12/1/2005										N		
11/6/2005										M		
1/19/2005										U		
7/11/2005										U		
28/05/2005										U	Ben	ml
20/03/2005										U	MS	ML
08/08/2005										N	DS	MS
19/05/2005										N	DS	MS
4/28/2005										N	SF	DB
4/26/2005										N		
6/7/2005		1	1						1	H		
11/03/2004		1					1			M	EV	AAD
07/11/2004										U	DS	ML
04/11/2004					1				1	U	DS	ML

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
11/10/2004	I	http://www.ntsb.go	TO	3	AUS	B737G3																																																														1											1	M	DS	ML
13/09/2004	N	http://www.ntsb.go	APR	3	NA	B737G3													1																																					N	DS	ML
01/09/2004	I	http://www.ntsb.go	TO	3	EUR	B737G3																				1																														N	DS	ML
19/08/2004	I	http://www.ntsb.go	TO	3	NA	B737G3							1			1	1																																							N	DS	ML
07/08/2004	I	http://www.ntsb.go	TO	3	NA	B737G3							1																																											N	DS	ML
04/06/2004	N	http://www.ntsb.go	CRZ	3	NA	B737G3				1																																														U	DS	ML
14/04/2004	N	http://www.ntsb.go	CRZ	3	NA	B737G3				1																																														U	DS	ML
10/04/2004	N	http://www.ntsb.go	CRZ	3	NA	B737G3				1																												1										1									M	DS	ML
24/02/2004	I	http://www.ntsb.go	LDG	3	NA	B737G3												1																				1										1					1			L	DS	ML
03/01/2004	F	http://www.ntsb.go	TO	3	ME	B737G3												1	1																			1						1				1	1					1	1	H	DS	ML
8/31/2004	N	http://www.ntsb.go	CRZ	3	ASIA	B747G3				1																																														U		
5/31/2004	I	http://www.ntsb.go	GRD	3	NA	B757																																																		N	SF	DB
1/24/2004	I	http://www.ntsb.go	GRD	3	EUR	B757																			1	1	1										1													1					N		
3/1/2004	N	http://www.ntsb.go	DES	3	NA	B757				1																																														U		
8/27/2004	I	http://www.ntsb.go	CLB	3	NA	B757																1																																		N		
10/19/2004	I	http://www.ntsb.go	CLB	3	UNK	B757																	1			1																														N		
9/29/2004	N	http://www.ntsb.go	CRZ	3	NA	B767				1																																														U		
11/7/2004	I	http://www.ntsb.go	GRD	3	EUR	B767		1																																																U		
2/19/2004	I	http://www.ntsb.go	LDG	3	NA	B767																				1																														N		
7/28/2004	N	http://www.ntsb.go	TO	3	EUR	B767																	1		1	1																														N		
8/7/2004	N	http://www.ntsb.go	LDG	3	SA	B767																																						1											1	M		
21/11/2004	I	http://www.ntsb.go	APR	3	NA	DC9-8x												1			1								1									1		1				1							1		1		1	H	Ben	ml
16/09/2004	I	http://www.ntsb.go	CLB	3	NA	DC9-8x																1	1		1																															L	Ben	ml
15/07/2004	N	http://www.ntsb.go	DES	3	NA	DC9-8x				1																												1										1									M	Ben	ml
26/05/2004	I	http://www.ntsb.go	DES	3	NA	DC9-8x				1																		1																												L	Ben	ml
20/02/2004	N	http://aviation-safet	TO	3	SA	DC9-8x																				1																														N	Ben	ml
29/08/2004	N	http://www.ntsb.go	CRZ	3	NA	EMB-135				1																																														L	MS	ML
11/06/2004	I	http://www.ntsb.go	LDG	3	NA	EMB-135																				1	1								1									1											1	M	MS	ML
19/01/2004	I	http://www.ntsb.go	TO	3	NA	EMB-135																				1																														N	ML	JS
10/8/2004	I	http://www.ntsb.go	TO	3	NA	MD11																	1	1		1				1	1							1				1		1								1	1			H	SF	DB
9/19/2004	N	http://www.ntsb.go	LDG	3	NA	MD11																																1						1							1		1		1	H		
1/26/2004	I	http://www.ntsb.go	LDG	3	NA	MD11																																						1											1	M		
10/04/2003	I	http://www.ntsb.go	CLB	3	NA	A306																			1	1																														N	EV	AAD
19/12/2003	N	http://www.ntsb.go	LDG	3	AFR	B737G3				1																												1						1							1				1	M	DS	ML
29/11/2003	I	http://www.ntsb.go	LDG	3	NA	B737G3																				1																														N	DS	ML
01/11/2003	N	http://www.ntsb.go	DES	3	NA	B737G3				1																																														U	DS	ML
06/10/2003	I	http://www.ntsb.go	UNK	3	ASIA	B737G3																																						1											1	U	DS	ML
04/10/2003	N	http://www.ntsb.go	GRD	3	NA	B737G3	1																																																	N	DS	ML
16/08/2003	N	http://www.ntsb.go	CRZ	3	NA	B737G3				1																																														U	DS	ML
24/05/2003	N	http://www.ntsb.go	LDG	3	NA	B737G3				1								1																				1						1							1		1		1	H	DS	ML
06/04/2003	N	http://www.ntsb.go	CRZ	3	NA	B737G3				1																																														U	DS	ML
01/02/2003	N	http://www.ntsb.go	LDG	3	NA	B737G3																																1						1				1							1	M	DS	ML
16/01/2003	I	http://www.ntsb.go	GRD	3	NA	B737G3	1																																																	N	DS	ML
3/12/2003	U	http://www.ntsb.go	TO	3	AUS	B747G3																																1						1				1					1		1	H		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
11/14/2003	N	http://www.ntsb.gov	TO	3	NA	B747G3				1	1	1																									1						1								1	1		1	H		
6/10/2003	I	http://www.ntsb.gov	CRZ	3	NA	B757																				1												1							1										N		
1/19/2003	N	http://www.ntsb.gov	GRD	3	NA	B757	1																																																N		
4/21/2003	N	http://www.ntsb.gov	CRZ	3	NA	B757				1																																													U		
8/24/2003	I	http://www.ntsb.gov	GRD	3	NA	B757		1																		1																													N		
4/17/2003	I	http://www.ntsb.gov	CLB	3	NA	B757																	1		1	1																													N		
1/11/2003	I	http://www.ntsb.gov	CRZ	3	NA	B757																			1	1																													N		
5/20/2003	N	http://www.ntsb.gov	GRD	3	NA	B757	1																																																N		
6/23/2003	N	http://www.ntsb.gov	GRD	3	NA	B757		1																	1	1											1										1								M		
7/22/2003	N	http://www.ntsb.gov	CLB	3	NA	B757				1																																													U		
5/7/2003	N	http://www.ntsb.gov	APR	3	NA	B767				1																																													N		
02/09/2003	N	http://www.ntsb.gov	LDG	3	NA	DC9-8x		1																		1											1													1					M	Ben	ml
07/08/2003	N	http://www.ntsb.gov	CRZ	3	NA	DC9-8x				1																																													L	Ben	ml
16/04/2003	N	http://www.ntsb.gov	GRD	3	NA	DC9-8x		1																	1	1		1																											N	Ben	ml
14/03/2003	I	http://www.ntsb.gov	LDG	3	NA	DC9-8x			1									1																			1						1				1					1			H	Ben	ml
27/09/2003	N	http://www.ntsb.gov	GRD	3	NA	EMB-135	1	1																					1								1									1						1			H	ML	JS
24/06/2003	N	http://www.ntsb.gov	GRD	3	NA	EMB-135	1	1																																															N	ML	JS
18/06/2003	N	http://www.ntsb.gov	APR	3	NA	EMB-145				1																		1																											L	DS	ML
06/01/2003	N	http://www.ntsb.gov	APR	3	NA	EMB-145			1	1		1						1											1		1						1						1							1		1		1	H	ML	JS
5/30/2003	I	http://www.ntsb.gov	UNK	3	NA	MD11												1																			1						1							1					M		
1/14/2003	I	http://www.ntsb.gov	UNK	3	NA	MD11																				1																													N		
1/15/2003	N	http://www.ntsb.gov	UNK	3	EUR	MD11																				1																													N		
10/06/2002	N	http://www.ntsb.gov	TO	3	NA	A306																				1											1					1	1				1					1	1	1	M	EV	AAD
13/09/2002	I	http://www.ntsb.gov	GRD	3	NA	B737G3	1																																																N	DS	ML
19/06/2002	I	http://www.ntsb.gov	LDG	3	AUS	B737G3																																					1											1	U	DS	ML
08/05/2002	I	http://www.ntsb.gov	CRZ	3	NA	B737G3																				1											1													1					M	DS	ML
07/05/2002	F	http://www.ntsb.gov	APR	3	ME	B737G3																																					1												U	DS	ML
19/02/2002	N	http://www.ntsb.gov	CLB	3	NA	B737G3				1																																													M	DS	ML
20/01/2002	I	http://www.ntsb.gov	LDG	3	EUR	B737G3																				1																													N	DS	ML
16/01/2002	F	http://www.ntsb.gov	APR	3	ASIA	B737G3																	1																																U	DS	ML
10/9/2002	I	http://www.ntsb.gov	CRZ	3	NA	B747G3																				1																													N	SF	DB
4/1/2002	N	http://www.ntsb.gov	CLB	3	OTH	B747G3				1																																													U		
8/30/2002	I	http://www.ntsb.gov	CLB	3	AUS	B747G3																				1																													N		
5/1/2002	N	http://www.ntsb.gov	CRZ	3	AUS	B747G3				1																																													U		
3/1/2002	I	http://www.ntsb.gov	CRZ	3	AUS	B747G3																	1			1																													N		
5/29/2002	N	http://www.ntsb.gov	DES	3	NA	B757				1																																													U		
10/20/2002	I	http://www.ntsb.gov	TO	3	NA	B757													1							1			1	1							1						1	1						1		1			H		
9/9/2002	N	http://www.ntsb.gov	LDG	3	NA	B757																							1								1		1				1	1				1				1		1	H		
5/11/2002	N	http://www.ntsb.gov	GRD	3	NA	B757		1																																															N		
6/2/2002	N	http://www.ntsb.gov	DES	3	NA	B757										1													1																							1			M		
5/22/2002	N	http://www.aaib.gov	LDG	3	EUR	B757																		1																			1											1	H		
3/2/2002	N	http://www.ntsb.gov	GRD	3	NA	B757	1																																																N		
4/18/2002	N	http://www.ntsb.gov	CRZ	3	NA	B757				1																			1		1						1						1									1			M		
7/1/2002	F	http://www.ntsb.gov	CRZ	3	EUR	B757							1			1																																							U		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
7/2/2002	I	http://www.ntsb.gov	CRZ	3	SA	B767																			1		
4/5/2002	N	http://www.ntsb.gov	CLB	3	NA	B767																				1	
4/22/2002	N	http://www.ntsb.gov	CRZ	3	NA	B767				1																	
10/19/2002	I	http://www.ntsb.gov	CLB	3	NA	B767																1	1			1	
12/8/2002	I	http://www.ntsb.gov	CLB	3	AUS	B767																	1			1	
10/21/2002	I	http://www.ntsb.gov	TO	3	SA	B767																				1	
8/24/2002	I	http://www.ntsb.gov	GRD	3	SA	B767		1																		1	
4/15/2002	F	http://www.ntsb.gov	APR	3	ASIA	B767															1						
6/26/2002	N	http://www.ntsb.gov	LDG	3	ASIA	B767																					
16/06/2002	N	http://www.ntsb.gov	LDG	3	NA	DC9-8x																					
26/03/2002	I	http://www.ntsb.gov	APR	3	NA	EMB-145				1																1	
3/17/2002	N	http://www.ntsb.gov	GRD	3	NA	MD11		1	1	1								1									
3/31/2002	N	http://www.ntsb.gov	CRZ	3	NA	MD11																			1	1	
2/3/2002	I	http://www.ntsb.gov	LDG	3	EUR	MD11			1	1		1															
5/31/2002	I	http://www.ntsb.gov	GRD	3	NA	MD11																			1	1	
6/3/2002	N	http://www.ntsb.gov	UNK	3	ASIA	MD11																				1	
6/2/2002	N	http://www.ntsb.gov	APR	3	ASIA	MD11																				1	
28/11/2001	I	http://www.ntsb.gov	CLB	3	SA	A306																					
12/11/2001	F	http://www.ntsb.gov	CLB	3	NA	A306														1							
30/07/2001	I	http://www.ntsb.gov	LDG	3	NA	A306																	1		1		
18/05/2001	N	http://aviation-safet	CRZ	3	ME	A306																	1				
08/07/2001	I	http://www.ntsb.gov	GRD	3	EUR	A310																					
28/12/2001	I	http://www.ntsb.gov	DES	3	NA	B737G3														1							
13/12/2001	I	http://www.ntsb.gov	DES	3	NA	B737G3														1							
10/10/2001	I	http://www.ntsb.gov	TO	3	NA	B737G3																				1	
25/08/2001	N	http://www.ntsb.gov	LDG	3	NA	B737G3				1								1									
16/08/2001	I	http://www.ntsb.gov	TO	3	NA	B737G3							1				1										
09/08/2001	N	http://www.ntsb.gov	CRZ	3	NA	B737G3				1																	
22/07/2001	N	http://www.ntsb.gov	LDG	3	AFR	B737G3																					
28/05/2001	N	http://www.ntsb.gov	CRZ	3	NA	B737G3				1																	
09/04/2001	N	http://www.ntsb.gov	GRD	3	NA	B737G3		1																			
25/03/2001	I	http://www.ntsb.gov	CRZ	3	ME	B737G3																				1	
17/03/2001	I	http://www.ntsb.gov	LDG	3	EUR	B737G3			1																		
04/03/2001	I	http://www.ntsb.gov	LDG	3	NA	B737G3																					
03/03/2001	F	http://www.ntsb.gov	GRD	3	ASIA	B737G3																			1		
03/02/2001	N	http://www.ntsb.gov	GRD	3	NA	B737G3	1	1																			
5/21/2001	N	http://www.ntsb.gov	CRZ	3	ASIA	B747G3				1																	
6/5/2001	I	http://www.ntsb.gov	CLB	3	ASIA	B747G3																				1	
6/5/2001	I	http://www.ntsb.gov	LDG	3	NA	B757																					
6/28/2001	I	http://www.ntsb.gov	GRD	3	NA	B757																				1	
10/29/2001	N	http://www.ntsb.gov	GRD	3	NA	B757																					
9/23/2001	N	http://www.ntsb.gov	GRD	3	NA	B757	1	1																			
6/5/2001	N	http://www.ntsb.gov	CRZ	3	NA	B757				1																	
7/11/2001	N	http://www.ntsb.gov	CRZ	3	NA	B757																					

	Factors (Non-Technical)																	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatigue	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
7/2/2002																		
4/5/2002										1								
4/22/2002																		
10/19/2002																		
12/8/2002																		
10/21/2002																		
8/24/2002																		
4/15/2002		1								1						1		
6/26/2002			1					1		1						1		
16/06/2002		1								1						1		
26/03/2002																		
3/17/2002		1							1	1						1		
3/31/2002																		
2/3/2002																		
5/31/2002																		
6/3/2002																		
6/2/2002																		
28/11/2001																		
12/11/2001								1		1						1		
30/07/2001																		
18/05/2001																		
08/07/2001																		
28/12/2001																		
13/12/2001																		
10/10/2001																		
25/08/2001		1								1						1		
16/08/2001																		
09/08/2001										1								
22/07/2001										1						1		
28/05/2001																		
09/04/2001																		
25/03/2001																		
17/03/2001																1		
04/03/2001		1								1						1		
03/03/2001																		
03/02/2001																		
5/21/2001																		
6/5/2001																		
6/5/2001																1		
6/28/2001																		
10/29/2001	1									1								
9/23/2001		1								1						1		
6/5/2001																		
7/11/2001												1			1	1		

	Competencies										Validation	
Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
7/2/2002										N	SF	DB
4/5/2002		1								N		
4/22/2002								1	1	U		
10/19/2002										N		
12/8/2002										N		
10/21/2002										N		
8/24/2002										N		
4/15/2002		1			1		1		1	H		
6/26/2002		1			1				1	H		
16/06/2002		1			1				1	H	Ben	ml
26/03/2002										N	DS	ML
3/17/2002		1					1		1	N	SF	DB
3/31/2002										N		
2/3/2002										N		
5/31/2002										N		
6/3/2002										N		
6/2/2002										N		
28/11/2001										U	EV	AAD
12/11/2001					1	1			1	H	EV	MS
30/07/2001										N	EV	AAD
18/05/2001										N	EV	AAD
08/07/2001										U	MS	AAD
28/12/2001										N	DS	ML
13/12/2001										N	DS	ML
10/10/2001										N	DS	ML
25/08/2001					1		1		1	H	DS	ML
16/08/2001										N	DS	ML
09/08/2001		1			1					L	DS	ML
22/07/2001		1							1	M	DS	ML
28/05/2001										U	DS	ML
09/04/2001										N	DS	ML
25/03/2001										N	DS	ML
17/03/2001									1	L	DS	ML
04/03/2001					1		1		1	H	DS	ML
03/03/2001										N	DS	ML
03/02/2001										N	DS	ML
5/21/2001										U		
6/5/2001										N		
6/5/2001									1	H		
6/28/2001										N		
10/29/2001			1		1					U		
9/23/2001	1						1		1	H		
6/5/2001										U		
7/11/2001		1		1				1	1	M		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
4/9/2001	N	http://www.ntsb.go	GRD	3	NA	B767		1										1																		1								1				1			1				1	U		
9/7/2001	N	http://www.ntsb.go	APR	3	SA	B767				1																																														U		
12/4/2001	I	http://www.ntsb.go	CLB	3	EUR	B767																				1																														N		
11/27/2001	I	http://www.ntsb.go	CLB	3	AUS	B767																	1			1																														N		
3/27/2001	I	http://www.ntsb.go	APR	3	EUR	B767				1																1	1																													L		
3/16/2001	N	http://www.ntsb.go	CRZ	3	NA	B767																				1																														N		
4/23/2001	I	http://www.ntsb.go	APR	3	EUR	B767																				1	1																													N		
30/11/2001	N	http://www.ntsb.go	CRZ	3	NA	DC9-8x				1																		1																												N	Ben	ml
30/08/2001	N	http://www.ntsb.go	DES	3	NA	EMB-135				1																																														M	ML	JS
12/04/2001	N	http://www.ntsb.go	GRD	3	NA	EMB-135	1	1																																																N	ML	JS
16/10/2001	N	http://www.ntsb.go	APR	3	NA	EMB-145																							1	1							1							1					1				1		1	H	DS	ML
25/04/2001	I	http://www.ntsb.go	CRZ	3	NA	EMB-145																				1																														N	ML	JS
11/20/2001	U	http://www.ntsb.go	LDG	3	ASIA	MD11																															1						1												1	M		
20/11/2000	F	http://www.ntsb.go	GRD	3	NA	A306																				1		1	1			1			1		1		1						1			1						1			H	EV	AAD
28/03/2000	I	http://www.ntsb.go	APR	3	NA	A306																			1	1																														N	EV	AAD
12/07/2000	N	http://aviation-safe	APR	3	EUR	A310																	1			1			1				1		1		1		1				1					1			1	1		1		H	EV	MS
30/01/2000	F	http://aviation-safe	TO	3	AFR	A310													1										1									1						1					1					1		1	H	EV	AAD
13/11/2000	N	http://www.ntsb.go	DES	3	NA	B737G3				1																																														M	DS	ML
15/09/2000	N	http://www.ntsb.go	GRD	3	NA	B737G3	1	1																																																N	DS	ML
31/07/2000	N	http://www.ntsb.go	DES	3	NA	B737G3										1																											1												1	L	DS	ML
02/07/2000	N	http://www.ntsb.go	GRD	3	NA	B737G3	1	1																					1								1						1					1					1		1	H	DS	ML
20/05/2000	N	http://www.ntsb.go	GRD	3	NA	B737G3																						1																												N	DS	ML
05/03/2000	N	http://www.ntsb.go	LDG	3	NA	B737G3							1																1								1						1								1		1		1	H	DS	ML
03/03/2000	N	http://ntsb.gov/ntsb	CRZ	3	NA	B737G3				1																																														U	DS	ML
27/02/2000	N	http://www.ntsb.go	LDG	3	SA	B737G3			1	1								1																			1						1								1				1	M	DS	ML
13/01/2000	I	http://www.ntsb.go	GRD	3	EUR	B737G3																				1																														N	DS	ML
8/6/2000	I	http://www.ntsb.go	TO	3	NA	B747G3							1			1																																								U		
12/12/2000	I	http://www.ntsb.go	CRZ	3	NA	B747G3				1			1																																											U		
10/31/2000	F	http://www.ntsb.go	TO	3	ASIA	B747G3	1			1		1						1											1								1		1				1						1		1				1	H		
11/15/2000	I	http://www.ntsb.go	APR	3	EUR	B757				1															1																															N		
4/2/2000	N	http://www.ntsb.go	CRZ	3	NA	B757				1																																														U		
8/23/2000	N	http://www.ntsb.go	CRZ	3	NA	B757				1																					1																									U		
1/11/2000	N	http://www.ntsb.go	CRZ	3	NA	B757				1																										1									1										L		
2/12/2000	N	http://www.ntsb.go	LDG	3	SA	B757				1		1						1																			1						1								1				1	H		
6/18/2000	I	http://www.ntsb.go	CRZ	3	AFR	B767																	1			1																														U	SF	DB
9/20/2000	N	http://www.ntsb.go	DES	3	NA	B767				1																																														U		
12/27/2000	N	http://www.ntsb.go	GRD	3	NA	B767	1																																																	N		
11/26/2000	N	http://www.ntsb.go	DES	3	NA	B767				1																																														U		
2/22/2000	N	http://www.ntsb.go	LDG	3	AFR	B767				1																																	1												1	H		
6/7/2000	I	http://www.ntsb.go	CRZ	3	NA	B767																				1	1																													N		
3/30/2000	I	http://www.ntsb.go	CLB	3	NA	B767				1									1																		1						1				1								1	M		
11/4/2000	N	http://www.ntsb.go	DES	3	NA	B767				1																																														U		
5/24/2000	N	http://www.ntsb.go	GRD	3	NA	B767		1																																																L		
29/11/2000	I	http://www.ntsb.go	CLB	3	NA	DC9-8x				1															1																															N	Ben	ml

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
10/10/2000	I	http://www.ntsb.go	APR	3	NA	DC9-8x													1																																					N	Ben	ml
27/12/2000	I	http://www.ntsb.go	TO	3	NA	EMB-135																				1	1								1																					M	ML	JS
11/25/2000	I	http://www.ntsb.go	CLB	3	NA	MD11																				1																														N		
9/29/2000	I	http://www.ntsb.go	TO	3	ASIA	MD11																	1			1																														N		
15/07/1999	N	http://www.ntsb.go	LDG	3	NA	A306						1																															1				1					1			1	H	EV	AAD
11/05/1999	I	http://www.ntsb.go	APR	3	NA	A306																				1																														U	EV	AAD
24/03/1999	N	http://aviation-safet	LDG	3	ASIA	A306			1	1														1		1			1															1								1	1		1	H	EV	AAD
27/12/1999	N	http://www.aaiu.ie/	LDG	3	EUR	A310						1																	1								1							1				1	1				1		1	H	EV	AAD
28/06/1999	N	http://www.ntsb.go	LDG	3	ASIA	A310																																					1											1	U	EV	AAD
24/12/1999	I	http://www.ntsb.go	GRD	3	NA	B737G3																				1																														N	DS	ML
11/11/1999	I	http://www.ntsb.go	CLB	3	NA	B737G3																				1																														N	DS	ML
02/11/1999	I	http://www.ntsb.go	LDG	3	NA	B737G3																							1								1									1	1								H	DS	ML
12/09/1999	N	http://www.ntsb.go	GRD	3	NA	B737G3	1	1																																															N	DS	ML
12/09/1999	N	http://www.ntsb.go	CLB	3	NA	B737G3																	1																																N	DS	ML
02/09/1999	N	http://www.ntsb.go	CRZ	3	NA	B737G3														1																																			L	DS	ML
08/07/1999	N	http://www.ntsb.go	CRZ	3	OTH	B737G3				1																																													U	DS	ML
25/06/1999	N	http://www.ntsb.go	CRZ	3	NA	B737G3				1																																													U	DS	ML
25/05/1999	N	http://www.ntsb.go	DES	3	NA	B737G3				1																																													U	DS	ML
07/04/1999	F	http://www.ntsb.go	TO	3	ME	B737G3				1																1			1								1		1				1	1			1					1		1	H	DS	ML
17/03/1999	N	http://www.ntsb.go	GRD	3	NA	B737G3	1																																																N	DS	ML
9/23/1999	U	Factual	LDG	3	ASIA	B747G3			1	1			1					1													1						1						1	1			1	1						1	H		
6/6/1999	N	http://www.ntsb.go	GRD	3	NA	B747G3		1					1																								1						1				1								M		
9/20/1999	N	http://www.ntsb.go	DES	3	NA	B757																				1									1								1											1	L	SF	DB
10/28/1999	I	http://www.ntsb.go	CRZ	3	NA	B757																				1																														N		
2/7/1999	N	Probable Cause	CRZ	3	NA	B757				1																																													U		
2/22/1999	N	http://www.ntsb.go	TO	3	NA	B757																1																																	N		
9/14/1999	N	http://aviation-safet	LDG	3	EUR	B757			1	1								1																		1		1				1				1			1					1	H		
7/24/1999	N	http://www.ntsb.go	GRD	3	NA	B757	1																						1								1		1							1						1			H		
6/2/1999	N	http://www.ntsb.go	LDG	3	NA	B757																		1																			1											1	M		
6/9/1999	I	http://www.ntsb.go	LDG	3	SA	B757																																					1											1	H		
9/27/1999	N	http://www.ntsb.go	APR	3	NA	B767				1			1			1		1																																					U		
10/31/1999	F	http://www.ntsb.go	CRZ	3	NA	B767																														1						1					1							1	U		
6/29/1999	I	http://www.ntsb.go	GRD	3	NA	B767		1					1																							1						1				1				1			1	H		
8/24/1999	I	http://www.ntsb.go	TO	3	EUR	B767																																																	U		
11/20/1999	I	http://www.ntsb.go	APR	3	NA	B767																				1										1																			N		
1/15/1999	N	http://www.aaib.go	LDG	3	EUR	B767																								1					1		1						1				1								H		
12/6/1999	I	http://www.ntsb.go	TO	3	NA	B767																				1																														N		
25/06/1999	I	http://www.ntsb.go	TO	3	NA	DC9-8x																	1																																N	Ben	ml
24/08/1999	I	http://www.ntsb.go	TO	3	NA	EMB-135																					1															1											1	L	ML	JS
8/23/1999	N	http://www.ntsb.go	LDG	3	ASIA	MD11																																				1											1	M		
6/30/1999	N	http://www.ntsb.go	APR	3	ASIA	MD11																				1																1											1	U		
10/5/1999	N	http://www.ntsb.go	LDG	3	NA	MD11																				1																														N		
8/8/1999	N	http://www.ntsb.go	LDG	3	ASIA	MD11																																				1											1	M		
4/15/1999	F	http://www.ntsb.go	CLB	3	ASIA	MD11																				1																														U		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
9/18/1999	I	http://www.aaiu.ie/	LDG	3	EUR	MD11			1	1		1															1
10/17/1999	N	http://www.ntsb.go	LDG	3	ASIA	MD11																					1
27/11/1998	I	http://www.ntsb.go	UNK	3	ASIA	A306																				1	
28/09/1998	I	http://www.ntsb.go	TO	3	EUR	A306																					
09/07/1998	I	http://www.ntsb.go	CLB	3	NA	A306																	1		1		
20/04/1998	I	http://www.ntsb.go	CRZ	3	OTH	A306																				1	
16/02/1998	F	http://aviation-safet	GA	3	ASIA	A306												1	1								
11/12/1998	F	http://aviation-safet	APR	3	ASIA	A310				1								1									
13/12/1998	N	http://www.ntsb.go	CRZ	3	NA	B737G3				1																	
06/11/1998	I	http://www.ntsb.go	LDG	3	NA	B737G3																				1	
16/09/1998	N	http://www.ntsb.go	LDG	3	NA	B737G3			1	1		1						1									
14/08/1998	N	http://www.ntsb.go	LDG	3	NA	B737G3																					
07/08/1998	I	http://www.ntsb.go	CLB	3	NA	B737G3														1							
07/07/1998	I	http://www.ntsb.go	APR	3	NA	B737G3																				1	
02/07/1998	I	http://www.ntsb.go	CRZ	3	SA	B737G3																				1	
27/06/1998	I	http://www.ntsb.go	LDG	3	EUR	B737G3																				1	
20/06/1998	I	http://www.ntsb.go	UNK	3	EUR	B737G3																				1	
17/06/1998	N	http://www.ntsb.go	GRD	3	NA	B737G3	1	1																			
11/11/1998	N	http://www.ntsb.go	GRD	3	NA	B747G3		1	1	1																	
7/31/1998	I	http://www.ntsb.go	UNK	3	EUR	B747G3																	1		1	1	
11/30/1998	N	http://www.ntsb.go	GRD	3	NA	B747G3	1	1																			
11/28/1998	I	http://www.ntsb.go	CRZ	3	EUR	B747G3																			1	1	
8/5/1998	N	http://www.ntsb.go	LDG	3	ASIA	B747G3			1	1								1									
3/17/1998	I	http://www.ntsb.go	UNK	3	SA	B757																					
2/17/1998	I	http://www.ntsb.go	GRD	3	EUR	B757		1																		1	
9/20/1998	N	http://www.ntsb.go	LDG	3	SA	B757																					
6/22/1998	I	http://www.ntsb.go	CRZ	3	EUR	B757																			1	1	
1/6/1998	N	http://www.ntsb.go	CRZ	3	NA	B757				1																	
1/1/1998	N	http://www.aaib.go	LDG	3	NA	B757				1								1									
11/29/1998	I	http://www.ntsb.go	LDG	3	NA	B757							1				1										
5/24/1998	N	http://www.ntsb.go	CRZ	3	NA	B757				1																	
5/12/1998	N	http://www.ntsb.go	TO	3	AFR	B767										1	1										
9/11/1998	N	http://www.ntsb.go	LDG	3	NA	B767			1	1		1						1									
4/4/1998	I	http://www.ntsb.go	CRZ	3	EUR	B767																			1	1	
11/25/1998	N	http://www.ntsb.go	CRZ	3	NA	B767																					
1/9/1998	N	http://www.ntsb.go	CLB	3	EUR	B767																			1	1	
7/22/1998	N	http://www.ntsb.go	CLB	3	NA	B767				1																	
10/4/1998	N	http://www.ntsb.go	APR	3	SA	B767				1																	
9/12/1998	I	http://www.ntsb.go	TO	3	ASIA	B767																					
29/07/1998	N	http://www.ntsb.go	TO	3	NA	EMB-135																					1
28/12/1998	N	http://www.ntsb.go	LDG	3	SA	EMB-145																					
11/02/1998	N	http://www.ntsb.go	TO	3	NA	EMB-145															1						
11/8/1998	I	http://www.ntsb.go	GRD	3	NA	MD11																			1		
10/21/1998	I	http://www.ntsb.go	TO	3	NA	MD11																				1	

	Factors (Non-Technical)																		Competencies									Validation		
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatigue	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
9/18/1999										1						1	1						1		1		1	H		
10/17/1999										1						1				1					1		1	H		
27/11/1998																												U	EV	AAD
28/09/1998																												U	EV	AAD
09/07/1998			1							1		1										1			1			H	EV	AAD
20/04/1998																												N	EV	AAD
16/02/1998		1								1						1					1					1	1	H	EV	AAD
11/12/1998																												U	EV	AAD
13/12/1998																												N	DS	ML
06/11/1998																												N	DS	ML
16/09/1998										1						1							1				1	L	DS	ML
14/08/1998										1						1									1		1	H	DS	ML
07/08/1998																												N	DS	ML
07/07/1998		EUR																										N	DS	ML
02/07/1998																												N	DS	ML
27/06/1998																												N	DS	ML
20/06/1998																												N	DS	ML
17/06/1998		1								1							1								1			L	DS	ML
11/11/1998																1											1	M	SF	DB
7/31/1998																												U		
11/30/1998										1									1	1								M		
11/28/1998																												U		
8/5/1998										1						1				1			1				1	M		
3/17/1998	1																											N		
2/17/1998																												N		
9/20/1998																1											1	M		
6/22/1998																												N		
1/6/1998																												U		
1/1/1998		1								1	1	1				1					1		1				1	M		
11/29/1998																												U		
5/24/1998																												U		
5/12/1998																												U		
9/11/1998				1						1						1							1		1		1	H		
4/4/1998																												N		
11/25/1998														1														N		
1/9/1998																												N		
7/22/1998	1																											U		
10/4/1998																												U		
9/12/1998																1											1	M		
29/07/1998																1											1	L	ML	JS
28/12/1998																1											1	U	ML	JS
11/02/1998		1								1						1				1					1		1	H	MS	ML
11/8/1998																												U		
10/21/1998																												U		

Evidence-Based Training Accident-Incident Matrix Continued

Accidents

Date	Severity	Info Source Link	Phase	Generation	Region	Type
6/14/1998	N	http://www.ntsb.go	LDG	3	SA	MD11
9/2/1998	F	http://www.ntsb.go	CRZ	3	NA	MD11
7/5/1998	I	http://www.ntsb.go	TO	3	EUR	MD11
11/11/1998	N	http://www.ntsb.go	LDG	3	NA	MD11
12/25/1998	I	http://www.ntsb.go	LDG	3	ASIA	MD11
9/10/1998	I	http://www.ntsb.go	LDG	3	ASIA	MD11
10/8/1998	I	http://www.ntsb.go	CRZ	3	EUR	MD11
11/27/1998	I	http://www.ntsb.go	CLB	3	Asia	MD11
26/09/1997	N	http://www.ntsb.go	DES	3	NA	A306
30/06/1997	I	http://www.ntsb.go	TO	3	ASIA	A306
12/05/1997	N	http://www.ntsb.go	DES	3	NA	A306
07/01/1997	N	http://www.ntsb.go	CRZ	3	NA	A306
25/12/1997	I	http://www.ntsb.go	GRD	3	NA	B737G3
27/09/1997	I	http://www.ntsb.go	TO	3	NA	B737G3
21/08/1997	I	http://www.ntsb.go	DES	3	NA	B737G3
20/06/1997	I	http://www.ntsb.go	APR	3	NA	B737G3
08/06/1997	N	http://www.ntsb.go	DES	3	NA	B737G3
11/05/1997	I	http://www.ntsb.go	APR	3	NA	B737G3
08/05/1997	F	http://www.ntsb.go	APR	3	ASIA	B737G3
18/04/1997	N	http://www.ntsb.go	DES	3	NA	B737G3
16/04/1997	I	http://www.ntsb.go	APR	3	NA	B737G3
18/01/1997	N	http://www.ntsb.go	TO	3	SA	B737G3
4/12/1997	N	http://www.ntsb.go	APR	3	NA	B747G3
9/14/1997	N	http://www.ntsb.go	CRZ	3	NA	B747G3
5/14/1997	N	http://www.ntsb.go	GRD	3	EUR	B747G3
12/24/1997	N	http://www.ntsb.go	LDG	3	EUR	B757
1/31/1997	I	http://www.ntsb.go	CLB	3	NA	B757
3/2/1997	N	http://www.ntsb.go	DES	3	NA	B757
3/1/1997	I	http://www.ntsb.go	GRD	3	NA	B757
7/10/1997	I	http://www.ntsb.go	CRZ	3	NA	B757
8/2/1997	F	http://www.ntsb.go	GRD	3	SA	B757
10/16/1997	I	http://www.ntsb.go	TO	3	NA	B757
6/3/1997	N	http://www.ntsb.go	CRZ	3	SA	B767
3/27/1997	I	http://www.ntsb.go	APR	3	NA	B767
5/22/1997	N	http://www.ntsb.go	LDG	3	NA	B767
2/25/1997	N	http://www.ntsb.go	DES	3	NA	B767
01/10/1997	N	http://www.ntsb.go	CRZ	3	NA	DC9-8x
25/09/1997	I	http://www.ntsb.go	LDG	3	NA	DC9-8x
01/09/1997	N	http://www.ntsb.go	LDG	3	NA	DC9-8x
14/03/1997	N	http://www.ntsb.go	TO	3	NA	DC9-8x
05/03/1997	N	http://www.ntsb.go	LDG	3	NA	DC9-8x
6/21/1997	N	http://www.ntsb.go	LDG	3	NA	MD11
10/24/1997	U	http://www.ntsb.go	LDG	3	SA	MD11
6/8/1997	N	http://www.mlit.go.j	DES	3	ASIA	MD11

Factors

Date	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
6/14/1998			1																		
9/2/1998																			1	1	
7/5/1998																				1	
11/11/1998																					
12/25/1998																					
9/10/1998																				1	
10/8/1998																			1		
11/27/1998																			1		
26/09/1997				1																	
30/06/1997																					
12/05/1997				1								1	1								
07/01/1997				1																	
25/12/1997																			1		
27/09/1997																				1	
21/08/1997																1					
20/06/1997																			1		
08/06/1997										1											
11/05/1997							1														
08/05/1997			1	1															1	1	
18/04/1997							1			1											
16/04/1997																			1	1	
18/01/1997																				1	
4/12/1997																1					
9/14/1997				1																	
5/14/1997		1																			
12/24/1997																				1	
1/31/1997																	1			1	
3/2/1997				1																	
3/1/1997		1					1														
7/10/1997				1																	
8/2/1997																					
10/16/1997																				1	
6/3/1997				1																	
3/27/1997																				1	
5/22/1997				1	1	1	1														
2/25/1997				1																	
01/10/1997				1																	
25/09/1997			1																		
01/09/1997																				1	1
14/03/1997				1								1					1				
05/03/1997			1	1			1														
6/21/1997																					
10/24/1997																					
6/8/1997				1	1		1														

Factors (Non-Technical)

Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
6/14/1998																1		
9/2/1998										1								
7/5/1998																		
11/11/1998										1				1	1	1		
12/25/1998																1		
9/10/1998																		
10/8/1998																		
11/27/1998																		
26/09/1997																		
30/06/1997				1														
12/05/1997		1								1					1	1		
07/01/1997	1																	
25/12/1997		1								1								
27/09/1997																		
21/08/1997																		
20/06/1997																		
08/06/1997																		
11/05/1997		1								1								
08/05/1997										1						1		
18/04/1997		1								1					1		1	
16/04/1997																		
18/01/1997																		
4/12/1997																		
9/14/1997																		
5/14/1997		1																
12/24/1997																		
1/31/1997																		
3/2/1997																		
3/1/1997		1								1						1		
7/10/1997				1						1								
8/2/1997																		
10/16/1997																		
6/3/1997																		
3/27/1997																		
5/22/1997				1						1						1		
2/25/1997																		
01/10/1997										1								
25/09/1997																		
01/09/1997																		
14/03/1997		1																
05/03/1997			1							1					1			
6/21/1997		1								1						1		
10/24/1997																1		
6/8/1997		1	1					1		1					1		1	

Competencies / Validation

Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
6/14/1998									1	M		
9/2/1998					1		1			M		
7/5/1998										N		
11/11/1998		1					1	1	1	H		
12/25/1998									1	U		
9/10/1998										N		
10/8/1998										N		
11/27/1998										U		
26/09/1997										N	EV	AAD
30/06/1997										U	EV	AAD
12/05/1997		1						1	1	H	EV	AAD
07/01/1997										N	EV	AAD
25/12/1997					1		1			M	DS	ML
27/09/1997										N	DS	ML
21/08/1997										N	DS	ML
20/06/1997										N	DS	ML
08/06/1997										N	DS	ML
11/05/1997		1					1			H	DS	ML
08/05/1997									1	H	DS	ML
18/04/1997			1					1		M	DS	ML
16/04/1997										N	DS	ML
18/01/1997										N	DS	ML
4/12/1997										N	SF	DB
9/14/1997										U		
5/14/1997										U		
12/24/1997										U	SF	DB
1/31/1997										N		
3/2/1997										U		
3/1/1997	1				1				1	M		
7/10/1997					1					U		
8/2/1997										N		
10/16/1997										N		
6/3/1997										U	SF	DB
3/27/1997										N		
5/22/1997		1			1				1	H		
2/25/1997										U		
01/10/1997	1									L	ml	ds
25/09/1997										U	ml	ds
01/09/1997										N	ml	ds
14/03/1997										H	ml	ds
05/03/1997					1	1				M	ml	ds
6/21/1997					1		1		1	H		
10/24/1997									1	M		
6/8/1997					1	1		1	1	H		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents

Date	Severity	Info Source Link	Phase	Generation	Region	Type
7/31/1997	N	http://www.ntsb.gov	LDG	3	NA	MD11
20/02/1996	N	http://www.ntsb.gov	GRD	3	NA	A306
17/01/1996	N	http://www.ntsb.gov	CRZ	3	NA	A306
22/12/1996	N	http://www.ntsb.gov	CRZ	3	NA	B737G3
19/11/1996	N	http://www.ntsb.gov	CRZ	3	NA	B737G3
29/08/1996	N	http://www.ntsb.gov	CRZ	3	NA	B737G3
06/06/1996	N	http://www.ntsb.gov	GRD	3	NA	B737G3
10/05/1996	I	http://www.ntsb.gov	LDG	3	NA	B737G3
30/04/1996	I	http://www.ntsb.gov	LDG	3	NA	B737G3
4/7/1996	N	http://www.ntsb.gov	CRZ	3	OTH	B757
2/20/1996	N	http://www.ntsb.gov	GRD	3	NA	B757
2/20/1996	N	http://www.ntsb.gov	GRD	3	NA	B757
10/2/1996	F	http://www.ntsb.gov	CLB	3	SA	B757
2/6/1996	F	http://www.ntsb.gov	CLB	3	NA	B757
3/23/1996	N	http://www.ntsb.gov	CRZ	3	NA	B757
12/11/1996	I	http://www.ntsb.gov	APR	3	NA	B757
5/28/1996	I	http://www.ntsb.gov	CRZ	3	NA	B767
11/19/1996	I	http://www.ntsb.gov	APR	3	NA	B767
6/25/1996	I	http://www.ntsb.gov	CLB	3	NA	B767
2/20/1996	I	http://www.ntsb.gov	APR	3	NA	B767
2/20/1996	N	http://www.ntsb.gov	GRD	3	NA	B767
6/19/1996	I	http://www.ntsb.gov	CLB	3	NA	B767
6/6/1996	N	http://www.ntsb.gov	GRD	3	NA	B767
05/06/1996	I	http://www.ntsb.gov	LDG	3	NA	DC9-8x
5/16/1996	N	http://www.ntsb.gov	LDG	3	NA	MD11
11/6/1996	I	http://www.ntsb.gov	LDG	3	SA	MD11
11/7/1996	I	http://www.ntsb.gov	DES	3	NA	MD11
5/25/1996	N	http://www.ntsb.gov	LDG	3	NA	MD11
1/23/1996	N	http://www.ntsb.gov	GRD	3	NA	MD11
7/13/1996	N	http://www.ntsb.gov	DES	3	NA	MD11
25/06/1995	I	http://www.ntsb.gov	CRZ	3	NA	A306
31/03/1995	F	http://aviation-safe	CLB	3	EUR	A310
25/11/1995	N	http://www.ntsb.gov	DES	3	NA	B737G3
02/11/1995	I	http://www.ntsb.gov	TO	3	NA	B737G3
29/10/1995	I	http://www.ntsb.gov	APR	3	NA	B737G3
26/09/1995	I	http://www.ntsb.gov	TO	3	NA	B737G3
06/09/1995	N	http://www.ntsb.gov	GRD	3	NA	B737G3
25/08/1995	I	http://www.ntsb.gov	DES	3	NA	B737G3
18/08/1995	I	http://www.ntsb.gov	TO	3	NA	B737G3
05/08/1995	I	http://www.ntsb.gov	DES	3	NA	B737G3
28/07/1995	N	http://www.ntsb.gov	GRD	3	NA	B737G3
18/07/1995	I	http://www.ntsb.gov	DES	3	NA	B737G3
19/05/1995	I	http://www.ntsb.gov	GRD	3	NA	B737G3
19/05/1995	N	http://www.ntsb.gov	CRZ	3	NA	B737G3

Factors

Date	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
7/31/1997																					1
20/02/1996		1																	1	1	
17/01/1996				1																	
22/12/1996				1																	
19/11/1996				1																	
29/08/1996				1																	
06/06/1996	1	1																			
10/05/1996			1	1		1						1									
30/04/1996																				1	
4/7/1996				1																	
2/20/1996		1																			
2/20/1996		1																			
10/2/1996																				1	
2/6/1996												1								1	
3/23/1996				1																	
12/11/1996																			1	1	
5/28/1996																				1	
11/19/1996							1		1		1										
6/25/1996																				1	
2/20/1996				1																	
2/20/1996		1																	1	1	
6/19/1996																	1	1	1	1	
6/6/1996		1																			
05/06/1996					1																
5/16/1996				1		1								1							1
11/6/1996																					
11/7/1996																				1	
5/25/1996																					
1/23/1996		1					1														
7/13/1996																					1
25/06/1995				1																	
31/03/1995													1							1	
25/11/1995				1																	
02/11/1995																1	1				
29/10/1995													1								
26/09/1995																			1	1	
06/09/1995	1	1																			
25/08/1995																				1	1
18/08/1995																				1	
05/08/1995																				1	
28/07/1995							1			1											
18/07/1995																				1	1
19/05/1995		1																			
19/05/1995				1																	

Factors (Non-Technical)

Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
7/31/1997										1						1		
20/02/1996	1																	
17/01/1996				1														
22/12/1996																		
19/11/1996																		
29/08/1996																		
06/06/1996																		
10/05/1996		1								1						1		
30/04/1996																		
4/7/1996	1			1														
2/20/1996		1								1								
2/20/1996																		
10/2/1996										1						1		
2/6/1996										1						1	1	
3/23/1996																		
12/11/1996																		
5/28/1996																		
11/19/1996		1								1								
6/25/1996																		
2/20/1996																		
2/20/1996																		
6/19/1996																		
6/6/1996								1										
05/06/1996				1														
5/16/1996		1	1					1		1						1		
11/6/1996																1		
11/7/1996																		
5/25/1996										1						1		
1/23/1996										1								
7/13/1996		1	1					1		1					1	1	1	
25/06/1995																		
31/03/1995										1					1	1		
25/11/1995																		
02/11/1995																		
29/10/1995																		
26/09/1995																		
06/09/1995																		
25/08/1995																		
18/08/1995																		
05/08/1995																		
28/07/1995										1								
18/07/1995																		
19/05/1995																		
19/05/1995																		

Competencies / Validation

Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
7/31/1997					1		1		1	H		
20/02/1996										H	EV	AAD
17/01/1996										N	EV	AAD
22/12/1996										N	DS	ML
19/11/1996										N	DS	ML
29/08/1996										N	DS	ML
06/06/1996										N	DS	ML
10/05/1996		1			1				1	H	DS	ML
30/04/1996										N	DS	ML
4/7/1996										U		
2/20/1996		1					1		1	M		
2/20/1996										N		
10/2/1996		1			1				1	M		
2/6/1996		1			1				1	H		
3/23/1996										U		
12/11/1996										N		
5/28/1996										N		
11/19/1996	1	1					1			M		
6/25/1996										N		
2/20/1996										U		
2/20/1996										N		
6/19/1996										N		
6/6/1996										M		
05/06/1996										U	ml	ds
5/16/1996					1	1			1	H	SF	DB
11/6/1996									1	M		
11/7/1996										N		
5/25/1996			1				1		1	M		
1/23/1996	1	1								L		
7/13/1996						1	1	1	1	M		
25/06/1995										N	EV	AAD
31/03/1995	1	1						1	1	H	EV	MS
25/11/1995										U	DS	ML
02/11/1995										N	DS	ML
29/10/1995										U	DS	ML
26/09/1995										N	DS	ML
06/09/1995										N	DS	ML
25/08/1995										N	DS	ML
18/08/1995										N	DS	ML
05/08/1995										N	DS	ML
28/07/1995	1	1								M	DS	ML
18/07/1995										N	DS	ML
19/05/1995										N	DS	ML
19/05/1995										N	DS	ML

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
13/04/1995	N	http://www.ntsb.go	LDG	3	NA	B737G3					1																			1									1							1					1				1		1	M	DS	ML
23/01/1995	I	http://www.ntsb.go	TO	3	NA	B737G3																				1																														N	DS	ML
01/01/1995	I	http://www.ntsb.go	DES	3	NA	B737G3														1																																				L	DS	ML
10/17/1995	N	http://www.ntsb.go	CRZ	3	OTH	B747G3				1																																														U		
12/20/1995	F	http://www.ntsb.go	DES	3	SA	B757												1			1								1					1			1		1			1	1	1			1			1			1	1	H		
8/4/1995	N	http://www.ntsb.go	CRZ	3	NA	B757				1																																												U		
4/11/1995	N	http://www.ntsb.go	GRD	3	NA	B757																							1								1						1									1		1	M		
6/20/1995	N	http://www.ntsb.go	CRZ	3	NA	B767				1							1																																					U		
5/19/1995	I	http://www.ntsb.go	GRD	3	NA	B767		1																																														U		
2/27/1995	I	http://www.ntsb.go	APR	3	NA	MD11							1																																									N		
4/2/1995	N	http://www.ntsb.go	GRD	3	NA	MD11																			1																													N		
10/08/1994	N	http://aviation-safe	LDG	3	ASIA	A306				1															1				1								1						1							1		1		1	H	EV	AAD
26/04/1994	F	http://aviation-safe	APR	3	ASIA	A306													1								1		1	1					1		1					1	1	1						1	1		1	1	H	AB	AAD
28/01/1994	N	http://aviation-safe	CRZ	3	NA	A306				1																																												N	AB	AAD
24/09/1994	N	http://aviation-safe	APR	3	EUR	A310													1								1		1								1					1	1				1					1		1	1	H	EV	MS
23/03/1994	F	http://aviation-safe	CRZ	3	ASIA	A310													1										1								1					1	1					1			1		1	1	N	EV	MS
29/12/1994	F	http://www.ntsb.go	APR	3	ME	B737G3				1								1			1								1								1						1				1					1				M	DS	ML
11/12/1994	N	http://www.ntsb.go	CLB	3	NA	B737G3																				1																														N	DS	ML
19/09/1994	N	http://www.ntsb.go	DES	3	OTH	B737G3				1																																												L	DS	ML
08/09/1994	F	http://www.ntsb.go	APR	3	NA	B737G3													1							1	1																												N	DS	ML
01/07/1994	I	http://www.ntsb.go	APR	3	NA	B737G3							1			1																																						L	DS	ML
2/12/1994	N	http://www.ntsb.go	CRZ	3	OTH	B747G3				1																																												U		
8/19/1994	N	http://www.ntsb.go	GRD	3	NA	B757		1																																														N		
11/6/1994	N	http://www.ntsb.go	GRD	3	NA	B757		1																					1								1						1							1				1	M		
11/25/1994	N	http://www.ntsb.go	LDG	3	NA	B757																															1						1							1				1	H		
6/29/1994	N	http://www.ntsb.go	CRZ	3	NA	B767				1																											1											1		1					M		
1/1/1994	I	http://www.ntsb.go	GRD	3	NA	B767		1																				1																												N		
22/11/1994	F	http://www.ntsb.go	TO	3	NA	DC9-8x											1	1																																				N	ml	ds
11/4/1994	N	http://www.ntsb.go	LDG	3	NA	MD11																					1										1						1					1			1	1		1	H	SF	DB
9/28/1994	I	http://www.ntsb.go	APR	3	NA	MD11																				1																														N	SF	DB
6/29/1994	N	http://www.ntsb.go	CRZ	3	SA	MD11																														1						1			1		1							1	M		
8/19/1994	N	http://www.ntsb.go	LDG	3	NA	MD11																					1																1												1	H		
10/13/1994	I	http://www.ntsb.go	CLB	3	NA	MD11																				1																														N		
08/12/1993	I	http://www.ntsb.go	LDG	3	NA	B737G3												1											1								1													1		1			H	DS	ML
21/09/1993	I	http://www.ntsb.go	CRZ	3	NA	B737G3																						1										1																	N	DS	ML
08/09/1993	I	http://www.ntsb.go	APR	3	NA	B737G3																				1																														N	DS	ML
23/04/1993	I	http://www.ntsb.go	APR	3	NA	B737G3														1																	1													1		1			M	DS	ML
9/15/1993	N	http://www.ntsb.go	CLB	3	NA	B757				1																											1											1		1					M		
6/24/1993	N	http://www.ntsb.go	DES	3	NA	B757				1																																												N		
8/2/1993	N	http://www.ntsb.go	LDG	3	NA	B757																														1						1					1						1	H		
10/4/1993	I	http://www.ntsb.go	TO	3	NA	B757																							1								1						1									1		1	H		
2/23/1993	N	http://www.ntsb.go	LDG	3	NA	B757																	1			1																		1											1	H		
2/13/1993	I	http://www.ntsb.go	CRZ	3	NA	B757																				1																														N		
4/7/1993	I	http://www.ntsb.go	CRZ	3	NA	B757				1																1																		1											1	L		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
9/13/1993	I	http://www.ntsb.go	CRZ	3	NA	B757																				1	
6/8/1993	I	http://www.ntsb.go	CLB	3	NA	B757																				1	
4/26/1993	N	http://www.ntsb.go	DES	3	NA	B757				1																	
10/22/1993	N	http://www.ntsb.go	CRZ	3	SA	B767				1																	
7/16/1993	N	http://www.ntsb.go	CRZ	3	NA	B767				1																	
1/8/1993	I	http://www.ntsb.go	CRZ	3	NA	B767																					
4/5/1993	N	http://www.ntsb.go	LDG	3	SA	B767				1		1					1										
4/10/1993	I	http://www.ntsb.go	CRZ	3	NA	B767				1																1	1
1/5/1993	N	http://www.ntsb.go	CRZ	3	NA	B767				1																	
02/09/1993	I	http://www.ntsb.go	GRD	3	NA	DC9-8x		1																		1	1
18/06/1993	I	http://www.ntsb.go	CLB	3	NA	DC9-8x																	1		1		
27/04/1993	N	http://www.ntsb.go	LDG	3	NA	DC9-8x																				1	
26/04/1993	N	http://www.ntsb.go	LDG	3	NA	DC9-8x				1	1																
10/01/1993	I	http://www.ntsb.go	LDG	3	NA	DC9-8x							1														
4/30/1993	I	http://www.ntsb.go	LDG	3	NA	MD11							1														1
4/6/1993	F	http://www.ntsb.go	CRZ	3	NA	MD11													1								1
31/07/1992	F	http://aviation-safe	APR	3	ASIA	A310							1								1					1	
08/12/1992	F	http://www.ntsb.go	GRD	3	NA	B737G3	1	1																			
12/10/1992	I	http://www.ntsb.go	TO	3	NA	B737G3																	1		1		
03/08/1992	N	http://www.ntsb.go	DES	3	NA	B737G3				1																	
03/01/1992	I	http://www.ntsb.go	CLB	3	NA	B737G3																				1	
11/13/1992	N	http://www.ntsb.go	GRD	3	NA	B757		1																			
5/4/1992	I	http://www.ntsb.go	GRD	3	NA	B757		1																			
3/27/1992	N	http://www.ntsb.go	GRD	3	NA	B757		1																			
1/23/1992	I	http://www.ntsb.go	DES	3	NA	B757				1								1					1			1	
3/21/1992	N	http://www.ntsb.go	GRD	3	NA	B757		1																			
6/27/1992	I	http://www.ntsb.go	CLB	3	NA	B767																	1			1	
5/13/1992	I	http://www.ntsb.go	TO	3	NA	B767																			1	1	
2/8/1992	I	http://www.ntsb.go	TO	3	NA	B767							1														
12/10/1992	I	http://www.ntsb.go	CRZ	3	NA	DC9-8x																		1		1	
8/2/1992	I	http://www.ntsb.go	LDG	3	NA	MD11																					1
9/16/1992	I	http://www.ntsb.go	LDG	3	NA	MD11																				1	
28/08/1991	I	http://www.ntsb.go	CRZ	3	UNK	A306				1																	
01/07/1991	N	http://www.ntsb.go	CRZ	3	NA	A306				1																	
18/12/1991	I	http://www.ntsb.go	TO	3	NA	A310																				1	
07/12/1991	I	http://www.ntsb.go	CLB	3	NA	A310																				1	
11/02/1991	N	http://aviation-safe	DES	3	EUR	A310													1								1
23/10/1991	N	http://www.ntsb.go	LDG	3	NA	B737G3																				1	
05/06/1991	N	http://www.ntsb.go	CRZ	3	NA	B737G3				1																	
01/02/1991	F	http://www.ntsb.go	LDG	3	NA	B737G3							1														
07/01/1991	I	http://www.ntsb.go	TO	3	NA	B737G3			1	1																	
6/16/1991	N	http://www.ntsb.go	DES	3	NA	B747G3				1																	
7/4/1991	N	http://www.ntsb.go	CRZ	3	NA	B757				1																	
8/29/1991	I	http://www.ntsb.go	TO	3	NA	B767																	1			1	

	Factors (Non-Technical)																		Competencies										Validation	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
9/13/1993																												N		
6/8/1993																												N		
4/26/1993		1																										M		
10/22/1993																												N		
7/16/1993																												N		
1/8/1993																1												N		
4/5/1993										1						1							1				1	M		
4/10/1993																												N		
1/5/1993																												U		
02/09/1993																												N	ml	ds
18/06/1993																												N	ml	ds
27/04/1993																	1											U	ml	ds
26/04/1993																1												L	ml	ds
10/01/1993																												N	ml	ds
4/30/1993																1											1	M		
4/6/1993										1						1								1			1	M		
31/07/1992		1			1					1		1			1	1			1	1		1				1		H	EV	MS
08/12/1992																												N	DS	ML
12/10/1992																												N	DS	ML
03/08/1992																												U	DS	ML
03/01/1992																												N	DS	ML
11/13/1992																												N		
5/4/1992																		1										N		
3/27/1992																												N		
1/23/1992		1								1						1					1				1			H		
3/21/1992																												N		
6/27/1992																												N		
5/13/1992	1																											N		
2/8/1992										1										1								U		
12/10/1992		1																										U	ml	ds
8/2/1992																1											1	M		
9/16/1992																												N		
28/08/1991																												N	AB	AAD
01/07/1991																												N	AB	AAD
18/12/1991																												N	EV	AAD
07/12/1991																												N	EV	AAD
11/02/1991		1								1					1	1				1				1		1	1	H	EV	MS
23/10/1991																												N	DS	ML
05/06/1991																												U	DS	ML
01/02/1991																												N	DS	ML
07/01/1991										1						1							1		1		1	H	DS	ML
6/16/1991										1									1		1							M		
7/4/1991																												U	SF	DB
8/29/1991																												N		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents / Factors

Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
5/4/1991	N	http://www.ntsb.go	CRZ	3	NA	B767				1																	
27/12/1991	N	http://www.ntsb.go	TO	3	EUR	DC9-8x				1													1			1	
23/12/1991	I	http://www.ntsb.go	TO	3	NA	DC9-8x							1				1										
23/09/1991	N	http://www.ntsb.go	GRD	3	NA	DC9-8x	1	1																			
12/08/1990	N	http://www.ntsb.go	UNK	3	EUR	A310																					
21/08/1990	I	http://www.ntsb.go	APR	3	NA	B737G3																				1	
09/08/1990	N	http://www.ntsb.go	CRZ	3	NA	B737G3				1																	
17/03/1990	I	http://www.ntsb.go	TO	3	NA	B737G3																	1		1	1	
16/03/1990	N	http://www.ntsb.go	TO	3	NA	B737G3																					
20/01/1990	I	http://www.ntsb.go	TO	3	NA	B737G3			1	1																	
2/14/1990	I	http://www.ntsb.go	LDG	3	NA	B747G3																				1	
1/16/1990	N	http://www.ntsb.go	TO	3	NA	B757																					
12/07/1989	F	http://www.ntsb.go	GRD	3	NA	A306		1																			
15/05/1989	I	http://www.ntsb.go	DES	3	NA	A310							1			1											
07/01/1989	I	http://www.ntsb.go	UNK	3	EUR	A310																					
27/10/1989	I	http://www.ntsb.go	CLB	3	NA	B737G3																			1	1	
20/09/1989	F	http://www.ntsb.go	TO	3	NA	B737G3																					
02/08/1989	I	http://www.ntsb.go	APR	3	NA	B737G3																					
17/03/1989	N	http://www.ntsb.go	GRD	3	NA	B737G3																				1	
12/15/1989	N	http://www.ntsb.go	DES	3	NA	B747G3				1																1	
1/19/1989	I	http://www.ntsb.go	CLB	3	NA	B757																				1	
9/13/1989	I	http://www.ntsb.go	LDG	3	NA	B757																					
11/6/1989	N	http://www.ntsb.go	GRD	3	NA	B757		1																			
10/9/1989	I	http://www.ntsb.go	DES	3	NA	B757																				1	
12/21/1989	N	http://www.ntsb.go	LDG	3	NA	B757																					
9/5/1989	I	http://www.ntsb.go	CRZ	3	NA	B767				1			1					1									
4/3/1989	N	http://www.ntsb.go	GRD	3	NA	B767																					
11/12/1989	I	http://www.ntsb.go	GRD	3	NA	DC9-8x			1																		
02/05/1989	I	http://www.ntsb.go	CRZ	3	NA	DC9-8x																				1	
01/03/1989	I	http://www.ntsb.go	APR	3	NA	DC9-8x							1			1											
27/11/1988	I	http://www.ntsb.go	CLB	3	NA	A306																	1		1	1	
24/10/1988	I	http://www.ntsb.go	TO	3	NA	A306																	1		1	1	
30/08/1988	I	http://www.ntsb.go	CRZ	3	NA	B737G3				1																	
26/07/1988	I	http://www.ntsb.go	DES	3	NA	B737G3				1													1				
24/05/1988	I	http://www.ntsb.go	DES	3	NA	B737G3				1													1				
18/03/1988	I	http://www.ntsb.go	CLB	3	NA	B737G3							1			1											
10/03/1988	I	http://www.ntsb.go	CRZ	3	NA	B737G3							1			1											
9/29/1988	N	Factual	UNK	3	SA	B757																					
3/22/1988	I	Probable Cause	UNK	3	NA	B757																					
4/16/1988	N	http://www.ntsb.go	UNK	3	SA	B757																					
1/25/1988	N	Probable Cause	UNK	3	NA	B767				1																	
8/26/1988	N	Probable Cause	UNK	3	NA	B767				1								1									
1/19/1988	N	Probable Cause	UNK	3	NA	B767				1																	
3/24/1988	I	Probable Cause	UNK	3	NA	B767				1																	

Factors (Non-Technical)

Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
5/4/1991										1						1		
27/12/1991			1					1		1					1			
23/12/1991										1								
23/09/1991										1								
12/08/1990																		
21/08/1990																		
09/08/1990																		
17/03/1990																		
16/03/1990		1								1						1		
20/01/1990		1																
2/14/1990																		
1/16/1990		1								1						1		
12/07/1989																		
15/05/1989																		
07/01/1989																		
27/10/1989																		
20/09/1989		1								1						1		
02/08/1989		1																
17/03/1989																		
12/15/1989		1		1		1				1								
1/19/1989																		
9/13/1989																1		
11/6/1989																		
10/9/1989																		
12/21/1989										1						1		
9/5/1989										1						1		
4/3/1989		1																
11/12/1989		1								1						1		
02/05/1989																		
01/03/1989										1								
27/11/1988																		
24/10/1988																		
30/08/1988		1								1								
26/07/1988		1								1								
24/05/1988										1								
18/03/1988																		
10/03/1988																		
9/29/1988																		
3/22/1988																		1
4/16/1988																		
1/25/1988																		
8/26/1988		1																
1/19/1988		1																
3/24/1988																		

Competencies / Validation

Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
5/4/1991					1		1			M		
27/12/1991		1				1		1		H	ml	MS
23/12/1991	1	1								L	ml	ds
23/09/1991		1			1					M	ml	ds
12/08/1990										U	MS	AAD
21/08/1990										N	DS	ML
09/08/1990										M	DS	ML
17/03/1990										N	DS	ML
16/03/1990		1					1		1	H	DS	ML
20/01/1990		1					1			H	DS	ML
2/14/1990										N		
1/16/1990		1	1						1	M		
12/07/1989										N	AB	AAD
15/05/1989										U	EV	AAD
07/01/1989										U	MS	AAD
27/10/1989										N	DS	ML
20/09/1989					1		1		1	H	DS	ML
02/08/1989										L	DS	ML
17/03/1989										N	DS	ML
12/15/1989						1	1			M	SF	DB
1/19/1989										N		
9/13/1989									1	H		
11/6/1989										N		
10/9/1989										N		
12/21/1989			1						1	H		
9/5/1989	1	1								M		
4/3/1989										H		
11/12/1989		1							1	M	ml	ds
02/05/1989										N	ml	ds
01/03/1989	1	1								N	ml	ds
27/11/1988										U	AB	AAD
24/10/1988										U	AB	AAD
30/08/1988		1					1			M	DS	ML
26/07/1988					1		1			M	DS	ML
24/05/1988					1		1			U	DS	ML
18/03/1988										N	DS	ML
10/03/1988										U	DS	ML
9/29/1988										U	SF	DB
3/22/1988										N		
4/16/1988										U		
1/25/1988										U		
8/26/1988										M		
1/19/1988										M		
3/24/1988										U		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents

Date	Severity	Info Source Link	Phase	Generation	Region	Type
03/02/1988	I	http://www.ntsb.gov	LDG	3	NA	DC9-8x
27/01/1988	N	http://www.ntsb.gov	CRZ	3	NA	DC9-8x
19/01/1988	N	http://www.ntsb.gov	CLB	3	NA	DC9-8x
11/11/1987	N	http://www.ntsb.gov	CRZ	3	NA	A310
08/09/1987	N	http://aviation-safet	LDG	3	AFR	A310
09/07/1987	I	http://www.ntsb.gov	CRZ	3	ASIA	A310
01/12/1987	I	http://www.ntsb.gov	GRD	3	NA	B737G3
25/11/1987	N	http://ntsb.gov/ntsb	GRD	3	NA	B737G3
29/10/1987	I	http://www.ntsb.gov	TO	3	NA	B737G3
16/03/1987	N	http://ntsb.gov/ntsb	CRZ	3	NA	B737G3
6/18/1987	I	Probable Cause	UNK	3	NA	B757
8/22/1987	I	Probable Cause	APR	3	NA	B767
7/12/1987	I	Probable Cause	UNK	3	NA	B767
8/16/1987	I	Factual	UNK	3	EUR	B767
10/4/1987	N	Probable Cause	UNK	3	NA	B767
01/11/1987	I	http://www.ntsb.gov	CLB	3	NA	DC9-8x
09/10/1987	I	http://www.ntsb.gov	CLB	3	NA	DC9-8x
16/08/1987	F	http://www.ntsb.gov	CLB	3	NA	DC9-8x
29/05/1987	I	http://www.ntsb.gov	CLB	3	NA	DC9-8x
23/03/1987	I	http://www.ntsb.gov	DES	3	NA	DC9-8x
26/10/1986	N	http://aviation-safet	CRZ	3	ASIA	A306
22/12/1986	N	http://ntsb.gov/ntsb	CRZ	3	NA	B737G3
20/02/1986	N	http://ntsb.gov/ntsb	TO	3	NA	B737G3
4/3/1986	I	Probable Cause	UNK	3	NA	B757
11/5/1986	I	Probable Cause	UNK	3	NA	B757
3/31/1986	I	Probable Cause	CLB	3	NA	B767
28/04/1985	N	http://ntsb.gov/ntsb	LDG	3	NA	B737G3
5/11/1985	I	Probable Cause	UNK	3	NA	B767
10/24/1985	I	Probable Cause	UNK	3	NA	B767
17/02/1984	I	http://www.ntsb.gov	CLB	3	NA	DC9-8x
12/9/1983	I	Probable Cause	UNK	3	NA	B767
8/19/1983	I	Probable Cause	DES	3	NA	B767
1/23/1983	I	Probable Cause	UNK	3	NA	B767
11/2/1983	I	Probable Cause	UNK	3	NA	B767
08/11/1983	I	http://www.ntsb.gov	LDG	3	NA	DC9-8x
27/09/1983	I	http://www.ntsb.gov	CLB	3	NA	DC9-8x
02/04/1983	I	http://www.ntsb.gov	CRZ	3	NA	DC9-8x
10/03/1982	I	http://www.ntsb.gov	GRD	3	NA	DC9-8x
26/05/2010	I	http://www.ntsb.gov	TO	2	EUR	A300
10/04/2010	I	http://www.ntsb.gov	TO	2	ASIA	A300
09/02/2010	I	http://www.ntsb.gov	LDG	2	EUR	A300
03/09/2010	F	http://www.ntsb.gov	APR	2	AFR	B747G2
04/05/2010	I	http://www.ntsb.gov	TO	2	ASIA	B747G2
02/09/2010	I	http://www.ntsb.gov	LDG	2	ASIA	B747G2

Factors

Date	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
03/02/1988																			1		1
27/01/1988																					
19/01/1988				1																	
11/11/1987				1																	
08/09/1987			1	1																	
09/07/1987							1			1											
01/12/1987		1									1										
25/11/1987		1																			
29/10/1987							1			1	1										
16/03/1987				1																	
6/18/1987																					
8/22/1987																				1	
7/12/1987				1			1					1								1	
8/16/1987																					
10/4/1987																					
01/11/1987							1			1											
09/10/1987										1											
16/08/1987																				1	
29/05/1987							1			1											
23/03/1987																	1			1	1
26/10/1986													1							1	
22/12/1986				1																	
20/02/1986																					
4/3/1986																					
11/5/1986				1																	
3/31/1986																				1	
28/04/1985				1		1															
5/11/1985																				1	
10/24/1985		1																			
17/02/1984																	1			1	
12/9/1983																				1	
8/19/1983																	1			1	
1/23/1983																				1	
11/2/1983		1																			
08/11/1983																				1	
27/09/1983																	1			1	
02/04/1983																	1				
10/03/1982		1																	1	1	
26/05/2010																	1			1	
10/04/2010																	1		1	1	
09/02/2010																	1			1	
03/09/2010																			1		
04/05/2010																					
02/09/2010				1		1															

Factors (Non-Technical)

Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
03/02/1988	1									1			1					
27/01/1988	1																	
19/01/1988																		
11/11/1987																		
08/09/1987		1																
09/07/1987																		
01/12/1987										1								
25/11/1987																		
29/10/1987																		
16/03/1987																		
6/18/1987		1														1		
8/22/1987																		
7/12/1987		1														1		
8/16/1987																		
10/4/1987																1		
01/11/1987																		
09/10/1987																		
16/08/1987		1								1								
29/05/1987																		
23/03/1987																		
26/10/1986	1									1		1	1			1		
22/12/1986				1														
20/02/1986										1						1		
4/3/1986								1								1		
11/5/1986																1		
3/31/1986											1						1	1
28/04/1985										1						1		
5/11/1985																		
10/24/1985																		
17/02/1984																		
12/9/1983										1								
8/19/1983																		
1/23/1983								1										
11/2/1983																		
08/11/1983																		
27/09/1983																		
02/04/1983		1								1		1					1	
10/03/1982																		
26/05/2010																		
10/04/2010																		
09/02/2010																		
03/09/2010																1		
04/05/2010																1		
02/09/2010										1						1		

Competencies / Validation

Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
03/02/1988	1				1					M	ml	ds
27/01/1988										N	ml	ds
19/01/1988										N	ml	ds
11/11/1987										U	EV	AAD
08/09/1987					1		1		1	M	EV	AAD
09/07/1987										U	EV	AAD
01/12/1987		1		1						L	DS	ML
25/11/1987										N	DS	ML
29/10/1987										N	DS	ML
16/03/1987										U	DS	ML
6/18/1987										H		
8/22/1987										N		
7/12/1987										H		
8/16/1987										U		
10/4/1987										H		
01/11/1987										N	ml	ds
09/10/1987										N	ml	ds
16/08/1987				1			1			H	ml	ds
29/05/1987										N	ml	ds
23/03/1987										N	ml	ds
26/10/1986	1						1		1	H	AB	AAD
22/12/1986										N	DS	ML
20/02/1986			1						1	H	DS	ML
4/3/1986										H		
11/5/1986										N		
3/31/1986										M		
28/04/1985					1		1		1	H	DS	ML
5/11/1985										N		
10/24/1985										M		
17/02/1984										N	ml	ds
12/9/1983		1								U		
8/19/1983										U		
1/23/1983										N		
11/2/1983										N		
08/11/1983										N	ml	MS
27/09/1983										N	ml	ds
02/04/1983			1	1						H	ml	ds
10/03/1982										N	ml	ds
26/05/2010										N	EV	AAD
10/04/2010										N	EV	AAD
09/02/2010										N	EV	AAD
03/09/2010									1	L		
04/05/2010									1	M		
02/09/2010		1					1		1	M		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
14/06/2010	I	http://www.ntsb.gov	GRD	2	NA	DC9																	1																																N	ml	MS
29/04/2009	F	http://www.ntsb.gov	CRZ	2	AFR	B7312															1																																		U		SD
27/04/2009	N	http://www.ntsb.gov	LDG	2	NA	B7312		1																		1																													N		SD
17/12/2009	I	http://www.ntsb.gov	CLB	2	ASIA	B747G2																	1			1																													U		
5/6/2009	N	http://www.ntsb.gov	LDG	2	NA	DC10																														1	1							1				1					1		1	H	SF	rs
3/26/2009	I	http://www.ntsb.gov	CLB	2	SA	DC10																	1			1																													N	SF	rs
24/08/2008	F	http://www.ntsb.gov	CLB	2	ASIA	B7312															1					1																													U		SD
23/08/2008	F	http://ntsb.gov/ntsb	APR	2	SA	B7312				1											1																																		U		SD
14/07/2008	I	http://www.ntsb.gov	LDG	2	AFR	B7312		1		1																																													U		SD
06/06/2008	I	http://www.ntsb.gov	TO	2	SA	B7312																				1																													N		SD
22/05/2008	N	http://www.ntsb.gov	CLB	2	NA	B7312																	1		1																														N		SD
03/03/2008	I	http://www.ntsb.gov	TO	2	SA	B7312		1															1																																H		SD
10/02/2008	I	http://www.ntsb.gov	TO	2	SA	B7312		1															1																																N		SD
30/01/2008	F	http://www.ntsb.gov	APR	2	SA	B7312															1																																		U		SD
08/01/2008	I	http://www.ntsb.gov	GRD	2	NA	B7312		1																		1																													N		SD
26/08/2008	I	http://www.ntsb.gov	TO	2	SA	B747G2																	1			1																													N		
07/07/2008	F	http://www.ntsb.gov	TO	2	SA	B747G2															1		1		1	1													1																U		
27/10/2008	I	http://www.ntsb.gov	TO	2	EUR	B747G2																							1								1				1		1							1		1		1	M		
25/05/2008	N	http://www.ntsb.gov	TO	2	EUR	B747G2																1	1			1											1					1					1					1	1		H		
19/04/2008	I	http://www.ntsb.gov	CLB	2	NA	B747G2																	1		1	1																													N		
23/12/2008	N	http://www.ntsb.gov	GRD	2	NA	B747G2		1																																															L		
5/19/2008	N	http://www.ntsb.gov	CRZ	2	UNK	DC10				1																																													N	SF	rs
03/12/2008	N	http://www.ntsb.gov	GRD	2	NA	DC9		1	1	1																																													N	ml	MS
06/07/2008	F	http://www.ntsb.gov	APR	2	NA	DC9				1																																													U	Ben	ml
15/04/2008	F	http://aviation-safet	TO	2	AFR	DC9																	1																																M	Ben	ml
12/02/2008	I	http://aviation-safet	GRD	2	SA	DC9		1																		1																													N	Ben	ml
28/01/2008	I	http://aviation-safet	GRD	2	NA	DC9	1																																																N	Ben	ml
23/03/2007	N	http://aviation-safet	LDG	2	ME	A300																																					1											1	U	EV	AAD
10/02/2007	I	http://www.ntsb.gov	CLB	2	ASIA	A300																	1			1																													N	EV	AAD
07/11/2007	N	http://www.ntsb.gov	CLB	2	AFR	B7312																	1																																N		SD
14/09/2007	N	http://www.ntsb.gov	LDG	2	NA	B7312		1																		1																													U		SD
10/07/2007	F	http://www.ntsb.gov	GRD	2	NA	B7312	1			1																																													N		SD
28/06/2007	F	http://www.ntsb.gov	LDG	2	AFR	B7312															1																									1							1	H		SD
16/12/2007	I	http://www.ntsb.gov	GRD	2	AFR	B747G2		1																													1									1								M		
19/04/2007	I	http://www.ntsb.gov	TO	2	AFR	B747G2																			1																														N		
10/02/2007	I	http://www.ntsb.gov	TO	2	ASIA	B747G2																	1			1																													U		
21/03/2007	I	http://www.ntsb.gov	CLB	2	ASIA	B747G2																	1			1																													U		
6/25/2007	N	http://www.ntsb.gov	DES	2	NA	DC10															1																1						1											1	H	SF	rs
5/2/2007	I	http://www.ntsb.gov	DES	2	NA	DC10																				1																													N	SF	rs
18/05/2007	N	http://www.ntsb.gov	CLB	2	NA	DC9	1																			1																													N	Ben	ml
01/05/2006	I	http://www.ntsb.gov	APR	2	NA	A300																				1																													N	EV	AAD
30/10/2006	I	http://www.ntsb.gov	TO	2	NA	B7312							1																																	1	1								U		SD
29/10/2006	F	http://www.ntsb.gov	CLB	2	AFR	B7312															1				1																														U		SD
12/06/2006	I	http://www.ntsb.gov	TO	2	AFR	B7312																1																																	N		SD

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
05/05/2006	N	http://www.ntsb.go	LDG	2	ASIA	B7312		1																		1																														U		SD
16/07/2006	I	Factual	TO	2	EUR	B747G2																				1																														U	SF	DB
23/12/2006	N	http://www.ntsb.go	CLB	2	NA	B747G2	1																			1																														U	SF	DB
07/07/2006	N	http://www.ntsb.go	TO	2	SA	B747G2																	1			1			1								1													1		1			H		
6/4/2006	N	http://www.ntsb.go	LDG	2	SA	DC10																															1						1							1				1	H	SF	rs
11/17/2006	I	http://www.ntsb.go	LDG	2	SA	DC10			1	1								1																			1						1							1		1		1	H	SF	rs
19/11/2006	I	http://aviation-safe	GRD	2	NA	DC9	1																																																	N	Ben	ml
29/06/2005	I	http://www.ntsb.go	CLB	2	EUR	A300																	1																																	N	EV	AAD
22/10/2005	F	http://www.ntsb.go	TO	2	AFR	B7312															1																																			U		SD
05/09/2005	F	http://www.ntsb.go	TO	2	ASIA	B7312															1																																			U		SD
25/04/2005	I	http://www.ntsb.go	GRD	2	NA	B7312	1	1																																																N		ML
03/02/2005	F	http://www.ntsb.go	CRZ	2	ME	B7312												1			1																1						1				1							1	M		ML
17/01/2005	N	http://www.ntsb.go	GRD	2	NA	B7312	1																																																	N		ML
19/04/2005	N	Probable Cause	LDG	2	AFR	B747G2																				1			1								1							1			1					1			H	SF	DB
1/24/2005	I	http://www.ntsb.go	LDG	2	EUR	B747G2			1	1																											1						1				1							1	H		
7/4/2005	I	http://www.ntsb.go	CLB	2	ASIA	B747G2																			1																														N		
7/1/2005	N	http://www.ntsb.go	LDG	2	ASIA	DC10																															1						1							1				1	H	SF	rs
10/12/2005	F	http://www.ntsb.go	APR	2	AFR	DC9				1																																													U	Ben	ml
07/12/2005	N	http://aviation-safe	LDG	2	AFR	DC9																																																1	U	Ben	ml
10/05/2005	N	http://www.ntsb.go	GRD	2	NA	DC9		1																		1			1								1													1	1			1	M	Ben	ml
05/05/2005	I	http://aviation-safe	GRD	2	NA	DC9	1																																																	N	Ben	ml
01/03/2004	N	http://aviation-safe	TO	2	ME	A300																			1	1																														N	EV	AAD
11/08/2004	N	http://www.ntsb.go	TO	2	AFR	B7312																																					1											1	U		ML
19/05/2004	I	http://www.ntsb.go	CLB	2	SA	B7312																	1																																	N		ML
12/29/2004	I	http://www.ntsb.go	TO	2	NA	B747G2																	1		1	1																														N	SF	DB
12/5/2004	I	http://www.ntsb.go	CRZ	2	NA	B747G2																				1																														U	SF	DB
10/14/2004	F	http://www.ntsb.go	TO	2	NA	B747G2																							1							1	1				1		1	1			1					1			H		
12/14/2004	I	http://www.ntsb.go	CLB	2	ASIA	B747G2																				1																														N		
12/12/2004	I	http://www.ntsb.go	APR	2	EUR	B747G2																							1								1						1									1		1	M		
7/29/2004	I	http://www.ntsb.go	CLB	2	ASIA	B747G2																	1		1	1																														N		
11/4/2004	I	http://www.ntsb.go	LDG	2	EUR	B747G2																																					1											1	M		
11/7/2004	I	http://www.ntsb.go	TO	2	AFR	B747G2		1																		1											1						1							1		1		1	H		
10/20/2004	N	http://www.ntsb.go	CLB	2	NA	B747G2																	1			1																														N		
4/28/2004	N	http://www.ntsb.go	LDG	2	SA	DC10			1																												1						1					1		1				1	H	SF	rs
4/10/2004	N	http://www.ntsb.go	CRZ	2	OTH	DC10																				1			1																										N	SF	rs
21/07/2004	N	http://www.ntsb.go	TO	2	NA	DC9				1	1																																1											1	U	Ben	ml
13/12/2003	N	http://www.ntsb.go	LDG	2	SA	B7312																				1																														U		ML
08/07/2003	F	http://www.ntsb.go	APR	2	AFR	B7312				1								1					1			1																	1											1	M		ML
11/03/2003	I	http://www.ntsb.go	CLB	2	NA	B7312																	1																																	N		ML
06/03/2003	F	http://www.ntsb.go	TO	2	AFR	B7312				1													1			1											1						1			1						1		1	M		ML
26/01/2003	N	http://www.ntsb.go	LDG	2	SA	B7312				1								1			1																1						1							1		1		1	H		ML
4/1/2003	I	http://www.ntsb.go	CRZ	2	NA	B747G2																				1																														N		
3/12/2003	U	http://www.ntsb.go	TO	2	AFR	B747G2																																					1											1	U		
11/29/2003	N	http://www.ntsb.go	LDG	2	AFR	B747G2	1						1																1								1									1	1								H		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents						
Date	Severity	Info Source Link	Phase	Generation	Region	Type
10/2/2003	I	http://www.ntsb.gov	CRZ	2	EUR	B747G2
2/13/2003	I	http://www.ntsb.gov	CRZ	2	ASIA	B747G2
7/6/2003	N	http://www.ntsb.gov	LDG	2	SA	DC10
12/10/2003	I	http://www.ntsb.gov	TO	2	NA	DC10
18/12/2003	F	http://aviation-safet	DES	2	SA	DC9
12/09/2003	F	http://www.ntsb.gov	GRD	2	NA	DC9
18/04/2003	N	http://aviation-safet	CLB	2	AFR	DC9
17/02/2002	N	http://www.ntsb.gov	UNK	2	SA	B7312
11/02/2002	N	http://www.ntsb.gov	CRZ	2	SA	B7312
1/3/2002	I	http://www.ntsb.gov	LDG	2	NA	B747G2
8/11/2002	N	http://www.ntsb.gov	CLB	2	NA	B747G2
5/25/2002	F	http://www.ntsb.gov	CRZ	2	ASIA	B747G2
6/13/2002	I	http://www.ntsb.gov	LDG	2	EUR	B747G2
8/10/2002	I	http://www.ntsb.gov	APR	2	NA	DC10
4/27/2002	N	http://www.ntsb.gov	TO	2	SA	DC10
3/22/2002	N	http://www.ntsb.gov	CRZ	2	OTH	DC10
31/10/2002	N	http://www.ntsb.gov	LDG	2	NA	DC9
22/09/2002	N	http://www.ntsb.gov	GRD	2	NA	DC9
14/06/2002	N	http://aviation-safet	LDG	2	SA	DC9
03/06/2002	N	http://www.ntsb.gov	LDG	2	NA	DC9
24/01/2002	N	http://www.ntsb.gov	GRD	2	NA	DC9
20/01/2002	N	http://www.ntsb.gov	GRD	2	NA	DC9
17/10/2001	N	http://aviation-safet	LDG	2	ME	A300
7/13/2001	F	http://www.ntsb.gov	APR	2	EUR	B727
5/25/2001	F	http://www.ntsb.gov	APR	2	NA	B727
3/23/2001	F	http://www.ntsb.gov	APR	2	NA	B727
3/11/2001	F	http://www.ntsb.gov	APR	2	NA	B727
1/9/2001	F	http://www.ntsb.gov	APR	2	NA	B727
1/6/2001	F	http://www.ntsb.gov	APR	2	NA	B727
17/04/2001	N	http://www.ntsb.gov	CLB	2	NA	B7312
12/28/2001	N	http://www.ntsb.gov	TO	2	NA	B747G2
1/5/2001	I	http://www.ntsb.gov	CRZ	2	NA	B747G2
11/23/2001	I	http://www.ntsb.gov	CRZ	2	ASIA	B747G2
2/4/2001	I	http://www.ntsb.gov	LDG	2	NA	B747G2
11/27/2001	U	http://www.ntsb.gov	APR	2	AFR	B747G2
3/6/2001	I	http://www.ntsb.gov	TO	2	NA	DC10
25/07/2001	N	http://www.ntsb.gov	DES	2	NA	DC9
01/05/2001	N	http://www.ntsb.gov	GRD	2	NA	DC9
12/02/2000	N	http://aviation-safet	GRD	2	ME	A300
10/23/2000	F	http://www.ntsb.gov	APR	2	NA	B727
10/17/2000	F	http://www.ntsb.gov	APR	2	NA	B727
9/10/2000	F	http://www.ntsb.gov	APR	2	NA	B727
8/16/2000	F	http://www.ntsb.gov	APR	2	NA	B727
7/28/2000	F	http://www.ntsb.gov	APR	2	NA	B727

	Factors																				
Date	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
10/2/2003																			1	1	
2/13/2003																	1			1	
7/6/2003			1																		
12/10/2003																				1	
18/12/2003																					
12/09/2003	1																				
18/04/2003																				1	
17/02/2002																				1	
11/02/2002				1																	
1/3/2002																				1	
8/11/2002																	1		1	1	
5/25/2002																				1	
6/13/2002																	1			1	
8/10/2002																				1	
4/27/2002			1																	1	
3/22/2002				1																	
31/10/2002			1	1								1									
22/09/2002		1																		1	
14/06/2002															1						
03/06/2002																				1	
24/01/2002		1																	1	1	
20/01/2002	1	1	1																		
17/10/2001																				1	
7/13/2001				1	1	1						1					1		1	1	
5/25/2001				1	1	1						1					1		1	1	
3/23/2001	1			1	1	1						1					1		1	1	
3/11/2001				1	1	1						1					1		1	1	
1/9/2001				1		1						1					1		1	1	
1/6/2001				1		1						1					1		1	1	
17/04/2001				1																	
12/28/2001																					
1/5/2001																			1	1	
11/23/2001																	1			1	
2/4/2001																	1			1	
11/27/2001												1									
3/6/2001				1													1		1		
25/07/2001																					
01/05/2001	1																				
12/02/2000		1																		1	
10/23/2000		1		1		1						1					1		1	1	
10/17/2000				1		1						1					1		1	1	
9/10/2000		1		1		1						1					1		1	1	
8/16/2000		1		1		1						1					1		1	1	
7/28/2000				1		1						1					1		1	1	

	Factors (Non-Technical)																	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
10/2/2003																		
2/13/2003																		
7/6/2003																1		
12/10/2003																		
18/12/2003																		
12/09/2003																		
18/04/2003																		
17/02/2002																		
11/02/2002																		
1/3/2002																		
8/11/2002																		
5/25/2002																		
6/13/2002																		
8/10/2002																		
4/27/2002																1		
3/22/2002										1						1		
31/10/2002																1		
22/09/2002																		
14/06/2002		1								1								
03/06/2002																		
24/01/2002	1																	
20/01/2002																		
17/10/2001																		
7/13/2001																		
5/25/2001																		
3/23/2001																		
3/11/2001																1		
1/9/2001																		
1/6/2001																		
17/04/2001				1														
12/28/2001		1								1						1		
1/5/2001																		
11/23/2001																		
2/4/2001																		
11/27/2001		1								1					1	1		
3/6/2001																		
25/07/2001	1																	
01/05/2001																		
12/02/2000																		
10/23/2000										1						1		
10/17/2000			1															
9/10/2000			1															
8/16/2000			1															
7/28/2000										1								

	Competencies										Validation	
Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
10/2/2003										N		
2/13/2003										U		
7/6/2003									1	M	SF	rs
12/10/2003										N	SF	rs
18/12/2003										U	Ben	ml
12/09/2003										N	Ben	ml
18/04/2003										U	Ben	ml
17/02/2002										N		ML
11/02/2002										U		ML
1/3/2002										U		
8/11/2002										N		
5/25/2002										U		
6/13/2002										U		
8/10/2002										N	SF	rs
4/27/2002									1	M	SF	rs
3/22/2002			1				1		1	H	SF	rs
31/10/2002									1	M	Ben	ml
22/09/2002										N	Ben	ml
14/06/2002		1					1			M	Ben	ml
03/06/2002										N	Ben	ml
24/01/2002										N	Ben	ml
20/01/2002										N	Ben	ml
17/10/2001										U	EV	AAD
7/13/2001									1	N	IG	AP
5/25/2001									1	N	IG	AP
3/23/2001									1	N	IG	AP
3/11/2001									1	H	IG	AP
1/9/2001									1	N	IG	AP
1/6/2001									1	U		
17/04/2001										N		ML
12/28/2001	1	1					1			M	SF	DB
1/5/2001										N		
11/23/2001										U		
2/4/2001										U		
11/27/2001		1					1	1	1	H		
3/6/2001										M	SF	rs
25/07/2001										N	Ben	ml
01/05/2001										N	Ben	ml
12/02/2000										N	EV	AAD
10/23/2000		1			1				1	H	IG	AP
10/17/2000									1	N	IG	AP
9/10/2000									1	N	IG	AP
8/16/2000									1	N	IG	AP
7/28/2000		1		1					1	H	IG	AP

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
4/2/2000	F	http://www.ntsb.go	APR	2	NA	B727				1		1						1					1		1	1																												1	N	IG	AP
3/24/2000	F	http://www.ntsb.go	APR	2	NA	B727		1		1		1						1					1		1	1																												1	N	IG	AP
3/20/2000	F	http://www.ntsb.go	APR	2	NA	B727				1		1						1					1		1	1																												1	U	IG	AP
3/13/2000	F	http://www.ntsb.go	APR	2	NA	B727				1		1						1					1		1	1																												1	N	IG	AP
2/12/2000	F	http://www.ntsb.go	APR	2	NA	B727				1		1						1					1		1	1											1						1				1							1	H	IG	AP
17/07/2000	F	http://www.ntsb.go	APR	2	ASIA	B7312												1											1								1						1				1					1		1	H		ML
13/06/2000	N	http://www.ntsb.go	CRZ	2	SA	B7312																				1																													N		ML
19/04/2000	F	http://www.ntsb.go	APR	2	ASIA	B7312															1																1						1				1					1			M		ML
5/12/2000	I	http://www.ntsb.go	UNK	2	EUR	B747G2																				1																													U	SF	DB
10/15/2000	I	http://www.ntsb.go	TO	2	NA	B747G2																				1																	1	1										1	M	SF	DB
6/12/2000	I	http://www.ntsb.go	CRZ	2	EUR	B747G2																				1																													U		
6/7/2000	I	http://www.ntsb.go	UNK	2	EUR	B747G2																	1			1																													U		
4/2/2000	N	http://www.ntsb.go	CLB	2	SA	B747G2																	1		1	1																													N		
9/5/2000	U	http://www.ntsb.go	UNK	2	ASIA	B747G2																	1			1																													U		
3/26/2000	I	http://www.ntsb.go	LDG	2	AFR	B747G2																	1		1	1																													N		
7/23/2000	I	http://www.ntsb.go	LDG	2	NA	B747G2				1								1																									1											1	M		
11/5/2000	N	http://www.ntsb.go	LDG	2	EUR	B747G2																							1								1						1	1				1				1		1	M		
2/27/2000	N	http://www.ntsb.go	DES	2	NA	B747G2																				1																													N		
4/22/2000	I	http://www.ntsb.go	GRD	2	EUR	B747G2																				1																													U		
9/7/2000	I	http://www.ntsb.go	TO	2	EUR	DC10																	1																																N	SF	rs
9/5/2000	I	http://www.ntsb.go	TO	2	NA	DC10																	1																																N	SF	rs
4/30/2000	F	http://www.ntsb.go	LDG	2	AFR	DC10			1															1													1						1									1		1	H	SF	rs
4/25/2000	N	http://www.ntsb.go	TO	2	NA	DC10																	1																																N	SF	rs
3/1/2000	N	http://www.ntsb.go	GRD	2	NA	DC10	1	1																																															N	SF	rs
12/23/2000	N	http://www.ntsb.go	LDG	2	OTH	DC10				1		1																									1						1								1				1	L	SF	rs
10/10/2000	N	http://www.ntsb.go	DES	2	EUR	DC10				1																																													N	SF	rs
27/12/2000	N	http://www.ntsb.go	TO	2	NA	DC9			1																	1																													N	Ben	ml
13/12/2000	I	http://www.ntsb.go	GRD	2	NA	DC9		1	1	1																																													N	Ben	ml
29/11/2000	N	http://www.ntsb.go	CLB	2	NA	DC9																			1	1																													N	Ben	ml
13/11/2000	N	http://aviation-safe	LDG	2	AFR	DC9																																																	U	Ben	ml
06/10/2000	F	http://www.ntsb.go	LDG	2	NA	DC9												1																									1											1	U	Ben	ml
08/08/2000	N	http://aviation-safe	CLB	2	NA	DC9																			1	1																													N	ml	ds
14/06/2000	N	http://www.ntsb.go	LDG	2	NA	DC9																							1								1						1					1				1		1	H	Ben	ml
31/01/2000	I	http://www.ntsb.go	GRD	2	NA	DC9																			1	1																													N	Ben	ml
3/10/1999	F	http://www.ntsb.go	APR	2	OTH	B727				1	1	1						1					1		1	1	1									1	1						1				1			1			1	1	H	IG	AP
1/13/1999	F	http://www.ntsb.go	APR	2	AFR	B727				1	1							1					1		1	1																	1											1	U	IG	
1/5/1999	F	http://www.ntsb.go	APR	2	AFR	B727				1	1							1					1		1	1																												1	N	IG	AP
8/23/1999	F	http://www.ntsb.go	APR	2	NA	B727		1		1		1						1					1		1	1																												1	N	IG	AP
11/27/1999	F	http://www.ntsb.go	APR	2	NA	B727	1	1		1		1						1					1		1	1																												1	N	IG	AP
7/7/1999	F	http://www.ntsb.go	APR	2	NA	B727				1			1					1			1		1		1	1											1										1	1						1	H	IG	AP
5/28/1999	F	http://www.ntsb.go	APR	2	NA	B727	1	1		1								1					1		1	1																												1	N	IG	AP
31/08/1999	F	http://www.ntsb.go	TO	2	SA	B7312																							1								1		1				1	1			1					1		1	H		ML
05/05/1999	N	http://www.ntsb.go	DES	2	NA	B7312				1																																													U		ML
2/8/1999	I	http://www.ntsb.go	LDG	2	EUR	B747G2																																					1											1	M	SF	DB

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
7/29/1999	N	http://www.ntsb.go	CLB	2	NA	B747G2																	1			1	1
1/19/1999	I	http://www.ntsb.go	GRD	2	NA	B747G2																	1		1	1	
6/6/1999	N	http://www.ntsb.go	GRD	2	NA	B747G2		1					1														
3/5/1999	N	http://www.ntsb.go	LDG	2	ASIA	B747G2																			1	1	
6/9/1999	N	http://www.ntsb.go	CRZ	2	OTH	B747G2																					
1/20/1999	I	http://www.ntsb.go	CRZ	2	OTH	B747G2				1								1									
12/22/1999	F	http://www.ntsb.go	CLB	2	EUR	B747G2												1	1							1	
9/2/1999	I	http://www.ntsb.go	LDG	2	ASIA	B747G2																					
8/7/1999	N	http://www.ntsb.go	APR	2	NA	DC10																				1	
6/24/1999	I	http://www.ntsb.go	APR	2	EUR	DC10																					
3/2/1999	I	http://www.ntsb.go	CRZ	2	NA	DC10							1		1	1											
12/21/1999	F	http://www.ntsb.go	LDG	2	SA	DC10			1																		
12/18/1999	N	http://www.ntsb.go	TO	2	EUR	DC10																	1				
11/7/1999	N	http://www.ntsb.go	CLB	2	NA	DC10										1			1								
09/11/1999	F	http://aviation-safe	TO	2	NA	DC9												1	1								
14/10/1999	I	http://www.ntsb.go	TO	2	NA	DC9																				1	1
09/09/1999	I	http://www.ntsb.go	LDG	2	NA	DC9																					
02/07/1999	N	http://www.ntsb.go	GRD	2	NA	DC9	1																				
09/04/1999	I	http://www.ntsb.go	CRZ	2	NA	DC9				1																	
21/03/1999	I	http://www.ntsb.go	CRZ	2	NA	DC9				1																	
04/03/1999	N	http://www.ntsb.go	APR	2	NA	DC9																1	1				
08/02/1999	N	http://aviation-safe	GRD	2	EUR	DC9		1																			
15/01/1999	N	http://www.ntsb.go	DES	2	NA	DC9														1							
11/12/1998	F	http://aviation-safe	LDG	2	ASIA	A300				1								1									
09/07/1998	I	http://www.ntsb.go	LDG	2	EUR	A300																	1		1		
12/21/1998	F	http://www.ntsb.go	APR	2	ASIA	B727		1	1	1	1							1					1		1	1	
10/20/1998	F	http://www.ntsb.go	APR	2	ASIA	B727				1	1							1					1		1	1	
10/7/1998	F	http://www.ntsb.go	APR	2	ASIA	B727				1	1	1						1					1		1	1	
10/2/1998	F	http://www.ntsb.go	APR	2	ASIA	B727				1	1	1						1					1		1	1	
8/31/1998	F	http://www.ntsb.go	APR	2	EUR	B727				1	1	1	1					1					1		1	1	
8/8/1998	F	http://www.ntsb.go	APR	2	EUR	B727		1	1	1	1	1						1					1		1	1	
5/7/1998	F	http://www.ntsb.go	APR	2	EUR	B727				1	1	1						1				1	1		1	1	
4/20/1998	I	http://www.ntsb.go	APR	2	NA	B727				1								1			1		1		1	1	
4/19/1998	I	http://www.ntsb.go	APR	2	NA	B727				1								1					1		1	1	
3/30/1998	I	http://www.ntsb.go	APR	2	NA	B727				1								1					1		1	1	
2/9/1998	I	http://www.ntsb.go	APR	2	NA	B727				1								1					1		1	1	
1/6/1998	I	http://www.ntsb.go	APR	2	NA	B727	1	1		1								1					1		1	1	
15/12/1998	I	http://www.ntsb.go	APR	2	NA	B7312																				1	
08/12/1998	I	http://www.ntsb.go	APR	2	NA	B7312										1											
01/11/1998	N	http://www.ntsb.go	APR	2	NA	B7312																		1	1	1	
13/08/1998	I	http://www.ntsb.go	APR	2	EUR	B7312																				1	
05/05/1998	F	http://www.ntsb.go	APR	2	SA	B7312				1								1									
04/05/1998	N	http://www.ntsb.go	LDG	2	SA	B7312			1	1	1							1									
12/04/1998	N	http://www.ntsb.go	LDG	2	EUR	B7312			1	1																	

	Factors (Non-Technical)																		Competencies										Validation	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
7/29/1999																												N	SF	DB
1/19/1999																												N		
6/6/1999								1		1						1				1								L		
3/5/1999										1													1		1			M		
6/9/1999	1																											N		
1/20/1999										1											1		1					M		
12/22/1999										1						1	1		1	1							1	H		
9/2/1999																1											1	L		
8/7/1999																												N	SF	rs
6/24/1999		1								1											1				1			U	SF	rs
3/2/1999																												N	SF	rs
12/21/1999																1											1	H	SF	rs
12/18/1999																												N	SF	rs
11/7/1999																1											1	M	SF	rs
09/11/1999		1								1		1				1				1		1			1		1	H	Ben	ml
14/10/1999																												N	Ben	ml
09/09/1999										1						1				1					1		1	H	Ben	ml
02/07/1999																												N	Ben	ml
09/04/1999																												L	Ben	ml
21/03/1999																												L	Ben	ml
04/03/1999																												N	Ben	ml
08/02/1999																												U	Ben	ml
15/01/1999	1																											L	Ben	ml
11/12/1998																												U	EV	AAD
09/07/1998																												N	EV	AAD
12/21/1998																											1	H	IG	AP
10/20/1998										1											1				1		1	H	IG	AP
10/7/1998																											1	N	IG	AP
10/2/1998										1						1											1	H	IG	AP
8/31/1998																											1	N	IG	AP
8/8/1998										1									1	1							1	H	IG	AP
5/7/1998																											1	U	IG	AP
4/20/1998																											1	H	IG	AP
4/19/1998	1																										1	L	IG	
3/30/1998																											1	N	IG	
2/9/1998										1						1							1			1	1	H	IG	
1/6/1998																											1	N	IG	
15/12/1998																												N		ML
08/12/1998																												N		ML
01/11/1998																												N		ML
13/08/1998																												N		ML
05/05/1998																1												U		ML
04/05/1998		1								1						1							1		1		1	H		ML
12/04/1998																1											1	L		ML

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
11/03/1998	I	http://www.ntsb.gov	GRD	2	NA	B7312																				1	
04/03/1998	N	http://www.ntsb.gov	CRZ	2	NA	B7312				1																	
7/20/1998	I	http://www.ntsb.gov	CLB	2	EUR	B747G2																				1	
4/18/1998	N	http://www.ntsb.gov	CRZ	2	OTH	B747G2				1																	
12/1/1998	N	http://www.ntsb.gov	GRD	2	NA	B747G2	1																		1		
5/18/1998	I	http://www.ntsb.gov	CRZ	2	NA	B747G2																				1	
10/5/1998	N	http://www.ntsb.gov	CLB	2	AFR	B747G2																	1			1	
5/11/1998	N	http://www.ntsb.gov	GRD	2	ASIA	B747G2																				1	
9/11/1998	I	http://www.ntsb.gov	TO	2	EUR	B747G2																			1		
9/20/1998	I	http://www.ntsb.gov	CRZ	2	EUR	DC10																			1		
5/21/1998	N	http://www.ntsb.gov	CLB	2	NA	DC10																				1	
4/4/1998	N	http://www.ntsb.gov	GRD	2	NA	DC10	1	1																			
3/8/1998	I	http://www.ntsb.gov	GRD	2	EUR	DC10																	1		1		
3/6/1998	N	http://www.ntsb.gov	GRD	2	NA	DC10	1																				
3/24/1998	I	http://www.ntsb.gov	TO	2	NA	DC10																	1			1	
13/10/1998	I	http://www.ntsb.gov	TO	2	EUR	DC10																				1	
02/09/1998	N	http://www.ntsb.gov	GRD	2	NA	DC9	1	1																			
16/07/1998	I	http://www.ntsb.gov	LDG	2	SA	DC9			1	1																	
07/05/1998	N	http://www.ntsb.gov	CLB	2	NA	DC9				1																	
30/04/1998	I	http://www.ntsb.gov	CLB	2	NA	DC9																				1	
09/02/1998	I	http://www.ntsb.gov	TO	2	NA	DC9																	1		1	1	
02/02/1998	F	http://www.ntsb.gov	DES	2	ASIA	DC9															1						
26/08/1997	F	http://aviation-safet	APR	2	ASIA	A300				1								1			1						
24/08/1997	I	http://www.ntsb.gov	TO	2	NA	A300																	1			1	
06/02/1997	N	http://www.ntsb.gov	APR	2	SA	A300																					
01/10/1997	I	http://www.ntsb.gov	APR	2	NA	B727	1	1		1								1					1		1	1	
09/07/1997	I	http://www.ntsb.gov	APR	2	NA	B727				1								1					1		1	1	
06/07/1997	I	http://www.ntsb.gov	APR	2	NA	B727				1								1					1		1	1	
10/03/1997	I	http://www.ntsb.gov	APR	2	NA	B727				1								1					1		1	1	
03/03/1997	I	http://www.ntsb.gov	APR	2	NA	B727				1								1					1		1	1	
13/02/1997	I	http://www.ntsb.gov	APR	2	NA	B727				1								1					1		1	1	
21/01/1997	I	http://www.ntsb.gov	CLB	2	NA	B727				1								1					1		1	1	
04/10/1997	I	http://www.ntsb.gov	LDG	2	NA	B7312																				1	
24/09/1997	I	http://www.ntsb.gov	LDG	2	NA	B7312																				1	
11/06/1997	N	http://www.ntsb.gov	DES	2	NA	B7312				1																	
04/05/1997	N	http://www.ntsb.gov	GRD	2	NA	B7312	1																				
28/04/1997	I	http://www.ntsb.gov	TO	2	NA	B7312																	1		1		
28/04/1997	N	http://www.ntsb.gov	CLB	2	NA	B7312				1																	
4/20/1997	I	http://www.ntsb.gov	GRD	2	NA	B747G2		1																			
3/22/1997	I	http://www.ntsb.gov	LDG	2	SA	B747G2				1								1									
4/19/1997	I	http://www.ntsb.gov	CRZ	2	NA	B747G2																				1	
8/6/1997	F	http://www.ntsb.gov	APR	2	ASIA	B747G2				1			1					1			1						
12/28/1997	F	http://www.ntsb.gov	CRZ	2	OTH	B747G2				1																	
7/25/1997	N	http://www.ntsb.gov	CRZ	2	OTH	DC10				1																	

	Factors (Non-Technical)																	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
11/03/1998																		
04/03/1998																		
7/20/1998																		
4/18/1998																		
12/1/1998																		
5/18/1998																		
10/5/1998																		
5/11/1998	1																	
9/11/1998		1								1								
9/20/1998																		
5/21/1998										1						1		
4/4/1998																		
3/8/1998																		
3/6/1998																		
3/24/1998																		
13/10/1998																		
02/09/1998																		
16/07/1998																1		
07/05/1998		1	1	1						1								
30/04/1998																		
09/02/1998			1			1												
02/02/1998																		
26/08/1997										1						1		
24/08/1997																		
06/02/1997		1						1								1		
01/10/1997										1								
09/07/1997																		
06/07/1997																		
10/03/1997																		
03/03/1997																		
13/02/1997																		
21/01/1997																		
04/10/1997																		
24/09/1997										1						1	1	
11/06/1997																		
04/05/1997																		
28/04/1997																		
28/04/1997		1								1								
4/20/1997										1								
3/22/1997										1						1		
4/19/1997																		
8/6/1997		1							1	1						1		
12/28/1997				1														
7/25/1997																		

	Competencies										Validation	
Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
11/03/1998										N		ML
04/03/1998										N		ML
7/20/1998										U	SF	DB
4/18/1998										N		
12/1/1998										U		
5/18/1998										N		
10/5/1998										U		
5/11/1998										L		
9/11/1998					1		1			H		
9/20/1998										N	SF	rs
5/21/1998									1	M	SF	rs
4/4/1998										N	SF	rs
3/8/1998										N	SF	rs
3/6/1998										N	SF	rs
3/24/1998										N	SF	rs
13/10/1998										N	SF	rs
02/09/1998										N	ml	ds
16/07/1998									1	U	ml	MS
07/05/1998		1			1					H	ml	ds
30/04/1998										N	ml	ds
09/02/1998										N	ml	ds
02/02/1998										U	ml	MS
26/08/1997		1						1		M	EV	AAD
24/08/1997										N	EV	AAD
06/02/1997		1			1				1	H	EV	AAD
01/10/1997		1		1					1	M	IG	
09/07/1997									1	N	IG	
06/07/1997									1	N	IG	AP
10/03/1997									1	N	IG	AP
03/03/1997									1	N	IG	AP
13/02/1997									1	N	IG	AP
21/01/1997									1	N	IG	AP
04/10/1997										N		ML
24/09/1997			1				1		1	M		ML
11/06/1997										U		ML
04/05/1997										N		ML
28/04/1997										N		ML
28/04/1997					1		1			M		ML
4/20/1997	1	1								M		
3/22/1997		1	1						1	M		
4/19/1997										U		
8/6/1997	1		1						1	H		
12/28/1997										N		
7/25/1997										N	SF	rs

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
6/9/1997	I	http://www.ntsb.go	GRD	2	NA	DC10		1																			
5/11/1997	N	http://www.ntsb.go	GRD	2	NA	DC10																			1	1	
4/9/1997	N	http://www.ntsb.go	CRZ	2	NA	DC10																					
2/1/1997	N	http://www.ntsb.go	CRZ	2	SA	DC10																					
07/12/1997	N	http://www.ntsb.go	GRD	2	NA	DC9																					
21/11/1997	N	http://www.ntsb.go	TO	2	NA	DC9																					
10/10/1997	F	http://www.ntsb.go	DES	2	SA	DC9				1								1									
12/07/1997	I	http://www.ntsb.go	APR	2	NA	DC9													1							1	
05/07/1997	I	http://www.ntsb.go	CRZ	2	NA	DC9																			1	1	
18/03/1997	I	http://www.ntsb.go	TO	2	NA	DC9																	1		1	1	
20/02/1997	I	http://www.ntsb.go	CRZ	2	NA	DC9																			1	1	
28/01/1997	N	http://www.ntsb.go	LDG	2	NA	DC9				1																	
15/08/1996	I	http://www.ntsb.go	CLB	2	NA	B727																	1		1	1	
14/08/1996	I	http://www.ntsb.go	CLB	2	NA	B727																	1		1	1	
14/06/1996	I	http://www.ntsb.go	CLB	2	NA	B727																	1		1	1	
12/05/1996	I	http://www.ntsb.go	CLB	2	NA	B727																	1		1	1	
28/04/1996	I	http://www.ntsb.go	CLB	2	NA	B727				1													1		1	1	
27/03/1996	I	http://www.ntsb.go	CLB	2	NA	B727	1	1					1										1		1	1	
18/11/1996	N	http://www.ntsb.go	GRD	2	NA	B7312																	1		1	1	
09/09/1996	I	http://www.ntsb.go	DES	2	NA	B7312													1							1	1
08/07/1996	N	http://www.ntsb.go	TO	2	NA	B7312																1	1		1	1	
22/06/1996	N	http://www.ntsb.go	DES	2	NA	B7312				1																	
20/03/1996	N	http://www.ntsb.go	GRD	2	NA	B7312																				1	
29/02/1996	F	http://www.ntsb.go	APR	2	SA	B7312															1						
20/02/1996	I	http://www.ntsb.go	LDG	2	NA	B7312			1	1																1	
7/17/1996	F	http://www.ntsb.go	CLB	2	NA	B747G2																			1	1	
12/5/1996	I	http://www.ntsb.go	GRD	2	ASIA	B747G2																				1	
6/17/1996	I	http://www.ntsb.go	CRZ	2	NA	B747G2																			1	1	
5/19/1996	I	http://www.ntsb.go	CRZ	2	NA	B747G2																				1	
1/5/1996	I	http://www.ntsb.go	GRD	2	NA	B747G2																	1			1	
1/23/1996	N	http://www.ntsb.go	GRD	2	NA	B747G2		1					1			1											
11/12/1996	F	http://www.ntsb.go	CLB	2	ASIA	B747G2										1											
9/5/1996	N	http://www.ntsb.go	CRZ	2	NA	DC10																			1		
12/22/1996	N	http://www.ntsb.go	GRD	2	NA	DC10	1	1																			
08/08/1996	I	http://www.ntsb.go	LDG	2	NA	DC9																				1	
14/05/1996	N	http://www.ntsb.go	APR	2	NA	DC9																	1			1	
11/05/1996	F	http://www.ntsb.go	CLB	2	NA	DC9																			1		
28/02/1996	I	http://www.ntsb.go	LDG	2	NA	DC9																					
19/02/1996	N	http://www.ntsb.go	LDG	2	NA	DC9																					
01/02/1996	N	http://www.ntsb.go	LDG	2	NA	DC9																				1	
07/01/1996	N	http://www.ntsb.go	CLB	2	NA	DC9																				1	
07/12/1995	I	http://www.ntsb.go	CLB	2	NA	B727				1													1		1	1	
07/11/1995	I	http://www.ntsb.go	CLB	2	NA	B727																	1			1	
04/07/1995	I	http://www.ntsb.go	CLB	2	NA	B727																	1			1	

	Factors (Non-Technical)																	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
6/9/1997																		
5/11/1997																		
4/9/1997																		
2/1/1997																		
07/12/1997	1																	
21/11/1997		1												1				
10/10/1997																		
12/07/1997																		
05/07/1997																		
18/03/1997																		
20/02/1997																		
28/01/1997	1																	
15/08/1996																		
14/08/1996																		
14/06/1996										1							1	
12/05/1996		1								1							1	1
28/04/1996																		
27/03/1996				1						1						1		
18/11/1996																		
09/09/1996																		
08/07/1996		1								1		1				1		
22/06/1996																		
20/03/1996																		
29/02/1996																1		
20/02/1996		1								1						1		
7/17/1996																		
12/5/1996																		
6/17/1996																		
5/19/1996																		
1/5/1996																		
1/23/1996															1	1		
11/12/1996																		
9/5/1996		1								1			1					
12/22/1996																		
08/08/1996																		
14/05/1996																		
11/05/1996													1					
28/02/1996		1								1						1		
19/02/1996		1								1		1				1		
01/02/1996																		
07/01/1996		1								1						1		
07/12/1995										1						1		
07/11/1995													1					
04/07/1995																		

	Competencies										Validation	
Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
6/9/1997										N	SF	rs
5/11/1997										N	SF	rs
4/9/1997										N	SF	rs
2/1/1997										N	SF	rs
07/12/1997										N	ml	ds
21/11/1997										H	ml	ds
10/10/1997										U	ml	MS
12/07/1997										N	ml	ds
05/07/1997										N	ml	ds
18/03/1997										N	ml	ds
20/02/1997										N	ml	ds
28/01/1997										M	ml	ds
15/08/1996									1	N	IG	AP
14/08/1996									1	N	IG	AP
14/06/1996		1				1			1	M	IG	AP
12/05/1996		1					1		1	H	IG	AP
28/04/1996									1	N	IG	AP
27/03/1996		1							1	L	IG	AP
18/11/1996										N		ML
09/09/1996										N		ML
08/07/1996					1		1			M		ML
22/06/1996										N		ML
20/03/1996										N		ML
29/02/1996										U		ML
20/02/1996					1		1		1	H		ML
7/17/1996										U		
12/5/1996										N		
6/17/1996										N		
5/19/1996										U		
1/5/1996										N		
1/23/1996		1			1			1	1	M		
11/12/1996										U		
9/5/1996			1							M	SF	rs
12/22/1996										N	SF	rs
08/08/1996										N	ml	ds
14/05/1996										U	ml	MS
11/05/1996										N	ml	ds
28/02/1996					1		1			M	ml	ds
19/02/1996					1	1				M	ml	ds
01/02/1996										N	ml	ds
07/01/1996						1	1			H	ml	ds
07/12/1995		1			1				1	H	IG	AP
07/11/1995									1	N	IG	AP
04/07/1995									1	N	IG	AP

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
05/08/1995	I	http://www.ntsb.go	CLB	2	NA	B727	1	1															1			1																												1	N	IG	AP
24/05/1995	I	http://www.ntsb.go	CLB	2	NA	B727	1	1															1			1																												1	N	IG	AP
19/05/1995	I	http://www.ntsb.go	CLB	2	NA	B727																	1			1		1																										1	N	IG	AP
03/04/1995	I	http://www.ntsb.go	CLB	2	NA	B727																	1			1																												1	U	IG	AP
16/03/1995	I	http://www.ntsb.go	CLB	2	NA	B727				1									1																																			1	M	IG	AP
19/05/1995	I	http://www.ntsb.go	CLB	2	NA	B727																																																1	N	IG	AP
29/12/1995	N	http://www.ntsb.go	GRD	2	NA	B7312	1	1																																															N		ML
03/12/1995	F	http://www.ntsb.go	APR	2	AFR	B7312																																																	U		ML
07/11/1995	N	http://www.ntsb.go	DES	2	NA	B7312				1																																													N		ML
09/08/1995	F	http://www.ntsb.go	APR	2	SA	B7312															1																																		U		ML
29/06/1995	I	http://www.ntsb.go	DES	2	NA	B7312																				1																													N		ML
07/04/1995	I	http://www.ntsb.go	TO	2	NA	B7312																				1																													N		ML
01/02/1995	N	http://www.ntsb.go	CLB	2	SA	B7312																				1																													N		ML
27/01/1995	N	http://www.ntsb.go	GRD	2	NA	B7312																																																	N		ML
19/01/1995	I	http://www.ntsb.go	LDG	2	NA	B7312																				1																													N		ML
12/10/1995	I	http://www.ntsb.go	LDG	2	EUR	B747G2				1								1																		1						1										1		1	H	SF	DB
1/28/1995	N	http://www.ntsb.go	TO	2	NA	B747G2																				1										1										1									M		
2/25/1995	I	http://www.ntsb.go	CLB	2	NA	B747G2										1																																							N		
12/20/1995	N	http://www.ntsb.go	TO	2	NA	B747G2			1	1		1																		1					1		1						1				1			1				1	H		
12/6/1995	I	http://www.ntsb.go	CLB	2	NA	B747G2																	1			1																													N		
8/14/1995	I	http://www.ntsb.go	CLB	2	NA	B747G2																	1																																U		
10/23/1995	N	http://www.ntsb.go	TO	2	NA	B747G2																	1		1	1			1																					1		1			U		
11/1/1995	N	http://www.ntsb.go	CRZ	2	OTH	B747G2				1																																													N		
6/3/1995	N	http://www.ntsb.go	LDG	2	SA	B747G2				1	1							1											1								1					1	1				1			1			1	1	H		
6/26/1995	I	http://www.ntsb.go	CRZ	2	NA	DC10				1																																1												1	M	SF	rs
5/1/1995	I	http://www.ntsb.go	TO	2	NA	DC10																	1			1																													N	SF	rs
19/12/1995	I	http://www.ntsb.go	LDG	2	NA	DC9			1	1													1			1																													M	ml	ds
12/12/1995	I	http://www.ntsb.go	CLB	2	NA	DC9																	1																																N	ml	ds
13/10/1995	N	http://www.ntsb.go	CLB	2	NA	DC9																				1																													N	ml	ds
08/06/1995	N	http://www.ntsb.go	TO	2	NA	DC9																	1		1	1		1																											N	ml	ds
29/03/1995	I	http://www.ntsb.go	CRZ	2	NA	DC9																															1																		N	ml	ds
11/01/1995	F	http://www.ntsb.go	DES	2	SA	DC9																			1	1																													U	ml	MS
10/01/1995	N	http://www.ntsb.go	GRD	2	NA	DC9	1	1																											1																				H	ml	ds
02/04/1994	I	http://www.ntsb.go	CLB	2	NA	B727																				1				1																								1	N	IG	AP
22/11/1994	I	http://www.ntsb.go	CLB	2	NA	B727	1																																															1	N	IG	AP
21/12/1994	F	http://www.ntsb.go	APR	2	EUR	B7312				1											1															1	1						1				1					1		1	M		ML
18/11/1994	I	http://www.ntsb.go	TO	2	NA	B7312																				1																													N		ML
07/07/1994	N	http://www.ntsb.go	DES	2	NA	B7312				1																																													L		ML
26/04/1994	I	http://www.ntsb.go	LDG	2	NA	B7312																			1	1																													N		ML
09/02/1994	I	http://www.ntsb.go	LDG	2	NA	B7312																				1			1																										L		ML
19/01/1994	I	http://www.ntsb.go	LDG	2	NA	B7312																				1																													N		ML
3/4/1994	I	http://www.ntsb.go	TO	2	NA	B747G2			1																				1								1						1				1					1			M	SF	DB
11/2/1994	I	http://www.ntsb.go	GRD	2	NA	B747G2																			1	1																													U		
12/18/1994	I	http://www.ntsb.go	LDG	2	NA	B747G2				1		1														1																													N		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
3/1/1994	N	http://www.ntsb.go	TO	2	ASIA	B747G2																			1	1	
4/7/1994	N	http://www.ntsb.go	UNK	2	NA	DC10																					
05/07/1994	N	http://www.ntsb.go	CLB	2	NA	DC9				1																	
02/07/1994	F	http://www.ntsb.go	APR	2	NA	DC9				1	1		1														
08/05/1994	I	http://www.ntsb.go	LDG	2	SA	DC9																					
05/05/1994	I	http://www.ntsb.go	TO	2	NA	DC9																	1				
28/01/1994	I	http://www.ntsb.go	TO	2	NA	DC9			1																		
06/12/1993	I	http://www.ntsb.go	LDG	2	NA	A300																				1	
15/11/1993	N	http://aviation-safe	APR	2	ASIA	A300				1								1								1	
19/10/1993	I	http://www.ntsb.go	CLB	2	NA	A300																	1			1	
15/11/1993	I	http://www.ntsb.go	CLB	2	NA	B727										1											
22/03/1993	I	http://www.ntsb.go	CLB	2	NA	B727							1			1											
15/03/1993	I	http://www.ntsb.go	CLB	2	NA	B727										1											
09/03/1993	I	http://www.ntsb.go	CLB	2	NA	B727							1			1											
11/02/1993	I	http://www.ntsb.go	CLB	2	NA	B727		1									1										
06/06/1993	I	http://www.ntsb.go	GRD	2	NA	B7312																				1	
15/03/1993	I	http://www.ntsb.go	TO	2	NA	B7312																				1	
13/02/1993	I	http://www.ntsb.go	LDG	2	NA	B7312			1	1																	
4/12/1993	I	http://www.ntsb.go	CLB	2	NA	B747G2																				1	
9/25/1993	I	http://www.ntsb.go	TO	2	NA	B747G2																1	1			1	
3/31/1993	N	http://www.ntsb.go	CLB	2	NA	B747G2				1													1			1	
7/25/1993	N	http://www.ntsb.go	GRD	2	NA	B747G2		1																			
8/27/1993	I	Factual	UNK	2	EUR	B747G2																					
9/11/1993	I	http://www.ntsb.go	CLB	2	NA	B747G2																				1	
7/10/1993	I	http://www.ntsb.go	CLB	2	NA	DC10																				1	
4/14/1993	N	http://www.ntsb.go	LDG	2	NA	DC10			1			1															
11/26/1993	N	http://www.ntsb.go	LDG	2	SA	DC10			1			1															
11/03/1993	N	http://www.ntsb.go	LDG	2	NA	DC9																					
28/09/1992	F	http://aviation-safe	APR	2	ASIA	A300				1			1					1			1						
17/12/1992	I	http://www.ntsb.go	CLB	2	NA	B727																				1	
27/11/1992	I	http://www.ntsb.go	CLB	2	NA	B727																					
01/10/1992	I	Factual	CLB	2	NA	B727																					
02/07/1992	I	http://www.ntsb.go	CLB	2	NA	B727				1																	
09/02/1992	I	http://www.ntsb.go	CLB	2	NA	B727																				1	
08/10/1992	I	http://www.ntsb.go	APR	2	NA	B7312							1			1											
26/08/1992	N	http://www.ntsb.go	GRD	2	NA	B7312																			1	1	
06/08/1992	N	http://www.ntsb.go	GRD	2	NA	B7312	1	1																			
15/07/1992	I	http://www.ntsb.go	APR	2	NA	B7312																				1	
14/05/1992	N	http://www.ntsb.go	DES	2	NA	B7312				1																	
07/01/1992	I	http://www.ntsb.go	CLB	2	NA	B7312																				1	
8/23/1992	F	http://www.ntsb.go	GRD	2	NA	B747G2	1	1																			
3/19/1992	I	http://www.ntsb.go	GRD	2	NA	B747G2	1	1																			
1/9/1992	N	Factual	UNK	2	ASIA	B747G2																					
8/11/1992	N	http://www.ntsb.go	GRD	2	NA	B747G2		1					1														

Date	Factors (Non-Technical)																		Competencies										Validation	
	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
3/1/1994																												U		
4/7/1994																												U	SF	rs
05/07/1994																												M	ml	ds
02/07/1994		1								1						1							1		1		1	H	ml	MS
08/05/1994																1												U	ml	ds
05/05/1994																												N	ml	ds
28/01/1994																1											1	M	ml	ds
06/12/1993																												N	AB	AAD
15/11/1993		1								1							1			1			1					H	AB	AAD
19/10/1993																												N	AB	AAD
15/11/1993		1								1		1					1			1					1		1	H	IG	AP
22/03/1993		1								1									1	1							1	M	IG	AP
15/03/1993										1										1							1	M	IG	AP
09/03/1993																											1	N	IG	AP
11/02/1993		1								1		1				1				1					1		1	H	IG	AP
06/06/1993																												N		ML
15/03/1993																												N		ML
13/02/1993		1														1							1		1		1	M		ML
4/12/1993																												N	SF	DB
9/25/1993																												L	SF	DB
3/31/1993																												N	SF	DB
7/25/1993										1						1				1		1					1	H		
8/27/1993																												U		
9/11/1993																												N		
7/10/1993																												N	SF	rs
4/14/1993										1						1											1	H	SF	rs
11/26/1993																1											1	M	SF	rs
11/03/1993		1								1													1		1			H	ml	MS
28/09/1992		1			1					1										1					1			H	AB	AAD
17/12/1992																											1	N	IG	AP
27/11/1992										1							1				1				1		1	L	IG	AP
01/10/1992																											1	U		
02/07/1992		1								1										1					1		1	H	IG	AP
09/02/1992		1								1							1							1	1		1	H	IG	AP
08/10/1992																												N		ML
26/08/1992																												N		ML
06/08/1992																												N		ML
15/07/1992																												N		ML
14/05/1992																												M		ML
07/01/1992																												N		ML
8/23/1992																												U		
3/19/1992		1								1										1		1						M		
1/9/1992																												U		
8/11/1992										1						1				1							1	M		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				Factors (Non-Technical)																	Competencies									Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatigue	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
9/19/1992	I	Factual	UNK	2	SA	B747G2																																																	U		
9/23/1992	I	http://www.ntsb.go	CLB	2	NA	DC10																	1																																N	SF	rs
3/3/1992	I	http://www.ntsb.go	LDG	2	NA	DC10																				1																													N	SF	rs
12/21/1992	F	http://www.ntsb.go	UNK	2	EUR	DC10			1	1	1	1	1																1								1											1							U	SF	rs
21/10/1992	N	http://www.ntsb.go	GRD	2	NA	DC9	1	1										1																																					N	ml	ds
08/04/1992	F	http://www.ntsb.go	GRD	2	NA	DC9		1																																															N	ml	ds
18/01/1992	N	http://www.ntsb.go	LDG	2	NA	DC9				1																																													U	ml	ds
13/12/1991	I	http://www.ntsb.go	CLB	2	NA	B727				1																											1						1				1							1	H	IG	AP
02/11/1991	I	http://www.ntsb.go	CLB	2	NA	B727																							1																									1	N	IG	AP
05/10/1991	I	http://www.ntsb.go	CLB	2	NA	B727				1																											1										1					1		1	H	IG	AP
20/09/1991	I	http://www.ntsb.go	CLB	2	NA	B727																				1																												1	N	IG	AP
02/07/1991	I	http://www.ntsb.go	CLB	2	NA	B727																				1																												1	N	IG	AP
06/06/1991	I	http://www.ntsb.go	CLB	2	NA	B727																																																1	N	IG	AP
15/05/1991	I	http://www.ntsb.go	CLB	2	NA	B727				1																			1								1						1				1							1	H	IG	AP
03/05/1991	I	http://www.ntsb.go	CLB	2	NA	B727																																																1	U	IG	AP
25/04/1991	I	http://www.ntsb.go	CLB	2	NA	B727		1																																														1	M	IG	AP
23/03/1991	I	http://www.ntsb.go	CLB	2	NA	B727				1																																												1	L	IG	AP
25/01/1991	I	http://www.ntsb.go	CLB	2	NA	B727		1												1									1								1									1		1						1	H	IG	AP
20/01/1991	I	http://www.ntsb.go	CLB	2	NA	B727		1																		1																												1	U	IG	AP
01/03/1991	I	http://www.ntsb.go	CLB	2	NA	B727																				1		1																										1	U	IG	AP
30/11/1991	N	http://www.ntsb.go	APR	2	NA	B7312												1				1																																	U		ML
16/10/1991	N	http://www.ntsb.go	GRD	2	NA	B7312		1					1			1																					1										1		1						M		ML
09/04/1991	I	http://www.ntsb.go	CLB	2	NA	B7312																	1		1																														N		ML
03/03/1991	F	http://www.ntsb.go	APR	2	NA	B7312																				1																													U		ML
13/02/1991	I	http://www.ntsb.go	APR	2	NA	B7312					1																																1											1	M		ML
4/29/1991	I	http://www.ntsb.go	CRZ	2	NA	B747G2																	1			1																													U		
10/24/1991	I	http://www.ntsb.go	CRZ	2	NA	B747G2																				1																													N		
10/17/1991	I	http://www.ntsb.go	LDG	2	NA	B747G2																			1				1								1						1					1				1		1	H		
8/12/1991	I	http://www.ntsb.go	TO	2	NA	B747G2							1			1		1																																					U		
12/12/1991	I	Factual	CRZ	2	NA	B747G2													1							1											1						1				1							1	L		
8/22/1991	I	http://www.ntsb.go	CLB	2	NA	B747G2																	1		1	1		1																											N		
12/29/1991	F	Factual	CLB	2	ASIA	B747G2															1		1			1																													U		
7/13/1991	I	http://www.ntsb.go	CLB	2	NA	DC10																				1																													N	SF	rs
12/23/1991	I	http://www.ntsb.go	TO	2	NA	DC10							1				1																				1									1									H	SF	rs
10/30/1991	I	http://www.ntsb.go	TO	2	NA	DC10			1			1																									1						1											1	H	SF	rs
10/28/1991	I	http://www.ntsb.go	CLB	2	NA	DC10																				1																													N	SF	rs
29/05/1991	I	http://www.ntsb.go	CRZ	2	NA	DC9				1																1		1																											U	ml	ds
17/02/1991	F	http://www.ntsb.go	TO	2	NA	DC9				1																				1					1		1										1			1					H	ml	ds
19/12/1990	I	http://www.ntsb.go	CLB	2	NA	B727																																																1	N	IG	AP
05/12/1990	I	http://www.ntsb.go	CLB	2	NA	B727																					1								1																			1	L	IG	AP
16/11/1990	I	Factual	CLB	2	NA	B727																																																1	U		
09/09/1990	I	http://www.ntsb.go	CLB	2	NA	B727																						1																										1	U	IG	AP
28/09/1990	I	http://www.ntsb.go	CLB	2	NA	B727																															1									1						1		1	H	IG	AP
03/12/1990	I	http://www.ntsb.go	CLB	2	NA	B727				1			1			1	1													1																								1	N	IG	AP

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies									Validation		
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
12/08/1990	I	http://www.ntsb.go	CLB	2	NA	B727																																																1	N	IG	AP
18/07/1990	I	http://www.ntsb.go	CLB	2	NA	B727				1																					1																							1	U	IG	AP
21/06/1990	I	http://www.ntsb.go	CLB	2	NA	B727																				1																												1	L	IG	AP
13/03/1990	I	http://www.ntsb.go	CLB	2	NA	B727							1																																									1	N	IG	AP
17/02/1990	I	http://www.ntsb.go	CLB	2	NA	B727																				1																												1	N	IG	AP
12/02/1990	I	http://www.ntsb.go	CLB	2	NA	B727																				1																												1	N	IG	AP
31/01/1990	I	http://www.ntsb.go	CLB	2	NA	B727	1																						1																									1	N	IG	AP
18/01/1990	I	http://www.ntsb.go	CLB	2	NA	B727							1			1	1																																					1	L	IG	AP
04/01/1990	I	http://www.ntsb.go	CLB	2	NA	B727																				1																												1	N	IG	AP
22/02/1990	I	http://www.ntsb.go	GRD	2	NA	B7312		1	1	1																																	1				1							1	H		ML
19/09/1990	I	http://www.ntsb.go	GRD	2	NA	B7312																			1	1			1								1															1			M		ML
22/07/1990	N	http://www.ntsb.go	TO	2	NA	B7312																				1																													N		ML
02/06/1990	N	http://www.ntsb.go	APR	2	NA	B7312																							1								1						1				1	1				1		1	H		ML
11/05/1990	N	http://www.ntsb.go	DES	2	NA	B7312				1																																													U		ML
1/10/1990	I	http://www.ntsb.go	UNK	2	NA	B747G2																			1																														U		
6/16/1990	N	http://www.ntsb.go	GRD	2	NA	B747G2		1																													1		1										1	1					M		
8/27/1990	I	http://www.ntsb.go	LDG	2	NA	B747G2																				1				1			1																						H		
7/14/1990	N	http://www.ntsb.go	DES	2	NA	B747G2				1																											1										1								U		
8/3/1990	N	http://www.ntsb.go	CRZ	2	NA	DC10																						1																											N	SF	rs
7/27/1990	N	Factual	UNK	2	ASIA	DC10																																																	U	SF	rs
4/18/1990	N	http://www.ntsb.go	LDG	2	NA	DC10																							1								1						1											1	H	SF	rs
20/01/1990	N	http://www.ntsb.go	DES	2	NA	DC10				1																																													N	SF	rs
02/01/1990	N	http://www.ntsb.go	CRZ	2	NA	DC10																			1	1																													N	SF	rs
03/12/1990	F	http://www.ntsb.go	GRD	2	NA	DC9							1				1	1																			1									1	1								H	ml	ds
29/10/1990	N	http://www.ntsb.go	GRD	2	NA	DC9		1																													1										1								L	ml	ds
03/10/1990	F	http://www.ntsb.go	CRZ	2	NA	DC9				1																		1	1								1									1		1							H	ml	ds
29/06/1990	I	http://www.ntsb.go	LDG	2	NA	DC9				1																			1																										H	ml	ds
21/06/1990	I	http://www.ntsb.go	TO	2	NA	DC9																				1																													N	ml	ds
07/06/1990	I	http://www.ntsb.go	TO	2	NA	DC9																	1			1																													N	ml	ds
31/05/1990	I	http://www.ntsb.go	CLB	2	NA	DC9																				1																													N	ml	ds
13/03/1990	I	http://www.ntsb.go	TO	2	NA	DC9																				1																													N	ml	ds
31/01/1990	I	http://www.ntsb.go	GRD	2	NA	DC9																				1																													N	ml	ds
18/01/1990	I	http://www.ntsb.go	TO	2	NA	DC9																							1								1						1				1					1			H	ml	ds
10/05/1989	N	http://www.ntsb.go	DES	2	NA	A300				1																																													N	AB	AAD
27/12/1989	I	http://www.ntsb.go	CLB	2	NA	B727																																																1	U	IG	AP
08/12/1989	I	http://www.ntsb.go	CLB	2	NA	B727																				1																												1	N	IG	AP
15/12/1989	I	http://www.ntsb.go	CLB	2	NA	B727							1			1																																						1	L	IG	AP
21/10/1989	I	Factual	CLB	2	NA	B727																							1								1										1							1	H	IG	
14/10/1989	I	http://www.ntsb.go	CLB	2	NA	B727																				1																												1	N	IG	AP
29/11/1989	I	http://www.ntsb.go	CLB	2	NA	B727																				1																												1	N	IG	AP
25/08/1989	I	http://www.ntsb.go	CRZ	2	NA	B727																							1	1					1		1				1		1	1				1				1		1	H	IG	AP
10/08/1989	I	http://www.ntsb.go	CRZ	2	NA	B727																				1																												1	N	IG	AP
10/08/1989	I	http://www.ntsb.go	CRZ	2	NA	B727																				1																													N	IG	AP
24/05/1989	I	http://www.ntsb.go	CRZ	2	NA	B727																				1																													N	IG	AP

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
23/04/1989	I	http://www.ntsb.go	CRZ	2	NA	B727																															1						1				1					1			H	IG	AP
23/04/1989	I	http://www.ntsb.go	CRZ	2	NA	B727							1			1																				1									1								L	IG	AP
21/03/1989	I	http://www.ntsb.go	CRZ	2	NA	B727							1			1																																						N	IG	AP
14/03/1989	I	http://www.ntsb.go	CRZ	2	NA	B727																				1																													N	IG	AP
09/01/1989	I	http://www.ntsb.go	CRZ	2	NA	B727		1																																														N	IG	AP
30/12/1989	N	http://www.ntsb.go	APR	2	NA	B7312																			1	1																												N		ML
08/09/1989	I	http://www.ntsb.go	APR	2	NA	B7312							1															1								1									1			1					H		ML
26/06/1989	N	http://www.ntsb.go	GRD	2	NA	B7312		1																																														N		ML
09/03/1989	I	http://www.ntsb.go	CRZ	2	NA	B7312																				1																													N		ML
20/01/1989	N	http://www.ntsb.go	TO	2	NA	B7312																	1			1																													N		ML
5/17/1989	I	http://www.ntsb.go	TO	2	NA	B747G2																				1			1								1														1	1			M	SF	DB
1/9/1989	I	http://www.ntsb.go	GRD	2	NA	B747G2		1																												1						1				1					1		1	H	SF	DB
2/24/1989	F	http://www.ntsb.go	CLB	2	NA	B747G2																	1			1	1	1																										N		
5/7/1989	I	http://www.ntsb.go	DES	2	NA	B747G2							1			1																				1									1								U		
4/23/1989	I	http://www.ntsb.go	APR	2	NA	B747G2										1																																							U		
2/19/1989	F	http://www.ntsb.go	APR	2	ASIA	B747G2				1			1					1			1							1								1						1			1	1								H		
8/9/1989	I	http://www.ntsb.go	CLB	2	NA	DC10																	1																																	N	SF	rs
7/19/1989	F	http://www.ntsb.go	CRZ	2	NA	DC10																	1		1	1																													N	SF	rs
7/18/1989	I	http://www.ntsb.go	LDG	2	NA	DC10			1																																		1											1	M	SF	rs
6/6/1989	I	http://www.ntsb.go	CRZ	2	NA	DC10				1																																														N	SF	rs
13/12/1989	I	http://www.ntsb.go	LDG	2	NA	DC9			1	1																																1											1	L	ml	MS
08/12/1989	I	http://www.ntsb.go	LDG	2	NA	DC9																								1								1						1				1							1	M	ml	ds
18/10/1989	I	http://www.ntsb.go	CRZ	2	NA	DC9																				1			1								1		1				1	1						1		1		1	H	ml	ds
07/10/1989	F	http://www.ntsb.go	GRD	2	NA	DC9		1		1																																											N	ml	ds
25/07/1989	I	http://www.ntsb.go	LDG	2	NA	DC9																				1																													N	ml	MS
09/07/1989	I	http://www.ntsb.go	CLB	2	NA	DC9										1												1								1									1		1						M	ml	ds
23/03/1989	I	http://www.ntsb.go	GRD	2	NA	DC9			1																				1								1									1	1								M	ml	ds
18/03/1989	F	http://www.ntsb.go	CLB	2	NA	DC9																								1				1		1		1		1				1							1			1			H	ml	ds
21/02/1989	I	http://www.ntsb.go	CLB	2	NA	DC9																	1		1	1																													N	ml	ds
09/02/1989	F	http://www.ntsb.go	CLB	2	NA	DC9																				1			1								1	1								1				1					M	ml	ds
09/01/1989	I	http://www.ntsb.go	LDG	2	NA	DC9			1	1																		1								1						1							1		1			M	ml	ds
14/11/1988	N	http://www.ntsb.go	UNK	2	SA	A300																																																	U	AB	AAD
03/07/1988	F	http://aviation-safe	CLB	2	ME	A300																																																	N	AB	AAD
23/05/1988	I	http://www.ntsb.go	CRZ	2	NA	A300							1			1																																						N	AB	AAD
10/08/1988	N	http://www.ntsb.go	TO	2	NA	B7312																	1		1	1		1																												L		ML
24/07/1988	I	http://www.ntsb.go	TO	2	NA	B7312																	1																																	N		ML
06/07/1988	I	http://www.ntsb.go	APR	2	NA	B7312																				1																													N		ML
26/06/1988	N	http://www.ntsb.go	CRZ	2	NA	B7312				1																																														U		ML
11/05/1988	I	http://www.ntsb.go	CRZ	2	NA	B7312																				1																													N		ML
28/04/1988	N	http://ntsb.gov/ntsb	CRZ	2	NA	B7312																				1																													N		ML
17/04/1988	I	http://www.ntsb.go	APR	2	NA	B7312																			1	1																												N		ML
09/03/1988	I	http://www.ntsb.go	GRD	2	NA	B7312	1	1																																														N		ML
12/23/1988	N	http://www.ntsb.go	CRZ	2	OTH	B747G2				1																	1			1																							U	SF	DB
11/3/1988	N	http://www.ntsb.go	CRZ	2	NA	B747G2																						1																												U		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L.F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
5/9/1988	N	http://www.ntsb.go	APR	2	NA	B747G2																				1																													N		
2/19/1988	I	Probable Cause	TO	2	NA	B747G2							1			1																																							U		
6/17/1988	I	Factual	UNK	2	SA	B747G2																																																	U		
9/21/1988	I	http://www.ntsb.go	CRZ	2	SA	B747G2				1																		1																											N		
6/1/1988	I	http://www.ntsb.go	LDG	2	NA	B747G2				1	1							1																			1						1				1					1		1	H		
12/21/1988	F	Factual	CRZ	2	EUR	B747G2																																																	U		
3/3/1988	N	Probable Cause	LDG	2	NA	B747G2																							1								1					1	1								1	1	1	1	H		
1/9/1988	I	Probable Cause	CRZ	2	NA	B747G2																				1																													U		
5/2/1988	I	Probable Cause	LDG	2	ASIA	B747G2																	1			1											1						1	1							1	1			H		
4/14/1988	I	Factual	UNK	2	EUR	B747G2																																																	U		
12/16/1988	N	Factual	UNK	2	OTH	B747G2																																																	U		
9/12/1988	N	Probable Cause	LDG	2	NA	DC10																				1											1						1			1								1	M	SF	rs
5/21/1988	N	Probable Cause	TO	2	NA	DC10																				1																													N	SF	rs
5/11/1988	I	Probable Cause	TO	2	NA	DC10							1			1																																							N	SF	rs
3/30/1988	I	http://www.ntsb.go	GRD	2	NA	DC10																			1	1																													N	SF	rs
2/10/1988	I	http://www.ntsb.go	LDG	2	NA	DC10	1										1																																						N	SF	rs
12/30/1988	I	Probable Cause	CRZ	2	OTH	DC10							1			1																																							N	SF	rs
10/01/1988	N	http://www.ntsb.go	GRD	2	NA	DC10																						1																											N	SF	rs
15/11/1988	I	http://www.ntsb.go	TO	2	NA	DC9																	1			1																													N	ml	ds
30/10/1988	N	http://www.ntsb.go	GRD	2	NA	DC9	1	1																																															N	ml	ds
20/08/1988	I	http://www.ntsb.go	LDG	2	NA	DC9														1																																			U	ml	ds
05/08/1988	I	http://www.ntsb.go	TO	2	NA	DC9																	1			1																													N	ml	ds
05/08/1988	I	http://www.ntsb.go	GRD	2	NA	DC9		1																																															N	ml	ds
10/05/1988	I	http://www.ntsb.go	TO	2	NA	DC9							1			1																																							N	ml	ds
21/09/1987	F	http://aviation-safet	LDG	2	ME	A300																							1								1						1				1			1				1	H	AB	AAD
03/08/1987	I	http://www.ntsb.go	TO	2	NA	A300																		1		1			1								1										1			1					M	AB	AAD
29/03/1987	N	http://www.ntsb.go	CRZ	2	NA	A300				1																																													N	AB	AAD
05/12/1987	N	http://ntsb.gov/ntsb	CLB	2	NA	B7312																	1			1																													N		ML
18/11/1987	N	http://ntsb.gov/ntsb	APR	2	NA	B7312				1																																													U		ML
10/11/1987	N	http://ntsb.gov/ntsb	CRZ	2	NA	B7312				1								1																																					U		ML
11/08/1987	I	http://www.ntsb.go	DES	2	NA	B7312							1			1																																							N		ML
07/07/1987	I	http://www.ntsb.go	LDG	2	NA	B7312								1				1											1								1									1	1					1			H		ML
22/06/1987	N	http://www.ntsb.go	GRD	2	NA	B7312		1																																															N		ML
18/06/1987	I	http://www.ntsb.go	TO	2	NA	B7312							1			1	1	1																																					L		ML
11/06/1987	I	http://www.ntsb.go	CRZ	2	NA	B7312																				1																													N		ML
25/02/1987	I	http://www.ntsb.go	LDG	2	NA	B7312			1	1		1																															1											1	M		ML
03/01/1987	I	http://www.ntsb.go	DES	2	NA	B7312																				1																													L		ML
12/16/1987	U	Factual	UNK	2	SA	B747G2																																																	U		
5/29/1987	I	Probable Cause	CRZ	2	SA	B747G2																																		1															N		
2/11/1987	N	Probable Cause	GRD	2	NA	B747G2																				1		1																											N		
8/7/1987	I	Probable Cause	APR	2	NA	B747G2							1					1																			1						1			1				1				1	M		
6/22/1987	N	http://www.ntsb.go	GRD	2	NA	B747G2		1																																															N		
2/26/1987	N	Probable Cause	GRD	2	NA	B747G2																						1							1																				N		
7/24/1987	N	Probable Cause	GRD	2	NA	B747G2	1	1																		1			1								1					1	1				1					1	1	1	H		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies									Validation		
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
8/9/1987	I	Probable Cause	APR	2	NA	B747G2							1			1		1																																					N		
8/11/1987	F	Probable Cause	GRD	2	NA	B747G2	1																																																	N		
8/2/1987	I	Probable Cause	TO	2	NA	DC10											1																																							N	SF	rs
7/9/1987	I	Probable Cause	CRZ	2	OTH	DC10							1			1																																								N	SF	rs
6/6/1987	I	Probable Cause	APR	2	NA	DC10																				1																														N	SF	rs
6/26/1987	I	Probable Cause	DES	2	NA	DC10																				1																														N	SF	rs
3/26/1987	I	Probable Cause	CRZ	2	NA	DC10																	1																																	N	SF	rs
3/25/1987	N	Probable Cause	GRD	2	NA	DC10																		1	1																															N	SF	rs
11/7/1987	I	Factual	UNK	2	NA	DC10																																																		U	SF	rs
11/21/1987	I	Probable Cause	LDG	2	NA	DC10																																						1		1									1	M	SF	rs
10/5/1987	I	Probable Cause	CLB	2	NA	DC10																				1																														N	SF	rs
10/28/1987	I	Probable Cause	CRZ	2	NA	DC10																				1																														N	SF	rs
27/12/1987	N	http://www.ntsb.go	LDG	2	NA	DC9				1																			1								1						1				1							1	H	ml	ds
05/12/1987	I	http://www.ntsb.go	CLB	2	NA	DC9							1			1																																								N	ml	ds
15/11/1987	I	http://www.ntsb.go	DES	2	NA	DC9																				1																														N	ml	ds
15/11/1987	F	http://www.ntsb.go	TO	2	NA	DC9				1			1																1								1						1									1		1	H	ml	ds
20/08/1987	N	http://www.ntsb.go	LDG	2	NA	DC9				1			1				1	1																																						L	ml	ds
29/09/1986	N	http://aviation-safe	TO	2	ASIA	A300																1	1						1								1						1							1		1		1	H	AB	AAD
13/07/1986	N	http://www.ntsb.go	DES	2	NA	A300				1																																														N	AB	AAD
25/10/1986	N	http://ntsb.gov/ntsb	LDG	2	NA	B7312			1	1		1																															1					1		1				1	H		ML
30/08/1986	I	http://www.ntsb.go	DES	2	NA	B7312							1			1																															1								L		ML
06/07/1986	I	http://www.ntsb.go	APR	2	NA	B7312																																1							1										N		ML
04/05/1986	N	http://ntsb.gov/ntsb	CRZ	2	NA	B7312				1																																													U		ML
08/04/1986	N	http://ntsb.gov/ntsb	LDG	2	NA	B7312																				1																														N		ML
21/03/1986	I	http://www.ntsb.go	DES	2	NA	B7312										1																																								N		ML
03/01/1986	I	http://www.ntsb.go	TO	2	NA	B7312																				1																														N		ML
3/3/1986	N	Probable Cause	CRZ	2	NA	B747G2				1																					1																									U		
12/21/1986	I	Probable Cause	GRD	2	NA	B747G2																																								1										M		
1/27/1986	I	Probable Cause	CLB	2	NA	B747G2																			1	1																														N		
6/24/1986	I	Probable Cause	CRZ	2	ASIA	B747G2																				1		1																												U		
5/23/1986	N	Factual	UNK	2	AUS	B747G2																																																		U		
8/10/1986	I	Probable Cause	GRD	2	NA	DC10																			1															1																N	SF	rs
5/7/1986	I	Probable Cause	GRD	2	NA	DC10																							1								1															1			H	SF	rs
4/7/1986	N	Probable Cause	CRZ	2	NA	DC10				1																																													L	SF	rs
3/2/1986	I	Probable Cause	CRZ	2	NA	DC10																																								1										N	SF	rs
11/7/1986	N	Probable Cause	CRZ	2	NA	DC10													1							1		1																												N	SF	rs
11/10/1986	I	Probable Cause	CRZ	2	NA	DC10							1			1																																								N	SF	rs
10/5/1986	I	Probable Cause	GRD	2	NA	DC10																				1																														N	SF	rs
02/01/1986	I	Probable Cause	LDG	2	NA	DC10			1																												1						1					1						1	H	SF	rs
01/12/1986	I	http://www.ntsb.go	GRD	2	NA	DC9			1	1		1																															1												L	ml	ds
25/09/1986	I	http://www.ntsb.go	LDG	2	NA	DC9												1											1								1						1				1							1	H	ml	ds
31/08/1986	F	http://www.ntsb.go	DES	2	NA	DC9							1			1																																								N	ml	ds
21/07/1986	N	http://www.ntsb.go	CRZ	2	NA	DC9				1																		1	1								1													1		1			M	ml	ds
30/05/1986	I	http://www.ntsb.go	DES	2	NA	DC9										1																																								N	ml	ds

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
17/05/1986	I	http://www.ntsb.go	TO	2	NA	DC9							1				1																																						N	ml	ds
13/03/1986	I	http://www.ntsb.go	LDG	2	NA	DC9			1	1		1																	1								1						1				1			1					M	ml	ds
21/02/1986	N	http://www.ntsb.go	LDG	2	NA	DC9			1	1		1						1											1								1						1							1		1			M	ml	ds
30/12/1985	I	http://www.ntsb.go	TO	2	NA	A300																	1			1																													N	AB	AAD
28/05/1985	N	http://www.ntsb.go	CRZ	2	NA	A300				1																											1									1		1							M	AB	AAD
03/11/1985	N	http://ntsb.gov/ntsb	CLB	2	NA	B7312				1																																													N		ML
25/09/1985	N	http://ntsb.gov/ntsb	LDG	2	NA	B7312			1	1	1	1						1												1					1		1						1					1		1				1	M		ML
27/06/1985	I	http://www.ntsb.go	CRZ	2	NA	B7312																				1																													N		ML
16/06/1985	N	http://ntsb.gov/ntsb	CRZ	2	NA	B7312			1	1																																	1			1				1					H		ML
12/04/1985	I	http://www.ntsb.go	TO	2	NA	B7312		1																	1	1																													N		ML
23/02/1985	I	http://www.ntsb.go	CLB	2	NA	B7312																																1							1										N		ML
12/15/1985	N	Probable Cause	APR	2	NA	B747G2																				1	1																												N		
4/25/1985	I	Probable Cause	GRD	2	NA	B747G2																			1	1											1											1		1					M		
11/28/1985	I	Probable Cause	CLB	2	NA	B747G2																	1		1	1																													N		
9/15/1985	I	Probable Cause	LDG	2	NA	B747G2																															1						1				1							1	H		
2/19/1985	N	Probable Cause	CRZ	2	NA	B747G2				1	1							1	1																		1		1				1						1			1		1	H		
9/8/1985	I	Probable Cause	GRD	2	NA	DC10	1	1																																															N	SF	rs
9/3/1985	I	Probable Cause	CRZ	2	NA	DC10																	1		1																														N	SF	rs
8/7/1985	I	Probable Cause	CLB	2	NA	DC10																	1																																N	SF	rs
6/27/1985	N	Probable Cause	TO	2	NA	DC10			1																	1																													N	SF	rs
6/2/1985	I	Probable Cause	CRZ	2	NA	DC10																				1																													N	SF	rs
5/28/1985	N	Probable Cause	CLB	2	NA	DC10																				1																													N	SF	rs
19/10/1985	I	http://www.ntsb.go	CLB	2	NA	DC9																	1			1																													N	ml	ds
06/09/1985	F	http://www.ntsb.go	TO	2	NA	DC9																	1			1			1								1						1				1					1		1	H	ml	ds
02/07/1985	I	http://www.ntsb.go	CLB	2	NA	DC9																																1																	N	ml	ds
26/03/1985	I	http://www.ntsb.go	CLB	2	NA	DC9																				1																													N	ml	ds
15/03/1985	I	http://www.ntsb.go	APR	2	NA	DC9							1																																										M	ml	ds
10/02/1985	I	http://www.ntsb.go	APR	2	NA	DC9				1								1																			1						1				1			1				1	M	ml	ds
05/02/1985	N	http://www.ntsb.go	GRD	2	NA	DC9				1													1				1		1								1						1							1				1	H	ml	ds
31/01/1985	I	http://www.ntsb.go	TO	2	NA	DC9			1	1													1						1															1						1		1			M	ml	ds
29/08/1984	I	http://www.ntsb.go	CLB	2	NA	B7312																	1																																N		ML
09/07/1984	I	http://www.ntsb.go	CLB	2	NA	B7312																				1																													N		ML
27/06/1984	I	http://www.ntsb.go	UNK	2	NA	B7312																				1			1								1													1					M		ML
08/03/1984	I	http://www.ntsb.go	LDG	2	NA	B7312				1			1				1	1																																					N		ML
1/1/1984	I	Probable Cause	CRZ	2	NA	B747G2							1			1																																							N		
11/16/1984	N	Probable Cause	TO	2	NA	B747G2																				1			1								1									1									M		
1/18/1984	I	Probable Cause	TO	2	NA	B747G2		1	1	1							1	1																																					N		
11/1/1984	I	Probable Cause	GRD	2	NA	B747G2		1					1					1																			1										1								L		
5/11/1984	I	Probable Cause	TO	2	NA	B747G2																	1			1																													N		
4/14/1984	I	Probable Cause	CLB	2	NA	B747G2																				1																													N		
12/20/1984	I	Probable Cause	APR	2	NA	B747G2										1			1												1	1																							U		
6/11/1984	I	Probable Cause	APR	2	NA	B747G2																				1											1										1								M		
9/29/1984	I	Probable Cause	CLB	2	NA	B747G2																	1			1																													N		
9/15/1984	I	Probable Cause	DES	2	NA	DC10																				1																													N	SF	rs

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Date	Severity	Info Source Link	Phase	Generation	Region	Type
6/10/1984	I	Probable Cause	CLB	2	NA	DC10
5/17/1984	I	Probable Cause	CLB	2	NA	DC10
2/28/1984	N	Probable Cause	APR	2	NA	DC10
12/12/1984	I	Probable Cause	GRD	2	NA	DC10
10/27/1984	I	Probable Cause	CLB	2	NA	DC10
01/01/1984	I	Probable Cause	CRZ	2	NA	DC10
07/12/1984	N	http://www.ntsb.go	CRZ	2	NA	DC9
14/10/1984	I	http://www.ntsb.go	LDG	2	NA	DC9
08/10/1984	I	http://www.ntsb.go	GRD	2	NA	DC9
25/08/1984	I	http://www.ntsb.go	GRD	2	NA	DC9
06/08/1984	I	http://www.ntsb.go	CLB	2	NA	DC9
25/07/1984	N	http://www.ntsb.go	CRZ	2	NA	DC9
13/06/1984	N	http://www.ntsb.go	APR	2	NA	DC9
04/05/1984	I	http://www.ntsb.go	CLB	2	NA	DC9
16/02/1984	I	http://www.ntsb.go	CLB	2	NA	DC9
21/01/1984	I	http://www.ntsb.go	CLB	2	NA	DC9
10/01/1984	I	http://www.ntsb.go	APR	2	NA	DC9
18/12/1983	N	http://aviation-safe	APR	2	ASIA	A300
06/11/1983	I	http://www.ntsb.go	TO	2	NA	A300
29/12/1983	N	http://ntsb.gov/ntsb	CRZ	2	NA	B7312
25/12/1983	N	http://ntsb.gov/ntsb	GRD	2	NA	B7312
16/06/1983	I	http://www.ntsb.go	CLB	2	NA	B7312
23/05/1983	I	http://www.ntsb.go	GRD	2	NA	B7312
23/03/1983	N	http://ntsb.gov/ntsb	LDG	2	NA	B7312
21/03/1983	I	http://www.ntsb.go	TO	2	NA	B7312
20/01/1983	I	http://www.ntsb.go	GRD	2	NA	B7312
12/19/1983	N	Probable Cause	LDG	2	NA	B747G2
6/20/1983	I	Probable Cause	GRD	2	NA	B747G2
6/20/1983	I	Probable Cause	GRD	2	NA	B747G2
10/11/1983	N	Factual	TO	2	EUR	B747G2
02/01/1983	I	Preliminary	CLB	2	AFR	B747G2
3/18/1983	I	Probable Cause	GRD	2	NA	B747G2
1/16/1983	I	Probable Cause	GRD	2	NA	B747G2
8/4/1983	N	Factual	LDG	2	ASIA	B747G2
9/1/1983	I	Probable Cause	APR	2	NA	DC10
8/21/1983	I	Probable Cause	CRZ	2	NA	DC10
6/4/1983	N	Probable Cause	CRZ	2	NA	DC10
5/26/1983	I	Probable Cause	DES	2	NA	DC10
12/7/1983	I	Probable Cause	LDG	2	NA	DC10
12/23/1983	N	Probable Cause	GRD	2	NA	DC10
12/14/1983	I	Probable Cause	GRD	2	NA	DC10
12/10/1983	I	Probable Cause	CRZ	2	OTH	DC10
13/01/1983	I	Probable Cause	TO	2	NA	DC10
24/06/1983	I	http://www.ntsb.go	GRD	2	NA	DC9

Date	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
6/10/1984																				1	
5/17/1984																			1		
2/28/1984																					
12/12/1984																				1	
10/27/1984																				1	
01/01/1984							1			1											
07/12/1984				1																	
14/10/1984				1								1									
08/10/1984				1							1	1									
25/08/1984																				1	
06/08/1984																	1			1	
25/07/1984				1																	
13/06/1984				1	1		1					1									
04/05/1984							1			1											
16/02/1984																	1			1	
21/01/1984																	1			1	
10/01/1984														1							
18/12/1983				1								1			1				1		
06/11/1983																				1	
29/12/1983				1																	
25/12/1983		1																			
16/06/1983				1																	
23/05/1983																				1	
23/03/1983																				1	
21/03/1983																				1	
20/01/1983		1	1																		
12/19/1983		1		1			1				1	1									
6/20/1983		1																			
6/20/1983		1																			
10/11/1983																				1	
02/01/1983																	1			1	
3/18/1983		1										1									
1/16/1983																				1	
8/4/1983			1	1														1		1	
9/1/1983																				1	
8/21/1983																	1				
6/4/1983																				1	
5/26/1983				1																1	
12/7/1983																				1	
12/23/1983											1	1									
12/14/1983																				1	
12/10/1983				1																	
13/01/1983																					
24/06/1983																	1		1	1	

Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
6/10/1984																		
5/17/1984																		
2/28/1984		1								1						1		
12/12/1984																		
10/27/1984																		
01/01/1984																		
07/12/1984	1																	
14/10/1984		1							1	1		1				1		
08/10/1984		1								1								
25/08/1984																		
06/08/1984																		
25/07/1984	1																	
13/06/1984		1								1								
04/05/1984																		
16/02/1984																		
21/01/1984																		
10/01/1984		1								1								
18/12/1983		1								1						1		
06/11/1983																		
29/12/1983	1			1						1								
25/12/1983																		
16/06/1983																		
23/05/1983																		
23/03/1983		1								1							1	
21/03/1983																		
20/01/1983										1						1		
12/19/1983																		
6/20/1983										1						1		
6/20/1983										1								
10/11/1983										1								
02/01/1983																		
3/18/1983										1								
1/16/1983																		
8/4/1983										1						1		
9/1/1983																		
8/21/1983																		
6/4/1983																		
5/26/1983																		
12/7/1983																		
12/23/1983		1								1						1		
12/14/1983																		
12/10/1983																		
13/01/1983										1						1		
24/06/1983																		

Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
6/10/1984										N	SF	rs
5/17/1984										N	SF	rs
2/28/1984			1					1	1	H	SF	rs
12/12/1984										N	SF	rs
10/27/1984										N	SF	rs
01/01/1984										N	SF	rs
07/12/1984										N	ml	ds
14/10/1984					1		1			M	ml	ds
08/10/1984	1	1								M	ml	ds
25/08/1984										N	ml	ds
06/08/1984										N	ml	ds
25/07/1984										N	ml	MS
13/06/1984					1		1			M	ml	ds
04/05/1984										N	ml	ds
16/02/1984										N	ml	ds
21/01/1984										N	ml	ds
10/01/1984		1			1					H	ml	ds
18/12/1983		1	1				1	1	1	H	AB	AAD
06/11/1983										N	AB	AAD
29/12/1983		1			1					M		ML
25/12/1983										N		ML
16/06/1983										N		ML
23/05/1983										N		ML
23/03/1983			1				1			H		ML
21/03/1983										N		ML
20/01/1983					1				1	H		ML
12/19/1983										N	SF	DB
6/20/1983		1								M		
6/20/1983	1	1								M		
10/11/1983	1									L		
02/01/1983										N		
3/18/1983		1								M		
1/16/1983										U		
8/4/1983							1		1	H		
9/1/1983										N	SF	rs
8/21/1983										N	SF	rs
6/4/1983										N	SF	rs
5/26/1983										N	SF	rs
12/7/1983										N	SF	rs
12/23/1983							1		1	H	SF	rs
12/14/1983										N	SF	rs
12/10/1983										N	SF	rs
13/01/1983			1						1	H	SF	rs
24/06/1983										N	ml	ds

Column groups: Accidents (Date to Type); Factors (Ground equipment to Ops/Type Spec); Factors (Non-Technical) (Cabin to Pilot Incap); Competencies (Communication to Improved Training); Validation (Analyst, Checker).

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
20/12/1983	F	http://www.ntsb.go	LDG	2	NA	DC9	1			1			1					1																																				N	ml	ds
18/12/1983	I	http://www.ntsb.go	TO	2	NA	DC9																	1		1	1																														N	ml	ds
09/11/1983	I	http://www.ntsb.go	LDG	2	NA	DC9			1				1					1											1								1						1				1			1					M	ml	ds
25/06/1983	I	http://www.ntsb.go	GRD	2	NA	DC9		1																	1																														N	ml	ds
21/06/1983	N	http://www.ntsb.go	GRD	2	NA	DC9	1																																																		N	ml	ds
02/06/1983	F	http://www.ntsb.go	CRZ	2	NA	DC9																			1	1		1									1									1				1					H	ml	ds
28/05/1983	I	http://www.ntsb.go	DES	2	NA	DC9																	1						1								1							1							1	1			H	ml	ds
17/03/1983	I	http://www.ntsb.go	CLB	2	NA	DC9				1																																															N	ml	ds
17/03/1983	I	Probable Cause	CLB	2	NA	DC9																				1																														N	SF	rs
07/02/1983	I	http://www.ntsb.go	LDG	2	NA	DC9				1								1										1								1						1				1			1					H	ml	ds
17/04/1982	N	http://aviation-safet	GRD	2	ME	A300																	1		1	1																														N	AB	AAD
28/12/1982	I	http://www.ntsb.go	APR	2	NA	B7312												1										1								1						1				1					1		1	H		ML
09/12/1982	N	http://ntsb.gov/ntsb	GRD	2	NA	B7312		1																				1								1						1									1		1	H		ML
05/12/1982	I	http://www.ntsb.go	APR	2	NA	B7312			1	1																											1						1						1				1	M		ML
02/11/1982	N	http://ntsb.gov/ntsb	CLB	2	NA	B7312			1	1																																															U		ML
12/08/1982	I	http://www.ntsb.go	APR	2	NA	B7312												1																			1						1				1							1	H		ML
05/08/1982	I	http://www.ntsb.go	TO	2	NA	B7312																				1																														N		ML
15/02/1982	I	http://www.ntsb.go	APR	2	NA	B7312				1		1		1				1			1					1			1								1						1				1					1		1	H		ML
13/01/1982	F	http://ntsb.gov/ntsb	TO	2	NA	B7312			1	1								1										1								1						1	1				1					1		1	H		ML
8/21/1982	I	Probable Cause	TO	2	NA	DC10																	1		1																																N	SF	rs
7/16/1982	N	Probable Cause	CRZ	2	NA	DC10				1																																															N	SF	rs
5/26/1982	N	Probable Cause	GRD	2	NA	DC10	1																																																		N	SF	rs
2/3/1982	N	Probable Cause	TO	2	NA	DC10																			1				1								1						1									1		1	H	SF	rs
12/30/1982	I	Probable Cause	CLB	2	NA	DC10				1																																															N	SF	rs
11/18/1982	N	Probable Cause	GRD	2	NA	DC10																																																			N	SF	rs
23/01/1982	F	Probable Cause	LDG	2	NA	DC10			1				1																								1						1									1		1	H	SF	rs
18/12/1982	I	http://www.ntsb.go	LDG	2	NA	DC9			1	1																																															U	ml	ds
01/12/1982	I	http://www.ntsb.go	CRZ	2	NA	DC9																															1																			N	ml	ds
18/10/1982	I	http://www.ntsb.go	TO	2	NA	DC9																				1																														N	ml	ds
05/07/1982	I	http://www.ntsb.go	TO	2	NA	DC9																				1																														N	ml	ds
22/05/1982	N	http://www.ntsb.go	DES	2	NA	DC9				1																		1																												N	ml	ds
02/06/1981	I	http://www.ntsb.go	CRZ	2	NA	A300				1																																															N	AB	AAD
06/02/1981	F	http://www.ntsb.go	GRD	2	NA	A300																																																			U	AB	AAD
23/10/1981	I	http://www.ntsb.go	GRD	2	NA	B727													1	1																																				L	IG	AP
13/10/1981	I	http://www.ntsb.go	GRD	2	NA	B727																						1																												N	IG	AP
12/10/1981	I	http://www.ntsb.go	GRD	2	NA	B727	1	1																				1								1						1				1								M	IG	AP
11/09/1981	I	http://www.ntsb.go	GRD	2	NA	B727																						1																												N	IG	AP
25/08/1981	I	http://www.ntsb.go	GRD	2	NA	B727				1																										1						1				1				1				H	IG	AP
17/08/1981	I	http://www.ntsb.go	GRD	2	NA	B727				1																		1								1						1								1					H	IG	AP
27/06/1981	I	http://www.ntsb.go	GRD	2	NA	B727																				1																														N	IG	AP
05/06/1981	I	http://www.ntsb.go	GRD	2	NA	B727				1																																															N	IG	AP
03/06/1981	I	http://www.ntsb.go	GRD	2	NA	B727		1																				1								1																				U	IG	AP
04/05/1981	I	http://www.ntsb.go	GRD	2	NA	B727		1																				1								1						1				1					1			M	IG	AP
14/04/1981	I	http://www.ntsb.go	GRD	2	NA	B727	1	1																				1																											L	IG	AP

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies									Validation		
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
09/04/1981	I	http://www.ntsb.go	GRD	2	NA	B727																				1			1																							1			M	IG	AP
08/04/1981	I	http://www.ntsb.go	GRD	2	NA	B727																				1																													N	IG	AP
12/02/1981	I	http://www.ntsb.go	GRD	2	NA	B727	1																																																N	IG	AP
31/01/1981	I	http://www.ntsb.go	GRD	2	NA	B727																				1																													N	IG	AP
14/01/1981	I	http://www.ntsb.go	GRD	2	NA	B727		1		1																			1								1										1								M	IG	AP
2/11/1981	N	http://www.ntsb.go	GRD	2	NA	B747G2		1																													1					1	1				1						1	1	M		
12/18/1981	I	http://www.ntsb.go	CRZ	2	NA	B747G2																	1			1			1								1							1				1				1			H		
7/5/1981	I	http://www.ntsb.go	CRZ	2	NA	B747G2																	1			1																	1												U		
7/9/1981	I	http://www.ntsb.go	APR	2	NA	B747G2																				1																													N		
9/7/1981	F	http://www.ntsb.go	GRD	2	NA	DC10																																																	N	SF	rs
9/22/1981	N	http://www.ntsb.go	TO	2	NA	DC10																	1																																N	SF	rs
9/20/1981	F	http://www.ntsb.go	CRZ	2	OTH	DC10																																																	N	SF	rs
5/20/1981	F	http://www.ntsb.go	GRD	2	NA	DC10																																																	N	SF	rs
4/3/1981	N	http://www.ntsb.go	CRZ	2	NA	DC10				1																																													N	SF	rs
11/17/1981	I	http://www.ntsb.go	TO	2	NA	DC10																	1																																N	SF	rs
10/17/1981	I	http://www.ntsb.go	CLB	2	NA	DC10																																							1										N	SF	rs
01/10/1981	I	http://www.ntsb.go	CLB	2	NA	DC10																				1																													N	SF	rs
31/01/1981	I	http://www.ntsb.go	CLB	2	NA	DC10																	1																																N	SF	rs
07/10/1981	I	http://www.ntsb.go	LDG	2	NA	DC9																																																	N	ml	ds
13/08/1981	N	http://www.ntsb.go	GRD	2	NA	DC9	1	1																																															N	ml	ds
18/06/1981	I	http://www.ntsb.go	GRD	2	NA	DC9																				1																													N	ml	ds
18/05/1981	N	http://www.ntsb.go	CRZ	2	NA	DC9				1																		1																											U	ml	ds
21/11/1980	I	http://www.ntsb.go	GRD	2	NA	B727																															1						1				1	1							H	IG	AP
11/11/1980	I	http://www.ntsb.go	GRD	2	NA	B727				1																			1								1						1												M	IG	AP
03/09/1980	I	http://www.ntsb.go	GRD	2	NA	B727				1																											1						1				1			1					H	IG	AP
04/07/1980	I	http://www.ntsb.go	GRD	2	NA	B727				1																																													N	IG	AP
11/04/1980	I	http://www.ntsb.go	GRD	2	NA	B727		1																		1																													N	IG	AP
15/01/1980	I	http://www.ntsb.go	GRD	2	NA	B727				1																																	1												U	IG	AP
9/2/1980	I	http://www.ntsb.go	GRD	2	NA	B747G2	1	1	1																												1						1				1							1	L		
12/15/1980	I	http://www.ntsb.go	TO	2	NA	B747G2																1	1																																U		
9/16/1980	N	http://www.ntsb.go	TO	2	EUR	DC10																			1																														N	SF	rs
7/24/1980	I	http://www.ntsb.go	CRZ	2	NA	DC10																				1																													N	SF	rs
10/09/1980	I	http://www.ntsb.go	CLB	2	NA	DC9																																					1											1	N	ml	ds
15/07/1980	N	http://www.ntsb.go	DES	2	NA	DC9				1																		1																											U	ml	ds
07/06/1980	N	http://www.ntsb.go	GRD	2	NA	DC9		1																																															U	ml	ds
02/05/1980	N	http://www.ntsb.go	LDG	2	NA	DC9																							1	1					1		1						1				1			1				1	M	ml	ds
04/04/1980	N	http://www.ntsb.go	DES	2	NA	DC9				1																		1																											U	ml	ds
20/03/1980	I	http://www.ntsb.go	CRZ	2	NA	DC9																				1																													N	ml	ds
17/03/1980	N	http://www.ntsb.go	LDG	2	NA	DC9			1	1		1																	1								1						1							1		1			M	ml	ds
21/02/1980	I	http://www.ntsb.go	TO	2	NA	DC9																																					1												N	ml	MS
01/10/1979	I	http://www.ntsb.go	GRD	2	NA	B727																																							1										N	IG	AP
15/09/1979	I	http://www.ntsb.go	GRD	2	NA	B727																						1																											N	IG	AP
07/08/1979	I	http://www.ntsb.go	GRD	2	NA	B727																				1																													N	IG	AP
21/06/1979	I	http://www.ntsb.go	GRD	2	NA	B727	1	1																													1						1				1								M	IG	AP

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents

Date	Severity	Info Source Link	Phase	Generation	Region	Type
19/04/1979	I	http://www.ntsb.go	GRD	2	NA	B727
04/04/1979	I	http://www.ntsb.go	GRD	2	NA	B727
02/03/1979	I	http://www.ntsb.go	GRD	2	NA	B727
23/02/1979	I	http://www.ntsb.go	GRD	2	NA	B727
15/02/1979	I	http://www.ntsb.go	GRD	2	NA	B727
15/02/1979	I	http://www.ntsb.go	GRD	2	NA	B727
08/01/1979	I	http://www.ntsb.go	GRD	2	NA	B727
17/11/1979	I	Probable Cause	GRD	2	NA	B727
07/11/1979	I	Probable Cause	GRD	2	NA	B727
6/1/1979	I	http://www.ntsb.go	CRZ	2	ASIA	B747G2
2/15/1979	N	http://www.ntsb.go	LDG	2	NA	B747G2
3/14/1979	I	http://www.ntsb.go	CRZ	2	NA	B747G2
9/16/1979	I	http://www.ntsb.go	LDG	2	EUR	B747G2
4/16/1979	N	http://www.ntsb.go	TO	2	EUR	B747G2
8/29/1979	I	http://www.ntsb.go	TO	2	NA	B747G2
12/27/1979	N	http://www.aaib.go	LDG	2	EUR	B747G2
9/9/1979	I	http://www.ntsb.go	TO	2	NA	B747G2
9/30/1979	I	http://www.ntsb.go	DES	2	OTH	B747G2
5/25/1979	F	http://www.ntsb.go	CLB	2	NA	DC10
11/11/1979	I	http://www.ntsb.go	CLB	2	EUR	DC10
10/31/1979	F	http://www.ntsb.go	LDG	2	NA	DC10
20/01/1979	I	http://www.ntsb.go	CRZ	2	NA	DC10
30/08/1979	I	http://www.ntsb.go	GRD	2	NA	DC9
21/04/1979	N	http://www.ntsb.go	LDG	2	NA	DC9
09/04/1979	N	http://www.ntsb.go	CRZ	2	NA	DC9
22/03/1979	I	http://www.ntsb.go	LDG	2	NA	DC9
09/02/1979	N	http://www.ntsb.go	CLB	2	NA	DC9
28/03/1978	F	http://www.ntsb.go	GRD	2	NA	A300
04/10/1978	I	http://www.ntsb.go	GRD	2	NA	B727
25/09/1978	I	http://www.ntsb.go	GRD	2	NA	B727
17/09/1978	I	http://www.ntsb.go	GRD	2	NA	B727
07/09/1978	I	http://www.ntsb.go	GRD	2	NA	B727
15/07/1978	I	http://www.ntsb.go	GRD	2	NA	B727
27/06/1978	I	http://www.ntsb.go	GRD	2	NA	B727
21/05/1978	I	http://www.ntsb.go	GRD	2	NA	B727
08/05/1978	I	http://www.ntsb.go	GRD	2	NA	B727
19/04/1978	I	http://www.ntsb.go	GRD	2	NA	B727
03/09/1978	I	http://www.ntsb.go	GRD	2	NA	B727
27/01/1978	I	http://www.ntsb.go	GRD	2	NA	B727
18/01/1978	I	http://www.ntsb.go	GRD	2	NA	B727
9/11/1978	I	http://www.ntsb.go	CRZ	2	UNK	B747G2
11/7/1978	I	http://www.ntsb.go	GRD	2	NA	B747G2
4/16/1978	I	http://www.ntsb.go	DES	2	NA	B747G2
8/8/1978	N	http://www.ntsb.go	GRD	2	NA	DC10

Factors

Date	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
19/04/1979				1																	
04/04/1979																				1	
02/03/1979																				1	
23/02/1979				1																	
15/02/1979																				1	
15/02/1979		1					1			1	1										
08/01/1979																				1	
17/11/1979				1																	
07/11/1979		1								1	1										
6/1/1979																				1	
2/15/1979							1			1											
3/14/1979																					
9/16/1979																					
4/16/1979			1																	1	
8/29/1979																				1	
12/27/1979				1		1											1		1	1	
9/9/1979																	1		1	1	
9/30/1979																					
5/25/1979																	1			1	
11/11/1979																				1	
10/31/1979	1	1	1				1					1									
20/01/1979																	1				
30/08/1979	1	1																			
21/04/1979																					
09/04/1979																					
22/03/1979			1	1								1									
09/02/1979																					
28/03/1978		1																			
04/10/1978	1	1																			
25/09/1978							1			1											
17/09/1978							1			1	1										
07/09/1978							1			1	1										
15/07/1978																					
27/06/1978		1					1			1	1										
21/05/1978																					
08/05/1978				1																	
19/04/1978				1																	
03/09/1978																					
27/01/1978																					
18/01/1978																				1	
9/11/1978				1								1									
11/7/1978												1									
4/16/1978																	1		1	1	
8/8/1978																					

Factors (Non-Technical)

Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
19/04/1979																1		
04/04/1979		1								1		1				1		
02/03/1979																		
23/02/1979		1								1								
15/02/1979										1						1		
15/02/1979										1								
08/01/1979																		
17/11/1979		1								1						1		
07/11/1979																		
6/1/1979																		
2/15/1979																		
3/14/1979																		1
9/16/1979										1						1		
4/16/1979										1						1	1	
8/29/1979														1				
12/27/1979																1		
9/9/1979																		
9/30/1979																		1
5/25/1979																		
11/11/1979		1								1						1		
10/31/1979		1								1						1		
20/01/1979																		
30/08/1979		1								1								
21/04/1979		1								1						1		
09/04/1979	1																	
22/03/1979		1								1						1		
09/02/1979		1								1						1		
28/03/1978																		
04/10/1978																		
25/09/1978		1								1						1		
17/09/1978										1								
07/09/1978																		
15/07/1978																		1
27/06/1978																		
21/05/1978	1																	
08/05/1978		1								1								
19/04/1978																		
03/09/1978																		
27/01/1978		1								1							1	
18/01/1978																		
9/11/1978																		
11/7/1978										1						1		
4/16/1978																		
8/8/1978																		

Competencies / Validation

Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
19/04/1979										H	IG	AP
04/04/1979				1			1			M	IG	AP
02/03/1979										N	IG	AP
23/02/1979	1						1			H	IG	AP
15/02/1979		1	1							H	IG	AP
15/02/1979		1	1							H	IG	AP
08/01/1979										N	IG	AP
17/11/1979		1			1					H	IG	AP
07/11/1979										U	IG	AP
6/1/1979										U	SF	DB
2/15/1979										U		
3/14/1979										U		
9/16/1979		1	1						1	H		
4/16/1979							1		1	H		
8/29/1979										U		
12/27/1979									1	M		
9/9/1979										N		
9/30/1979										U		
5/25/1979										N	SF	rs
11/11/1979							1		1	H	SF	rs
10/31/1979			1				1		1	H	SF	rs
20/01/1979										N	SF	rs
30/08/1979		1			1					U	ml	ds
21/04/1979		1							1	M	ml	ds
09/04/1979										N	ml	ds
22/03/1979		1			1				1	M	ml	ds
09/02/1979			1						1	H	ml	ds
28/03/1978										U	MS	AAD
04/10/1978										N	IG	AP
25/09/1978		1					1			H	IG	AP
17/09/1978	1									M	IG	AP
07/09/1978										N	IG	AP
15/07/1978										N	IG	AP
27/06/1978										U	IG	AP
21/05/1978										N	IG	AP
08/05/1978			1				1			H	IG	AP
19/04/1978										U	IG	AP
03/09/1978										N	IG	AP
27/01/1978							1			H	IG	AP
18/01/1978										N	IG	AP
9/11/1978										U		
11/7/1978		1							1	M		
4/16/1978										N		
8/8/1978										N	SF	rs

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
8/29/1978	I	http://www.ntsb.go	CLB	2	NA	DC10																	1																																N	SF	rs
5/9/1978	I	http://www.ntsb.go	GRD	2	NA	DC10	1	1																																															N	SF	rs
5/27/1978	N	http://www.ntsb.go	CRZ	2	OTH	DC10				1																																													N	SF	rs
4/11/1978	I	http://www.ntsb.go	TO	2	NA	DC10																				1																													N	SF	rs
3/1/1978	F	http://www.ntsb.go	TO	2	NA	DC10																				1																													N	SF	rs
27/11/1978	I	http://www.ntsb.go	CLB	2	NA	DC9				1																			1								1											1				1			M	ml	ds
12/08/1978	I	http://www.ntsb.go	CLB	2	NA	DC9																				1																													N	ml	ds
26/07/1978	I	http://www.ntsb.go	CRZ	2	NA	DC9										1																																							U	ml	ds
21/07/1978	I	http://www.ntsb.go	LDG	2	NA	DC9				1		1																	1								1						1							1		1			M	ml	ds
05/04/1978	N	http://www.ntsb.go	CRZ	2	NA	DC9				1																		1																											U	ml	ds
10/02/1978	I	http://www.ntsb.go	CRZ	2	NA	DC9																			1	1		1																											N	ml	ds
31/12/1977	I	http://www.ntsb.go	GRD	2	NA	B727																				1			1																										N	IG	AP
17/11/1977	I	http://www.ntsb.go	GRD	2	NA	B727				1																1																													N	IG	AP
21/09/1977	I	http://www.ntsb.go	GRD	2	NA	B727				1																																													N	IG	AP
13/07/1977	I	http://www.ntsb.go	GRD	2	NA	B727																				1																													N	IG	AP
09/06/1977	I	http://www.ntsb.go	GRD	2	NA	B727				1																																													U	IG	AP
03/06/1977	I	http://www.ntsb.go	GRD	2	NA	B727				1																											1						1					1		1					M	IG	AP
25/05/1977	I	http://www.ntsb.go	GRD	2	NA	B727			1																				1								1						1							1		1			H	IG	AP
04/03/1977	I	http://www.ntsb.go	GRD	2	NA	B727				1																																													N	IG	AP
11/02/1977	I	http://www.ntsb.go	GRD	2	NA	B727				1																																													N	IG	AP
28/01/1977	I	http://www.ntsb.go	GRD	2	NA	B727				1					`																						1						1				1			1					H	IG	AP
25/01/1977	I	http://www.ntsb.go	GRD	2	NA	B727		1	1	1						1													1								1						1				1			1					M	IG	AP
10/12/1977	I	http://www.ntsb.go	TO	2	NA	B747G2							1			1																																							U		
9/3/1977	I	http://www.ntsb.go	CLB	2	NA	B747G2																	1			1																													N		
8/13/1977	F	http://www.ntsb.go	GRD	2	NA	B747G2	1	1																																															U		
11/17/1977	N	http://www.ntsb.go	LDG	2	NA	B747G2			1	1		1						1																			1						1				1			1				1	M		
3/24/1977	I	http://www.ntsb.go	TO	2	EUR	B747G2																				1																													N		
3/27/1977	F	http://www.ntsb.go	GRD	2	AFR	B747G2		1		1			1			1		1																			1									1									U		
3/27/1977	F	http://www.ntsb.go	TO	2	AFR	B747G2				1			1			1		1											1								1									1		1							H		
8/19/1977	N	http://www.ntsb.go	TO	2	NA	DC10																	1																																N	SF	rs
8/1/1977	I	http://www.ntsb.go	CLB	2	NA	DC10				1																																													L	SF	rs
7/6/1977	N	Probable Cause	DES	2	NA	DC10																				1															1	1													L	SF	rs
7/28/1977	I	http://www.ntsb.go	TO	2	NA	DC10																	1																																N	SF	rs
7/10/1977	I	http://www.ntsb.go	LDG	2	NA	DC10				1																											1						1											1	H	SF	rs
6/2/1977	I	http://www.ntsb.go	CLB	2	NA	DC10																	1																																N	SF	rs
22/11/1977	I	http://www.ntsb.go	DES	2	NA	DC9																							1								1						1				1					1			M	ml	ds
21/08/1977	N	http://www.ntsb.go	GRD	2	NA	DC9	1	1																					1								1										1			1					M	ml	ds
04/04/1977	F	http://www.ntsb.go	CRZ	2	NA	DC9				1													1			1											1													1		1			H	ml	ds
27/12/1976	I	http://www.ntsb.go	GRD	2	NA	B727																				1																													N	IG	AP
07/12/1976	I	http://www.ntsb.go	GRD	2	NA	B727			1	1																											1						1				1								H	IG	AP
21/11/1976	I	http://www.ntsb.go	GRD	2	NA	B727							1			1	1																																						U	IG	AP
02/11/1976	I	http://www.ntsb.go	GRD	2	NA	B727																				1																													N	IG	AP
25/10/1976	I	http://www.ntsb.go	GRD	2	NA	B727			1	1																																	1												M	IG	AP
13/10/1976	I	http://www.ntsb.go	GRD	2	NA	B727	1																																																N	IG	AP

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
08/08/1976	I	http://www.ntsb.go	GRD	2	NA	B727				1																	
04/08/1976	I	http://www.ntsb.go	GRD	2	NA	B727																				1	
08/02/1976	I	Probable Cause	GRD	2	NA	B727				1																	
12/06/1976	I	http://www.ntsb.go	GRD	2	NA	B727				1																	
25/05/1976	I	http://www.ntsb.go	GRD	2	NA	B727				1																	
18/05/1976	I	http://www.ntsb.go	GRD	2	NA	B727																					
27/04/1976	I	http://www.ntsb.go	GRD	2	NA	B727																					
05/04/1976	I	http://www.ntsb.go	GRD	2	NA	B727			1	1																	
16/03/1976	I	http://www.ntsb.go	GRD	2	NA	B727			1	1																	
04/03/1976	I	http://www.ntsb.go	GRD	2	NA	B727																					
03/03/1976	I	http://www.ntsb.go	GRD	2	NA	B727				1																	
23/02/1976	I	http://www.ntsb.go	GRD	2	NA	B727							1			1	1										
22/02/1976	I	http://www.ntsb.go	GRD	2	NA	B727				1																	
19/02/1976	I	http://www.ntsb.go	GRD	2	NA	B727																				1	
16/02/1976	I	http://www.ntsb.go	GRD	2	NA	B727				1																	
16/02/1976	I	http://www.ntsb.go	GRD	2	NA	B727																				1	
20/01/1976	I	http://www.ntsb.go	GRD	2	NA	B727																					
20/01/1976	I	http://www.ntsb.go	GRD	2	NA	B727							1			1											
17/01/1976	I	http://www.ntsb.go	GRD	2	NA	B727	1																				
5/6/1976	N	http://www.ntsb.go	LDG	2	NA	B747G2																					
9/19/1976	N	http://www.ntsb.go	GRD	2	NA	B747G2		1																			
12/12/1976	I	http://www.ntsb.go	CLB	2	NA	B747G2																				1	
5/27/1976	N	http://www.ntsb.go	GRD	2	NA	DC10	1																				
5/13/1976	I	http://www.ntsb.go	CRZ	2	NA	DC10																					
3/28/1976	I	http://www.ntsb.go	TO	2	NA	DC10																	1				
12/26/1976	I	http://www.ntsb.go	LDG	2	NA	DC10			1																		
02/01/1976	N	http://www.ntsb.go	APR	2	EUR	DC10																	1				
17/11/1976	N	http://www.ntsb.go	CRZ	2	NA	DC9							1			1											
16/11/1976	N	http://www.ntsb.go	TO	2	NA	DC9																			1	1	
12/11/1976	N	http://www.ntsb.go	GRD	2	NA	DC9		1					1														
23/06/1976	N	http://www.ntsb.go	LDG	2	NA	DC9				1	1		1					1									
01/04/1976	I	http://www.ntsb.go	APR	2	NA	DC9							1			1				1							
22/12/1975	I	http://www.ntsb.go	GRD	2	NA	B727				1																	
12/11/1975	I	http://www.ntsb.go	GRD	2	NA	B727				1																	
11/10/1975	I	http://www.ntsb.go	LDG	2	NA	B727																				1	
23/08/1975	I	http://www.ntsb.go	LDG	2	NA	B727																				1	
16/08/1975	I	http://www.ntsb.go	LDG	2	NA	B727		1																		1	
07/08/1975	I	http://www.ntsb.go	LDG	2	NA	B727				1																	
24/07/1975	I	http://www.ntsb.go	LDG	2	NA	B727																				1	
24/06/1975	I	http://www.ntsb.go	LDG	2	NA	B727				1			1														
18/06/1975	I	http://www.ntsb.go	LDG	2	NA	B727																				1	
06/05/1975	I	http://www.ntsb.go	LDG	2	NA	B727		1								1											
06/05/1975	N	http://www.ntsb.go	LDG	2	NA	B727	1	1																			
04/02/1975	N	http://www.ntsb.go	LDG	2	NA	B727																				1	

	Factors (Non-Technical)																	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
08/08/1976																		
04/08/1976																		
08/02/1976	1																	
12/06/1976																		
25/05/1976										1						1		
18/05/1976	1																	
27/04/1976		1								1						1		
05/04/1976		1								1						1		
16/03/1976										1						1		
04/03/1976										1						1		
03/03/1976																		
23/02/1976																		
22/02/1976																		
19/02/1976																		
16/02/1976																		
16/02/1976																		
20/01/1976	1																	
20/01/1976																		
17/01/1976	1																	
5/6/1976		1								1						1		
9/19/1976	1																	
12/12/1976																		
5/27/1976		1																
5/13/1976																		1
3/28/1976																		
12/26/1976										1						1		
02/01/1976										1						1		
17/11/1976																		
16/11/1976		1								1						1		
12/11/1976		1								1								
23/06/1976		1								1								
01/04/1976		1								1								
22/12/1975		1								1								
12/11/1975		1								1						1		
11/10/1975																		
23/08/1975																		
16/08/1975		1								1							1	
07/08/1975										1								
24/07/1975																		
24/06/1975		1								1								
18/06/1975																		
06/05/1975		1								1								
06/05/1975																		
04/02/1975																		

	Competencies										Validation	
Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
08/08/1976										N	IG	AP
04/08/1976										N	IG	AP
08/02/1976										N	IG	AP
12/06/1976										N	IG	AP
25/05/1976		1			1					H	IG	AP
18/05/1976										N	IG	AP
27/04/1976					1		1			H	IG	AP
05/04/1976					1		1			H	IG	AP
16/03/1976		1			1					H	IG	AP
04/03/1976					1					H	IG	AP
03/03/1976										N	IG	AP
23/02/1976										N	IG	AP
22/02/1976										N	IG	AP
19/02/1976										N	IG	AP
16/02/1976										N	IG	AP
16/02/1976										N	IG	AP
20/01/1976										N	IG	AP
20/01/1976										U	IG	AP
17/01/1976										N	IG	AP
5/6/1976			1				1		1	H		
9/19/1976										U		
12/12/1976										N		
5/27/1976										N	SF	rs
5/13/1976										N	SF	rs
3/28/1976										N	SF	rs
12/26/1976									1	H	SF	rs
02/01/1976									1	N	SF	rs
17/11/1976										M	ml	ds
16/11/1976					1		1		1	H	ml	ds
12/11/1976		1		1						M	ml	ds
23/06/1976					1		1			U	ml	ds
01/04/1976					1		1			M	ml	ds
22/12/1975					1		1			M	IG	AP
12/11/1975					1		1			H	IG	AP
11/10/1975										N	IG	AP
23/08/1975										N	IG	AP
16/08/1975					1		1			H	IG	AP
07/08/1975		1								H	IG	AP
24/07/1975										N	IG	AP
24/06/1975		1			1					H	IG	AP
18/06/1975										N	IG	AP
06/05/1975		1			1					H	IG	AP
06/05/1975										N	IG	AP
04/02/1975										N	IG	AP

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
08/01/1975	N	http://www.ntsb.go	LDG	2	NA	B727				1			1														
12/14/1975	I	http://www.ntsb.go	CRZ	2	OTH	B747G2																				1	
12/16/1975	N	http://www.ntsb.go	GRD	2	NA	B747G2		1	1	1		1															
7/12/1975	N	http://www.ntsb.go	DES	2	OTH	B747G2				1																	
10/21/1975	I	http://www.ntsb.go	TO	2	NA	B747G2																				1	
7/17/1975	I	http://www.ntsb.go	CRZ	2	NA	B747G2																				1	
9/11/1975	I	http://www.ntsb.go	TO	2	EUR	B747G2																				1	
8/24/1975	I	http://www.ntsb.go	CRZ	2	OTH	B747G2																	1		1	1	
9/15/1975	N	http://www.ntsb.go	CRZ	2	NA	B747G2				1																	
9/8/1975	N	http://www.ntsb.go	APR	2	NA	B747G2																				1	
9/17/1975	I	http://www.ntsb.go	CLB	2	NA	DC10																	1		1		
8/25/1975	N	http://www.ntsb.go	TO	2	NA	DC10																	1			1	
7/25/1975	I	http://www.ntsb.go	APR	2	NA	DC10																	1				
7/18/1975	I	http://www.ntsb.go	CRZ	2	NA	DC10				1																	
7/15/1975	I	http://www.ntsb.go	CRZ	2	NA	DC10																			1		
3/13/1975	N	http://www.ntsb.go	CLB	2	NA	DC10				1	1																
2/28/1975	I	http://www.ntsb.go	CLB	2	NA	DC10																				1	
11/3/1975	N	http://www.ntsb.go	CRZ	2	NA	DC10				1																	
11/26/1975	N	http://www.ntsb.go	CRZ	2	NA	DC10							1			1											
11/12/1975	N	http://www.ntsb.go	TO	2	NA	DC10																1	1			1	
10/16/1975	N	http://www.ntsb.go	GRD	2	NA	DC10			1																1		
31/12/1975	I	http://www.ntsb.go	LDG	2	NA	DC9				1								1									
29/11/1975	I	http://www.ntsb.go	LDG	2	NA	DC9			1	1																	
07/11/1975	I	http://www.ntsb.go	LDG	2	NA	DC9			1	1								1								1	
29/09/1975	I	http://www.ntsb.go	GRD	2	NA	DC9																				1	
03/08/1975	I	http://www.ntsb.go	CRZ	2	NA	DC9				1																	
14/12/1974	N	http://www.ntsb.go	LDG	2	NA	B727				1																1	
01/12/1974	N	http://www.ntsb.go	LDG	2	NA	B727				1			1														
01/12/1974	N	http://www.ntsb.go	LDG	2	NA	B727													1								
01/12/1974	N	http://www.ntsb.go	LDG	2	NA	B727				1																	
25/11/1974	N	http://www.ntsb.go	LDG	2	NA	B727	1	1																			
17/11/1974	N	http://www.ntsb.go	LDG	2	NA	B727				1																	
21/09/1974	N	http://www.ntsb.go	LDG	2	NA	B727				1																	
03/08/1974	N	http://www.ntsb.go	LDG	2	NA	B727																					
10/07/1974	N	http://www.ntsb.go	LDG	2	NA	B727																				1	
30/04/1974	N	http://www.ntsb.go	LDG	2	NA	B727																				1	
05/04/1974	N	http://www.ntsb.go	LDG	2	NA	B727																					
01/04/1974	N	http://www.ntsb.go	LDG	2	NA	B727				1																	
04/01/1974	N	http://www.ntsb.go	LDG	2	NA	B727																				1	
11/17/1974	I	http://www.ntsb.go	CLB	2	NA	B747G2																	1		1	1	
2/2/1974	F	http://www.ntsb.go	CRZ	2	NA	B747G2																					
11/21/1974	N	http://www.ntsb.go	GRD	2	NA	B747G2		1																			
5/4/1974	I	http://www.ntsb.go	CLB	2	NA	B747G2																				1	
3/17/1974	I	http://www.ntsb.go	CRZ	2	OTH	B747G2																			1	1	

	Factors (Non-Technical)																	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
08/01/1975		1								1						1		
12/14/1975																		
12/16/1975																1		
7/12/1975																		
10/21/1975																		
7/17/1975																		
9/11/1975																		
8/24/1975																		
9/15/1975																		
9/8/1975																		
9/17/1975																		
8/25/1975																		
7/25/1975																		
7/18/1975																		
7/15/1975																		
3/13/1975																		
2/28/1975																		
11/3/1975																		
11/26/1975																		
11/12/1975																		
10/16/1975																		
31/12/1975										1						1		
29/11/1975										1								
07/11/1975		1		1						1							1	
29/09/1975																		
03/08/1975										1								
14/12/1974		1								1						1		
01/12/1974		1			1					1								
01/12/1974		1								1							1	
01/12/1974																		
25/11/1974																		
17/11/1974																		
21/09/1974																		
03/08/1974													1					
10/07/1974																		
30/04/1974																		
05/04/1974													1					
01/04/1974																		
04/01/1974																		
11/17/1974																		
2/2/1974	1																	
11/21/1974										1	1					1		
5/4/1974																		
3/17/1974	1																	

	Competencies										Validation	
Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
08/01/1975		1					1			H	IG	AP
12/14/1975										N	SF	DB
12/16/1975									1	L	SF	DB
7/12/1975										U		
10/21/1975										N		
7/17/1975										N		
9/11/1975										U		
8/24/1975										N		
9/15/1975										U		
9/8/1975										N		
9/17/1975										N	SF	rs
8/25/1975										L	SF	rs
7/25/1975										N	SF	rs
7/18/1975										N	SF	rs
7/15/1975										N	SF	rs
3/13/1975										N	SF	rs
2/28/1975										N	SF	rs
11/3/1975										N	SF	rs
11/26/1975										N	SF	rs
11/12/1975										N	SF	rs
10/16/1975										N	SF	rs
31/12/1975		1			1					M	ml	ds
29/11/1975		1			1				1	L	ml	ds
07/11/1975		1					1		1	H	ml	ds
29/09/1975										N	ml	ds
03/08/1975					1					H	ml	ds
14/12/1974					1		1			H	IG	AP
01/12/1974		1			1					H	IG	AP
01/12/1974		1					1			H	IG	AP
01/12/1974										N	IG	AP
25/11/1974										N	IG	AP
17/11/1974										N	IG	AP
21/09/1974										N	IG	AP
03/08/1974										U	JS	AP
10/07/1974										N	IG	AP
30/04/1974										N	IG	AP
05/04/1974										N	IG	AP
01/04/1974										N	IG	AP
04/01/1974										N	IG	AP
11/17/1974										U		
2/2/1974										N		
11/21/1974		1							1	M		
5/4/1974										N		
3/17/1974										U		

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies									Validation		
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L.F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
7/11/1974	N	http://www.ntsb.go	GRD	2	NA	B747G2	1	1															1			1											1						1				1							1	M		
9/21/1974	N	http://www.ntsb.go	CRZ	2	OTH	B747G2				1																																													U		
11/26/1974	N	http://www.ntsb.go	GRD	2	EUR	B747G2																			1																															N		
4/16/1974	N	http://www.ntsb.go	GRD	2	NA	B747G2	1																																																	U		
7/18/1974	I	http://www.ntsb.go	APR	2	AUS	B747G2																				1																														U		
7/8/1974	N	http://www.ntsb.go	CLB	2	NA	DC10																	1			1																														N	SF	rs
5/14/1974	I	http://www.ntsb.go	DES	2	NA	DC10				1																1																														N	SF	rs
10/3/1974	I	http://www.ntsb.go	DES	2	NA	DC10																		1		1			1								1							1					1				1			H	SF	rs
19/12/1974	I	http://www.ntsb.go	LDG	2	NA	DC9																				1																														N	ml	ds
21/11/1974	N	http://www.ntsb.go	GRD	2	NA	DC9		1																																																N	ml	ds
05/11/1974	I	http://www.ntsb.go	DES	2	NA	DC9																			1	1			1																											N	ml	ds
11/09/1974	F	http://www.ntsb.go	APR	2	NA	DC9															1								1								1						1								1		1				H	ml	ds
01/09/1974	N	http://www.ntsb.go	CRZ	2	NA	DC9				1																		1																											U	ml	ds
20/04/1974	I	http://www.ntsb.go	TO	2	NA	DC9																	1			1																														N	ml	ds
06/04/1974	I	http://www.ntsb.go	CRZ	2	NA	DC9																																	1																	N	ml	ds
21/02/1974	N	http://www.ntsb.go	DES	2	NA	DC9				1																		1	1		1						1														1		1				M	ml	ds
15/02/1974	N	http://www.ntsb.go	CRZ	2	NA	DC9				1																		1																											U	ml	ds
22/12/1973	N	http://www.ntsb.go	LDG	2	NA	B727																																																	U	MH	AP
20/12/1973	N	http://www.ntsb.go	LDG	2	NA	B727																																							1											N	MH	AP
09/12/1973	N	http://www.ntsb.go	LDG	2	NA	B727		1																												1						1					1									M	MH	AP
07/11/1973	N	Probable Cause	LDG	2	NA	B727																							1								1					1		1				1						1				H	MH	AP
14/08/1973	N	http://www.ntsb.go	LDG	2	NA	B727																				1																														U	MH	AP
12/08/1973	N	http://www.ntsb.go	LDG	2	NA	B727																				1				1											1					1													M	MH	AP
08/08/1973	N	http://www.ntsb.go	LDG	2	NA	B727																				1																														U	MH	AP
27/07/1973	N	http://www.ntsb.go	LDG	2	NA	B727							1			1													1								1																1				U	MH	AP
10/06/1973	N	http://www.ntsb.go	LDG	2	NA	B727																							1								1									1	1									L	MH	AP
10/04/1973	N	http://www.ntsb.go	LDG	2	NA	B727				1											1								1								1						1				1						1				H	MH	AP
17/03/1973	N	http://www.ntsb.go	LDG	2	NA	B727				1																																													N	MH	AP
03/03/1973	N	http://www.ntsb.go	LDG	2	NA	B727			1	1																										1						1				1								H	MH	AP
19/01/1973	N	http://www.ntsb.go	LDG	2	NA	B727																				1			1								1						1					1				1			H	MH	AP
9/17/1973	I	http://www.ntsb.go	GRD	2	NA	B747G2		1										1																			1						1				1					1		1	M		
9/4/1973	N	http://www.ntsb.go	CRZ	2	OTH	B747G2				1																																													U		
4/26/1973	N	http://www.ntsb.go	CRZ	2	NA	B747G2				1																																													U		
8/10/1973	N	http://www.ntsb.go	CRZ	2	NA	DC10																														1		1										1			1			N	SF	rs
7/8/1973	I	http://www.ntsb.go	CRZ	2	NA	DC10																			1			1																											U	SF	rs
5/9/1973	I	http://www.ntsb.go	LDG	2	NA	DC10																														1						1									1			1	H	SF	rs
5/8/1973	I	http://www.ntsb.go	CRZ	2	NA	DC10																				1																														N	SF	rs
5/7/1973	I	http://www.ntsb.go	DES	2	NA	DC10																				1																														N	SF	rs
3/19/1973	I	http://www.ntsb.go	LDG	2	NA	DC10			1																											1						1							1				1	H	SF	rs
12/17/1973	N	http://www.ntsb.go	APR	2	NA	DC10				1	1																									1						1									1		1	M	SF	rs
11/3/1973	F	http://www.ntsb.go	CRZ	2	NA	DC10																	1			1																														N	SF	rs
21/12/1973	N	http://www.ntsb.go	CRZ	2	NA	DC9				1																																													U	ml	ds
17/12/1973	N	http://www.ntsb.go	TO	2	NA	DC9			1	1													1		1				1								1										1			1					H	ml	ds
27/11/1973	N	http://www.ntsb.go	APR	2	NA	DC9				1	1							1											1								1						1				1			1					H	ml	ds

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
27/11/1973	N	http://www.ntsb.go	LDG	2	NA	DC9			1	1		1						1											1								1						1				1					1			H	ml	ds
13/09/1973	I	http://www.ntsb.go	APR	2	NA	DC9															1								1								1						1				1			1					H	ml	ds
31/07/1973	I	http://www.ntsb.go	LDG	2	NA	DC9			1																				1								1						1							1		1			H	ml	ds
31/07/1973	F	http://www.ntsb.go	APR	2	NA	DC9				1								1			1								1								1						1							1		1			M	ml	ds
22/06/1973	I	http://www.ntsb.go	TO	2	NA	DC9																				1																													N	ml	ds
01/04/1973	N	http://www.ntsb.go	CRZ	2	NA	DC9				1																		1																											U	ml	ds
08/01/1973	I	http://www.ntsb.go	TO	2	NA	DC9																			1	1																													N	ml	ds
08/11/1972	N	http://www.ntsb.go	LDG	2	NA	B727		1																		1																													N	MH	AP
30/10/1972	N	http://www.ntsb.go	LDG	2	NA	B727																				1																													U	MH	AP
01/10/1972	N	http://www.ntsb.go	LDG	2	NA	B727																				1																													U	MH	AP
30/09/1972	N	http://www.ntsb.go	LDG	2	NA	B727				1																			1																										U	MH	AP
19/08/1972	N	http://www.ntsb.go	LDG	2	NA	B727																				1																													U	MH	AP
12/08/1972	N	http://www.ntsb.go	LDG	2	NA	B727	1	1																																															U	MH	AP
26/07/1972	N	http://www.ntsb.go	LDG	2	NA	B727				1			1								1																																		U	MH	AP
28/06/1972	N	http://www.ntsb.go	LDG	2	NA	B727				1																											1									1									U	MH	AP
24/06/1972	N	http://www.ntsb.go	LDG	2	NA	B727	1																					1																											U	MH	AP
10/06/1972	N	http://www.ntsb.go	LDG	2	NA	B727																				1																													U	MH	AP
01/05/1972	N	http://www.ntsb.go	LDG	2	NA	B727							1																1								1						1						1			1			M	MH	AP
19/04/1972	N	http://www.ntsb.go	LDG	2	NA	B727																																							1										N	MH	AP
11/04/1972	N	http://www.ntsb.go	LDG	2	NA	B727																				1			1								1							1			1					1			M	MH	AP
19/02/1972	N	http://www.ntsb.go	LDG	2	NA	B727																																																	U	MH	AP
10/01/1972	N	http://www.ntsb.go	LDG	2	NA	B727				1																																													U	MH	AP
11/1/1972	N	http://www.ntsb.go	LDG	2	NA	B747G2																				1			1								1										1					1			H	SF	DB
5/24/1972	I	http://www.ntsb.go	LDG	2	NA	B747G2																	1		1	1																													N		
9/1/1972	N	http://www.ntsb.go	GRD	2	NA	B747G2																			1	1			1								1							1				1				1			H		
4/18/1972	I	http://www.ntsb.go	LDG	2	NA	B747G2																				1																													N		
1/4/1972	N	http://www.ntsb.go	CRZ	2	NA	B747G2				1																																													U		
3/8/1972	N	http://www.ntsb.go	GRD	2	EUR	B747G2																																																	U		
6/26/1972	I	http://www.ntsb.go	TO	2	EUR	B747G2																				1																													U		
12/15/1972	N	http://www.ntsb.go	LDG	2	NA	B747G2			1													1	1			1																	1											1	U		
11/22/1972	I	http://www.ntsb.go	GRD	2	NA	B747G2		1																													1						1				1							1	H		
5/6/1972	N	http://www.ntsb.go	CRZ	2	OTH	B747G2				1																																													U		
7/14/1972	I	http://www.ntsb.go	CRZ	2	OTH	B747G2				1																																													U		
4/12/1972	N	http://www.ntsb.go	CRZ	2	OTH	B747G2				1																																													U		
10/19/1972	I	http://www.ntsb.go	DES	2	NA	B747G2				1																1											1										1				1				U		
11/21/1972	I	http://www.ntsb.go	CRZ	2	NA	B747G2																				1																													U		
8/4/1972	I	http://www.ntsb.go	DES	2	NA	DC10																				1																													N	SF	rs
7/27/1972	I	http://www.ntsb.go	CLB	2	NA	DC10																	1																																N	SF	rs
6/12/1972	N	http://www.ntsb.go	CLB	2	NA	DC10																				1																													N	SF	rs
5/2/1972	I	http://www.ntsb.go	CRZ	2	NA	DC10																	1			1																													N	SF	rs
4/9/1972	I	http://www.ntsb.go	LDG	2	NA	DC10																	1			1																													N	SF	rs
10/30/1972	I	http://www.ntsb.go	CLB	2	NA	DC10	1															1	1																																N	SF	rs
20/12/1972	F	http://www.ntsb.go	CLB	2	NA	DC9							1			1		1																																					N	ml	ds
28/09/1972	N	http://www.ntsb.go	LDG	2	NA	DC9																							1								1						1				1							1	M	ml	ds

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
03/07/1972	I	http://www.ntsb.go	CRZ	2	NA	DC9																				1	
01/07/1972	I	http://www.ntsb.go	CLB	2	NA	DC9																				1	
14/06/1972	N	http://www.ntsb.go	LDG	2	NA	DC9																					
30/05/1972	F	http://www.ntsb.go	APR	2	NA	DC9														1							
18/05/1972	N	http://www.ntsb.go	LDG	2	NA	DC9				1								1									
10/05/1972	N	http://www.ntsb.go	GRD	2	NA	DC9																			1	1	
19/03/1972	N	http://www.ntsb.go	TO	2	NA	DC9																	1		1	1	
13/02/1972	I	http://www.ntsb.go	TO	2	NA	DC9			1														1			1	
29/12/1971	N	http://www.ntsb.go	LDG	2	NA	B727				1																	
21/12/1971	N	http://www.ntsb.go	LDG	2	NA	B727				1																	
17/11/1971	N	http://www.ntsb.go	LDG	2	NA	B727																					
04/09/1971	N	http://www.ntsb.go	LDG	2	NA	B727				1											1						
19/07/1971	N	http://www.ntsb.go	LDG	2	NA	B727			1																	1	
27/06/1971	N	http://www.ntsb.go	LDG	2	NA	B727			1	1														1			
08/06/1971	N	http://www.ntsb.go	LDG	2	NA	B727				1																	
25/05/1971	N	http://www.ntsb.go	LDG	2	NA	B727																				1	
14/05/1971	N	http://www.ntsb.go	LDG	2	NA	B727				1																	
14/04/1971	N	http://www.ntsb.go	LDG	2	NA	B727																					
01/04/1971	N	http://www.ntsb.go	LDG	2	NA	B727																				1	
29/03/1971	N	http://www.ntsb.go	LDG	2	NA	B727				1																	
13/03/1971	N	http://www.ntsb.go	LDG	2	NA	B727																				1	
11/03/1971	N	http://www.ntsb.go	LDG	2	NA	B727																				1	
26/02/1971	N	http://www.ntsb.go	LDG	2	NA	B727																				1	
15/02/1971	N	http://www.ntsb.go	LDG	2	NA	B727																				1	
07/02/1971	N	http://www.ntsb.go	LDG	2	NA	B727				1																	
02/01/1971	N	http://www.ntsb.go	LDG	2	NA	B727				1																	
7/23/1971	N	http://www.ntsb.go	GRD	2	NA	B747G2																			1	1	1
4/26/1971	I	http://www.ntsb.go	LDG	2	NA	B747G2			1																		
2/24/1971	I	http://www.ntsb.go	GRD	2	NA	B747G2		1					1														
1/17/1971	I	Probable Cause	CRZ	2	NA	B747G2																				1	
5/13/1971	I	http://www.ntsb.go	TO	2	NA	B747G2																	1		1	1	
11/8/1971	I	http://www.ntsb.go	TO	2	NA	B747G2																	1		1	1	
1/14/1971	I	http://www.ntsb.go	LDG	2	NA	B747G2			1	1																1	
1/4/1971	I	http://www.ntsb.go	CLB	2	NA	B747G2																				1	
8/24/1971	I	http://www.ntsb.go	TO	2	NA	B747G2																	1		1	1	
7/21/1971	I	http://www.ntsb.go	GRD	2	NA	B747G2	1	1																		1	
5/20/1971	I	http://www.ntsb.go	LDG	2	NA	B747G2																				1	
6/29/1971	N	http://www.ntsb.go	GRD	2	EUR	B747G2																					
7/30/1971	N	http://www.ntsb.go	TO	2	NA	B747G2																					
10/9/1971	I	http://www.ntsb.go	LDG	2	NA	B747G2				1								1									
9/2/1971	I	http://www.ntsb.go	LDG	2	NA	B747G2																				1	
7/18/1971	I	http://www.ntsb.go	LDG	2	AUS	B747G2																					
6/20/1971	N	http://www.ntsb.go	TO	2	ASIA	B747G2			1																		
10/20/1971	I	http://www.ntsb.go	TO	2	NA	B747G2			1																		

Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
03/07/1972																		
01/07/1972																		
14/06/1972		1								1						1	1	
30/05/1972										1								
18/05/1972		1								1								
10/05/1972																		
19/03/1972																		
13/02/1972		1								1						1		
29/12/1971																		
21/12/1971		1								1					1	1		
17/11/1971																		
04/09/1971		1								1						1	1	
19/07/1971		1								1		1				1	1	
27/06/1971		1								1						1		
08/06/1971																		
25/05/1971																		
14/05/1971				1														
14/04/1971																		
01/04/1971	1																	
29/03/1971				1														
13/03/1971																		
11/03/1971																		
26/02/1971																		
15/02/1971																		
07/02/1971		1								1						1		
02/01/1971				1														
7/23/1971		1								1							1	
4/26/1971		1								1						1		
2/24/1971		1								1						1		
1/17/1971																		
5/13/1971																		
11/8/1971																		
1/14/1971																		
1/4/1971																		
8/24/1971																		
7/21/1971		1								1						1		
5/20/1971																		
6/29/1971	1																	
7/30/1971		1		1						1				1		1		
10/9/1971										1						1		
9/2/1971																		
7/18/1971		1								1						1		
6/20/1971																1		
10/20/1971																1		

Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
03/07/1972										N	ml	ds
01/07/1972										N	ml	ds
14/06/1972							1		1	M	ml	ds
30/05/1972		1								M	ml	ds
18/05/1972					1		1			H	ml	ds
10/05/1972										N	ml	ds
19/03/1972										N	ml	ds
13/02/1972							1		1	M	ml	ds
29/12/1971										U	MH	AP
21/12/1971		1					1	1		M	MH	AP
17/11/1971										U	MH	AP
04/09/1971		1					1	1		M	MH	AP
19/07/1971				1			1			H	MH	AP
27/06/1971							1			H	MH	AP
08/06/1971										U	MH	AP
25/05/1971										U	MH	AP
14/05/1971										U	MH	AP
14/04/1971										N	MH	AP
01/04/1971										U	MH	AP
29/03/1971										U	MH	AP
13/03/1971										U	MH	AP
11/03/1971										U	MH	AP
26/02/1971										U	MH	AP
15/02/1971										U	MH	AP
07/02/1971					1		1			M	MH	AP
02/01/1971										U	MH	AP
7/23/1971		1					1			H		
4/26/1971		1					1			H		
2/24/1971	1									H		
1/17/1971										N		
5/13/1971										N		
11/8/1971										N		
1/14/1971										N		
1/4/1971										N		
8/24/1971										N		
7/21/1971		1					1			H		
5/20/1971										N		
6/29/1971										U		
7/30/1971			1				1		1	H		
10/9/1971		1			1				1	H		
9/2/1971										N		
7/18/1971					1		1			H		
6/20/1971									1	M		
10/20/1971									1	M		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
2/7/1971	N	http://www.ntsb.go	CRZ	2	NA	B747G2				1																			1		1						1										1			1					M		
8/17/1971	I	http://www.ntsb.go	CLB	2	NA	DC10																				1																													N	SF	rs
3/19/1971	I	http://www.ntsb.go	CLB	2	NA	DC10																				1																													N	SF	rs
12/4/1971	I	http://www.ntsb.go	LDG	2	NA	DC10																			1	1																													N	SF	rs
11/26/1971	I	http://www.ntsb.go	GRD	2	NA	DC10																															1														1	1			N	SF	rs
04/12/1971	F	http://www.ntsb.go	APR	2	NA	DC9							1			1																																							U	ml	ds
09/10/1971	N	http://www.ntsb.go	GRD	2	NA	DC9	1																																																N	ml	MS
24/08/1971	I	http://www.ntsb.go	CLB	2	SA	DC9																				1			1								1														1	1			M	ml	ds
18/08/1971	N	http://www.ntsb.go	CLB	2	NA	DC9																1																																	N	ml	ds
23/06/1971	I	http://www.ntsb.go	TO	2	NA	DC9																				1																													N	ml	ds
22/06/1971	I	http://www.ntsb.go	APR	2	NA	DC9															1								1								1						1				1					1			H	ml	ds
18/06/1971	I	http://www.ntsb.go	DES	2	NA	DC9																																1																	N	ml	ds
06/06/1971	F	http://www.ntsb.go	CLB	2	NA	DC9							1			1		1											1								1										1					1			M	ml	ds
01/06/1971	I	http://www.ntsb.go	LDG	2	NA	DC9																	1			1											1						1				1							1	N	ml	MS
22/05/1971	N	http://www.ntsb.go	CLB	2	NA	DC9																				1																													N	ml	ds
21/05/1971	I	http://www.ntsb.go	CLB	2	NA	DC9																				1																													N	ml	ds
12/04/1971	I	http://www.ntsb.go	LDG	2	NA	DC9																							1								1						1				1							1	M	ml	ds
19/03/1971	I	http://www.ntsb.go	CLB	2	NA	DC9																				1																													N	ml	ds
17/02/1971	N	http://www.ntsb.go	APR	2	NA	DC9												1											1								1		1										1			1			H	ml	ds
11/01/1971	N	http://www.ntsb.go	LDG	2	NA	DC9												1											1								1						1				1							1	M	ml	ds
28/12/1970	N	http://www.ntsb.go	LDG	2	NA	B727																															1						1							1					H	MH	AP
16/12/1970	N	http://www.ntsb.go	LDG	2	NA	B727																				1																													U	MH	AP
20/11/1970	N	http://www.ntsb.go	LDG	2	NA	B727				1																																													U	MH	AP
17/11/1970	N	http://www.ntsb.go	LDG	2	NA	B727																				1																													U	MH	AP
08/11/1970	N	http://www.ntsb.go	LDG	2	NA	B727																				1																													U	MH	AP
04/11/1970	N	http://www.ntsb.go	LDG	2	NA	B727		1																		1																													U	MH	AP
22/10/1970	N	http://www.ntsb.go	LDG	2	NA	B727																																							1										N	MH	AP
01/10/1970	N	http://www.ntsb.go	LDG	2	NA	B727																																							1										N	MH	AP
23/09/1970	N	http://www.ntsb.go	LDG	2	NA	B727																																																	N	MH	AP
22/07/1970	N	http://www.ntsb.go	LDG	2	NA	B727																				1																													U	MH	AP
28/06/1970	N	http://www.ntsb.go	LDG	2	NA	B727																																																	U	MH	AP
27/06/1970	N	http://www.ntsb.go	LDG	2	NA	B727																																							1										N	MH	AP
16/06/1970	N	http://www.ntsb.go	LDG	2	NA	B727																																																	N	MH	AP
03/06/1970	N	http://www.ntsb.go	LDG	2	NA	B727																				1																													U	MH	AP
19/05/1970	N	http://www.ntsb.go	LDG	2	NA	B727																																							1										N	MH	AP
18/05/1970	N	http://www.ntsb.go	LDG	2	NA	B727																				1		1																											N	MH	AP
07/05/1970	N	http://www.ntsb.go	LDG	2	NA	B727			1	1																											1						1				1			1					M	MH	AP
27/03/1970	N	http://www.ntsb.go	LDG	2	NA	B727																																							1										N	MH	AP
10/03/1970	N	http://www.ntsb.go	LDG	2	NA	B727			1	1																			1								1						1							1		1			M	MH	AP
25/02/1970	N	http://www.ntsb.go	LDG	2	NA	B727				1																																													U	MH	AP
27/01/1970	N	http://www.ntsb.go	LDG	2	NA	B727	1	1																													1						1				1								U	MH	AP
07/01/1970	N	http://www.ntsb.go	LDG	2	NA	B727																				1																													U	MH	AP
8/26/1970	I	http://www.ntsb.go	APR	2	NA	B747G2																				1																													U		
10/26/1970	I	http://www.ntsb.go	CRZ	2	NA	B747G2																				1																													N		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents

Date	Severity	Info Source Link	Phase	Generation	Region	Type
11/28/1970	I	http://www.ntsb.go	CRZ	2	NA	B747G2
12/4/1970	I	http://www.ntsb.go	CRZ	2	NA	B747G2
12/18/1970	I	http://www.ntsb.go	LDG	2	NA	B747G2
9/19/1970	I	http://www.ntsb.go	GRD	2	NA	B747G2
8/25/1970	I	http://www.ntsb.go	CLB	2	NA	B747G2
6/26/1970	I	http://www.ntsb.go	GRD	2	NA	B747G2
6/4/1970	I	http://www.ntsb.go	TO	2	NA	B747G2
1/21/1970	I	http://www.ntsb.go	GRD	2	NA	B747G2
1/10/1970	I	http://www.ntsb.go	GRD	2	NA	B747G2
10/19/1970	I	http://www.ntsb.go	APR	2	NA	B747G2
12/27/1970	N	http://www.ntsb.go	CRZ	2	NA	B747G2
12/13/1970	I	http://www.ntsb.go	CLB	2	EUR	B747G2
10/27/1970	I	http://www.ntsb.go	GRD	2	NA	B747G2
12/29/1970	I	http://www.ntsb.go	APR	2	NA	B747G2
12/12/1970	I	http://www.ntsb.go	GRD	2	NA	B747G2
10/8/1970	I	http://www.ntsb.go	CRZ	2	NA	B747G2
12/1/1970	I	http://www.ntsb.go	GRD	2	NA	B747G2
5/24/1970	I	http://www.ntsb.go	APR	2	NA	B747G2
2/9/1970	I	http://www.ntsb.go	CRZ	2	OTH	B747G2
11/4/1970	N	http://www.ntsb.go	CLB	2	NA	B747G2
8/15/1970	I	http://www.ntsb.go	TO	2	NA	B747G2
6/11/1970	I	http://www.ntsb.go	CLB	2	NA	B747G2
5/26/1970	I	http://www.ntsb.go	APR	2	NA	B747G2
9/18/1970	I	http://www.ntsb.go	TO	2	NA	B747G2
8/26/1970	I	http://www.ntsb.go	CLB	2	NA	B747G2
8/17/1970	I	http://www.ntsb.go	CRZ	2	NA	B747G2
10/2/1970	I	http://www.ntsb.go	CLB	2	NA	B747G2
12/30/1970	I	http://www.ntsb.go	CRZ	2	NA	B747G2
29/12/1970	I	http://www.ntsb.go	LDG	2	NA	DC9
14/11/1970	F	http://www.ntsb.go	APR	2	NA	DC9
08/09/1970	N	http://www.ntsb.go	LDG	2	NA	DC9
02/05/1970	F	http://www.ntsb.go	APR	2	NA	DC9
19/03/1970	I	http://www.ntsb.go	CRZ	2	NA	DC9
17/03/1970	I	http://www.ntsb.go	CRZ	2	NA	DC9
11/01/1970	N	http://www.ntsb.go	APR	2	NA	DC9
13/12/1969	N	http://www.ntsb.go	LDG	2	NA	B727
14/11/1969	N	http://www.ntsb.go	LDG	2	NA	B727
26/09/1969	N	http://www.ntsb.go	LDG	2	NA	B727
15/09/1969	N	http://www.ntsb.go	LDG	2	NA	B727
29/07/1969	N	http://www.ntsb.go	LDG	2	NA	B727
29/07/1969	N	http://www.ntsb.go	LDG	2	NA	B727
20/07/1969	N	http://www.ntsb.go	LDG	2	NA	B727
25/06/1969	N	http://www.ntsb.go	LDG	2	NA	B727
04/06/1969	N	http://www.ntsb.go	LDG	2	NA	B727

Factors

Date	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
11/28/1970																				1	
12/4/1970																				1	
12/18/1970																				1	
9/19/1970																	1		1	1	
8/25/1970																	1		1	1	
6/26/1970																	1		1	1	1
6/4/1970			1																	1	
1/21/1970																	1		1	1	
1/10/1970																			1		
10/19/1970																				1	
12/27/1970																					
12/13/1970																	1		1	1	
10/27/1970																	1		1	1	
12/29/1970																				1	
12/12/1970	1																				
10/8/1970																				1	
12/1/1970																				1	
5/24/1970																				1	
2/9/1970																	1			1	
11/4/1970				1																	
8/15/1970																				1	
6/11/1970																	1		1	1	
5/26/1970																	1		1	1	
9/18/1970																	1		1	1	
8/26/1970																	1		1		
8/17/1970																	1			1	
10/2/1970																	1		1	1	
12/30/1970																				1	
29/12/1970			1				1														
14/11/1970															1						
08/09/1970															1						
02/05/1970																	1				
19/03/1970																					
17/03/1970																					
11/01/1970												1									
13/12/1969																					
14/11/1969																				1	
26/09/1969																					
15/09/1969																					
29/07/1969																					
29/07/1969			1	1																	
20/07/1969																				1	
25/06/1969		1	1				1														
04/06/1969																					

Factors (Non-Technical)

Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
11/28/1970																		
12/4/1970																		
12/18/1970																		
9/19/1970																		
8/25/1970																		
6/26/1970		1								1							1	
6/4/1970		1								1						1		
1/21/1970								1										
1/10/1970																		
10/19/1970																		
12/27/1970	1																	
12/13/1970																		
10/27/1970																		
12/29/1970																		
12/12/1970																		
10/8/1970																		
12/1/1970																		
5/24/1970																		
2/9/1970																		
11/4/1970								1		1								
8/15/1970										1						1		
6/11/1970																		
5/26/1970																		
9/18/1970																		
8/26/1970																		
8/17/1970																		
10/2/1970																		
12/30/1970																		
29/12/1970				1														
14/11/1970																		
08/09/1970		1								1						1		
02/05/1970		1								1		1					1	
19/03/1970											1							
17/03/1970	1																	
11/01/1970		1		1					1		1					1		
13/12/1969	1																	
14/11/1969																		
26/09/1969																		
15/09/1969	1																	
29/07/1969		1								1								
29/07/1969																1	1	
20/07/1969																		
25/06/1969										1						1		
04/06/1969																		

Competencies / Validation

Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
11/28/1970										N		
12/4/1970										N		
12/18/1970										N		
9/19/1970										N		
8/25/1970										U		
6/26/1970						1	1			H		
6/4/1970						1	1		1	H		
1/21/1970										M		
1/10/1970										N		
10/19/1970										N		
12/27/1970										U		
12/13/1970										N		
10/27/1970										N		
12/29/1970										N		
12/12/1970										U		
10/8/1970										N		
12/1/1970										N		
5/24/1970										U		
2/9/1970										N		
11/4/1970	1									N		
8/15/1970					1		1		1	H		
6/11/1970										N		
5/26/1970										N		
9/18/1970										N		
8/26/1970										N		
8/17/1970										N		
10/2/1970										N		
12/30/1970										N		
29/12/1970										N	ml	ds
14/11/1970										U	ml	ds
08/09/1970		1			1					M	ml	ds
02/05/1970					1		1			M	ml	ds
19/03/1970										N	ml	ds
17/03/1970										N	ml	ds
11/01/1970					1		1			M	ml	ds
13/12/1969										U	MH	AP
14/11/1969										N	MH	AP
26/09/1969										U	MH	AP
15/09/1969										U	MH	AP
29/07/1969		1					1			M	MH	AP
29/07/1969										U	MH	AP
20/07/1969										U	MH	AP
25/06/1969					1					M	MH	AP
04/06/1969										U	MH	AP

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L.F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
14/05/1969	N	http://www.ntsb.go	LDG	2	NA	B727		1																													1						1				1								M	MH	AP
14/05/1969	N	http://www.ntsb.go	LDG	2	NA	B727		1																																															U	MH	AP
11/05/1969	N	http://www.ntsb.go	LDG	2	NA	B727																																																	U	MH	AP
09/05/1969	N	http://www.ntsb.go	LDG	2	NA	B727																																																	U	MH	AP
01/05/1969	N	http://www.ntsb.go	LDG	2	NA	B727																				1																													U	MH	AP
12/04/1969	N	http://www.ntsb.go	LDG	2	NA	B727																				1																													U	MH	AP
23/03/1969	N	http://www.ntsb.go	LDG	2	NA	B727																				1																													U	MH	AP
09/02/1969	N	http://www.ntsb.go	LDG	2	NA	B727																																																	U	MH	AP
09/02/1969	N	http://www.ntsb.go	LDG	2	NA	B727				1																																													U	MH	AP
18/01/1969	N	http://www.ntsb.go	LDG	2	NA	B727				1									1					1		1											1						1				1								H	MH	AP
16/01/1969	N	http://www.ntsb.go	LDG	2	NA	B727										1																																							U	MH	AP
15/01/1969	N	http://www.ntsb.go	LDG	2	NA	B727										1																					1										1								U	MH	AP
14/01/1969	N	http://www.ntsb.go	LDG	2	NA	B727	1																																																U	MH	AP
13/01/1969	N	http://www.ntsb.go	LDG	2	NA	B727			1																																														U	MH	AP
07/01/1969	N	http://www.ntsb.go	LDG	2	NA	B727																				1																													U	MH	AP
12/13/1969	I	http://www.ntsb.go	LDG	2	NA	B747G2			1																				1								1						1				1					1		1	H		
14/12/1969	I	http://www.ntsb.go	CLB	2	NA	DC9																	1		1	1																													N	ml	ds
17/10/1969	I	http://www.ntsb.go	CRZ	2	NA	DC9																				1																													N	ml	ds
09/09/1969	F	http://www.ntsb.go	DES	2	NA	DC9							1			1																																							U	ml	ds
29/08/1969	N	http://www.ntsb.go	LDG	2	NA	DC9																							1								1						1							1				1	H	ml	ds
19/08/1969	I	http://www.ntsb.go	TO	2	NA	DC9																	1			1																													N	ml	ds
18/08/1969	N	http://www.ntsb.go	GRD	2	NA	DC9	1	1																					1								1										1					1			H	ml	ds
15/08/1969	I	http://www.ntsb.go	TO	2	NA	DC9																				1																													N	ml	ds
12/08/1969	N	http://www.ntsb.go	LDG	2	NA	DC9	1		1																				1								1						1					1						1	M	ml	ds
09/06/1969	I	http://www.ntsb.go	CLB	2	NA	DC9																	1			1																													N	ml	ds
11/05/1969	I	http://www.ntsb.go	CRZ	2	NA	DC9																	1			1																													N	ml	ds
08/05/1969	I	http://www.ntsb.go	CLB	2	NA	DC9																	1			1																													N	ml	ds
03/05/1969	N	http://www.ntsb.go	LDG	2	NA	DC9																							1								1						1					1						1	H	ml	ds
24/04/1969	N	http://www.ntsb.go	DES	2	NA	DC9				1																		1																											N	ml	ds
10/03/1969	I	http://www.ntsb.go	LDG	2	NA	DC9																				1																													U	ml	ds
06/02/1969	N	http://www.ntsb.go	APR	2	NA	DC9										1													1								1										1					1			M	ml	ds
21/12/1968	N	http://www.ntsb.go	LDG	2	NA	B727				1																			1								1						1					1				1			H	MH	AP
28/11/1968	N	http://www.ntsb.go	LDG	2	NA	B727																															1						1									1			M	MH	AP
16/11/1968	N	http://www.ntsb.go	LDG	2	NA	B727																																																	U	MH	AP
24/10/1968	N	http://www.ntsb.go	LDG	2	NA	B727																				1																													U	MH	AP
03/10/1968	N	http://www.ntsb.go	LDG	2	NA	B727				1																																													U	MH	AP
23/09/1968	N	http://www.ntsb.go	LDG	2	NA	B727																						1																											U	MH	AP
04/09/1968	N	http://www.ntsb.go	LDG	2	NA	B727																															1						1				1								M	MH	AP
07/08/1968	N	http://www.ntsb.go	LDG	2	NA	B727																															1						1				1								H	MH	AP
20/07/1968	N	http://www.ntsb.go	LDG	2	NA	B727																																																	U	MH	AP
11/07/1968	N	http://www.ntsb.go	LDG	2	NA	B727				1			1																								1													1					U	MH	AP
07/07/1968	N	http://www.ntsb.go	LDG	2	NA	B727																																																	U	MH	AP
05/07/1968	N	http://www.ntsb.go	LDG	2	NA	B727				1																																													U	MH	AP
26/06/1968	N	http://www.ntsb.go	LDG	2	NA	B727																				1																													U	MH	AP

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents / Factors

Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
23/06/1968	N	http://www.ntsb.go	LDG	2	NA	B727																				1	
12/06/1968	N	http://www.ntsb.go	LDG	2	NA	B727										1											
08/06/1968	N	http://www.ntsb.go	LDG	2	NA	B727			1	1																	
03/06/1968	N	http://www.ntsb.go	LDG	2	NA	B727																					
02/04/1968	N	http://www.ntsb.go	LDG	2	NA	B727				1																	
23/03/1968	N	http://www.ntsb.go	TO	2	NA	B727																				1	
21/03/1968	N	http://www.ntsb.go	TO	2	NA	B727																					
02/03/1968	N	http://www.ntsb.go	TO	2	NA	B727										1											
16/02/1968	N	http://www.ntsb.go	TO	2	NA	B727																					
27/12/1968	N	http://www.ntsb.go	CLB	2	NA	DC9				1								1									
26/12/1968	I	http://www.ntsb.go	LDG	2	NA	DC9															1						
18/05/1968	I	http://www.ntsb.go	GRD	2	NA	DC9	1	1																		1	
27/03/1968	F	http://www.ntsb.go	LDG	2	NA	DC9										1											
12/11/1967	N	http://www.ntsb.go	TO	2	NA	B727																					
29/08/1967	N	http://www.ntsb.go	TO	2	NA	B727																					
19/07/1967	N	http://www.ntsb.go	TO	2	NA	B727							1			1											
02/07/1967	N	http://www.ntsb.go	TO	2	NA	B727																					
09/06/1967	N	http://www.ntsb.go	TO	2	NA	B727				1																	
08/06/1967	N	http://www.ntsb.go	TO	2	NA	B727																					
07/06/1967	N	http://www.ntsb.go	TO	2	NA	B727																					
02/06/1967	N	http://www.ntsb.go	TO	2	NA	B727																					
15/05/1967	N	http://www.ntsb.go	TO	2	NA	B727				1																	
29/04/1967	N	http://www.ntsb.go	TO	2	NA	B727			1	1																	
19/04/1967	N	http://www.ntsb.go	TO	2	NA	B727																					
11/04/1967	N	http://www.ntsb.go	TO	2	NA	B727	1	1																			
07/04/1967	N	http://www.ntsb.go	TO	2	NA	B727																				1	
22/03/1967	N	http://www.ntsb.go	TO	2	NA	B727																				1	
14/03/1967	N	http://www.ntsb.go	TO	2	NA	B727																					
08/03/1967	N	http://www.ntsb.go	TO	2	NA	B727																1					
06/03/1967	N	http://www.ntsb.go	TO	2	NA	B727				1																	
25/02/1967	N	http://www.ntsb.go	TO	2	NA	B727				1																	
20/02/1967	N	http://www.ntsb.go	TO	2	NA	B727				1																	
09/04/1967	I	http://www.ntsb.go	LDG	2	NA	DC9																				1	
09/03/1967	F	http://www.ntsb.go	DES	2	NA	DC9							1			1											
15/11/1966	N	http://www.ntsb.go	TO	2	NA	B727				1																	
02/11/1966	N	http://www.ntsb.go	TO	2	NA	B727				1																	
25/09/1966	N	http://www.ntsb.go	TO	2	NA	B727																				1	
01/09/1966	N	http://www.ntsb.go	TO	2	NA	B727																				1	
27/08/1966	N	http://www.ntsb.go	TO	2	NA	B727																					
28/07/1966	N	http://www.ntsb.go	TO	2	NA	B727																					
18/06/1966	N	http://www.ntsb.go	TO	2	NA	B727				1																	
28/05/1966	N	http://www.ntsb.go	TO	2	NA	B727		1																			
26/05/1966	N	http://www.ntsb.go	TO	2	NA	B727		1																			
20/05/1966	N	http://www.ntsb.go	TO	2	NA	B727																					

Factors (Non-Technical)

Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
23/06/1968																		
12/06/1968																		
08/06/1968										1								
03/06/1968										1						1		
02/04/1968																		
23/03/1968																		
21/03/1968		1								1						1	1	
02/03/1968																		
16/02/1968																1		
27/12/1968		1								1								
26/12/1968		1								1						1		
18/05/1968																		
27/03/1968		1								1								
12/11/1967													1					
29/08/1967																		
19/07/1967										1		1						
02/07/1967																		
09/06/1967																		
08/06/1967																1		
07/06/1967																1		
02/06/1967																		
15/05/1967																		
29/04/1967																		
19/04/1967																		
11/04/1967										1						1		
07/04/1967																		
22/03/1967																		
14/03/1967																1		
08/03/1967																		
06/03/1967																		
25/02/1967										1						1		
20/02/1967		1								1						1		
09/04/1967																		
09/03/1967		1								1								
15/11/1966																	1	
02/11/1966		1								1						1	1	
25/09/1966										1						1	1	
01/09/1966																		
27/08/1966																		
28/07/1966																1		
18/06/1966										1								
28/05/1966										1						1		
26/05/1966										1						1		
20/05/1966																		

Competencies / Validation

Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
23/06/1968										U	MH	AP
12/06/1968										U	MH	AP
08/06/1968					1					M	MH	AP
03/06/1968		1			1					M	MH	AP
02/04/1968										U	MH	AP
23/03/1968										U	MH	AP
21/03/1968					1		1			H	MH	AP
02/03/1968										U	MH	AP
16/02/1968										M	MH	AP
27/12/1968					1		1			M	ml	ds
26/12/1968		1			1					U	ml	ds
18/05/1968										N	ml	ds
27/03/1968		1					1			M	ml	ds
12/11/1967										U	MH	AP
29/08/1967										U	MH	AP
19/07/1967		1								U	MH	AP
02/07/1967										U	MH	AP
09/06/1967										U	MH	AP
08/06/1967										M	MH	AP
07/06/1967										M	MH	AP
02/06/1967										U	MH	AP
15/05/1967										L	MH	AP
29/04/1967										U	MH	AP
19/04/1967										U	MH	AP
11/04/1967		1								M	MH	AP
07/04/1967										U	MH	AP
22/03/1967										U	MH	AP
14/03/1967										M	MH	AP
08/03/1967										U	MH	AP
06/03/1967										U	MH	AP
25/02/1967					1					M	MH	AP
20/02/1967					1		1			M	MH	AP
09/04/1967										N	ml	ds
09/03/1967		1					1			M	ml	ds
15/11/1966										L	MH	AP
02/11/1966		1					1			M	MH	AP
25/09/1966						1				H	MH	AP
01/09/1966										U	MH	AP
27/08/1966										U	MH	AP
28/07/1966										H	MH	AP
18/06/1966		1								L	MH	AP
28/05/1966		1								M	MH	AP
26/05/1966		1								M	MH	AP
20/05/1966										U	MH	AP

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatigue	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
08/05/1966	N	http://www.ntsb.go	TO	2	NA	B727																				1																													L	MH	AP
20/04/1966	N	http://www.ntsb.go	TO	2	NA	B727																																																	U	MH	AP
20/04/1966	N	http://www.ntsb.go	TO	2	NA	B727		1																													1						1				1								M	MH	AP
10/04/1966	N	http://www.ntsb.go	TO	2	NA	B727																																																	U	MH	AP
19/03/1966	N	http://www.ntsb.go	TO	2	NA	B727																																					1												U	MH	AP
15/03/1966	N	http://www.ntsb.go	TO	2	NA	B727																				1			1								1						1	1								1			M	MH	AP
05/03/1966	N	http://www.ntsb.go	TO	2	NA	B727																							1								1							1						1		1			L	MH	AP
20/02/1966	N	http://www.ntsb.go	TO	2	NA	B727																				1																													U	MH	AP
09/02/1966	N	http://www.ntsb.go	TO	2	NA	B727																																																	U	MH	AP
05/01/1966	N	http://www.ntsb.go	TO	2	NA	B727																				1																													U	MH	AP
01/10/1966	F	http://www.ntsb.go	DES	2	NA	DC9															1																1						1				1								L	ml	ds
04/03/1966	N	http://www.ntsb.go	GRD	2	NA	DC9																				1		1																											N	ml	ds
16/12/1965	N	http://www.ntsb.go	TO	2	NA	B727																				1																													U	MH	AP
16/12/1965	N	http://www.ntsb.go	TO	2	NA	B727				1																																													U	MH	AP
07/12/1965	N	http://www.ntsb.go	TO	2	NA	B727																																																	U	MH	AP
11/11/1965	N	http://www.ntsb.go	TO	2	NA	B727																							1								1						1					1				1			H	MH	AP
08/11/1965	N	http://www.ntsb.go	TO	2	NA	B727				1																			1								1						1				1					1			M	MH	AP
29/09/1965	N	http://www.ntsb.go	TO	2	NA	B727																																																	U	MH	AP
28/09/1965	N	http://www.ntsb.go	TO	2	NA	B727																																					1												M	MH	AP
18/08/1965	N	http://www.ntsb.go	TO	2	NA	B727																				1																													U	MH	AP
18/08/1965	N	http://www.ntsb.go	TO	2	NA	B727																																																	U	MH	AP
16/08/1965	N	http://www.ntsb.go	TO	2	SA	B727																																																	U	MH	AP
16/07/1965	N	http://www.ntsb.go	TO	2	SA	B727																																																	U	MH	AP
29/05/1965	N	http://www.ntsb.go	TO	2	SA	B727																																																	U	MH	AP
26/04/1965	N	http://www.ntsb.go	TO	2	SA	B727																																																	U	MH	AP
17/03/1965	N	http://www.ntsb.go	TO	2	SA	B727																																																	M	MH	AP
06/02/1965	N	http://www.ntsb.go	TO	2	SA	B727		1																																															U	MH	AP
12/01/1965	N	http://www.ntsb.go	UNK	2	SA	B727																																																	U	MH	AP
06/12/1964	N	http://www.ntsb.go	UNK	2	SA	B727																																																	U	MH	AP
02/12/1964	N	http://www.ntsb.go	UNK	2	SA	B727																																																	U	MH	AP
21/10/1964	N	http://www.ntsb.go	UNK	2	SA	B727																																																	U	MH	AP
18/10/1964	N	http://www.ntsb.go	UNK	2	SA	B727																																																	U	MH	AP
02/10/1964	N	http://www.ntsb.go	UNK	2	SA	B727																																																	U	MH	AP
01/07/1964	U	http://www.ntsb.go	UNK	2	OTH	B727																																																	U	MH	AP
30/04/1964	U	http://www.ntsb.go	UNK	2	OTH	B727																																					1												M	MH	AP
21/10/2009	F	Factual	TO	1	AFR	B707																																																	U		
3/19/2005	N	Factual	APR	1	AFR	B707												1																			1						1							1				1	H		
7/4/2002	F	Factual	LDG	1	AFR	B707																				1																													U		
3/7/2001	N	Factual	LDG	1	SA	B707																																					1											1	U		
9/21/2000	N	Factual	LDG	1	AFR	B707																			1	1																													U		
2/3/2000	N	Factual	APR	1	AFR	B707																															1						1							1				1	H		
2/7/1999	N	Factual	TO	1	AFR	B707																				1																	1											1	M		
11/14/1998	U	Factual	CLB	1	EUR	B707																				1																													N		
3/10/1998	F	Factual	TO	1	AFR	B707																																					1												U		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents / Factors

Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
12/5/1997	I	Factual	CLB	1	SA	B707																				1	
10/22/1996	F	Factual	TO	1	SA	B707																			1	1	
2/22/1996	I	Probable Cause	LDG	1	NA	B707																				1	
8/2/1993	I	Probable Cause	CLB	1	NA	B707																				1	
4/25/1992	N	Probable Cause	CLB	1	NA	B707																				1	
7/8/1991	N	Probable Cause	TO	1	NA	B707																				1	
9/20/1990	F	Probable Cause	TO	1	NA	B707																					
4/24/1990	I	Probable Cause	TO	1	NA	B707																					
1/25/1990	F	Probable Cause	APR	1	NA	B707				1	1		1					1									
2/8/1989	F	Factual	APR	1	EUR	B707							1								1						
1/22/1989	I	Probable Cause	LDG	1	NA	B707												1									
11/16/1988	I	Probable Cause	LDG	1	NA	B707																					
10/12/1988	I	Probable Cause	DES	1	NA	B707							1														
1/13/1988	N	Factual	UNK	1	SA	B707																					
4/30/1987	N	Probable Cause	GRD	1	NA	B707		1																			
4/13/1987	F	Probable Cause	APR	1	NA	B707				1								1			1						
2/14/1987	F	Factual	UNK	1	NA	B707																			1	1	
6/23/1984	I	Probable Cause	LDG	1	NA	B707			1	1								1									
12/29/1983	I	Probable Cause	LDG	1	NA	B707																				1	
4/2/1983	N	Probable Cause	DES	1	NA	B707				1								1									
11/27/1982	N	Probable Cause	TO	1	NA	B707																			1	1	1
11/11/1982	F	Probable Cause	CRZ	1	NA	B707																				1	
3/24/1982	N	Probable Cause	LDG	1	NA	B707																				1	
3/8/1982	I	Probable Cause	GRD	1	NA	B707																					
12/16/1981	N	Probable Cause	LDG	1	NA	B707																				1	
6/20/1981	I	Probable Cause	GRD	1	NA	B707	1																				
6/3/1981	N	Probable Cause	GRD	1	NA	B707																					
11/12/1980	I	Probable Cause	CRZ	1	NA	B707																					
10/17/1980	N	Probable Cause	CLB	1	NA	B707				1																	
4/21/1980	N	Probable Cause	DES	1	NA	B707				1																	
9/18/1979	N	Probable Cause	APR	1	NA	B707																				1	
4/21/1979	N	Probable Cause	DES	1	SA	B707				1								1									
4/10/1979	I	Probable Cause	TO	1	NA	B707																				1	
4/6/1979	I	Probable Cause	GRD	1	NA	B707																				1	
9/20/1978	N	Probable Cause	CLB	1	NA	B707				1								1									
8/6/1978	I	Probable Cause	GRD	1	NA	B707																					
10/27/1977	I	Probable Cause	CLB	1	SA	B707																				1	
6/22/1977	I	Probable Cause	LDG	1	NA	B707																				1	
4/5/1977	I	Probable Cause	CLB	1	NA	B707																				1	
1/25/1977	N	Probable Cause	GRD	1	SA	B707		1	1																		
1/12/1977	I	Probable Cause	LDG	1	NA	B707																				1	
4/24/1976	N	Probable Cause	LDG	1	EUR	B707																				1	
12/22/1975	N	Probable Cause	APR	1	EUR	B707																					
9/14/1975	I	Probable Cause	TO	1	NA	B707																				1	

Factors (Non-Technical)

Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
12/5/1997																		
10/22/1996																1		
2/22/1996									1	1						1		
8/2/1993																		
4/25/1992																		
7/8/1991																		
9/20/1990		1				1		1		1						1		
4/24/1990														1				
1/25/1990		1								1		1				1	1	
2/8/1989		1								1						1		
1/22/1989		1							1	1						1		
11/16/1988										1						1		
10/12/1988																		
1/13/1988																		
4/30/1987		1								1								
4/13/1987		1								1						1		
2/14/1987																		
6/23/1984		1								1		1				1		
12/29/1983										1								
4/2/1983										1								
11/27/1982																		
11/11/1982																		1
3/24/1982										1						1	1	
3/8/1982																		
12/16/1981																		
6/20/1981																		
6/3/1981																		
11/12/1980																		1
10/17/1980																		
4/21/1980																		
9/18/1979																		
4/21/1979																		
4/10/1979																		
4/6/1979																		
9/20/1978										1								
8/6/1978																		1
10/27/1977																		
6/22/1977																		
4/5/1977																		
1/25/1977										1						1		
1/12/1977																		
4/24/1976																		
12/22/1975		1								1						1		
9/14/1975																		

Competencies / Validation

Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
12/5/1997										N		
10/22/1996										M		
2/22/1996						1	1			H		
8/2/1993										N		
4/25/1992										N		
7/8/1991										N		
9/20/1990		1			1				1	H		
4/24/1990										U		
1/25/1990	1				1					H		
2/8/1989	1						1			H		
1/22/1989		1			1				1	U		
11/16/1988			1				1		1	M		
10/12/1988										N		
1/13/1988										U		
4/30/1987	1						1			M		
4/13/1987			1				1		1	H		
2/14/1987										N		
6/23/1984					1		1		1	H		
12/29/1983					1					M		
4/2/1983	1	1								M		
11/27/1982										N		
11/11/1982										U		
3/24/1982						1			1	M		
3/8/1982										N		
12/16/1981										N		
6/20/1981										U		
6/3/1981										U		
11/12/1980										N		
10/17/1980										U		
4/21/1980										U		
9/18/1979										N		
4/21/1979										U		
4/10/1979										N		
4/6/1979										N		
9/20/1978			1		1					M		
8/6/1978										N		
10/27/1977										N		
6/22/1977										N		
4/5/1977										N		
1/25/1977		1								M		
1/12/1977										N		
4/24/1976										N		
12/22/1975					1				1	H		
9/14/1975										N		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
8/13/1975	N	Factual	CRZ	1	NA	B707				1								1									
8/6/1975	N	Probable Cause	CRZ	1	ASIA	B707				1																	
7/27/1975	N	Probable Cause	CRZ	1	NA	B707				1																	
7/12/1975	N	Probable Cause	DES	1	NA	B707				1																	
4/7/1975	I	Probable Cause	CRZ	1	NA	B707																				1	
2/18/1975	N	Probable Cause	LDG	1	NA	B707																				1	
12/28/1974	N	Probable Cause	DES	1	NA	B707													1								
12/10/1974	N	Probable Cause	DES	1	NA	B707																					
11/25/1974	N	Probable Cause	TO	1	ASIA	B707																	1			1	
10/24/1974	I	Probable Cause	CLB	1	SA	B707																					
5/13/1974	N	Probable Cause	CRZ	1	NA	B707				1																	
5/8/1974	I	Probable Cause	TO	1	NA	B707																	1			1	
4/22/1974	F	Probable Cause	APR	1	ASIA	B707																					
4/1/1974	N	Probable Cause	CRZ	1	NA	B707				1								1									
3/20/1974	I	Probable Cause	DES	1	NA	B707							1			1											
2/16/1974	N	Probable Cause	APR	1	NA	B707																				1	
1/30/1974	F	Probable Cause	APR	1	ASIA	B707																					
1/17/1974	N	Probable Cause	LDG	1	NA	B707				1								1									
1/16/1974	N	Probable Cause	LDG	1	NA	B707												1									
1/12/1974	N	Probable Cause	LDG	1	NA	B707																				1	
1/8/1974	I	Probable Cause	GRD	1	NA	B707		1					1														
1/1/1974	N	Probable Cause	GRD	1	NA	B707		1					1					1									
12/17/1973	I	Probable Cause	GRD	1	EUR	B707																					
11/3/1973	F	Probable Cause	CRZ	1	NA	B707												1							1	1	
9/5/1973	I	Probable Cause	CRZ	1	NA	B707																			1		
8/28/1973	F	Probable Cause	DES	1	NA	B707																				1	
8/27/1973	N	Probable Cause	CRZ	1	OTH	B707				1																	
7/22/1973	F	Probable Cause	CLB	1	ASIA	B707																					
5/1/1973	I	Probable Cause	CRZ	1	OTH	B707																			1	1	
4/9/1973	N	Probable Cause	GRD	1	NA	B707																				1	
4/6/1973	N	Probable Cause	CLB	1	NA	B707											1										
3/5/1973	N	Probable Cause	TO	1	NA	B707				1								1			1						
1/20/1973	N	Probable Cause	CLB	1	NA	B707																				1	
12/14/1972	I	Probable Cause	CRZ	1	NA	B707																					
12/12/1972	N	Probable Cause	APR	1	NA	B707												1									
11/1/1972	N	Probable Cause	LDG	1	NA	B707																			1	1	
10/24/1972	N	Probable Cause	CRZ	1	SA	B707				1																	
9/13/1972	N	Probable Cause	TO	1	NA	B707																				1	
9/13/1972	I	Probable Cause	LDG	1	NA	B707																				1	
8/13/1972	N	Probable Cause	TO	1	NA	B707																				1	
7/30/1972	I	Probable Cause	LDG	1	NA	B707																				1	
7/20/1972	I	Probable Cause	CRZ	1	NA	B707							1			1		1									
7/18/1972	N	Probable Cause	CRZ	1	NA	B707																				1	
5/23/1972	I	Probable Cause	GRD	1	NA	B707																			1		

	Factors (Non-Technical)																	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
8/13/1975																		
8/6/1975																		
7/27/1975																		
7/12/1975																		
4/7/1975																		
2/18/1975																		
12/28/1974		1								1						1		
12/10/1974										1						1		
11/25/1974																		
10/24/1974													1					
5/13/1974		1								1								
5/8/1974																		
4/22/1974		1								1						1		
4/1/1974										1								
3/20/1974																		
2/16/1974																		
1/30/1974		1								1		1				1		
1/17/1974		1								1						1		
1/16/1974		1								1						1		
1/12/1974																		
1/8/1974										1						1		
1/1/1974										1						1		
12/17/1973																		
11/3/1973										1			1			1		
9/5/1973																		
8/28/1973																		
8/27/1973																		
7/22/1973																		
5/1/1973																		
4/9/1973																		
4/6/1973																		
3/5/1973		1								1						1		
1/20/1973																		
12/14/1972																		1
12/12/1972		1								1						1		
11/1/1972																		
10/24/1972																		
9/13/1972		1								1						1		
9/13/1972																		
8/13/1972																1		
7/30/1972																		
7/20/1972																		
7/18/1972																		
5/23/1972													1					

	Competencies										Validation	
Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
8/13/1975										U		
8/6/1975										U		
7/27/1975										U		
7/12/1975										U		
4/7/1975										N		
2/18/1975										N		
12/28/1974		1							1	M		
12/10/1974		1			1				1	L		
11/25/1974										N		
10/24/1974										U		
5/13/1974			1		1					H		
5/8/1974										N		
4/22/1974			1						1	H		
4/1/1974		1			1					M		
3/20/1974										U		
2/16/1974										N		
1/30/1974		1			1				1	H		
1/17/1974			1		1				1	H		
1/16/1974					1		1		1	H		
1/12/1974										N		
1/8/1974	1	1								M		
1/1/1974	1	1							1	M		
12/17/1973										U		
11/3/1973					1		1		1	H		
9/5/1973										N		
8/28/1973										N		
8/27/1973										U		
7/22/1973										U		
5/1/1973										N		
4/9/1973										N		
4/6/1973										U		
3/5/1973			1		1				1	H		
1/20/1973										N		
12/14/1972										U		
12/12/1972		1			1				1	H		
11/1/1972										N		
10/24/1972										U		
9/13/1972					1		1		1	H		
9/13/1972										N		
8/13/1972									1	N		
7/30/1972										N		
7/20/1972										U		
7/18/1972										N		
5/23/1972										N		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
4/9/1972	I	Probable Cause	GRD	1	NA	B707	1	1																			
3/20/1972	N	Probable Cause	LDG	1	ASIA	B707																					
3/8/1972	N	Probable Cause	GRD	1	EUR	B707		1																			
1/14/1972	I	Probable Cause	CRZ	1	NA	B707																					
12/12/1971	N	Probable Cause	DES	1	NA	B707				1																	
11/13/1971	N	Probable Cause	CRZ	1	NA	B707				1																	
9/23/1971	N	Probable Cause	CLB	1	EUR	B707				1																	
8/4/1971	N	Probable Cause	DES	1	NA	B707										1											
7/25/1971	F	Probable Cause	APR	1	ASIA	B707															1						
7/21/1971	I	Probable Cause	TO	1	NA	B707																			1	1	
6/20/1971	N	Probable Cause	CRZ	1	OTH	B707				1																	
6/12/1971	I	Probable Cause	GRD	1	NA	B707	1	1																			
6/11/1971	I	Probable Cause	CRZ	1	NA	B707							1			1											
5/8/1971	I	Probable Cause	CRZ	1	OTH	B707																					
4/7/1971	I	Probable Cause	TO	1	NA	B707																				1	
3/8/1971	I	Probable Cause	LDG	1	NA	B707																				1	
1/9/1971	F	Probable Cause	CRZ	1	NA	B707										1											
12/24/1970	N	Probable Cause	CRZ	1	NA	B707				1																	
12/18/1970	I	Probable Cause	DES	1	NA	B707																					
12/5/1970	I	Probable Cause	TO	1	NA	B707																				1	
11/30/1970	F	Probable Cause	TO	1	ASIA	B707											1										
11/7/1970	N	Probable Cause	CLB	1	OTH	B707				1																	
10/28/1970	I	Probable Cause	CLB	1	NA	B707																					
10/20/1970	I	Probable Cause	LDG	1	NA	B707																					
10/16/1970	I	Probable Cause	GRD	1	NA	B707																				1	
9/18/1970	N	Probable Cause	CRZ	1	OTH	B707				1																	
8/22/1970	I	Probable Cause	DES	1	NA	B707																					
8/13/1970	N	Probable Cause	DES	1	SA	B707				1																	
6/9/1970	I	Probable Cause	CRZ	1	NA	B707																				1	
4/22/1970	I	Probable Cause	GRD	1	NA	B707																			1	1	
3/28/1970	I	Probable Cause	CRZ	1	NA	B707																					
2/11/1970	N	Probable Cause	LDG	1	NA	B707																					
2/10/1970	I	Probable Cause	TO	1	NA	B707																				1	
12/1/1969	N	Probable Cause	TO	1	AUS	B707																1	1			1	
10/14/1969	I	Probable Cause	TO	1	ASIA	B707																				1	
10/12/1969	N	Probable Cause	CRZ	1	OTH	B707				1																	
10/11/1969	N	Probable Cause	CRZ	1	OTH	B707				1																	
8/29/1969	N	Probable Cause	GRD	1	ASIA	B707																					
8/26/1969	N	Probable Cause	CRZ	1	OTH	B707				1																	
8/3/1969	F	Probable Cause	CRZ	1	NA	B707										1											
8/2/1969	N	Probable Cause	CRZ	1	OTH	B707				1								1									
8/1/1969	N	Probable Cause	LDG	1	EUR	B707																					
7/26/1969	F	Probable Cause	APR	1	NA	B707																					
6/5/1969	I	Probable Cause	GRD	1	NA	B707		1																			

	Factors (Non-Technical)																	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
4/9/1972		1								1								
3/20/1972																1		
3/8/1972																		
1/14/1972																		1
12/12/1971																		
11/13/1971																		
9/23/1971										1								
8/4/1971																		
7/25/1971		1								1						1		
7/21/1971																		
6/20/1971		1								1								
6/12/1971										1						1		
6/11/1971																		
5/8/1971																		1
4/7/1971																		
3/8/1971								1		1						1	1	
1/9/1971																		
12/24/1970																		
12/18/1970		1								1								
12/5/1970																		
11/30/1970																		
11/7/1970								1										
10/28/1970																		1
10/20/1970										1						1		
10/16/1970																		
9/18/1970																		
8/22/1970																		1
8/13/1970																		
6/9/1970																		
4/22/1970																		
3/28/1970																		1
2/11/1970		1								1						1		
2/10/1970																		
12/1/1969		1		1						1				1		1		
10/14/1969																		
10/12/1969		1								1						1		
10/11/1969																		
8/29/1969																		
8/26/1969																		
8/3/1969																		
8/2/1969																		
8/1/1969																1		
7/26/1969			1		1			1		1						1		
6/5/1969																1		

	Competencies										Validation	
Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
4/9/1972	1	1					1			M		
3/20/1972									1	M		
3/8/1972										U		
1/14/1972										U		
12/12/1971										U		
11/13/1971										U		
9/23/1971			1		1					M		
8/4/1971										U		
7/25/1971			1				1			M		
7/21/1971										N		
6/20/1971			1				1			M		
6/12/1971		1							1	M		
6/11/1971										U		
5/8/1971										U		
4/7/1971										N		
3/8/1971		1				1			1	M		
1/9/1971										U		
12/24/1970										U		
12/18/1970	1	1								H		
12/5/1970										N		
11/30/1970										U		
11/7/1970										U		
10/28/1970										N		
10/20/1970		1			1				1	H		
10/16/1970										N		
9/18/1970										U		
8/22/1970										U		
8/13/1970										U		
6/9/1970										N		
4/22/1970										N		
3/28/1970										U		
2/11/1970		1	1						1	M		
2/10/1970										N		
12/1/1969					1		1			H		
10/14/1969										N		
10/12/1969		1	1							M		
10/11/1969										U		
8/29/1969										U		
8/26/1969										U		
8/3/1969										U		
8/2/1969										U		
8/1/1969									1	M		
7/26/1969					1	1			1	H		
6/5/1969									1	U		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
22/04/1969	I	Probable Cause	CLB	1	NA	B707																	1			1	
4/19/1969	I	Probable Cause	CLB	1	NA	B707																				1	
4/8/1969	N	Probable Cause	CRZ	1	NA	B707				1																	
3/20/1969	N	Probable Cause	CRZ	1	NA	B707				1																	
2/7/1969	N	Probable Cause	CRZ	1	OTH	B707				1																	
2/2/1969	N	Probable Cause	GRD	1	NA	B707	1																				
12/26/1968	F	Probable Cause	TO	1	NA	B707				1								1									
12/12/1968	F	Probable Cause	APR	1	SA	B707												1									
12/10/1968	I	Probable Cause	GRD	1	NA	B707		1																			
11/23/1968	N	Probable Cause	CRZ	1	SA	B707				1																	
11/19/1968	N	Probable Cause	CLB	1	NA	B707																			1	1	
11/19/1968	I	Probable Cause	DES	1	NA	B707																			1		
10/28/1968	N	Probable Cause	CRZ	1	OTH	B707				1																	
10/5/1968	N	Probable Cause	DES	1	NA	B707																					
9/14/1968	N	Probable Cause	CRZ	1	OTH	B707				1																	
8/5/1968	N	Probable Cause	LDG	1	NA	B707																			1	1	
7/23/1968	N	Probable Cause	CRZ	1	NA	B707				1																	
6/13/1968	F	Probable Cause	APR	1	ASIA	B707												1									
3/7/1968	I	Probable Cause	CLB	1	NA	B707																				1	
1/27/1968	N	Probable Cause	TO	1	NA	B707																					
1/25/1968	N	Probable Cause	CRZ	1	ASIA	B707				1																	
1/13/1968	N	Probable Cause	CRZ	1	OTH	B707				1																	
11/21/1967	N	Probable Cause	TO	1	NA	B707																				1	
11/6/1967	F	Probable Cause	TO	1	NA	B707							1				1									1	
11/1/1967	I	Probable Cause	LDG	1	NA	B707																				1	
10/17/1967	I	Probable Cause	CLB	1	EUR	B707			1																	1	
9/29/1967	N	Probable Cause	CRZ	1	ASIA	B707				1																	
9/14/1967	I	Probable Cause	DES	1	NA	B707																			1	1	
9/9/1967	N	Probable Cause	TO	1	EUR	B707																			1	1	
8/18/1967	N	Probable Cause	CLB	1	ASIA	B707				1																	
7/15/1967	I	Probable Cause	CRZ	1	NA	B707				1									1								
5/19/1967	I	Probable Cause	LDG	1	NA	B707																				1	
4/25/1967	N	Probable Cause	LDG	1	NA	B707																				1	
3/11/1967	N	Probable Cause	DES	1	NA	B707										1		1									
1/6/1967	I	Probable Cause	GRD	1	NA	B707	1																				
11/26/1966	N	Probable Cause	LDG	1	NA	B707																				1	
11/4/1966	I	Probable Cause	APR	1	NA	B707																				1	
10/18/1966	N	Probable Cause	LDG	1	NA	B707																				1	
10/10/1966	I	Probable Cause	CRZ	1	EUR	B707													1							1	
9/26/1966	I	Probable Cause	CLB	1	NA	B707																			1	1	
9/9/1966	N	Probable Cause	CRZ	1	NA	B707				1																	
8/30/1966	I	Probable Cause	TO	1	NA	B707																					
8/9/1966	N	Probable Cause	DES	1	NA	B707				1																	
6/11/1966	I	Probable Cause	CLB	1	NA	B707																				1	

	Factors (Non-Technical)																	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
22/04/1969																		
4/19/1969																		
4/8/1969																		
3/20/1969																		
2/7/1969																		
2/2/1969																		
12/26/1968		1		1						1		1				1	1	
12/12/1968		1								1						1		
12/10/1968										1						1		
11/23/1968																		
11/19/1968																		
11/19/1968																		
10/28/1968										1								
10/5/1968																		
9/14/1968										1								
8/5/1968																		
7/23/1968																		
6/13/1968		1								1						1		
3/7/1968																		
1/27/1968		1								1						1		
1/25/1968																		
1/13/1968		1								1								
11/21/1967																		
11/6/1967										1						1		
11/1/1967		1								1						1		
10/17/1967																		
9/29/1967																		
9/14/1967																		
9/9/1967																		
8/18/1967																		
7/15/1967																		
5/19/1967																		
4/25/1967																		
3/11/1967																		
1/6/1967																		
11/26/1966										1		1				1		
11/4/1966																		
10/18/1966		1								1						1		
10/10/1966																		
9/26/1966																		
9/9/1966		1								1								
8/30/1966																		
8/9/1966																		
6/11/1966																		

	Competencies										Validation	
Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
22/04/1969										N		
4/19/1969										N		
4/8/1969										U		
3/20/1969										U		
2/7/1969										U		
2/2/1969										N		
12/26/1968			1				1			H		
12/12/1968		1				1			1	M		
12/10/1968		1							1	M		
11/23/1968										U		
11/19/1968										N		
11/19/1968										N		
10/28/1968	1				1					M		
10/5/1968										U		
9/14/1968	1		1							M		
8/5/1968										N		
7/23/1968										U		
6/13/1968			1		1				1	H		
3/7/1968										N		
1/27/1968			1		1				1	H		
1/25/1968										U		
1/13/1968		1								M		
11/21/1967										N		
11/6/1967		1			1		1			U		
11/1/1967			1		1				1	M		
10/17/1967										U		
9/29/1967										U		
9/14/1967										N		
9/9/1967										U		
8/18/1967										U		
7/15/1967										U		
5/19/1967										N		
4/25/1967										U		
3/11/1967										U		
1/6/1967										N		
11/26/1966			1		1				1	H		
11/4/1966										N		
10/18/1966			1						1	M		
10/10/1966										U		
9/26/1966										N		
9/9/1966			1							M		
8/30/1966										U		
8/9/1966										U		
6/11/1966										N		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
6/7/1966	I	Probable Cause	CLB	1	NA	B707				1																																													U		
5/5/1966	I	Probable Cause	CRZ	1	ASIA	B707																																																	U		
4/30/1966	I	Probable Cause	CRZ	1	OTH	B707																				1																													N		
4/24/1966	I	Probable Cause	APR	1	NA	B707																							1								1						1					1		1				1	H		
1/30/1966	N	Probable Cause	DES	1	NA	B707				1																																													U		
1/23/1966	N	Probable Cause	LDG	1	NA	B707				1		1						1																			1						1												M		
12/4/1965	F	Probable Cause	CRZ	1	NA	B707										1																					1										1							1	L		
11/20/1965	I	Probable Cause	CRZ	1	NA	B707																				1																													N		
10/17/1965	N	Probable Cause	CRZ	1	NA	B707				1																																													U		
9/17/1965	F	Probable Cause	DES	1	OTH	B707				1																			1								1						1				1			1					H		
7/6/1965	N	Probable Cause	CRZ	1	NA	B707				1																1																													U		
7/5/1965	N	Probable Cause	CRZ	1	NA	B707				1																																													U		
7/5/1965	I	Probable Cause	UNK	1	NA	B707																																																	U		
7/1/1965	N	Probable Cause	LDG	1	NA	B707			1																																		1											1	M		
6/28/1965	N	Probable Cause	CLB	1	NA	B707																	1		1	1																													N		
5/11/1965	N	Probable Cause	CLB	1	NA	B707																				1																													N		
5/9/1965	N	Probable Cause	LDG	1	NA	B707				1																			1								1											1		1					M		
4/23/1965	N	Probable Cause	LDG	1	NA	B707																																					1											1	M		
3/26/1965	N	Probable Cause	LDG	1	ASIA	B707																																					1											1	M		
3/4/1965	I	Probable Cause	TO	1	NA	B707																																					1											1	U		
2/17/1965	N	Probable Cause	GRD	1	NA	B707		1																													1						1				1	1						1	M		
2/13/1965	I	Probable Cause	LDG	1	NA	B707																																					1											1	H		
1/31/1965	N	Probable Cause	CRZ	1	OTH	B707				1																			1								1						1							1					M		
1/17/1965	I	Probable Cause	TO	1	NA	B707																				1																													N		
12/21/1964	I	Probable Cause	CLB	1	NA	B707																1				1																													N		
12/7/1964	I	Probable Cause	DES	1	NA	B707																																																	U		
11/23/1964	F	Probable Cause	TO	1	EUR	B707																				1											1						1	1			1							1	M		
11/12/1964	N	Probable Cause	GRD	1	NA	B707		1																		1																													N		
11/11/1964	I	Probable Cause	GRD	1	NA	B707																																																	U		
11/10/1964	I	Probable Cause	CRZ	1	NA	B707																							1																										U		
9/30/1964	I	Probable Cause	CRZ	1	NA	B707																1																																	N		
9/25/1964	I	Probable Cause	CRZ	1	NA	B707																				1																													N		
9/25/1964	I	Probable Cause	CRZ	1	NA	B707				1																																													U		
9/20/1964	I	Probable Cause	CRZ	1	NA	B707																				1																													N		
8/26/1964	N	Probable Cause	APR	1	NA	B707																							1								1						1				1							1	H		
8/21/1964	I	Probable Cause	LDG	1	NA	B707																																					1											1	M		
8/21/1964	I	Probable Cause	TO	1	NA	B707																	1			1																	1											1	M		
8/13/1964	I	Probable Cause	GRD	1	NA	B707	1	1																													1						1											1	M		
6/14/1964	I	Probable Cause	GRD	1	NA	B707																			1																														N		
6/9/1964	I	Probable Cause	GRD	1	NA	B707		1																													1						1				1							1	M		
5/29/1964	N	Probable Cause	TO	1	EUR	B707																				1																													N		
4/7/1964	N	Probable Cause	LDG	1	NA	B707																							1								1						1					1		1				1	H		
3/5/1964	I	Probable Cause	CRZ	1	EUR	B707																																																	U		
2/15/1964	I	Probable Cause	CLB	1	EUR	B707																1																																	N		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
12/8/1963	F	Probable Cause	CRZ	1	NA	B707				1															1	1	
9/28/1963	N	Probable Cause	GRD	1	NA	B707	1	1																			
9/23/1963	N	Probable Cause	DES	1	NA	B707										1											
9/21/1963	N	Probable Cause	DES	1	NA	B707				1																	
9/10/1963	N	Probable Cause	GRD	1	NA	B707		1																			
8/13/1963	N	Probable Cause	CRZ	1	NA	B707				1																	
7/8/1963	N	Probable Cause	CRZ	1	NA	B707				1																	
6/28/1963	N	Probable Cause	CRZ	1	NA	B707				1																	
4/18/1963	N	Probable Cause	CRZ	1	NA	B707				1																	
3/25/1963	N	Probable Cause	DES	1	NA	B707				1																	
11/9/1962	N	Probable Cause	DES	1	SA	B707				1																	
7/26/1962	N	Probable Cause	DES	1	EUR	B707										1											
6/15/1962	N	Probable Cause	CLB	1	NA	B707										1											
5/22/1962	F	Probable Cause	DES	1	NA	B707																					
4/27/1962	N	Probable Cause	APR	1	ASIA	B707																					
3/1/1962	F	Probable Cause	CLB	1	NA	B707													1							1	
1/11/2010	I	Preliminary	TO	P3	NA	ATR72																	1		1		
12/25/2009	I	Preliminary	CRZ	P3	NA	ATR72																				1	
5/9/2004	N	Probable Cause	LDG	P3	NA	ATR72																					
9/6/1995	I	Probable Cause	UNK	P3	NA	ATR72																	1		1	1	
3/4/1994	I	Probable Cause	GRD	P3	NA	ATR72																	1		1	1	
8/6/2005	F	Factual	CRZ	P3	EUR	ATR72																	1			1	1
4/28/2007	N	Probable Cause	DES	P3	NA	ATR72				1																	
3/1/2003	N	Probable Cause	CRZ	P3	NA	ATR72				1																	
2/8/2003	N	Probable Cause	GRD	P3	NA	ATR72																				1	
11/20/2000	N	Probable Cause	DES	P3	NA	ATR72				1																	
3/10/2000	N	Probable Cause	CRZ	P3	NA	ATR72				1																	
12/1/1998	N	Probable Cause	DES	P3	NA	ATR72										1											
6/14/1997	I	Probable Cause	APR	P3	NA	ATR72																	1		1	1	
10/24/1995	I	Probable Cause	CRZ	P3	NA	ATR72																	1		1	1	
7/9/1995	I	Probable Cause	CLB	P3	NA	ATR72																					
1/17/1995	I	Probable Cause	LDG	P3	NA	ATR72																			1	1	
12/12/1994	I	Probable Cause	GRD	P3	NA	ATR72																			1	1	
10/31/1994	F	Probable Cause	CRZ	P3	NA	ATR72				1																1	1
6/17/1994	I	Probable Cause	CRZ	P3	NA	ATR72																			1	1	
6/4/1993	N	Probable Cause	CLB	P3	NA	ATR72				1																	
3/8/1993	I	Probable Cause	TO	P3	NA	ATR72							1			1											
12/21/2009	I	Factual	CLB	P3	EUR	DHC8																				1	
4/20/2009	N	Preliminary	GRD	P3	NA	DHC8	1	1																			
2/12/2009	F	Probable Cause	APR	P3	NA	DHC8				1								1									
11/16/2008	I	Probable Cause	LDG	P3	NA	DHC8																				1	
2/3/2008	N	Probable Cause	DES	P3	NA	DHC8				1																	
1/31/2007	N	Probable Cause	DES	P3	NA	DHC8				1																	
8/29/2005	N	Probable Cause	GRD	P3	NA	DHC8		1																			

	Factors (Non-Technical)																	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
12/8/1963				1														
9/28/1963																		
9/23/1963																		
9/21/1963																		
9/10/1963										1								
8/13/1963																		
7/8/1963		1								1								
6/28/1963																		
4/18/1963																		
3/25/1963																		
11/9/1962																		
7/26/1962																		
6/15/1962																		
5/22/1962													1					
4/27/1962		1								1						1		
3/1/1962																		
1/11/2010																		
12/25/2009																		
5/9/2004										1								
9/6/1995																		
3/4/1994																		
8/6/2005																		
4/28/2007																		
3/1/2003																		
2/8/2003																		
11/20/2000										1								
3/10/2000																		
12/1/1998																		
6/14/1997																		
10/24/1995																		
7/9/1995																		
1/17/1995																		
12/12/1994																		
10/31/1994			1	1				1										
6/17/1994																		
6/4/1993										1						1		
3/8/1993																		
12/21/2009																		
4/20/2009										1								
2/12/2009		1	1						1	1					1			
11/16/2008																		
2/3/2008																		
1/31/2007																		
8/29/2005																		

	Competencies										Validation	
Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
12/8/1963										U		
9/28/1963										U		
9/23/1963										U		
9/21/1963										U		
9/10/1963			1		1					U		
8/13/1963										U		
7/8/1963			1		1					M		
6/28/1963										U		
4/18/1963										U		
3/25/1963										U		
11/9/1962										U		
7/26/1962										U		
6/15/1962										U		
5/22/1962										U		
4/27/1962		1	1						1	H		
3/1/1962										U		
1/11/2010										N		
12/25/2009										N		
5/9/2004					1				1	H		
9/6/1995										N		
3/4/1994										N		
8/6/2005										N		
4/28/2007										N		
3/1/2003										N		
2/8/2003										N		
11/20/2000	1		1							M		
3/10/2000										N		
12/1/1998									1	M		
6/14/1997										N		
10/24/1995										N		
7/9/1995										N		
1/17/1995										N		
12/12/1994										N		
10/31/1994										H		
6/17/1994										N		
6/4/1993		1			1					H		
3/8/1993										N		
12/21/2009										N		
4/20/2009		1								H		
2/12/2009						1	1		1	H		
11/16/2008										N		
2/3/2008										L		
1/31/2007										L		
8/29/2005										N		

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
5/30/2005	I	Probable Cause	GRD	P3	NA	DHC8	1	1																			
5/19/2004	I	Factual	GRD	P3	EUR	DHC8																	1		1	1	
1/19/2004	I	Probable Cause	LDG	P3	NA	DHC8												1									
1/8/2003	N	Probable Cause	APR	P3	NA	DHC8																1				1	
10/14/2002	N	Probable Cause	APR	P3	NA	DHC8																1				1	
3/1/2002	I	Probable Cause	CRZ	P3	NA	DHC8																				1	
8/28/2001	I	Probable Cause	CLB	P3	NA	DHC8																				1	
3/6/2001	N	Probable Cause	APR	P3	NA	DHC8																	1		1		
3/12/2000	I	Probable Cause	GRD	P3	NA	DHC8																				1	
10/6/1999	N	Probable Cause	CRZ	P3	NA	DHC8																1					
9/27/1998	N	Probable Cause	APR	P3	NA	DHC8				1																	
3/26/1997	N	Probable Cause	GRD	P3	NA	DHC8	1	1																			
2/24/1997	I	Probable Cause	CLB	P3	NA	DHC8																				1	
2/20/1997	I	Probable Cause	CLB	P3	NA	DHC8																				1	1
1/22/1997	I	Probable Cause	TO	P3	NA	DHC8																				1	1
12/15/1996	N	Probable Cause	LDG	P3	NA	DHC8																				1	
4/3/1995	I	Probable Cause	APR	P3	NA	DHC8																				1	1
8/1/1994	N	Probable Cause	GRD	P3	NA	DHC8	1																				
2/11/1994	I	Probable Cause	APR	P3	NA	DHC8				1																	
3/23/1993	N	Probable Cause	APR	P3	NA	DHC8				1																	
1/9/1993	I	Probable Cause	TO	P3	NA	DHC8																				1	
1/8/1993	I	Probable Cause	TO	P3	NA	DHC8																	1				1
1/12/1992	I	Probable Cause	TO	P3	NA	DHC8																	1		1	1	
10/8/1992	I	Probable Cause	DES	P3	NA	DHC8							1			1		1									
7/16/1991	I	Probable Cause	TO	P3	NA	DHC8																				1	
7/25/1990	I	Probable Cause	TO	P3	NA	DHC8																		1		1	
4/22/1988	I	Probable Cause	CRZ	P3	NA	DHC8																	1		1	1	
4/15/1988	N	Probable Cause	CLB	P3	NA	DHC8																	1		1	1	
6/19/1987	I	Probable Cause	CLB	P3	NA	DHC8																	1			1	
12/2/1986	I	Probable Cause	CLB	P3	NA	DHC8																	1		1	1	
9/11/2009	N	Preliminary	UNK	P3	NA	DHC8																					
6/26/2009	I	Probable Cause	GRD	P3	NA	DHC8							1				1										
8/5/2009	N	Factual	CRZ	P3	NA	DHC8				1								1									
11/8/2010	N	Preliminary	DES	P3	NA	DHC8																1					
24/09/2009	F	actual	TO	P2	AFR	BAE Jetstream 41																	1			1	
29/12/2000	N	Probable Cause	LDG	P2	NA	BAE Jetstream 41																				1	
07/01/1994	F	Probable Cause	APR	P2	NA	BAE Jetstream 41				1								1									
06/09/1997	N	Probable Cause	CRZ	P3	NA	BAE-ATP				1																	
25/02/1994	I	Probable Cause	DES	P3	NA	BAE-ATP																			1	1	
19/01/1994	I	Probable Cause	GRD	P3	NA	BAE-ATP																			1	1	
07/05/1993	N	Probable Cause	GRD	P3	NA	BAE-ATP																					
11/04/1993	I	Probable Cause	CRZ	P3	NA	BAE-ATP				1								1					1			1	
08/01/1992	I	Probable Cause	DES	P3	NA	BAE-ATP				1								1								1	
27/11/1999	N	Probable Cause	LDG	P2	NA	DeHavilland DH7																				1	

	Factors (Non-Technical)																	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
5/30/2005										1								
5/19/2004																		
1/19/2004										1								
1/8/2003																		
10/14/2002																		
3/1/2002																		
8/28/2001																		
3/6/2001																		
3/12/2000		1								1							1	
10/6/1999																		
9/27/1998																		
3/26/1997		1						1		1								
2/24/1997																		
2/20/1997																		
1/22/1997																		
12/15/1996																		
4/3/1995																		
8/1/1994																		
2/11/1994										1								
3/23/1993			1							1								
1/9/1993		1								1							1	
1/8/1993																		
1/12/1992																		
10/8/1992										1								
7/16/1991																		
7/25/1990																		
4/22/1988																		
4/15/1988																		
6/19/1987																		
12/2/1986																		
9/11/2009																		
6/26/2009																		
8/5/2009																		
11/8/2010																		
24/09/2009		1								1		1				1	1	
29/12/2000		1								1						1	1	
07/01/1994		1	1					1		1		1				1	1	
06/09/1997																		
25/02/1994																		
19/01/1994																		
07/05/1993	1																	
11/04/1993																		
08/01/1992																		
27/11/1999		1								1							1	

	Competencies										Validation	
Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
5/30/2005	1		1							H		
5/19/2004										N		
1/19/2004		1				1				M		
1/8/2003										N		
10/14/2002										L		
3/1/2002										N		
8/28/2001										N		
3/6/2001										N		
3/12/2000		1								M		
10/6/1999										N		
9/27/1998										L		
3/26/1997		1								H		
2/24/1997										N		
2/20/1997										N		
1/22/1997										N		
12/15/1996										U		
4/3/1995										N		
8/1/1994										N		
2/11/1994		1								M		
3/23/1993	1	1								M		
1/9/1993		1			1				1	H		
1/8/1993										N		
1/12/1992										N		
10/8/1992		1								M		
7/16/1991										N		
7/25/1990										L		
4/22/1988										N		
4/15/1988										L		
6/19/1987										N		
12/2/1986										N		
9/11/2009										U		
6/26/2009										N		
8/5/2009										L		
11/8/2010										N		
24/09/2009		1	1				1		1	H	DS	SF
29/12/2000		1					1		1	H	DS	SF
07/01/1994		1		1		1	1		1	H	DS	SF
06/09/1997										U	DS	SF
25/02/1994										N	DS	SF
19/01/1994										N	DS	SF
07/05/1993										N	DS	SF
11/04/1993										N	DS	SF
08/01/1992										N	DS	SF
27/11/1999			1		1	1	1			H	SF	DS

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatigue	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
05/03/1993	N	Probable Cause	APR	P2	NA	DeHavilland DH7				1																																												U	SF	DS
29/07/1990	N	Probable Cause	APR	P2	NA	DeHavilland DH7																				1			1								1							1						1	1	1			H	SF	DS
11/01/1989	I	Probable Cause	LDG	P2	NA	DeHavilland DH7																				1																													N	SF	DS
08/04/1987	I	Probable Cause	APR	P2	NA	DeHavilland DH7							1			1																																							N	SF	DS
15/04/1985	N	Probable Cause	CRZ	P2	NA	DeHavilland DH7																	1		1	1																													N	SF	DS
29/07/1984	I	Probable Cause	TO	P2	NA	DeHavilland DH7																				1																													N	SF	DS
15/05/1984	I	Probable Cause	APR	P2	NA	DeHavilland DH7																				1																													N	SF	DS
22/12/1983	N	Probable Cause	APR	P2	NA	DeHavilland DH7														1																																			U	MS	DS
10/06/1981	I	http://www.ntsb.go	LDG	P2	NA	DeHavilland DH7				1																1			1								1		1				1	1				1	1			1			M	SF	DS
18/08/1980	I	http://www.ntsb.go	APR	P2	NA	DeHavilland DH7																				1																													N	SF	DS
03/03/1979	I	http://www.ntsb.go	LDG	P2	NA	DeHavilland DH7			1																	1																													N	SF	DS
06/12/1977	N	http://www.ntsb.go	GRD	P2	NA	DeHavilland DH7																				1				1					1																				U	SF	DS
03/06/2006	N	Probable Cause	TO	P2	NA	Dornier 328																				1			1								1						1				1			1		1			M	SF	DS
03/05/2004	I	Probable Cause	TO	P2	NA	Dornier 328																				1																													N	SF	DS
02/09/2003	N	Probable Cause	GRD	P2	NA	Dornier 328																																																	N	SF	DS
24/04/2003	N	Probable Cause	CRZ	P2	NA	Dornier 328				1																																													N	SF	DS
13/03/2003	I	Probable Cause	APR	P2	NA	Dornier 328				1																																													N	SF	DS
28/07/2002	I	Probable Cause	CLB	P2	NA	Dornier 328																				1																													N	SF	DS
17/06/2002	I	Probable Cause	GRD	P2	NA	Dornier 328																						1																											N	SF	DS
06/06/2002	I	Probable Cause	APR	P2	NA	Dornier 328																				1																													N	SF	DS
22/05/2002	I	Probable Cause	DES	P2	NA	Dornier 328																				1																													N	SF	DS
02/05/2002	I	Probable Cause	CRZ	P2	NA	Dornier 328				1																1																													N	SF	DS
09/04/2001	N	Probable Cause	APR	P2	NA	Dornier 328				1																		1																											N	SF	DS
20/03/2000	N	Probable Cause	LDG	P2	NA	Dornier 328																				1																													N	SF	DS
29/05/1996	I	Probable Cause	CRZ	P2	NA	Dornier 328				1																1	1																												N	SF	DS
31/03/1996	I	Probable Cause	CLB	P2	NA	Dornier 328				1																1																													N	SF	DS
03/08/1995	N	Probable Cause	LDG	P2	NA	Dornier 328				1		1																		1					1																1				H	SF	DS
22/03/2010	F	Factual	TO	P3	AUS	EMB-120																	1			1											1													1		1		1	H	SF	DS
16/02/2010	I	Preliminary	GRD	P3	NA	EMB-120	1	1																																															L	SF	DS
21/02/2009	I	Probable Cause	GRD	P3	NA	EMB-120	1	1																																							1	1								H	SF	DS
26/06/2008	I	Factual	APR	P3	AUS	EMB-120																	1			1																													N	SF	DS
26/05/2007	I	Probable Cause	LDG	P3	NA	EMB-120							1				1																																						N	SF	DS
28/11/2005	I	Probable Cause	LDG	P3	NA	EMB-120												1											1								1						1						1	1			1		1	H	SF	DS
02/06/2003	N	Probable Cause	GRD	P3	NA	EMB-120	1	1																																															L	SF	DS
16/03/2003	I	Probable Cause	TO	P3	NA	EMB-120			1	1								1																			1											1							1	L	SF	DS
16/10/2001	N	Probable Cause	APR	P3	NA	EMB-120												1											1								1												1	1			1		1	M	SF	DS
19/03/2001	N	Probable Cause	CRZ	P3	NA	EMB-120				1																			1								1												1	1			1		1	M	SF	DS
25/02/2001	N	Probable Cause	DES	P3	NA	EMB-120				1																1																													N	SF	DS
06/12/2000	N	Probable Cause	LDG	P3	NA	EMB-120				1								1																																					N	SF	DS
12/08/2000	I	Probable Cause	DES	P3	NA	EMB-120																				1																													N	SF	DS
21/02/2000	I	Probable Cause	DES	P3	NA	EMB-120																				1																													N	SF	DS
21/05/1997	N	Probable Cause	CRZ	P3	NA	EMB-120																	1		1	1																													N	SF	DS
09/01/1997	F	Probable Cause	APR	P3	NA	EMB-120				1																					1						1												1		1	1	1		1	H	SF	DS
29/11/1996	I	Probable Cause	APR	P3	NA	EMB-120																																																	N	SF	DS

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				Factors (Non-Technical)																	Competencies									Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
23/06/1996	N	Probable Cause	APR	P3	NA	EMB-120																			1				1			1																						N	SF	DS
20/02/1996	I	Probable Cause	CLB	P3	NA	EMB-120																			1																													N	SF	DS
21/08/1995	F	Probable Cause	CLB	P3	NA	EMB-120																1			1																													M	SF	DS
17/07/1995	N	Probable Cause	GRD	P3	NA	EMB-120		1										1											1								1											1	1			1			L	SF	DS
29/04/1993	N	Probable Cause	CRZ	P3	NA	EMB-120				1									1										1							1	1		1										1	1		1		1	M	SF	DS
09/12/1992	I	Probable Cause	CLB	P3	NA	EMB-120																			1																													N	SF	DS
21/07/1992	I	Probable Cause	APR	P3	NA	EMB-120				1																1																													N	SF	DS
11/09/1991	F	Probable Cause	DES	P3	NA	EMB-120																			1																													N	SF	DS
05/04/1991	F	Probable Cause	APR	P3	NA	EMB-120																1			1																													N	SF	DS
25/08/1990	I	Probable Cause	CLB	P3	NA	EMB-120																1			1																													N	SF	DS
09/04/1990	F	Probable Cause	CLB	P3	NA	EMB-120									1		1																			1										1								M	SF	DS
09/12/1987	N	Probable Cause	LDG	P3	NA	EMB-120																						1								1		1										1	1		1			M	SF	DS
13/07/1987	N	Probable Cause	LDG	P3	NA	EMB-120																						1								1		1										1	1		1			M	SF	DS
23/01/1987	I	Probable Cause	CLB	P3	NA	EMB-120																1			1																													U	SF	DS
23/12/1986	I	Probable Cause	APR	P3	NA	EMB-120																1			1																													N	SF	DS
31/10/2007	N	Factual	TO	P2	SA	Fokker F-27				1																																												U	IG	DS
27/04/2004	N	Factual	CRZ	P2	SA	Fokker F-27																		1																														N	IG	DS
10/02/2004	F	Factual	APR	P3	ASIA	Fokker F-27																1			1																													U	IG	DS
17/04/2003	N	Probable Cause	DES	P2	NA	Fokker F-27																1			1																													N	IG	DS
22/05/2000	N	Factual	LDG	P2	SA	Fokker F-27																			1																													N	IG	DS
05/03/1999	N	Factual	TO	P2	SA	Fokker F-27																			1																												1	U	IG	DS
01/04/1997	N	Probable Cause	GRD	P2	NA	Fokker F-27	1	1																																															N	IG	DS
04/11/1992	I	Probable Cause	LDG	P2	NA	Fokker F-27																			1																													N	IG	DS
23/02/1990	I	Probable Cause	LDG	P2	NA	Fokker F-27			1	1		1						1																			1						1				1			1					M	IG	DS
30/09/1989	N	Probable Cause	LDG	P2	NA	Fokker F-27				1	1	1																			1						1						1				1			1		1		1	H	IG	DS
03/05/1989	I	Probable Cause	LDG	P2	NA	Fokker F-27																			1																													N	IG	DS
29/10/1987	I	Probable Cause	LDG	P2	NA	Fokker F-27							1			1																																							N	IG	DS
07/10/1985	N	Probable Cause	LDG	P2	NA	Fokker F-27				1		1												1		1			1								1		1				1				1		1		1			1	H	IG	DS
09/09/1985	I	Probable Cause	TO	P2	NA	Fokker F-27																1		1	1																													N	IG	DS
20/03/1985	I	Probable Cause	GRD	P2	NA	Fokker F-27																		1	1																													N	IG	DS
13/01/1984	N	Probable Cause	TO	P2	NA	Fokker F-27																1			1			1								1													1	1	1			H	IG	DS
18/05/2011	F	Preliminary	CRZ	P3	SA	SAAB 340				1									1																		1						1				1			1					M	SF	IG
05/04/2010	N	Probable Cause	CRZ	P3	NA	SAAB 340				1																																													U	SF	IG
04/10/2009	I	Factual	CLB	P3	NA	SAAB 340																1			1																													N	SF	IG
30/07/2009	I	Probable Cause	CRZ	P3	NA	SAAB 340																					1																											N	SF	IG
29/07/2008	I	Probable Cause	GRD	P3	NA	SAAB 340																1			1																													N	SF	IG
16/12/2006	I	Factual	TO	P3	AUS	SAAB 340																1			1																													N	SF	IG
13/03/2006	N	Probable Cause	GRD	P3	NA	SAAB 340	1			1																																													N	SF	IG
02/01/2006	I	Probable Cause	CLB	P3	NA	SAAB 340				1									1					1		1			1						1		1										1	1			1	1	1		H	SF	IG
08/06/2005	I	Probable Cause	LDG	P3	NA	SAAB 340																			1																													N	SF	IG
11/02/2005	N	Probable Cause	DES	P3	NA	SAAB 340				1																																													U	SF	IG
13/11/2004	N	Probable Cause	GRD	P3	NA	SAAB 340	1																																																N	SF	IG
25/10/2004	N	Probable Cause	GRD	P3	NA	SAAB 340	1	1																																															N	SF	IG
24/02/2004	N	Probable Cause	GRD	P3	NA	SAAB 340		1								1		1																			1										1								L	SF	IG

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
01/02/2004	N	Probable Cause	GRD	P3	NA	SAAB 340	1																																															N	SF	IG
12/11/2003	N	Probable Cause	APR	P3	NA	SAAB 340																1																																	N	SF	IG
21/05/2003	N	Probable Cause	GRD	P3	NA	SAAB 340		1								1																																							L	SF	IG
04/09/2002	I	Probable Cause	CLB	P3	NA	SAAB 340																				1																														N	SF	IG
21/07/2002	N	Probable Cause	GRD	P3	NA	SAAB 340	1																																															N	SF	IG
16/07/2002	N	Probable Cause	GRD	P3	NA	SAAB 340	1																																															N	SF	IG
06/09/2001	N	Factual	LDG	P3	NA	SAAB 340																	1			1																														U	SF	IG
23/05/2001	I	Factual	TO	P3	AUS	SAAB 340																	1			1																														N	SF	IG
10/01/2001	I	Probable Cause	CRZ	P3	NA	SAAB 340				1													1			1																														N	SF	IG
08/11/2000	N	Probable Cause	APR	P3	NA	SAAB 340																1					1																												N	SF	IG
29/09/2000	N	Probable Cause	GRD	P3	NA	SAAB 340	1																																															N	SF	IG
25/04/2000	N	Probable Cause	TO	P3	NA	SAAB 340																																																	N	SF	IG
21/03/2000	N	Probable Cause	LDG	P3	NA	SAAB 340			1	1		1						1			1									1								1						1						1			1		1		1	1	H	SF	IG
12/02/2000	I	Probable Cause	GRD	P3	NA	SAAB 340	1																																															N	SF	IG
10/01/2000	F	Preliminary	CLB	P3	EUR	SAAB 340				1								1	1											1								1	1	1			1	1				1	1				1	1	1	H	SF	IG
08/05/1999	N	Probable Cause	LDG	P3	NA	SAAB 340			1	1								1										1							1	1						1				1		1		1		1	H	SF	IG
12/04/1999	N	Probable Cause	GRD	P3	NA	SAAB 340	1																																															N	SF	IG
03/03/1999	N	Probable Cause	DES	P3	NA	SAAB 340				1																																												U	SF	IG
11/11/1998	I	Factual	APR	P3	AUS	SAAB 340				1								1								1										1						1	1			1			1	1				M	SF	IG
03/11/1998	F	Probable Cause	GRD	P3	NA	SAAB 340	1																																															N	SF	IG
18/03/1998	F	Factual	CLB	P3	ASIA	SAAB 340				1								1	1					1		1			1							1	1		1				1	1			1			1	1	1		1	H	SF	IG
22/02/1998	I	Probable Cause	LDG	P3	NA	SAAB 340																				1			1	1			1		1		1											1			1	1				M	SF	IG
20/01/1998	I	Factual	CLB	P3	EUR	SAAB 340																	1		1	1																														U	SF	IG
11/12/1997	N	Probable Cause	DES	P3	NA	SAAB 340				1																																												U	SF	IG
11/08/1997	I	Probable Cause	GRD	P3	NA	SAAB 340		1																	1	1																														N	SF	IG
13/05/1997	I	Probable Cause	CLB	P3	NA	SAAB 340																	1			1			1								1		1								1		1	1	1			H	SF	IG
20/09/1996	N	Probable Cause	GRD	P3	NA	SAAB 340																																																	N	SF	IG
11/07/1996	N	Probable Cause	GRD	P3	NA	SAAB 340																																																	N	SF	IG
01/07/1996	N	Probable Cause	CLB	P3	NA	SAAB 340																	1			1																														N	SF	IG
17/11/1995	I	Probable Cause	CLB	P3	NA	SAAB 340																	1			1	1			1			1		1																							U	SF	IG
17/08/1995	N	Probable Cause	GRD	P3	NA	SAAB 340		1																	1	1	1			1					1																							N	SF	IG
05/07/1995	I	Probable Cause	TO	P3	NA	SAAB 340																				1																														N	SF	IG
12/05/1994	I	Probable Cause	TO	P3	NA	SAAB 340																				1			1								1											1			1	1	1			H	SF	IG
03/05/1994	I	Probable Cause	CRZ	P3	NA	SAAB 340				1												1			1	1																														U	SF	IG
01/02/1994	N	Probable Cause	DES	P3	NA	SAAB 340																	1			1	1		1								1							1				1					1		M	SF	IG
02/01/1993	N	Probable Cause	LDG	P3	NA	SAAB 340				1							1										1	1						1					1	1			1		1				1	1		1	M	SF	IG
31/08/1992	I	Probable Cause	CRZ	P3	NA	SAAB 340																	1			1																														N	SF	IG
21/11/1991	I	Probable Cause	CRZ	P3	NA	SAAB 340																	1			1																														N	SF	IG
10/11/1990	I	Probable Cause	CRZ	P3	NA	SAAB 340																								1								1											1		1	1	1		1	H	SF	IG
22/11/1989	I	Probable Cause	APR	P3	NA	SAAB 340				1	1						1	1									1								1						1						1			1		1		1	H	SF	IG
24/10/1988	I	Probable Cause	CRZ	P3	NA	SAAB 340																	1		1	1	1																												N	SF	IG
02/02/1988	I	Probable Cause	LDG	P3	NA	SAAB 340																	1		1	1																														N	SF	IG
09/03/1987	I	Probable Cause	GRD	P3	NA	SAAB 340		1		1		1														1																														U	SF	IG

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
29/10/1985	I	Probable Cause	LDG	P3	NA	SAAB 340																			1																												N	SF	IG
05/02/2006	F	Probable Cause	CRZ	P2	NA	Shorts SD360										1																						1											1		1				1	H	SF	DS
05/02/2006	F	Probable Cause	CRZ	P2	NA	Shorts SD360										1																						1											1		1				1	H	SF	DS
16/12/2004	N	Factual	LDG	P2	NA	Shorts SD360												1								1			1								1						1					1		1		1		1	H	SF	DS
09/04/2003	N	Probable Cause	APR	P2	NA	Shorts SD330												1											1								1											1		1		1		1	H	SF	DS
30/07/2000	N	Probable Cause	CRZ	P2	NA	Shorts SD330																																																	N	SF	DS
25/11/1997	N	Probable Cause	APR	P2	NA	Shorts SD360				1																											1						1					1				1		1	L	SF	DS
09/05/1997	I	Probable Cause	CLB	P2	NA	Shorts SD360																			1																												N	SF	DS
09/07/1996	I	Probable Cause	CLB	P2	NA	Shorts SD360																			1																												N	SF	DS
02/06/1996	I	Probable Cause	CLB	P2	NA	Shorts SD360																			1																												N	SF	DS
12/03/1995	N	Probable Cause	GRD	P2	NA	Shorts SD360		1																																														N	SF	DS
18/02/1995	I	Probable Cause	LDG	P2	NA	Shorts SD360																			1																												N	SF	DS
14/06/1993	I	Probable Cause	CRZ	P2	NA	Shorts SD360																		1	1																												N	SF	DS
22/04/1993	I	Probable Cause	CRZ	P2	NA	Shorts SD360				1																					1						1											1				1			M	SF	DS
11/05/1991	N	Probable Cause	GRD	P2	NA	Shorts SD360		1																		1																												N	SF	DS
02/03/1991	N	Probable Cause	LDG	P2	NA	Shorts SD360																			1										1											1		1		1		1	H	SF	DS
11/05/1990	N	Probable Cause	GRD	P2	NA	Shorts SD360		1																						1																									H	SF	DS
19/02/1990	I	Probable Cause	LDG	P2	NA	Shorts SD360																1			1																												N	SF	DS
24/03/1989	I	Probable Cause	CRZ	P2	NA	Shorts SD360				1																		1								1											1		1		1			H	SF	DS
07/03/1989	I	Probable Cause	TO	P2	NA	Shorts SD360																															1		1							1		1							L	SF	DS
03/06/1988	I	Probable Cause	APR	P2	NA	Shorts SD360																			1																												N	SF	DS
21/05/1986	N	Probable Cause	CRZ	P2	NA	Shorts SD330				1																		1																											U	SF	DS
26/04/1984	N	Probable Cause	GRD	P2	NA	Shorts SD330	1	1																		1																												1	M	SF	DS
21/03/1984	I	Probable Cause	APR	P2	NA	Shorts SD330																1			1										1													1		1			M	SF	DS
28/10/1983	F	Probable Cause	CLB	P2	NA	Shorts SD330																						1																											N	SF	DS
18/10/1981	N	Probable Cause	CRZ	P2	NA	Shorts SD330				1																																													N	SF	DS
22/06/1981	N	Probable Cause	CRZ	P2	NA	Shorts SD330				1																																													N	SF	DS
11/06/1981	N	Probable Cause	LDG	P2	NA	Shorts SD330																			1																												U	SF	DS
03/06/1980	N	Probable Cause	GRD	P2	NA	Shorts SD330				1								1																																					N	SF	DS
06/08/1979	I	Probable Cause	TO	P2	NA	Shorts SD330																1			1																												N	SF	DS
13/02/1979	I	Probable Cause	LDG	P2	NA	Shorts SD330			1	1																1																												N	SF	DS
10/03/1978	I	Probable Cause	LDG	P2	NA	Shorts SD330																			1																												N	SF	DS
04/12/2004	N	Probable Cause	LDG	P2	NA	Convair 580			1	1								1					1			1			1								1		1				1	1					1	1	1	1			H	js	DS
13/08/2004	F	Probable Cause	APR	P2	NA	Convair 580																1			1	1		1								1		1				1	1				1	1		1	1			H	js	DS
03/10/2003	F	Foreign	DES	P2	AUS	Convair 580				1									1												1												1								1				M	JS	DS
06/12/2001	N	Probable Cause	CLB	P2	NA	Convair 580																1			1			1								1							1			1	1				1			M	JS	DS
02/02/1992	F	Foreign	APR	P2	AFR	Convair 580												1																				1						1				1								H	JS	DS
20/11/1991	N	Probable Cause	APR	P2	NA	Convair 600 series							1																									1		1								1								L	JS	DS
18/09/1991	F	Probable Cause	CRZ	P2	NA	Convair 580				1								1	1																								1											1	M	JS	DS
04/08/1989	N	Probable Cause	LDG	P2	NA	Convair 600 series				1													1			1										1													1				M	JS	DS
03/08/1989	N	Probable Cause	LDG	P2	NA	Convair 600 series																							1								1						1							1		1		1	M	JS	DS
20/01/1989	N	Probable Cause	CRZ	P2	NA	Convair 580															1		1			1	1		1								1		1				1	1			1	1				1			M	JS	DS
02/02/1988	N	Probable Cause	LDG	P2	NA	Convair 580			1	1								1																			1						1				1							1	M	JS	DS
28/10/1987	N	Probable Cause	DES	P2	NA	Convair 600 series			1													1			1	1		1								1						1	1				1		1		1			H	JS	DS

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
24/03/1987	N	Probable Cause	TO	P2	NA	Convair 580				1		1											1			1			1								1						1					1		1		1		1	H	JS	DS
25/04/1986	N	Probable Cause	CRZ	P2	NA	Convair 580				1																																														U	JS	DS
06/11/1983	N	Probable Cause	APR	P2	NA	Convair 580												1				1																																		N	JS	DS
09/01/1983	F	Probable Cause	LDG	P2	NA	Convair 580			1									1			1		1			1					1												1												1	M	JS	DS
04/11/1981	N	Probable Cause	TO	P2	NA	Convair 580																															1						1	1		1								1	M	JS	DS
30/12/1980	I	Probable Cause	TO	P2	NA	Convair 580																				1																													N	JS	DS
07/08/1980	I	Probable Cause	LDG	P2	NA	Convair 580																				1	1																												N	JS	DS
31/10/1979	I	Probable Cause	LDG	P2	NA	Convair 580			1	1		1						1																									1												M	JS	DS
26/07/1979	N	Probable Cause	CRZ	P2	NA	Convair 580																						1																											N	JS	DS
31/05/1979	N	Probable Cause	GRD	P2	NA	Convair 600 series																			1	1																													U	JS	MS
19/01/1979	N	Probable Cause	GRD	P2	NA	Convair 580																				1	1																												N	JS	MS
18/11/1978	N	Probable Cause	GRD	P2	NA	Convair 600 series																				1	1																												N	JS	MS
03/10/1978	I	Probable Cause	CLB	P2	NA	Convair 600 series																			1	1																													N	JS	MS
25/07/1978	N	Probable Cause	TO	P2	NA	Convair 580																1	1			1			1								1						1					1				1		1	H	JS	MS
20/04/1978	N	Probable Cause	LDG	P2	NA	Convair 580																	1			1			1								1						1							1				1	M	JS	MS
18/03/1977	N	Probable Cause	GRD	P2	NA	Convair 580		1																					1								1		1								1		1			1		1	M	JS	MS
21/12/1976	N	Probable Cause	GRD	P2	NA	Convair 580				1								1																																					N	JS	MS
10/11/1975	N	Probable Cause	LDG	P2	NA	Convair 580																	1		1	1																													U	JS	MS
09/07/1975	I	Probable Cause	CLB	P2	NA	Convair 580																	1		1	1																													N	JS	MS
20/06/1975	N	Probable Cause	CRZ	P2	NA	Convair 580				1																																													U	JS	MS
13/01/1974	N	Probable Cause	APR	P2	NA	Convair 580				1																																													U	JS	MS
27/09/1973	F	Probable Cause	CRZ	P2	NA	Convair 600 series				1								1			1								1								1						1					1		1		1			H	JS	MS
12/06/1973	N	Probable Cause	LDG	P2	NA	Convair 580																				1	1																												U	JS	MS
31/05/1973	I	Probable Cause	LDG	P2	NA	Convair 580																				1	1																												U	JS	MS
04/12/1972	N	Probable Cause	CRZ	P2	NA	Convair 580				1								1																																					U	JS	MS
24/11/1972	I	Probable Cause	GRD	P2	NA	Convair 580		1					1				1																																						U	JS	MS
29/06/1972	F	Probable Cause	CRZ	P2	NA	Convair 580				1						1		1																			1										1								U	JS	MS
08/05/1972	N	Probable Cause	GRD	P2	NA	Convair 600 series																				1	1																												U	JS	MS
23/03/1972	I	Probable Cause	LDG	P2	NA	Convair 600 series																				1	1																												U	JS	MS
11/03/1972	N	Probable Cause	LDG	P2	NA	Convair 580																	1			1																	1	1										1	H	JS	MS
16/02/1972	N	Probable Cause	LDG	P2	NA	Convair 600 series																	1		1	1																													U	JS	MS
20/08/1971	N	Probable Cause	LDG	P2	NA	Convair 580																				1	1																												N	JS	MS
07/06/1971	F	Probable Cause	APR	P2	NA	Convair 580				1								1			1								1								1						1			1				1		1		1	H	JS	MS
29/01/1971	I	Probable Cause	TO	P2	NA	Convair 580																				1																	1											1	M	JS	MS
04/01/1971	I	Probable Cause	APR	P2	NA	Convair 580																				1	1																												N	JS	MS
23/12/1970	N	Probable Cause	LDG	P2	NA	Convair 580																				1	1																												U	JS	MS
01/01/1970	I	Probable Cause	LDG	P2	NA	Convair 580																				1	1																												N	JS	MS
10/12/1970	N	Probable Cause	LDG	P2	NA	Convair 600 series				1		1														1																	1											1	H	JS	MS
03/11/1970	I	Probable Cause	CRZ	P2	NA	Convair 580																				1												1																	N	JS	AS
20/10/1970	I	Probable Cause	CRZ	P2	NA	Convair 580																			1	1																													N	JS	AS
16/09/1970	N	Probable Cause	CRZ	P2	NA	Convair 600 series				1																																													U	JS	AS
28/06/1970	I	Probable Cause	CRZ	P2	NA	Convair 580																																		1					1										U	JS	AS
01/02/1970	I	Probable Cause	LDG	P2	NA	Convair 580			1																												1						1	1				1		1				1	H	JS	AS
01/02/1970	N	Probable Cause	LDG	P2	NA	Convair 580																							1							1	1						1	1				1	1			1			M	JS	AS

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																					Factors (Non-Technical)																		Competencies										Validation	
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
01/08/1969	N	Probable Cause	LDG	P2	NA	Convair 600 series																			1	1																													N	JS	AS
27/12/1968	F	Probable Cause	APR	P2	NA	Convair 580				1								1			1								1								1					1	1					1		1				1	H	JS	AS
24/12/1968	F	Probable Cause	APR	P2	NA	Convair 580				1								1											1								1						1					1		1		1			H	JS	AS
12/11/1968	N	Probable Cause	LDG	P2	NA	Convair 580																				1			1								1						1	1				1	1			1			M	JS	AS
04/08/1968	F	Probable Cause	DES	P2	NA	Convair 580				1								1								1											1						1					1		1					M	JS	AS
25/07/1968	N	Probable Cause	LDG	P2	NA	Convair 580																				1																													N	JS	AS
23/07/1968	I	Probable Cause	CRZ	P2	NA	Convair 580				1																											1						1				1			1					M	JS	AS
24/06/1968	N	Probable Cause	APR	P2	NA	Convair 580				1								1			1		1		1	1			1								1	1	1								1	1				1			H	JS	AS
28/01/1968	N	Probable Cause	CRZ	P2	NA	Convair 600 series				1								1																																					U	JS	AS
08/09/1967	N	Probable Cause	LDG	P2	NA	Convair 580																				1	1																												N	JS	AS
25/04/1967	N	Probable Cause	APR	P2	NA	Convair 600 series																			1	1	1																												N	JS	AS
27/03/1967	I	Probable Cause	CRZ	P2	NA	Convair 580																																							1										N	JS	AS
24/01/1967	I	Probable Cause	GRD	P2	NA	Convair 580																															1						1				1	1						1	H	JS	AS
23/01/1967	N	Probable Cause	APR	P2	NA	Convair 600 series																							1								1						1				1		1			1		1	H	JS	AS
14/12/1966	I	Probable Cause	GRD	P2	NA	Convair 580																							1														1				1	1						1	M	JS	AS
11/07/1966	N	Probable Cause	APR	P2	NA	Convair 600 series																				1																													U	JS	AS
27/06/1966	N	Probable Cause	DES	P2	NA	Convair 600 series				1								1																																					U	JS	AS
9/13/2010	U	Factual	UNK	P3	SA	ATR42																																																	U	JS	AS
11/20/1996	I	Probable Cause	GRD	P3	NA	ATR42																				1																													N	JS	AS
4/3/1996	I	Probable Cause	LDG	P3	NA	ATR42																				1																													N	JS	AS
3/4/1995	I	Probable Cause	DES	P3	NA	ATR42				1																																													N	JS	AS
3/13/1993	I	Probable Cause	TO	P3	NA	ATR42							1			1																																							N	JS	AS
12/22/1988	I	Probable Cause	APR	P3	NA	ATR42				1									1																		1						1	1			1					1			H	JS	AS
1/18/1988	I	Probable Cause	CRZ	P3	NA	ATR42																	1		1	1																													N	JS	AS
12/18/1986	I	Probable Cause	APR	P3	NA	ATR42				1																				1							1															1			H	JS	AS
8/6/2000	I	Probable Cause	TO	P3	NA	ATR42							1			1																																							N	JS	AS
6/15/2005	N	Probable Cause	DES	P3	NA	ATR42				1																																													N	JS	AS
3/19/2003	N	Factual	CRZ	P3	SA	ATR42				1																																													N	JS	AS
4/26/2001	N	Probable Cause	CRZ	P3	OTH	ATR42				1																											1									1				1					M	JS	AS
7/23/2000	I	Probable Cause	CRZ	P3	NA	ATR42																				1																													N	JS	AS
8/13/1999	N	Probable Cause	GRD	P3	NA	ATR42		1																																															N	JS	AS
12/17/1998	N	Probable Cause	LDG	P3	NA	ATR42			1	1		1																									1													1				1	H	JS	AS
10/25/1998	N	Probable Cause	GRD	P3	NA	ATR42		1																													1										1					1			H	JS	AS
9/17/1998	N	Probable Cause	DES	P3	NA	ATR42														1																																			N	JS	AS
3/10/1998	I	Probable Cause	CRZ	P3	NA	ATR42																				1																													N	JS	AS
12/30/1995	N	Probable Cause	DES	P3	NA	ATR42				1																																													N	JS	AS
7/25/1993	N	Probable Cause	GRD	P3	NA	ATR42		1																																															N	JS	AS
5/4/1993	N	Probable Cause	LDG	P3	NA	ATR42																															1						1							1				1	H	JS	AS
4/4/1993	F	Probable Cause	GRD	P3	NA	ATR42		1																		1																													N	JS	AS
3/31/1993	I	Probable Cause	UNK	P3	NA	ATR42																			1	1		1																											N	JS	AS
3/4/1993	I	Probable Cause	APR	P3	NA	ATR42				1																			1								1						1	1						1		1			M	JS	AS
11/20/1991	I	Probable Cause	DES	P3	NA	ATR42														1																																			N	JS	AS
9/14/1991	N	Probable Cause	CRZ	P3	NA	ATR42																	1		1	1																													N	JS	AS
7/17/1991	N	Probable Cause	APR	P3	NA	ATR42																	1		1	1																													N	JS	AS

Figure A3.1 (cont.)

Evidence-Based Training Accident-Incident Matrix Continued

Accidents							Factors																				
Date	Severity	Info Source Link	Phase	Generation	Region	Type	Ground equipment	Ground manoeuvring	Runway/Taxi condition	Adverse Weather/Ice	Windshear	Crosswind	ATC	NAV	Loss of comms	Traffic	R/W Incursion	Poor Visibility	Upset	Wake Vortex	Terrain	Birds	Eng Fail	MEL	Fire	Syst mal	Ops/Type Spec
11/26/1990	I	Probable Cause	GRD	P3	NA	ATR42		1																		1	
11/6/1990	I	Probable Cause	CLB	P3	NA	ATR42													1								1
10/12/1988	I	Probable Cause	TO	P3	NA	ATR42							1			1											
8/12/1988	I	Probable Cause	LDG	P3	NA	ATR42																					
1/27/2009	N	Preliminary	APR	P3	NA	ATR42				1																	
10/13/2001	N	Probable Cause	CRZ	P3	NA	ATR42																1	1			1	
1/21/1998	N	Probable Cause	LDG	P3	NA	ATR42																			1	1	
1/7/1997	N	Probable Cause	GRD	P3	NA	ATR42												1									
10/12/1991	F	Probable Cause	GRD	P3	NA	ATR42		1																			
1/12/2002	N	Factual	CLB	P3	SA	ATR42																	1			1	
7/28/1999	F	Probable Cause	GRD	P3	NA	ATR42		1																			

Accidents	Factors (Non-Technical)																	
Date	Cabin	Compliance	Def Manuals	Def-Ops data	Def-Charts	Def-Chk lists	Def-DBs	Def-Proc's	Fatique	CRM	Physio	Workload Distraction Pressure	D.G	L..F.P	Mis-AFS	Mis A/C State	Mis-Sys	Pilot Incap
11/26/1990																		
11/6/1990			1					1		1						1	1	
10/12/1988																		
8/12/1988										1							1	
1/27/2009																		
10/13/2001																		
1/21/1998																		
1/7/1997				1						1						1		
10/12/1991																		
1/12/2002																		
7/28/1999																		

Accidents	Competencies										Validation	
Date	Communication	SA	Leadership and Teamwork	Workload Management	Problem Solving Decision Making	Knowledge	Application of Procedures & Knowledge	Flight Management, Guidance and Automation	Manual Aircraft Control	Improved Training	Analyst	Checker
11/26/1990										N	JS	AS
11/6/1990					1	1			1	H	JS	AS
10/12/1988										N	JS	AS
8/12/1988					1		1			M	JS	AS
1/27/2009										U	JS	AS
10/13/2001										N	JS	AS
1/21/1998		1					1			M	JS	AS
1/7/1997		1				1				M	JS	AS
10/12/1991										N	JS	AS
1/12/2002										N	JS	AS
7/28/1999										N	JS	AS

Figure A3.1 (cont.)

3.2 ACCIDENT/INCIDENT SPREAD SHEET – GUIDANCE FOR PILOT-ANALYSTS

The following instructions were given to pilot analysts in order to complete the spreadsheets. For further information see Chapter 3, Methodology.

1. Read the Accident/incident Report from the NTSB database carefully and insert information in the spreadsheet based on that information. If the information is sketchy or not sufficient, then you may find that same accident in the ASN database particularly if it is a fatal accident. Use that information as well if the source of the ASN report is an official accident report or refers to an official document. The link to the ASN Accident database is: http://aviation-safety.net/database/
2. The first 9 columns are general information and should be filled already except for the **phase** (of flight) column. You should fill out the **Phase** column from the information in the report. Sometime the events occurs over several phases and when that is the situation, use the initial phase where the event occurred (Note there is a pull down menu for the phase column – please use it).
3. The 10th column begins the Factors (Note the title in blue). Insert the number 1 in the cell if parameter occurred **during** the accident/incident; if it did not occur during the accident/incident, leave the cell blank. The factor should be mentioned or logically implied for you to put a 1 in the cell.
4. The next 5 columns after the Factor columns are the non Technical Competencies columns Note that the title cells are magenta. **Important: For each accident/incident you are allowed only two insertions in the columns that have magenta highlighted titles.** In other words you must choose the two best non-technical competencies of the 5 magenta titled columns.
5. The next 4 columns (title cells are highlighted in green) are technical competencies. There is no restriction here so please fill any cell that applies to the accident-incident event.
6. The next column is labeled **Improved Training** – insert a **letter** grade from the drop down menu. The meaning of each letter is defined by the comment imbedded in the title cell for that column.
7. Highlight a cell blue if you are unsure of the response that you made or if you are unsure if a response is required from the report. The reconciliation team will decide the appropriate response.
8. The last two columns are for your initials. If you are the primary analyst initial each cell in the Analyst column as you complete the analysis for the accident-incident in that row; if you are the Checker initial each cells in the Checker column.
9. If you are the **Checker** and you **disagree** with the response of the **Analyst**, highlight the appropriate cell in red. (Do not change the original response) (Applies to all columns).
10. *For column labeled **Improved Training*** – If you are the Checker and you disagree with the analyst, highlight the analyst's choice in red and insert your response in the first open cell to right on the same row. The reconciliation team will decide the appropriate response.
11. If you are the **Checker and you think that a cell should have a '1' but the cell does not,** then highlight the empty cell in red. (An empty cell highlighted in red indicates that the checker thinks the cell should have a 1 but the analyst did not put insert a '1'. In the following round (Reconciliation) a decision will be made as to whether or not the factor or competency was merited.
12. **Special notes:** Experience has shown that common error occurs so here are a few things to watch:
    a. Remember, if you have inserted any 1's in magenta labeled columns (non-technical skills), then you must insert a 1 in the column labeled CRM as a non technical skill is part of CRM..
    b. Pay special attention to Ops/Type Spec. Its comment is not as clear as it should be. The meaning of this parameter is type specific characteristics of the aircraft such as: Side stick and non-moving thrust levers on the FBW (Airbus), deep stall characteristics on some T-tailed aircraft, go-levers, etc. One that comes to mind is the Autopilot override on the A300. If any of these characteristics were a factor in the accident/incident mark a 1 in the applicable cell. Disregard the phrase in the comment "Please state the issue you are grading".

c. Pay special attention to Mismanaged Aircraft State as it occurs quite frequently e.g. unstable approach, abnormal landing etc. particularly if manual handling or automation is an issue. Do not forget it even though it was noted in those specific cases.
d. Keep in mind that the factor columns are not mutually exclusive. Some factors are subsets of others. Some examples of this are:
    i. If there is Adverse Weather than most probably there will be at least one or more factors present e.g. visibility, crosswind etc.
    ii. If you have inserted a 1 for Eng. Fail, a 1 is required for Sys Mal.

13. Please make no other changes to the spreadsheet, as they all must have the same format for the 2nd stage of analysis.
14. Please work by alone, so as to be able to have an independent check function.
15. If you have any question on a response highlight the cell blue – For general questions email johnscully@gmail.com
16. When finished please **save the file exactly as you received it** except for the following:
    - Change the version number by one (e.g. v5 becomes v6)
    - Change the date to the current date saved
    - Put your initials after the date if you are the Analyst or after the initials of the Analyst, if you are the Checker.
    - An example of a file name saved by a checker might be: Accident-threats_t9 DC 9 2010 11-07_v8 ML_DS.xlsx

Note: ML is the initials of the analyst and DS are the initials of the checker.

APPENDIX 4
AIRLINE PILOT PERCEPTIONS OF TRAINING EFFECTIVENESS

Airline Pilot Perceptions of Training Effectiveness

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Introduction

In collaboration with the International Air Transport Association (IATA) and the International Federation of Air Line Pilots Associations (IFALPA), Boeing surveyed the professional pilot community for their perspectives on pilot training and the application of those knowledge and skills presented in training to operational contexts. The results indicate that improvements are needed in the areas of instruction, content, and delivery methods.

We conclude training could be improved to prepare pilots for their actual work by delivering content that is relevant to daily flight operations. Training delivery mechanisms could be modernized, instruction could be improved through instructor qualification, standardization, and calibration. For training change to be successful and sustainable all interacting dimensions of instructors, content, methods, and airline culture must be addressed.

Method

The survey explored pilot perceptions of current training and the effectiveness of their application to the operational context of airline flying. It was intended to identify areas where training may be lacking to create targeted interventions or to identify follow-on research activities. Boeing made the survey available to airline pilots through a link on the International Federation of Air Line Pilots Association (IFALPA) website. IATA member airlines were notified of the survey via email. All responses were anonymous.

The results will be added to the International Air Transport Association (IATA) data corpus, which includes data from Line Oriented Safety Audit (LOSA) reports, global accident and incident data, and other surveys. Because this survey was conducted to supplement the IATA Evidence Based Training (EBT) initiative the probe topics were defined by the EBT data team. The were areas where current data was needed on specific topics or where there were gaps in the data corpus.

Pilot Demographics

Nine hundred and sixty-six pilots completed the survey: fifty-six percent captains and forty-four percent first officers. Figure 1 shows the distribution of respondents with majorities based in Europe, North America, and Oceania. We attribute the higher response rates in these regions to the higher IFALPA representation across these regions. Other regions represented were Middle East, Asia, Central and South America, Africa, and the Commonwealth of Independent States (CIS). The lowest response rate came from regions that also have the highest regional safety risk. Regulators could actively promote higher levels of safety in these regions by supporting improvements to global training and, thus, all operators would be training to a higher safety standard.

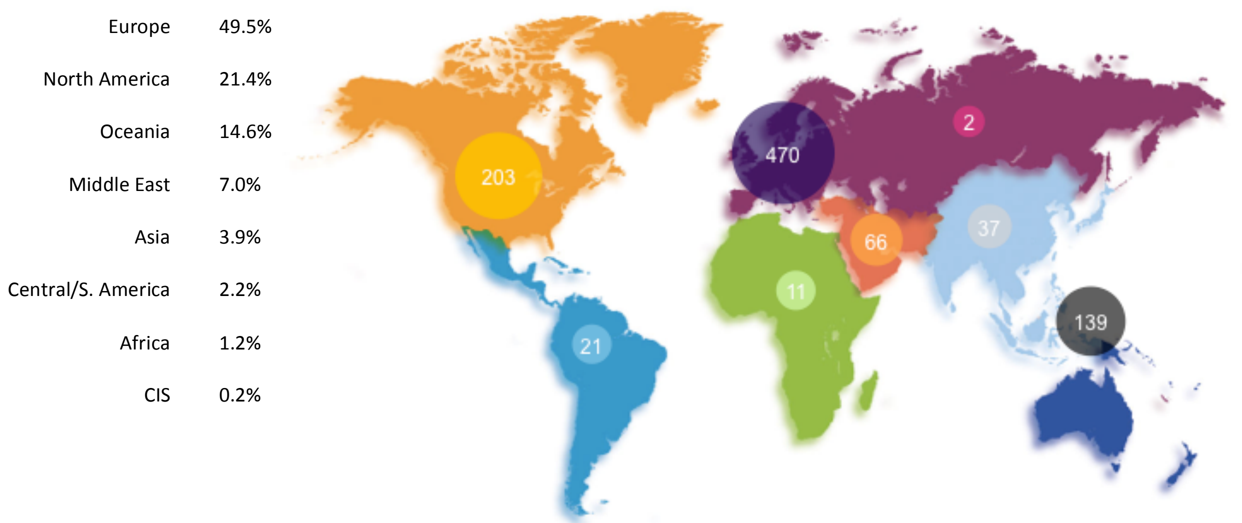

Figure 1. Global Distribution of Respondents

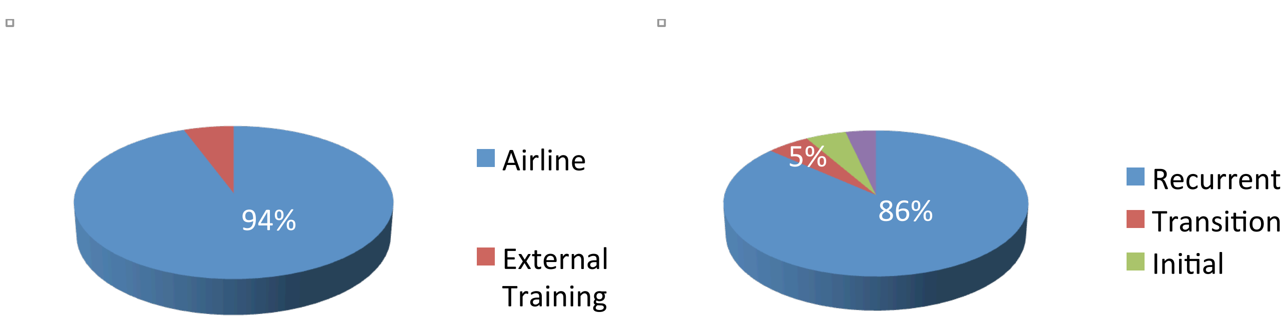

Figure 2. Pilot Training Delivery and Most Recently Completed Training

Most pilots (94%) are trained by their airline so instituting change in training practices will require motivating airlines to invest in change and their regulators to approve change (Figure 2). The most recently completed training for our respondents was recurrent training (84%), therefore the responses given are likely to be framed in the context of their last recurrent training experience.

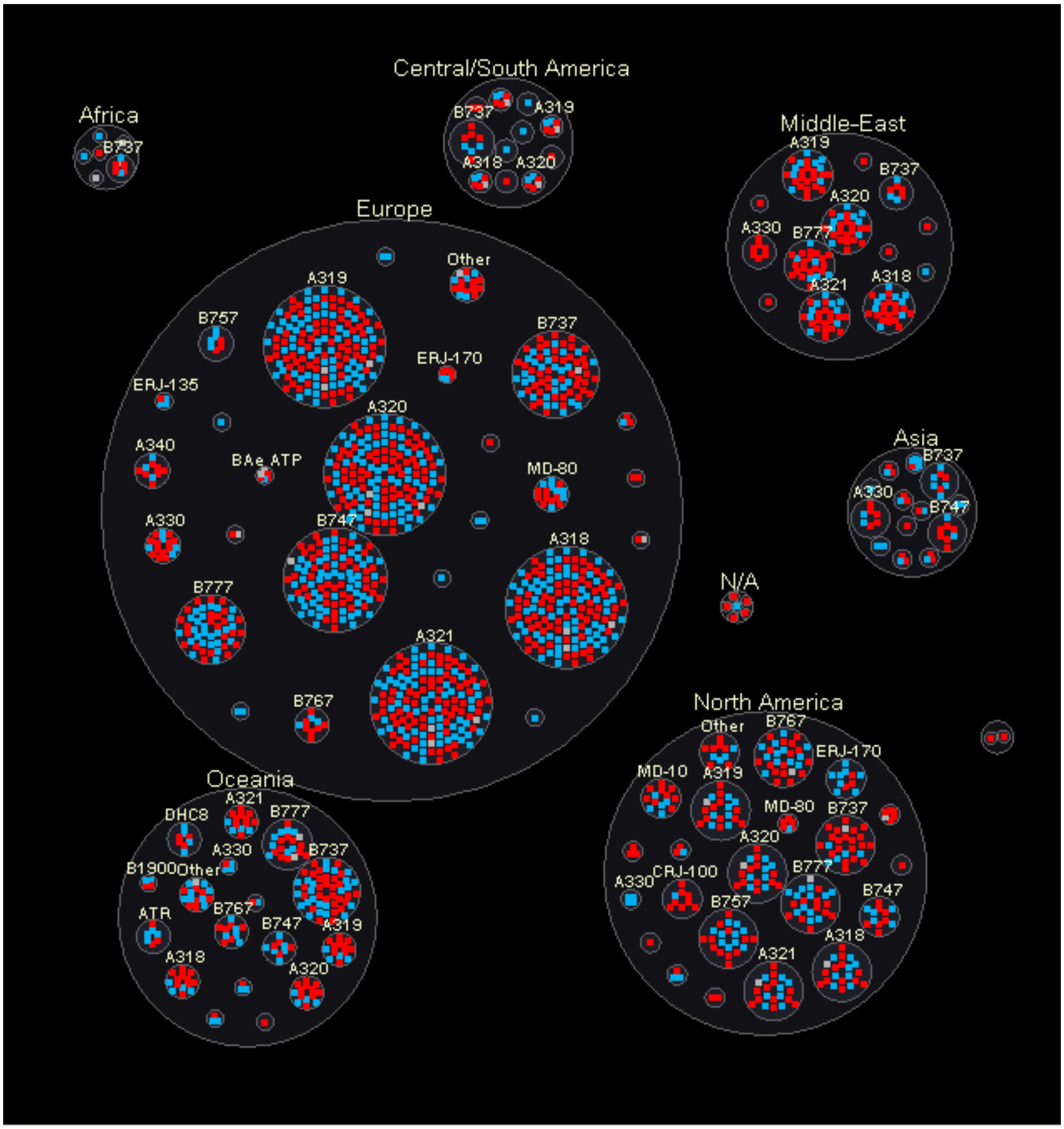

Figure 3. Distribution of Aircraft, Base Location, and Pilot Rank—Captains are represented in blue, first officers are represented in red, and aircraft are identified by type.

Automation

Learning to use the flight management automation in modern airplanes continues to be a challenge for many pilots. Training should enable pilots to develop a functional understanding of the system as well as operational understanding of how to use the system across operational situations.

Pilots were asked: in the first 6 months of flying their current aircraft type, did you encounter a situation where you had difficulty performing particular tasks using the flight management system (FMS)? This question was framed in the last 6 months so that we could get a recent sample of events and issues encountered and most pilots (64%) responded they had difficulty performing tasks with the FMS (Figure 4).

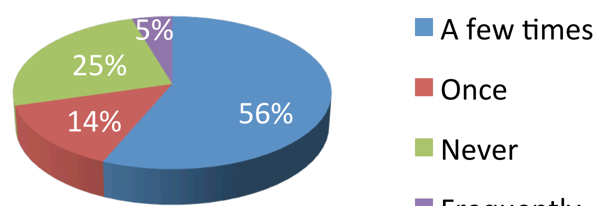

Figure 4. First 6 Months on Current Aircraft: Difficulty Performing Tasks Using FMS

Next, we asked for an assessment of their comfort level in operating the FMS after the completion of the type-rating course. Comfort is a term pilots frequently use to describe confidence in their ability to perform. The question was framed in terms of time increments following the type course to identify the time by when comfort is acquired. Respondents could choose one of the following categories: on your first aircraft flight, after initial operating evaluation (IOE), after 3 months of operation, after 6 months of operation, and after 12 or more months of operation (Figure 5).

Most pilot (62%) felt comfortable operating the FMS only *after* gaining line experience. A few (15%) were comfortable after their initial operating experience (IOE). Others (41%) reported comfort after three months of line operations, after six months (15%) and after twelve months (7%).

If the type-rating course did in fact prepare pilots for line operations, we would expect their reported comfort level to be highest immediately after completion of training. It appears some training programs do instill pilot confidence on their first aircraft flight after training since a quarter (23%) reported being comfortable operating the FMS on their first flight.

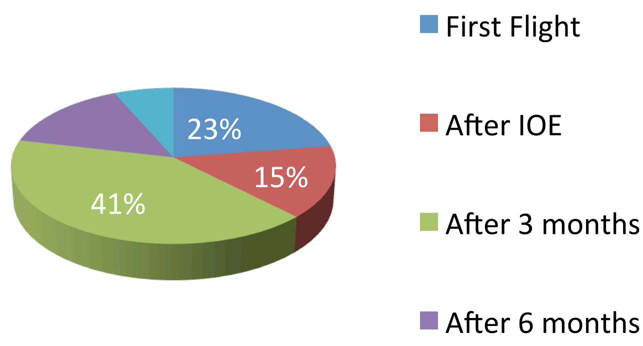

Figure 5. When Pilots Felt Comfortable Operating FMS After Type-Rating Course

These results raise some interesting questions about what is being learned after IOE that enables the feeling of comfort that could be brought into training earlier. We also need to know what specifically constitutes effective learning on the line.

Pilots often report that the learning of the flight management system (FMS) occurs over time. We designed the next question to identify how FMS learning is distributed. Respondents estimated the percentage of learning they acquired between training, line operations, and self-study. The results showed the following distribution:

- FMS learning on the line—42%.
- FMS learning from training—38%.
- FMS learning through self-study—20%.

If it is the case that only thirty-eight percent of learning occurs in training then we are failing our pilot community by unnecessarily forcing learning this important system through other means that may or may not be effective. We need to identify what content is needed in training to address this issue and define effective delivery methods that enable higher retention and understanding.

Line operations may be the best context for the integration of skills and knowledge across operational contexts but we need to ensure that airlines are equipped with the tools and guidance needed to enable effective line learning.

The next question inquired about areas of automation training that could be improved and respondents could check up to three options (Figure 6). Operational situations such as automation surprises (57%), hands-on use in operational situations (52%), and transitions between modes (32%), received the highest response rates. Pilot training needs to include functional operation of systems but clearly operational situations need to be introduced into training to expose pilots to using the system in the context of flight operations.

Pilots also cited basic knowledge of the system and programming as areas for improvement which is surprising because these areas tend to be emphasized in recurrent and type-rating courses and indicate functional training of the system could be improved.

1. 57.1% Automation surprises
2. 52% Hands on use in operational situations
3. 32.8% Transitions between modes
4. 26.7% Basic knowledge of the system
5. 21% Programming
6. 18.8% Keyboard, navigation, menus…
7. 6.6% Other

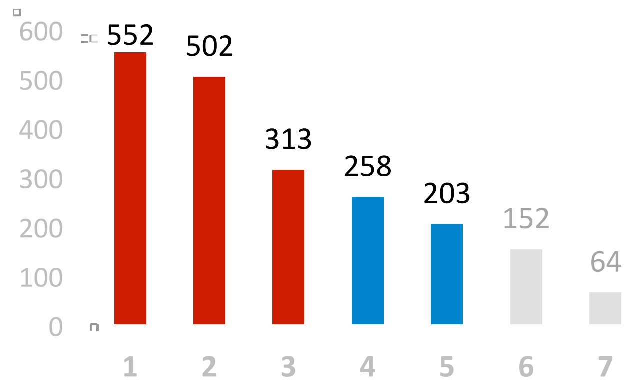

Figure 6. Potential Areas of Improvement for Automation Training

Go-Around Maneuvers

The industry currently regards go-around maneuvers as a safety issue because they are either poorly executed or not executed when they should be. The next set of questions probe the rationale underlying rationale the go around decision to continue to landing when a go-around should have been made. The first question inquires about the teamwork component of the decision. We asked, “Did you encounter situations where there should have been a go-around but the approach was continued to a landing?” If they answered yes, they were presented with three options:

a. I suggested a go-around, but the other pilot disagreed (20%).
b. The other pilot suggested a go-around, but I disagreed (8%).
c. Neither pilot suggested a go-around (72%).

The majority of the reported cases, neither pilot suggested a go-around and in the remaining cases the pilots did not agree to go-around. Pilots were permitted to report up to five go-around cases and in all cases, the main result was: neither pilot suggested a go-around. We asked the pilots to report their rank (captain, first officer) and role (pilot flying, pilot monitoring, and augmented crew).

In the cases when one pilot suggested a go-around and the other pilot disagreed, we correlated their rank to compliance with the suggestion of a go-around (Table 1). These results raise concerns regarding the effectiveness of training team decision making and effective communication because we do see the influence of rank entering the decision making process.

Table 1. Distribution of Responses by Rank

Response Categories	Captain	First Officer
I suggested a go-around, but the other pilot disagreed	13.8%	27.6%
The other pilot suggested a go-around, but I disagreed	12.3%	2.8%
Neither pilot suggested a go-around	73.9%	69.7%

Although a pilot may feel he can suggest a go-around or even demand one from the pilot flying, the other pilot may not comply. For those cases where neither pilot suggested a go-around, it may be that pilots lack familiarity with the go-around criteria or the skill to recognize the need in time to make the decision across operational contexts. Neither pilot suggesting a go-around may be due to the pilots' ability to make the approach work and apply judgment to maintain safety.

The next question inquires about how assertive a pilot feels he can be while in the role of pilot monitoring across different contexts. We asked, "When you are the Pilot Monitoring, you feel you may without hesitation..." Pilots were asked to indicate their agreement with each of the context categories and the percentages in Table 2 represent the distribution of agreement.

Pilots reported high levels of assertiveness in four of the five categories, with taking control from the pilot flying registering the lowest at forty-nine percent. The level of reported assertiveness appears to be linked to the level of resulting intervention. Tasks such as identifying a deviation (92%) or proposing a checklist (91%) are reportedly more likely to be asserted than tasks such as proposing a go-around (83%) or demanding a go-around (80%). One could argue deviations and checklists are higher to assert because they are routine and do not so much challenge the skill or judgment of the pilot flying.

Table 2. Distribution of Responses to Assertiveness

Response Categories	Distribution
Tell the pilot flying about a deviation	92%
Take control from the pilot flying	49%
Propose a checklist if the pilot flying delays asking for it	91%
Propose a go-around during an unstable approach	83%
Verbally demand a go-around if you think it is required	80%

We learned from the previous question that pilots do assert themselves in the go around maneuver however at a much lower rate (28%) than the case where neither pilot suggested a go-around (72%). It is possible that a lack of assertiveness is the underlying reason why, in the majority of the cases, neither pilot suggested a go-around and that there is an underlying hesitation to assert oneself as the context shifts to a control or judgment assessment. Half the pilots reported they would not hesitate to take control from the pilot flying yet at what point does it become acceptable to take control? How should this skill be trained and assessed? Taking control away from the pilot flying perhaps crosses the boundaries of judgment with regard to one's partner and oneself. A pilot will need to be very confident in his judgment of the need to take control. How best to train and assess these behaviors on a global scale needs further investigation.

The Line Operations Safety Audit (LOSA) reports database suggests most unstable approaches are continued to landing. We asked the respondents to make a judgment about why another pilot would not initiate a go-around to probe for possible rationales for not doing the maneuver. We asked, "In your opinion what are the reasons for not initiating a Go-Around?" They were presented with the six following options and could choose up to three:

a. According to the judgment by the pilot, the landing can be performed safely
b. There is a big psychological barrier to go around because they are so rare events
c. Operational inconvenience
d. Embarrassment related to a go around
e. Pilots are not as familiar with unstable approach criteria as they should be
f. Making a go-around mandates a report

Pilot judgment was most cited (82%) as the reason a pilot would choose not to go around if the approach was unstable (Table 3). This response is certainly reasonable. One of the primary roles of pilots is to apply judgment and interventions in the moment-to-moment context of activity. However, it is our assessment that most training programs train judgment implicitly and if pilots are going to be relying on judgment we should make sure it is explicitly trained to effectively transition to the operational context.

The next two major category responses were psychological barriers (37%) and operational inconvenience (35%). Psychological barriers may be perceived by pilots do the maneuver infrequently in operations and in training. By providing opportunities to practice the maneuver across contexts (such as all engine go around) is important to building a pilot's confidence in his skills. Operational inconvenience could be a safety concern if pilots are choosing to not go around for the wrong reasons.

Table 3. Reasons for Not Choosing Go-Around

Response Categories	Distribution
Pilot judgment	**82%**
Psychological barrier	37%
Operational inconvenience	35%
Embarrassment	24%
Unfamiliar with criteria	17%
Mandates a report	10%

Monitoring and Cross-Checking

The next set of questions was designed to inquire about the pervasiveness of error management in flight training and the perceived value as a skill. Monitoring and cross-checking, two key components of error management, are perceived as important piloting skills (Figure 7). Forty-seven percent of the pilots reported the topic of detecting and managing errors are included in their recurrent training as a specific topic in both theory and practice (Figure 7). However the remaining respondents reported the topic as implicitly covered, marginally covered, or not covered at all.

Although a majority of pilots believe these are important skills, the training of these tasks is not as wide-spread as previously thought and is evidence that guidance for training monitoring and cross-checking skills is needed. The pilot monitoring role is one of the most important for maintaining high levels of safety and operational efficiency and should be trained explicitly on a global scale.

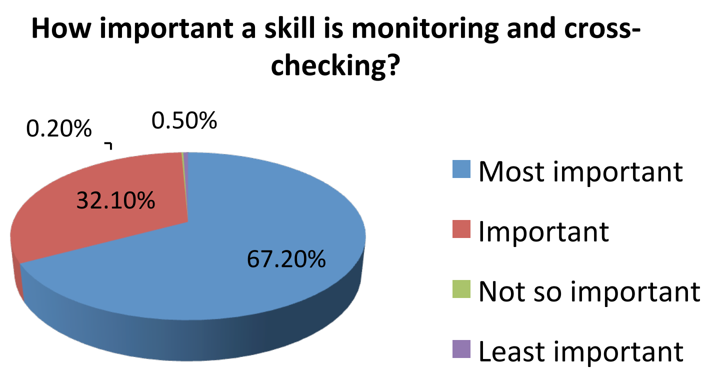

Figure 7. Monitoring and Cross-Checking

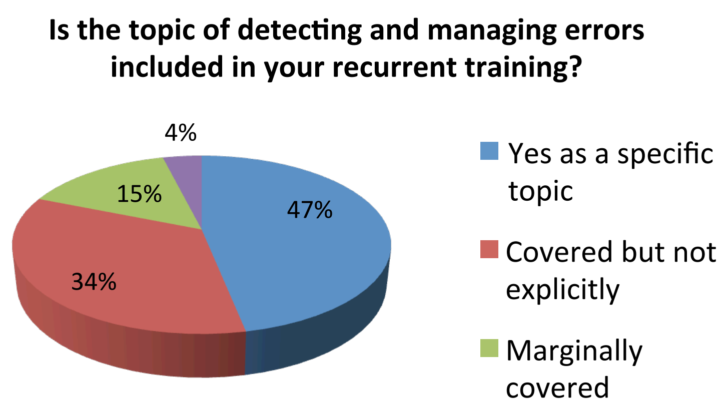

Figure 8. Inclusion of Error Management in Recurrent Training

The LOSA reports identified the *climb phase of flight* as one with the highest rate of poor monitoring performance. We asked why this might be the case and the respondents reported the main causes of degradation in monitoring during the climb to be complacency and secondary task loading (Figure 8). Complacency may be induced by the transition from a high workload flight phase to lower workload flight phase. Monitoring tasks are often dropped for competing secondary task demands. In training, monitoring should be emphasized as one of the most important primary tasks and pilots should be taught how to monitor and when. We should also give pilots strategies for managing their workload in all flight phases so that monitoring is not dropped inappropriately.

Most pilots (93%) believe detecting and managing errors is the most effective strategy for error management (Figure). A small percentage of pilots (7%) believe that errors should not be committed.

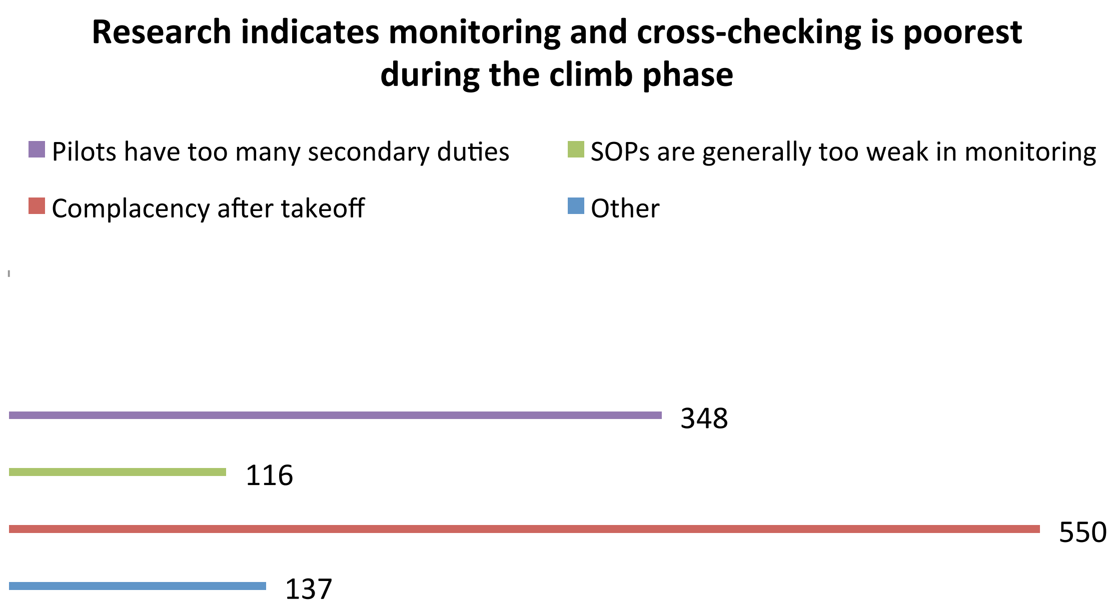

Figure 9. Monitoring and Cross-Checking During Climb

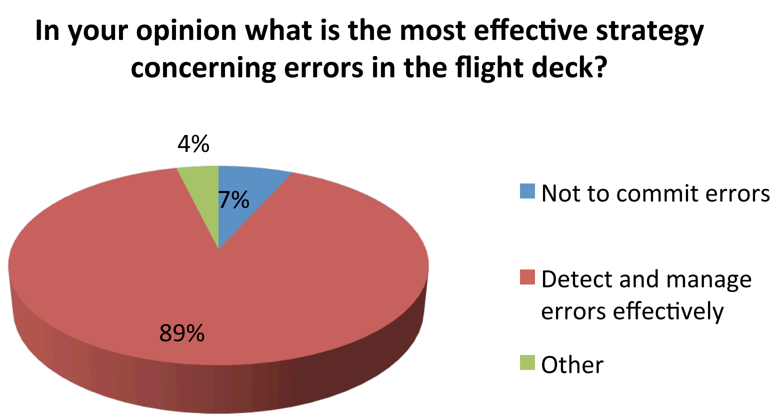

Figure 10. Strategy for Error Management

Briefings

Briefings present an important opportunity for pilots to construct a team concept and build shared understandings about what to expect, each other's roles, and contingency plans. It is important that briefings be included in training so pilots can practice these skills and receive feedback on their content, duration, and effectiveness.

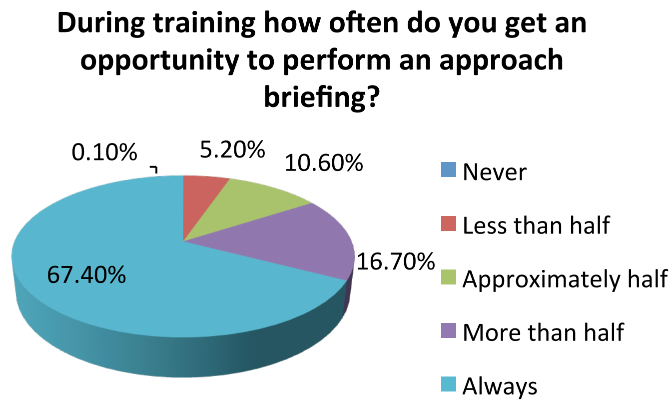

Figure 11. Approach Briefing Frequency in Training

Approach briefings are included in training (Figure 11) however there were a number of respondents provided comments citing that appropriate briefing content is generally not known or practiced. It is a positive finding that pilots get an opportunity in the training environment to practice briefings and providing guidance on their conduct and content would be a positive step toward improving their effectiveness in operations.

Briefings prior to the simulation sessions are regularly included in training and present a potentially valuable opportunity for focused instruction (Figure 12). These sessions tend to be longer than the debriefing sessions by 20-30 minutes (Figure 13). Because debrief sessions are vulnerable to dismissal due to time constraints or late night sessions, care should be taken to make effective use of the debrief. At minimum, instructors should use the debrief sessions as an opportunity for the trainees to review and reflect on their performance. Instructors have a crucial role in making effective use of briefings and ensuring that all appropriate feedback (positive and negative) is given.

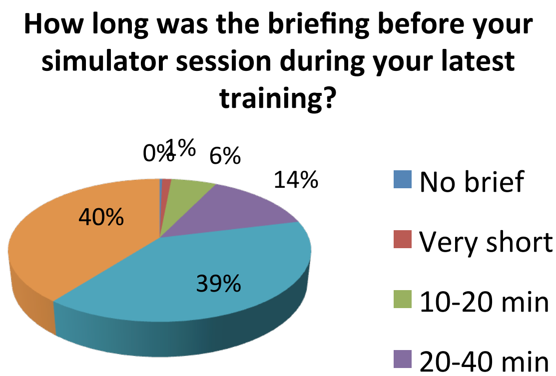

Figure 12. Briefing Duration Before Simulator Session

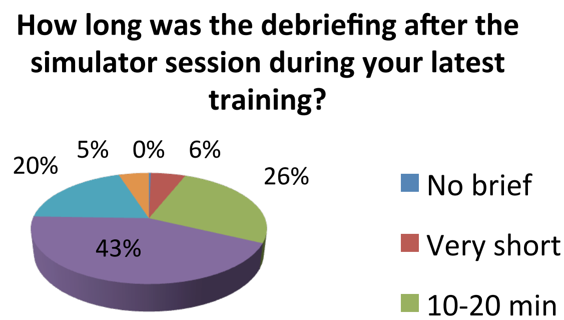

Figure 13. Debriefing Duration After Simulator Session

Intentional Deviations

Part of pilot judgment and expertise involves knowing when to deviate from Standard Operating Procedures (SOP). We were interested in the frequency and conditions under which pilots might deviate from their company's SOPs (Figure 14).

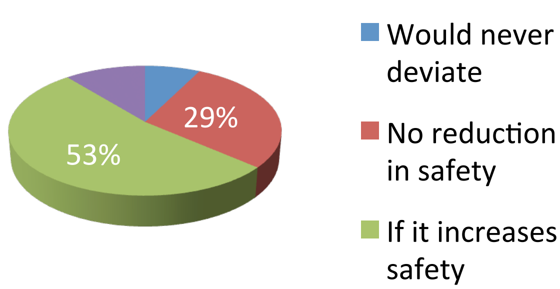

Figure 14. Frequency of Pilot Deviation From SOPs

Figure 14 shows that a majority of the respondents (53%) would deviate if they believe it increases safety and twenty-nine percent would deviate if it resulted in no reduction in safety. Overall, most (83%) pilots would exercise judgment to intentionally deviate from company SOPs with their judgment being the pilot's assessment of safety. Another seven percent reported they would never deviate. In the next series of questions, we asked pilots to identify the specific intentional deviations they have experienced on the flight deck.

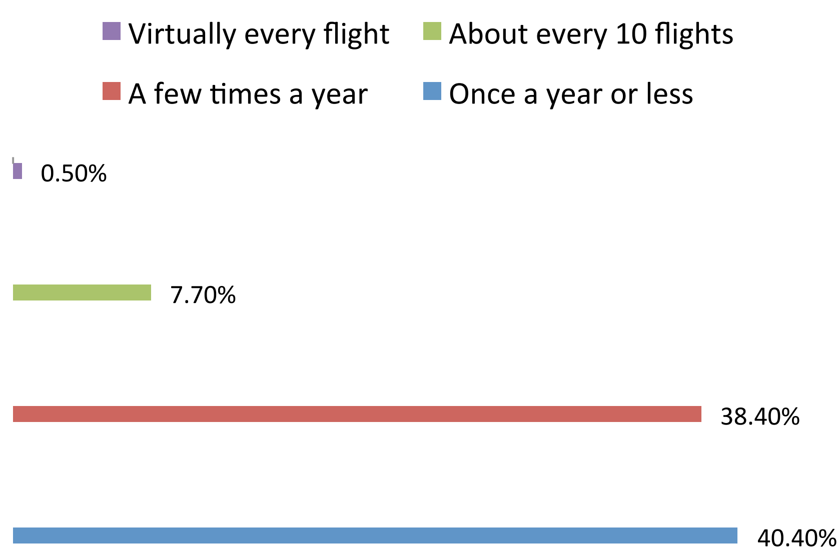

Figure 15. Frequency of Intentional Deviation From Stable Approach Criteria

Intentional deviations from stable approach criteria were reported to occur at a rate of once per year by 40% of the respondents and more than a few times a year by 38% of the respondents (Figure 15). However, some pilots report intentional deviations from stable approach at a higher rate of every ten flights, or virtually every flight. Further inquiry into stable approach deviations should identify the contexts in which these judgments are made and why they are made. It would seem these rates are indicative of conflict between the criteria and the realities of the operational context.

Intentional deviations from checklists occurred a reported every ten flights by 13% of the respondents, a few times a year by 30% of the respondents, and once a year by 36% of the respondents. Very few (4%) reported a deviation on every flight. Checklist deviations occurring at this high of a rate suggest other factors may be involved not related to compliance. Perhaps the pilot does not know the procedure or policy, or does not understand it and several pilots commented to us they would like to know the underlying rationale of the procedure. Further the procedure may not make operational sense to the pilot, it may not fit into the operational context where it is to be applied, or the procedure

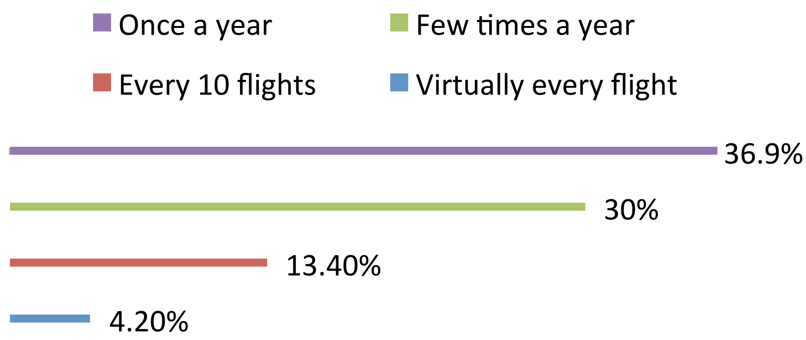

Figure 16. Frequency of Intentional Deviation From Checklist

may be interrupted by competing demands on attention—all of which may result in noncompliance. Finally poorly designed procedures may impose excessive cognitive workload, thereby making them difficult to perform correctly.

Callouts had a high intentional deviation rate with about half the respondents (49%) reporting deviations on every 10 flights and virtually every flight (Figure 17). There are several possible reasons why non-compliance is high, most again not necessarily related to compliance. Callouts serve an important purpose of establishing shared understandings and representations of the situation. If pilots do not understand the purpose of the callout or if the callout does not fulfill the purpose by design then we would expect pilots to not use them. The shear number of callouts to remember may be a reason for not making them; pilots may simply forget to make them in the context of a demanding situation or a lapse in monitoring, or the pilots may not feel they are important. If we are to understand intentional deviations from callouts, we will need to investigate the specific callouts deviated from and the contexts of their occurrence and provide guidance on appropriate training of callout use.

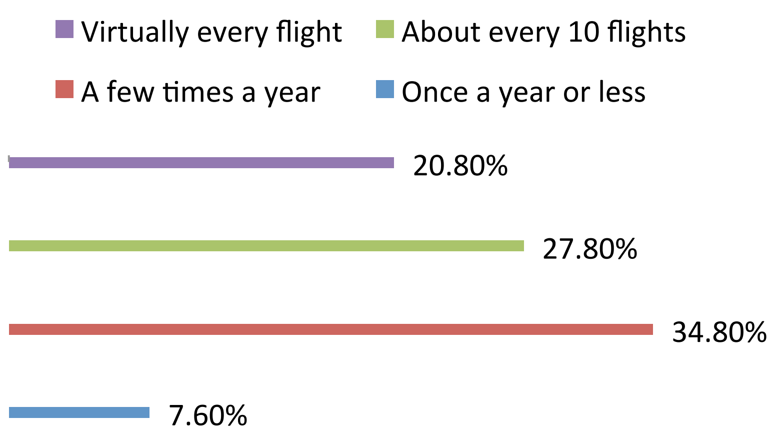

Figure 17. Frequency of Intentional Deviation From Callouts

Operational Situations

It is important that the knowledge and skill acquired in training transfer to operations. We tried to identify areas where knowledge and skill transfer may break down and to identify gaps in training content. We asked, “In the last six months, did you encounter an operational situation where you did not feel comfortable?” Just over half (54%) of the respondents answered yes (Figure 18). Within that category, 57% of the reporting pilots were ranked captain and 43% were ranked first officer.

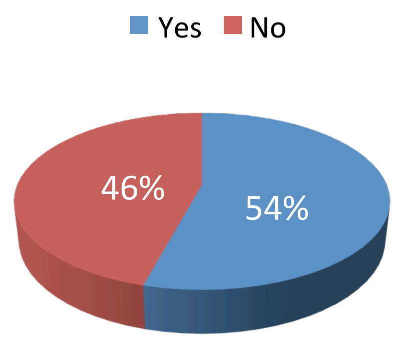

Figure 18. Experienced Uncomfortable Operational Situations During Last Six Months

If they answered yes, we then asked the pilots to specify what kind of training might have helped in the situation and to select all areas of training that would have helped (Figure 19).

Adverse weather	29.6%
Crew resource management	22.5%
Non-normal checklists	15.5%
Flight management	15.4%
Airplane handling	13.1 %
Systems	11.6%
Maneuvers	10.4%
Other	9.7%
Normal procedures, checklist	4.8%

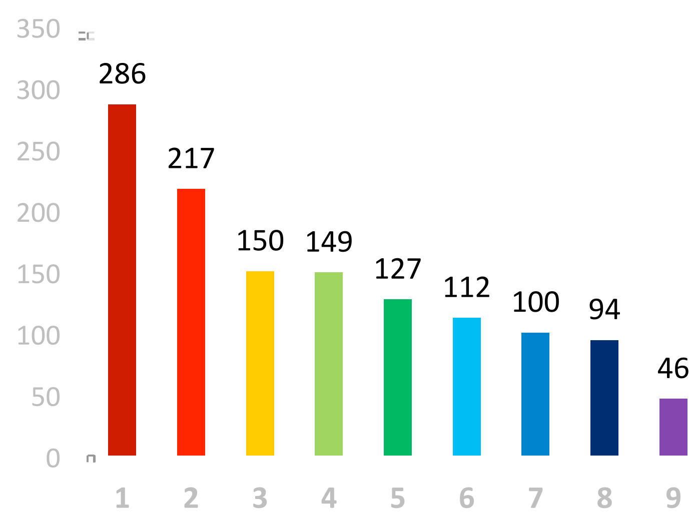

Figure 19. Training Identified by Pilots to Deal With Uncomfortable Operational Situations

Adverse weather (30%) and crew resource management (23%) were ranked highest for being helpful in dealing with uncomfortable operational situations, followed by training in non-normal checklists (16%), flight management (15%), airplane handling (13%), systems (12%), and maneuvers (10%). All of these categories are addressed in recurrent training sessions. These results question the effectiveness of the training and its transfer to the operational contexts where they are encountered.

The pilots were then asked to describe the situation they encountered (Table 4). The responses included flight management specific to operational tasks, such as a late runway change or reroute, knowledge issues related to auto flight mode understanding, and procedural issues associated with the introduction of new procedures or changes driven by mergers that resulted in poor procedure integration. Infrequent non-normal events such as low fuel, bird strike, CDU failure, upset recovery, and volcanic ash were also mentioned. Adverse weather responses specified cold weather operations, de-icing, contaminated runway operations and high altitude turbulence. Also cited were non-precision and visual approaches, energy management in the approach, severe crosswinds, go-around and missed approaches, and aircraft handling and maneuvers, particularly in regions of mountainous terrain. Performance calculations, diversion, minimum equipment list (MEL) items, systems knowledge, and conflict management with a crewmember or a passenger were cited.

Table 4. Uncomfortable Operational Situations Described by Pilots

Runway closure at destination prompting holding and possible divert in busy European airspace
Visual circle to land in EWR Rwy 29 due to massive crosswind
In everyday ATC requirements of speed and last minute changes, there is no training given
While flying at FL400, encountered stick shaker in turbulence due to momentary severe updraft
Tailwind approach over steep terrain simultaneously intercepting localizer and glide slope
At 37,000 feet, escape maneuver for wake turbulence from heavy aircraft (747)
Procedures and terrain unique to foreign airports
Planning/performance done manually on contaminated runways with MEL items
Winter operations with contaminated runway and related decision making with regard to takeoff and landing performance
U turns on the runway.

Negative Experiences in Training

A positive social context for training is a key component of training effectiveness. We asked a series of questions to probe for any negative experiences pilots may face in training. The instructor–trainee relationship was a known area of concern. We asked pilots to indicate if their instructor had raised their confidence during their last training session (Figure 20). Unfortunately, 43% of the responses were negative.

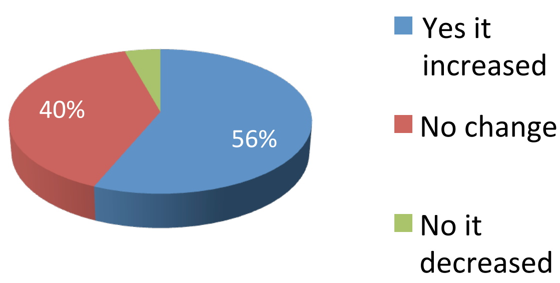

Figure 20. Instructor Effect on Pilot's Confidence in Proficiency

We then asked pilots if any negative experiences were encountered in training within the past 5 years (Figure 21). The broad time range was to ensure we captured all possible training cycles. Forty-six percent of the pilots responded yes to having a negative experience in training in the past 5 years and we asked the pilots to specify the cause of the negative experience. Responses were coded and grouped by topic (Table 5) and Table 6 provides specific negative training situations reported by pilots in training. The most frequent source of negative experiences in training was the instructor. The other two categories were course content and delivery.

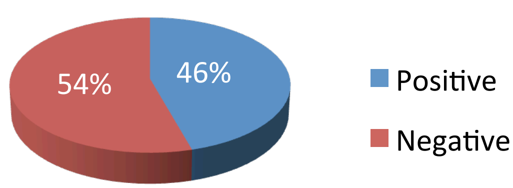

Figure 21. Pilots Having Negative Training Experiences in Last 5 Years

Table 5. Negative Experiences' Codes and Frequency

Frequency	Codes for Open Entry Comments
118	Instructor intimidation
51	Instructor knowledge deficiency
40	Instructor standardization
40	Inappropriate assessment
36	Unrealistic scenarios or task loading by instructor
36	SOPs violated by instructor for scenario
36	Poor syllabus content
35	Time compression
34	Disagreement with instructor
34	Focus on checking
21	Inappropriate training method
14	Inappropriate pairing
12	No opportunity to practice
11	Simulator inaccuracy
4	Poor training manuals
3	Poor brief prior to simulator

The results point to some areas to target for immediate improvement in training. Instruction, content, and delivery represent the main concerns. Providing comprehensive guidance for instructor qualification, calibration, and standardization should be a top priority. The training environment should facilitate learning and promote the free exchange of ideas, questions, and discussions. The content and its delivery must be operationally relevant and presented in a way that increases retention so knowledge and skills may be transferred.

Table 6. Some Reported Negative Situations

I had a instructor that loved to "play" with the flight simulator and I had sessions with 8 multiple faults at the same time, fire, fuel leak, generators' faults, door opens... it wasn't training was more like a massacre.
Training is too geared up to meeting LPC and OPC requirements and so we tend to leave little time for the unusual situations that can arise. Example is engine failure at V1 rarely at V2.
Four-hour recurrent session with too many emergencies. Cognitive overload at the end with little learning.
There are times you will ask a question and all it does is put a target on your back.
Cowboy instructor very nonstandard deviation from **tco**.
Check pilots who aren't familiar w/ the "real world."
Too much content to cover in the available time leading to nothing being covered adequately.
Instructor not understanding priorities and unable to accept that he was wrong and the Capt under check was right.
Instructors in my company are not able to tell a captain he is bad. Most of the time the first officers are charged with every mistake.
Not teaching, just checking.
Nit-picky witch-hunt atmosphere on last evaluation.
Instructor who thought he was still in the military and felt the need to yell. Not very conducive to learning.
Variations by check pilots on procedures.
Training pilot who would not discuss procedure but demanded we follow his procedure.

Anything Else We Should Know

At the end of the survey, we gave the pilots an opportunity to comment freely about their training experiences and they provided detail on what they perceive to be key barriers to improved training. Regarding content, they want access to definitive technical information from the airplane manufacturers. Pilots feel they do not get all the information they need via training or through bulletins and other means of communication. Explanation of the rationale underlying the standard operating procedures was frequently requested, "Explain why SOPs are written that way." Several wrote that their company's SOPs are not compatible with the operational environment and require "adaptation of the SOPs to make it work." Systems training and knowledge were reported to be "gone" from training and pilot knowledge and crew resource management training was reported "ineffective" or "absent." Pilots believe that flight management automation is a "crutch" and hand flying should be encouraged.

Regarding training delivery, pilots cited the issue of being time compressed in training courses that do not provide sufficient opportunity to assimilate, think, and reflect on what they are learning. Pilots believe the social interaction of learning in a classroom is superior to distance learning programs and "ineffective" self-study. Pilots suggested training occur more frequently and for a reduced duration to enable maintaining proficiency.

We were delighted to receive a few positive comments about training from pilots reporting their company training is "excellent" and "the best training I have ever had." Pilots expressed their appreciation for the opportunity to participate in the survey and were thankful for being able to share their experiences. Pilots are concerned about their training and want improved training for safety, confidence building, and enhanced performance.

Conclusion

Introducing change to an existing training program will require investment on the part of the airlines, the regulators, and the manufacturers. As an industry, we need to find a way to motivate operator investments in training improvements and ways to motivate regulators to approve training enhancements, while removing barriers to change. Current training programs focus on fulfilling regulatory requirements sufficient to meet a minimum level of proficiency but as one of the pilots said, "Passing does not equal preparation."

The majority of the survey respondents are from regions where the safety record is high (North America and Europe). Regions with the lowest response rates are the regions currently with the highest safety risk. We need to work on improving communication and engagement in these regions and work with the regulators to actively raise the bar of global safety by supporting changes to training so that all operators will be trained to a higher standard.

The results suggest training is multidimensional and all dimensions must be addressed for interventions to be successful and sustainable. A review of instructional practices, content completeness, and delivery methods represent a good place to start improvement. Pilots believe training should prepare them for their actual work and equip them with a transferable toolkit of resources to draw upon in the conduct of their work. Training content should be operationally relevant to the specific operator and scenario-driven to expose pilots to situations they may face in their operations and to build their confidence.

Flight management training is one of the areas where content and delivery need careful reconsideration. Training will need to address the functional use of the system but it also needs to integrate functional use with operational use. Continued line training may be appropriate to meet business objectives at the airlines, but if we are going to have pilots training while they fly, we should design such training and assess the training to ensure it is appropriate and effective. Training of functional use could be conducted in the context of the operational demands so that automation surprises and mode transition confusion are substantially reduced.

Approach and go-around were identified as areas where training could be improved, particularly the ability to recognize when a go-around is or is not the safest solution. Pilots need training on risk assessment, judgment making, and functioning together as a team. In 82% of the reported cases where pilots decided not to go-around, they believed there would be no reduction in safety. Training pilots to make judgments will be a challenge but it will be important as less-experienced pilots begin to enter the profession.

Although the constructs for crew resource management and threat and error management have high visibility, their current implementation and training appears to be ineffective. Because technical skills and nontechnical skills must be applied in the conduct of operating an airplane, pilots need to be trained on all skills in an integrated manner. Proper guidance material is needed and perhaps even industry standardization is needed for what constitutes effective Crew Resource Management training and application.

Instructors play an important role in achieving successful training by motivating pilots to improve and to create and maintain a culture of safety. To be effective, instructors must receive qualification and be calibrated with proper validation criteria. Industry needs guidance on how to provide these in an affordable and effective way. Change to the instructor qualification and instructional practices would yield an immediate improvement to training experience and effectiveness.

The industry needs guidance on how to develop and deliver operationally relevant training that transfers to actual operations. Operators may need comprehensive guidance on what to train pilots to do and how to measure training effectiveness in the context of an airline's entire culture. This is a challenging task for any operator, therefore effective guidance and standards are required, and standardization is needed to ensure consistency of delivery. Training delivery methods must advance to deliver an embodied, situated learning environment conducive to skill and knowledge development. To make change happen on a global scale, clear validated guidance for content development and training implementation is needed with regulatory engagement.

Acknowledgements

I am grateful to IFALPA and IATA for supporting the development and distribution of this survey. Thanks to John Scully and Jari Nisula who collaborated on drafting the survey. I'm grateful to Jerry Preiser, Ray Roberts, and Wiley Moore for helpful reviews of this paper. Special thanks to all the pilots who completed the survey for their time and dedication to advancing pilot training and aviation safety.

APPENDIX 5
ASSESSMENT OF PILOT PERFORMANCE MANEUVER GRADES

Assessment of Pilot Performance Maneuver Grades

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University of New Mexico

January, 2009

Structural Knowledge Analysis of Aviation Safety Reports

Quarterly Progress Report for FAA Grant 07-G-004

October-December, 2008

Our work during the last quarter of 2008 focused on analyzing a very large set of pilot performance data obtained from the Federal Aviation Administration. The data were de-identified maneuver validation (MV) and first look (FL) grades given to pilots during continuing qualification evaluations. The primary purpose of our analyses was to determine if there was any evidence of skill decay over the course of a retention interval. We did not find evidence of skill decay. In addition, we examined several other variables including phase of flight, normal and abnormal maneuvers, and type of aircraft. The results of our analyses are given below.

Skill Retention after Training

The Federal Aviation Administration (FAA) requires airlines to perform recurrent training on pilots at standardized intervals to insure pilots retain acceptable levels of performance. Airlines spend large amounts of money to retrain and evaluate pilots. It would be beneficial to find the optimal intervals of retraining for different types of pilots and for different task types. In addition to cost savings, optimal retraining intervals would also help ensure safer flights.

In psychology, several factors have been investigated as causes of skill retention (see Arthur et al., 1998 for a review of skill retention). Among the factors known to affect skill retention, in the current study we focused on: (a) length of retention interval, (b) practice level (normal or frequently performed tasks vs. abnormal or infrequently performed tasks), and (c) task characteristics (perceptual motor tasks vs. cognitive tasks). We examine each of these in pilot performance data we have available.

Retention interval. Perhaps the best known factor affecting retention of skill is the amount of time that has elapsed between learning a skill and the subsequent assessment. The overall conclusion regarding retention interval is that as the period of skill nonuse increases, skill decay increases (Annett, 1979; Arthur et al., 1998; Farr, 1987; Gardlin & Sitterley, 1972; Hurlock & Montague, 1982; Naylor &

Briggs, 1961; Prophet, 1976). In the current study pilots' skills were evaluated right after qualification training and then at a first look evaluation after 12 months of flying on the line.

Practice level. A second factor affecting retention is practice or rehearsal. A long history of research on learning and forgetting has validated the beneficial role of practice in maintaining performance over a retention interval. The question of practice or rehearsal seems particularly germane to flying. Pilots routinely practice those tasks and maneuvers that regularly occur in the course of flying, whereas other tasks, such as emergency maneuvers, receive little or no rehearsal. Exactly how beneficial to maintaining proficiency is the routine performance of maneuvers? In the current study, we attempted to address this question by examining differences between performance on normal and emergency maneuvers over a retention interval.

Task type. Psychologists have distinguished among different types of knowledge and skill including declarative, procedural, verbal, and perceptual-motor. Complex, realistic tasks involve several types of knowledge and this is certainly true of flying. Pilots need to know basic declarative facts (e.g., knowledge of electrical systems), perceptual-motor sequences (e.g., ability to hand fly an ILS), procedural skills (e.g., how to enter coordinates into a flight management system), and even social and interpersonal skills (crew resource management; CRM). Do these distinct components of performance decay at the same rate? If not, what are the implications of different decay rates for retraining pilots?

In a review of decay for general skills, Arthur, Bennett, Stanush, and McNelly (1998) found that type of task was a major variable affecting rate of skill decay. Skills used for physical tasks were generally retained better than mental skills. More specific to piloting, Childs and Spears (1986) reported that cognitive and procedural elements of flying decayed more rapidly than perceptual-motor skills. As an example, flying a radar intercept mission showed little decay even after 24 months of non-practice (Fleishman & Parker, 1962). In contrast, Adams & Hufford (1962) found that cognitive/procedural skills associated with complex tasks declined significantly (85% decline) within 10 months. In the current study, we examined whether pilots' performance decayed differentially across sets of maneuvers that emphasized different types of knowledge or skill.

In the previous section, although we mentioned that a practice can be generally regarded as beneficial for skill retaining, not all practice is equally effective (Schmidt & Bjork, 1992). Practice effects can vary by task similarity between practice and assessment, amount and type of feedback, and individual differences such as motivation level. Further, the nature of practice effects has been shown to vary between different types of learning tasks such as between verbal and motor tasks.

In an earlier study based on data collected over a decade ago we found a statistically significant and meaningful decreased in maneuver validation performance as the training interval was increased from either 6- to 12-months or 9- to 12-months. During the ensuing decade with the widespread implementation of AQP throughout the industry there have been a number of improvements in training methods designed to improve skill retention. In this study we conduct a comprehensive large scale investigation using more current data to determine is there continues to exist a meaningful loss in commercial pilots' retention of critical maneuvers over a 12-month interval.

Methods

The data analyzed in this study were de-identified maneuvers validation grades from eight carriers involving 25 fleets ranging from long-haul 747, 777, and 757/67 aircraft down to short-haul twin engine turbo aircraft. This data set comprises over two million maneuver grades collected over a nine year period (2000 to 2008). The data represent an extensive range of maneuvers occurring across all phases of flight under both normal and abnormal (e.g., engine-out) conditions. Unlike the previous study the where pilots within the same fleet were assessed at different training intervals (6-, 9- or 12-months), all of the current pilots were on a 12-month training interval. However, each training session began with a first-look (FL) evaluation prior to any re-training, followed by maneuvers validation (MV) training, which allowed us to assess skill retention by comparing grades collected during MV training (0-month retention interval), with FL grades collected 12-months later,(i.e., the decay effect = MV minus FL). This calculation of the decay effect was repeated eight times over the succeeding nine years from 2000 through 2008.

There were 2,098,946 evaluations in the original data. The data come from seven different sub data sets. Table 1 shows the number of evaluations from each sub data set. Each data set presents for different carrier. However, we will not consider the different carrier types in this paper.

Table 1. Number of evaluations and proportions from each original data set.

Data name	Number of observation	Proportion
1st	248810	0.12
BLAH	297695	0.14
MSTK	929194	0.44
OLDR	76132	0.04
SEAA	391547	0.19
SIKA	121251	0.06

UHAL	34317	0.02
Total	2098946	1.00

*Note. Data names was arbitrarily assigned to each sub data set by FAA.

Scale issue

As we mentioned before, the data came from seven different carriers and each data set had a different scale as shown in Table 2.

Table 2. Original scale in each data set and newly assigned scales.

Data name	Original scale	Meaning	New scale	# of observation
1st	1	Unsafe	1	13
	1	Unsatisfactory	1	1471
	2	Not Proficient	1	658
	2	Satisfactory	2	16249
	3	Competent	2	3157
	3	Standard	3	137328
	4	CRM/TEM/Policy	Excluded	495
	4	Excellent	4	46786
	5	Not Graded	Excluded	666
	5	Proficient	3	28233
	6	Outstanding	4	13753
	9	N/A	Excluded	1
BLAH	1	Unsatisfactory:Red, Additional Train Req	1	82
	2	Unsat:Yellow/Red, Errors Unmitigated	1	2639
	3	Sat:Green/Yellow, Errors Debriefed	2	13678
	3	Satisfactory: Yellow, Errors Debriefed	2	50
	4	Sat:Green, Errors Mitigated	3	108292
	4	Satisfactory:Green, Errors Mitigated	3	390
	5	Sat:Green, No Errors	4	171747
	5	Satisfactory:Green, No Errors	4	392

	7	Additional Training Provided	Excluded	3
	8	Normal Progress	Excluded	20
	9	Proficient	Excluded	402
MSTK	1	Excellent	4	168710
	2	Above Average	3	20468
	2	Above Expectations	3	384004
	3	Average	2	23115
	3	Expected Performance	2	319213
	4	Meets Minumum Standards	1	11900
	5	Unsatisfactory	1	1784
OLDR	1	UNSAT	1	843
	1	UNSATISFACTORY	1	276
	2	SAT	2	206
	2	SATISFACTORY	2	51317
	3	ABOVE STANDARD	3	648
	3	STANDARD	3	16095
	4	EXCELLENT	4	721
	4	NOT OBSERVED	4	6026
SEAA	0	0-Incomp	Excluded	98
	1	1-Unsat	1	7434
	1	Unsat	1	97
	2	2-Min Acc	2	22083
	2	Min Acc	2	87
	2	Min. Acceptable	2	159
	3	3-Profic	3	254965
	3	Profic	3	702
	3	Proficient	3	2454
	4	4-Abv Stnd	3	91047

	4	Abv Standard	3	497
	4	Abv Stnd	3	1665
	5	5-Except	4	9770
	5	Except	4	327
	5	Exceptional	4	162
SIKA	1	Unsatisfactory/Repeat	1	3607
	2	Debrief	2	6371
	3	Standard	3	98936
	4	Excellent	4	12337
UHAL	1	Not Proficient	1	638
	1	Not Proficient/Unsafe	1	218
	2	Meets Minimum Standards	2	2204
	2	Satisfactory	2	2077
	3	Standard	3	28896
	4	Exceeds Standards	4	284

To create a uniform sale across all the data sets, we assigned a new 1-4 scale to the 1st data set, BLAH, MSTK and SEAA so that all data sets had the same 1 through 4 grade levels. This new scale was derived from the meaning of the original scale labels. For example, in the 1st data set scale, level 1 had two different meanings of 'Unsafe' and 'Unsatisfactory' and level 2 also had two different meanings of 'Not Proficient' and 'Satisfactory'. We grouped level 2 with a meaning of 'Not Proficient' together with level 1 (i.e., we assigned 1 to original level 2 if it has a meaning of 'Not Proficient').

Some of the original grade levels were of a qualitatively different nature. For example, in the first data set, level 4, 5, 9 had meanings of 'CRM/TEM/Policy', 'Not Graded' and 'N/A', respectively. We excluded evaluations under these levels. Excluded evaluations were marked with "Excluded" in the third column of Table #. Finally, among all the 2,098,946 evaluations, 1,685 evaluations were excluded giving 2,097,261evaluations.

Maneuver Names

At this point the data contained 1,944 different maneuver names. Some of these maneuver names occurred infrequently, less than 20 times in each sub data set, and these maneuvers were simply excluded from the data set. A total of 974 evaluations were excluded. Some ambiguous maneuver names were also excluded, for example, 'approach in direct law', 'Climb/Cruise/Descent Operations', 'EP PERFORM #1 HYDR FLRE PROC.', 'FMS Departures, Transitions, and Approaches'. These ambiguous maneuver names that were excluded had 1458, 29266, 118, and 1397 observations, respectively (32239 in total, 0.0154%). Finally, many of the maneuver names were actually the same maneuver but with slightly different names. We grouped similar maneuver names into a single maneuver name. After this maneuver name change, 1,049 maneuver names were left with 2,064,048 evaluations. We assigned maneuver type and phase of flight on each of these 1,049 maneuver name as described in the following section.

Assigning maneuver type, phase of flight and retention interval

Two individuals familiar with the performance data assigned maneuver type (normal or abnormal) and phase of flight (Approach, Automation, Climb, CRM, Cruise, Holding, Landing, Preflight, Takeoff, Taxi, N/A) to each maneuver name. Finally, based on when the evaluation was made, each evaluation was assigned as a maneuver validation (MV, an evaluation made right after pilots' training) or a first-look (FL, an evaluation made 12 months after the qualification training).

Results

The statistical analyses revealed that with the large sample sizes used in the present study, exceedingly small differences in mean grades (e.g., 0.02) were highly statistically significant ($p < .001$), while being meaningless in terms of real world implications. To address this problem we only treated differences having a Cohen's d value of 0.2 (i.e., 0.2 of the standard deviation of the sample) or greater as being meaningful .

The following tables show mean grade, standard deviation, and number of observations for comparing normal with abnormal maneuvers (Table 3), maneuver validation with first-look performance (Table 4), and for crossing each level of maneuver type with each time of evaluation (Table 5).

Table 3. Number of evaluations of each maneuver type and its mean and standard deviation of rating.

Maneuver type	# of observation	Mean	Standard deviation
Abnormal	846485	2.87	0.67
Normal	1217563	3.00	0.71

$F(1, 2064046)=3946.382$ ($p<0.000$) $d=0.187$

Table 4. Number of evaluations of each retention interval and its mean and standard deviation of rating.

Retention Interval	# of observation	Mean	Standard deviation
MV	1770383	2.95	0.70
FL	293665	2.93	0.67

F(1,2064046)=208.1032 (p<0.000) d=0.0287

Table 5. Cross table of maneuver type and retention interval.

Maneuver type	MV	FL
Abnormal	2.87(0.67)	2.84(0.63)
	692310	154175
Normal	3.00(0.71)	3.02(0.71)
	1078073	139490

The following tables show the same descriptive statistics for phase of flight (Table 6), phase of flight crossed with maneuver type (Table 7), and phase of flight crossed with retention interval (Table 8).

Table 6. Number of evaluations of each phase and its mean and standard deviation of rating.

Phase	# of observation	Mean	Standard deviation
Approach	648812	3.00	0.69
Automation	1014	2.72	0.65
Climb	18853	3.04	0.75
CRM	145170	2.86	0.69
Cruise	2867	3.61	0.55
Holding	44148	3.08	0.64
Landing	338752	2.99	0.67
N/A	394632	2.83	0.70
Preflight	21037	2.86	0.77
Takeoff	421839	2.96	0.69
Taxi	26924	2.96	0.66

Table 7. Crossing of phase of flight with maneuver type

Phase	Normal_count	Abnormal_count
Approach	3.04 (0.71)_ 395459	2.93 (0.66)_ 253353
Automation	2.72 (0.65)_ 1014	
Climb	3.11 (0.74)_ 16033	2.65 (0.69)_ 2820
CRM	2.86 (0.69)_ 144962	2.83 (0.72)_ 207
Cruise	3.61 (0.55)_ 2867	
Holding	3.09 (0.64)_ 43354	2.97 (0.36)_ 794
Landing	3.05 (0.70)_ 163640	2.94 (0.64)_ 175112
N/A	2.91 (0.72)_ 212074	2.74 (0.67)_ 182558
Preflight	2.86 (0.77)_ 21037	
Takeoff	3.09 (0.69)_ 192763	2.85 (0.67)_ 229076
Taxi	2.96 (0.67)_ 24359	2.99 (0.62)_ 2565

Table 8. Cross table of phase and retention interval.

Phase	MV	FL
Approach	3.00 (0.70)_ 538830	2.98 (0.65)_ 109982
Automation	2.72 (0.65)_ 1014	
Climb	3.02 (0.75)_ 17144	3.27 (0.70)_ 1709
CRM	2.86 (0.69)_ 145170	
Cruise	3.61 (0.55)_ 2867	
Holding	3.11 (0.64)_ 38429	2.91 (0.60)_ 5719
Landing	3.00 (0.67)_ 294656	2.95 (0.64)_ 44096
N/A	2.83 (0.71)_ 346488	2.79 (0.65)_ 48144
Preflight	2.83 (0.76)_ 19979	3.43 (0.70)_ 1058
Takeoff	2.97 (0.68)_ 342035	2.90 (0.72)_ 79804
Taxi	2.92 (0.66)_ 23771	3.24 (0.65)_ 3153

There were 119 different simulators represented within the data. To examine whether there were systematic differences in grades as a function of simulator type we selected simulators that had at least 10,000 grades associated with them. Table 9 shows the mean and standard deviation across these simulators.

Table 9. Mean and Standard Deviation associated with particular Simulators.

Fleet	SimID	CountOfRe_MRate	AvgOfRe_MRate	StDevOfRe_MRate
A-320	598	43112	3.51	0.66
	613	41106	3.49	0.66
	539	36704	2.96	0.40
	335	27644	2.94	0.39
	299	27296	2.93	0.42
	607	26471	2.95	0.41
	865	12469	2.98	0.44
	643	10856	3.57	0.62
B-727	58	19952	2.87	0.39
B-737	28	197531	2.84	0.79
	616	106220	2.89	0.79
	473	104670	2.83	0.79
	316	101452	2.78	0.78
	303	43131	3.52	0.63
	247	42079	3.50	0.63
	178	30048	3.49	0.62
	591	21505	3.03	0.77
	1004	10646	2.98	0.76
B-747-200	311	28720	2.95	0.30
B-747-400	273	21719	2.95	0.27
	317	18824	2.96	0.26
B-757	513	111237	2.64	0.65
	691	111075	2.65	0.65
	297	22807	2.89	0.48
	325	22509	2.92	0.45
	119	17492	2.91	0.43
B-757/767	403	34172	3.18	0.56
	46	33819	3.14	0.57

	280	33162	3.17	0.58
	353	32573	3.14	0.58
	45	32450	3.16	0.58
	766	30558	3.09	0.59
	601	27895	3.11	0.58
	671	18468	3.20	0.59
B-767	60	24519	3.51	0.60
B-777	606	136949	2.75	0.72
CR7	846	25519	3.03	0.41
CRJ	768	51528	2.98	0.55
	775	23146	2.98	0.56
	683	13305	2.96	0.55
DC-10	552	21441	2.92	0.34
DC-9	148	31177	2.91	0.43
	149	21948	2.88	0.41
	322	17750	2.92	0.42
	308	12889	2.93	0.43
DH8	393	59790	2.37	0.63

Most of the simulators had a mean grade of around 3. However, seven of the simulators had mean grades around 3.5 and one simulator had an average grade below 2.5. To investigate the simulator effect within each fleet type, we selected only fleets with at least five different simulator IDs (fleets with less than 5 simulator IDs showed almost the same mean rating across the simulators within each fleet type). Table 10 presents the results.

Table 10. Simulator by Fleet Statistics.

Fleet	SimID	# of observation	Mean	Standard deviation
A-320	643	10856	3.57	0.62
	598	43112	3.51	0.66

	613	41106	3.49	0.66
	865	12469	2.98	0.44
	539	36704	2.96	0.40
	607	26471	2.95	0.41
	335	27644	2.94	0.39
	299	27296	2.93	0.42
B-737	303	43131	3.52	0.63
	247	42079	3.50	0.63
	178	30048	3.49	0.62
	591	21505	3.03	0.77
	1004	10646	2.98	0.76
	616	106220	2.89	0.79
	28	197531	2.84	0.79
	473	104670	2.83	0.79
	316	101452	2.78	0.78
B-757	325	22509	2.92	0.45
	119	17492	2.91	0.43
	297	22807	2.89	0.48
	691	111075	2.65	0.65
	513	111237	2.64	0.65
B-757/767	671	18468	3.20	0.59
	403	34172	3.18	0.56
	280	33162	3.17	0.58
	45	32450	3.16	0.58
	46	33819	3.14	0.57
	353	32573	3.14	0.58
	601	27895	3.11	0.58
	766	30558	3.09	0.59

Fleets A-320, B-737 and B-757 showed heavy fluctuation of mean grades across the individual simulators. There was no relation between mean grade and corresponding standard deviation. In fleet

A-320, the standard deviation showed a similar pattern to mean grade, however, this pattern was reversed for the B-737 and B-757 fleets.

We investigated whether simulator effect within these three fleets was confounded with a certain maneuver type, retention interval or phase of flight. That is, although there were significant simulator effects, this result could be due to confounding simulator ID with these other factors. For example, in fleet A-320, the first two simulators showed higher mean grades than the remaining simulators. Perhaps this result occurred because these simulators were used to evaluate MV rather than FL maneuvers, or they were used more for evaluating normal than abnormal maneuvers.

We investigated this question with data from the A-320 simulators. Although these two simulators had fewer observations of abnormal maneuvers than other simulators (see Table 11), within each simulator type, mean grades for the two different maneuver types were almost the same. Regardless of the number of observation of each maneuver type, the first two simulators had higher mean grades from each maneuver type than the other simulators.

Table 11. Data from A-320 Simulators broken out by abnormal and normal maneuvers.

SimID	Maneuvertype	# of observation	Proportion	Mean
598	A	6426	0.15	3.41
598	N	36686	0.85	3.52
613	A	6325	0.15	3.41
613	N	34781	0.85	3.51
539	A	20820	0.57	2.95
539	N	15884	0.43	2.96
607	A	14885	0.56	2.94
607	N	11586	0.44	2.97
335	A	16051	0.58	2.94
335	N	11593	0.42	2.94
299	A	15587	0.57	2.93
299	N	11709	0.43	2.93

As for retention interval, each simulator had a similar number of observations for each retention interval (MV vs. FL). Again, in A-320, the first two simulators had higher mean grades for the two different retention intervals than other simulators (see Table 12).

Table 12. Data from A-320 Simulators broken out by MV and FL maneuvers.

SimID	Retention interval	# of observation	Proportion	Mean
598	MV	35757	0.83	3.50
598	FL	7355	0.17	3.51
613	MV	33690	0.82	3.49
613	FL	7416	0.18	3.51
539	MV	30246	0.82	2.96
539	FL	6458	0.18	2.93
607	MV	22480	0.85	2.95
607	FL	3991	0.15	2.94
335	MV	22484	0.81	2.94
335	FL	5160	0.19	2.93
299	MV	22609	0.83	2.94
299	FL	4687	0.17	2.92

As for different phases of flight across the simulator type, there were similar numbers of observations for each phase. Again, the first two simulators had higher mean rate for each phase than other simulators (see Table 13).

Table 13. Data from A-320 Simulators broken out by Flight Phases.

SimID	Phase	# of observation	Proportion	Mean
598	Approach	18401	0.51	3.46
598	Landing	8000	0.22	3.62
598	Takeoff	9971	0.27	3.47
613	Approach	17488	0.50	3.44
613	Landing	7480	0.22	3.61
613	Takeoff	9676	0.28	3.46
539	Approach	13926	0.49	2.94
539	Landing	5328	0.19	3.00
539	Takeoff	9309	0.33	2.95

607	Approach	9756	0.48	2.93
607	Landing	4061	0.20	2.99
607	Takeoff	6440	0.32	2.93
335	Approach	10168	0.48	2.93
335	Landing	3871	0.18	2.98
335	Takeoff	7207	0.34	2.93
299	Approach	10087	0.48	2.91
299	Landing	3937	0.19	2.98
299	Takeoff	6870	0.33	2.92

Up to this point, the simulator effect seemed to be not confounded with any other factors. However, upon further analysis, it appeared that there were two different groups of evaluators with one group being assigned to the first two simulators and the second group assigned to the remaining simulators. Our current analyses are focused on examining how much variability in the grades is associated with particular evaluators, and once evaluator variation is held constant, what effects continue to be or now become meaningfully significant.

Discussion

The major finding in our analyses was that the mean difference (0.03) between MV (2.96) and FL(2.93) grades averaged across the entire time interval and all 25 fleets and was not meaningfully significant (Cohens'= .03). Moreover, looking the MV-FL difference from 2000 to 2008 showed no indication of a trend. When we partitioned the maneuvers into Normal (practiced regularly on the line) and Abnormal (rarely performed on the line) we found the mean grade for Normal (3.00) maneuvers was not meaningfully higher than the mean grade of Abnormal maneuvers (2.87), Cohens' d = .19. However, when we looked at this difference across phases of flight it was found that Normal (3.09) maneuvers were performed better than Abnormal (2.85) maneuvers on Takeoffs ,Cohens' d = .24. Importantly, the superior performance for Normal maneuvers over Abnormal maneuvers remained constant across the 0- (MV) to 12-month (FL) retention interval. In sum, these findings suggest that pilots are maintaining proficiency across the standard 12-month retraining interval.

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Appendix A: Detailed Summary Statistics

1. Score distribution in takeoff.

	Takeoff				
EvalType	1	2	3	4	Total
MV	6017	67167	199427	69424	342035
FL	3400	14576	48109	13719	79804

Takeoff				
1	2	3	4	Total
0.02	0.20	0.58	0.20	1
0.04	0.18	0.60	0.17	1

EvalType	1&2	3&4	Total
MV	73184	268851	342035
FL	17976	61828	79804

1&2	3&4	Total
0.21	0.79	1
0.23	0.77	1

2. Fleet size.

Fleet	Size	CountOfFleet
A-300	M	4270
A-320	M	219465
A-330	L	25301
B-727	M	23611
B-737	M	677764
B-747-200	L	37316
B-747-400	L	40543
B-757	L	294988
B-757/767	L	247637
B-767	L	32714
B-777	L	139504
CR7	S	25519
CRJ	S	95635
DC-10	L	25700
DC-8	M	7783
DC-9	M	87140
DH8	M	75994

E-190	S	3164
Total		2064049

2.5 Mean and standard deviations for different fleet sizes

FleetSize	# of observation	Mean	Standard deviation
S	124318	3.01	0.53
M	1096027	2.96	0.75
L	843703	2.92	0.64

3. Retention interval rating across fleet size.

FleetSize	Retention Interval	# of observation	Mean	Standard deviation
S	MV	109918	3.02	0.51
	FL	14400	2.90	0.68
M	MV	916971	2.96	0.75
	FL	179056	2.96	0.71
L	MV	743494	2.93	0.64
	FL	100209	2.86	0.61

d(S)=0.23

d(M)=0

d(L)=0.11

4. Maneuver type rating across fleet size.

FleetSize	Maneuver type	# of observation	Mean	Standard deviation
S	A	64523	2.96	0.56
	N	59795	3.06	0.50
M	A	431288	2.83	0.73
	N	664739	3.05	0.75
L	A	350674	2.90	0.60
	N	493029	2.93	0.67

d(S)=0.19

d(M)=0.30

d(L)=0.05

Fleet size and phase.

Fleet size	Phase	# of observation	Mean	Standard deviation
S	Approach	52993	3.03	0.53
	Landing	23659	3.01	0.52
	Takeoff	23800	2.94	0.65
M	Approach	363634	2.96	0.75
	Landing	164545	3.09	0.72
	Takeoff	225388	2.95	0.76
L	Approach	232185	3.04	0.63
	Landing	150548	2.89	0.62
	Takeoff	172651	2.97	0.60

Fleet size	Phase	Maneuver type	# of observation	Mean	Standard deviation
S	Approach	A	16746	2.98	0.57
		N	36247	3.05	0.51
	Landing	A	16672	2.96	0.53
		N	6987	3.13	0.47
	Takeoff	A	10480	2.78	0.79
		N	13320	3.08	0.47
M	Approach	A	139122	2.91	0.72
		N	224512	3.00	0.76
	Landing	A	76623	2.96	0.71
		N	87922	3.20	0.71
	Takeoff	A	108394	2.76	0.73

		N	116994	3.13	0.74
L	Approach	A	97485	2.94	0.57
		N	134700	3.11	0.65
	Landing	A	81817	2.93	0.59
		N	68731	2.84	0.65
	Takeoff	A	110202	2.94	0.59
		N	62449	3.03	0.62

Fleet size	Phase	Retention interval	# of observation	Mean	Standard deviation
S	Approach	MV	46879	3.03	0.53
		FL	6114	3.01	0.53
	Landing	MV	21802	3.02	0.50
		FL	1857	2.93	0.69
	Takeoff	MV	18561	2.98	0.60
		FL	5239	2.81	0.77
M	Approach	MV	296836	2.95	0.77
		FL	66798	3.02	0.68
	Landing	MV	135833	3.10	0.73
		FL	28712	3.00	0.65
	Takeoff	MV	177497	2.95	0.76
		FL	47891	2.94	0.76
L	Approach	MV	195115	3.07	0.62
		FL	37070	2.90	0.61
	Landing	MV	137021	2.89	0.62
		FL	13527	2.84	0.60
	Takeoff	MV	145977	2.99	0.60
		FL	26674	2.86	0.62

EvalType	Maneuvertype	1	2	3	4	Total
MV	A	12954	168331	405626	105399	692310
	N	9382	239568	569182	259941	1078073
FL	A	5693	27240	106915	14327	154175
	N	3389	23422	79440	33240	139491

1	2	3	4	Total
0.02	0.24	0.59	0.15	1
0.01	0.22	0.53	0.24	1
0.04	0.18	0.69	0.09	1
0.02	0.17	0.57	0.24	1

EvalType	Maneuvertype	1&2	3&4	Total
MV	A	181285	511025	692310
	N	248950	829123	1078073
FL	A	32933	121242	154175
	N	26811	112680	139491

EvalType	Maneuvertype	1&2	3&4	Total
MV	A	0.26	0.74	1
	N	0.23	0.77	1
FL	A	0.21	0.79	1
	N	0.19	0.81	1

FleetSize	EvalType	Maneuvertype	1	2	3	4	Total
S	MV	A	1871	3096	46822	5162	56951
		N	774	2231	42139	7823	52967
	FL	A	690	662	5179	1041	7572
		N	281	462	5438	647	6828
M	MV	A	7595	109211	163892	62822	343520
		N	6296	127516	271861	167778	573451

	FL	A	2979	17212	58065	9512	87768
		N	2115	15291	47003	26879	91288
L	MV	A	3488	56024	194912	37415	291839
		N	2312	109821	255182	84340	451655
	FL	A	2024	9366	43671	3774	58835
		N	993	7669	26998	5714	41374

FleetSize	EvalType	Maneuvertype	1	2	3	4	Total
S	MV	A	0.03	0.05	0.82	0.09	1
		N	0.01	0.04	0.80	0.15	1
	FL	A	0.09	0.09	0.68	0.14	1
		N	0.04	0.07	0.80	0.09	1
M	MV	A	0.02	0.32	0.48	0.18	1
		N	0.01	0.22	0.47	0.29	1
	FL	A	0.03	0.20	0.66	0.11	1
		N	0.02	0.17	0.51	0.29	1
L	MV	A	0.01	0.19	0.67	0.13	1
		N	0.01	0.24	0.56	0.19	1
	FL	A	0.03	0.16	0.74	0.06	1
		N	0.02	0.19	0.65	0.14	1

FleetSize	Phase	EvalType	Maneuvertype	1	2	3	4	Total
S	Approach	MV	A	508	999	11338	1644	14489
			N	579	1591	25612	4608	32390
		FL	A	70	133	1704	350	2257
			N	92	213	3189	363	3857
	Landing	MV	A	416	902	12219	1282	14819
			N	56	213	5507	1207	6983
		FL	A	127	139	1333	254	1853
			N			3	1	4

	Takeoff	MV	A	712	670	4980	676	7038
			N	115	378	9345	1685	11523
		FL	A	493	390	2122	437	3442
			N	70	71	1485	171	1797
M	Approach	MV	A	3083	28788	55117	22865	109853
			N	3315	46312	86422	50934	186983
		FL	A	732	3201	21611	3725	29269
			N	957	6486	19536	10550	37529
	Landing	MV	A	840	15546	31606	15604	63596
			N	713	9671	35012	26841	72237
		FL	A	317	2103	9644	963	13027
			N	307	2092	8715	4571	15685
	Takeoff	MV	A	2680	24438	41663	11207	79988
			N	1022	19470	44967	32050	97509
		FL	A	1524	7421	16167	3294	28406
			N	376	2163	9720	7226	19485
L	Approach	MV	A	1159	10663	54700	10316	76838
			N	868	15152	69596	32661	118277
		FL	A	601	2901	15868	1277	20647
			N	576	2465	10482	2900	16423
	Landing	MV	A	683	13805	51679	9875	76042
			N	492	16996	35060	8431	60979
		FL	A	145	951	4036	643	5775
			N	179	1796	5184	593	7752
	Takeoff	MV	A	1259	13303	62352	12715	89629
			N	229	8908	36120	11091	56348
		FL	A	877	3352	15142	1202	20573
			N	60	1179	3473	1389	6101

FleetSize	Phase	EvalType	Maneuvertype	1	2	3	4	Total
S	Approach	MV	A	0.04	0.07	0.78	0.11	1
			N	0.02	0.05	0.79	0.14	1
		FL	A	0.03	0.06	0.75	0.16	1
			N	0.02	0.06	0.83	0.09	1
	Landing	MV	A	0.03	0.06	0.82	0.09	1
			N	0.01	0.03	0.79	0.17	1
		FL	A	0.07	0.08	0.72	0.14	1
			N	0.00	0.00	0.75	0.25	1
	Takeoff	MV	A	0.10	0.10	0.71	0.10	1
			N	0.01	0.03	0.81	0.15	1
		FL	A	0.14	0.11	0.62	0.13	1
			N	0.04	0.04	0.83	0.10	1
M	Approach	MV	A	0.03	0.26	0.50	0.21	1
			N	0.02	0.25	0.46	0.27	1
		FL	A	0.03	0.11	0.74	0.13	1
			N	0.03	0.17	0.52	0.28	1
	Landing	MV	A	0.01	0.24	0.50	0.25	1
			N	0.01	0.13	0.48	0.37	1
		FL	A	0.02	0.16	0.74	0.07	1
			N	0.02	0.13	0.56	0.29	1
	Takeoff	MV	A	0.03	0.31	0.52	0.14	1
			N	0.01	0.20	0.46	0.33	1
		FL	A	0.05	0.26	0.57	0.12	1
			N	0.02	0.11	0.50	0.37	1
L	Approach	MV	A	0.02	0.14	0.71	0.13	1
			N	0.01	0.13	0.59	0.28	1
		FL	A	0.03	0.14	0.77	0.06	1
			N	0.04	0.15	0.64	0.18	1
	Landing	MV	A	0.01	0.18	0.68	0.13	1
			N	0.01	0.28	0.57	0.14	1

	FL	A	0.03	0.16	0.70	0.11	1
		N	0.02	0.23	0.67	0.08	1
Takeoff	MV	A	0.01	0.15	0.70	0.14	1
		N	0.00	0.16	0.64	0.20	1
	FL	A	0.04	0.16	0.74	0.06	1
		N	0.01	0.19	0.57	0.23	1

APPENDIX 6
ANALYSIS OF GLOBAL FATAL ACCIDENT DATA

Analysis of Global Fatal Accident Data

Worldwide fatal accidents have been analysed using the ITQI Intuitive Risk Matrix. The following criteria were applied to the data:

- Fixed-wing jet and turbo-prop aeroplanes with original certified MTWA above 5,700 kg or 12,500 lbs
- Civil passenger and cargo flights only
- Fatalities within 30 days of the accident (as per ICAO Annex 13 definition)
- Occurring between 1 January 1997 and 31 December 2008 (inclusive)
- Excluding violent acts (e.g. sabotage, terrorism, etc.)

Data was also analysed for the following five separate categories:

- All fatal accidents
- Passenger flights only
- Cargo flights only
- Western-built jets only
- Western-built jets on passenger flights only

Other points to note are the inclusion of two extra items at the end: 'Other', which includes possible suicide (e.g. SilkAir B737 and Egyptair B767) and 'Unknown', which signifies that there is an element of uncertainty surrounding the circumstances of an accident (e.g. many accidents in Africa).

Data Sources:
Ascend (formally Airclaims) CASE database
CAA Fatal accident database

Background Supporting Statistics

Phase of Flight	All Fatal Accidents	Passenger Flights Only	Cargo Flights Only	Western-Built Jets Only	Western-Built Jets on Passenger Flights Only
Pre-Flight and Taxi-Out	2	1	1	1	1
Take-Off	36	23	13	12	10
Climb	58	32	26	16	11
Cruise	48	33	15	13	12
Descent	13	8	5	4	3
Approach	108	74	34	32	25
Landing	36	30	6	18	18
Post-Flight	2	2	0	2	2
Total	**303**	**203**	**100**	**98**	**82**

Main Data analysis

		All Fatal Accidents	Passenger Flights Only	Cargo Flights Only	Western-Built Jets Only	Western-Built Jets on Passenger Flights Only
1. GENERAL OPERATIONAL THREATS						
1.1	Deficiency within Manuals	4	3	1	0	0
1.2	Deficiency within Charts	2	2	0	1	1
1.3	Deficiency in Ops Data	9	7	2	5	4
1.4	Deficiency within Database	0	0	0	0	0
1.5	Deficiency within Checklists	0	0	0	0	0
1.6	Compliance failure	100	76	24	43	38
1.7	Mishandled Aircraft	68	43	25	23	20
1.8	Mismanaged Aircraft State	41	33	8	20	18
1.9	Mishandled Auto Flight Systems	10	7	3	6	5
1.10	Other Mishandled system	20	17	3	9	9
1.11	Loading/fuel/Performance	22	8	14	4	2
1.12	Workload/ Distraction/ Pressure	18	14	4	7	7
1.13	Fatigue	18	12	6	7	6
1.14	Procedures	36	24	12	13	9
1.15	Cabin issues	3	3	0	1	1
1.16	*Terrorism [Note: not covered by AAG]*	*0*	*0*	*0*	*0*	*0*
1.17	Physiological	4	3	1	1	1
1.18	Human Factors and CRM	169	122	47	63	53
2. PRE-FLIGHT & TAXI-OUT						
2.1	Ground equipment	0	0	0	0	0
2.2	Ground manoeuvring	0	0	0	0	0
2.3	Runway/Taxi condition	0	0	0	0	0
2.4	Adverse Weather/Ice	0	0	0	0	0
2.5	Wind	0	0	0	0	0
2.6	ATC	1	0	1	0	0
2.7	NAV	0	0	0	0	0
2.8	Loss of comms	0	0	0	0	0
2.9	Traffic	1	0	1	0	0
2.1	R/W incursion	1	0	1	0	0
2.11	Poor Visibility	0	0	0	0	0
2.12	Eng Fail	0	0	0	0	0
2.13	MEL	0	0	0	0	0
2.14	Fire	1	1	0	1	1
2.15	System malfunction	0	0	0	0	0
2.16	Pilot Incapacitation	0	0	0	0	0
2.17	Dangerous goods	0	0	0	0	0

3. TAKE-OFF						
3.1	Windshear	0	0	0	0	0
3.2	Adverse Weather/Ice	6	5	1	3	3
3.3	Runway/Taxi condition	5	5	0	3	3
3.4	Wind	1	1	0	1	1
3.5	ATC	2	2	0	2	2
3.6	NAV	0	0	0	0	0
3.7	Loss of comms	0	0	0	0	0
3.8	Traffic	1	1	0	1	1
3.9	R/W incursion	1	1	0	1	1
3.10	Poor Visibility	3	3	0	2	2
3.11	Wake vortex	0	0	0	0	0
3.12	Upset	0	0	0	0	0
3.13	Terrain	1	1	0	0	0
3.14	Birds	3	1	2	0	0
3.15	Eng Fail	11	5	6	3	2
3.16	MEL	0	0	0	0	0
3.17	Fire	4	2	2	2	1
3.18	System malfunction	8	5	3	2	2
3.19	Pilot Incapacitation	0	0	0	0	0
3.20	Dangerous goods	0	0	0	0	0
4. CLIMB						
4.1	Windshear	1	0	1	0	0
4.2	Adverse Weather/Ice	13	7	6	4	3
4.3	ATC	1	0	1	1	0
4.4	NAV	0	0	0	0	0
4.5	Loss of comms	0	0	0	0	0
4.6	Traffic	0	0	0	0	0
4.7	Poor Visibility	11	5	6	1	1
4.8	Wake vortex	1	1	0	1	1
4.9	Upset	2	1	1	2	1
4.10	Terrain	3	2	1	1	1
4.11	Birds	2	1	1	0	0
4.12	Eng Fail	17	9	8	1	1
4.13	MEL	1	1	0	0	0
4.14	Fire	3	0	3	0	0
4.15	System malfunction	10	7	3	3	2
4.16	Pilot Incapacitation	0	0	0	0	0
4.17	Dangerous goods	1	0	1	0	0

5. CRUISE						
5.1	Windshear	2	2	0	2	2
5.2	Adverse Weather/Ice	16	10	6	2	2
5.3	ATC	3	2	1	2	1
5.4	NAV	0	0	0	0	0
5.5	Loss of comms	0	0	0	0	0
5.6	Traffic	5	3	2	2	1
5.7	Poor Visibility	6	6	0	0	0
5.8	Wake vortex	0	0	0	0	0
5.9	Upset	2	1	1	1	1
5.10	Terrain	10	10	0	0	0
5.11	Birds	0	0	0	0	0
5.12	Eng Fail	5	2	3	1	1
5.13	MEL	0	0	0	0	0
5.14	Fire	1	1	0	1	1
5.15	System malfunction	11	10	1	5	5
5.16	Pilot Incapacitation	2	2	0	2	2
5.17	Dangerous goods	0	0	0	0	0
6. DESCENT						
6.1	Windshear	0	0	0	0	0
6.2	Adverse Weather/Ice	4	2	2	1	1
6.3	ATC	0	0	0	0	0
6.4	NAV	0	0	0	0	0
6.5	Loss of comms	0	0	0	0	0
6.6	Traffic	0	0	0	0	0
6.7	Poor Visibility	4	3	1	1	1
6.8	Wake vortex	0	0	0	0	0
6.9	Upset	1	0	1	0	0
6.10	Terrain	6	5	1	2	2
6.11	Birds	0	0	0	0	0
6.12	Eng Fail	4	2	2	1	1
6.13	MEL	0	0	0	0	0
6.14	Fire	0	0	0	0	0
6.15	System malfunction	1	1	0	0	0
6.16	Pilot Incapacitation	0	0	0	0	0
6.17	Dangerous goods	1	1	0	0	0

7. APPROACH						
7.1	Windshear	2	2	0	1	1
7.2	Adverse Weather/Ice	25	22	3	9	9
7.3	Wind	5	4	1	3	3
7.4	ATC	4	4	0	3	3
7.5	NAV	0	0	0	0	0
7.6	Loss of comms	0	0	0	0	0
7.7	Traffic	1	0	1	0	0
7.8	R/W incursion	1	0	1	0	0
7.9	Poor Visibility	47	36	11	16	15
7.10	Wake vortex	0	0	0	0	0
7.11	Upset	1	1	0	0	0
7.12	Terrain	50	36	14	16	14
7.13	Birds	0	0	0	0	0
7.14	Eng Fail	15	10	5	3	1
7.15	MEL	1	0	1	0	0
7.16	Fire	1	1	0	0	0
7.17	System malfunction	14	8	6	5	3
7.18	Pilot Incapacitation	1	1	0	1	1
7.19	Dangerous goods	1	0	1	1	0
8. LANDING						
8.1	Windshear	3	3	0	3	3
8.2	Adverse Weather/Ice	13	13	0	12	12
8.3	Runway/Taxiway condition	11	10	1	8	8
8.4	Wind	8	8	0	6	6
8.5	ATC	2	2	0	2	2
8.6	NAV	1	1	0	1	1
8.7	Loss of comms	0	0	0	0	0
8.8	Traffic	1	1	0	0	0
8.9	R/W incursion	1	1	0	0	0
8.10	Poor Visibility	9	8	1	7	7
8.11	Wake vortex	0	0	0	0	0
8.12	Upset	0	0	0	0	0
8.13	Birds	0	0	0	0	0
8.14	Eng Fail	3	2	1	0	0
8.15	MEL	3	3	0	3	3
8.16	Fire	0	0	0	0	0
8.17	System malfunction	7	6	1	6	6
8.18	Pilot Incapacitation	1	1	0	1	1
8.19	Dangerous goods	0	0	0	0	0

9. POST-FLIGHT						
9.1	Ground equipment	0	0	0	0	0
9.2	Ground manoeuvring	0	0	0	0	0
9.3	Runway/Taxi condition	0	0	0	0	0
9.4	Adverse Weather/Ice	0	0	0	0	0
9.5	Wind	0	0	0	0	0
9.6	ATC	0	0	0	0	0
9.7	NAV	0	0	0	0	0
9.8	Loss of comms	0	0	0	0	0
9.9	Traffic	0	0	0	0	0
9.10	R/W incursion	0	0	0	0	0
9.11	Poor Visibility	0	0	0	0	0
9.12	Eng Fail	0	0	0	0	0
9.13	MEL	0	0	0	0	0
9.14	Fire	0	0	0	0	0
9.15	System malfunction	2	2	0	2	2
9.16	Pilot Incapacitation	0	0	0	0	0
9.17	Dangerous goods	0	0	0	0	0
10. OTHER						
10.1	Possible suicide	2	2	0	2	2
11. UNKNOWN						
11.1	Element of uncertainty about accident scenario	37	18	19	5	3

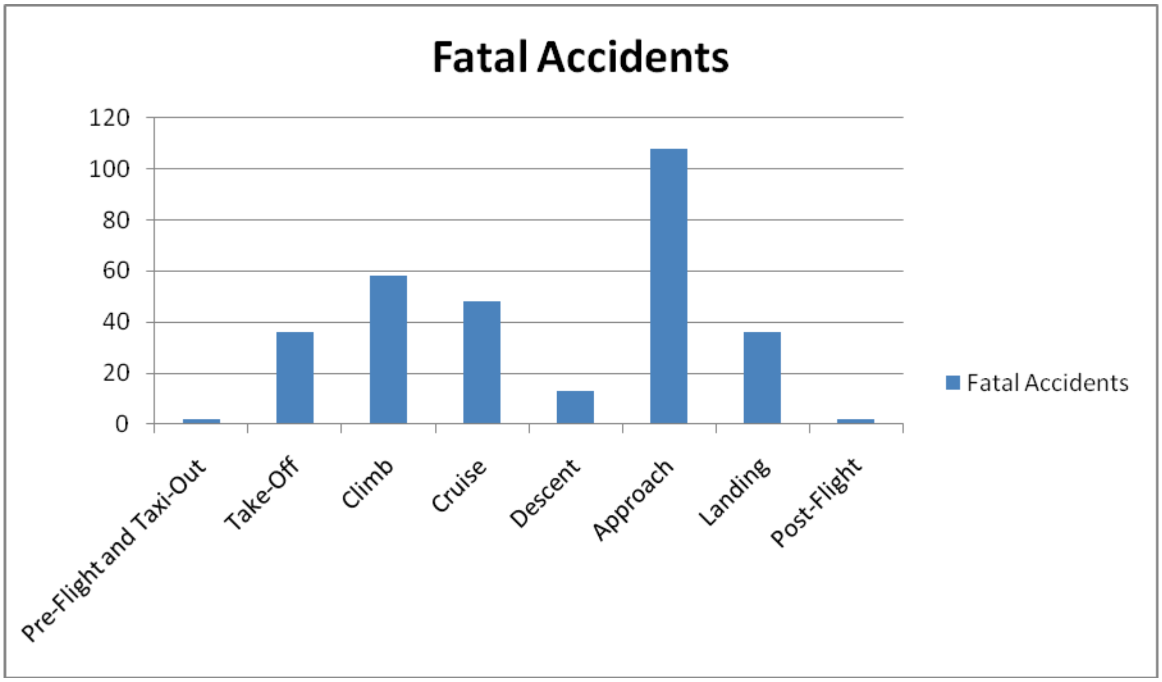


Figure 1 Fatal accidents by phase of flight (ITQI Matrix)

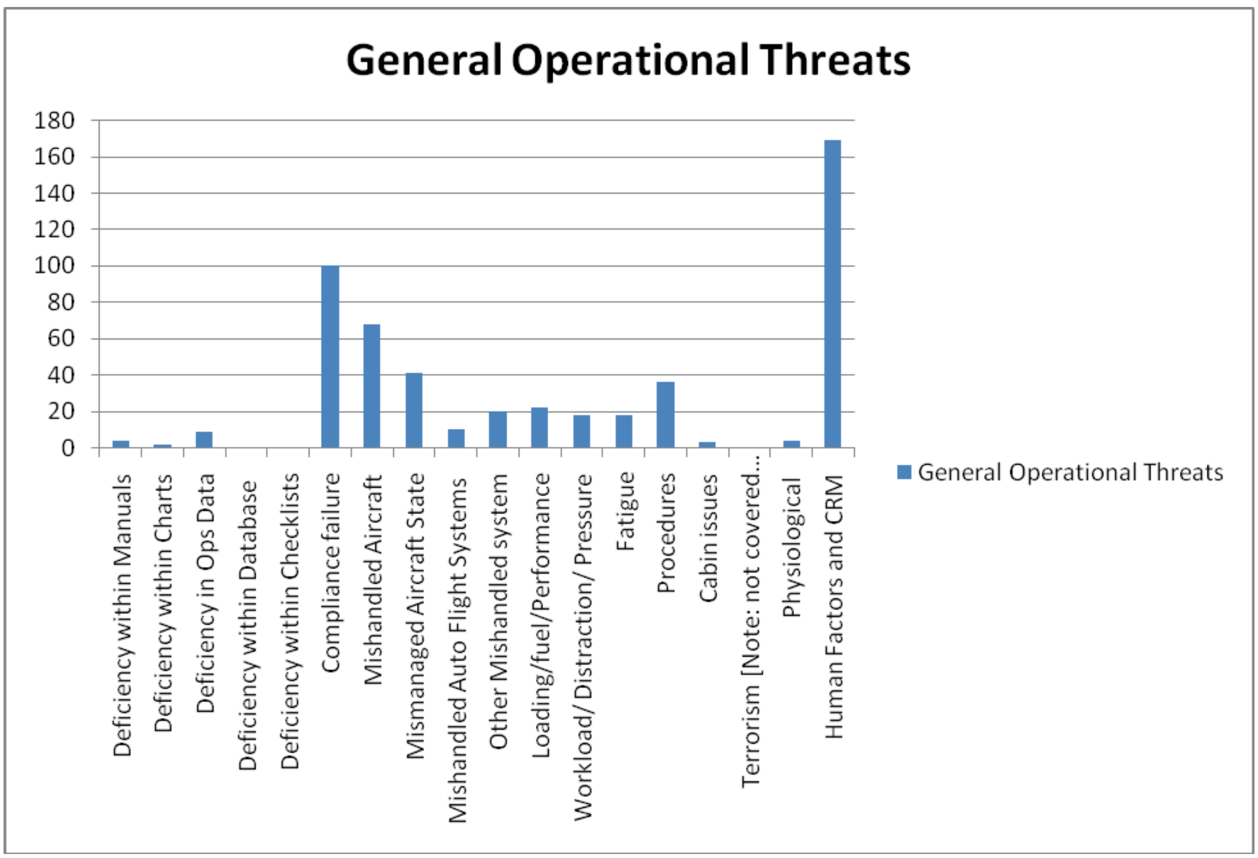


Figure 2 Fatal accidents by operational threat (ITQI Matrix)

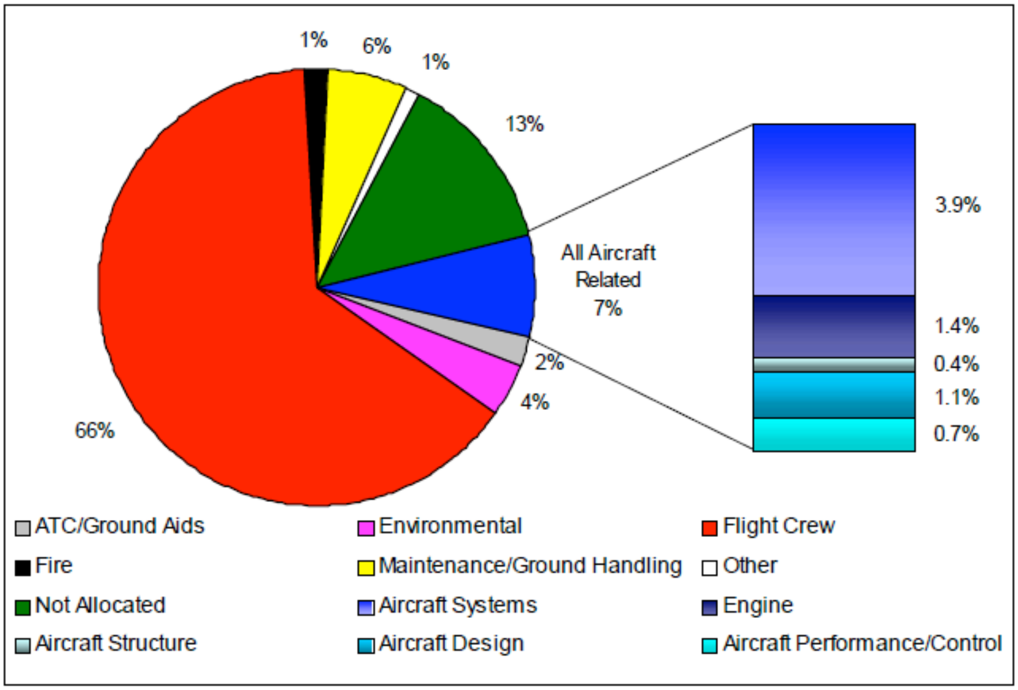


Figure 3 Breakdown of all fatal accidents by causal group (for primary causal factors only) for the ten-year period 1997 to 2006 (CAP 776)

Table 1 Top-ten primary causal factors allocated for all fatal accidents for the ten-year period 1997 to 2006

Rank	Causal Group	Primary Causal Factor	No. Fatal Accidents	%
1	Flight crew	Omission of action/inappropriate action	63	22.3%
2	Flight crew	Lack of positional awareness – in air	40	14.1%
3	Flight crew	Flight handling	39	13.8%
4	Flight crew	Poor professional judgement/airmanship	16	5.7%
5	Maintenance/ ground handling	Maintenance or repair error/oversight/inadequacy	12	4.2%
6	Environmental	Windshear/upset/turbulence/gusts	6	2.1%
7=	Flight crew	Loading incorrect	5	1.8%
7=	Flight crew	Deliberate non-adherence to procedures	5	1.8%
7=	Maintenance/ ground handling	Loading error	5	1.8%
10=	Aircraft systems	System failure – flight deck information	4	1.4%
10=	Aircraft systems	System failure – other	4	1.4%
10=	ATC/ground aids	Incorrect or inadequate instruction/advice (ATC)	4	1.4%
10=	Flight crew	Lack of awareness of circumstances in flight	4	1.4%
10=	Flight crew	Disorientation or visual illusion	4	1.4%

Table 2 Five most common causal factor groups (CAP 780)

Causal factor	Percent of accidents with factor
Crew - Omission of action/inappropriate action	36%
Crew - Flight handling	28%
Crew - Lack of positional awareness – in air	25%
Crew - Failure in CRM (cross check/co-ordinate)	22%
Crew - Poor professional judgement/airmanship	20%

Comment

1. The global fatal accident data was re-analysed by means of the ITQI Intuitive Threat Matrix.
2. Analysis, by phase of flight (Figure 1), clearly shows that the greatest risk is within the approach phase of flight.
3. Further analysis to determine the areas of general operational threat it is clear that the major threat is that of the non-technical area of human factors (Figure 2).
4. The UK Civil Aviation Authority publications CAP 776 Global Fatal Accident Review 1997 – 2006 and CAP 780 Aviation Safety Review 2008 both suggest that the main areas of concern are non technical ones by nature (Figure 3).
5. Table 1 (CAP 776) demonstrates that the top two primary causal factors, accounting for 36.4% of accidents, are non technical in nature. This is further reinforced by data from the CAP 780 which shows that the top five most common causal factors groups contain a significant component of non-technical elements (Human Factors).
6. Table 2 (CAP 780) again demonstrates that the most frequently occurring causal factors are crew related.

APPENDIX 7
FLIGHT DATA ANALYSIS (FDA)

INTRODUCTION

This introduction contains data in graphic format of the three formal flight data analysis studies used in the EBT analysis:

1. A Study of Normal Operational Landing Performance on Subsonic Civil Narrow Body Jet Aircraft during ILS Approaches – NLR – The full report can be accessed using the link in section 7.1.
2. The EBT Flight Data Analysis – A de-identified confidential analysis that was performed by the EBY Data subgroup primarily focusing on unstable approaches.
3. Long Aircraft Type/Variant difference on Landing and Takeoff - A de-identified confidential report study takeoffs and landings of long body aircraft.

7.1 NLR REPORT

Landings in NLR Study	
Aircraft Type	**Number of Landings**
$G4_1$	7,474
$G4_2$	12,245
$G4_3$	5,952
$G3_1$	12,093
Aircraft Types have been de-identified.	
Subscripts indicate de-identified type.	

Figure 3.3.3 – Number of Aircraft by Generation and de-identified type in NLR

(See Link for the published NLR Study – http://www.tc.faa.gov/its/worldpac/techrpt/ar077.pdf)

7.2 EBT FLIGHT DATA ANALYSIS

EBT Flight Data Analysis	
Event ID	Landing Events
1022	Speed High at Touch Down
1023	Speed Low at Touch down
1024	Speed Above Maximum Tire Speed
1029	Braking Delayed at Landing
1033	Tail wind High at Landing
1035	Braking Questionable at Landing
1105	Pitch Input cycling at Landing (below 100ft)
1108	Pitch High at Touch Down
1109	Pitch Low at Touch Down
1111	Pitch Rate High at Landing
1200	Bank High in Approach (below 100ft)
1205	Roll input cycling (below 200ft)
1210	Bank High during Flare (below 10ft)
1211	Bank Oscillation in Approach (below 100ft)
1219	Roll Spoilers extension at Landing (below 50ft)
1405	Path High at Landing (below 20ft)
1504	Vertical Acceleration High at Touchdown
1505	High Lateral Load at Touch Down
1510	Lateral Acceleration High at Touchdown
1602	Flaps Questionable Setting at Landing
1611	Late Reverser Use at Landing
1619	Reversers High Thrust at Low Speed
1703	Thrust Reduction Late at Landing
1706	Thrust Asymmetry in Reverse
1714	Thrust Low at Landing (50ft)
1807	Heading Deviation at Landing (above 60kts)
1808	Long Flare Time
1812	Height Low at Threshold
1813	Height High at Threshold
1815	Heading Excursion During Landing Roll
1817	Short Flare Distance
1818	Long Flare Distance
1819	Short Flare Time
1820	High Vertical Speed before Touchdown
1821	Localizer Deviation at Landing (threshold)
1822	Aircraft not on center line
1905	Engine Reverser selected in Flight
1906	Bounced Landing
1917	Dual Input
1950	Questionable decrab
2206	Wing Strike Risk at Landing
2207	Hard Landing Risk

Figure 3.3.1.4.4 – Landing Events used in EBT FDA Study by name and number

EBT Flight Data Analysis	
Event ID	Serious Landing Events
1200	Bank High in Approach (below 100ft)
1210	Bank High During Flare (below 10ft)
1211	Bank oscillation in Approach (below 100ft)
1812	Height Low at Threshold
1815	Heading Excursion During Landing Roll
1906	Bounced Landing
2206	Wing Strike Risk at Landing
2207	Hard Landing Risk
1922	GPWS Warning (below 500ft)

Figure 3.3.1.4.4b – Serious Landing Events used in EBT FDA Study by name and number

EBT Flight Data Analysis	
Event ID	Go Around Events
1008	Speed Above VLO Retraction
1009	Speed Above VLE
1016	Speed Above VLO Extension
1017	Speed Above VFE
1025	Speed Above Recommended Turbulence Speed
1028	Speed Low
1032	Speed High in Climb (below 1000ft)
1038	Speed Low in Climb (100ft - 1500ft)
1100	Pitch High at Take Off
1101	Pitch Rate High at Take Off
1102	Pitch Rate Low at Take Off
1103	Pitch High in Climb
1104	Pitch Low in Climb
1206	Bank High in Climb (Take Off - 100ft)
1207	Bank High in Climb (100ft - 400ft)
1208	Bank High in Climb (400ft - 1000ft)
1209	Bank Cycling at Take Off
1407	Rate Of Climb Low in Climb (below 1000ft AFE)
1500	Vertical Acceleration High at Take Off
1501	Vertical Acceleration Hi in Flight
1600	Flaps Early Retraction at Take Off
1605	Configuration Change Questionable during Go Around
1609	Landing Gear Late Retraction
1613	Speed Brakes Out with Significant Thrust
1618	Rudder Large Inputs (above 200ft)
1702	EGT High
1800	HDG Deviation at Take Off (100kts - Rotation)
1903	Windshear Warning
1909	Alpha Floor
1910	Alternate Law
1911	Direct Law
1917	Dual Inputs
1918	TCAS Resolution Advisory
1921	GPWS Warning (1000ft - 500ft)
1922	GPWS Warning (below 500ft)
1930	Stall Warning

Figure 3.3.1.4.4a– Go-around Events used in EBT FDA Study by name and number

Unstable Approach Event Set	
2000	Continuously Low during final
2001	Continuously Slow during final
2002	Continuously High during final
2003	Continuously Fast during final
2004	Continuously Steep during final
2009	Late Offset in Short Final
2012	Roll Oscillations prior to Flare

Figure 3.3.1.4.1 – Events used in EBT FDA Study by name and number to define the set of Unstable Approaches.

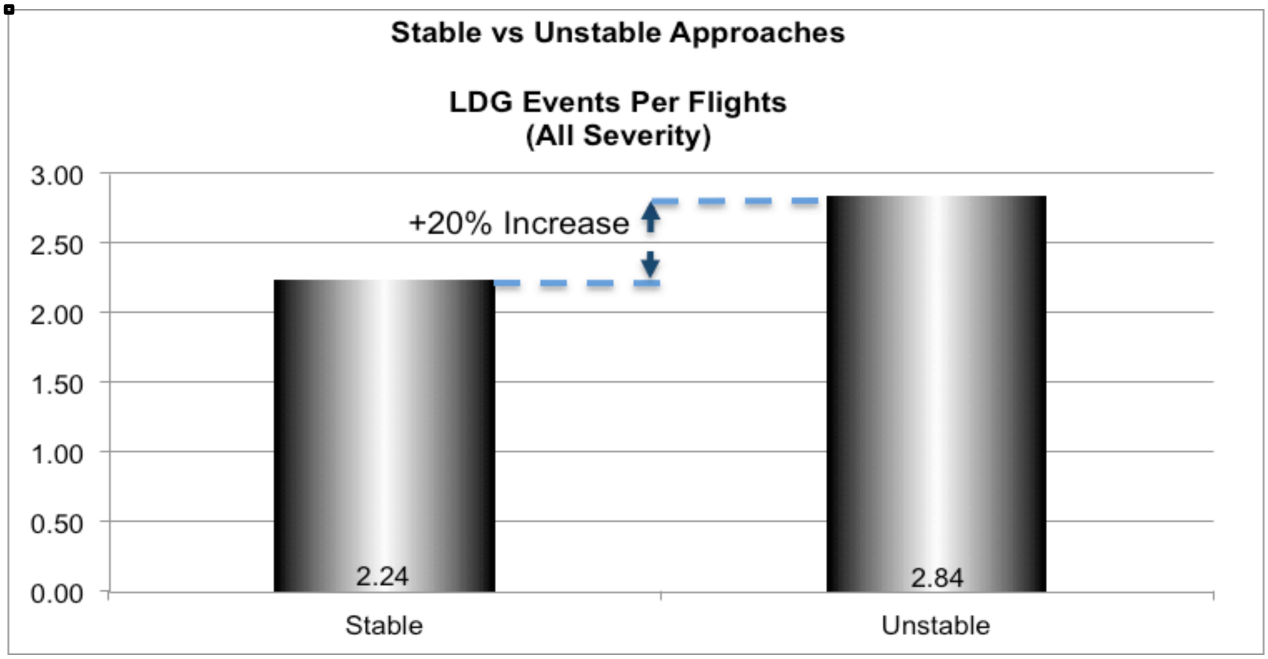


Figure 2.3c – Comparison of Stable versus Unstable approaches by the rate of landing events per flight using events of all severity

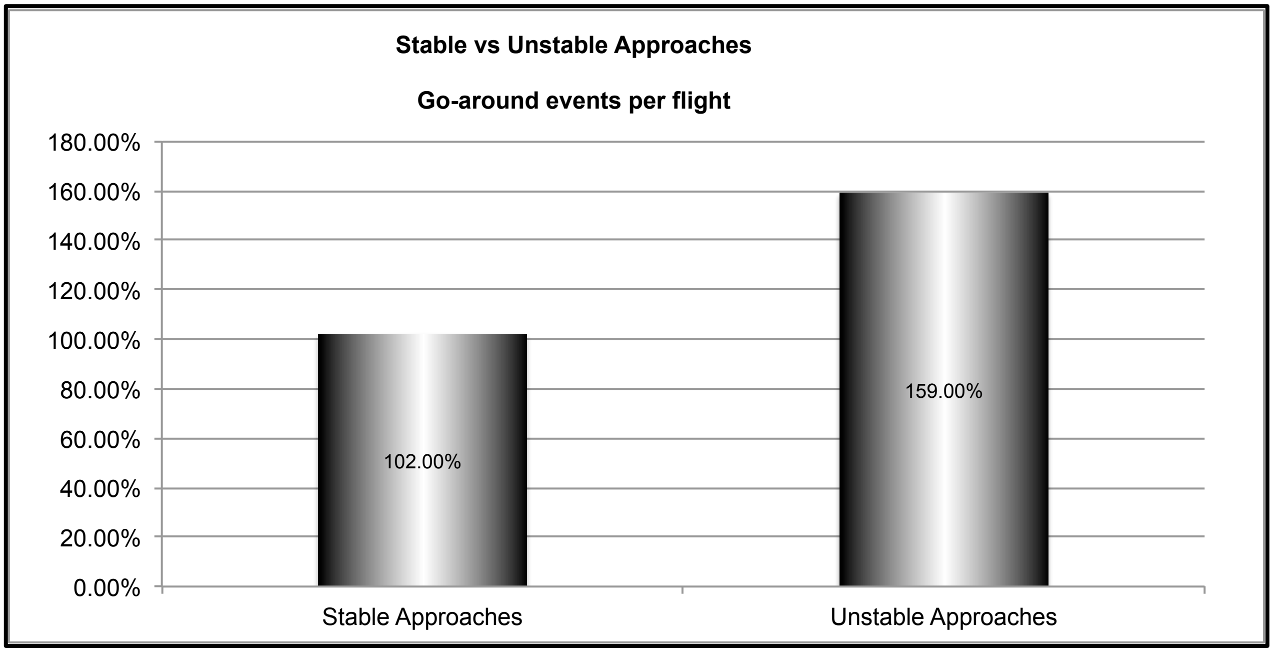


Figure 2.3d – Comparison of Stable versus Unstable approaches by the percentage rate of Go-around events per flight using events of all severity

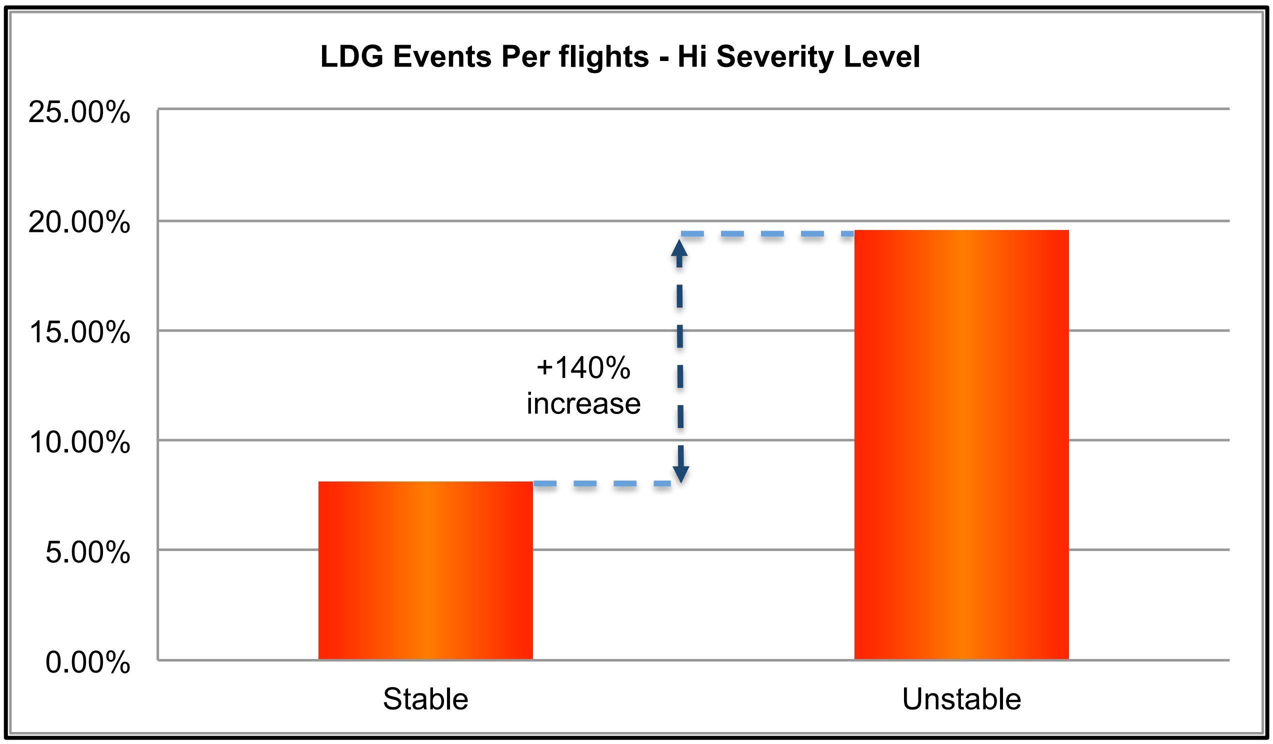


Figure 2.3e – Comparison of Stable versus Unstable approaches by the percentage rate of landing events per flight using events of high severity

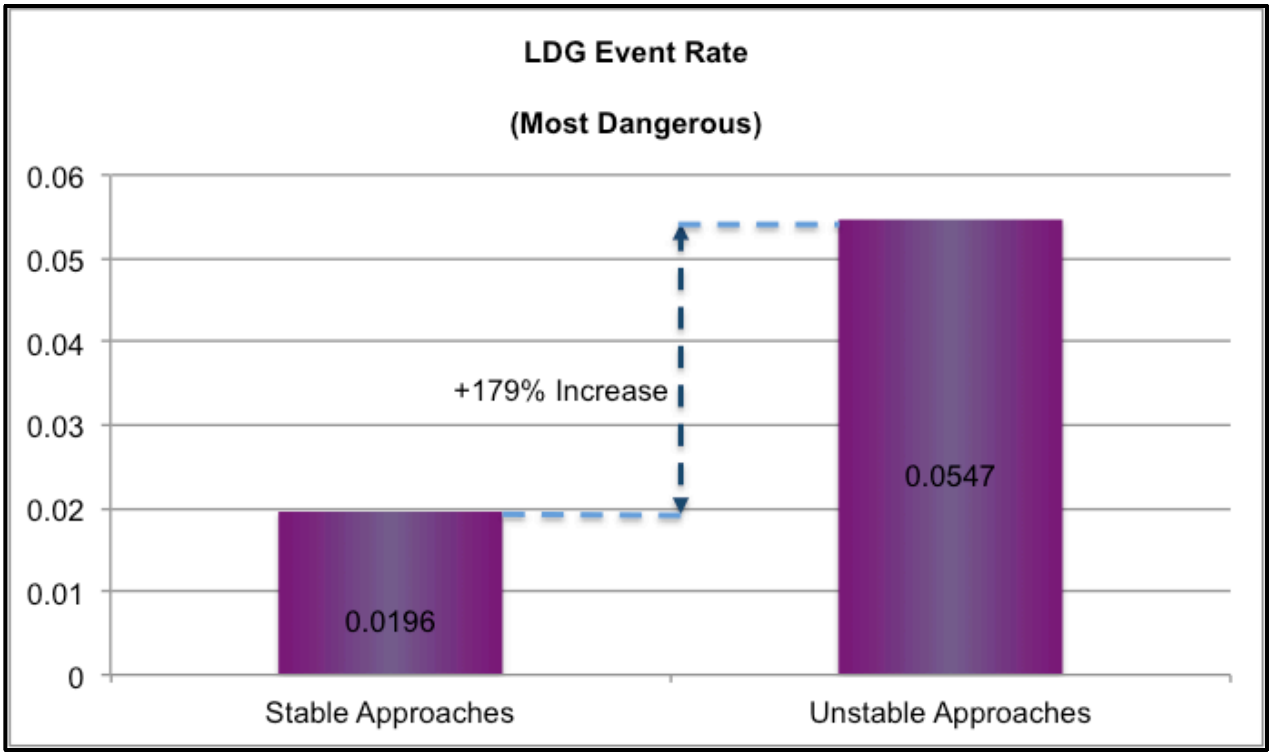


Figure 2.3g – Comparison of Stable versus Unstable approaches by the rate of landing events per flight using events categorized as Most Dangerous

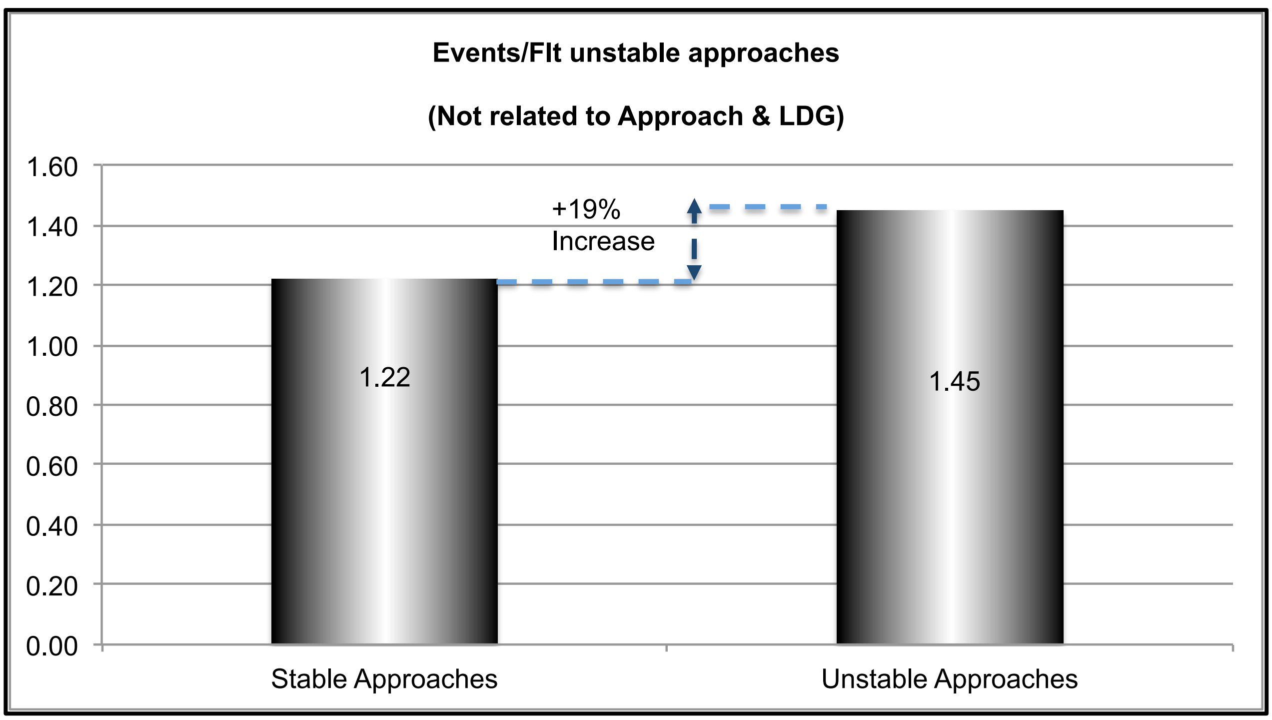


Figure 2.3h – Comparison of Stable versus Unstable approaches by the all event rate per flight using events occurring in flight phases other than approach and landing

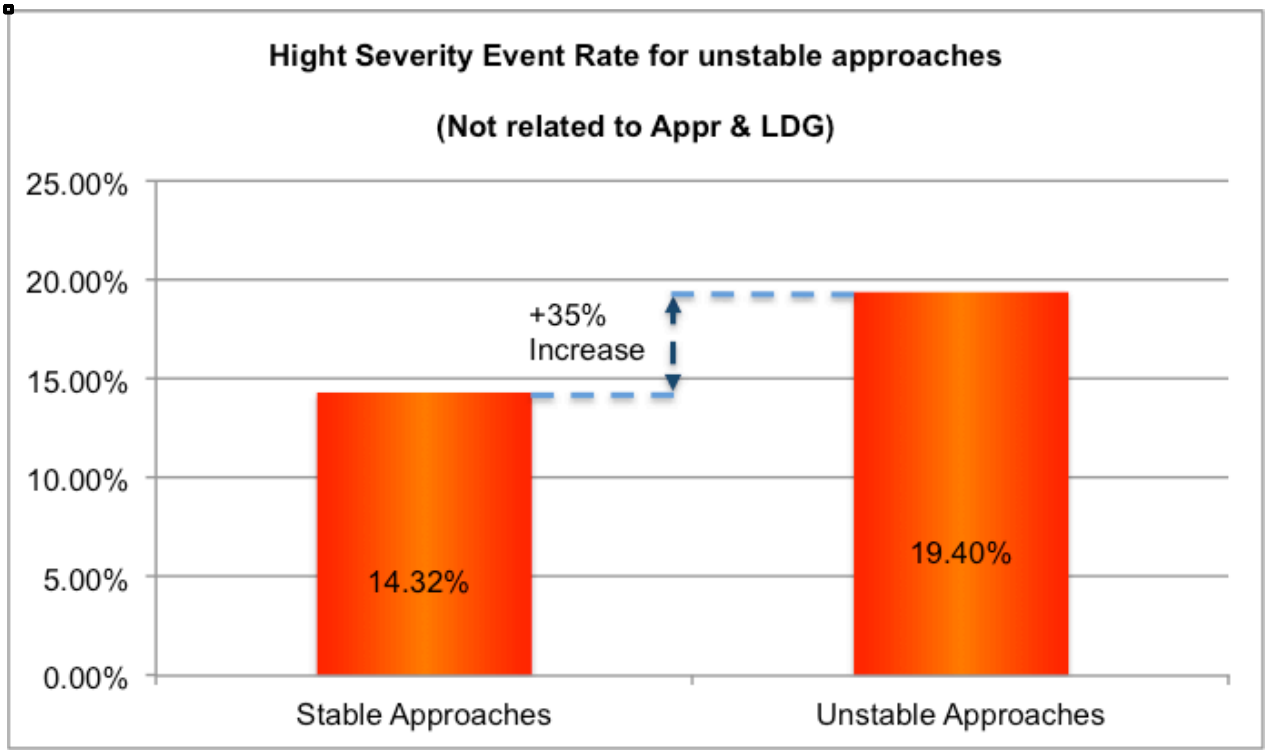


Figure 2.3i – Comparison of Stable versus Unstable approaches by the percentage of high severity events per flight using events occurring in flight phases other than approach and landing

EBT FDA Partitions
All flights
All go arounds
All stable approaches
All unstable approaches
Go-arounds from unstable approaches
Go-arounds from stable approaches
Landing from unstable approaches
Landing from unstable appraoches with a detected event at landing (high, medium or low)
Landing from unstable appraoches with a detected event at landing (high, medium)
Landing from unstable appraoches with a detected event at landing (high)
Landing from stable approaches
Landing from stable approaches with a detected event at landing (high, medium or low)
Landing from stable approaches with a detected event at landing (high, medium)
Landing from stable approaches with a detected event at landing (high)
Events in stable landings (high, medium or low)
Events in stable landings (high, medium)
Events in stable landings (high)
Events in unstable landings (high, medium or low)
Events in unstable landings (high, medium)
Events in unstable landings (high)

Figure 3.3.1.4.2 – Definition of the EBT FDA partitions of the sets for comparison of stable approaches to unstable approaches

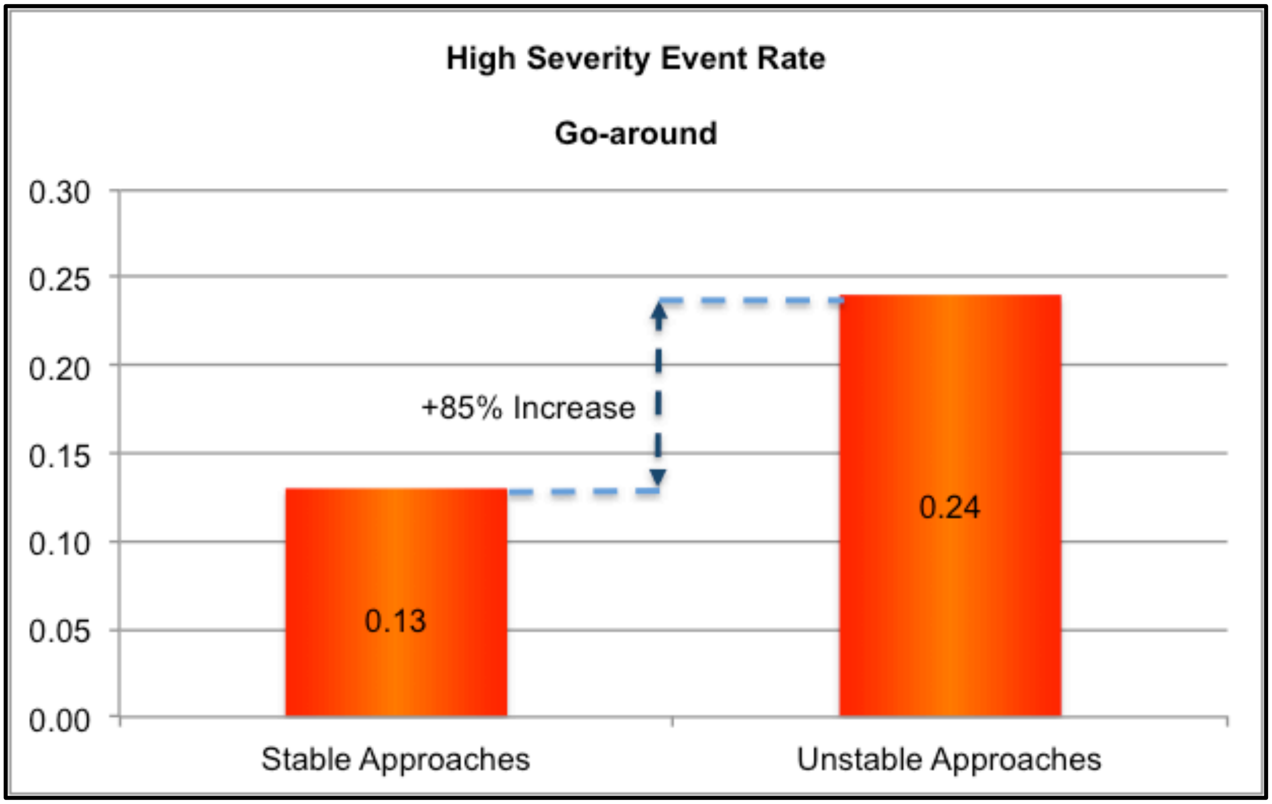


Figure 2.3f – Comparison of Stable versus Unstable approaches by the percentage rate of Go-around events per flight using events of high severity

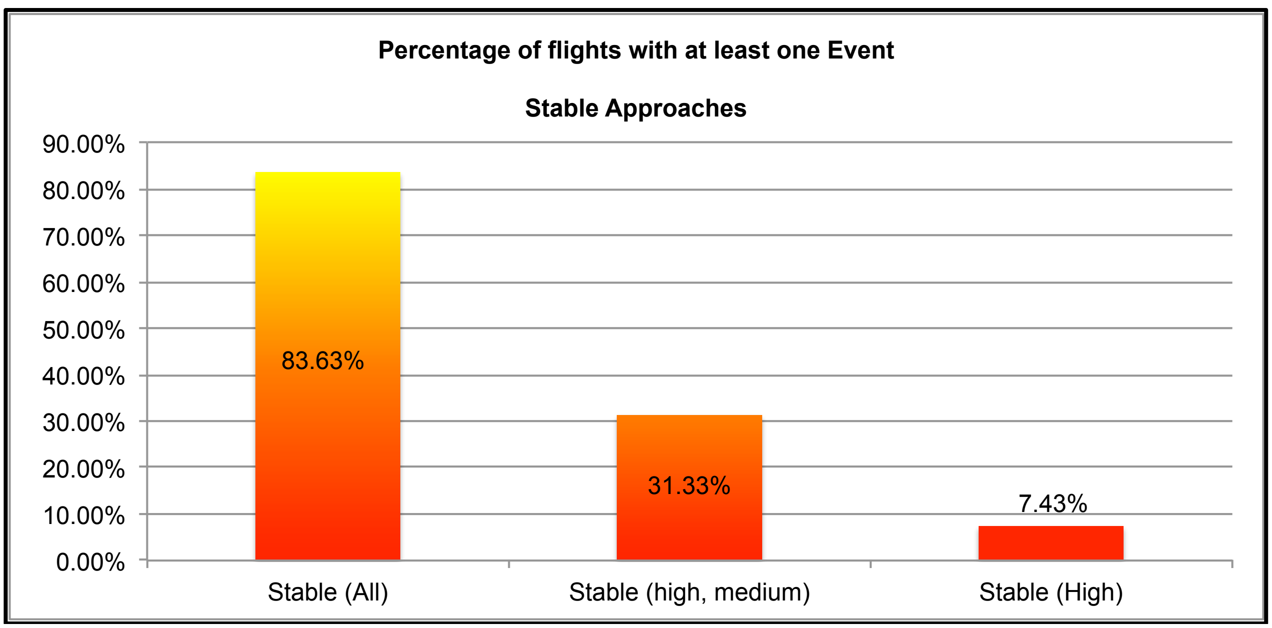


Figure 2.3b – Comparison of the percentage flights for the set of stable approaches with at least one event by severity levels

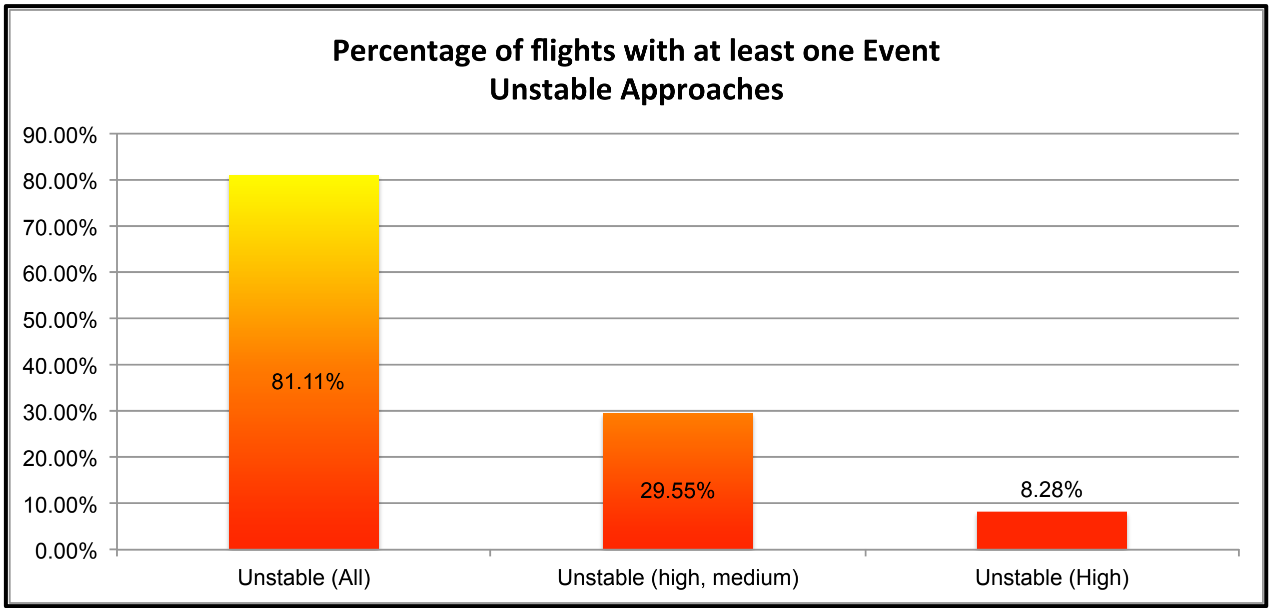


Figure 2.3c – Comparison of the percentage flights for the set of unstable approaches with at least one event by severity levels

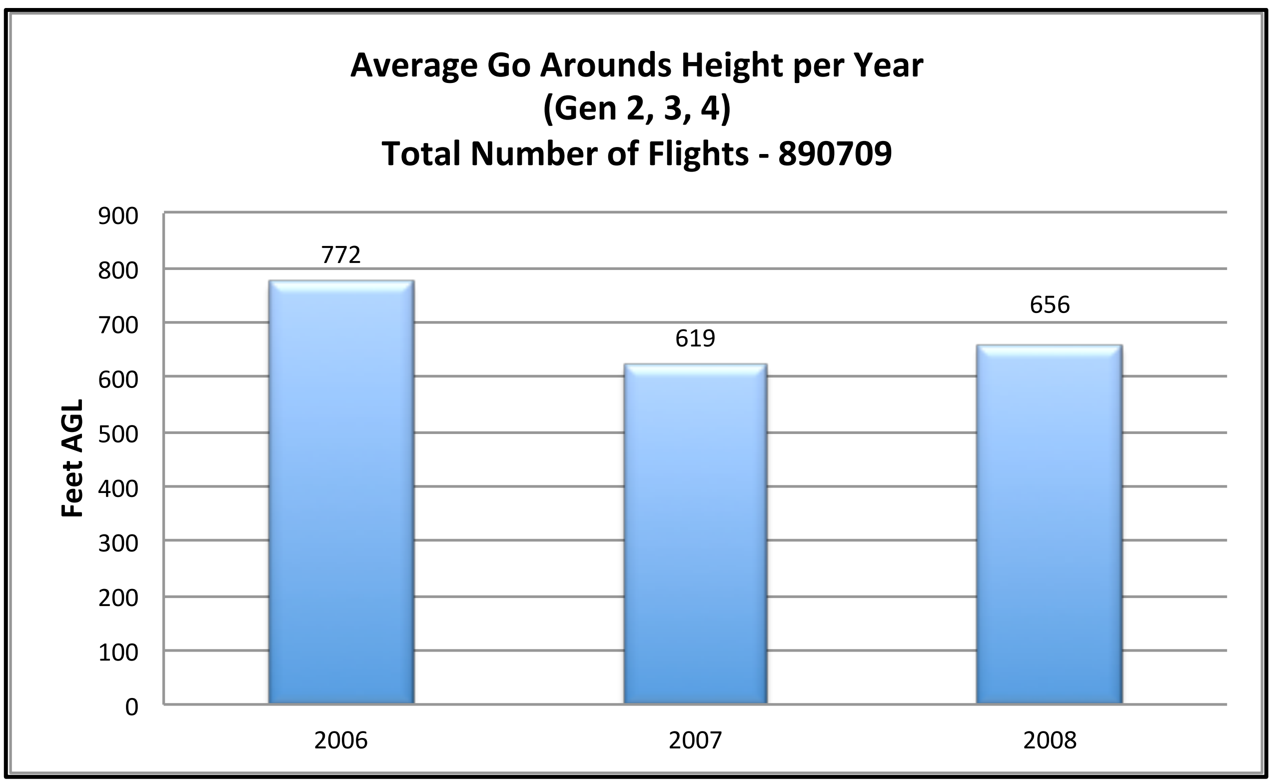


Figure A7.1– Average Go-around initiation height by for generation 2, 3, and 4 aircraft for the years 2006, 2007 and 2008 for a set of flights from multiple airlines with a sample size of N = 890,709

7.3 LONG AIRCRAFT TYPE/VARIANT DIFFERENCE ON LANDING AND TAKEOFF

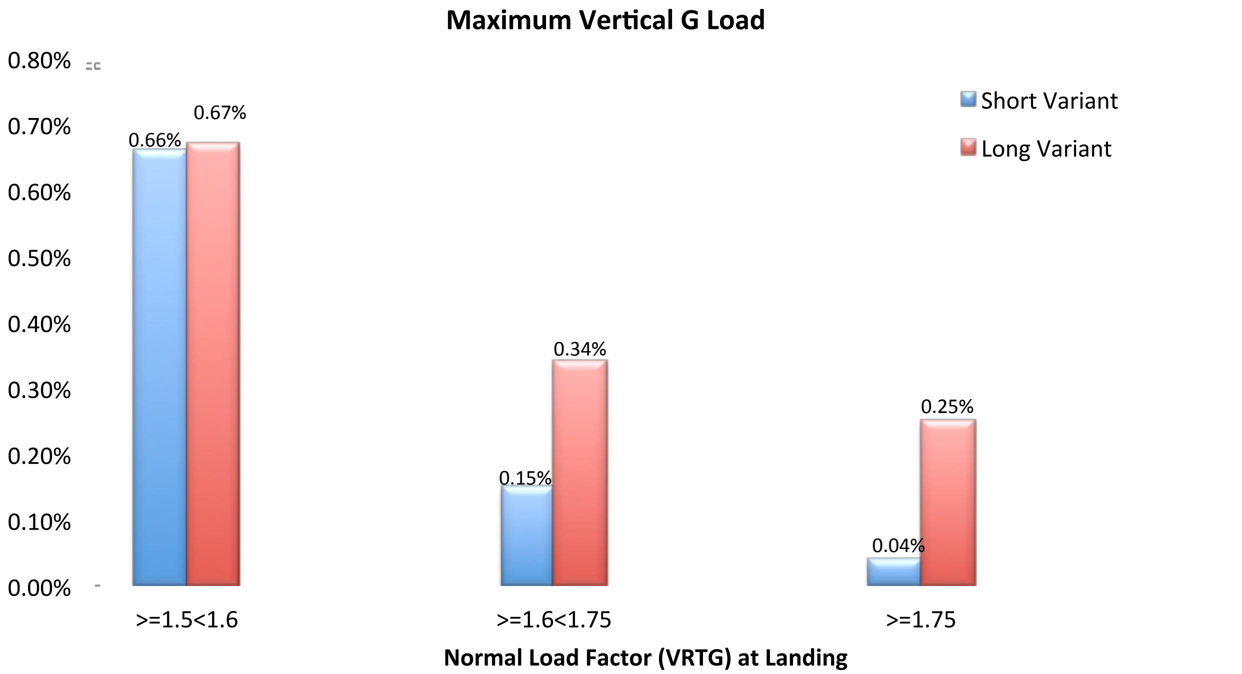


Figure 4.2.3.2.1 – Comparison of landing rates of long variant aircraft versus short variant aircraft in terms of maximum vertical acceleration during touchdown in three defined acceleration intervals

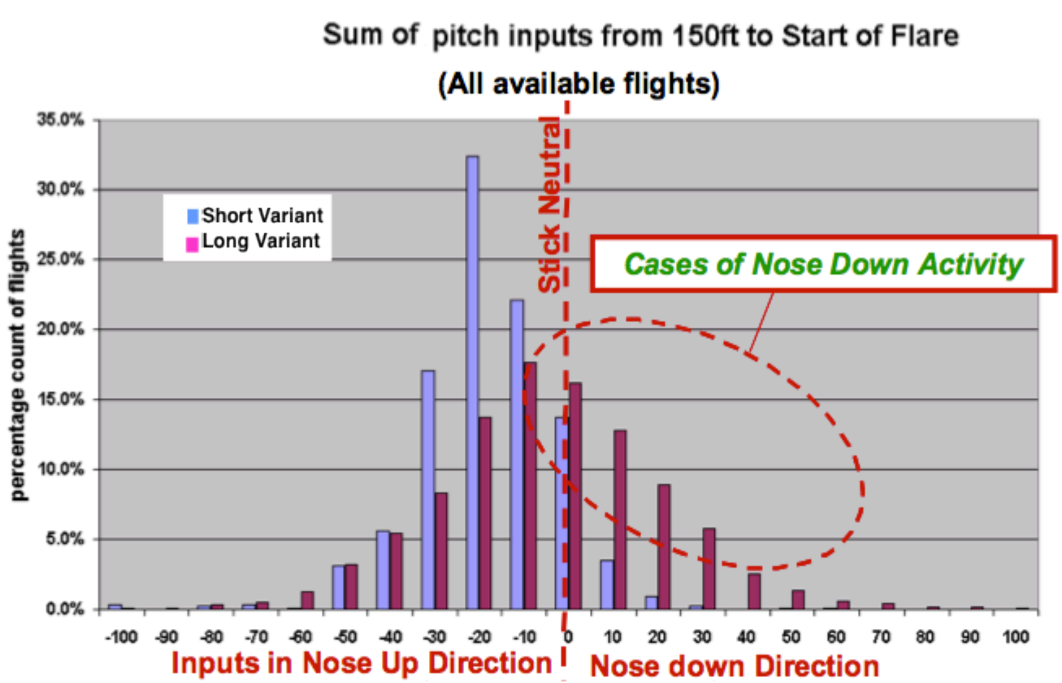


Figure 4.2.3.2.1a – Comparison of Long variant aircraft versus short variant aircraft in terms of pitch inputs from 150ft above runway threshold to beginning of flare

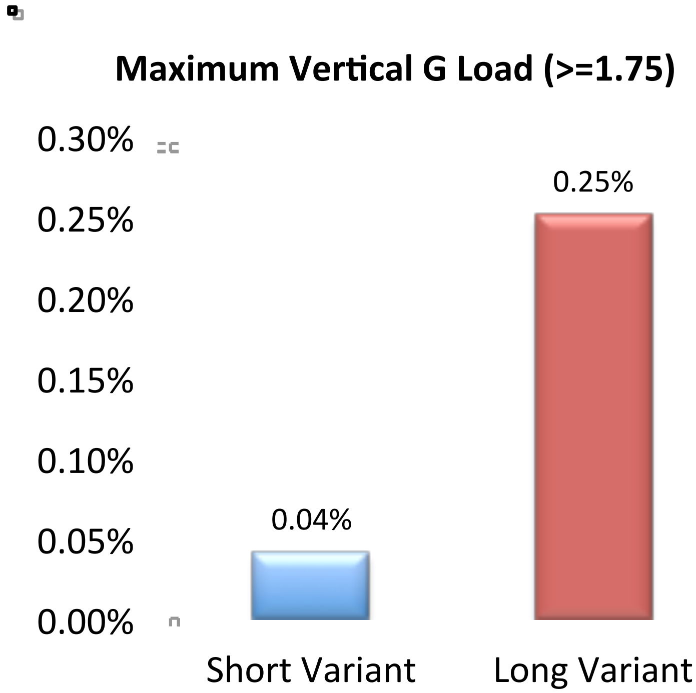


Figure 4.2.2.2a – Comparison of landing rates of long variant aircraft versus short variant aircraft in terms of maximum vertical acceleration during touchdown with values equal to or greater than 1.75g

APPENDIX 8
DEFINITIONS OF EVENTS USED IN EBT FDA

8.1 INTRODUCTION

All the events below were utilized in the EBT Flight Data Analysis Study and are defined by event number and operational goal.

1008 – Speed Above VLO Retraction Operational Goal

When the landing gear is selected to retract/up, this event is raised if the airspeed or Mach number exceeds the Maximum Landing Gear Operating Speed (_**VLO**) for more than 3 seconds.

If the landing gear is operated from extend to retract above the Maximum Landing Gear Operating Speed (_**VLO**) the gear doors may be damaged, with possible damage to the gear assembly.

The event is triggered only in the High severity level.

1009 – Speed Above VLE Operational Goal

This event is raised if the airspeed or Mach number exceeds for more than 3 seconds the Maximum Landing Gear Extended Speed limit (VLE) when the landing gear is extended/down.

Exceeding the VLE limit with the landing gear extended can damage the structure of the **AC** or the landing gear.

The event is triggered only in High severity level.

1016 – Speed Above VLO Extension Operational Goal

While the landing gear is selected to extend/down, this event is raised if the airspeed exceeds the Maximum Landing Gear Operating Speed (VLO) for more than 3 seconds.

If the landing gear is operated above the Maximum Landing Gear Operating Speed (VLO), the gear doors may be damaged with possible consequences to the gear assembly.

The event is triggered in High severity level only.

1017 – Speed Above VFE Operational Goal

Before the flaps / slats are retracted after take-off, this event detects if the **AC** speed exceeds the Maximum Flap Extended Speed limit (_**VFE**) for more than 3 seconds.

Exceeding AC structural limit speeds can cause AC damage and any exceedances will generate hearing and visual warnings to alert the crew.

Events to detect these exceedances and **AC** warnings are essential in a Flight Analysis System. The severity levels are Medium and High, with no Low level.

1022 – Speed High at Touch Down

Operational Goal

This event is raised if the **AC** airspeed (**_CAS**) at landing is faster than the Approach Speed (**_VAPP**). The **AC** flies the approach at the required approach speed **_VAPP**, and by the landing the airspeed will normally be reduced below **_VAPP**.

A high speed at landing can cause extra brake and tire wear or lead to over-runs on short or slippery runways.

1023 – Speed Low at Touch down Operational Goal

This event detects if the airspeed at landing is more than 5 kts. below the aircraft minimum airspeed (_VLS).

A low airspeed at landing may result in a heavy, or short landing, or a tail-strike due to the high pitch attitude at low speed.

1024 – Speed Above Maximum Tire Speed Operational Goal

This event detects if the AC ground speed (_GS) exceeds the Maximum Tire Limit Speed with the AC on the ground.

The AC tires have a maximum speed limit, which varies according to the aircraft type. If this ground speed is exceeded, damage to the tires can occur, such as treads detaching or tires weakening so it may fail later at normal speeds.

1025 – Speed Above Recommended Turbulence Speed Operational Goal

This event detects if AC speed exceeds the Turbulence Target Speed (280 kts or .78 Mach) in turbulent conditions.

In turbulence the AC speed and vertical acceleration fluctuate significantly, and may reach the high and low speed limits in extreme conditions. While flying fast, the maximum speed limit can be exceeded and the probability of passenger injury is increased.

While flying slowly, airspeed may drop below the minimum speed with the likelihood of control difficulties.

The turbulence target speed is chosen to give sufficient margins from both the high and low speed limits.

1028 – Speed Low Operational Goal

This event detects if the airspeed (_CAS) decreases for more than 3 seconds below the lowest selectable speed (_VLS), which is the lowest speed permitted in normal operations.

The auto-thrust system should always prevent the airspeed decreasing below VLS.

Any decrease below VLS indicates an abnormal situation, which should have been detected and corrected by the crew.

1029 – Braking Delayed at Landing Operational Goal

This event is raised when the **AC** deceleration from high speed is slow by comparing the time to decelerate 50 kts against the Deviation time limits.

Immediately after main landing gear touch down, reverse thrust is normally selected which decelerates the aircraft the most effectively from high speed, and may be augmented by auto-brake, with manual braking being used at low speed.

Slow deceleration at high speed indicates a delay in reverse thrust selection when it is the most effective and thus a possible abnormality. However some operators use minimum reverse to keep brake temperatures at optimum, and certain airfields prohibit use of max reverse thrust for noise abatement.

The crew may have elected minimum reverse and braking if they have to continue to the end of a long runway after landing.

1032 – Speed High in Climb (below 1000ft) Operational Goal

This event is raised when the AC climb speed is more than 30 kts above V2 and the Pitch attitude is less than 15 degrees when below 1000ft AFE, indicating that the aircraft has accelerated too soon during the initial climb.

The initial profile after take off normally requires a climb speed of V2 plus 10-15 kts to at least 1000ft AFE, and besides being non-standard early acceleration to higher speeds may erode terrain clearance in limiting conditions.

1033 – Tail Wind at Landing (below 100ft)

Operational Goal

This event detects a landing with a tail wind of more than 8 kts A strong tail wind increases the landing speed and the required runway distance.

Most aircrafts have a tail wind limit for landing of 10 kts but this may be increased with an amendment to the Aircraft Flight Manual.

It may be preferable to land at certain airports on runways where the tail wind is the lowest available; however some airport authorities use runways that are preferred for noise abatement with significant tail-winds which may adversely affect safety standards.

1035 – Braking Questionable at Landing Operational Goal

This event detects harsh braking when the **AC** deceleration below 100 kts on runway is at least 0.35G for 3 seconds.

Braking should always be made smoothly for passenger comfort and to minimize wear of aircraft systems.

Harsh braking can indicate poor planning, or execution of the approach and landing, or an external problem, which might point to a possible ground incident. Harsh braking can also indicate unnecessary early runway exit, which may be due to ATC factors.

1038 – Speed Low in Climb (100ft – 1500ft) Operational Goal

This event detects if the airspeed (_CAS) in the initial climb between 100 feet and 1500 feet is below V2 plus 6 kts for more than 3 seconds.

The AC should initially climb at close to V2 + 10 kts with all engines operating.

A lower speed may indicate wind shear or questionable handling technique, and safety margins may be affected if speed falls below V2.

1100 – Pitch High at Take Off Operational Goal

This event detects high pitch attitude at take-off. If the HIGH limit of this event is exceeded, a tail strike may occur.

High pitch at take-off may be linked to a wrong pitch trim setting, an AC balance error, or a questionable rotation technique

1101 – Pitch Rate High at Take Off Operational Goal

This event detects a too rapid rotation rate at take-off. If the rotation rate exceeds the relevant triggering values during the MW, the event is raised with the corresponding severity.

The normal rotation rate during take-off is 3° per second, and a very strong rotation can lead to the possibility of a tail strike, a low initial climb speed affecting performance and/or an abnormal G factor.

Higher rotation rates than usual ones might be necessary or explained in abnormal circumstances such as wind shear or take-off roll longer than expected.

1102 – Pitch Rate Low at Take Off

Operational Goal

This event detects too slow rotation rate at take-off if the rotation rate is less than 2.25° per second.

The normal rotation rate during take-off is 3° per second, and a slow rotation rate can lead to a high initial climb speed reducing obstacle clearance.

Slow rotation rates might be necessary in abnormal circumstances such as wind shear.

1103 – Pitch High in Climb

Operational Goal

This event detects if the AC pitch angle is above a defined value in initial climb for longer than 3 seconds. A pitch angle above this value may indicate aircraft mishandling or an abnormal situation such as wind shear.

1104 – Pitch Low in Climb

Operational Goal

This event detects if the AC pitch angle is less than a defined value in initial climb for more than 3 seconds. A pitch angle below this value can indicate aircraft mishandling or an abnormal situation such as system failure or wind shear. A low pitch may also significantly reduce the obstacle clearance

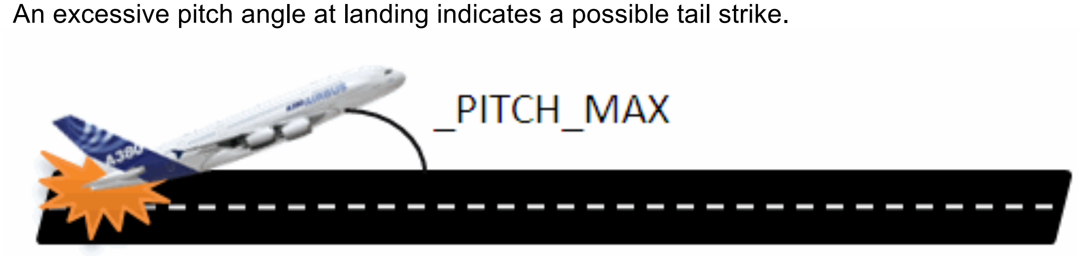
1105 – Side Stick Pitch cycling at Landing (below 200ft) Operational Goal

Side stick pitch cycling has been identified as a contributing factor in high G landings. Nose down input should be avoided below 100ft. Side stick pitch cycling is detrimental to a well-controlled flare and landing.

1108 – Pitch High at Touch Down Operational Goal

This event detects if the AC pitch angle exceeds the limit imposed by the geometric configuration of the AC at landing (rear fuselage length, and landing gear extension when compressed).

An excessive pitch angle at landing indicates a possible tail strike.



1109 – Pitch Low at Touch Down

Operational Goal

This event detects a pitch attitude of less than 2,5° during landing.

Low pitch angle during landing can indicate high approach airspeed or under-flare, which could lead to a heavy touch down. In some cases it may even lead to a nose gear harsh touch down.

1111 – Pitch Rate High at Landing

Operational Goal

This event detects a rapid rotation rate (more than 2° per second) during the landing flare.

Following a stabilized approach the landing flare should consist of a gentle increase in pitch from the approach attitude to arrest the rate of decent prior to touch down.

A too strong flare may lead to a tail strike or indicate an abnormal approach. Rapid rotations in the flare might be necessary in wind shear or with a down draft close to the runway.

1200 – Bank High in Approach (below 100ft)

Operational Goal

This event detects if the AC bank angle is more than 6° below 100 feet AFE in final approach.

High bank angles at very low altitude could be due to wind shear or a severe crosswind, or could indicate a poor approach technique and may lead to wingtip strike or engine nacelle damage or a runway lateral excursion. It may also lead to poor accuracy at landing resulting in reduced lateral margins from obstacles or other aircraft on ground.

1205 – Side Stick Roll cycling (below 200ft)

Operational Goal

Side stick roll cycling has been identified as contributing factors to high g landings. Side stick roll cycling is detrimental to a well-controlled flare and a wings level landing.

1206 – Bank High in Initial Climb (Take Off – 100ft)

Operational Goal

This event detects if the AC bank angle is more than 6° for longer than 3 seconds below 100 feet AFE in the initial take-off phase.

High bank angles at very low altitude after take-off may indicate directional control problems perhaps after an engine failure or in wind shear or a severe crosswind. It may also be associated to a questionable side stick lateral input during rotation initiation.

1207 – Bank High in Initial Climb (100ft – 400ft)

Operational Goal

This event detects if the AC bank angle is more than 15° for longer than 3 seconds between 100 feet AFE and 400 feet AFE in the initial climb.

High bank angles at low altitude in the initial climb might indicate directional control problems perhaps after an engine failure, which could significantly degrade climb performance, or could simply be required by tight turns in the departure procedure.

1208 – Bank High in Initial Climb (400ft – 1000ft)

Operational Goal

This event detects if bank angle is more than 25° between 400 feet AFE and 1000 feet AFE in the initial climb for longer than 5 seconds.

High bank angles in the initial climb might indicate directional control problems perhaps after an engine failure, which could significantly degrade, climb performance, or could simply be required by tight turns in the departure procedure.

1209 – Bank Cycling during Initial Climb

Operational Goal

This event detects abnormal bank oscillations during the initial climb by counting the number of times the AC rolls in opposite directions around the average bank angle taken over a maximum time interval.

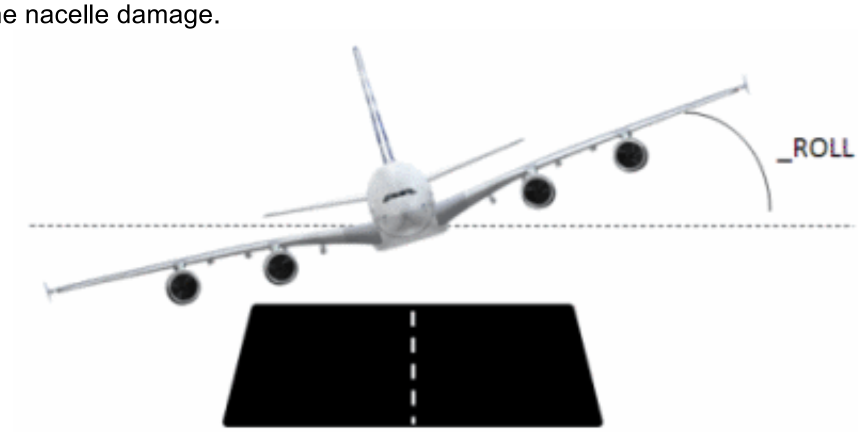
Bank oscillations during the initial climb could indicate a control problem due to a system failure or over- controlling by the pilot.

1210 – Bank High during Flare (below 10ft)

Operational Goal

This event detects bank angles of more than 5° below 10ft Radio Altimeter (RA) and lasts the first 10 seconds of the landing roll.

Bank angles during the flare could be required to align the aircraft with the runway centerline in strong crosswinds, otherwise significant bank angles in the flare and initial landing roll could indicate an abnormal situation possibly leading to a runway lateral excursion and/or wingtip strike or engine nacelle damage.



1211 – Bank Oscillation in Approach (below 100ft)

Operational Goal

This event detects large bank angle changes below 100 feet AFE.

Significant bank angles below 100ft may be required for runway alignment during strong cross winds, but large changes in bank angles could indicate an abnormal situation possibly leading to a runway lateral excursion and/or wingtip strike or engine nacelle damage.

1219 – Roll Spoilers extension at Landing (below 50ft)

Operational Goal

Except for strong crosswind de-crab techniques, roll spoilers extension during flare may lead to a residual bank at landing and to a possible wing tip /engine nacelle damage or may lead to a runway excursion

1405 – Path High at Landing (below 20ft)

Operational Goal

This event detects if the descent slope from 20 feet to the ground is steeper than 2.25. A steep descent slope below 50ft may lead to a hard landing and possible AC damage.

1407 – Rate of Climb Low in Initial Climb (below 1000ft)

Operational Goal

This event detects if the climb rate after take-off is less than 1000 feet per minute for longer than 5 seconds. With all engines operating after take-off, rates of climb should normally be higher than 1000 feet per minute.

Lower climb rates may indicate an engine failure or weather conditions such as wind shear or abnormal aircraft handling resulting in early acceleration. Low climb rates may conflict with the obstacle clearance requirements.

1500 – Vertical Acceleration High at Take Off

Operational Goal

This event detects if the vertical acceleration for a normal take-off is exceeded. A high acceleration rate during rotation can indicate incorrect operational technique, control system abnormality, aircraft erroneous balance or external influence such as wind shear.

1501 – Vertical Acceleration High in Flight

Operational Goal

This event detects abnormalities such as in flight turbulence by monitoring abnormal vertical accelerations during the flight.

1504 – Vertical Acceleration High at Touchdown

Operational Goal

This event detects High G landings by monitoring touchdowns, which exceed Vertical Acceleration of 1.5G. A family of High G landings might be associated to local factors (high altitude airports, wind shear, surrounding terrain, uphill runways etc.). A severe High G landing might indicate, but not always, a hard landing as per the maintenance manual.

1510 – Lateral Acceleration High at Touchdown

Operational Goal

High Lateral acceleration may occur with crosswind or engine out landings. It may result in undue fatigue or damage for the landing gear and the AC structure.

1602 – Flaps Questionable Setting at Landing

Operational Goal

This event detects an incorrect flap setting on landing (LANDING).

AIRBUS recommendation is to land in CONF FULL except if a possible wind shear can be anticipated. An INFO event is raised if landing is done in CONF 3.

1605 – Configuration Change Questionable during Go Around

Operational Goal

This event is detected when a Go Around Procedure is carried out incorrectly by monitoring that the flap configuration changes and gear selection are made in the correct sequence and time frame.

1609 – Landing Gear Late Retraction

Operational Goal

This event detects if the landing gear is retracted significantly later than normal after take off, missed approach or go-around. In normal operation the gear is retracted as soon as the crew confirms a positive climb from the flight instruments, normally by about 100ft AFE.

If the gear retraction is delayed, the increased aerodynamic drag could reduce terrain clearance during the initial climb especially following an engine failure.

After a touch and go, the gear may be left extended to cool the wheel assembly

1611 – Reversers Delayed at Landing

Operational Goal

This event detects late selection of engine thrust reversers after landing.

Reverse thrust is normally selected immediately after main gear touchdown, and late selection of reversers delays the ground spoilers extension back-up logics (when spoilers are not armed); It increases landing distance, which is aggravated with a slippery runway surface; It also affects brake wear.

1613 – Speed Brakes Out with Significant Thrust

Operational Goal

This event detects when the speed brakes, also called airbrakes, are selected out with engines at thrust above 60% N1 (or 1.15 EPR) for longer than 20 seconds.

This condition is normally a result of the crew forgetting to retract the speed brakes, and is accompanied by an ECAM warning.

1618 – Rudder Large Inputs (above 200ft)

Operational Goal

This event detects abnormal rudder deflection commands from the crew. Excessive rudder deflection commands can over stress the AC structure and reveals highly abnormal handling of the AC.

1619 – Reversers High Thrust at Low Speed

Operational Goal

This event detects if the thrust reversers are not cancelled at the normal speed during the landing roll.

Thrust reversers are most effective at high speed. At low speed hot airflow from the reverser exhaust can be ingested by engines causing surges or loud explosions as well as possible engine damage from the shock and ingestion of foreign objects.

Reverse thrust should therefore be reduced at 70kts towards idle reverse, which should be cancelled by taxi speed of about 25 knots. However in an emergency, full reverse thrust can be kept until the aircraft has stopped.

Triggering of this event would usually indicate mishandling of reverse thrust, but could indicate an emergency stop.

1702 – EGT High

Operational Goal

This event is raised when an engine Exhaust Gas Temperature (EGT) exceeds the manufacturer's limit during a take-off or Go Around for more than 2 seconds.

An excessive EGT may damage the engine hot end section with a likelihood of subsequent failure if maintenance actions are not taken.

This event alerts that an engine inspection is required.

1703 – Thrust Reduction Late at Landing

Operational Goal

This event detects if the thrust is reduced late (below 10ft) during landing, both with and without active Auto thrust.

A hard or bounced landing can result if the thrust is not reduced at the correct rate and height above the runway. It may affect the landing distance performance.

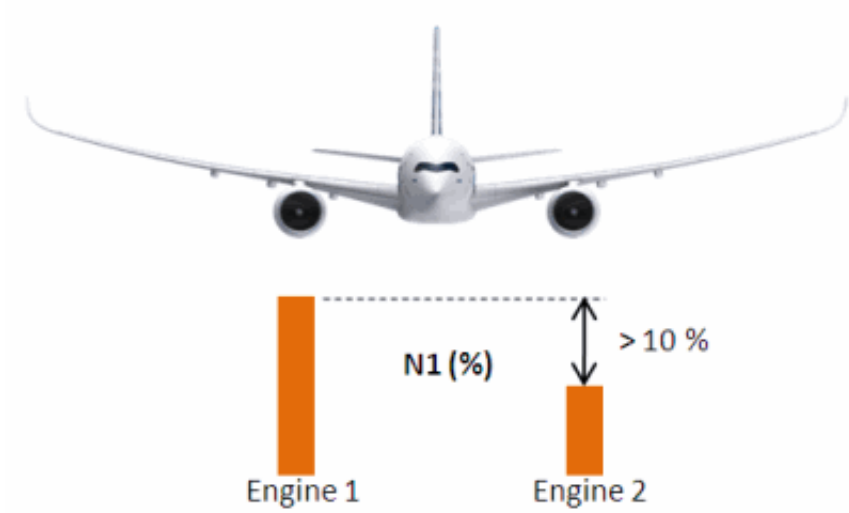
If the thrust levers are not retarded to Idle the Auto thrust will still be operative and as the aircraft is flared and the speed tends to decrease this will cause an increase in thrust. An increase in thrust during the flare will cause an increase in flare distance with its associated hazards.

1706 – Thrust Asymmetry during Landing Roll Out

Operational Goal

This event detects if thrust asymmetry between right and left engines at landing exceeds a certain threshold with both engines operative in reverse thrust.

With both engines operative reverse thrust asymmetry can be due to crew thrust lever mishandling or an engine malfunction, and can lead to runway excursions especially on a slippery runway surface.



1800 – HDG Deviation at Take Off (100kts – Rotation)

Operational Goal

This event detects significant aircraft heading changes during the take-off roll. This can indicate a lateral control problem due to an incorrect control input, a residual rudder trim setting, a crosswind factor or another abnormality causing a deviation from the centerline, which require heading changes to realign the aircraft with the runway.

1807 – Heading Deviation at Landing (above 60kts)

Operational Goal

This event detects if there is a Heading Deviation during the landing roll (LANDING) above 60 kts. This can be due to severe crosswinds, crew mishandling or an abnormal aircraft condition leading to an AC deviation from the runway centerline.

1808 – Long Flare Time

Operational Goal

This event detects if a flare is abnormally long. A flare which is too long consumes excessive runway length, and on short runways, or runways with a slippery surface, this may lead to a hazardous situation.

1812 – Height Low at Threshold

Operational Goal

This event detects if the AC crosses the runway threshold (THR) at (or below) 35ft after an ILS approach.

The ILS normally guides the AC to cross the THR at 50 feet AFE, and passing the THR significantly lower indicates a landing close to the runway THR, which can lead to land before the runway paved surface (Short Landing).

1813 – Height High at Threshold

Operational Goal

This event detects if the AC crosses the runway threshold (THR) at (or above) 60ft AFE after an ILS approach.

The ILS normally guides the AC to cross the THR at 50 feet AFE, and passing the THR significantly higher can indicate an abnormal approach perhaps of high energy and may lead to overruns of the runway in limiting conditions.

1814 – HDG Significant Change in Approach (below 500ft)

Operational Goal

This event detects a significant heading change during final approach below 500 ft. AFE.

This often indicates a late parallel runway change, but could be a late alignment after a circling or visual approach, or corrections due to a strong cross wind.

1816 – Lateral Deviation at Landing

Operational Goal

This event detects significant excursions from the runway centerline from Touch Down to 50kts. Large lateral deviations at landing may lead to possible runway lateral excursions due to track size of this category of airplane and to a critical reduction in wing tip clearance to surrounding obstacles. Roll out should be laterally stable and not deviate from the centerline to prevent FOD on external engines (the external engines are high over ground and less prone to FOD than the internal engines on the A380).

1817 – Short Flare Distance

Operational Goal

This event detects when the AC lands too close to the runway threshold (THR), by monitoring the distance from THR to the first touch down point (LANDING) after an ILS approach.

AC, which lands short or close after the runway threshold may land in the approach area before the runway paved surface with inevitable AC damage.

1818 – Long Flare Distance

Operational Goal

This event detects if the AC lands too far from threshold (THR), by monitoring the distance from THR to the first touch down point (LANDING) after an ILS approach.

The hazard of an AC which lands considerably after the threshold is over-running the runway paved surface when the runway distance is limiting for the conditions, e.g. with slippery runway or tailwind.

1819 – Short Flare Time

Operational Goal

This event detects when a flare is abnormally short.

A short flare may lead to a hard landing, since the rate of descent may be abnormally high and or the flare maneuver started late by the pilot.

1820 – High Vertical Speed before Touchdown

Operational Goal

This event detects when the last part of the flare is performed with a high rate of descent. This can lead to a hard landing.

1821 – Heading Deviation at Take-Off

Operational Goal

This event detects significant aircraft heading changes late in the take-off roll during TAKE_OFF.

This can indicate a wing lifting due to an incorrect control input for a crosswind or other abnormality causing a deviation from the centerline, which require heading changes to realign the aircraft with the runway.

1822 – Aircraft not on centerline

Operational Goal

This event detects significant excursions from the runway centerline from runway threshold to Touch Down. Large lateral deviations at landing may lead to possible runway lateral excursions due to track size of this category of airplane and to a critical reduction in wing tip clearance to surrounding obstacles. Roll out should be laterally stable and not deviate from the centerline to prevent FOD on internal engines.

1903 – Windshear Warning

Operational Goal

This event is raised if the AC EGPWS system predicts Windshear conditions below 1500ft AFE.

1905 – Engine Reverser selected in Flight

Operational Goal

This event detects if reversers are engaged while aircraft is in flight.

1906 – Bounced Landing

Operational Goal

This event detects a bounced landing if the aircraft is airborne 1 second after a touch down.

1909 – Alpha Floor

Operational Goal

This event is raised when the Alpha floor high angle of attack protection is activated to apply full engine thrust (TOGA).

1910 – Alternate Law

Operational Goal

This event detects if the AC reverts to the Alternate Flight Control Law for 5 seconds.

1911 – Direct Law

Operational Goal

This event is raised when the AC reverts to the Direct Flight Control Law for 5 seconds.

1917 – Dual Stick Inputs

Operational Goal

This event detects occurrences of sidestick deflection occurring from both sidesticks at the same time (beyond thresholds in roll or pitch axis) that could affect aircraft trajectory or altitude beyond the path as intended by the PFs inputs. Dual inputs can also cause the PF to be out of the aircraft control loop. The aircraft is designed to be flown manually by one pilot and double stick inputs should not occur.

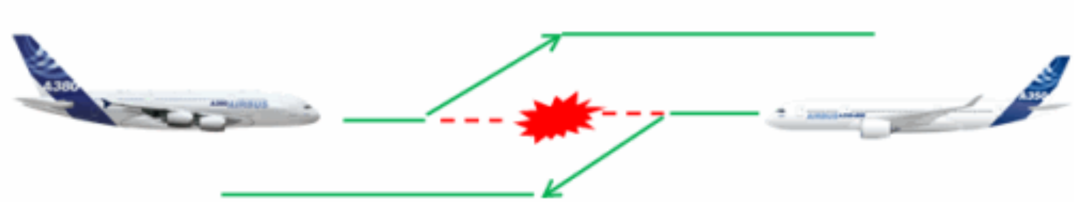
The thresholds used in the aircraft dual stick input logic have resulted from design and testing to represent the amount of significant sidestick inputs needed to start potentially unsafe trajectory changes. Hence AirFASE needs to monitor this same risk to safe flight.

It is not the intent of this event to monitor SOPs. Therefore for cases where the take-over button is used by the PNF, then event reset conditions are applied (i.e. no event is triggered or the event triggering condition is reset if it was previously triggered)

1918 – TCAS Resolution Advisory

Operational Goal

This event detects if the AC TCAS system issued a Resolution Advisory for 3 seconds. A TCAS systems issues a Resolution Advisory to the aircraft (e.g. to climb or descend) to avoid a possible collision with another aircraft. All Resolution Advisories should be investigated.



1921 – GPWS Warning (1000ft – 500ft)

Operational Goal

This event detects if the AC GPWS (Ground Proximity Warning System) issues a warning between 1000 feet AFE and 500 feet AFE.

A GPWS Glideslope warning is advisory only.

1922 – GPWS Warning (below 500ft)

Operational Goal

This event detects if the AC GPWS (Ground Proximity Warning System) issues a warning below 500 feet AFE.

2000 – Continuously Low during final

Operational Goal

This event detects approaches that cross 2 or more of 3 Altitude Gates at a shallow flight path angle, as detected by LEVEL 1 (M1) Path Low events

- 1313 – Path Low in Approach (at 1200ft),
- 1315 – Path Low in Approach (at 800ft) and
- 1317 – Path Low in Approach (at 400ft)

An approach with abnormally low path angle can lead to short landings or possibly infringe obstacle clearance margins.

2001 – Continuously Slow during final

Operational Goal

This event detects approaches that cross 2 or more of 3 altitude gates at low approach speed, as detected by the LEVEL 1 (M1) Events Approach Speed Low

- 1011 – Speed Low in Approach (at 1000ft),
- 1013 – Speed Low in Approach (at 500ft) and
- 1015 – Speed Low in Approach (at 50ft)

AC with abnormally low speed in approach have low energy and may not have sufficient engine thrust response to recover from windshear or downdrafts, leading to short / hard landings, together with risk of tail strikes due to high pitch attitude.

2002 – Continuously High during final

Operational Goal

This event detects approaches that cross 2 or more of 3 altitude gates significantly above the 3° glide path angle to the runway (or the local ILS glidepath angle), as detected by the individual LEVEL 1 (M1) Path High Events

- 1312 – Path High in Approach (at 1200ft),
- 1314 – Path High in Approach (at 800ft) and
- 1316 – Path High in Approach (at 400ft)

Flying significantly above the 3° glide path during approach can lead to final descents on steep approach angles, causing high rates of descent, difficult speed management and unstable approaches with high risk of a runway excursion.

2003 – Continuously Fast during final

Operational Goal

This event detects approaches that cross 2 or more of 3 altitudes gates with Approach Speed High, as detected by the LEVEL 1 (M1) Approach Speed High events

- 1010 – Speed High in Approach (at 1000ft),
- 1012 – Speed High in Approach (at 500ft) and
- 1014 – Speed High in Approach (at 50ft)

An abnormally fast approach speed can lead to long flares and high risk of runway over-runs on short and/or slippery runways.

2004 – Continuously Steep during final

Operational Goal

This event detects approaches that pass 2 or more of 3 altitude gates with High Rate of Descent as detected by the LEVEL 1 (M1) High Rate of Descent events

- 1402 – Rate Of Descent High in Approach (from 2000ft – 1000ft),
- 1403 – Rate Of Descent High in Approach (from 1000ft – 500ft) and
- 1404 – Rate Of Descent High in Approach (below 500ft)

An abnormally steep approach with high rates of descent has a high risk of leading to landing incident such as a hard landing.

2009 – Late Offset in Short Final

Operational Goal

This event detects a late runway alignment combined with large bank angles below 400ft AFE using LEVEL 1 (M1) events

- 1814 – HDG Significant Change in Approach (below 500ft) and
- 1201 – Bank High in Approach (400ft – 100ft)

Late runway alignment and large bank angles close to the ground carry a high risk of a landing incident.

2012 – Roll Oscillations prior to Flare

Operational Goal

This event detects abnormal bank oscillations prior to flare from the LEVEL 1 (M1) events

- 1200 – Bank High in Approach (below 100ft) and
- 1211 – Bank Oscillation in Approach (below 100ft)

Large bank angles and rapid roll movements close to the ground carry a high risk of runway excursion and / or AC damage.

APPENDIX 9
ADVANCED QUALIFICATION PROGRAM (AQP)

INTRODUCTION

This appendix provides the comparative, generational results in graphical format of the de-identified EBT AQP study. The figures are briefly described at the bottom of the graphic next to the figure number.

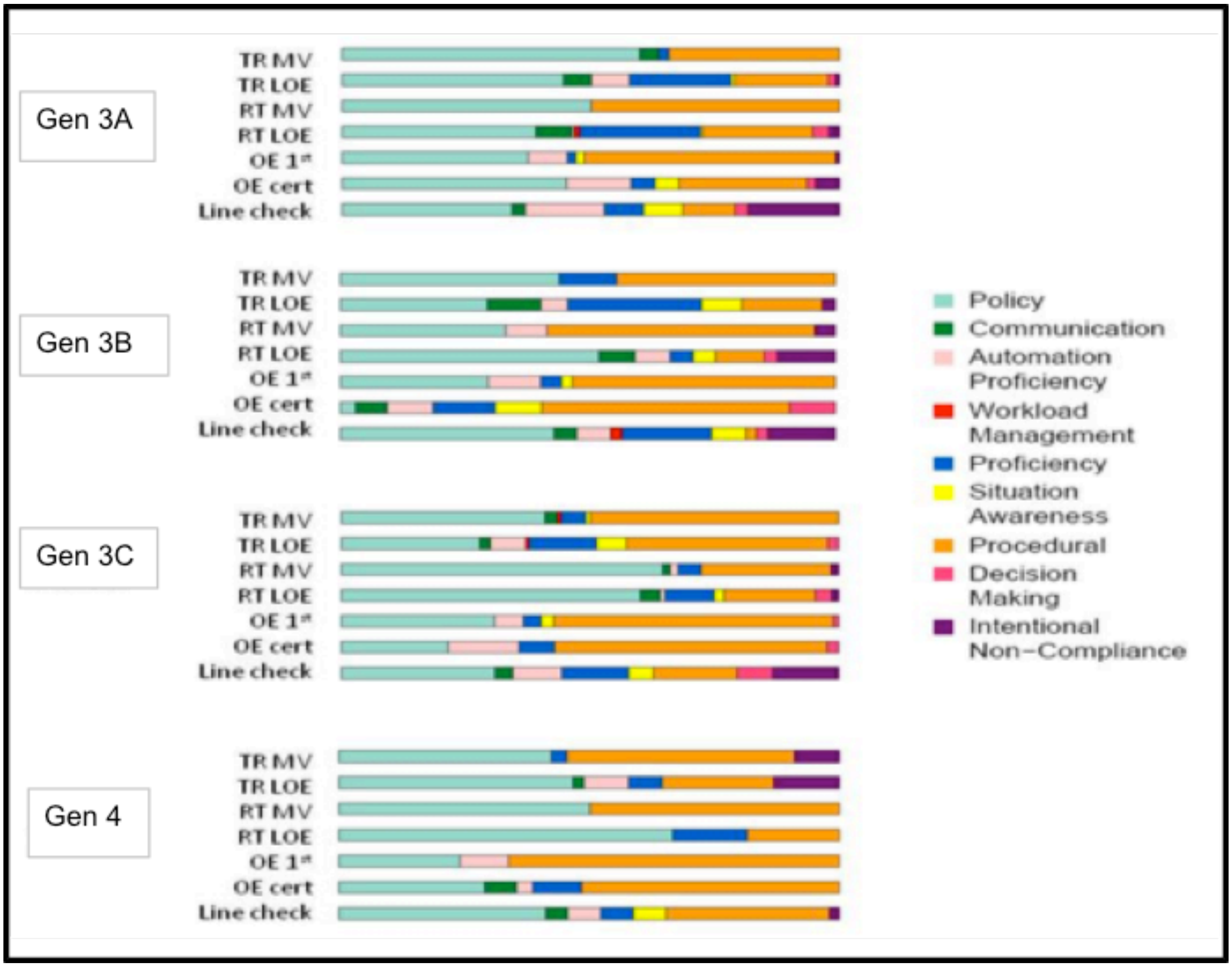


Figure **4.2.4.1.2** – Proportionality of grading criteria per type of training session

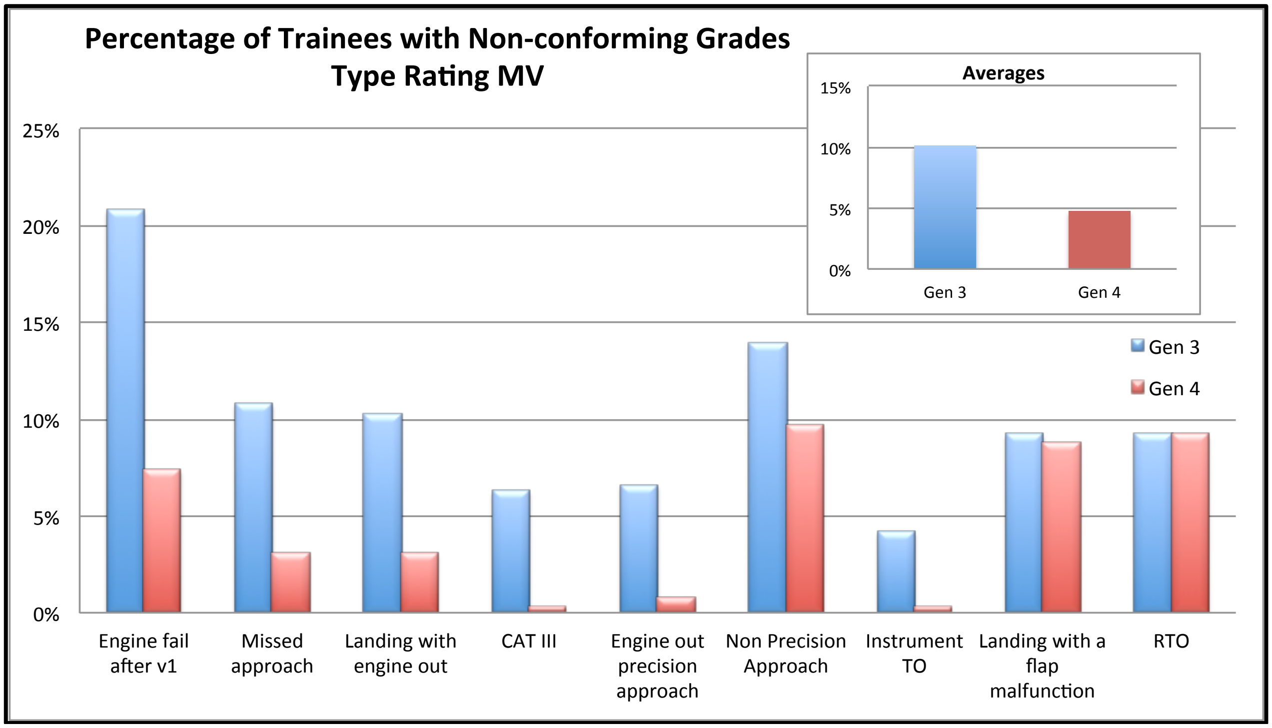


Figure 4.2.4.1.3 – Comparing the Non Conforming Grades (NCGs) distributions of maneuver validation exercises for generation 3 versus generation 4 pilot crewmembers in Initial Qualification (IQ) along with weighted averages

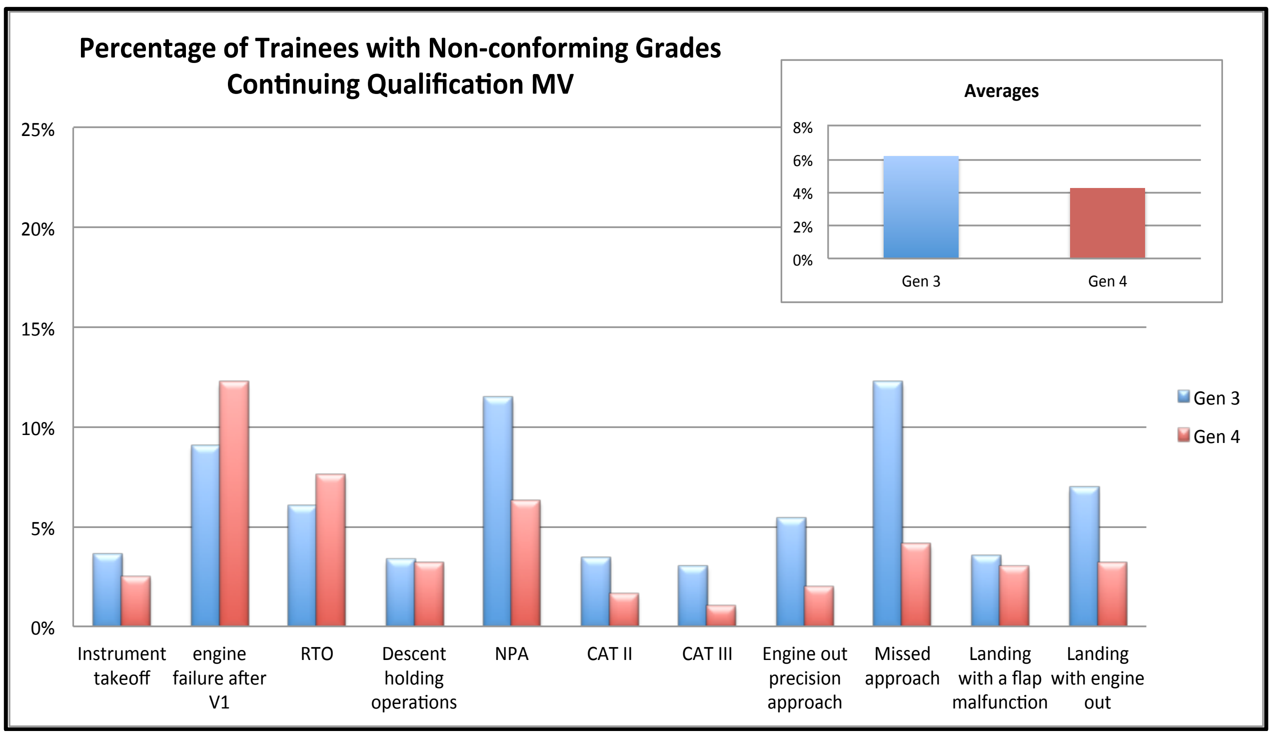


Figure 4.2.4.1.3a – Comparing the Non Conforming Grades (NCGs) distributions of maneuver validation exercises for generation 3 versus generation 4 pilot crewmembers in Continuing Qualification (CQ) along with weighted averages

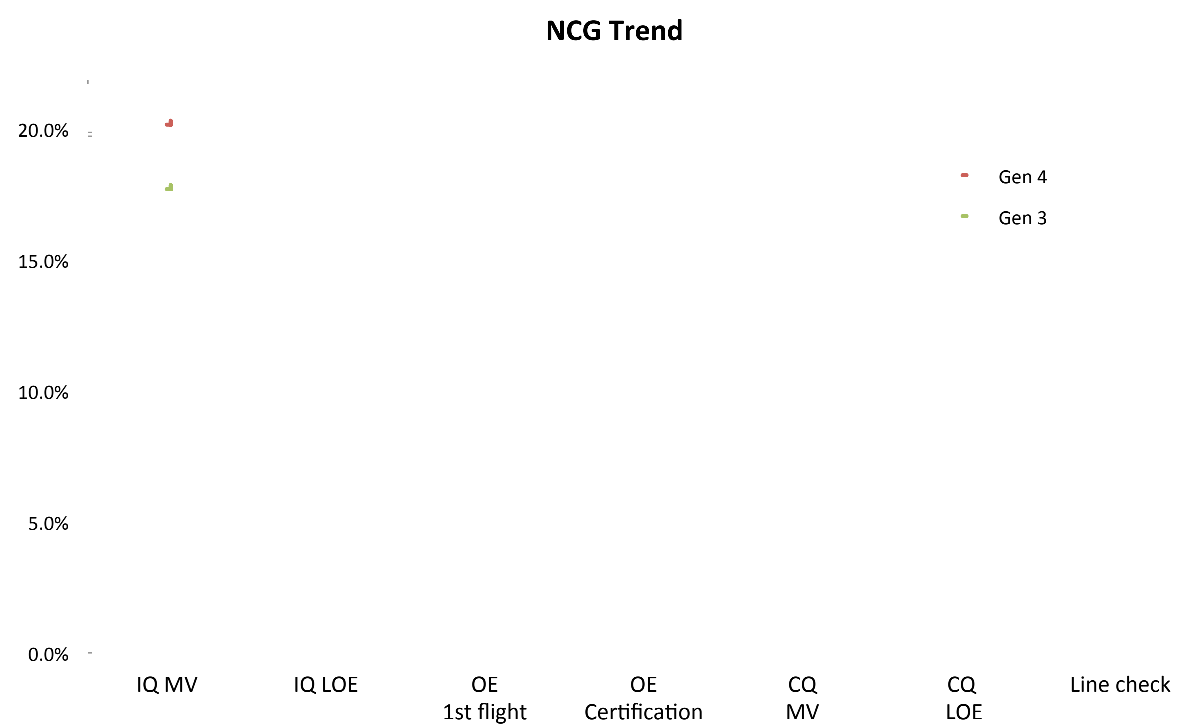


Figure 4.2.4.1.5 – Comparison of the trending of NCGs percentages for generation 3 versus generation 4 crewmembers in the training progression from the first assessment of IQ to annual assessments in line operations

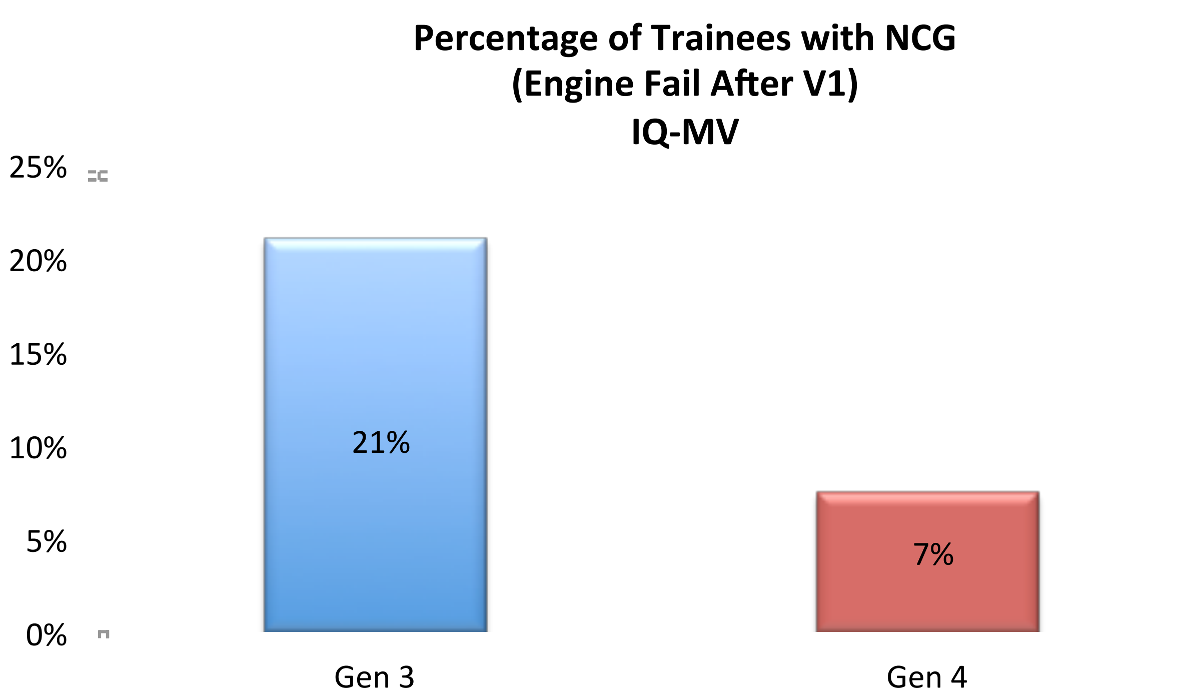


Figure 4.2.4.1.5a – Comparison of percentage of NCGs for generation 3 versus generation 4 of Engine Failure at/after V1 in Initial Qualification (IQ) Maneuver Validation (MV)

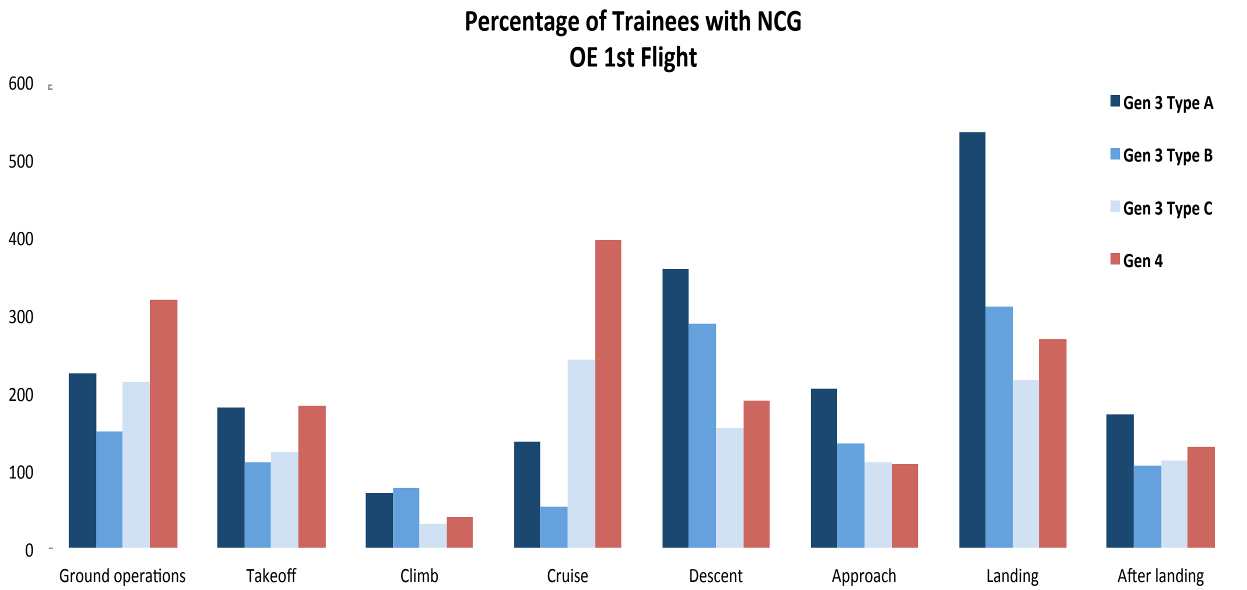


Figure 4.2.4.1.5c – Comparing the Non Conforming Grades (NCGs) distributions of Operational Evaluation 1st Flight (OE) by phase of flight for generation 3 versus generation 4 pilot crewmembers in Initial Qualification (IQ)

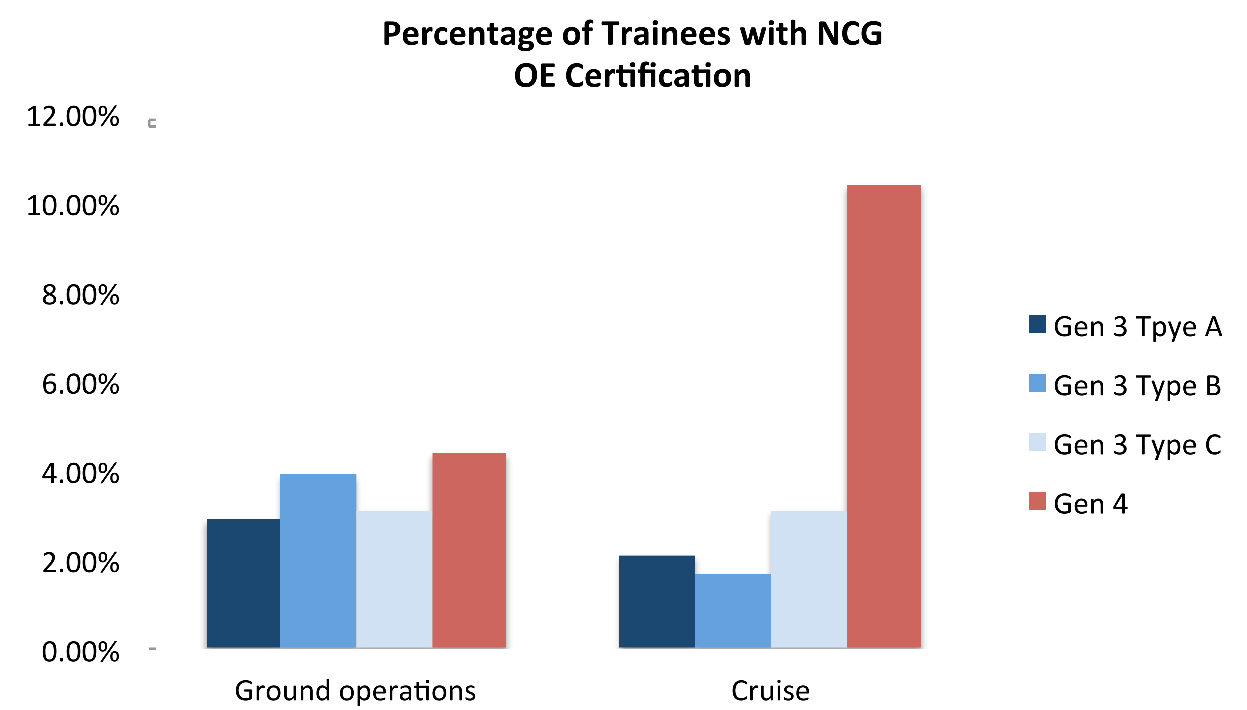


Figure 4.2.4.1.5b – Comparing the Non Conforming Grades (NCGs) in Operational Evaluation Certification for phases of flight Ground Operations and Cruise for generation 3 versus generation 4 pilot crewmembers in final assessment of Initial Qualification (IQ)

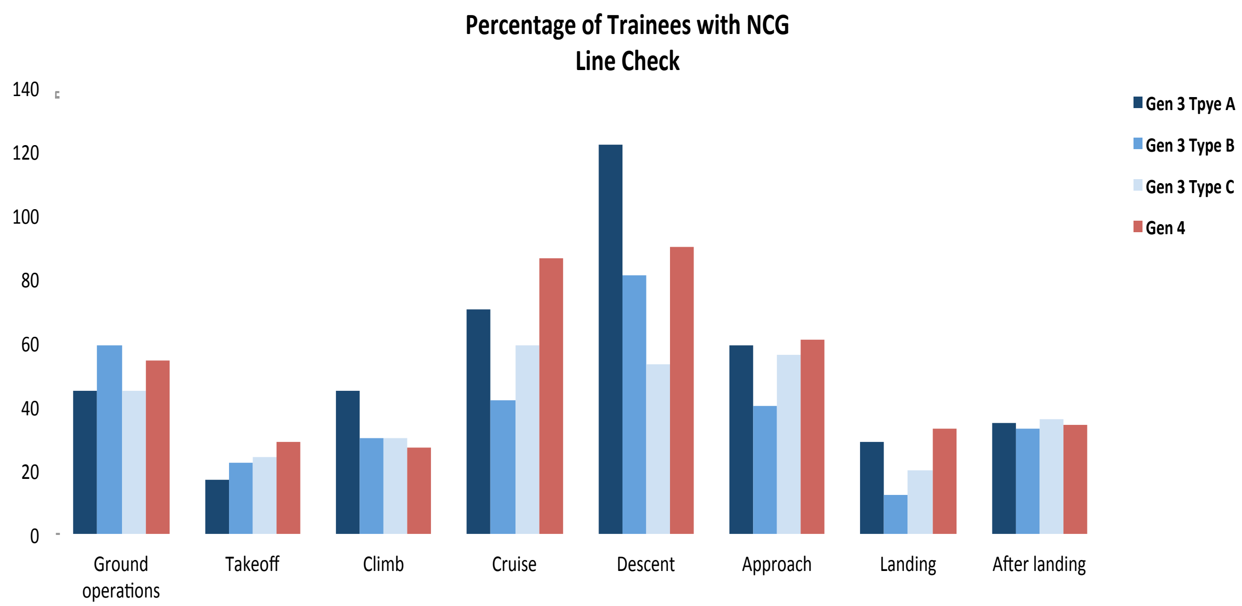


Figure 4.2.4.1.6a – Comparing the Non Conforming Grades (NCGs) in Operational Evaluation Continuing Qualification (IQ) (i.e. Line Checks) by phases of flight for generation 3 versus generation 4

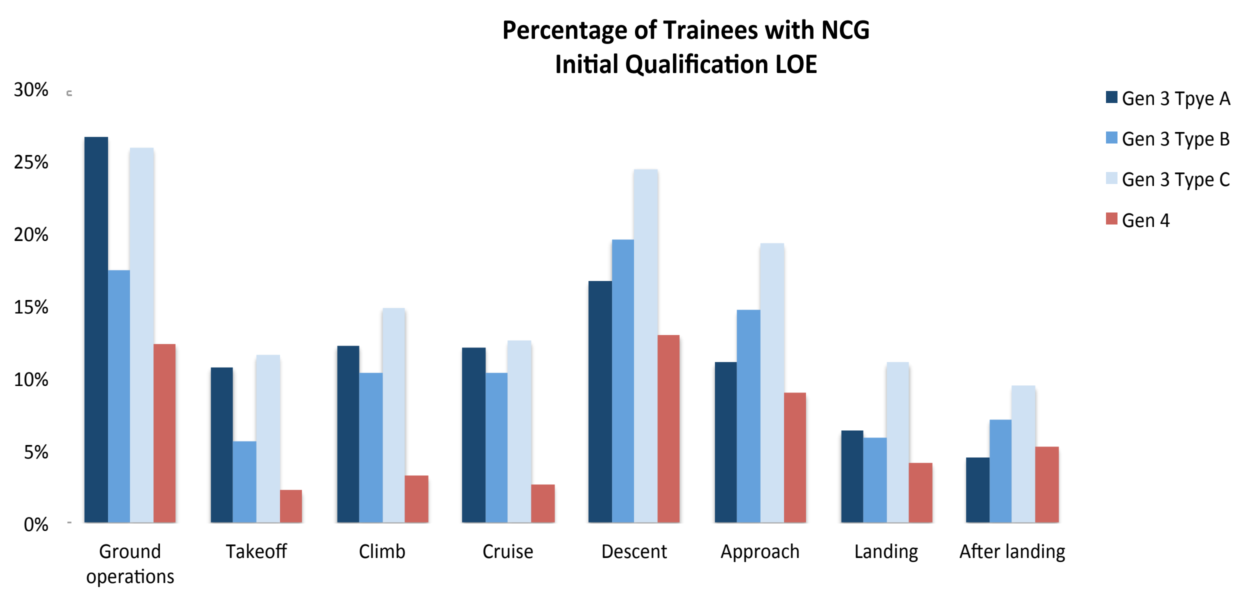


Figure 4.2.4.1.6 – Comparing the Non Conforming Grades (NCGs) distributions of Line Operational Evaluation (LOE) exercises for generation 3 versus generation 4 pilot crewmembers in Initial Qualification (IQ)

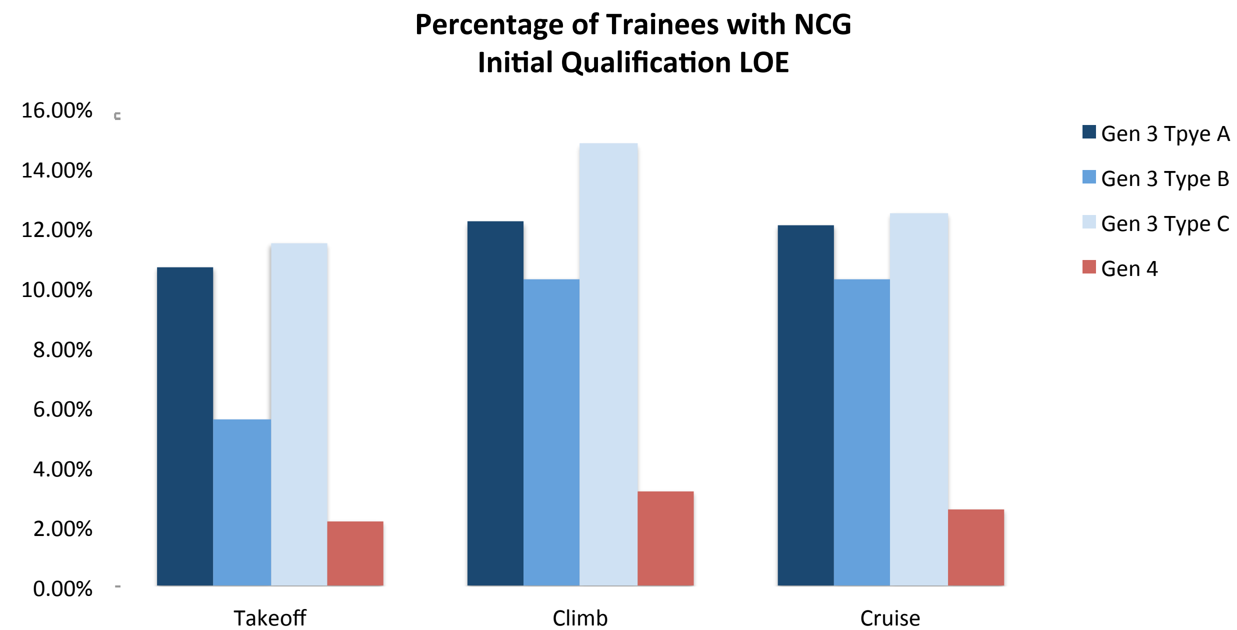


Figure 4.2.4.1.7 d – Comparing the Non Conforming Grades (NCGs) distributions of Line Operational Evaluation (LOE) by phase of flight for generation 3 versus generation 4 pilot crewmembers in Initial Qualification (IQ)

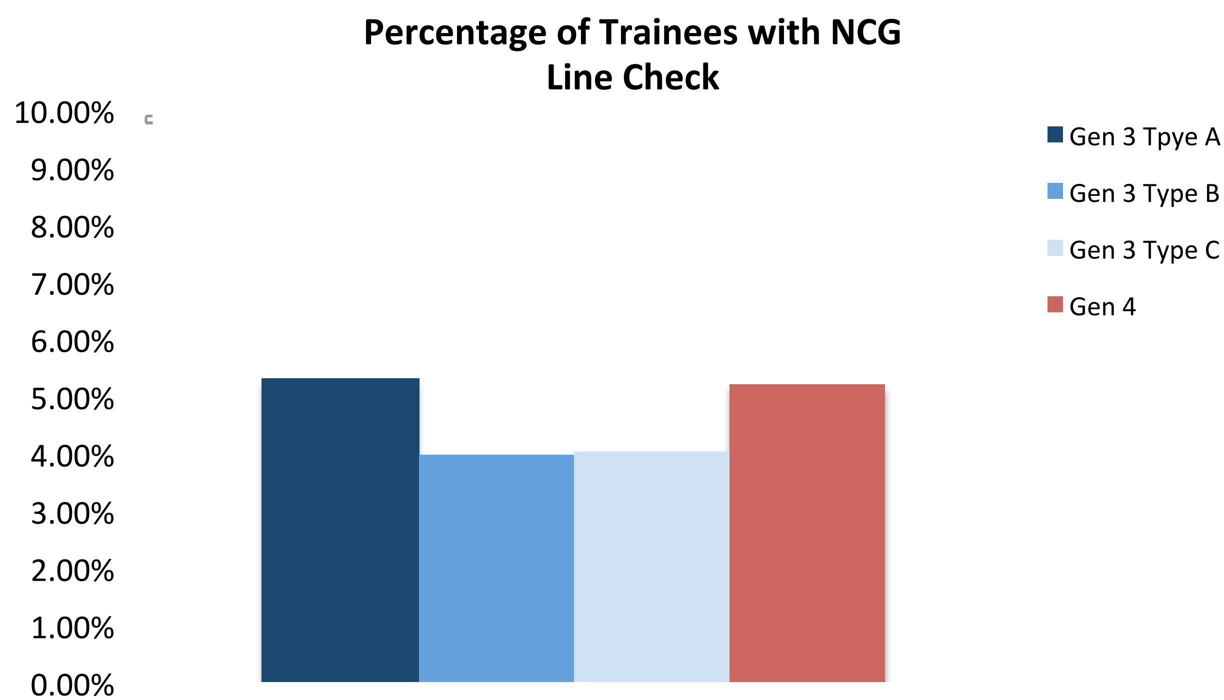


Figure 4.2.4.1.7a – Comparing percentages of NCGs by type/generation in annual line assessments (Line Checks)

APPENDIX 10
ATQP STUDY

INTRODUCTION

This appendix provides the, generational results in graphical format of generation 3 and 4 aircraft the de-identified study was done and provided by the ATQP airline. The figures are briefly described at the bottom of the graphic next to the figure number

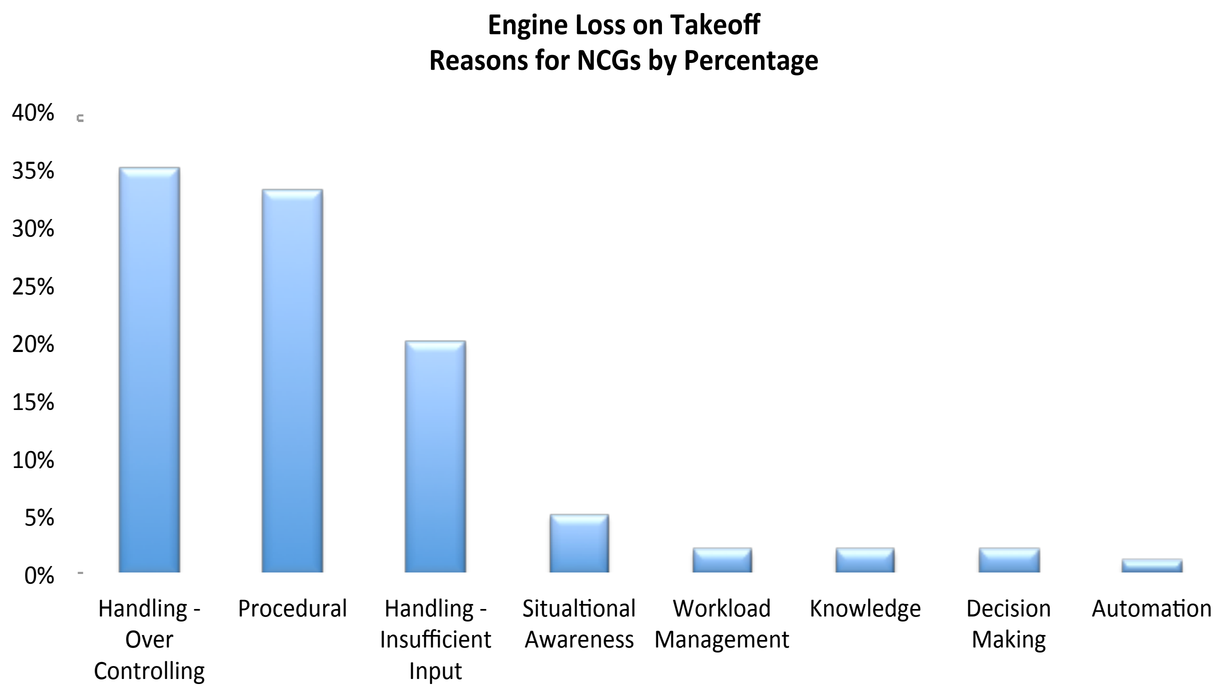


Figure 4.2.4.2.3 – Grading criteria percentage rates for NCGs with respect to the maneuver – Engine Failure at/after V1 – during Recurrent Training for all aircraft types over 1 year cycle

Note: These criteria map into the Competencies (i.e. they are a subset)

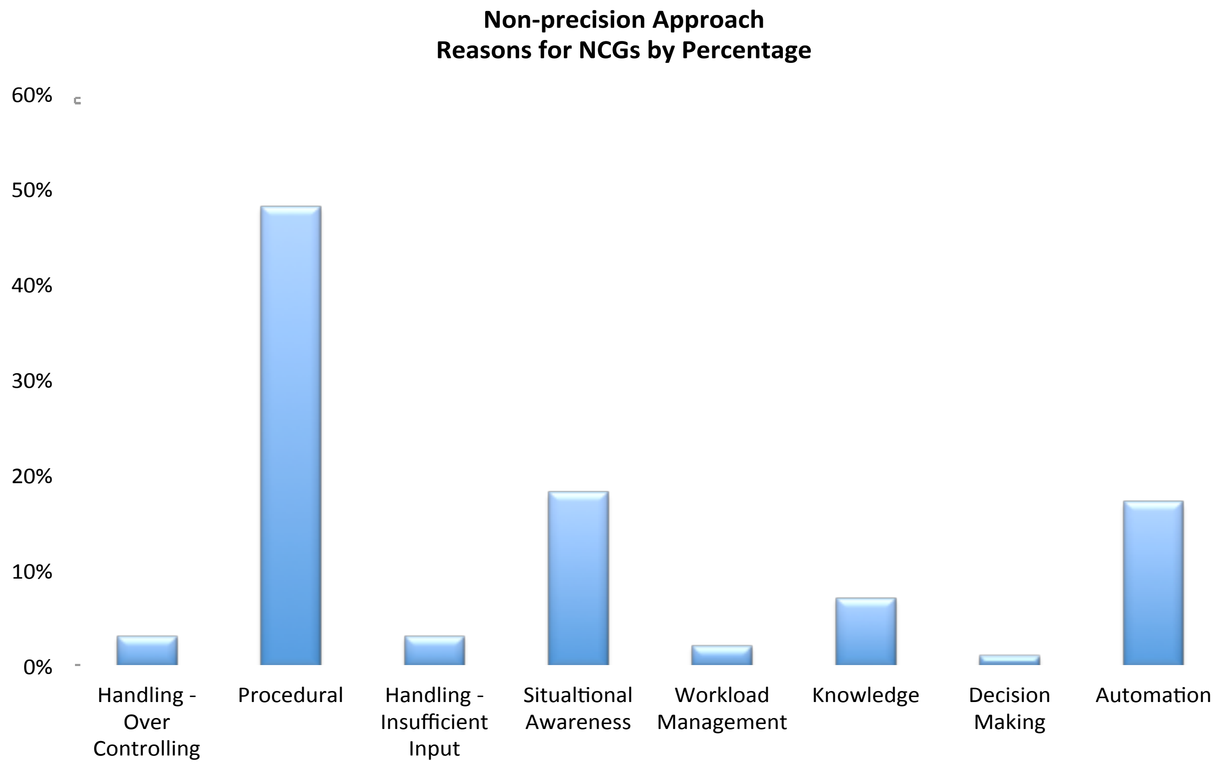


Figure 4.2.4.2.3a – Grading criteria percentage rates for NCGs with respect to the maneuver – Non-precision Approach – during Recurrent Training for all aircraft types over 1 year cycle

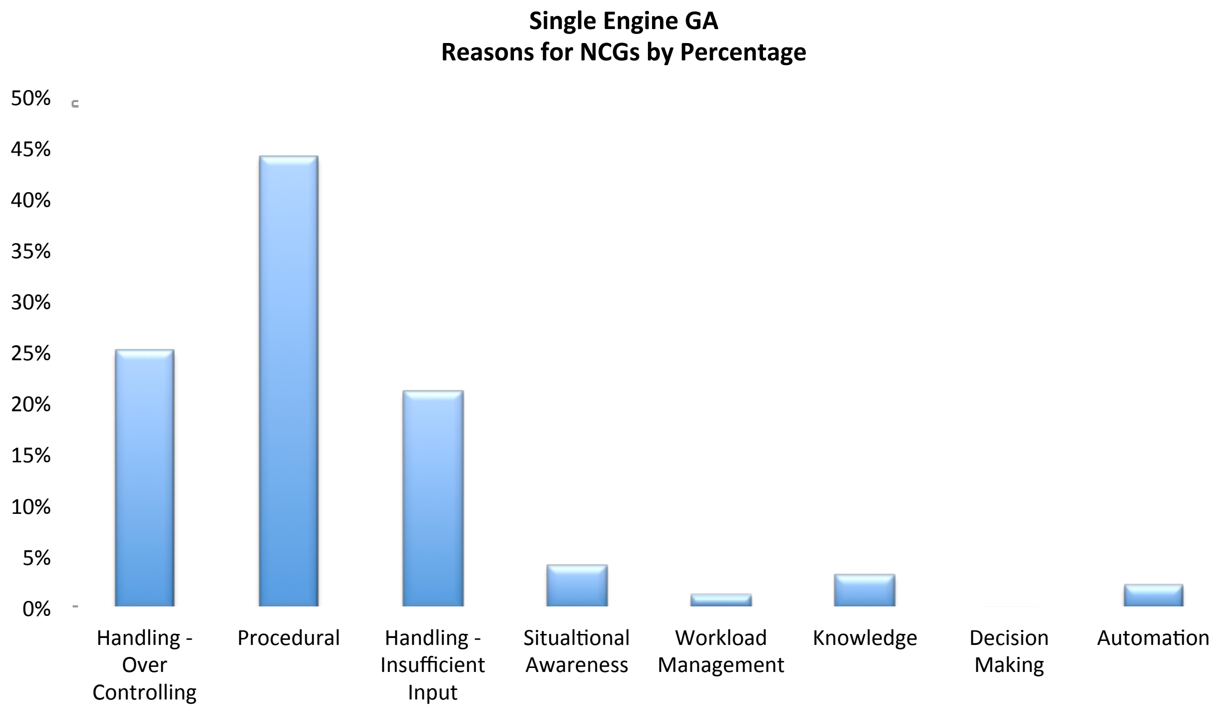


Figure 4.2.4.2.3b – Grading criteria percentage rates for NCGs with respect to the maneuver – Engine out Go-around – during Recurrent Training for all aircraft types over 1 year cycle

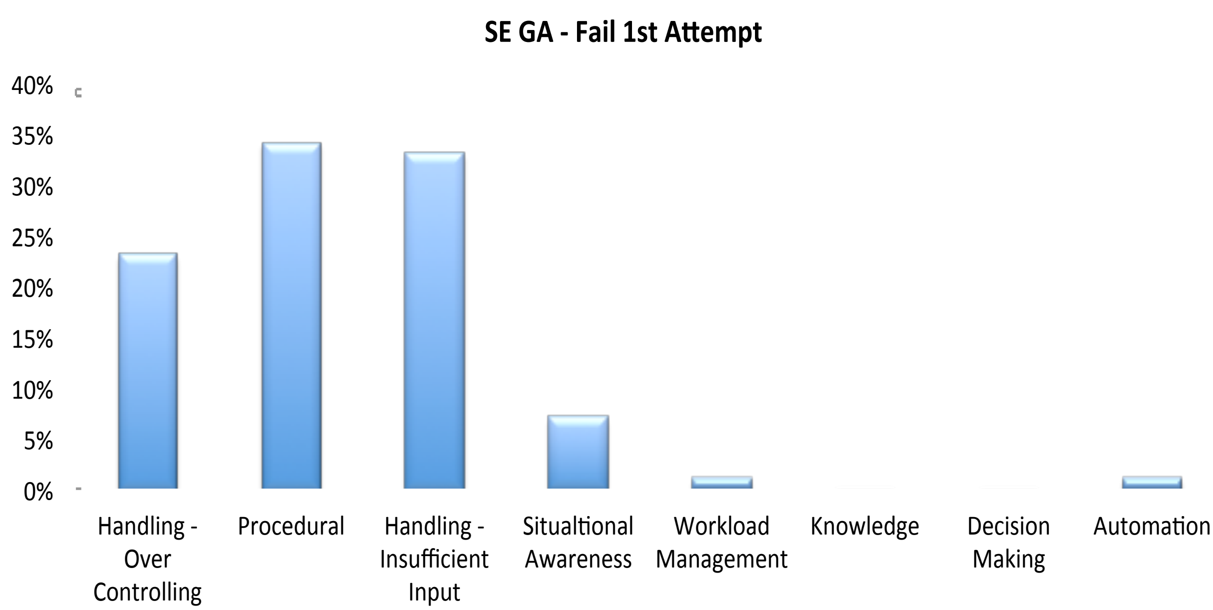


Figure A10. – Grading criteria percentage rates for failure on first attempt with respect to the maneuver – Engine out Go-around – during Recurrent Training for all aircraft types over 1 year cycle

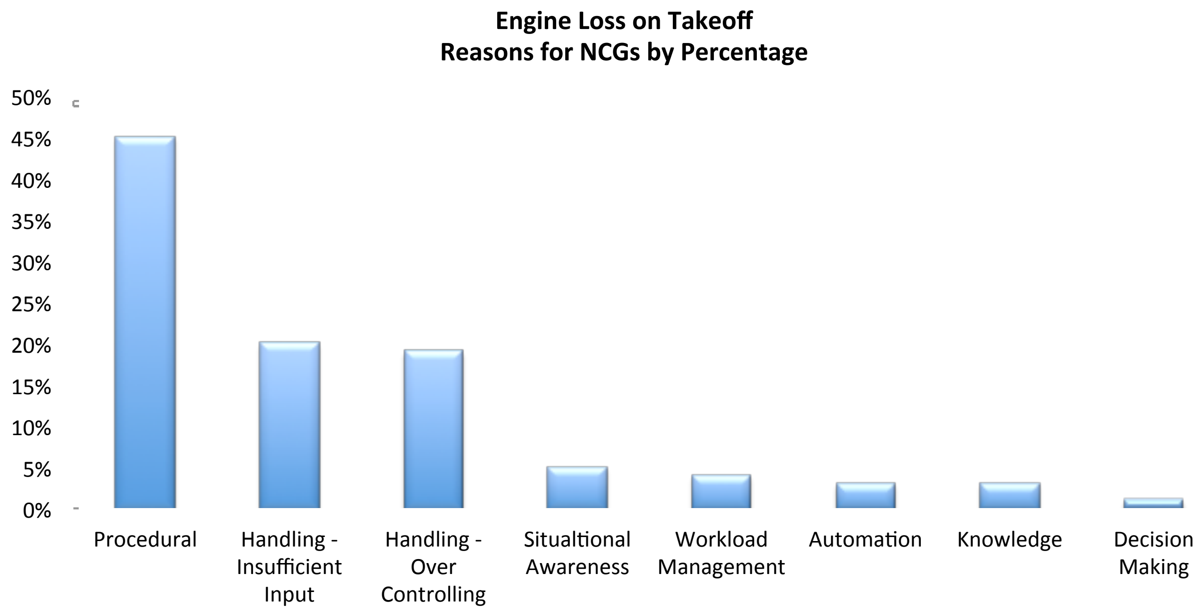


Figure A10.2 – Grading criteria percentage rates for Pass but with a repeat pertaining to the maneuver – Engine Failure at/after V1 – during Recurrent Training for all aircraft types over 1 year cycle

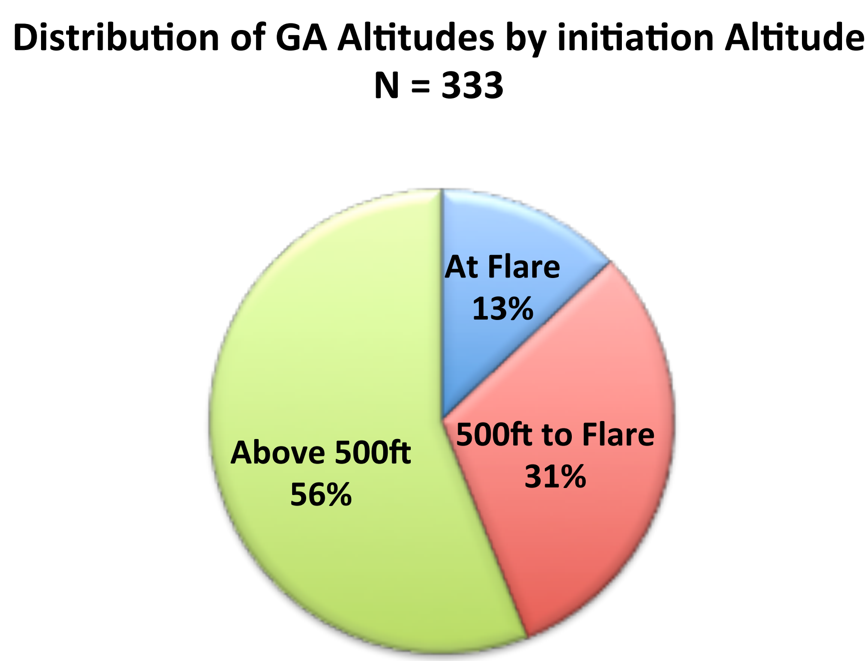


Figure 4.2.4.2.5 – Distribution of Go-around initiation heights above the runway threshold as reported by pilots during a two-year interval during ATQP implementation

APPENDIX 11
TRAINING CRITICALITY SURVEY (TCS)

INTRODUCTION

This appendix contains the data and analysis of the TCS. The correlations are shown here, but only a cursory analysis of generation 4 was done as a small example of the potential of the technique. None of the results were used in the overall EBT analysis and conclusions because the data sample was felt to be less than sufficient in terms of size and symmetry. That being the case, the method is very powerful and the technique and data collection will be improved to be an important part of future EBT analysis in the future.

11.1 LOGISTICAL AND GENERAL DATA PROVIDED BY EVALUATION PILOTS ON SURVEY FORMS

ID Eval Pilot	Organisation	Operation	Aircraft	Region	Date Survey Processed
836	Qantas	short/medium range	B737 600-800	Australia /Pacific	25-May-11
837	Unknown	short/medium range	A320 FAM	Europe	25-May-11
838	British Airways	longrange	B767	Worldwide	25-May-11
839	WIZZAIR	AIRLINE	A-320	Europe	25-May-11
840	TRTO	short/medium range	CE 550B, CE 560XL/XLS	Worldwide	25-May-11
841	Twinjet Aircraft Ltd	longrange	A320 FAM	Worldwide	25-May-11
842	Air Transat	longrange	A330	Worldwide	25-May-11
843	AIR FRANCE	longrange	A330	Worldwide	25-May-11
844	Aire France	longrange	A380	Worldwide	25-May-11
845	Qatar Airways	longrange	B777	Worldwide	25-May-11
846	EMIRATES (EK)	longrange	A380	Worldwide	25-May-11
847	ANA	short/medium range	B737 300-500	Asia	25-May-11
848	Flight Safety	commuter	Cessna Mustang	Worldwide	25-May-11
849	TRTO	commuter	CE-550B	Europe	25-May-11
850	Flightsafety International	short/medium range	Hawker 800	Europe	25-May-11
851	TRTO	short/medium range	Gulfstream GV	Worldwide	25-May-11
852	Qatar Airways	short/medium range	A320 FAM	Worldwide	25-May-11
853	Emirates	longrange	A330	Worldwide	25-May-11
854	Wizz Air	short/medium range	A320 FAM	Europe	25-May-11
855	EMIRATES AIRLINES	longrange	A330	Worldwide	25-May-11
856	FlightSafety International, Inc.	Training	DA-2000	North America	25-May-11
857	TRTO	commuter	CE560XL	Europe	25-May-11
858	FlightSafety International	longrange	Falcon 900EX	Worldwide	25-May-11
859	FSI	Unknown	C-680/ DHC 8/ Be40	Worldwide	25-May-11
860	FlightSafety Intl	short/medium range	Falcon 2000	Worldwide	25-May-11
861	FlightSafety International	short/medium range	CE525A, B, C	Worldwide	25-May-11
862	FlightSafety International	short/medium range	CE560XLS	Worldwide	25-May-11
863	FlightSafety International	longrange	CE750	Worldwide	25-May-11
864	FlightSafety International	short/medium range	CE560	Worldwide	25-May-11

Figure A11.1

865	FlightSafety	Traning	Simulators	North America	25-May-11
866	Flight Safety Int. - KTEB	Training	2000EX EASy	Worldwide	25-May-11
867	FlightSafety	short/medium range	Hawker 850	Europe	25-May-11
868	Emirates Airline	longrange	B777	Worldwide	25-May-11
869	AIRBUS TRAINING	short/medium range	A320 FAM	Worldwide	25-May-11
870	Air France	longrange	B777	Worldwide	25-May-11
871	QATAR AIRWAYS	longrange	A330	Worldwide	25-May-11
872	FlightSafety International	longrange	Gulfstream 450	Worldwide	25-May-11
873	British Airways	short/medium range	B737 300-500	Europe	25-May-11
874	Qatar Airways	freight	A300-600	Worldwide	25-May-11
875	Emirates Airlines	short/medium range	A330	Worldwide	25-May-11
876	LFT	longrange	A340 200/300	Worldwide	25-May-11
877	DLH	short/medium range	B737 300-500	Europe	25-May-11
878	FlightSafety International	short/medium range	ERJ-170/190	Worldwide	25-May-11
879	AIRBUS	short/medium range	A330	Worldwide	25-May-11
880	Lufthansa Flight Training	longrange	A340-300+600/A330-300	Worldwide	25-May-11
881	FlightSafety International	longrange	Gulfstream 450	Worldwide	25-May-11
882	British Airways	short/medium range	B737 300-500	Europe	25-May-11
883	British Airways	short/medium range	A320 FAM	Europe	25-May-11
884	Airbus Training	short/medium range	A320 FAM	Asia	25-May-11
885	Emirates Airline	short/medium range	A340 MFF200-600	Worldwide	25-May-11
886	British Airways	longrange	B777	Worldwide	25-May-11
887	IFALPA- SNPL	longrange	B777	Worldwide	25-May-11
888	qatar airways	longrange	B777	Worldwide	25-May-11
889	BRITISH AIRWAYS	longrange	B747-400	Worldwide	25-May-11
890	Wizz Air	short/medium range	A320 FAM	Europe	25-May-11
891	Qantas	short/medium range	B737 600-800	Australia/Pacific	25-May-11
892	Lufthansa Flight Training	short/medium range	A320 FAM,A330,340	Worldwide	25-May-11
893	Emirates	longrange	B777	Worldwide	25-May-11
894	Emirates	longrange	B777	Worldwide	25-May-11
895	Qatar Airways	freight	A300-600	Worldwide	25-May-11

Figure A11.1 cont.

896	British Airways	longrange	B777	Worldwide	25-May-11
897	Qatar Airways	short/medium range	A320 FAM	Worldwide	25-May-11
898	AIR FRANCE	short/medium range	A320 FAM	Worldwide	25-May-11
899	Qantas	longrange	B747-400	Worldwide	25-May-11
900	Wzzair	short/medium range	A320 FAM	Europe	25-May-11
901	Air Transat, Canada	longrange	A310	Worldwide	25-May-11
902	Emirates	longrange	B777	Worldwide	25-May-11
903	Qatar Airways	freight	A300-600	Worldwide	25-May-11
904	Unknown	short/medium range	A320 FAM	Europe	25-May-11
905	Wizz-Air	short/medium range	A320 FAM	Europe	25-May-11
906	GULFAIR	short/medium range	A330	Worldwide	25-May-11
907	Qatar Airways	short/medium range	A320 FAM	Worldwide	25-May-11
908	Airbus Training	short/medium range	A320 FAM	Worldwide	25-May-11
909	Qatar Airways	freight	A300-600	Asia	25-May-11
910	Emirates	longrange	A330	Worldwide	25-May-11
911	WIZZAIR	short/medium range	A320 FAM	Europe	25-May-11
912	Emirates Airline	longrange	A380	Worldwide	25-May-11
913	TUIfly GmbH	short/medium range	B737 600-800	Europe	25-May-11
914	Emirates Airline	longrange	A330	Worldwide	25-May-11
915	Air France	longrange	B777	Worldwide	25-May-11
916	WiZZ AIR Airlines	short/medium range	A320 FAM	Europe	25-May-11
917	GULFAIR	short/medium range	A330	Worldwide	25-May-11
918	Qatar Airways	longrange	B777	Worldwide	25-May-11
919	Air France	short/medium range	A320 FAM	Worldwide	25-May-11
920	Cathay Pacific Airways	short/medium range	B747-400	Worldwide	25-May-11
921	Cathay Pacific Airways	short/medium range	A330	Asia	25-May-11
922	Various	longrange	A330	Worldwide	25-May-11
923	Airbus Training Toulouse	short/medium/long	A320/330/340families	Worldwide	25-May-11
924	Airline	short/medium range	A320 FAM	Europe	25-May-11
925	Delta Air Lines	longrange	B767	Worldwide	25-May-11
926	qatarairways	short/medium range	A330	Worldwide	25-May-11

Figure A11.1 cont.

927	Cathay Pacific	short/medium range	A330	Asia	25-May-11
928	Cathay Pacific Airways	short/medium range	A330/A340	Worldwide	25-May-11
929	Cathay Pacific	short/medium range	A330	Worldwide	25-May-11
930	Wizz Air	short/medium range	A320 FAM	Europe	25-May-11
931	Emirates	longrange	B777	Worldwide	25-May-11
932	WIZZAIR	short/medium range	A320 FAM	Europe	25-May-11
933	Qatar Airways	freight	A300-600	Worldwide	25-May-11
934	EK	short/medium range	B777	Worldwide	25-May-11
935	Wizz Air	short/medium range	A320 FAM	Europe	25-May-11
936	Cathay Pacific Airways	longrange	B777	Worldwide	25-May-11
937	Air Transat	longrange	A330	Worldwide	25-May-11
938	Cathay Pacific Airways	longrange	B747-400	Worldwide	25-May-11
939	Delta Airlines	longrange	B757	Worldwide	25-May-11
940	Delta Air Lines	longrange	B777	Worldwide	25-May-11
941	Lufthansa	longrange	B747-400	Worldwide	25-May-11
942	Emirates Airline	longrange	A340 MFF200-600	Worldwide	25-May-11
943	Emirates Airline	short/medium range	A330	Worldwide	25-May-11
944	Qatar Airways	freight	A300-600	Worldwide	25-May-11
945	QATAR AIRWAYS	short/medium range	A320 FAM	Worldwide	25-May-11
946	GULFAIR	short/medium range	A330	Worldwide	25-May-11
947	Cathay Pacific Airways	longrange	B777	Worldwide	25-May-11
948	Axis Airways	short/medium range	B737 300-500	Worldwide	25-May-11
949	WizzAir	short/medium range	A320 FAM	Europe	25-May-11
950	Emirates Airline	longrange	A380	Worldwide	25-May-11
951	Anonymous	short/medium range	B737 600-800	Europe	25-May-11
952	Airline	short/medium range	A320 FAM	Europe	25-May-11
953	Emirates	longrange	B777	Worldwide	25-May-11
954	Qatar Airways	freight	A300-600	Worldwide	25-May-11
955	Unknown	Enter/Select type	Enter/Select type	Select region	25-May-11
956	Unknown	Enter/Select type	Enter/Select type	Select region	25-May-11
957	FlightSafety	short/medium range	G450	Worldwide	25-May-11
958	LFT	longrange	B747-400	Worldwide	25-May-11

Figure A11.1 cont.

959	Lufthansa Flight Training	short-long	A320/A330/A340	Worldwide	25-May-11
960	Lufthansa	longrange	A340 200/300	Worldwide	25-May-11
961	Austrian Airlines	short/medium range	MD80	Europe	25-May-11
962	FlightSafety International	short/medium range	CE510 Mustang	Worldwide	25-May-11
963	AIR FRANCE	short/medium range	A320 FAM	Europe	25-May-11
964	AIR FRANCE	short/medium range	A320 FAM	Europe	25-May-11
965	FlightSafety International	longrange	Gulfstream 450	Worldwide	25-May-11
966	TRTO	short/medium range	Hawker 400	Europe	25-May-11
967	QATAR AIRWAYS	short/medium range	A320 FAM	Worldwide	25-May-11
968	Qatar Airways	short/medium range	A320 FAM	Worldwide	25-May-11
969	Qatar Airways	longrange	B777	Worldwide	25-May-11
970	Qatar Airways	freight	A300-600	Worldwide	25-May-11
971	Qatar Airways	longrange	B777	Worldwide	25-May-11
972	Qatar Airways	short/medium range	A320 FAM	Worldwide	25-May-11
973	Qatar Airways	short/medium range	A320 FAM	Worldwide	25-May-11
974	Qatar Airways	longrange	A330	Worldwide	25-May-11
975	Qatar Airways	short/medium range	A320 FAM	Worldwide	25-May-11
976	Qatar Airways	short/medium range	A320 FAM	Worldwide	25-May-11
977	Qatar Airways	longrange	B777	Worldwide	25-May-11
978	Qatar Airways	short/medium range	A330	Worldwide	25-May-11
979	Qatar Airways	freight	A300-600	Worldwide	25-May-11
980	easyJet Oxford Aviation Academy	short/medium range	A320 FAM	Europe	25-May-11
981	STL FlightSafety International	short/medium range	EMB 170 190	North America	25-May-11
982	STL FlightSafety International	short/medium range	EMB 170 190	North America	25-May-11
983	AIRBUS training	short and long	All AIRBUS FBW	Worldwide	25-May-11
984	Qatar Airways	longrange	A330	Worldwide	25-May-11
985	WIZZ AIR	short/medium range	A320 FAM	Europe	25-May-11
986	Emirates Airline	short/medium range	A330	Worldwide	25-May-11
987	QatarAirways	freight	A300	Worldwide	25-May-11
988	QANTAS	longrange	B747-400	Worldwide	25-May-11
989	ALPA-Japan	short/medium range	A320 FAM	Asia	25-May-11

Figure A11.1 cont.

990	FlightSafety	short/medium range	Falcon 900EX EASy	Worldwide	25-May-11
991	AIRBUS	short/medium range	A320 FAM	Worldwide	25-May-11
992	British Airways	short/medium range	B767	Worldwide	25-May-11
993	Etihad Airways	longrange	A340 500/600	Worldwide	25-May-11
994	TRTO	short/medium range	CE 680	Europe	25-May-11
995	FlightSafety International	Part 142 Training Center	L-1329 Lockheed JetStar	North America	25-May-11
996	FSI Savannah	longrange	GIV	Worldwide	25-May-11
997	British Airways	longrange	B747-400	Worldwide	25-May-11
998	Emirates	longrange	B777	Worldwide	25-May-11
999	Qatar Airways	longrange	A330	Worldwide	25-May-11
1000	Air Transat	longrange	A330	Worldwide	25-May-11
1001	British Airways plc	short/medium range	A320 FAM	Europe	25-May-11
1002	British Airways	longrange	B747-400	Worldwide	25-May-11

Figure A11.1 cont.

11.2 PAGE 1 OF TRAINING CRITICALITY SURVEY (TCS) COMPLETED BY QUALIFIED VOLUNTEER PILOTS DENOTING THREATS AND ERRORS IN ALL PHASES OF FLIGHT (PHASE Φ)

Organisation	XYZ Airline			
Aircraft Type	B777-200ER			
Type of Operation	Long Haul, Overwater International			
Area of Operation	De-identified			
	Likelihood	**Severity**	**Training**	**Result**
Unique Aircraft elements and characteristics	1	1	1	1
Deficiency within Manuals	2	2	2	8
Deficiency within Charts (design & error)	2	2	2	8
Deficiency within Database (design & error)	2	2	2	8
Deficiency within Checklists	2	1	1	2
Incapacitation	1	3	3	9
Compliance failure	3	3	3	27
Miss handling Aircraft including unstable approach	3	3	3	27
Loading/fuel/Performance	2	2	3	12
Workload/ distraction/ pressure	5	3	3	45
Fatigue	5	3	1	15
Procedures	2	2	1	4
Crew issues	1	2	2	4
Terrorism	1	2	2	4
Physiological	2	2	2	8
CRM (poor) inc. Communications	5	2	3	30
Black Swan	2	3	1	6

Likelihood

The probability that over the course of one year a pilot will experience a defined event, requiring intervention to ensure a safe outcome.
1. Rare - once in career or less
2. Unlikely - few times in career
3. Moderate - once every 3-5 years
4. Likely - probably once a year
5. Almost Certain - more than once a year

Severity

The most likely outcome given that the event has occurred for a pilot not trained to manage that defined event

1. Negligible – insignificant effect not compromising safety
2. Minor – reduction in safety margin
3. Moderate – safety compromise
4. Major – aircraft damage and/or personal injury
5. Catastrophic - significant damage or hull loss

Training Benefit

Consider the effect of training to reduce the severity by one level, e.g. the most likely result of an engine failure during take off is catastrophic at least in a conventional aircraft. Effective training reduces this severity to major.
1. Unimportant – training has no impact
2. Minor - enhances performance in managing an event
3. Moderate – having no training compromises safety
4. Significant – Safe outcome is unlikely without effective training
5. Critical – essential to understanding and coping with the event

THREATS

Figure A11.2

11.3 PAGE 2 OF TRAINING CRITICALITY SURVEY (TCS) DENOTING THREATS AND ERRORS IN GROUND AND PREFLIGHT FLIGHT PHASES

Organisation	XYZ Airlines
Aircraft Type	B777-200ER
Type of Operation	Long Haul, Overwater International
Area of Operation	De-identified

	Likelihood	Severity	Training	Result
Ground equipment	3	2	2	12
Ground manoeuvring	3	3	3	27
Runway/Taxi condition	5	4	5	100
Adverse Weather/Ice	5	4	5	100
Crosswind	5	4	5	100
ATC	3	3	2	18
NAV	2	2	2	8
Loss of comms	2	2	1	4
Traffic	3	4	5	60
R/W incursion	1	4	4	16
Poor Visibility	5	3	5	75
Terrain	1	5	6	30
Birds	1	1	1	1
Eng Fail	1	1	1	1
MEL	5	1	2	10
Fire	1	4	5	20
System malfunction	3	2	3	18

Likelihood

The probability that over the course of one year a pilot will experience a defined event, requiring intervention to ensure a safe outcome.
1. Rare - once in career or less
2. Unlikely - few times in career
3. Moderate - once every 3-5 years
4. Likely - probably once a year
5. Almost Certain - more than once a year

Severity

The most likely outcome given that the event has occurred for a pilot not trained to manage that defined event

1. Negligible – insignificant effect not compromising safety
2. Minor – reduction in safety margin
3. Moderate – safety compromise
4. Major – aircraft damage and/or personal injury
5. Catastrophic - significant damage or hull loss

Training Benefit

Consider the effect of training to reduce the severity by one level, e.g. the most likely result of an engine failure during take off is catastrophic at least in a conventional aircraft. Effective training reduces this severity to major.
1. Unimportant – training has no impact
2. Minor - enhances performance in managing an event
3. Moderate – having no training compromises safety
4. Significant – Safe outcome is unlikely without effective training
5. Critical – essential to understanding and coping with the event

GROUND & PRE FLIGHT

Figure A11.3

11.4 PAGE 3 OF TRAINING CRITICALITY SURVEY (TCS) DENOTING THREATS AND ERRORS IN TAKE-OFF FLIGHT PHASE

Organisation	XZY Airlines
Aircraft Type	B777-200ER
Type of Operation	Long Haul, Overwater International
Area of Operation	De-identified

	Likelihood	Severity	Training	Result
Windshear	1	4	5	20
Adverse Weather/Ice	5	4	4	80
Crosswind	5	4	3	60
ATC	3	3	2	18
NAV	2	2	2	8
Loss of comms	3	2	2	12
Traffic	3	4	5	60
R/W incursion	1	3	3	9
Poor Visibility	5	3	4	60
Wake vortex	2	3	2	12
Upset	1	4	4	16
Terrain	1	5	5	25
Birds	1	4	4	16
Eng Fail	1	4	5	20
MEL	5	1	2	10
Fire	1	4	5	20
System malfunction	3	2	3	18

Likelihood

The probability that over the course of one year a pilot will experience a defined event, requiring intervention to ensure a safe outcome.
1. Rare - once in career or less
2. Unlikely - few times in career
3. Moderate - once every 3-5 years
4. Likely - probably once a year
5. Almost Certain - more than once a year

Severity

The most likely outcome given that the event has occurred for a pilot not trained to manage that defined event

1. Negligible – insignificant effect not compromising safety
2. Minor – reduction in safety margin
3. Moderate – safety compromise
4. Major – aircraft damage and/or personal injury
5. Catastrophic - significant damage or hull loss

Training Benefit

Consider the effect of training to reduce the severity by one level, e.g. the most likely result of an engine failure during take off is catastrophic at least in a conventional aircraft. Effective training reduces this severity to major.
1. Unimportant – training has no impact
2. Minor - enhances performance in managing an event
3. Moderate – having no training compromises safety
4. Significant – Safe outcome is unlikely without effective training
5. Critical – essential to understanding and coping with the event

TAKE-OFF

Figure A11.4

11.5 PAGE 4 OF TRAINING CRITICALITY SURVEY (TCS) DENOTING THREATS AND ERRORS IN CLIMB FLIGHT PHASE

Organisation	XYZ Airlines			
Aircraft Type	B777-200ER			
Type of Operation	Long Haul, Overwater International			
Area of Operation	De-identified			
	Likelihood	**Severity**	**Training**	**Result**
Windshear	1	4	5	20
Adverse Weather/Ice	5	4	4	80
ATC	3	3	2	18
NAV	2	2	2	8
Loss of comms	3	2	2	12
Traffic	3	4	5	60
Poor Visibility	5	3	4	60
Wake vortex	2	3	2	12
Upset	1	4	5	20
Terrain	1	5	5	25
Birds	1	4	4	16
Eng Fail	1	4	5	20
MEL	5	1	2	10
Fire	1	4	5	20
System malfunction	3	2	3	18

Likelihood

The probability that over the course of one year a pilot will experience a defined event, requiring intervention to ensure a safe outcome.
1. Rare - once in career or less
2. Unlikely - few times in career
3. Moderate - once every 3-5 years
4. Likely - probably once a year
5. Almost Certain - more than once a year

Severity

The most likely outcome given that the event has occurred for a pilot not trained to manage that defined event

1. Negligible – insignificant effect not compromising safety
2. Minor – reduction in safety margin
3. Moderate – safety compromise
4. Major – aircraft damage and/or personal injury
5. Catastrophic - significant damage or hull loss

Training Benefit

Consider the effect of training to reduce the severity by one level, e.g. the most likely result of an engine failure during take off is catastrophic at least in a conventional aircraft. Effective training reduces this severity to major.
1. Unimportant – training has no impact
2. Minor - enhances performance in managing an event
3. Moderate – having no training compromises safety
4. Significant – Safe outcome is unlikely without effective training
5. Critical – essential to understanding and coping with the event

CLIMB

Figure A11.5

11.6 PAGE 5 OF TRAINING CRITICALITY SURVEY (TCS) DENOTING THREATS AND ERRORS IN CRUISE FLIGHT PHASE

Organisation	XYZ Airlines			
Aircraft Type	B777-200ER			
Type of Operation	Long Haul, Overwater International			
Area of Operation	De-identified			
	Likelihood	**Severity**	**Training**	**Result**
Windshear	1	4	5	20
Adverse Weather/Ice	5	3	3	45
ATC	3	2	2	12
NAV	2	2	2	8
Loss of comms	3	2	2	12
Traffic	3	4	5	60
Poor Visibility	5	2	3	30
Wake vortex	3	2	2	12
Upset	1	3	4	12
Terrain	1	5	5	25
Birds	1	4	4	16
Eng Fail	1	4	5	20
MEL	5	1	2	10
Fire	1	4	5	20
System malfunction	3	2	3	18

Likelihood

The probability that over the course of one year a pilot will experience a defined event, requiring intervention to ensure a safe outcome.
1. Rare - once in career or less
2. Unlikely - few times in career
3. Moderate - once every 3-5 years
4. Likely - probably once a year
5. Almost Certain - more than once a year

Severity

The most likely outcome given that the event has occurred for a pilot not trained to manage that defined event

1. Negligible – insignificant effect not compromising safety
2. Minor – reduction in safety margin
3. Moderate – safety compromise
4. Major – aircraft damage and/or personal injury
5. Catastrophic - significant damage or hull loss

Training Benefit

Consider the effect of training to reduce the severity by one level, e.g. the most likely result of an engine failure during take off is catastrophic at least in a conventional aircraft. Effective training reduces this severity to major.
1. Unimportant – training has no impact
2. Minor - enhances performance in managing an event
3. Moderate – having no training compromises safety
4. Significant – Safe outcome is unlikely without effective training
5. Critical – essential to understanding and coping with the event

CRUISE

Figure A11.6

11.7 PAGE 6 OF TRAINING CRITICALITY SURVEY (TCS) DENOTING THREATS AND ERRORS IN DESCENT FLIGHT PHASE

Organisation	XYZ Airlines			
Aircraft Type	B777-200ER			
Type of Operation	Long Haul, Overwater International			
Area of Operation	De-identified			
	Likelihood	**Severity**	**Training**	**Result**
Windshear	1	3	5	15
Adverse Weather/Ice	5	3	3	45
ATC	3	3	3	27
NAV	2	2	2	8
Loss of comms	3	2	2	12
Traffic	3	4	5	60
Poor Visibility	5	2	3	30
Wake vortex	3	2	2	12
Upset	1	3	4	12
Terrain	1	5	5	25
Birds	1	4	4	16
Eng Fail	1	4	5	20
MEL	5	1	2	10
Fire	1	4	4	16
System malfunction	3	2	3	18

Likelihood

The probability that over the course of one year a pilot will experience a defined event, requiring intervention to ensure a safe outcome.
1. Rare - once in career or less
2. Unlikely - few times in career
3. Moderate - once every 3-5 years
4. Likely - probably once a year
5. Almost Certain - more than once a year

Severity

The most likely outcome given that the event has occurred for a pilot not trained to manage that defined event

1. Negligible – insignificant effect not compromising safety
2. Minor – reduction in safety margin
3. Moderate – safety compromise
4. Major – aircraft damage and/or personal injury
5. Catastrophic - significant damage or hull loss

Training Benefit

Consider the effect of training to reduce the severity by one level, e.g. the most likely result of an engine failure during take off is catastrophic at least in a conventional aircraft. Effective training reduces this severity to major.
1. Unimportant – training has no impact
2. Minor - enhances performance in managing an event
3. Moderate – having no training compromises safety
4. Significant – Safe outcome is unlikely without effective training
5. Critical – essential to understanding and coping with the event

DESCENT

Figure A11.7

11.8 PAGE 7 OF TRAINING CRITICALITY SURVEY (TCS) DENOTING THREATS AND ERRORS IN APPROACH FLIGHT PHASE

Organisation	XYZ Airlines			
Aircraft Type	B777-200ER			
Type of Operation	Long Haul, Overwater International			
Area of Operation	De-identified			
	Likelihood	**Severity**	**Training**	**Result**
Windshear	2	3	5	30
Adverse Weather/Ice	5	3	3	45
Crosswind	5	2	5	50
ATC	3	3	3	27
NAV	2	3	3	18
Loss of comms	3	3	3	27
Traffic	2	3	5	30
R/W incursion	1	4	5	20
Poor Visibility	5	3	4	60
Wake vortex	3	3	3	27
Upset	1	5	5	25
Terrain	1	5	5	25
Birds	1	4	4	16
Eng Fail	1	4	5	20
MEL	5	1	2	10
Fire	1	4	4	16
System malfunction	3	2	3	18

Likelihood

The probability that over the course of one year a pilot will experience a defined event, requiring intervention to ensure a safe outcome.
1. Rare - once in career or less
2. Unlikely - few times in career
3. Moderate - once every 3-5 years
4. Likely - probably once a year
5. Almost Certain - more than once a year

Severity

The most likely outcome given that the event has occurred for a pilot not trained to manage that defined event

1. Negligible – insignificant effect not compromising safety
2. Minor – reduction in safety margin
3. Moderate – safety compromise
4. Major – aircraft damage and/or personal injury
5. Catastrophic - significant damage or hull loss

Training Benefit

Consider the effect of training to reduce the severity by one level, e.g. the most likely result of an engine failure during take off is catastrophic at least in a conventional aircraft. Effective training reduces this severity to major.
1. Unimportant – training has no impact
2. Minor - enhances performance in managing an event
3. Moderate – having no training compromises safety
4. Significant – Safe outcome is unlikely without effective training
5. Critical – essential to understanding and coping with the event

APPROACH & GO AROUND

Figure A11.8

11.9 PAGE 8 OF TRAINING CRITICALITY SURVEY (TCS) DENOTING THREATS AND ERRORS IN THE LANDING FLIGHT PHASE

Organisation	XYZ Airlines			
Aircraft Type	B777-200ER			
Type of Operation	Long Haul, Overwater International			
Area of Operation	De-identified			
	Likelihood	**Severity**	**Training**	**Result**
Windshear	2	4	5	40
Adverse Weather/Ice	5	3	3	45
Crosswind	5	3	5	75
ATC	3	3	3	27
NAV	2	3	3	18
Loss of comms	3	3	3	27
Traffic	2	4	5	40
R/W incursion	1	4	5	20
Poor Visibility	5	3	4	60
Wake vortex	3	3	3	27
Upset	1	5	5	25
Terrain	1	1	1	1
Birds	1	2	2	4
Eng Fail	1	3	3	9
MEL	1	1	1	1
Fire	1	4	4	16
System malfunction	1	1	1	1

Likelihood

The probability that over the course of one year a pilot will experience a defined event, requiring intervention to ensure a safe outcome.
1. Rare - once in career or less
2. Unlikely - few times in career
3. Moderate - once every 3-5 years
4. Likely - probably once a year
5. Almost Certain - more than once a year

Severity

The most likely outcome given that the event has occurred for a pilot not trained to manage that defined event

1. Negligible – insignificant effect not compromising safety
2. Minor – reduction in safety margin
3. Moderate – safety compromise
4. Major – aircraft damage and/or personal injury
5. Catastrophic - significant damage or hull loss

Training Benefit

Consider the effect of training to reduce the severity by one level, e.g. the most likely result of an engine failure during take off is catastrophic at least in a conventional aircraft. Effective training reduces this severity to major.
1. Unimportant – training has no impact
2. Minor - enhances performance in managing an event
3. Moderate – having no training compromises safety
4. Significant – Safe outcome is unlikely without effective training
5. Critical – essential to understanding and coping with the event

LANDING

Figure A11.9

11.10 PAGE 9 OF TRAINING CRITICALITY SURVEY (TCS) DENOTING THREATS AND ERRORS IN AFTER LANDING AND POSTFLIGHT FLIGHT PHASE

Organisation	XYZ Airlines			
Aircraft Type	B777-200ER			
Type of Operation	Long Haul, Overwater International			
Area of Operation	De-identified			
	Likelihood	**Severity**	**Training**	**Result**
Ground equipment	**1**	**2**	**2**	4
Ground manoeuvring	**1**	**2**	**2**	4
Runway/Taxi condition	**5**	**2**	**3**	30
Windshear	1	1	1	1
Adverse Weather/Ice	5	3	4	60
Crosswind	1	1	1	1
ATC	2	2	2	8
NAV	1	1	1	1
Loss of comms	2	1	1	2
Traffic	2	2	2	8
R/W incursion	2	4	1	8
Poor Visibility	5	3	3	45
Terrain	1	1	1	1
Birds	1	1	1	1
Eng Fail	1	1	1	1
MEL	1	1	1	1
Fire	1	4	4	16
System malfunction	1	1	1	1

Likelihood

The probability that over the course of one year a pilot will experience a defined event, requiring intervention to ensure a safe outcome.
1. Rare - once in career or less
2. Unlikely - few times in career
3. Moderate - once every 3-5 years
4. Likely - probably once a year
5. Almost Certain - more than once a year

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Consider the effect of training to reduce the severity by one level, e.g. the most likely result of an engine failure during take off is catastrophic at least in a conventional aircraft. Effective training reduces this severity to major.
1. Unimportant – training has no impact
2. Minor - enhances performance in managing an event
3. Moderate – having no training compromises safety
4. Significant – Safe outcome is unlikely without effective training
5. Critical – essential to understanding and coping with the event

AFTER LANDING & POST FLIGHT

Figure A11.10

11.11 THE NUMBER OF RESPONSES PER EVALUATION PILOT FROM THE TOTAL OF 159 SURVEY QUESTIONS

Total Number of questions per survey	
159	
Evaluation Pilot ID	Pilot Answered Question Count
912	67
856	91
936	95
869	105
902	110
973	111
988	112
885	113
860	115
872	119
927	119
930	120
899	121
880	122
868	124
854	125
910	127
957	128
994	129
938	130
837	131
853	131
965	132
980	132
932	133
877	134
952	134
844	135
855	135
929	136
959	136
1001	137
977	137
919	139
963	139
964	139
847	140
889	140
942	140
915	141
918	141
895	142
954	142

Average questions answered per survey	
147.0060976	
Evaluation Pilot ID	Pilot Answered Question Count
970	142
875	143
890	143
913	143
968	143
870	144
985	145
840	146
925	146
949	146
876	147
859	148
976	148
997	148
851	149
926	149
978	149
984	149
848	150
850	150
857	150
878	150
892	150
901	150
937	150
991	150
841	151
911	151
881	152
896	152
923	152
960	152
993	152
908	153
914	153
921	153
939	153
836	154
858	154
884	154
888	154
891	154
975	154

Evaluation Pilot ID	Pilot Answered Question Count
983	154
1000	155
838	155
845	155
882	155
922	155
935	155
943	155
972	155
986	155
996	155
852	156
903	156
905	156
907	156
920	156
931	156
940	156
974	156
990	156
999	156
843	157
849	157
861	157
873	157
879	157
886	157
897	157
904	157
933	157
951	157
953	157
961	157
966	157
967	157
995	157
998	157
1002	158
842	158
846	158
916	154
944	154
948	154
894	158
898	158

Figure A11.11

11.12 SURVEY QUESTIONS ANSWERED PER FACTOR

Factors	Reponses per factor
Adverse Weather/Ice	1230
ATC	1251
Birds	897
Cabin issues	148
Compliance failure	161
Dangerous goods	1174
Deficiency in Ops Data	148
Deficiency within Charts	156
Deficiency within Checklists	155
Deficiency within Database	153
Deficiency within Manuals	155
Eng Fail	1192
Fatigue	145
Fire	1206
Ground equipment	299
Ground manoeuvring	303
Human Factors and CRM	154
Loading/fuel/Performance	156
Loss of comms	1202
MEL	1214
Mishanded Aircraft	144
Mishandled Auto Flight Systems	157
Mismanaged Aircraft State	156
NAV	1212
Other Mishandled system	157
Physiological	149
Pilot Incapacitation	1218
Poor Visibility	1222
Procedures	151
R/W incursion	748
Runway/Taxi condition	463
System malfunction	1225
Terrain	755
Traffic	1200
Upset	910
Wake vortex	916
Wind	757
Windshear	920
Workload/ Distraction/ Pressure	150

Figure A11.12

11.13 SURVEY QUESTIONS ANSWERED PER FACTOR BY GENERATION PROVIDING INSIGHT INTO RELATIVE SIZE OF DATA SAMPLE BY GENERATION

Factors	Responses/Factor		
	Gen 2	Gen 3	Gen 4
Adverse Weather/Ice	32	284	914
ATC	32	284	935
Birds	24	202	671
Cabin issues	4	35	109
Compliance failure	4	37	120
Dangerous goods	32	273	869
Deficiency in Ops Data	4	37	107
Deficiency within Charts	4	35	117
Deficiency within Checklists	4	36	115
Deficiency within Database	4	35	114
Deficiency within Manuals	4	36	115
Eng Fail	32	276	884
Fatigue	4	31	110
Fire	28	274	904
Ground equipment	4	69	226
Ground manoeuvring	8	70	225
Human Factors and CRM	4	35	115
Loading/fuel/Performance	4	33	119
Loss of comms	32	277	893
MEL	32	280	902
Mishanded Aircraft	4	33	107
Mishandled Auto Flight Systems	4	35	118
Mismanaged Aircraft State	4	35	117
NAV	32	275	905
Other Mishandled system	4	35	118
Physiological	4	35	110
Pilot Incapacitation	32	273	913
Poor Visibility	32	282	908
Procedures	4	35	112
R/W incursion	20	172	556
Runway/Taxi condition	12	103	348
System malfunction	32	286	907
Terrain	20	174	561
Traffic	32	282	886
Upset	24	207	679
Wake vortex	24	214	678
Wind	20	172	565
Windshear	24	213	683

Figure A11.13

11.14 THE ANALYSIS

The Methodology Chapter (refer to 3.12) discusses the technique, data and relevance of the Training Criticality Study. In the analysis section, the set of responses from the TCS regarding likelihood of occurrence and severity (risk) is compared and correlated to analogous parameters from the EBT accident-Incident study. (See Chapter 4 for the risk ranking of gen 4, 3 and 2 of the EBT accident-Incident study.)

The TSC analysis is performed in a matrix from left to right. in 4 (see figure fig 5.11.15 next page for the case for gen 3).

The 2nd column of the matrix denotes the sum of the risk (**Σ risk**) for each threat/error in the generation. The respondents of the Training Criticality Survey assessed the threat/error in terms of its components (likelihood and severity) according to their professional experience for each of the phases of flight for which the risk was relevant. The responses for all the surveys for the particular risk of each threat/error in the respective generation are then summed for a raw risk score and depicted in column 2. (See Chapter 3 Methodology (section 3.11.2) for the definitions and scales of risk, likelihood and severity.)

Not all the questions are answered in any survey, so the parameters in the next two columns are used to correct for this effect. A lack of response would indicate no risk, so that problem is addressed by weighting the sum of the scores. The column labeled ***Ans. Count*** (3rd column) shows the total number of responses for each item while the 4th column shows the total number of queries. By dividing the sum of the risk (2nd column) by the number of responses, (3rd column) times the total number of queries, (4th column), the corrected sum of the risk is obtained in 5th column.

In the survey, if threat and/or error were present in multiple phases it was considered to be in the in the Φ phase (See the Methodology Chapter 3.11.1 for a description of the Φ phase, where the risk was only assessed once as a way to shorten the survey. This provided a bias if the total risk of the flight is desired unless the threats/errors are multiplied by the number of phases in which they occur. In order to compensate for this bias all the threats in the ***Φ phase*** were multiplied by the number of relevant phases for which the threat/error was relevant. The column Φ phase depicts these particular phases of flight and the column labeled ***X Phases*** contains the numerical value for which the associated threats are relevant. By multiplying the values in ***X Phases*** times the ***Corrected Σ risk*** a corrected result was obtained and is depicted in column 10 labeled **Corrected for phase**.

The sum of all the risk per flight for a given generation resulting from the Training Criticality Study are ranked in descending order of risk as shown in the last amber highlighted column labeled ***Rank Value***. The final ranking of the threats/errors themselves are shown in the 1st amber column in the ranking number is in the 2nd amber column. It is this ordering (array of numbers in the 2nd amber column labeled ***Rank No#*** that is correlated to the EBT Accident Incident risk ranking.

The columns that are highlighted in red show the risk data resulting from the EBT Accident-Incident Study (See fig 3.2.2.12, Chapter 3) for an example of a chart denoting the analysis producing the ranking of the factors analogous to the TCS threats/errors from the Accident-Incident study. The first red column, ***Gen [i] Final Rank (Red)*** shows the factors ranked by descending risk. The numbers in the 2nd red column correspond to the ranking positions in the (amber) TCS outcome but appear in the order of the (red) accident – Incident study. If the arrays were identical the correlation would be 1, If they were random, the correlation would be 0, and if they reversely correlated the correlation would be -1. So in a certain sense the closer the arrays are to each other the closer the correlation is to 1.

11.15 THE CORRELATIONS

11.15.1 Generation 4

The correlation generation 4 Training Criticality Study (TCS) risk ranking to the EBT Accident-Incident Analysis is **0.583526383526384**.

See figure 5.11.15, which shows the ranking values by bar height (1 – 36) of each of the threats/errors from the TCS in the order (left to right of the EBT Accident-Incident Study). This depiction provides a graphical notion of the closeness of the ranking as the red line indicates how each threat/error in the TCS compares to its counterpart the other study. It is interesting to see where the risks match well but it is equally interesting to see where they differ as this shows the biases of each study. For example (See figure 5.11.15) the risk rank associated with Adverse WX, CRM, Compliance and Mismanaged A/C State from the TCS all are very close to the red line denoting the order of the accident-incident study. However, the pilot perception or risk reflected in the TCS regarding ATC and Fatigue are much greater than that resulting from the accident-incident study.

Accident-incident reports tend to be quite factual at recording factors that are concrete such as ATC but not so complete about documenting issues like fatigue, especially the older reports. Another example of source bias is the risk associated with birds. The Training Criticality Study was taken not so long after the ditching accident resulting from dual engine failure due to multiple bird ingestions. Perhaps the fact that birds have a much higher risk ranking resulting from the TCS (pilot responses) versus from the accident-incident analysis is that the bird factor was such a topical issue at the time of the survey.

Correlating the results of data sources such as was done in this report can be a powerful tool to provide perspective and insight into the results of the analyses. In addition to these attributes, all sources except the collective expertise of our flight crews are limited in terms of scope. While the perceptions of pilots are not always unbiased, they are open to almost any question.

Gen	Σ risk	Ans count	s_b	Corrected Σ risk	Gen 4 Amber Rank	Corrected Σ of risk	0 phase	x Phases	Corrected for phase	Gen 4 Final Rank (Amber)	Rank no#	Rank value	Gen 4 Final Rank (Red)	Rank no#	Rank value
4	10409	848	984	12078.4	Adverse Weather/Ice	12078.37	Cabin issues	1	12078.37	Adverse Weather/Ice	1	12078	Adverse Weather/Ice	1	36
4	8279	848	984	9606.76	ATC	9606.764	Compliance failure	1	9606.764	Mismanaged Aircraft State	2	11279	CRM	4	33
4	6673	848	984	7743.2	Poor Visibility	7743.198	Deficiency in Ops Data	1	7743.198	Compliance failure	3	10462	Compliance	3	34
4	6081	848	984	7056.25	Traffic	7056.255	Deficiency within Charts	1	7056.255	Human Factors and CRM	4	9997.8	Mis A/C State	2	35
4	5456	848	984	6331.02	Wind	6331.019	Deficiency within Checklists	1	6331.019	ATC	5	9606.8	Man handling	8	29
4	5334	848	984	6189.45	MEL	6189.453	Deficiency within Database	1	6189.453	Workload/ Distraction/ Pressure	6	9204.1	Runway/Taxi condition	24	13
4	5241	848	984	6081.54	System malfunction	6081.538	Deficiency within Manuals	1	6081.538	Poor Visibility	7	7743.2	Fire	21	16
4	4795	848	984	5564.01	Windshear	5564.009	Fatigue	1	5564.009	Mishanded Aircraft	8	7574.9	Syst mal	14	23
4	4527	848	984	5253.03	Birds	5253.028	Human Factors and CRM	1	5253.028	Fatigue	9	7100.8	Mis-Sys	10	27
4	4345	848	984	5041.84	Dangerous goods	5041.84	Loading/fuel/ Performance	0	0	Other Mishandled system	10	7045.8	Workload Distraction Pressure	6	31
4	4188	848	984	4859.66	Loss of comms	4859.66	Mishanded Aircraft	1	4859.66	Traffic	11	7056.3	Crosswind	12	25
4	4176	848	984	4845.74	Wake vortex	4845.736	Mishandled Auto Flight Systems	1	4845.736	Wind	12	6331	Poor Visibility	7	30
4	3930	848	984	4560.28	Fire	4560.283	Mismanaged Aircraft State	1	4560.283	MEL	13	6189.5	MEL	13	24
4	3504	848	984	4065.96	NAV	4065.962	Other Mishandled system	1	4065.962	System malfunction	14	6081.5	Physio	32	5
4	3396	848	984	3940.64	R/W incursion	3940.642	Physiological	1	3940.642	Windshear	15	5564	Terrain	28	9
4	3175	848	984	3684.2	Runway/Taxi condition	3684.198	Procedures	1	3684.198	Birds	16	5253	Eng Fail	29	8
4	3039	848	984	3526.39	Upset	3526.387	Workload/ Distraction/ Pressure	1	3526.387	Mishandled Auto Flight Systems	17	5221.7	ATC	5	32
4	2794	848	984	3242.09	Terrain	3242.094		1	3242.094	Loss of comms	18	4859.7	Traffic	11	26
4	2785	848	984	3231.65	Eng Fail	3231.651		1	3231.651	Wake vortex	19	4845.7	Cabin	33	4
4	2778	848	984	3223.53	Pilot Incapacitation	3223.528		1	3223.528	Procedures	20	4790	Def-Proc's	20	17
4	1666	848	984	1933.19	Ground manoeuvring	1933.189		1	1933.189	Fire	21	4560.3	R/W Incursion	23	14
4	1661	848	984	1927.39	Ground equipment	1927.387		1	1927.387	NAV	22	4066	Def-Ops data	31	6
4	1464	541	656	1775.2	Fatigue	1775.201		4	7100.806	R/W incursion	23	3940.6	Def-Chk lists	35	2

Figure A5.11.14 – Analysis of generation 4 aircraft from the TCS (Amber Study) with resultant ranking of factors in terms of risk and a correlation with the EBT Accident Study (Red Study) risk ranking of gen 4 aircraft.

4	1322	848	984	1534.02	Workload/ Distraction/ Pressure	1534.019		6	9204.113	Runway/Taxi condition	24	3684.2	Mis-AFS	17	20
4	1215	848	984	1409.86	Mismanaged Aircraft State	1409.858		8	11278.87	Upset	25	3526.4	Birds	16	21
4	1127	848	984	1307.75	Compliance failure	1307.745		8	10461.96	Deficiency within Charts	26	3439.4	Upset	25	12
4	1125	848	984	1305.42	Mishandled Auto Flight Systems	1305.425		4	5221.698	Deficiency within Manuals	27	3430.1	Windshear	15	22
4	1110	848	984	1288.02	Loading/fuel/ Performance	1288.019		1	1288.019	Terrain	28	3242.1	Loss of comms	18	19
4	1077	848	984	1249.73	Human Factors and CRM	1249.726		8	9997.811	Eng Fail	29	3231.7	Def Manuals	27	10
4	816	848	984	946.868	Mishanded Aircraft	946.8679		8	7574.943	Pilot Incapacitation	30	3223.5	Fatique	9	28
4	759	848	984	880.726	Other Mishandled system	880.7264		8	7045.811	Deficiency in Ops Data	31	3211.9	L..F.P	36	1
4	741	848	984	859.84	Deficiency within Charts	859.8396		4	3439.358	Physiological	32	3003.1	Def-Charts	26	11
4	739	848	984	857.519	Deficiency within Manuals	857.5189		4	3430.075	Cabin issues	33	2863.8	Def-DBs	34	3
4	692	848	984	802.981	Deficiency in Ops Data	802.9811		4	3211.925	Deficiency within Database	34	2757.1	NAV	22	15
4	647	848	984	750.764	Physiological	750.7642		4	3003.057	Deficiency within Checklists	35	2659.6	Pilot Incap	30	7
4	617	848	984	715.953	Cabin issues	715.9528		4	2863.811	Loading/fuel/P erformance	36	1288	Wake Vortex	19	18
4	594	848	984	689.264	Deficiency within Database	689.2642		4	2757.057	*Ground manoeuvring*		1933.2	*Removed GRD because of q bias*		
4	573	848	984	664.896	Deficiency within Checklists	664.8962		4	2659.585	*Ground equipment*		1927.4	*Removed D.G. because of NTSB db bias*		
4	516	848	984	598.755	Procedures	598.7547		8	4790.038	*Dangerous goods*		0	*Op Spec removed due to lack of responses*	**Corre-lation**	**0.58**

Legend	
	0 Phase
	Amber Study (TCS)
	Red Study (EBT Accid Study

Figure A5.11.14 cont.

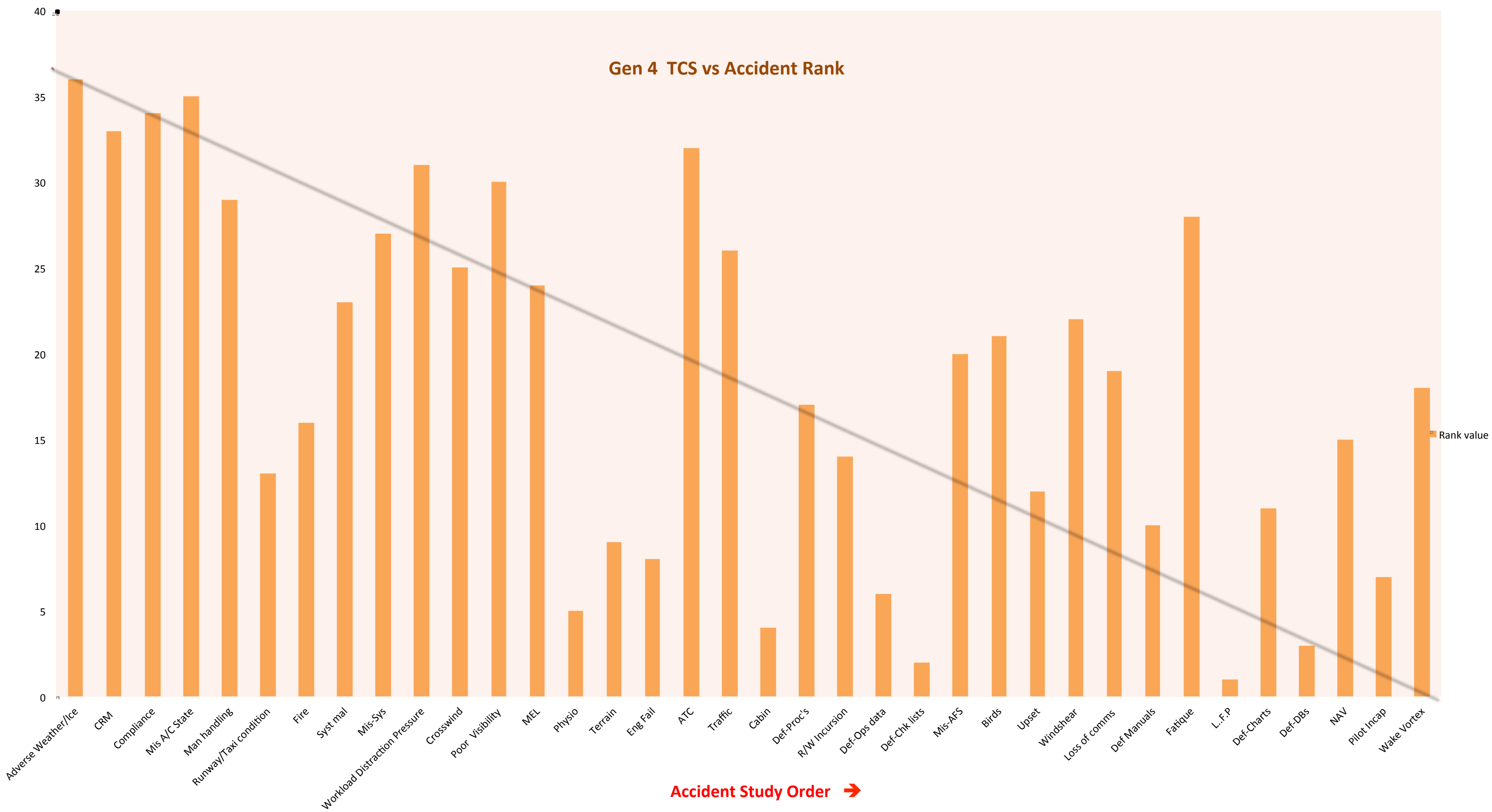


Figure A5.11.15 – Bar Chart showing the ranking of the threats and errors resulting from TCS (Amber Study) in the order of the ranking of the factors from the EBT accident study (Red Study)

11.15.2 Gen3 Jet

The correlation generation 3 Training Criticality Study (TCS) risk ranking to the EBT Accident-Incident Analysis is 0.636808237.

Gen	Σ risk	Ans count	s_b	Corrected Σ risk	Gen 4 Amber Rank	Corrected Σ of risk	Φ phase	x Phases	Corrected for phase	Gen 4 Final Rank (Amber)	Rank no#	Rank value	Gen 4 Final Rank (Red)	Rank no#	Rank value
4	10409	848	984	12078.4	Adverse Weather/Ice	12078.37	Cabin issues	1	12078.37	Adverse Weather/Ice	1	12078	Adverse Weather/Ice	1	36
4	8279	848	984	9606.76	ATC	9606.764	Compliance failure	1	9606.764	Mismanaged Aircraft State	2	11279	CRM	4	33
4	6673	848	984	7743.2	Poor Visibility	7743.198	Deficiency in Ops Data	1	7743.198	Compliance failure	3	10462	Compliance	3	34
4	6081	848	984	7056.25	Traffic	7056.255	Deficiency within Charts	1	7056.255	Human Factors and CRM	4	9997.8	Mis A/C State	2	35
4	5456	848	984	6331.02	Wind	6331.019	Deficiency within Checklists	1	6331.019	ATC	5	9606.8	Man handling	8	29
4	5334	848	984	6189.45	MEL	6189.453	Deficiency within Database	1	6189.453	Workload/ Distraction/ Pressure	6	9204.1	Runway/Taxi condition	24	13
4	5241	848	984	6081.54	System malfunction	6081.538	Deficiency within Manuals	1	6081.538	Poor Visibility	7	7743.2	Fire	21	16
4	4795	848	984	5564.01	Windshear	5564.009	Fatigue	1	5564.009	Mishanded Aircraft	8	7574.9	Syst mal	14	23
4	4527	848	984	5253.03	Birds	5253.028	Human Factors and CRM	1	5253.028	Fatigue	9	7100.8	Mis-Sys	10	27
4	4345	848	984	5041.84	Dangerous goods	5041.84	Loading/fuel/ Performance	0	0	Other Mishandled system	10	7045.8	Workload Distraction Pressure	6	31
4	4188	848	984	4859.66	Loss of comms	4859.66	Mishanded Aircraft	1	4859.66	Traffic	11	7056.3	Crosswind	12	25
4	4176	848	984	4845.74	Wake vortex	4845.736	Mishandled Auto Flight Systems	1	4845.736	Wind	12	6331	Poor Visibility	7	30
4	3930	848	984	4560.28	Fire	4560.283	Mismanaged Aircraft State	1	4560.283	MEL	13	6189.5	MEL	13	24
4	3504	848	984	4065.96	NAV	4065.962	Other Mishandled system	1	4065.962	System malfunction	14	6081.5	Physio	32	5
4	3396	848	984	3940.64	R/W incursion	3940.642	Physiological	1	3940.642	Windshear	15	5564	Terrain	28	9
4	3175	848	984	3684.2	Runway/Taxi condition	3684.198	Procedures	1	3684.198	Birds	16	5253	Eng Fail	29	8
4	3039	848	984	3526.39	Upset	3526.387	Workload/ Distraction/ Pressure	1	3526.387	Mishandled Auto Flight Systems	17	5221.7	ATC	5	32
4	2794	848	984	3242.09	Terrain	3242.094		1	3242.094	Loss of comms	18	4859.7	Traffic	11	26
4	2785	848	984	3231.65	Eng Fail	3231.651		1	3231.651	Wake vortex	19	4845.7	Cabin	33	4
4	2778	848	984	3223.53	Pilot Incapacitation	3223.528		1	3223.528	Procedures	20	4790	Def-Proc's	20	17
4	1666	848	984	1933.19	Ground manoeuvring	1933.189		1	1933.189	Fire	21	4560.3	R/W Incursion	23	14

Figure A5.11.16 – Analysis of generation 3 aircraft from the TCS (Amber Study) with resultant ranking of factors in terms of risk and a correlation with the EBT Accident Study (Red Study) risk ranking of Gen3 Jet aircraft.

3	471	916	984	505.9651	Ground equipment	505.9651		0	0	NAV	1187	22	Wake Vortex	21	16
3	384	916	984	412.5066	Workload/ Distraction/ Pressure	412.5066		6	2475.039	Birds	1181	23	Def-DBs	35	2
3	378	606	656	409.1881	Fatigue	409.1881		4	1636.752	Eng Fail	1046	24	Def-Charts	33	4
3	314	916	984	337.31	Human Factors and CRM	337.31		8	2698.48	Deficiency within Manuals	1040	25	Def-Ops data	27	10
3	300	916	984	322.2707	Mismanaged Aircraft State	322.2707		8	2578.166	Cabin issues	973	26	Mis-AFS	18	19
3	296	916	984	317.9738	Mishandled Auto Flight Systems	317.9738		4	1271.895	Deficiency in Ops Data	967	27	Def Manuals	25	12
3	291	916	984	312.6026	Compliance failure	312.6026		8	2500.821	Deficiency within Checklists	963	28	R/W Incursion	20	17
3	242	916	984	259.9651	Deficiency within Manuals	259.9651		4	1039.86	Upset	943	29	Birds	23	14
3	225	916	984	241.7031	Deficiency in Ops Data	241.7031		4	966.8122	Terrain	893	30	L..F.P	36	1
3	224	916	984	240.6288	Deficiency within Checklists	240.6288		4	962.5153	Runway/Taxi condition	836	31	Def-Chk lists	28	9
3	197	916	984	211.6245	Loading/fuel/ Performance	211.6245		1	211.6245	Physiological	834	32	Fatique	12	25
3	196	916	984	210.5502	Mishanded Aircraft	210.5502		8	1684.402	Deficiency within Charts	821	33	Physio	32	5
3	194	916	984	208.4017	Physiological	208.4017		4	833.607	Pilot Incapacitation	794	34	NAV	22	15
3	191	916	984	205.179	Deficiency within Charts	205.179		4	820.7162	Deficiency within Database	653	35	Pilot Incap	34	3
3	191	916	984	205.179	Other Mishandled system	205.179		8	1641.432	Loading/fuel/ Performance	212	36	Loss of comms	16	21
3	154	916	984	165.4323	Procedures	165.4323		8	1323.459	Dangerous goods	0		*Removed GRD because lack of response*		
3	152	916	984	163.2838	Deficiency within Database	163.2838		4	653.1354	Ground manoeuvring	0		*Removed D.G. because of NTSB db bias*		
3	151	916	984	162.2096	Cabin issues	162.2096		6	973.2576	Ground equipment	0		*Op Spec removed due to lack of responses*	**Corre-lation**	**0.637**

Legend	
	0 Phase
	Amber Study (TCS)
	Red Study (EBT Accid Study

Figure A5.11.16 cont.

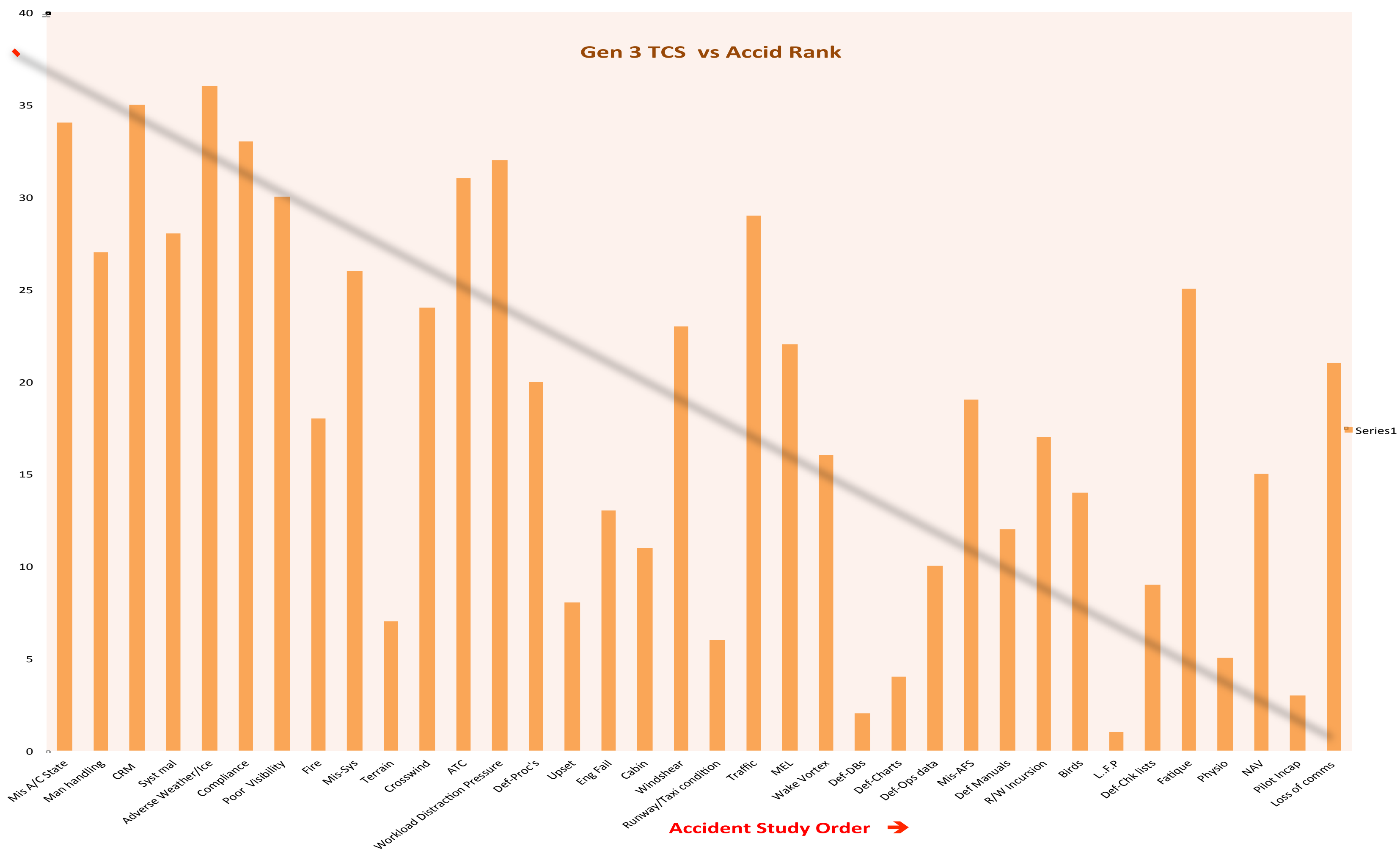


Figure A5.11.17 – Bar Chart showing Gen 3 ranking of the threats and errors resulting from TCS (Amber Study) in the order of the ranking of the factors from the EBT accident study (Red Study)

11.15.2.1 Gen2 Jet

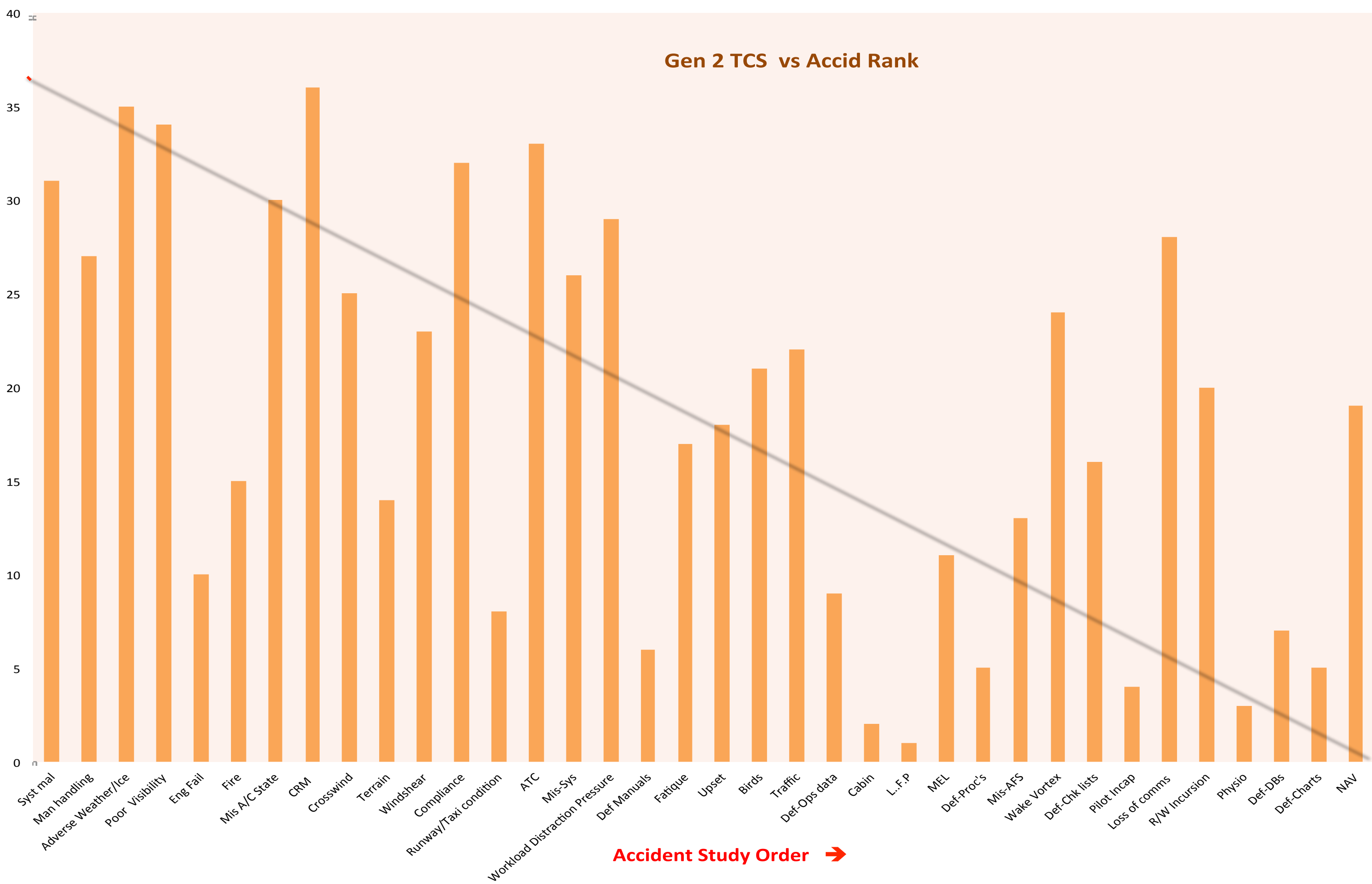
The correlation generation 2 Training Criticality Study (TCS) risk ranking to the EBT Accident-Incident Analysis is **0.553783408**.

Gen	Σ risk	Ans count	s_b	Corrected Σ risk	Gen 2 Amber Rank	Corrected Σ risk	0 phase	x Phases	Corrected for phase	Gen 2 Final Rank (Amber)	Rank no#	Values	Gen 2 Final Rank(Red)	Rank no#	Rank value
2	288	159	164	297.057	Adverse Weather/Ice	297.0566	Cabin issues	1	297.0566	Human Factors and CRM	305	1	Syst mal	6	31
2	267	159	164	275.396	Poor Visibility	275.3962	Compliance failure	1	275.3962	Adverse Weather/Ice	297	2	Man handling	10	27
2	262	159	164	270.239	ATC	270.239	Deficiency in Ops Data	1	270.239	Poor Visibility	275	3	Adverse Weather/Ice	2	35
2	218	159	164	224.855	System malfunction	224.8553	Deficiency within Charts	1	224.8553	ATC	270	4	Poor Visibility	3	34
2	196	159	164	202.164	Loss of comms	202.1635	Deficiency within Checklists	1	202.1635	Compliance failure	248	5	Eng Fail	27	10
2	182	159	164	187.723	Wind	187.7233	Deficiency within Database	1	187.7233	System malfunction	225	6	Fire	22	15
2	174	159	164	179.472	Wake vortex	179.4717	Deficiency within Manuals	1	179.4717	Mismanaged Aircraft State	215	7	Mis A/C State	7	30

Figure A5.11.18 – Analysis of generation 3 aircraft from the TCS (Amber Study) with the resultant ranking of factors in terms of risk and a correlation with the EBT Accident Study (Red Study) risk ranking of gen 3 aircraft.

2	173	159	164	178.44	Windshear	178.4403	Fatigue	1	178.4403	Workload/ Distraction/ Pressure	210	8	CRM	1	36
2	157	159	164	161.937	Traffic	161.9371	Human Factors and CRM	1	161.9371	Loss of comms	202	9	Crosswind	12	25
2	153	159	164	157.811	Birds	157.8113	Loading/fuel/ Performance	1	157.8113	Mishanded Aircraft	198	10	Terrain	23	14
2	147	159	164	151.623	R/W incursion	151.6226	Mishanded Aircraft	1	151.6226	Other Mishandled system	198	11	Windshear	14	23
2	144	159	164	148.528	NAV	148.5283	Mishandled Auto Flight Systems	1	148.5283	Wind	188	12	Compliance	5	32
2	132	159	164	136.151	Upset	136.1509	Mismanaged Aircraft State	1	136.1509	Wake vortex	179	13	Runway/Tax i condition	29	8
2	130	159	164	134.088	Dangerous goods	134.0881	Other Mishandled system	0	0	Windshear	178	14	ATC	4	33
2	122	159	164	125.836	Fire	125.8365	Physiologica l	1	125.8365	Traffic	162	15	Mis-Sys	11	26
2	122	159	164	125.836	Terrain	125.8365	Procedures	1	125.8365	Birds	158	16	Workload Distraction Pressure	8	29
2	106	159	164	109.333	MEL	109.3333	Workload/ Distraction/ Pressure	1	109.3333	R/W incursion	152	17	Def Manuals	31	6
2	105	159	164	108.302	Eng Fail	108.3019		1	108.3019	NAV	149	18	Fatique	20	17
2	88	159	164	90.7673	Runway/Taxi condition	90.7673		1	90.7673	Upset	136	19	Upset	19	18
2	78	159	164	80.4528	Pilot Incapacitation	80.45283		1	80.45283	Fatigue	132	20	Birds	16	21
2	43	159	164	44.3522	Ground manoeuvring	44.3522		0	0	Deficiency within Checklists	128	21	Traffic	15	22
2	37	159	164	38.1635	Human Factors and CRM	38.16352		8	305.3082	Fire	126	22	Def-Ops data	28	9
2	34	159	164	35.0692	Workload/ Distraction/ Pressure	35.06918		6	210.4151	Terrain	126	23	Cabin	35	2
2	32	159	164	33.0063	Fatigue	33.00629		4	132.0252	Mishandled Auto Flight Systems	124	24	L..F.P	36	1
2	31	159	164	31.9748	Deficiency within Checklists	31.97484		4	127.8994	Procedures	116	25	MEL	26	11
2	30	159	164	30.9434	Compliance failure	30.9434		8	247.5472	MEL	109	26	Def-Proc's	32	5
2	30	159	164	30.9434	Mishandled Auto Flight Systems	30.9434		4	123.7736	Eng Fail	108	27	Mis-AFS	24	13
2	26	159	164	26.8176	Ground equipment	26.81761		0	0	Deficiency in Ops Data	99	28	Wake Vortex	13	24
2	26	159	164	26.8176	Mismanaged Aircraft State	26.81761		8	214.5409	Runway/Taxi condition	90.8	29	Def-Chk lists	21	16
2	24	159	164	24.7547	Deficiency in Ops Data	24.75472		4	99.01887	Deficiency within Database	86.6	30	Pilot Incap	33	4
2	24	159	164	24.7547	Mishanded Aircraft	24.75472		8	198.0377	Deficiency within Manuals	86.6	31	Loss of comms	9	28
2	24	159	164	24.7547	Other Mishandled system	24.75472		8	198.0377	Deficiency within Charts	82.5	32	R/W Incursion	17	20
2	23	159	164	23.7233	Loading/fuel/P erformance	23.72327		1	23.72327	Pilot Incapacitation	80.5	33	Physio	34	3
2	21	159	164	21.6604	Deficiency within Database	21.66038		4	86.64151	Physiological	74.3	34	Def-DBs	30	7
2	21	159	164	21.6604	Deficiency within Manuals	21.66038		4	86.64151	Cabin issues	61.9	35	Def-Charts	32	5
2	20	159	164	20.6289	Deficiency within Charts	20.62893		4	82.51572	Loading/fuel/P erformance	23.7	36	NAV	18	19
2	18	159	164	18.566	Physiological	18.56604		4	74.26415	Dangerous goods	0				
2	14	159	164	14.4403	Procedures	14.44025		8	115.522	Ground manoeuvring	0				
2	10	159	164	10.3145	Cabin issues	10.31447		6	61.88679	Ground equipment	0			Corre- lation	0.554

Legend
- 0 Phase
- Amber Study (TCS)
- Red Study (EBT Accid Study


Gen 2 TCS vs Accid Rank
40
35
30
25
20
15
10
5
0
Syst mal
Man handling
Adverse Weather/Ice
Poor Visibility
Eng Fail
Fire
Mis A/C State
CRM
Crosswind
Terrain
Windshear
Compliance
Runway/Taxi condition
ATC
Mis-Sys
Workload Distraction Pressure
Def Manuals
Fatique
Upset
Birds
Traffic
Def-Ops data
Cabin
L.F.P
MEL
Def-Proc's
Mis-AFS
Wake Vortex
Def-Chk lists
Pilot Incap
Loss of comms
R/W Incursion
Physio
Def-DBs
Def-Charts
NAV
Accident Study Order

11.15.3 Comparison of Gen 3 Jet and Gen 4 Jet in the TCS

Figure 5.11.20 shows a comparison of generation 4 aircraft in the TCS with generation 3 aircraft in the same study to provide a graphic representation of where the differences lie between these two generations.

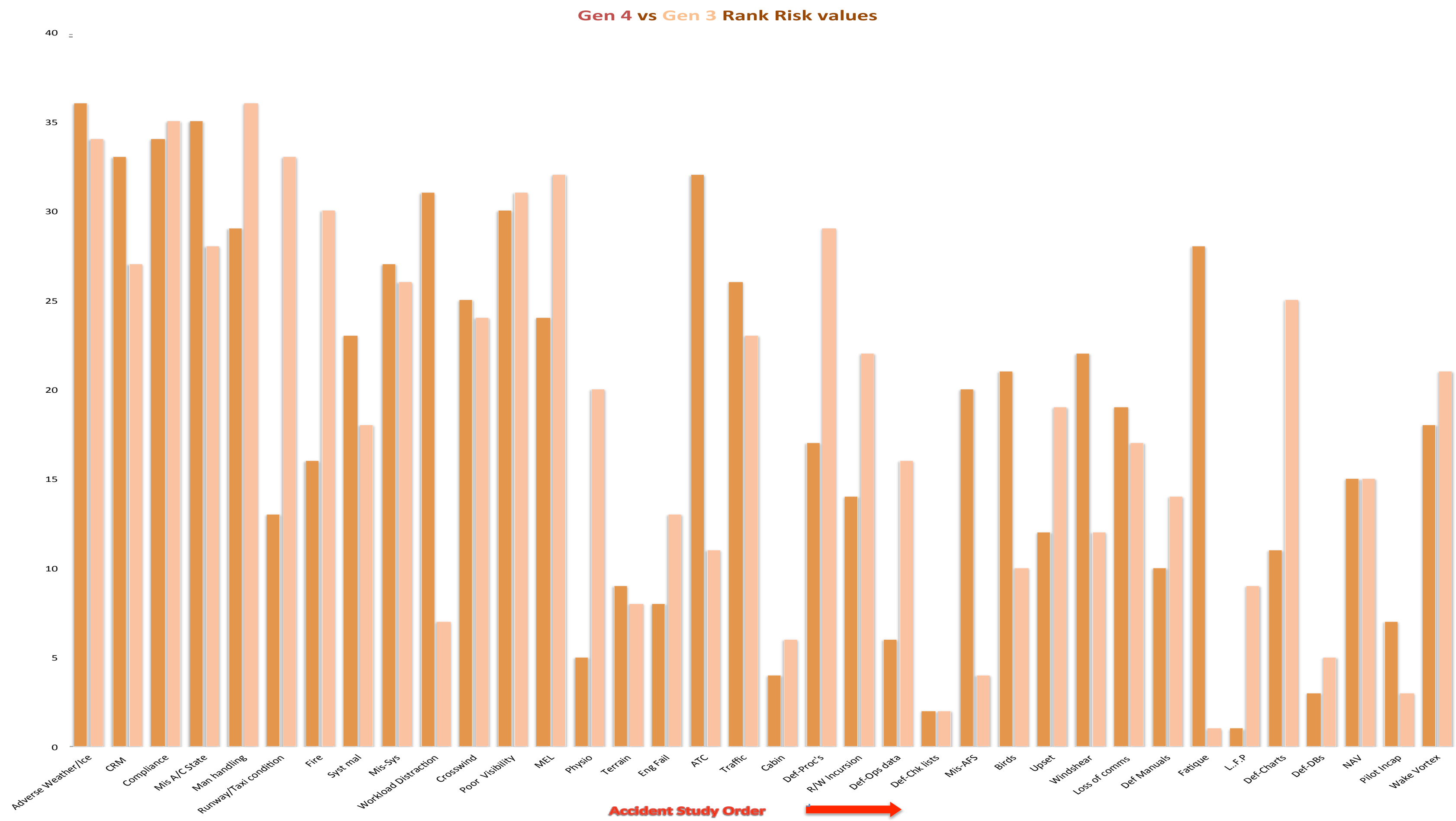


Figure A5.11.20

APPENDIX 12
EVIDENCE TABLE

12.1 EVIDENCE TABLE

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
1	Unstable Apprs: 4% of approaches were unstable. 97% continued to landing.1% of such landings were abnormal. Both crew members willing to continue even if unstable.	1			APP	234	All	LOSA	Unstable APR/GA	Unstable APP Go Around	CRM Mis A/C State Compliance	Flight Management Guidance/Automation
2	Pilots did not know stable approach criteria.	1			APP	234	All	LOSA	Unstable APR/GA Training	Unstable APP Go Around	CRM	Knowledge
3	3% of Unstable Approaches are linked to weather and ATC.		1		APP	234	All	LOSA	Unstable APR/GA	Unstable APP WX	Adverse WX ATC	
4	Missed Approaches as result of Unstable Approaches are rarely handled well. Risk rises dramatically which is problematic.	1	1		APP GA	234	All	LOSA	Competencies Unstable APR/GA Training	Unstable APP Go Around	Mis A/C State	Application of Procedures/Knowledge
5	Usually a surprise to the crew. None occurred at standard missed approach height briefed.	1			APP	234	All	LOSA	Competencies Unstable APR/GA	Go Around Surprise	Compliance CRM	SA Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control
6	28% of flights in the LOSA Archive have an Automation error. Almost 1% of total flights have Automation errors that have consequential results.	1			All	234	All	LOSA	Automation Error Training	Automation Error Mgt	Mis-AFS Mis A/C State	Flight Management Guidence/Automation
7	In terms of mismanaged errors guidance are far more prevalent than programming errors.				All	234	All	LOSA	Error Automation Training	Automation Error Mgt	Mis-AFS	Flight Management Guidance/Automation
8	Technical understanding of the Automation	1			All	234	All	LOSA	Automation Competencies Training	Automation	Mis-AFS CRM	Flight Management Guidance/Automation Knowledge
9	A lack of "verbalization" by crew to share mental models	1	1		All	234	All	LOSA	Competencies Automation Training	Automation Error Mgt	Mis-AFS CRM	Flight Management Guidance/Automation Communication
10	The late engagement of autopilot after takeoff or early disengagement in Descent/Approach/Land,Basically hand flying at an inappropriate time. Common errors include hand flying in a busy Terminal Area.	1	1		CLB APP	234	All	LOSA	Automation Competencies	Automation Manual AC Control Error Mgt	Mis-AFS CRM	Flight Management Guidance/Automation Problem Solving Decision Making
11	Control Zone, looking through the FD, not checking modifications to the SID, STAR or Approach profile and relying on the PM to effect FMC/FMGC changes.	1	1		CLB APP	234	All	LOSA	Automation Training	Automation Manual AC Control Monitor Xcheck	Mis-AFS CRM	Flight Management Guidance/Automation Workload Management Manual Aircraft Control Application of Procedures/Knowledge
12	The overarching element is Monitoring/Cross-Checking, with little to no dialogue between the pilots during most of the errors.	1			All	234	All	LOSA	Automation Error MonitoringXchecking Training	Automation Monitor Xcheck Error Mgt	Mis-AFS CRM	Flight Management Guidance/Automation Communication SA
13	21% of the Automation induced undesired aircraft states result from SOP Cross-Verification errors	1	1		All	234	All	LOSA	Automation Error MonitoringXchecking UAS	Automation Monitor Xcheck Error Mgt	Mis-AFS CRM Mis A/C State	Flight Management Guidance/Automation SA
14	There are often misunderstandings of autopilot modes.	1	1		All	234	All	LOSA	Automation Competencies Training	Automation Error Mgt	Mis-AFS CRM	Flight Management Guidance/Automation Knowledge
15	There is a high prevalence of altimeter errors versus other aircraft systems and instruments. Wrong primary altimeter setting" errors occur on about 3-4% of flights. 46% of these errors are mismanaged.	1	1		All	234	All	LOSA	Error	Error Mgt	Mis-Sys Mis A/C State Compliance	SA Application of Procedures/Knowledge
16	Many flights have improperly set secondary altimeters. Proper use of secondary altimeters does not seem to be taught in training or imbedded in SOPs	1	1		All	234	All	LOSA	Error	Error Mgt Terrain	Mis-Sys Mis A/C State Def-Proc's	SA
17	MSA issues: In areas of high Terrain in many cases, no altimeter is set to QNH. Direct to – clearances rarely result in pilots checking revised MSA. In briefing, only the 25 mile airfield MSA is considered, not that for the descent corridor.	1	1		TO CLB APP LDG	234	All	LOSA	MonitoringXchecking	Monitor Xcheck Error Mgt Terain	Terrain Compliance CRM Mis-Sys	SA Leadership and Teamwork Application of Procedures/Knowledge
18	About 4% of all flights are rated poor or marginal on Monitoring/Cross-Checking in at least one phase of flight. Flights with poor or marginal monitoring/Cross-Checking ratings have double the rate of mismanaged threats than those with Good or above.	1	1		All	234	All	LOSA	MonitoringXchecking	Monitor Xcheck Error Mgt	CRM Workload Distraction Compliance	SA Workload Management Application of Procedures/Knowledge

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
19	Two of the more frequent Monitor/Cross-Checking errors logged in LOSA are Callout and SOP Cross verification errors.	1	1		All	234	All	LOSA	MonitoringXchecking	Monitor Xcheck Error Mgt	CRM Workload Distraction Compliance	SA Workload Management Application of Procedures/Knowledge
20	Among callout errors, the ones for omitted deviation callouts have the highest risk (65% UAS/added error rate).	1	1		All	234	All	LOSA	MonitoringXchecking UAS	Leadership Error Mgt Monitor Xcheck	Compliance	Leadership and Teamwork Application of Procedures/Knowledge
21	2% of omitted callouts are intentional.	1	1		All	234	All	LOSA	MonitoringXchecking Compliance	Leadership Error Mgt	Compliance	Communication SA Leadership and Teamwork Application of Procedures/Knowledge
22	There is a strong association between non compliance and poor TEM performance.	1	1		All	234	All	LOSA	Compliance	Error Mgt	Compliance CRM	Communication SA Leadership and Teamwork Workload Management Problem Solving Decision Making Knowledge Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control
23	28% of flights in the LOSA Archive have an SOP Cross-Verification error. 1% of these are mismanaged.	1	1		All	234	All	LOSA	MonitoringXchecking Training	Monitor Xcheck Error Mgt	Mis-AFS Mis A/C State Mis-Sys	Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control
24	Most Frequent cross-verification errors: Omitted flight mode verification – 2%, Failure to cross-verify alt setting – 18%, Failure to cross-verify FMS settings – 16%, Failure to cross verify documentation and performance – 9%	1			All	234	All	LOSA	MonitoringXchecking Training	Monitor Xcheck Error Mgt	Mis-Sys Mis-AFS Compliance	SA Flight Management Guidance/Automation Application of Procedures/Knowledge
25	Most Risky cross-verification errors: Failure to cross-verify alt setting, Failure to cross-verify FMS settings (14% UAS/added error rate).	1	1		All	234	All	LOSA	MonitoringXchecking UAS Training	Monitor Xcheck Error Mgt	Mis-Sys Mis-AFS Compliance	SA Flight Management Guidance/Automation Application of Procedures/Knowledge
26	Most important mismanaged Threat: Terrain. Both omitted callouts and failure to select Terrain feature on Nav Display are a common and risky combination. Airlines that operate in high Terrain areas tend to get too used to this threat.	1			TO CLB DES APP LDG	234	All	LOSA	Terrain MonitoringXchecking Training	Terrain Monitor Xcheck Error Mgt	Mis-Sys Compliance	SA Application of Procedures/Knowledge
27	Thunderstorms/Turbulence: Common errors associated are ManualACControl, Flight control and System, Instrument and Radio error. – exacerbate the situation.	1			TO CLB DES APP	234	All	LOSA	ManualACControl Error	WX Error Mgt Manual AC Control	Adverse WX Workload Distraction Mis A/C State Mis-Sys	Communication SA Workload Management Application of Procedures/Knowledge Manual Aircraft Control
28	Unexpected aircraft malfunction. Crew applying engineering shortcuts or workarounds instead of following ECAM, QRH, MEL. High degree of intentional non-compliance.	1	1		All	234	All	LOSA	Compliance	Error Mgt System Malfunction Surprise	Syst mal Compliance CRM Workload Distraction	Application of Procedures/Knowledge
29	Icing and Snow – The most common error associated with this threat is failure to select anti-ice on. That situation leads to a UAS. Usually coupled with poor/marginal monitoring / cross-checking.	1	1		All	234	All	LOSA	Error MonitoringXchecking UAS	WX Error Mgt Monitor Xcheck	Adverse WX Compliance CRM Workload Distraction Mis-Sys	SA Workload Management Application of Procedures/Knowledge
30	Intentional Noncompliance: significant positive correlation between this and the number of mismanaged threats, unintentional errors, mismanaged errors and UAS.	1	1		All	234	All	LOSA	Compliance UAS Training	Error Mgt	Compliance CRM Mis-AFS Mis A/C State Mis-Sys	Leadership and Teamwork Application of Procedures/Knowledge
31	Number 1 non-compliance item: Non standard checklist protocol. Almost half during ground/taxi out.	1	1		All	234	All	LOSA	Compliance	Error Mgt Leadership	Ground manoeuvring CRM Compliance	Application of Procedures/Knowledge
32	Number 2 non-compliance item: Omitted altitude callouts	1	1		All	234	All	LOSA	Compliance Error	Monitor Xcheck Error Mgt	Compliance CRM Workload Distraction	Communication SA Application of Procedures/Knowledge

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
33	Number 3 non-compliance item: Fail to execute missed appr when required	1	1		APP	234	All	LOSA	Unstable APR/GA Compliance	Unstable APP Landing Issues Go Around	Compliance CRM Mis A/C State	Leadership and Teamwork Problem Solving Decision Making Application of Procedures/Knowledge
34	Number 4 non-compliance item: PF makes own changes	1	1		All	234	All	LOSA	Compliance	Leadership Error Mgt Monitor Xcheck	Compliance CRM	Communication SA Leadership and Teamwork Application of Procedures/Knowledge
35	Number 5 non-compliance item: Taxi duties commence before runway exit	1	1		GND	234	All	LOSA	Compliance	Monitor Xcheck Error Mgt Leadership Landing Issues	Compliance CRM Ground manoeuvring	Communication SA Leadership and Teamwork Application of Procedures/Knowledge
36	Captains display significantly more non-compliance than first officers.	1	1		All	234	All	LOSA	Compliance	Leadership	Compliance CRM	Leadership and Teamwork Application of Procedures/Knowledge
37	Flights with outstanding ratings for Leadership and Communication Environment have on average 2.3 errors/flight vs 7. errors/flights for poor Leadership and Communication Environment. Flights with poor ratings have approximately 3 times the number of mismanaged threats.	1	1		All	234	All	LOSA	Leadership Communication Error	Leadership Error Mgt Surprise	CRM Mis A/C State	Communication Leadership and Teamwork
38	If communication is poor, TEM is poor despite good Leadership by captain.	1	1		All	234	All	LOSA	Leadership Communication Training	Error Mgt	CRM	Communication Leadership and Teamwork
39	Most common threat type: Adverse weather.	1	1		All	234	All	LOSA	WX	WX	Adverse WX Windshear Crosswind Poor Visibility	SA Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control
40	ATC threats are the second most common threat type observed in the LOSA Archive.	1			All	234	All	LOSA	Communication Training		ATC	Communication
41	ATC threat 1: Challenging clearances or tough to meet restrictions, leading to ManualACControl & Automation issues.	1	1		CLB DES APP	234	All	LOSA	ManualACControl Automation	Error Mgt Manual AC Control	ATC Workload Distraction Pressure Mis A/C State Mis-AFS	Flight Management Guidance/Automation Manual Aircraft Control
42	ATC threat 2: Runway Changes, leading to Automation Issues, Briefing errors, SOP errors, Aircraft configuration issues.	1	1		APP GND	234	All	LOSA	Communication Automation Error	Error Mgt Automation	ATC Workload Distraction Mis A/C State Mis-AFS CRM Compliance	Communication Application of Procedures/Knowledge Flight Management Guidance/Automation
43	ATC threat 3: Difficulty understanding Controller, leading to communication issues, mainly ground navigation related (5%).	1	1		All	234	All	LOSA	Communication	Error Mgt	Ground manoeuvring ATC R/W Incursion Compliance	Communication Application of Procedures/Knowledge
44	Crews often agree to ATC clearances in order to "help".		1		CLB DES APP	234	All	LOSA	Unstable APR/GA	Error Mgt Leadership	ATC Workload Distraction Mis A/C State Mis-AFS	Communication Flight Management Guidance/Automation Manual Aircraft Control Problem Solving Decision Making
45	ATC induced problems often linked with poor communication and cross-checking in the cockpit.	1	1		TO CLB DES APP	234	All	LOSA	Communication MonitoringXchecking Training	Error Mgt Monitor Xcheck	ATC CRM	Communication SA Application of Procedures/Knowledge
46	Weather radar usage: 8% of flights face Thunderstorm, 1% mismanaged; half of errors lead to UAS. Most common linked errors are: Wrong radar settings, Course or heading deviations without ATC clearance, Weather penetration.	1	1		All	234	All	LOSA	Compliance Error UAS WX	WX	Adverse WX ATC CRM Mis A/C State Mis-Sys Compliance	Knowledge Communication Application of Procedures/Knowledge

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
47	About 25% of Weather avoidance events involve intentional non-compliance: deviation without ATC clearance and deliberately penetrating bad weather. Offsets are often less than company requirements.	1	1		CLB CRZ DES	234	All	LOSA	Compliance Error WX	WX	Adverse WX ATC CRM Mis A/C State Mis-Sys Compliance	Communication Application of Procedures/Knowledge Problem Solving Decision Making
48	Key theme in weather avoidance errors is lack of forward planning. Late identification contributed in all penetration events.	1	1		All	234	All	LOSA	Error WX	WX	Adverse WX CRM Mis A/C State	SA Problem Solving Decision Making
49	The two most important radar errors were: radar not switched on and incorrect use of gain and especially tilt.	1	1		All	234	All	LOSA	Error WX	WX Error Mgt	Compliance CRM Mis-Sys	Knowledge Workload Management Application of Procedures/Knowledge
50	Flight phases: most threats in pre-departure.	1	1		GND	234	All	LOSA	Error Management	Error Mgt	Cabin CRM Workload Distraction	Leadership and Teamwork Workload Management
51	Flight phases: most mismanaged errors and UAS in DES, APP, LND	1	1		DES APP LDG	234	All	LOSA	Error Management UAS	Error Mgt	CRM Workload Distraction Pressure Mis A/C State Mis-Sys	Leadership and Teamwork Workload Management
52	In top 5 - UAS in DES/APP/LND: speed too high	1	1		DES APP LDG	234	All	LOSA	Unstable APR/GA UAS	Unstable APP Landing Issues	ATC Compliance CRM Mis A/C State	SA Workload Management Problem Solving Decision Making Flight Management Guidance/Automation
53	In Top 5 - UAS in DES/APP/LND: Unstable App	1	1		DES APP LDG	234	All	LOSA	Unstable APR/GA UAS	Unstable APP Landing Issues	ATC Compliance CRM Mis A/C State	SA Workload Management Problem Solving Decision Making Flight Management Guidance/Automation Application of Procedures/Knowledge
54	In top 5 - UAS in DES/APP/LND: incorrect A/C config-Automation	1	1		DES APP LDG	234	All	LOSA	Unstable APR/GA UAS	Unstable APP	Compliance CRM Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance/Automation Application of Procedures/Knowledge
55	In top 5 - UAS in DES/APP/LND: incorrect A/C config-systems	1	1		DES APP LDG	234	All	LOSA	Unstable APR/GA UAS	Unstable APP Go Around	Compliance CRM Mis A/C State Mis-Sys	Problem Solving Decision Making Application of Procedures/Knowledge
56	In top 5 - UAS in DES/APP/LND: continued landing after Unstable App	1	1		DES APP LDG	234	All	LOSA	Unstable APR/GA UAS	Unstable APP	Compliance CRM Mis A/C State	Leadership and Teamwork Problem Solving Decision Making
57	In all phases, according to LOSA, weather is either the most significant threat or in the top three.	1	1		All	234	All	LOSA	Error Management WX	WX	Adverse WX	
58	Predeparture/Taxi-out are extremely important phases from the point of view that they are fertile territory for mitigating threats by training. 4	1	1		GND	234	All	LOSA	Error Management Training	Error Mgt	Ground manoeuvring CRM	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Communication Knowledge Application of Procedures/Knowledge Flight Management Guidance/Automation
59	strong support for a new kind of training concept: Scenario-based, matter brought in blocks, gradually, adapted individually. Teach Automation Knowledge, the why's. Teach and test the conceptual Knowledge. [details: see Lyall]	1	1		All	All	All	Automation Lyall	Automation Generation		Mis-AFS	Knowledge Flight Management Guidance/Automation
60	Make sure flight crews learn to fly manually without the Automation.	1	1		All	All	34	Automation Lyall	ManualACControl Automation Generation Training	Manual AC Control Automation	Mis-AFS Pilot Incap	Manual Aircraft Control Flight Management Guidance/Automation

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
61	Good CRM is especially important in automated aircraft; CRM should be integrated and used throughout the training.	1	1		All	All	34	Automation Lyall	Automation Generation Training	Automation Error Mgt	CRM Workload Distraction Mis A/C State	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Communication Knowledge Application of Procedures/Knowledge Flight Management Guidance/Automation
62	Decide what pilots really need to learn about the Automation. (don't try to teach everything).	1	1		All	All	34	Automation Lyall	Automation Error MonitoringXchecking Generation	Automation	CRM	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Communication Knowledge Application of Procedures/Knowledge Flight Management Guidance/Automation
63	Train also to monitor Automation. (This point is strongly underlined by the LOSA data	1	1		All	All	34	Automation Lyall	Automation Generation Training	Automation Monitor Xcheck Error Mgt	Compliance CRM Workload Distraction	SA Communication Flight Management Guidance/Automation
64	Use multiple assessment techniques to evaluate Automation Knowledge.	1	1		All	All	34	Automation Lyall	Automation	Automation		Knowledge Flight Management Guidance/Automation
65	Pilots need to be taught how the components of Automation work together in the overall system.	1	1		All	All	34	Automation Lyall	Automation Generation Training	Automation		Knowledge Flight Management Guidance/Automation
66	Provide as much hands-on experience with the Automation as possible. (One cannot learn by just watching).	1	1		All	All	34	Automation Lyall	Automation Generation Training	Automation		Flight Management Guidance/Automation
67	There are tools for creating the training scenarios. Using a tool is better than creating them "manually" from scratch. (Objective 3)	1	1	1	All	All		Automation Lyall	Automation	Automation		
68	Teach the logic underlying the Automation and cover its limitations	1	1		All	All	34	Automation Lyall	Automation Generation Training	Automation		Knowledge Flight Management Guidance/Automation
69	Flight crews should explicitly receive instruction and practice in when and how to: a. Appropriately use Automation; b. Transition between levels of Automation. c .Revert to manual flight."	1	1		All	All	34	Automation Lyall	Automation ManualACControl generation Training	Automation Error Mgt Manual Aircraft Control	Mis-AFS	Knowledge SA Problem Solving Decision Making Manual Aircraft Control Flight Management Guidance/Automation Manual Aircraft Control
70	There is less skill decay for physical tasks compared to cognitive tasks.				All		All	Skill Decay & Skill Retention Studies	Skill Decay	Automation Surprise Error Mgt Manual Aircraft Control System Malfunction	Manual AC Control	Communication SA Problem Solving Decision Making Knowledge Manual Aircraft Control
71	Large regional variations in accident rates				All	All	all	ACC IATA	Criticality			All
72	IATA 29 ACC statistics: Flight Crew Errors fully in support of LOSA results (ManualACControl, compliance, failure to go-around, Automation)	1	1		All	All	all	ACC IATA	ManualACControl Compliance Automation	Manual AC Control Go Around Automation	Compliance CRM Mis A/C State Mis-AFS	Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control Flight Management Guidance/Automation
73	Top threat weather 29%	1	1		All	All	All	ACC IATA	Error Management WX	WX	Adverse WX Windshear Crosswind Poor Visibility	SA Problem Solving Decision Making Application of Procedures/Knowledge
74	Top errors Manual Handling (33%), SOP 30%, Fail to GA 11%	1			All	All	All	ACC IATA	Error	Manual AC Control Error Mgt Unstable APP Go Around	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge Manual Aircraft Control
75	Top UAS: improper landing 21%	1			LDG	All	All	ACC IATA	Error ManualACControl UAS	Landing Issues	Runway/ Taxiway condition Mis A/C State	Problem Solving Decision Making Manual Aircraft Control

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
76	For 23% of 29 accidents, training could have been effective in reducing the likelihood	1			All	All	All	ACC IATA	Error Management	Error Mgt		
77	Countermeasures include monitoring / cross-checking and Automation mgt	1	1		All	All	All	ACC IATA	MonitoringXchecking Automation	Error Mgt Automation Monitor Xcheck	Mis-AFS CRM	SA Flight Management Guidance/Automation
78	ManualACControl needs to be reinforced in Training	1	1		All	All		ACC IATA Comments	ManualACControl	Manual AC Control Training Effect	Mis A/C State	Manual Aircraft Control
79	Flight Crews are becoming more reluctant to revert to manual flying when Automation fails.	1			All	All	34	ACC IATA Comments	Automation ManualACControl	Manual AC Control Error Mgt Automation	CRM Mis-AFS Syst mal Mis A/C State	Problem Solving Decision Making Flight Management Guidance/Automation Manual Aircraft Control
80	Gross error checks are required when inputting data in FMS.	1	1		All	All	34	ACC IATA Comments	Automation Error Management	Automation Error Mgt	CRM Mis-AFS	SA Flight Management Guidance/Automation
81	Decision to GA needs to be reinforced in training for abnormal landings (existing training counterproductive to this objective 4)	1			LDG	All	All	ACC IATA Comments	Unstable APR/GA Compliance Training effect	Go Around Landing Issues Error Mgt	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge
82	Many abnormal events that crews face are not covered in training.	1			All	All	34	ACC IATA Comments	Surprise	Surprise		SA
83	Training should be designed to take pilots to the edge of the envelope. (black/grey Surprise)	1			All	All	All	ACC IATA Comments	Training effect	Surprise Upset		SA Problem Solving Decision Making Application of Procedures/Knowledge
84	Briefing should be adapted to the situation.	1			All	All	All	ACC IATA Comments	Error Management	Error Mgt	CRM	Communication SA
85	Introduce Unstable App training in simulators	1			APP	All	All	ACC IATA Comments	Unstable APR/GA Training Effect	Unstable APP	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge
86	Go-Arounds need training in terms of Decision making, surprise, execution, two engine, any point during the approach and landing	1	1		APP LDG GA	All	All	ACC IATA Comments	GA Training Effect	Go Around Surprise	CRM Mis A/C State	SA Problem Solving Decision Making Application of Procedures/Knowledge Application of Procedures/Knowledge Manual Aircraft Control
87	CAA report supports main threats (compliance, HF/CRM, mishandling a/c, SOP's). Compared to LOSA, bigger bars in CRZ and APP.	1	1		All	All	All	ACC CAA	Compliance ManualACControl	Error Mgt	CRM Mis A/C State Compliance	Communication SA Leadership and Teamwork Workload Management Problem Solving Decision Making Flight Management Guidance/Automation Manual Aircraft Control
88	During ATQP implementation period, no significant variation in the Flight Ops risk value			1	All	3 4	34	ATQP airline	ATQP/AQP			
89	During ATQP implementation periodTop RV events have remained substantially unchanged			1	All	3 4	34	ATQP airline	ATQP/AQP			
90	During ATQP implementation period Slight increase in high speed descents below FL100 but APProach stability remaining			1	DES APP	3 4	34	ATQP airline FDA	Unstable APR			
91	During ATQP implementation period Stability remaining static at 1000' and 500'.			1	APP	3 4	34	ATQP airline FDA	Unstable APR	Unstable APP	Mis A/C State	Application of Procedures/Knowledge
92	During ATQP implementation period G/A's from Unstable Approaches account for approximately 1/2 of all G/A's	1		1	APP GA	3 4	34	ATQP airline	Unstable APR/GA Compliance	Go Around Unstable APP	Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
93	Factors contributing to Unstable Approaches are: 1. Accepting ATC vectors or speed control. 2. Turning too tight when visual, 3. FMGS mis-selections, 4. Energy Management 5. Lack of proficiency when manually flying instrument approaches.	1	1		APP	3 4	34	ATQP airline	Unstable APR/GA	Unstable APP	ATC Mis A/C State Mis-AFS	SA Problem Solving Decision Making Flight Management Guidance/Automation Manual Aircraft Control
94	During ATQP implementation period There has been an increase in the number of fast touchdowns. AND There has been a reduction in landing events	1		1	LDG	3 4	34	ATQP airline	ATQP/AQP	Landing Issues	Mis A/C State	Manual Aircraft Control
95	During ATQP implementation period (Missed Approach 1. Approximately 1/10 G/A's failed to comply with SOP's and just over 1/10 G/A's resulted in a flap over speed.2. There has been no significant change in G/A rates3. Flight Management remains the biggest cause	1	1	1	APP GA	3 4	34	ATQP airline	GA	Go Around	Compliance CRM Mis-AFS Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge Flight Management Guidance/Automation
96	During ATQP implementation period, the number of APProaches not meeting company criteria at 1000 ft has significantly reduced.	1		1	APP	3 4	34	ATQP airline	Unstable APR Training	Go Around	Compliance CRM Mis A/C State	Problem Solving Decision Making Application of Procedures/Knowledge
97	During ATQP implementation period, the training failure rate has dropped from approximately 4% during LPC/OPC checks to approximately 1%	1		1	All	3 4	34	ATQP airline	ATQP/AQP			
98	During ATQP implementation period, inadvertent mis-selections appear to occur most during operations that are not routinely practised	1	1	1	All	3 4	34	ATQP airline	Error Training	Error Mgt Surprise	Mis-Sys Mis-AFS	Problem Solving Decision Making Application of Procedures/Knowledge
99	During ATQP implementation period, dual Inputs have reduced but need to be carefully monitored.	1	1	1	All	3 4	34	ATQP airline FDA	ManualACControl MonitoringXchecking	Error Mgt Manual AC Control	Mis-Sys Ops/Type Spec Compliance	SA Manual Aircraft Control Application of Procedures/Knowledge
100	Engine Failure on TO 1. Approximately a 1/5 failed or only passed with a repeat 2. Almost ½ were procedural errors 3. 1% related to Situational awareness or Decisions making	1	1	1	TO	3 4	34	ATQP airline	ManualACControl	System Malfunction	Eng Fail Syst mal Compliance CRM Mis-Sys	SA Problem Solving Decision Making Application of Procedures/Knowledge
101	Single Engine NPA 1. Just over 1% failed 2. 5% were procedural errors, 3. 2% Automation, 4. 2% situational awareness. 5. 5% were handling errors	1	1	1	APP	3 4	34	ATQP airline	ManualACControl Automation	System Malfunction Manual AC Control Automation	Eng Fail Syst mal Compliance CRM Mis-Sys Mis A/C State	SA Problem Solving Decision Making Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control
102	SE Go-Around 1. Approximately 2% failed or only passed after a repeat 2. Of the repeats a. just over 4% were procedural errors, b. just over 4% handling 3. Of the failed a. 2% Automation and a 2% situational awareness. b. Approx 1/3 were procedural errors and ½ handling.	1	1	1	GA	3 4	34	ATQP airline	ManualACControl Automation GA	Go Around Automation Error Mgt System Malfunction	Eng Fail Compliance CRM Mis-AFS Mis A/C State	SA Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control
103	Procedures not routinely flown, 2 Eng G/A, EFATO, SE NPA and SE G/A appear to present the greatest difficulty to crew, with procedural error and ManualACControl being the biggest factors.	1		1	TO GA	3 4	34	ATQP airline	ManualACControl GA	Go Around System Malfunction Error Mgt Surprise	Eng Fail Syst mal Compliance CRM Mis A/C State	Application of Procedures/Knowledge Manual Aircraft Control
104	Procedures not routinely flown, 2 Eng G/A, EFATO, SE NPA and SE G/A flown with Automation the error rate is reduced.			1	TO GA	3 4	34	ATQP airline	ManualACControl Automation GA Training	Manual AC Control	Workload Distraction Pressure	Problem Solving Decision Making Manual Aircraft Control
105	EFATO, SE NPA and SE GA should be retained in the ISS.	1	1	1	TO APP GA	3 4	34	ATQP airline	ManualACControl GA	System Malfunction Go Around	Eng Fail Syst mal	Manual Aircraft Control

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
106	2 Eng G/A should be scheduled into recurrent training.	1	1	1	GA	3 4	34	ATQP airline	GA ManualACControl	Go Around Surprise	Mis A/C State	Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control
107	Training in energy Management and environmental descent planning needs to be more specific.	1	1	1	DES	3 4	34	ATQP airline	Unstable APR Training	Error Mgt Unstable APP	Mis A/C State	Problem Solving Decision Making SA
108	Innovative training solutions should be sought for crew to maintain currency with FMGS and technical / procedural Knowledge.	1	1	1	All	3 4	34	ATQP airline	Automation	Automation	Compliance CRM Mis-AFS	Knowledge Application of Procedures/Knowledge Flight Management Guidance/Automation
109	Data shows that leadership and workload mgt can be taught / learned. 7% to 2%.	1	1	1	All	3 4	34	ATQP airline	Leadership Training	Leadership	Workload Distraction Mis A/C State	Leadership and Teamwork Workload Management
110	ManualACControl/Flight Control error detection/action taken is notably stronger in Predeparture/Taxi-Out than in the other phases of flight	1			GND	234	All	LOSA 2	ManualACControl Error Management	Manual AC Control Error Mgt Monitor Xcheck	Mis-Sys Mis A/C State	SA Problem Solving Decision Making Manual Aircraft Control
111	Callout error detection is better in Takeoff/Climb.	1			CLB	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt Monitor Xcheck	Compliance CRM	Communication SA Application of Procedures/Knowledge
112	41% of Aircraft Handling errors are detected and acted upon vs. 16% of Procedural errors Automation has the best rate of all error types. (53%)	1	1		All	234	234	LOSA 2	Error ManualACControl MonitoringXchecking	Error Mgt Automation Monitor Xcheck	Compliance CRM Mis A/C State Mis-Sys	SA Leadership and Teamwork Workload Management Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control
113	Captains detect 27% of the First Officer mistakes; First Officers detect 18% of the Captain's errors.	1			All	234	234	LOSA 2	Error MonitoringXchecking	Error Mgt Monitor Xcheck	Compliance Mis-AFS Mis A/C State Mis-Sys	Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control Communication
114	Once an error has been committed, people are more capable of detecting other people's errors than their own.	1			All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt Monitor Xcheck	Compliance Mis-AFS Mis A/C State Mis-Sys	Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control Communication
115	Across all three error groups, the Captain as PF detects/acts on more errors than does the First Officer as PF, particularly for Communication errors. There is little difference in PM rates.	1			All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt Monitor Xcheck	Compliance Mis-AFS Mis A/C State Mis-Sys	Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control Communication
116	As the rate of Intentional Noncompliance increases, the rate of errors detected and acted on decreases.	1			All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt	Compliance	Application of Procedures/Knowledge
117	The LOSA Archive shows that 26% of all errors logged by observers are detected and acted upon by flight crews.	1			All	234	234	LOSA 2	Error MonitoringXchecking	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
118	Error detection is most closely aligned with the quality of Monitoring/Cross-Checking in all phases of flight and the quality of the Briefing.	1			All	234	All	LOSA 2	Error MonitoringXchecking Training	Error Mgt Monitor Xcheck	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
119	One-quarter of all errors in the cockpit are detected, acted upon and inconsequential.	1			All	234	234	LOSA 2	Error MonitoringXchecking	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
120	One-half of all errors in the cockpit go undetected/not acted upon and are also inconsequential.	1			All	234	234	LOSA 2	Error MonitoringXchecking	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
121	'taking shortcuts' reinforces over and over that most errors are inconsequential, whether they act on them or not. PARADOX	1			All	234	234	LOSA 2	Error MonitoringXchecking	Error Mgt Complaince	CRM Compliance	Communication Application of Procedures/Knowledge Manual Aircraft Control

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
122	An error that is detected and acted upon does not guarantee an inconsequential outcome. In fact, 1% of errors detected and acted upon by a flight crew link to an additional error or undesired aircraft state due to active misManagement.	1			All	234	234	LOSA 2	Error MonitoringXchecking UAS	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
123	There is little difference amongst the first four phases of flight in that 25-30% of errors are detected and acted upon.	1			All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
124	Taxi/Park has the lowest rate of errors detected and acted upon (17%) because approximately one-half of the errors in Taxi/Park are Intentional Noncompliance errors vs. about one-quarter of errors in the other phases.	1			GND	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
125	Noncompliance errors are typically not corrected because they are intentionally committed by the crew.	1			All	234	All	LOSA 2	Compliance Error MonitoringXchecking	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
126	ManualACControl/Flight Control errors - error detection/action is notably stronger in Predeparture/Taxi-Out than in the other phases of flight (53% of ManualACControl/Flight Control errors are detected and acted upon during Predeparture/Taxi-Out vs. 21-30% of ManualACControl/Flight Control errors being detected and acted upon in later phases of flight	1			GND All	234	All	LOSA 2	ManualACControl Error MonitoringXchecking	Error Mgt	Mis A/C State	Manual Aircraft Control
127	When compared with the other Aircraft Handling error types, it seems that error detection for ManualACControl/Flight Control errors weakens notably after departure/Taxi-Out, while Automation and System/Instrument/Radio error detection rates stay relatively the same	1			GND All	234	All	LOSA 2	Error ManualACControl MonitoringXchecking	Error Mgt	Mis A/C State	Manual Aircraft Control
128	Procedural error types, Checklist error detection is better in Cruise and Descent/Approach/Land while Callout error detection is better in Takeoff/Climb.	1			TO CLB CRZ DES LDG	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt	Mis-Sys Compliance	Application of Procedures/Knowledge
129	The rates of error detection and action are much higher for Aircraft Handling errors than for Procedural errors.	1			All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt	Mis-Sys Compliance Mis A/C State	Application of Procedures/Knowledge Manual Aircraft Control
130	Specifically, 41% of Aircraft Handling errors are detected and acted upon vs. 34% of Communication errors and 16% of Procedural errors.	1			All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
131	The detection and action rates for Procedural errors are shown below: o Briefing 20% o Callout 22% o Checklist 20% o Documentation 30% o General Procedural 7% o PF/PM Duty 5% o SOP Cross-Verification 9%	1	1		All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt Monitor Xcheck	Compliance	Communication Application of Procedures/Knowledge
132	Automation errors have the best detection with action rates of all error types - 53% of Automation errors are detected and acted upon by flight crews.	1			All	234	234	LOSA 2	Error MonitoringXchecking	Automation Error Mgt	Mis-AFS	Flight Management Guidance/Automation
133	The Aircraft handling with the lowest rate of detection are: (Many are not detected until UAS) o Unintentional vertical deviation 41% o Wrong speed brakes setting 39% o Incorrect Nav Display setting 35% o Unintentional landing deviation 32% o Wrong radar setting 30% o Unintentional lateral deviation 29% o Unintentional speed deviation 24% o Wrong power/thrust setting 22% o Wrong anti-ice setting 19%	1	1		All	234	All	LOSA 2	Error ManualACControl MonitoringXchecking UAS Training	Landing Issues Manual AC Control Error Mgt	Mis-AFS Mis A/C State Mis-Sys	Problem Solving Decision Making Manual Aircraft Control

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
134	People are not good at detecting their own error.	1			All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt	CRM Workload Distraction	SA Problem Solving Decision Making Knowledge Flight Management Guidance/Automation
135	Both Captains and First Officers detect only 5-6% of the errors that they make.	1			All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
136	About one-quarter of the time, the pilots detect the error together	1			All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
137	First Officers detect 18% of Captain's errors, whereas Captains detect 27% of the First Officer's mistakes.	1			All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
138	The general pattern is consistent across error types i.e. o Captains can detect 39% of the Aircraft Handling errors made by First Officers but only 9% of their own Aircraft Handling errors o First Officers can detect 12% of the Procedural errors made by Captains, but only 4% of their own Procedural errors.	1			All	234	All	LOSA 2	ManualACControl Error MonitoringXchecking	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
139	There is very little difference in error rate detection between the crew member position as PF and PM and very little difference between Capt and F/O as error detectors with the Capt detecting slightly more in either case. o Capt as PF – 7% vs Capt as PM – 7% o F/O as PF – 4% vs F/O as PM – 6%	1			All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
140	There is however a difference between Capt's and F/Os when action is combined with detection. The Capt is much more likely to act when detecting own error while pilot flying VS the F/O (23% vs 13%)	1			All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
141	When the Capt is PM the rate for detecting own error and taking action is about the same as F/O as PM (25% vs 22% respectively)	1			All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt	Compliance Mis-AFS Mis A/C State Mis-Sys	Communication Application of Procedures/Knowledge Manual Aircraft Control
142	25% of all errors are recorded as Intentional Noncompliance errors, of which 96% are not acted upon.	1			All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt Leadership	Compliance	Application of Procedures/Knowledge
143	There is a negative correlation between the rate of noncompliance and the rate of errors, other than noncompliance, detected and acted upon. That is to say that noncompliance is an inhibitor to detection and correction. (multiplier in a negative sense) This is true across all error types	1			All	234	All	LOSA 2	Error MonitoringXchecking	Error Mgt	Compliance	Application of Procedures/Knowledge
144	The significant finding is the clear advantage of Gen4-type over the Gen 3 aircraft in Type Rating results.	1			All	234	34	AQP	ATQP/AQP Generation	Error Mgt Manual AC Control	Mis A/C State Mis-AFS Mis-Sys	All
145	There is a very significant peak in NCG in the 1st flight (OE) on all types. The peak is most pronounced on the GEN 4 TYPE. The downhill after the peak reflects the huge amount of learning and training on the aircraft during IOE. Such significant learning at this stage of the training program is not desirable. It reflects that the training does not really prepare the trainees for the real operation	1			All	234	4	AQP	ATQP/AQP Generation Learning on Line. Trainability			All
146	Post-first flight, the Gen 4 type continues at the same low level as in TR, but the curve for Gen 3 increases for RT-MV and forms a secondary peak for RT-LOE.	1			All	234	34	AQP	ATQP/AQP Generation Learing on line. Trainability			All
147	Compared to the significant advantage of the GEN 4 –TYPE in TR, this advantage has to a large extent disappeared post-first flight.	1			All	234	4	AQP	ATQP/AQP Generation Trainability			All

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
148	Generally, the data supports the notion that generation 4 aircraft are easier to train. However, the training challenge on GEN 4 –TYPE for windshear scenarios illustrates that training data needs to be analysed to optimize the training program.	1	1		All	234	4	AQP	ATQP/AQP Generation WX. Trainability			All
149	Finally, it is worth mentioning that the sensitivity of the 6-grade grading system in use at this airline provides an excellent basis for analyses, such as these.			1	All	234	All	AQP	ATQP/AQP			
150	TR/MV validation data indicate that pilots have less difficulty to perform the defined maneuvers in the GEN 4 –TYPE (gen.4) vs. gen 3 -type – with the exception of the windshear maneuvers.	1	1		All	234	43	AQP	ATQP/AQP Generation WX. Trainability	Manual AC Control	Manual AC Control	Manual Aircraft Control
151	In the most extreme case (eng failure at V1) the failure rates were 0.208 (Gen 3 –type) and 0.074 (GEN 4 -TYPE) which indicates a significant difference in difficulty.	1	1		TO	234	34	AQP	ATQP/AQP Generation Trainability	Manual AC Control	Eng Fail Manual AC control	Manual Aircraft Control
152	Exceptionally, the only two items in TR/MV where the GEN 4 –TYPE proved more difficult were the two windshear items (takeoff and approach). The most extreme case is approach where the failure rates were 0.084 (Gen 3 -type) and 0.154 (GEN 4 -TYPE).	1	1		TO APP	234	34	AQP	ATQP/AQP Generation LOSA support for threats with most threats. Trainability	Manual AC Control	Manual AC Control	Manual Aircraft Control
153	The two flight phases with the highest non-conforming grades in TR/LOE were the Ground and Descent phases, which could be considered planning or preparatory phases.	1	1		GND DES	234	All	AQP	ATQP/AQP Trainability		CRM Mis-AFS	Problem Solving Decision Making Application of Procedures/Knowledge Flight Management Guidance/Automation
154	In every phase the GEN 4 –TYPE (gen 4) has a significantly lower rate of non-conforming grades than types A, B and C (all gen 3). (the only exception is the slightly better performance of type A in the After landing phase). The effect is even greater in Takeoff, Climb and Cruise. The average over all flight phases for GEN 4 –TYPE is 6.4% and for the other types 13.3%, in other words the ratio is about 1:2.	1	1		TO CLB CRZ All	234	34	AQP	ATQP/AQP Generation. Trainability Phase			All
155	There is a very significant overall increase in the non-confirming grades compared to LOEs in TR and RT. The values have roughly doubled. This appears to be an indication that the type rating course is not adequately preparing the pilots for IOE.	1			All	234	All	AQP	ATQP/AQP. Trainability			All
156	The 1st flight profiles are still different across all types, with differences exceeding 20 percentage points.	1			All	234	All	AQP	ATQP/AQP Generation Trainability			All
157	The two flight phases where the GEN 4 –TYPE has a significantly higher rate of non-conforming grades are Ground Operations and Cruise, which are preparatory phases. Based on instructor comments, in cruise the high rate is driven by difficulties with international procedures – some problems also related to the use of Automation. For the Ground phase, the instructor comments were not specific enough to determine the types of problems.	1	1		GND CRZ	234	34	AQP	ATQP/AQP Generation Automation generation phases of flight	Automation Compliance	CRM Mis-AFS	Application of Procedures/Knowledge Flight Management Guidance/Automation
158	The profile for OE cert for all four types is roughly the same: descent, approach and landing phases are in the range of 6%-12% whereas the other phases are at a much lower rate of around 2 % (3%-4% for ground operations). This kind of pattern is not visible in any other stage of training/checking.		1		All	234	All	AQP	ATQP/AQP generation phase			All
159	In the OE cert profiles, the only significant variation across types is the rate for GEN 4 –TYPE in cruise, which is around 10% whereas the other types are in the range 2%-3%. Based on instructor comments, the reason for the high GEN 4 –TYPE rate is international procedures related to navigation.	1			CRZ	234	34	AQP	ATQP/AQP Generation phase	Compliance	Compliance	Application of Procedures/Knowledge
160	The advantage of the GEN 4 –TYPE has disappeared to the point that the Type A (Gen 3) now shows less non-conforming grades (average 3.6%).				All	234	234	AQP	ATQP/AQP Generation Trainability			
161	Even though the overall performance is similar between these two best performing types (Type A (Gen 3) and GEN 4 -TYPE), their profiles are very different, indicating that what needs to be emphasized in training is very different.	1			All	234	34	AQP	ATQP/AQP Generation Trainability			

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
162	Overall, the grades in both generations are better than in TR-LOE but for Gen 3 significantly worse than in OE certification or RT-MV.	1			All	234	34	AQP	ATQP/AQP Generation Trainability	Manual Aircraft Control	Manual AC Control	Manual Aircraft Control
163	In RT-LOE, the GEN 4 –TYPE performs generally better than the gen 3 types, but not to the extent it does in TR. The main changes are in ground and approach phases where the advantage of the GEN 4 –TYPE has disappeared (otherwise its profile is similar to TRLOE). The GEN 4 –TYPE is significantly better than Gen 3 in takeoff, climb and cruise phases – by a factor of three to one or more.	1			GND APP All	234	34	AQP	ATQP/AQP Generation Trainability			All
164	At line check, the rates are quite similar for all types. In cruise, descent, approach and landing, the Type A (Gen 3) and GEN 4 –TYPE both have higher rates of non-confirming grades than the other two types. Paradoxically, these two were the best performers during training. This is an indicator that the initial training performance does not necessarily correlate well with the actual operational performance.	1			CRZ DES APP LDG	234	234	AQP	ATQP/AQP Generation Trainability			All
165	The descent phase has the highest non-confirming grades. Based on the instructor comments, the three areas of concern are Automation, system Management and briefings. Line check	1	1		DES	234	234	AQP	ATQP/AQP Generation Trainability	Automation Compliance	Mis-AFS Mis-Sys	Communication Application of Procedures/Knowledge Flight Management Guidance/Automation
166	The biggest error category is Policy. It is equally present for all types and makes about 50% of all errors. The second biggest category is Procedural.	1			All	234	All	AQP	Competencies Error ATQP/AQP Procedures	Error Mgt Compliance	Compliance	Application of Procedures/Knowledge
167	In the OE 1st flight error distribution charts, the Gen 3 types present errors related to Proficiency and Situational Awareness while this is not the case for GEN 4 -TYPE.	1			All	234	34	AQP	Competencies Error SA ATQP/AQP Generation Trainability	Error Mgt		SA
168	The more the training cycle advances towards the line check, the more the Gen 3 types present Intentional Non-Compliance and Decision Making errors. This is not the case for GEN 4 -TYPE, which, on the contrary, presents some Intentional Non-Compliance during TR. This difference is noticeable.	1			All	234	34	AQP	Competencies Error ATQP/AQP Generation Compliance Decision making	Error Mgt	Compliance	Problem Solving Decision Making Application of Procedures/Knowledge
169	The more the training cycle advances towards the line check, the more the Gen 3 types present errors related to non-technical skills, compared to the GEN 4 -TYPE	1			All	234	34	AQP	Competencies Error ATQP/AQP Generation trainability	Error Mgt	CRM	Communication SA Leadership and Teamwork Workload Management Problem Solving Decision Making
170	3.5% of approaches are unstable	1			APP	34	34	FDA	Unstable APR/GA	Unstable APP	Mis A/C State	
171	Only 1.4% of them lead to a Go-Around	1			APP	34	34	FDA	Unstable APR/GA	Unstable APP Go Around	Mis A/C State Compliance	Application of Procedures/Knowledge
172	(0.31% of stable approaches lead to a Go-Around)				APP	34	34	FDA	Unstable APR/GA	Unstable APP Go Around		
173	A GA from an Unstable App causes on average 1.6 FDA risk events				APP GA	34	34	FDA	Unstable APR/GA	Unstable APP Go Around	Mis A/C State	All
174	24% rate of hi risk events during GA from unstable apprs				APP GA	34	34	FDA	Unstable APR/GA	Unstable APP Go Around	Mis A/C State	All
175	FDA cannot detect many errors; e.g. Lat Flight Plan deviations.				APP GA	34	All	FDA	Unstable APR/GA	Go Around	Mis A/C State Mis-AFS Mis-Sys	All
176	Distribution of GAs by initiation altitude: 56% ABOVE 500 FT, 31% 500 FT to flare, and 13% at Flare				APP GA	34	34	ATQP	Unstable APR/GA	Go Around Surprise		All

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
177	The ratio of GA>200' To GA ≤200' is more than 6:1 The ratio for Stable Approaches is higher				APP GA	34	34	FDA	Unstable APR/GA	Go Around Surprise		All
178	Frequency of flts having at least one FDA event (all severity levels) is the same for stable and Unstable Appr's (83.63 vs 81.11 stable vs unstable respectively) indicating there are landing problems with stable approaches as well.				APP	34	34	FDA	Unstable APR/GA	Landing Issues	Compliance Mis A/C State Mis-Sys	All
179	Comparing events per flt (all severities) stable vs unstable is 2.24:2:84 or r=1.3 (approx)				APP	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	All
180	Comparing event rates (high severity) stable vs unstable is 8.11% vs 19.53 (approximately 2.4 times) indicating that there are more than double the hi risk events on landing with Unstable Approaches				APP	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	All
181	Comparing event rates stable vs Unstable Approaches (all severities) for the selected 10 serious landing events stable vs unstable is 14.33% to 34.52% or r=2.4 (approx)				APP	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	All
182	Comparing event rate (high severity) stable vs unstable for the set of 10 serious events is 1.96% vs 5.47% or r=2.8 (approx) indicating that there are almost 3 times the hi risk events on landing with Unstable Approaches				APP	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	All
183	Unstable Approaches are not the cause of all landing problems. This is particularly concerning if we remember that the ratio of stable approaches over Unstable Approaches is approx 27:1				APP	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	Manual Aircraft Control
184	But if we drill down we see that when Unstable Approaches occur, ther are many more of severe events during landings (Things go more wrong when unstable.)				APP	34	34	FDA	Unstable APR/GA	Unstable APP Landing Issues Error Mgt	Compliance Mis A/C State Mis-Sys	Manual Aircraft Control
185	Flights with Unstable Approaches produce more events than flights with stable approaches even in phases of flight outside of APP and LDG				All	34	All	FDA	Unstable APR/GA	Unstable APP Error Mgt	Compliance Mis A/C State Mis-Sys	All
186	Unstable APP correlate with elevated FDA event frequency in other phases of flight other than APP and LDG. This trend increases with severity: Looking at the All Events/flt exclusive of APP & LDG, the rate is 1.22 for flts with stable approaches and:1.45 for Unstable APP (r= 1.19). For Hi Sev events not related to Appr & LDG the rates are 14.32% to 19.4% respectively (r=1.35)				APP All	34	34	FDA	Unstable APR/GA	Unstable APP Error Mgt	Compliance Mis A/C State Mis-Sys	All
187	Looking at a cross secton of types (5 types and 9 models) over a three year period including 1.6 million flights and approximately 5700 go- arounds) the average height above the field was over 800 at the initiation of the GA. All types in the study had a least one GA from 0 ft agl. Many GAs occured close to 2000 agl.				APP	34	234	FDA	Unstable APR/GA	Go Around Surprise		All
188	The influence of the threshold crossing height appears to have the strongest influence on the airborne distance				LDG	34	All	NLR	Generation Automation Unstable APR/GA	Error Mgt Landing Issues	Compliance Mis A/C State	Application of Procedures/Knowledge Manual Aircraft Control
189	The speed loss from flare initiation to touchdown has a very significant influence on the airborne distance				LDG	34	All	NLR	Generation Automation Unstable APR/GA	Error Mgt Landing Issues	Mis A/C State	Manual Aircraft Control
190	The difference in the actual speed and the reference speed over the threshold has a strong influence on the airborne distance.		1		LDG	34	All	NLR	Generation Automation Unstable APR/GA	Error Mgt Landing Issues	Mis A/C State	Application of Procedures/Knowledge Manual Aircraft Control
191	The Gen 3 type shows a higher tendency to over speed at the threshold compared to the other types. This is most likely caused by the fact the fly-by-wire aircraft usually fly with the auto thrust (A/THR) engaged during a landing whereas a conventional controlled aircraft with wing mounted engines disengages the A/THR as soon as the auto pilot is disengaged to avoid pitch up tendencies (like on the B737). With A/THR engaged the speed control is more accurate	1	1		LDG	34	34	NLR	Generation Automation Unstable APR/GA	Landing Issues	Mis A/C State	Manual Aircraft Control

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
192	The autolands have a lower average airborne distance than manual landings and also show less deviation from the average airborne performance	1	1		LDG	34	34	NLR	Generation Automation Unstable APR/GA	Landing Issues	Mis A/C State	Manual Aircraft Control
193	From the evidence, identified issues that show vulnerabilities in flightcrew Management of Automation and situation awareness are: • Pilot understanding of the Automation's capabilities, limitations, modes, and operating principles and techniques. • Differing pilot Decisions about the appropriate Automation level to use.	1	1		All	34	34	FAA 1996 Automation Report	Automation Generation Error	Automation	Mis-AFS	SA Problem Solving Decision Making Knowledge Flight Management Guidance/Automation
194	Flightcrew situation awareness issues included vulnerabilities in: • Automation/mode awareness. • Flight path awareness: • including insufficient Terrain awareness sometimes involving loss of control or controlled flight into Terrain) and energy awareness (especially low energy state).	1	1		All	34	34	FAA 1996 Automation Report	Automation Generation SA Error UAS Competencies	Automation Terrain Error Mgt	Mis-AFS Mis A/C State Terrain	SA Flight Management Guidance/Automation
195	Processes used for design, training, and regulatory functions inadequately address human performance issues: • users can be surprised by subtle behavior • overwhelmed by the complexity embedded in current systems operated within the current operating environment	1	1		All	34	34	FAA 1996 Automation Report	Automation Generation Error	Surprise Automation	Ops/Type Spec Mis-AFS	SA Flight Management Guidance/Automation
196	Process improvements are needed to provide the framework for consistent application of principles and methods for eliminating vulnerabilities in design, training, and operations.	1			All	34	All	FAA 1996 Automation Report	Automation Generation Error	Automation		Flight Management Guidance/Automation
197	Insufficient criteria, methods, and tools for design, training, and evaluation. Existing methods, data, and tools are inadequate to evaluate and resolve many of the important human performance issues	1	1		All	34	All	FAA 1996 Automation Report	Automation Generation Error	Automation		Flight Management Guidance/Automation
198	Designers, pilots, operators, regulators, and researchers do not always possess adequate Knowledge and skills in certain areas related to human performance.	1			All	34	All	FAA 1996 Automation Report	Automation Generation Error	Automation		Flight Management Guidance/Automation
199	Two-thirds to three-quarters of all accidents have flightcrew error cited as a major factor. Flightcrew training investments should be re-balanced to ensure appropriate coverage of Automation issues.	1	1		All	34	34	FAA 1996 Automation Report	Automation Error	Error Mgt Automation	Mis-AFS	Flight Management Guidance/Automation
200	It is important to improve how design, training, operations, and certification are accomplished. Current Regulatory standards for type certification and operations have not kept pace with changes in technology and increased Knowledge about human performance.	1			All	34	34	FAA 1996 Automation Report	Automation Generation Error	Automation		Flight Management Guidance/Automation
201	Recommendation SA-1: The FAA should require operators to increase flightcrews' understanding of and sensitivity to maintaining situation awareness, particularly: • Mode and airplane energy awareness issues associated with autoflight systems (i.e., autopilot, autothrottle, flight Management system, and fly-by-wire flight control systems); • Position awareness with respect to the intended flight path and proximity to Terrain, obstacles, or traffic; and • Potential causes, flight crew detection, and recovery from hazardous pitch or bank angle Upsets while under autopilot control (e.g., wake vortex, subtle autopilot failures, engine failure in cruise, atmospheric turbulence).	1	1		All	34	34	FAA 1996 Automation Report	Automation Upset Generation Error	Error Mgt Automation Terrain	Mis-AFS Terrain	SA Flight Management Guidance/Automation
202	Recommendation SA-2: The FAA should require operators' initial and recurrent training programs as well as appropriate operating manuals to: • Explicitly address autoflight mode and airplane energy awareness hazards; • Provide information on the characteristics and principles of the autoflight system's design that have operational safety consequences; and • Provide training to proficiency of the flight Management system capabilities to be used in operations.	1			All	34	34	FAA 1996 Automation Report	Automation Generation	Error Mgt Automation	Mis-AFS	SA Flight Management Guidance/Automation
203	Recommendation SA-3: The FAA should encourage the aviation industry to develop and implement new concepts to provide better Terrain awareness.	1	1		All	34	All	FAA 1996 Automation Report	MonitoringXchecking Terrain SA	Terrain	Terrain	SA
204	Recommendation SA-5: The FAA should encourage the exploration, development, and testing of new ideas and approaches for providing effective feedback to the flightcrew to support error detection and improved situation awareness.	1			All	34	All	FAA 1996 Automation Report	MonitoringXchecking Error SA	Error Mgt	Compliance CRM	SA

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
205	Recommendation SA-8: The FAA should ensure that flightcrews are educated about hazardous states of awareness and the need for countermeasures to maintain vigilance. The FAA should encourage operators to: • Develop operational procedures and strategies to foster attention Management skills with the objective of avoiding hazardous states of awareness; and • Develop techniques to apply during training to identify and minimize hazardous states of awareness.	1			All	34	All	FAA 1996 Automation Report	MonitoringXchecking Error SA UAS	Error Mgt	Compliance CRM	SA
206	Recommendation Comm/ Coord-3: The FAA should lead an industry-wide effort to share safety information obtained from in-service data and from difficulties encountered in training. This effort should be capable of assisting in the identification and resolution of problems attributed to flight crew error.	1		1	All	34	All	FAA 1996 Automation Report	Criticality	Error Mgt	Mis A/C State Compliance Mis-Sys Mis-AFS	All
207	Recommendation Knowledge-2: The FAA should reassess the requirements that determine the content, length, and type of initial and recurrent flightcrew training. Ensure that the content appropriately includes: • Management and use of Automation, including mental models of the Automation and moving between levels of Automation; • Flightcrew situation awareness, including mode and Automation awareness; • Basic airmanship; • Crew Resource Management; • Decision making, including unanticipated event training; • Examples of specific difficulties encountered either in service or in training; and • Workload Management (task Management).	1		1	All	34	All	FAA 1996 Automation Report	Automation Competencies Generation SA	Leadership Automation	Compliance CRM	SA Problem Solving Decision Making Workload Management
208	Recommendation Knowledge-3: The FAA should strongly encourage or provide incentives to make advanced maneuvers training an integral part of the training curriculum, especially in recurrent training.	1			All	34	All	FAA 1996 Automation Report	Competencies Generation ManualACControl Upset		Upset Adverse WX Mis A/C State	Manual Aircraft Control
209	Recommendation Knowledge-5: The FAA should reassess the airman certification criteria to ensure that pilots are released with a satisfactory level of skills for managing and using Automation. Since current training is often oriented toward preparing pilots for checkrides, the airman certification criteria should be reassessed to ensure appropriate coverage of the topics listed in Recommendation Knowledge-2.	1			All	34	34	FAA 1996 Automation Report	Automation	Automation	Mis-AFS	Flight Management Guidance/Automation
210	Recommendation Culture-1: The FAA should ensure that research is conducted to characterize cultural effects and provide better methods to adapt design, training, publications, and operational procedures to different cultures. The results of the research should also be used to identify significant vulnerabilities, if any, in existing flight deck designs, training, or operations, and how those vulnerabilities should be addressed.	1			All	34	All	FAA 1996 Automation Report	Criticality	Automation		
211	From the evidence, the HF Team identified issues that show vulnerabilities in flightcrew Management of Automation and situation awareness. Issues associated with flightcrew Management of Automation include concerns about: • Pilot understanding of the Automation's capabilities, limitations, modes, and operating principles and techniques. The HF Team frequently heard about Automation "surprises," where the Automation behaved in ways the flightcrew did not expect. "Why did it do that?" "What is it doing now?" and "What will it do next?" were common questions expressed by flightcrews from operational experience. • Differing pilot Decisions about the appropriate Automation level to use or whether to turn the Automation on or off when they get into unusual or non-normal situations.	1	1		All	34	34	FAA 1996 Automation Report	Automation SA Generation Error	Automation Surprise	Mis-AFS	Flight Management Guidance/Automation Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
212	Flightcrew situation awareness issues included vulnerabilities in, for example: • Automation/mode awareness. This was an area where we heard a universal message of concern about each of the aircraft in our charter. • Flight path awareness, including insufficient Terrain awareness (sometimes involving loss of control or controlled flight into Terrain) and energy awareness (especially low energy state).	1	1		All	34	34	FAA 1996 Automation Report	Terrain SA Automation UAS Competencies	Automation Terrain	Terrain Mis-AFS Mis A/C State	SA Flight Management Guidance/Automation Manual Aircraft Control
213	Processes used for design, training, and regulatory functions inadequately address human performance issues. As a result, users can be surprised by subtle behavior or overwhelmed by the complexity embedded in current systems operated within the current operating environment. Process improvements are needed to provide the framework for consistent application of principles and methods for eliminating vulnerabilities in design, training, and operations.	1			All	34	All	FAA 1996 Automation Report	Automation Competencies	Surprise	Mis A/C State Mis-AFS Mis-Sys	SA Problem Solving Decision Making Knowledge
214	Insufficient criteria, methods, and tools for design, training, and evaluation. Existing methods, data, and tools are inadequate to evaluate and resolve many of the important human performance issues. It is relatively easy to get agreement that Automation should be human-centered, or that potentially hazardous situations should be avoided; it is much more difficult to get agreement on how to accomplish these objectives.	1			All	34	All	FAA 1996 Automation Report	Competencies	Automation Error Mgt	Mis-AFS Mis-Sys	SA Problem Solving Decision Making Knowledge Flight Management Guidance/Automation

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
215	Insufficient Knowledge and skills. Designers, pilots, operators, regulators, and researchers do not always possess adequate Knowledge and skills in certain areas related to human performance. It is of great concern to this team that investments in necessary levels of human expertise are being reduced in response to economic pressures when two-thirds to three-quarters of all accidents have flightcrew error cited as a major factor.	1			All	34	All	FAA 1996 Automation Report	Competencies Error	Automation		all
216	Flightcrew training investments should be re-balanced to ensure appropriate coverage of Automation issues.	1			All	34	34	FAA 1996 Automation Report	Automation	Automation	Mis-AFS	Flight Management Guidance/Automation
217	Regulatory standards. Current standards for type certification and operations have not kept pace with changes in technology and increased Knowledge about human performance. For example, flightcrew workload is the major human performance consideration in existing Part 25 regulations; other factors should be evaluated as well, including the potential for designs to induce human error and reduce flightcrew situation awareness.	1			All	34	All	FAA 1996 Automation Report	Automation Generation Error Competencies	Automation		all
218	The HF Team's assessment of flightcrew Management of Automation issues includes concerns in two major areas: (1) Pilot understanding of the Automation, its capabilities, behavior, modes of operation, and procedures for use; and (2) Differing pilot Decisions about the appropriate Automation level to use (if any) in normal and non-normal circumstances.	1	1		All	34	34	FAA 1996 Automation Report	Knowledge Automation Generation Competencies	Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge Problem Solving Decision Making
219	There have been situations where flightcrews have either inappropriately continued to use the Automation when they found themselves in an abnormal situation.	1			All	34	34	FAA 1996 Automation Report	Automation Error	Automation Surprise	Mis-AFS	Flight Management Guidance/Automation Knowledge Problem Solving Decision Making
220	Flightcrews should be given sufficient training on using the FMS to ensure proficiency at least for those capabilities used in normal day-to-day operations. The HF Team considers the practice of expecting flightcrews to acquire these basic skills while flying the line to be inappropriate.	1		1	All	34	34	FAA 1996 Automation Report	Automation Competencies	Automation Terrain Error Mgt	Mis-AFS	Flight Management Guidance/Automation
221	The flightcrew must be able to understand the Automation's status and behavior, especially during unusual or demanding situations.	1			All	34	34	FAA 1996 Automation Report	Automation Error SA	Automation Surprise	Mis-AFS Workload Distraction	Flight Management Guidance/Automation Knowledge
222	The way pilots operate airplanes has changed as the amount of Automation and the Automation's capabilities have increased	1			All	34	34	FAA 1996 Automation Report	Generation Automation	Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge
223	In fact,many sources have shown how increased Automation creates new Knowledge and skill requirements." - Dr. David Woods	1			All	34	34	FAA 1996 Automation Report	Generation Automation Knowledge Competencies	Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge
224	Industry investigations have shown that the complexities of the automated flight decks make it easy for pilots to develop oversimplified or erroneous mental models of system operation, particularly mode and transition logic.	1			All	34	34	FAA 1996 Automation Report	Generation Automation Knowledge Competencies	Automation Terrain Error Mgt	Mis-AFS	Flight Management Guidance/Automation Knowledge
225	The HF Team believes it is important for flightcrews to be prepared by their training (as opposed to "picking it up on the line"), so that they will be prepared to successfully cope with probable, but unusual situations.	1			All	34		FAA 1996 Automation Report	Competencies Surprise	Automation Surprise	Mis-AFS	Flight Management Guidance/Automation Knowledge
226	Pilots must have the opportunities to practice what they have learned in realistic operational settings through Line Operational Simulations (LOS) and LOFT scenarios: • Create a larger set of line-oriented scenarios to practice • Update these scenarios regularly to reflect the latest information about vulnerabilities from incident reporting systems or other sources. • Expand scenarios to focus more on unique error-vulnerable situations.	1		1	All	34	All	FAA 1996 Automation Report	Error	Automation Surprise	Mis-AFS Workload Distraction	Flight Management Guidance/Automation Knowledge Problem Solving Decision Making
227	Invest in more coaching and less pass/fail testing.: • Improve the debriefing of flightcrew performance after simulator sessions, IOE, proficiency checks, etc. (e.g., standardization of instructor debriefs, video replays). • Focus more on practicing how to manage the different automated systems in different circumstances, especially the judgments that have to be made on transitioning between different levels of Automation (e.g., when to turn it off or on, or to change to a different level or mode). • Encourage initial/recurrent assessments or checks to be more "learning oriented." Emphasis should be focused so that learning becomes the primary objective rather than passing or failing.	1		1	All	34	All	FAA 1996 Automation Report	Automation	Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
228	In addition to using time better, such a system might incorporate progressive assessment of individual elements/maneuvers or event sets.	1		1	All	34	All	FAA 1996 Automation Report	Competencies	Automation		All
229	Assessment may also provide for levels of individual performance based on a graduated scale, rather than an "all or nothing" grading system that may diminish opportunities for learning	1		1	All	34	All	FAA 1996 Automation Report	Criticality Competencies	Automation		
230	Use Automation surprises that occur on the line as subsequent training opportunities to learn more about the Automation and how to manage it.	1		1	All	34	34	FAA 1996 Automation Report	Criticality Competencies	Automation Surprise	Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance/Automation Knowledge
231	Support follow-up of Automation surprises in a simulator environment in LOFT scenarios or line operational evaluations.	1		1	All	34	34	FAA 1996 Automation Report	Criticality Competencies	Automation Surprise	Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance/Automation Knowledge
232	Provide more opportunities to learn and practice, especially how to handle surprising situations.	1		1	All	34	All	FAA 1996 Automation Report	Criticality Competencies Surprise	Automation Surprise	Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance/Automation Knowledge
233	Identify and correct oversimplifications in pilots' mental models of system functions.	1		1	All	34	All	FAA 1996 Automation Report	Criticality Competencies Knowledge	Automation Error Mgt	Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance/Automation Knowledge
234	Promote understanding rather than using rote training.	1		1	All	34	All	FAA 1996 Automation Report	Criticality Competencies Knowledge	Automation Surprise	Mis A/C State Mis-AFS Mis-Sys	Flight Management Guidance/Automation Knowledge
235	Treat mistakes and errors as opportunities for learning.	1		1	All	34	All	FAA 1996 Automation Report	Criticality Competencies Error			
236	Allow sufficient time for questions and thorough understanding.	1		1	All	34	All	FAA 1996 Automation Report	Criticality Competencies			
237	Continuous learning is one way to help ensure that pilots have the Knowledge they will need in order to effectively manage and use the Automation in a wide range of situations.	1		1	All	34	All	FAA 1996 Automation Report	Automation Knowledge Criticality Competencies	Automation Surprise	Mis-AFS	Flight Management Guidance/Automation Knowledge
238	Initial and recurrent training should provide a clear understanding of operationally relevant Automation principles and ensure user proficiency for the cockpit automated systems	1		1	All	34	34	FAA 1996 Automation Report	Automation	Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge Problem Solving Decision Making
239	Pilots benefit from increased: Basic airmanship, unusual attitude recovery, CRM, team Decision making, awareness of operational aspects of aircraft design philosophy, Automation and mode Management;	1		1	All	34	All	FAA 1996 Automation Report	Automation Upset Criticality Competencies	Manual AC Control Monitor Xcheck Error Mgt Leadership	Upset Compliance CRM	SA Leadership and Teamwork Problem Solving Decision Making Flight Management Guidance/Automation Manual Aircraft Control
240	Based on the incident data, accident data, and pilot and operator input evaluated by the HF team the following concerns surfaced: • degradation of manual flying skills of pilots who use Automation frequently, or who participate in long-haul operations, • A second area of concern is in the skills needed to perform recovery from unusual aircraft attitudes.	1	1		All	34	All	FAA 1996 Automation Report	Generation Automation Competencies Upset ManualACControl	Manual AC Control Automation	Upset Mis A/C State	Flight Management Guidance/Automation Manual Aircraft Control
241	Flightcrews should explicitly receive instruction and practice in when and how to: (1) appropriately use Automation; (2) transition between various levels of Automation,; and (3) revert to manual flight.	1		1	All	34	34	FAA 1996 Automation Report	Generation Automation Competencies	Manual AC Control Automation	Compliance CRM Mis-AFS	Flight Management Guidance/Automation Manual Aircraft Control Application of Procedures/Knowledge
242	Other important Knowledge and skill areas for flightcrews are: • understanding of Decision making processes (including team Decision making and handling unanticipated events), • workload and attention Management, and • understanding of other human cognitive processes (especially cognitive biases and limitations as they apply to flightcrew problem solving in airline operations).	1		1	All	34	All	FAA 1996 Automation Report	Competencies	Surprise Leadership	Workload Distraction	Leadership and Teamwork Problem Solving Decision Making Knowledge

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
243	Checkride criteria do not include or emphasize some of the skill areas mentioned above, such as Management of Automation or other known problem areas of line operation.	1		1	All	34	34	FAA 1996 Automation Report	Generation Automation Competencies	Automation Error Mgt	Mis-AFS Mis-AFS	Flight Management Guidance/Automation Knowledge Problem Solving Decision Making
244	Maneuvers included in checkrides should be evaluated for continued relevance, be phased out.	1		1	All	34	All	FAA 1996 Automation Report	Competencies Generation			All
245	Training should also be adapted to the background of the pilot.	1		1	All	34	All	FAA 1996 Automation Report	Competencies Generation			
246	Difficulty with Automation in first 6 mos on type • 25% were prepared • 14% had one encounter • 61% had multiple encounters	1			All	234	34	Survey	Automation	Automation Surprise	Mis-AFS	Flight Management Guidance/Automation Knowledge
247	• 42 % of the Pilots believe that the training of the FMS on the type they are currently flying needs to be improved • Only 51% believed it was adequate • 32% believed it was minimal	1			All	234	34	Survey	Automation	Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge
248	Only 15% of pilots felt "comfortable" operating the FMS After type rating course, 41% acquired comfort after 3 months of operation 21% acquired comfort after 6 to 12 months of operation	1			All	234	34	Survey	Automation	Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge
249	Distribution of learning the operational use of the FMS : • In training: 38% • On the line: 42% • Self study: 20%	1			All	234	34	Survey	Automation	Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge
250	62% acquired comfort during 3-12 months of line experience. The results suggest that comfort in using the FMS develops over time with 3 months of line experience being the critical learning period for the respondents followed by 6 months, then one year.	1			All	234	34	Survey		Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge
251	The results suggest that 41% of the respondents felt comfortable operating the FMS after completion of their initial operating experience (IOE). The remaining 59% acquired comfort during the 3 to 12 month period following completion of training	1			All	234	34	Survey		Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge
252	Pilots often report that the learning of the flight management system (FMS) occurs over time. FMS learning on the line—42%. • FMS learning from training—38%. • FMS learning through self---study—20%.	1			All	234	34	Survey		Automation	Mis-AFS	Flight Management Guidance/Automation Knowledge
253	Areas where FMS training can be improved in order of importance per surveyed pilot opinion: 1. Automation surprises - 57.1% 2. Hands on use in the operational situation – 52% 3. Transitions between modes – 32.8% 4. Basic Knowledge of the system – 26.7% 5. Programming – 21%	1			All	234	34	Survey	Automation Criticality	Automation Surprise	Mis-AFS	Knowledge Flight Management Guidance/Automation Problem Solving Decision Making Knowledge
254	In cases where Go-arounds should have been performed: • 71% of the cases neither pilot suggested a go-around	1			All	234	All	Survey	GA	Go Around Leadership Compliance	Compliance CRM Mis A/C State	Flight Management Guidance/Automation Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
255	In almost 30% of the cases when a Go-around was suggested the other pilot disagreed (Influenced by rank)	1			APP	234	All	Survey		Go Around Leadership	Compliance CRM Mis A/C State	Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
256	Psychological barriers to a go around suggests more practice in training may be beneficial, especially for all engine scenarios	1			APP	234	All	Survey	Criticality	Go Around Leadership	Compliance CRM Mis A/C State	All

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
257	Neither pilot suggesting a go-around implies pilots are making it work by applying judgment.	1			APP	234	All	Survey		Go Around Unstable AP	Compliance CRM	Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
258	Reasons pilots give for not going-around from an Unstable App: 1. Pilot judgment that landing is still safe even though the approach is unstable (82%) 2. There is a psychological barrier because go-arounds are rare (37%) 3. Operational inconvenience (35%) 4. Embarrassment (24%) 5. Unfamiliar with criteria (17%) 6. Mandates a report	1			APP LDG GA	234	All	Survey	GA Descision making complaince	Go Around Leadership Unstable APP	Compliance CRM Mis A/C State	Knowledge Flight Management Guidance/Automation Problem Solving Decision Making Knowledge Application of Procedures/Knowledge Leadership and Teamwork
259	Pilot response to the question of whether monitoring and cross checking is taught in training: • 47% explicitly • 34% include it implicitly • 15% marginally • 4% not at all	1			All	234	All	Survey	MonitoringXchecking	Monitor Xcheck	CRM	SA Application of Procedures/Knowledge
260	Results imply gaps in Recurrent Training re Monitor/Cross check	1				234	All	Survey				
261	Survey implies that pilots believe that monitoring and cross-checking is the poorest during the CLIMB phase because of complancy (57%) and too many secondary duties (36%).	1			All	234	All	Survey	MonitoringXchecking	Monitor Xcheck	CRM Workload Distraction	SA Application of Procedures/Knowledge Workload Management
262	90% of surveyed pilots believe that detecting and managiung errors is the most effective strategy concerning errors on the flight deck	1			All	234	All	Survey	Error	Error Mgt Monitor Xcheck	CRM	SA Problem Solving Decision Making Knowledge
263	More than 2/3 of pilots report that they get a chance to practice approach briefings during training	1			CRZ APP	234	All	Survey	Error	Error Mgt	CRM	SA Application of Procedures/Knowledge Workload Management
264	The approach briefing is included and conducted in training. However based on comments, appropriate briefing content may not be known or practiced.	1			APP	234	All	Survey		Leadership	CRM	Communication Application of Procedures/Knowledge
265	Pilot responses for deviating from SOPs: • 53% say they would deviate only if it increases safety • 29% say they would deviate if no reduction in safety • 7.5% say they would never deviate from SOPs.	1			All	234	All	Survey	Error Compliance	Error Mgt Leadership	Compliance CRM	Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
266	18% if pilots admit to deviating from checklists frequently	1			All	234	All	Survey	Error Compliance	Error Mgt Leadership	Compliance CRM	Application of Procedures/Knowledge
267	Approximately 21% of the pilot respondents admit to call out deviations on virtually every flight. Approximately 28% of the pilot respondents admit to call out deviation on about every 10 flights.	1			All	234	All	Survey	Error Compliance	Error Mgt	Compliance CRM Workload Distraction	Leadership and Teamwork Application of Procedures/Knowledge
268	Unstalble approach deviations are infrequent but consistent	1			All	234	All	Survey	Unstable APR/GA Error	Unstable APP	Mis A/C State	SA Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
269	Unstable approach rate calculated from Pilot Survey Reponse is consistent with LOSA and FDA rates and Survey.	1			APP	234	All	Survey	Unstable APR/GA	Unstable APP	Mis A/C State	All
270	49% of deviations from SOPs occur on every 10 flights	1			All	234	All	Survey		Compliance	Compliance	Application of Procedures/Knowledge
271	Unstable approach rate calculated from Pilot Survey Reponse is consistent with LOSA and FDA rates and Survey.	1			APP	234	All	Survey	Unstable APR/GA Criticality	Unstable APP	Mis A/C State	All

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
272	54% had a negative experience in training in the last 5 years	1			All	234	All	Survey	Criticality			
273	Training should be about learning, developing, strengthening skills and Knowledge.	1			All	234	All	Survey	Competencies			
274	Ensure that instruction and assessment components of training delivery are improved. Instructor quality and consistency must be addressed	1			All	234	All	Survey	Competencies			
275	Analyze current training content and emphasis to ensure content gaps are identified.	1			All	234	All	Survey				
276	Training is multi-dimensional. All dimensions must be addressed for improvement to be successful and sustainable: • Content (operational and functional) • Delivery methods and tools • Airline Culture	1			All	234	All	Survey	Criticality			
277	Training needs (per analyzed survey comments) in terms of pilot-operational discomfort by order of priority: 1. Adverse weather 30% 2. Crew Resource Management 23% 3. Non-normal checklists 16% 4. Flight management 15% 5. Airplane handling 13% 6. Systems 12% 7. Maneuvers 10%	1	1		All	234	All	Survey	Criticality	WX Automation Manual AC Control	Syst mal CRM WX Manual AC Ccontrol Mis AFS	All
278	Over the last 20 years the World fleet and flight cycles have increased almost linearly (except for a plateau (2001–2003) and 2007 –2008) by respectively 85% and 77%.				All	All	All	CAST+				
279	Most accidents happened during the takeoff or landing phases.		1		TO LDG	All	All	CAST+	Competencies			
280	The trend over the last 20 years shows that the number of accidents has decreased by 33%.		1		All	All	All	CAST+	Generation Automation			
281	Over the last 20 years, the hull loss accident rate has decreased 50%. The rate of fatal accidents has reduced by 65%		1		All	All	All	CAST+	Generation Automation			
282	From 1991 to 2010, Runway Excursion (RE) represented by far the main accident category, accounting for 28% of all events.	1			TO LDG	All	All	CAST+	ManualACControl	Landing Issues Manual AC Control	Mis A/C State	
283	Runway Excursion, together with Controlled Flight Into Terrain (CFIT), Loss Of Control (LOC), System/Component Failure (SCF) and Abnormal Runway Contact (ARC) accounted for 78% of all accidents.	1	1		All	All	All	CAST+	ManualACControl	Manual AC Control Landing Issues System Malfunction	Upset Syst mal Mis A/C State	All
284	Runway excursion (RE), which accounted for 26% of all accidents between 1991 and 2000, increased by almost 10% in the 2001- 2010 period	1			TO LDG	All	All	CAST+	ManualACControl	Manual AC Control Landing Issues	Mis A/C State	
285	Between the 90 decade and 2000 decade CFIT decreased 17% to 9%	1	1		All	All	All	CAST+	Terrain	Manual AC Control Landing Issues	Terrain	SA
286	Between the 90 decade and 2000 decade Loss or Control accidents remained steady at around 13%.	1	1		All	All	All	CAST+	-	Terrain	Upset Mis A/C State	All
287	Between the 90 decade and 2000 decade System Malfunction accidents decreased (14% to 11%)	1			All	All	All	CAST+	-	System Malfunction	Syst mal	
288	While abnormal runway contact remains relatively high, between the 90 decade and 2000 decadeit decreased significantly.	1	1		TO LDG	All	TO LDG	CAST+	ManualACControl	Landing Issues Manual AC Control	Manual AC Control	

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
289	Between the 90 decade and 2000 decade Land Short or Undershoot Runway Excursions doubled from 3% to 7% (Manual Handling)	1	1		APP LDG	All	All	CAST+	ManualACControl	Manual AC Control Landing Issues	Mis A/C State	Manual Aircraft Control SA
290	Looking at Runway Issues comparing the 90 decade and the 2000 decade, the percentage of accidents for wihich runway issues were considered causal was almost 50% (47% and 49%)	1			TO LDG	All	All	CAST+	ManualACControl	Manual AC Control Landing Issues	Mis A/C State	Manual Aircraft Control SA
291	Undershoot emerged as important categories (ie > 5%) during the 2000 decade a 8%	1			TAXI	All	All	CAST+	ManualACControl	Manual AC Control Landing Issues	Mis A/C State	Manual Aircraft Control SA
292	Over the last 20 years, 84% of all accidents happened during the approach/ landing or takeoff/climb phases. The approach/landing is by far the most critical of the flight phases, accounting for 63% of all occurrences. The takeoff/climb phase is the second most hazardous phase, accounting for 21% of all events.	1	1		APP LDG TO CLB	All	All	CAST+	Phase	Manual AC Control Landing Issues	Mis A/C State	Manual Aircraft Control SA
293	Accidents by Phase: o Parking/Taxi 4% o Takeoff/Initial Climb 16% o Climb 5% o Cruise 7% o Descent 5% o Approach & GA 22% (GA 3%) o Landing 41%	1	1		All	All	All	CAST+	Phase	Landing Issues Unstable APP	Mis A/C State	All
294	EGPWS / TAWS technology has entered airline and corporate operations during the last five years; to date no aircraft fitted with such a system has been involved in a CFIT accident.	1			All	All	All	TAWS Saves	Terrain	Landing Issues Terrain	Ground manoeuvring Mis A/C State	
295	The 'saves' confirm that TAWS is a very effective safety tool yet it still depends on crew action for the last defence; always pull up when a warning is given.	1			APP	All	All	TAWS Saves	Terrain	Terrain	Terrain Compliance	SA Application of Procedures/Knowledge
296	98.7 % of the Long aircraft variant landings had a maximum vertical acceleration less than 1.5g.	1		1	LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues	Terrain	SA Application of Procedures/Knowledge
297	Long aircraft type variant landings with vertical acceleration above 1.5g were more frequent compared to the shorter versions resulting in higher scatter of the landing assessment parameters.	1			LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual AC Control	Knowledge Application of Procedures/Knowledge Manual Aircraft Control
298	for 1.3% of the landings, the long aircraft type variant had a higher rate of high vertical acceleration landings compared to the shorter type variant. From the data - the probability of a landing > 1.75 g was found to be 0.25 % on long aircraft type variant compared to 0.04 % on shorter versions.	1			LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual AC Control	Manual Aircraft Control
299	it was noted that the obvious difference in inertia implied that in certain circumstances (such as recovery from a steep approach gradient) more anticipation would be needed in the long aircraft type/variant than the shorter versions	1			APP LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual AC Control	Manual Aircraft Control Knowledge
300	Speed tracking on approach is not significantly different between the two models, and statistical variations in approach speed are not related to vertical speed (Vz) at touchdown.	1			APP LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control Surprise	Manual AC Control	Manual Aircraft Control SA
301	Pitch stick inputs required for the flare do not change with cg, which implies that the pitch characteristics in the flare are not significantly affected by cg.	1			LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Unstable APP	Mis A/C State Compliance	Manual Aircraft Control Application of Procedures/Knowledge
302	One of the most interesting results is a strong correlation between high Vz at touchdown and a lack of effective pitch stick input. This is either due to insufficient or late aft input and provides a clear implication that pitch control authority is not in question	1			LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual AC Control	Manual Aircraft Control SA Application of Procedures/Knowledge
303	Compared to the shorter version, statistically the long aircraft type variant shows: – A slightly steeper approach gradient at the start of the flare – More forward stick input below 150 ft – A shorter time from flare to touchdown	1			APP LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual AC Control	Manual Aircraft Control SA

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
304	A dedicated examination of all the hard landings* available in the database confirmed that a majority (60%) of these cases involved a late "Duck Under" (pilot action to steepen the slope at or just below 150 feet AFE to bring the touch down point closer to the threshold), followed by an insufficient flare (too low and/or not enough nose up pitch input) * Landings having a maximum vertical acceleration > 1.75g (Note that this is not the AMM definition of hard landing	1			APP LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual AC Control Mis A/C State	Manual Aircraft Control SA Application of Procedures/Knowledge
305	There is a need for pilots to better anticipate and monitor the final approach and flare on the long aircraft type variant has become evident.	1			APP LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual AC Control Mis A/C State	Manual Aircraft Control SA
306	To avoid hard landings, handling recommendations include: - Maintaining a stable slope prior to flare (no "duck under") - Avoidance of under flaring - Avoidance of significant nose down inputs during flare - Crosswind landing reminders - Reminder of pitch monitoring and aircraft pitch geometric limits	1			APP LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control Monitor xcheck Surprise	Manual AC Control Mis A/C State Compliance	Manual Aircraft Control SA Communication Application of Procedures/Knowledge
307	It is recommended to highlight differences to pilots receiving training to operate long aircraft type variant either in a mixed fleet or single fleet environment. These differences can be highlighted within the scope of type rating training and recurrent.	1			APP LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing issues Unstable APP Manual AC Control Compliance Error Mgt	Crosswind Compliance CRM mis A/C state	Knowledge Application of Procedures/Knowledge Manual Aircraft Control
308	On difficult runways, use of dedicated markings in conjunction with a predetermined Auto-brake setting may increase crew confidence to achieve the proper touchdown point without the need to duck under.	1			APP LDG	4	4	Long Aircraft FDA Study	Hard landing	Landing Issues Manual AC Control	Manual AC Control Mis A/C State Compliance	Knowledge Application of Procedures/Knowledge Manual Aircraft Control
309	– Airlines are also encouraged to use their own FDA system in order to monitor all operations for identification of precursors to hard landings. (e.g. duck under, high slope, pitch oscillations, specific airports, etc.)	1			APP LDG	4	4	Long Aircraft FDA Study	Hard landing			
310	Long aircraft with high power tend to have: • Lower rotation rates which could result in degraded TO performance • Require a greater attention to making a smooth rotation to avoid PIO on takeoff.	1			TO	4	All	Long Aircraft FDA Study	Rotation Technique PIO		Mis A/C State Compliance	Manual Aircraft Control SA Application of Procedures/Knowledge
311	Go-Around Maneuvers 1. I suggested a go---around, but the other pilot disagreed (20%). 2. The other pilot suggested a go---around, but I disagreed (8%). 3. Neither pilot suggested a go---around (72%).	1			APP LDG GA	All	All	Survey	GA Descision making compliance	Go Around Surprise	Compliance CRM	Communication Leadership and Teamwork
312	Pilots report high levels of assertiveness in 4 of the 5 categories, with taking control from the pilot flying registering the lowest at 49%. The level of assertiveness appears to be linked to the level of resulting intervention. Tasks such as identifying a deviation (92%) or proposing a checklist (91%) are more likely to be asserted than tasks such as proposing a GA (83%) or demanding a GA (80%).	1			APP LDG GA	All	All	Survey	GA Descision making assertiveness	Leadership Error Mgt MonitorXcheck Go Around	Compliance CRM	Communication Leadership Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
313	Most pilots (93%) believe detecting and managing errors is the most effective strategy for error management (Figure). A small percentage of pilots (7%) believe that errors should not be committed.	1		1	All	All	All	Survey	MonitoringXchecking error management	Moniter Xcheck		Leadership and Teamwork Application of Procedures/Knowledge
314	a majority of the respondents (53%) would deviate if they believe it increases safety and twenty---nine percent would deviate if it resulted in no reduction in safety. Overall, most (83%) pilots would exercise judgment to intentionally deviate from company SOPs with their judgment being the pilot's assessment of safety. Another seven percent reported they would never deviate.	1			All	All	All	Survey	Compliance Error	Error Mgt Leadership	Compliance CRM	SA Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
315	Intentional deviations from checklists occurred a reported every ten flights by 13% of the respondents, a few times a year by 30% of the respondents, and once a year by 36% of the respondents. Very few (4%) reported a deviation on every flight. Checklist deviations occurring at this high of a rate suggest other factors may be involved not related to compliance.	1			All	All	All	Survey	Compliance Error	Error Mgt Leadership	Compliance CRM	Application of Procedures/Knowledge

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
316	We asked, "In the last six months, did you encounter an operational situation where you did not feel comfortable?" Just over half (54%) of the respondents answered yes (Figure 18). Within that category, 57% of the reporting pilots were ranked captain and 43% were ranked first officer.	1			All	All	All	Survey	Knowledge Automation Competencies criticality	Surprise	Syst mal CRM Adverse WX Manual AC Control Mis AFS	SA Problem Solving Decision Making Knowledge Application of Procedures/Knowledge
317	Skill loss can be substantial and generally increases with the duration of non-use / non-practice	1			All	All	All	Skill Decay & Skill Retention Studies	Criticality	ManualACControl Go Arounds Automation Unstable APP Landing Issues	Manual AC Control	All
318	Retention of open-loop tasks was better than of closed-loop tasks.	1			All	All	All	Skill Decay & Skill Retention Studies	Criticality	Error Mgt Leadership System Malfunction		All
319	Skill decay for "accuracy" tasks was three times higher than for "speed" tasks, i.e. for tasks where it was necessary to perform the trained skill fast.	1			All	All	All	Skill Decay & Skill Retention Studies	Criticality	Automation		All
320	There was no evidence of significant skill decay among pilots in 12-month training cycle (Maneuver Validation vs. First Look grades).	1		1	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Manual AC Control Landing Issues	Manual AC Control	Manual Aircraft Control Application of Procedures/Knowledge
321	There were no detectable trends in the MV-FL difference within the 2000 -2008 period.	1		1	All	All	All	Skill Decay & Skill Retention Studies	Criticality	Manual AC Control Landing Issues	Manual AC Control	Manual Aircraft Control Application of Procedures/Knowledge
322	There was no significant difference between normal vs. abnormal maneuvers; except for the takeoff flight phase, where the "normal" got significantly better grades at all times during the 12-month retention interval.	1		1	All	All	All	Skill Decay & Skill Retention Studies	Criticality	System Malfunction Compliance Manual AC Control	Syst mal Compliance	Manual Aircraft Control Application of Procedures/Knowledge
323	The results suggest pilots maintain their proficiency across the 12-month re-training interval				All	All	All	Skill Decay & Skill Retention Studies	Criticality	Go Arounds System Malfunction Landing Issues	Syst mal Compliance	Manual Aircraft Control Application of Procedures/Knowledge
324	Accidents by Phase of Flight: a. Pre-Flight and Taxi-Out – 0.7% b. Take-Off – 11.9% c. Climb – 19.1% d. Cruise – 15.8% e. Descent – 4.3% f. Approach – 35.6% g. Land – 11.9% h. Post-Flight and Taxi-In - 0.7%	1	1		All	All	All	ACC CAA	Phase Criticality			
325	General Operational Threats by Rank - (TEM Phase) a. Human Factors – 32.3% b. Compliance failure – 19.1% c. Mishandled Aircraft – 13% d. Mismanaged Aircraft State - 7.8% e. Procedures – 6.9% f. Performance – 4.2% g. Mishandled systems (other than FMS) – 3.8% h. Workload Distribution – 3.4% i. Fatigue – 3.4% j. Mishandled Auto-Flight – 1.9% k. Performance Miscalculation – 1.7% l. Deficiencies in Manuals – 0.8% m. Physiological – 0.8% n. Cabin – 0.6% o. Deficiencies in Charts – 0.4%	1	1		All	All	All	ACC CAA	Threats and Errors TEM	Automation Compliance Error Mgt	Compliance Def Manuals Def-Charts Fatique CRM Workload Distraction Pressure Mis-AFS Mis A/C State Mis-Sys Manual AC Control	Workload Management Application of Procedures/Knowledge Flight Management Guidance/Automation Manual Aircraft Control

Evidence Table Continued

E ref	Evidence Statement	Need for change	Challenge Validate TCS	Feedback of Changes	Flight Phase	Gen Specific	Applicability to Gens	Source	Keywords	Training Topics	Factors	Competencies
326	Five most common causal factor groups (CAP 780) a. Omission/inappropriate Action – 36% b. Flight Handling – 28% c. Lack of Positional awareness – 25% d. Failure of CRM – 22% e. Poor Judgment/Airmanship – 20%	1	1		All	All	All	ACC CAA	Causes Criticality Errors SA	Manual AC Control Error Mgt Leadership	CRM Manual AC Control	Application of Procedures/Knowledge Leadership and Teamwork Manual Aircraft Control
327	The global fatal accident data was re-analyzed by means of the ITQI Intuitive Threat Matrix.	1	1					ACC CAA				
328	Analysis, by phase of flight clearly shows that the greatest risk is within the approach phase of flight.	1	1		APP	All	All	ACC CAA	Phase Criticality			
329	Further analysis to determine the areas of general operational threat it is clear that the major threat is that of the non-technical area of human factors	1	1		All	All	All	ACC CAA	Criticality CRM	Error Mgt Leadership Compliance	CRM Workload Distraction Pressure Compliance Mis-AFS Mis A/C State Mis-Sys Manual AC Control	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Application of Procedures/Knowledge
330	The UK Civil Aviation Authority publications CAP 776 Global Fatal Accident Review 1997 – 2006 and CAP 780 Aviation Safety Review 2008 both suggest that the main areas of concern are non technical ones by nature	1	1		All	All	All	ACC CAA	Criticality CRM	Error Mgt Leadership Compliance	CRM Workload Distraction Pressure Compliance Mis-AFS Mis A/C State Mis-Sys Manual AC Control	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Application of Procedures/Knowledge
331	(CAP 776) demonstrates that the top two primary causal factors, accounting for 36.4% of accidents, are non technical in nature. This is further reinforced by data from the CAP 780 which shows that the top five most common causal factors groups contain a significant component of non-technical elements (Human Factors).	1	1		All	All	All	ACC CAA	Criticality CRM	Error Mgt Leadership Compliance	CRM Workload Distraction Pressure Compliance Mis-AFS Mis A/C State Mis-Sys Manual AC Control	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Application of Procedures/Knowledge
332	(CAP 780) again demonstrates that the most frequently occurring causal factors are crew related	1	1		All	All	All	ACC CAA	Criticality CRM	Error Mgt Leadership Compliance Manual AC Control Compliance	CRM Workload Distraction Pressure Compliance Mis-AFS Mis A/C State Mis-Sys Manual AC Control	SA Leadership and Teamwork Workload Management Problem Solving Decision Making Application of Procedures/Knowledge
333	Top 10 ASR's in operations in percentage of reports o Aircraft limit exceedance 9.2% o Unstable approach 8.3% o Turbulence 7.6% o Flight crew missed selection 6.3% o Traffic on runway during short final 5.9% o Windshear 4.2% o ATC traffic separation 3.8% o Checklist/S0P use 3.5% o Manual handling 3.4% o ATC communication lost 3.1%	1	1		All	All	All	Incid Anal STEADES		Manual AC Control Automation WX Unstable APP Compliance	Adverse WX ATC Loss of comms Traffic Windshear Compliance Mis A/C State Mis-Sys Manual AC Control	Communication Application of Procedures/Knowledge Workload Managementt SA
334	Top 10 ASR's in training flights o Unstable approach 16.7% o Manual handling 9.4% o Flight crew missed selection 9.2% o Heavy/hard Landings 7.5% o Deep (long) Landings 5.5% o Procedures (operational) 5.2% o EGPWS G/S Alert 4.3% o Aircraft limit exceedance 3.6% o Checklist/S0P use 3.3% o Aircraft anti/de-ice 3.1%	1	1		All	All	All	Incid Anal STEADES		Unstable APP Manual AC Control Error Mgt Landing Issues Compliance WX	Adverse WX Compliance Mis-AFS Mis A/C State Mis-Sys Manual AC Control	Leadership and Teamwork Application of Procedures/Knowledge Manual Aircraft Control Workload Management
335	There are twice the percentage of ASRs for unstable approaches during training flights compared to the main ASR database	1			All	All	All	Incid Anal STEADES	Criticality	Unstable APP	Mis A/C State Compliance	Leadership and Teamwork Application of Procedures/Knowledge Manual Aircraft Control Workload Management
336	Heavy/hard landings is number 4 in terms of percentage of reports during training flights but outside of the top twenty for normal ops.	1	1		All	All	All	Incid Anal STEADES	Criticality	Landing Issues	Mis A/C State	Manual Aircraft Control
337	Manual handling is number 2 in percentage of ASRs for training flights (9.2%) but number 9 for normal ops at 3,5%.	1	1		All	All	All	Incid Anal STEADES		Manual AC Control	Mis A/C State	Manual Aircraft Control
338	Flight crew mis-selection is ranked approximately the same in both databases but generates a 50% higher the percentage figure of reports during training flights as compared to normal operations.	1	1		All	All	All	Incid Anal STEADES		Error Mgt	Mis-Sys Mis A/C State Mis-AFS	Leadership and Teamwork Workload Management
339	Problems with checklist use and SOPs is ranked 8th in ASR percentage in the main database and ranked 9th for training flights. The percentage of occurrence for both is nearly the same at approximately 3.5%.	1	1		All	All	All	Incid Anal STEADES	Criticality	Compliance Error Mgt	Compliance Workload Distraction	Application of Procedures/Knowledge Workload Management

APPENDIX 13
MATRIX OF SUMMARIES FROM THE EVIDENCE TABLE

INTRODUCTION

This appendix contains the 15x17 Summary Matrix and the 15 Analysis Worksheets, both of which are used to consolidate information from the Evidence Matrix. The Summary Matrix is essentially used to transform the results from the data sources to the training topics after which the worksheets further consolidate and structure the results to highlight training effect and criticality.

13.1 SUMMARY MATRIX

EVIDENCE TABLE - SUMMARY ANALYSIS

	Unstable Approach	Automation	Error Management	Manual Aircraft Control	Go-Around
LOSA Study 4.1	Unstable approaches remain a consistent problem at a rate of approximately 4%. They almost always result in an uneventful landing. The crews in most cases have mismanaged the situation but are willing to continue the approach, violate SOPs and/or are unsure of the appropriate stabilized approach criteria. Landings are often performed in the wrong aircraft configuration.	The overarching problem with automation for the flight crews is monitoring and cross checking. 28% of the flights have at least one automation error with almost half of them not detected or acted upon by the crew. In addition there is a basic problem with understanding the system, mode confusion and using the automation and/or flying manually at inappropriate times.	A key strategy for managing flight crew errors is monitoring and crosschecking. The situation is critical as just over 25% of the errors made by the flight crews are detected and rectified. The highest risk is crosschecking errors (e.g. omitted deviations as they result 65% of UAS). The flight phase with the most threats is pre-departure, while the most mismanaged errors occur in DES, APP and LDG. Error detection is generally better in the early phases of flight with automation error captured being the best overall (53%) and procedure (16%) being the poorest. The Captain detects more errors than the First Officer (27% versus 18%) but neither rates highly at detecting their own errors (5-6%).	According to LOSA, manual control errors, while not the most frequent type of error (41% occurrence by flight), are only exceeded by automation errors. Many manual control errors result from the improper technique, flight crews ignoring or "flying through" the indicated flight guidance. Manual control problems are exacerbated in adverse weather. The leading error type is unintentional vertical deviation (32%) followed closely by deviations in landing, lateral, speed and improper thrust.	According to LOSA, go-around from unstable approaches occur only 3% of the time (contrary to SOP's). Landings from unstable approaches rank in the top 5 UAS during the LDG phase and are the number 3 non-compliance item in the LOSA database). When a go-around from an unstable approach is performed it is usually a surprise to the crew and poorly executed.
EBT Flight Data analysis 4.2.1	The FDA unstable approach rate is around 3.5%. This is consistent across aircraft types and geographical regions. There are as many flights that have landing events following stable approaches as there are following unstable approaches. Solving the unstable approach problem will not address all landing issues. The increased risk associated with unstable approaches becomes evident when examining event rates and event severity. Landings from unstable approaches have a higher event rate and as the events themselves become more severe, the event rate becomes even higher. Unstable approaches can be viewed as a barometer of the flight itself; flights with unstable approaches generally have more FDA events all in-flight phases, including phases not associated with the approach.	Intentionall Blank	Intentionall Blank	Intentionall Blank	Only 1.4% of unstable approaches lead to a go-around, with an FDA all event rate of 1.6 occurrences in the immediate phases after go-around (GA, CLB). The high-risk event rate for the same period is 0.24. Both these rates are conservative because the flight recorder cannot capture many of the crew errors that could occur. Go-around initiation heights overwhelmingly occur at heights different from those briefed.
Long body aircraft Studies 4.2.2	Intentionall Blank	Intentionall Blank	Intentionall Blank	Long body aircraft are more prone to high "G" landings. Because of geometric considerations, perspectives from the cockpit are slightly different laterally and vertically and tend to produce steeper approach gradients just prior to flare as well as centreline displacement in crosswinds. To compensate for this crews should be attentive to landings in crosswind, avoid last minute pitch-down and a tendency to under-flare. There is a tendency to under-rotate in long body aircraft, which degrades take-off performance; pilots should make smooth accurate rotations avoiding "pilot induced oscillations.	Intentionall Blank
LANDING DURING ILS APPROACHES 4.2.3	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank
AQP Study 4.3.1	Intentionall Blank	Automation is an issue of concern regarding assessments in AQP in both the planning and execution phases of flight. The phases most concerned are CRZ and DES.	In all AQP evaluations, whether type rating courses (IQ) or recurrent training (CQ), policy and procedural error types are ranked 1st and 2nd, accounting for the majority of all errors. Crews operating Gen 3 jet aircraft show proportionally a greater percentage of errors relating to proficiency, situation awareness, non-compliance and decision making when compared with crews operating Gen 4 jets. This trend increases as the training cycle progresses from the type rating to recurrent line checks.	Training results in AQP show quicker mastery of manual handling skills in initial training, particularly the case in gen 4 aircraft and while Gen 3 improves with experience it remains below Gen 4.	Intentionall Blank
ATQP 4.3.2	Unstable approaches were closely monitored during the transition to ATQP and the rate of unstable approach remained constant, indicating that a major change in training can be performed without increasing risk as far as approaches are concerned. Approximately 50% of go-arounds during this transition resulted from unstable approaches. The causes of unstable approaches in order of importance were poor decisions in accepting ATC clearances, mismanaged visual approaches, mismanaged energy, and poor manual aircraft control.	Mismanaged auto-flight is a major factor, contributing to unstable approaches and go-around errors, both in training and line operations. This remains constant, whether in the all engines operating, or engine-out case.	Both operational and training data confirm that crews have problems with manoeuvres that are not routinely practiced. Procedural and manual control skills need reinforcement, as these areas are where most of the errors occur. In addition, descent planning and energy management also need specific training.	The evidence gathered during ATQP shows that manual aircraft control is a problem on modern aircraft and more practice in training is needed.	Mismanagement of auto-flight systems, resulting in unstable approaches, are the biggest cause for go-arounds in operations. A significant percentage of go-arounds result in flap over-speeds and violations of SOP. Engine out go-arounds form part of the regulated training programme, but still result in a significant percentage of unacceptable performance grades. Surprise go-arounds do not form part of the training programme, and are not well executed by crews in line operations. Consequently, the all –engines go-around is a target for improvement in ATQP.
Pilot Survey TBD 4.4	The pilot survey shows that unstable approaches are a consistent problem, with rates similar to those from LOSA and FDA data. The fact that pilots believe that they can and in most case do make a successful landing when unstable reinforces the continuation of this problem. (82% cite belief that landing can be safely made even though approach is not stable.) Other reasons that pilots continue to land are that they admit to a psychological barrier inhibiting a go-around (37%); it is operationally inconvenient (35%); it is professionally embarrassing (24%); 17% admit that they are unfamiliar with the stable approach criteria and others simply do not want to write the mandatory report. From this information it is clear that there are issues of knowledge, skills and particularly attitudes that foster an unstable approach culture, which needs to be treated on several levels, one certainly being training.	The pilot survey was heavily critical of automation training during the initial type rating. Only 25% of the pilots felt prepared to utilize the automation when released to line operations. In reality 61% had multiple encounters on the line during their first 6 months of flying where they reported being involved in uncomfortable situations. Over 60% felt that the operational aspect of FMS training was missing during training requiring them to learn to use the system effectively during the first year after training. When asked how the training could be improved, the majority felt that automation surprises was the most important issue followed by hands on use in operational situations; while about a third recommended better training in transitioning between levels. The prevailing sentiment was that the operational aspect of the FMS was seriously lacking in training, the focus being on the functional, such as basic knowledge and programming	Almost all pilots believe that the most important strategy in error management is monitoring and crosschecking and that it is emphasized most of the time in training and taught explicitly about half of the time. There are however, problems in error management that are not so well addressed. Non-compliance with procedures is too high, for example, 21% of pilots admit to call out deviations on virtually every flight, cross checking is particularly bad in the CLB phase because of complacency and too many secondary duties. Intentional non-compliance on a fairly regular basis was reported by 13% of those surveyed. The issue of assertiveness was questioned and while the monitoring pilot almost always speaks up if there is a flight path deviation (90%), but less than half of the respondents (49%) reported that they would be willing to take control from the flying pilot.	The pilots were allowed to make whatever comments on any training subject and these comments were subsequently analysed and added to the results from the formal survey questions. There were a significant number of comments on training needs and these needs were prioritized according to the analysis of the comments. Two categories referred to manual aircraft control, manual handling and manoeuvres. Together they indicated that pilots feel quite strongly that manual aircraft control is a high priority item in training.	The survey shows as pilots readily admit that they are not going around per the airline SOP. The reason most often cited is a feeling that the landing can be successful despite the unstable condition. In the majority of the cases the prospect of a go-around is not discussed during an unstable approach. Pilots report a psychological barrier to performing a go-around.
IATA Safety Report 2008 & 2009 4.5	The IATA Accident Reports find unstable approaches to be a concern and a frequent error. The report recommends FTSD training in order to reduce the problem.	The IATA accident reports generally support the LOSA finding with regard to automation. Specifically, flight crews were found reluctant to revert to manual flying even when the situation required it. In addition, crosschecking is promoted to be the best countermeasure to mitigate automations errors and further finds that gross error checks should be made when imputing data into the FMS to trap errors easily made with this function	Error management results from the IATA studies echo the LOSA findings. Error management is listed as being the most important countermeasure to accident prevention. In addition, training is recommended to reinforce go-around in appropriate situations. Manual aircraft handling is also cited as an area to be improved by training in addition to automation management i.e. flight path management. Other specific areas noted are gross error checks when inputting FMS data as well as dealing with pilot reluctance to revert to manual flying when appropriate	The IATA report recommends reinforcing manual aircraft control skills through training and notes that crews are reluctant to revert to manual flying from automation. Poor manual aircraft control ranks as the number 1 error in their accident reports. The report cites problems during landing in addition to go-arounds.	The results from IATA accident statistics support the LOSA findings in terms of the high degree of failure to go-around when the approach is unstable. This crew error is ranked high in IATA accident analysis and the report recommends training in go-arounds with regard to decision-making and execution of any type of go-around, at any point during the approach.

	Adverse Weather	System Malfunction	Terrain	Surprise	Landing Issues	Compliance
LOSA Study 4.1	Weather is the number 1 threat in the LOSA database and significant in all flight phases. 8% of all flights encounter thunderstorms with over 6% of these encounters resulting in UAS. Less than 3% of unstable approaches are due to weather. Turbulence exacerbates other common errors, specifically manual aircraft control. Weather avoidance errors are associated with SOP non-compliance (25%), poor planning and radar misuse. The number 1 error associated with ice and snow is failure to select the anti-ice system on.	There is a high degree of intentional non-compliance associated with procedures during the management of unexpected system malfunctions. In addition, unexpected system malfunction is in the top 5 threats as well as in the top 5 mismanaged threats in LOSA database. System malfunction ranks 3rd as a contributory factor in UAS.	LOSA indicates that proper altimeter use should be emphasized during training and that terrain is one of the most important mismanaged threats in LOSA database. In addition, Airlines that operate in high terrain environment tend to be complaisant to terrain threat.	GA is generally a surprise to crew and not well performed. An unexpected malfunction is number 4 threat as well as number 4 mismanaged threat in LOSA database.	1% of all landings in LOSA database result in an abnormal landing. The number 3 non-compliance item in the database is landing from an unstable approach. Aircraft handling errors on landing are not well detected as they rank 2nd in least detected error during landing phase. The early commencement of after landing and taxi-in during the landing rollout is prevalent and ranked 5 overall in non-compliance.	There is a significant positive correlation between non-compliance and UAS, while there is a negative correlation between non-compliance and error. 25% of all errors are non-compliance errors. The top ranked non-compliance error is checklist protocol, followed by omitted call-outs. Omitted call-outs results have highest risk (65% lead to UAS). The 3rd ranked non-compliance issue is failure to execute a missed approach when required. The 4th and 5th ranked non-compliances are PF making their own changes and PM commencing taxi duties before leaving runway respectively. With respect to weather avoidance errors, 25% result from deviations without ATC clearances. Paradoxically, the fact that most errors are inconsequential reinforces crew inaction, creating additional non-compliance with associated negative effects.
EBT Flight Data analysis 4.2.1	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank
Long body aircraft Studies 4.2.2	In low visibility and/or crosswind conditions common errors such as "duck under" and misalignment with the runway centreline are more critical in long body aircraft.	Intentionall Blank	Intentionall Blank	Intentionall Blank	Landing events are statistically more likely with long body aircraft, especially with respect to heavy landings. Pilots need to be especially cognizant of not 'ducking under' the glideslope. In addition, pilots need to understand the and differences in ground speed and momentum as well as perceptual differences both laterally and vertically resulting from the extended length between the main gear and cockpit.	In long aircraft, following the recommendations of the manufacturer provided in SOP's and training mitigates the tendency toward high "G" landings. Application of take-off procedures is equally important in the prevention of "pilot induced oscillations" during take-off
LANDING DURING ILS APPROACHES 4.2.3	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	FDA statistical analysis on a large sample of Gen 3 and 4 jet aircraft indicated that automation (autoland and autothrottle/autothrust) provide greater touchdown accuracy, with Gen 4 jet aircraft being more accurate than Gen 3 jet aircraft. The two parameters most affecting airborne distance are threshold crossing height and airspeed over-speed at threshold, in that order.	Intentionall Blank
AQP Study 4.3.1	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	The biggest problem with NCGs (non-conforming grades) throughout all operational evaluations is non-compliance with airline policy, amounting to 50% of errors committed. In addition, non-compliance with international procedures is also substantial. The flight phase where the crews have the most difficulty in following procedures is DES. Data from international flights show that the CRZ phase has significantly more NCGs than domestic flights.
ATQP 4.3.2	Intentionall Blank	Procedures and handling associated with manoeuvres after engine failure result in the highest rates of unacceptable performance in training. Despite the emphasis in training on engine failure, its effects continue to be problematic to crews in terms of procedures and manual aircraft control.	Intentionall Blank	Surprises need to be incorporated in training particularly with respect to automation and engine failure situations both from a proactive and reactive perspective	Intentionall Blank	Intentionall Blank
Pilot Survey TBD 4.4	The survey showed that in the opinion of the pilots, WX is the most important training need. This result came from the analysis of voluntary comments made by the pilots.	The survey showed that in the opinion of the pilots, Sys Mal is an important training need in terms of the non-normal checklists (ranked 3rd). This result came from the analysis of voluntary comments made by the pilots.	Intentionall Blank	A high percentage of pilots found themselves in a 'surprise' situation after initial training. These uncomfortable situations continued in despite experience on type. Automation surprises are particularly problematic as the majority of respondents report this issue as the number 1 topic for automation training improvement. It is clear from what the pilots are saying that current training does not deal adequately with unexpected operational situations.	Intentionall Blank	The pilot survey is probably most revealing in the subject of compliance. If what LOSA postulates is true i.e. that the error rate is multiplicative when non compliance is involved, then the following statistics speak for themselves: • 21% of pilots admit to call out Intentional deviations on virtually every flight. • 13% if pilots admit to intentional deviations from checklists on a frequent basis. • In a go around situation 71% of time neither pilot mentioned a go-around.
IATA Safety Report 2008 & 2009 4.5	The top threat in the IATA accident reports is weather	Intentionall Blank	Intentionall Blank	Maintaining situation awareness by specific briefings as well as monitoring and cross checking are effective countermeasures for dealing with all operational situations, including surprises. The IATA accident reports recommend training to deal with unusual "edge of the envelope" situations as well as specific training to cope with surprise go-arounds.	According to the IATA accident reports, the number 1 UAS is improper landing. Training should reinforce GA from abnormal landings.	The IATA reports echo LOSA findings. Compliance is rated as one of the top errors and specific training is recommended particularly with respect to following SOPs (i.e. to go-around) when an approach is not stable, and when the landing is improper.

	Leadership	Mismanaged Aircraft State	Upset	Generational Aspects	Phase of Flight	Training Effect
LOSA Study 4.1	Leadership is an effective positive catalyst in terms of reducing errors per flight, provided that it is accompanied by good communications.	Omitted callout deviations are associated with the greatest risk; 65% of omissions contribute towards UAS. Intentional non-compliances correlate positively with UAS rates. The flight phases having the most mismanaged aircraft states are DES, APP and LDG. Detected handling errors account for between 20% - 40%, but most are not detected until a mismanaged aircraft state occurs.	Intentionall Blank	Intentionall Blank	Weather is considered a major threat in all flight phases. LOSA data shows that it is in the top three threats for all flight phases. Flight phases have different characteristics in terms of threats, errors, error detection rates and undesired aircraft states.	The LOSA study was specifically targeted to address issues likely to receive effective mitigation in training. Some of the more important findings in the report highlight automation problems, specifically in terms of operational performance as well as conceptual understanding and procedural knowledge. Monitoring and crosschecking is the overarching element that needs to be improved according to the LOSA report and this is emphasized repetitively in the data. Communication, particularly with ATC, remains a frequent threat and is often linked with poor TEM. Findings in most cases are presented in terms of TEM and show specific operational areas such as, the pre-departure/taxi that in the words of the report: "are fertile territory for mitigating threats by training".
EBT Flight Data analysis 4.2.1	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank
Long body aircraft Studies 4.2.2	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank
LANDING DURING ILS APPROACHES 4.2.3	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank
AQP Study 4.3.1	Intentionall Blank	Intentionall Blank	Intentionall Blank	Certain manual aircraft control manoeuvre skills are demonstrably easier to acquire in Gen 4 jet aircraft, when compared to Gen 3 jets, and performance data indicates a lower level of skill decay. This advantage is minimized in recurrent training (CQ) but training challenges remain different across generations with certain phases of flight, certain issues being more problematic for different types. This clearly makes a case for the regulation of training being adapted to aircraft generation, and for the focus of assessments to be aligned with overall competency, rather than pure manoeuvre based skills.	During the type-rating course (IQ) the crews of Gen 4 jet aircraft performed considerably better than those operating Gen 3 jet aircraft in all evaluations. For recurrent training (CQ) Gen 4 jet crews maintained this advantage but to a lesser degree, and not in all phases of flight. GND and DES become equally problematic, especially with regard to flight preparation and automation issues. During line checks the Gen 4 jet advantage was less significant, except that there was a marked deterioration with certain Gen 3 jet types. This could indicate a lack of relevancy for the training courses, and consequent preparedness for line operations	Certain manual aircraft control manoeuvre skills are demonstrably easier to acquire in Gen 4 jet aircraft, when compared to Gen 3 jets, and performance data indicates a lower level of skill decay. This advantage is minimized in recurrent training (CQ) but training challenges remain different across generations with certain phases of flight, certain issues being more problematic for different types. This clearly makes a case for the regulation of training being adapted to aircraft generation, and for the focus of assessments to be aligned with overall competency, rather than pure manoeuvre based skills.
ATQP 4.3.2	ATQP training and operational data provide encouraging results showing that leadership showed remarkable improvement in training as well as better performance on the line.	Studies during ATQP highlight the need for specific training in planning and energy management to reduce mismanaged aircraft states. Go-arounds continue to be mismanaged and 50% of them result from mismanaged approaches. During the go-around, mismanaged autoflight continues to result in mismanaged aircraft states including flap over-speeds and SOP violations.	Intentionall Blank	Intentionall Blank	APP, TO and GA appear most in the ATQP data as expected in training courses. DES is noted because of planning and energy management problems. Autoflight accounts for most of the problems in the go-around because of the dynamic nature of the phase.	Data gathered from operations and training show that ATQP type training is effective in improving crew performance, reducing the rate of unstable approaches in addition to improving leadership. It also shows a need for specific training dedicated to planning and energy management, as well as autoflight training in highly dynamic and unexpected situations
Pilot Survey TBD 4.4	The pilot survey provided both encouraging and discouraging results with regard to leadership. On the one hand most pilots are willing to make appropriate decisions to promote safety. However, there is too often a casual attitude indicated by significant intentional disregard for procedural compliance.	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	The pilot survey highlighted some important topics for which training is needed. Pilots indicated the need for more training in go-arounds from various altitudes especially with all engines operating. Training also needs to be more operational in nature to deal with the shortfalls commented on by the survey respondents. In addition, the ranking of topics where effective training is needed parallels the priorities established by other data analyses in the EBT data study.
IATA Safety Report 2008 & 2009 4.5	Intentionall Blank	Mismanaged aircraft states occur for many reasons. The IATA report recommends reinforcement training in basic flying skills such as manual handling, landings and go-arounds. Flight crews are reluctant to revert to manual flight from automation, while basic manoeuvres such as landings and go-arounds continue to be a problem. The reports propose that proficiency and confidence be fostered during training.	Training should enable pilots to respond to unexpected events throughout the flight regime at various levels of difficulties	Intentionall Blank	Intentionall Blank	As evidenced by the recommendations in the IATA accident reports, the analysts and authors believe that FSTD training would be effective to mitigate unstable approaches, reinforce the decision to go-around when appropriate as well as improve the performance of the go-around manoeuvre itself.

Figure 13.1

Incidents during training 4.6	According to pilot reporting, not only do the unstable approaches rank high in reported incidents; but also the percentage of reports is twice as high during training flights.	Intentionall Blank	Comparing the subjects of the incident reports for the training flights with the main ASR database provides some insight into the evolution of pilots as they acquire more experience on the line. The training flight database is heavily populated with errors, rather than threats, but not the case for the main database. This is not only true for the rankings of the incidents, but also for the percentages of actual reports with similar rankings across the two groupings of flights.	Reported incidents show manual aircraft control is a concern, as it is 3.4% of the total incidents reported. However it is three times more likely to be reported when the flight is a training flight and it is the 2nd most reported incident for the set of training flights.	Intentionall Blank	Weather is a major threat for flight crews, and this source continues to corroborate the threat. The fact that it is ranked so low according to the training flight ASR data (4.8% versus 17,8% in all-flight database), indicates that new pilots are absorbed with other concerns, related to errors.
UK CAA Accident Reports 4.7	Intentionall Blank	The ranking of automation as a causal factor is generally low in accident reporting and the CAA accident reporting is no exception at 1.9%. The prevailing opinion by many analysts is that because mismanaged automation is further upstream in the error chain it is under reported in causal accident investigation	The CAA accident reports (CAP 776 & CAP 780) cite human factors as the major concern in accident causation. The top five HF issues with their percentage rate of occurrence in accidents are inappropriate actions or omissions (38%), flight mishandling (28%), lack of positional awareness (25%) and failure of CRM (22%).	Flight mishandling is ranked second in percentage of occurrence in accidents (28%) by the UK Accident Report CAP 780.	Intentionall Blank	Intentionall Blank
Skill Retention after Training/Skill Decay 4.8	The skill decay study shows that skill losses can be substantial and decay without practice, making the case for including energy management and recoveries from unstable approaches as part of a training curriculum.	The skill decay study shows that skill losses can be substantial and decay without practice. This deterioration is much greater for skilled tasks, such as certain automation skills making it important to assess these skills in training particularly for pilots that do on operate routinely.	Error management is cognitive in nature implying that its rate of decay is greater than for many other the tasks that pilot perform. This decay aspect makes it important that error management be assessed and reinforced as necessary.	Manual aircraft control shows greater resistance to skill decay over time than other competencies. This is supported by two skill studies, (see appendix 5). The first is a meta study published by Texas A&M and the second was provided by the FAA, which ran for almost 10 years and included over 2 million training sessions across multiple types of aircraft.	Intentionall Blank	Intentionall Blank
FAA Human Factors Team Report 1996 4.9	Intentionall Blank	The FAA automation report found that pilots have various situation awareness issues with automation. They are vulnerable to lack of flight path and energy awareness when using autoflight. In addition they are surprised by the subtleties and complexities of automation and the training courses fail to focus on operation principles of the autoflight architecture. Many pilots use the autoflight when inappropriate and fail to revert to manual flight. The training courses at the time of the study tended to be checking rather than learning oriented and had not kept pace with human factor issues in regard to automation. The report recommends that training enhance mode and position awareness when using automation, particularly with regard to terrain, energy and upset. In addition, the report recommends that there be adequate training content to insure airmanship, CRM, decision-making, workload/task management when utilizing automation especially in demanding situations.	The report recognized that monitoring and awareness skills were lacking in the automation environment at the time the report was issued. It begins by recommending education of the "hazardous states of awareness", a term it uses to denote a certain phenomenon with rest to situation awareness. Next it recommends sharing operational information to learn from crew errors, followed by proposing to improve the training of operational understanding of the automated systems in order to improve performance. Finally the report recognizes that the evaluation process simply does not address automation skill and should be modified	The FAA 1996 automation report found that pilots who utilized automation frequently and/or flew long haul flights experienced a degradation in manual aircraft control and recommended explicit instruction and practice in reverting to manual flight path control	Intentionall Blank	Intentionall Blank
Automation Training Practitioners' Guide 4.10	Intentionall Blank	The Automation Training Practitioners' Guide advocates a new training concept. Specifically it recommends training in blocks, adapting to individual trainees, integrating CRM throughout training, and major emphasis on the "need to know" items. In addition it recommends using multiple assessment techniques, confirming that pilots understand the logic, design purpose and limitations of the automation. Lastly it recommends practice in operational setting of managing automation throughout the various levels including eversion to manual flight.	The Automation Training Practitioners' Guide stresses that good CRM is particularly important with automation. It espouses monitoring of automation and notes that this skill must be taught and practiced. Finally it points that in order to deal with unexpected situations, including crew errors, pilots must be skilled in managing the transition between the various levels of automation including reversion to manual flight.	The Automation Training Practitioners' Guide explicitly states that flight crews need to be able to fly manually in automated aircraft. It continues by saying that trainees should receive instruction on when and how to revert to manual flight and practice accordingly in training.	Intentionall Blank	Intentionall Blank
TAWS 'Saves' 4.11	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank
Accident Study using CAST+ Data 4.12	Intentionall Blank	Intentionall Blank	Intentionall Blank	When looking at accident data for over twenty years from the CAST archives augmented with data from 2009 and 2010 from the NTSB, it is clear that accidents where it is highly likely that the pilots are hand flying the aircraft, such as takeoff, landing and taxing; the data show a very significant percentage increase in these types of accidents. While this does not definitively confirm that manual aircraft control skills are decreasing, the trend is consistent with that hypothesis supported by other very different kinds of sources that this is indeed the case.	Intentionall Blank	Intentionall Blank

Incidents during training 4.6	Intentionall Blank	Intentionall Blank	Intentionall Blank	Reported landing incidents account for 13% of reports in the main ASR database. This coupled with the fact that manual handling is ranked 2nd implies that there is still a considerable amount of learning skills are not fully acquired prior to IOE.	STEADES data draws little distinction between the two groupings of flights (training and all flights). Most of the training flights are for the purpose of IOE, and data indicates issues with checklists and SOPs, which are similar despite varying experience levels.	Intentionall Blank
UK CAA Accident Reports 4.7	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	Part of the team that authored CAA CAP 780 Report analysed the fatal accidents set used in the CAP 780 Report (i.e. occurring during the period between 1 January 1997 and 31 December 2008 (inclusive)) for the EBT Data Report. The analysis was made in terms of the threats and errors defined in the EBT Training Criticality Survey (TCS) and the study determined that compliance failure ranked number 2 at a 19.1% rate of occurrence	Intentionall Blank
Skill Retention after Training/Skill Decay 4.8	The FAA skill decay study tends to support the notion that system malfunction proficiency is resistant to skill decay over time. The skill retention study conclusions are consistent with this finding. Management of the majority of malfunctions involves following defined procedures and checklists, the exception being a malfunction not anticipated by procedure and checklist design, or one with unexpected consequences. It is likely that skills required to deal with a less defined problem or malfunction will be more vulnerable to decay.	Intentionall Blank	Intentionall Blank	Landings are generally practiced in the interval between training cycles and so not generally a problem for skill decay. This is indicated in the the FAA skill decay study. Skill decay is a problem for pilots without landing practice, and this may affect those involved in ultra long haul operations.	Intentionall Blank	Intentionall Blank
FAA Human Factors Team Report 1996 4.9	Intentionall Blank	The FAA Automation report found disturbing occurrences of lack of situation awareness in regards to flight path proximity to terrain. It recommends increasing the understanding of the crews with regard to this deficiency and the potential risks involved.	The report found that pilots could be surprised by subtle behaviour and overwhelmed by complexity of current systems operated in current flight environment. The evidence shows vulnerabilities to surprise because of incomplete system understanding as well as the lack of appropriate responses in terms of utilizing the appropriate responses in dealing with the situations. The report recommends dedicated LOFT type training to give pilots practice in responding to system surprises, promoting better system understanding through training and developing good decisions and proper execution regarding reversion to appropriate levels of automation when surprises occur.	Intentionall Blank	Intentionall Blank	The report found that leadership in the complex automated airline environment is especially important. The traits involved relate to understanding the process as well as making good decisions as a team, particularly in unfamiliar situations.
Automation Training Practitioners' Guide 4.10	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank
TAWS 'Saves' 4.11	Intentionall Blank	The TAWS Saves report is essentially an accident report without an accident. Five incidents that the writers of the report felt would probably have resulted in accidents are studied in an accident-investigation format. Two major points emerge from this report. Firstly, a proper EGPWS is an effective tool in reducing CFIT accidents and secondly, that no matter how good the warning system is, terrain avoidance still depends on a properly trained reaction of the flight crew.	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank
Accident Study using CAST+ Data 4.12	While system malfunctions still rank as a major cause of accidents (11%) their percentage of total accidents has decreased more than 20% when comparing the last ten-years to the previous ten year-period.	While terrain still rank as a major cause of accidents (9%) their percentage of total accidents has decreased approximately 50% when comparing the last ten-years to the previous ten year-period.	Intentionall Blank	Landing issues are a major component of all aircraft accidents and are increasing as shown by the data in the last 20 years. 41% of all accidents happen in the landing phase, the leading phase in which accidents occur. In the last two decades the statistics show a significant increase in the proportion of accidents related to various landing issues particularly with regard to runway excursions and landing short.	Intentionall Blank	Intentionall Blank

Incidents during training 4.6	The training flight database is heavily populated with incidents that are classified as mismanaged aircraft states while this is not nearly the case for the database of all flights. This fact is not only true for the rankings of the incidents, but also true for the percentages of actual reports with similar rankings across the two groupings of flights. Examples of this are unstable approaches (16.7% versus 8.3%), landing with incident, EGPWS and manual handling.	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank
UK CAA Accident Reports 4.7	Intentionall Blank	Intentionall Blank	Intentionall Blank	According to the UK Fatal Accident Report CAP 780, the APP phase of flight hosts the most accidents (35.6%) followed by the CLB phase at 19.1%. The rankings change significantly if all accidents are considered.	Intentionall Blank
Skill Retention after Training/Skill Decay 4.8	Intentionall Blank	Summary – Upset still ranks as a major cause of accidents. its percentage of total accidents has remained steady at around 13% in the last two decades.	Intentionall Blank	Intentionall Blank	The FAA skill decay study tends to support the notion that system malfunction proficiency is resistant to skill decay over time. The skill retention study conclusions are consistent with this finding. Management of the majority of malfunctions involves following defined procedures and checklists, the exception being a malfunction not anticipated by procedure and checklist design, or one with unexpected consequences. It is likely that skills required to deal with a less defined problem or malfunction will be more vulnerable to decay.
FAA Human Factors Team Report 1996 4.9	The report found weakness in prevention of mismanaged aircraft states as well as in the skills to recover from them after entry. The states cited include flight path issues involving loss of control, terrain and energy awareness. Recommendations include regular training to avoid mismanage aircraft states as well as recovery from inadvertent entries.	The FAA automation report cited detection and recovery from unusual attitudes as an area of concern. It went on to recommend increasing flight crew understanding and sensitivity in maintaining situation awareness regarding potential causes and detection of upsets from wake vortex, autopilot failures, engine failures and atmospheric disturbances as well as recommending advance manoeuvre training an integral part of training.	The FAA automation report found that pilots have various situation awareness issues with automation. Pilots need a general understanding of capabilities, limitations and modes, in addition to hazards of non-standard utilisation. They are vulnerable to lack of flight path and energy awareness when using autoflight. In addition they are surprised by the subtleties and complexities of automation and the training courses fail to focus on operational principles of the autoflight architecture. Many pilots use the autoflight when inappropriate and fail to revert to manual flight. The training courses at the time of the study tended to be checking rather than learning oriented and had not kept pace with human factor issues in regard to automation. The report recommends that training enhance mode and position awareness when using automation, particularly with regard to terrain, energy and upset. In addition, the report recommends that there be adequate training content to ensure airmanship, CRM, decision-making, workload/task management when utilizing automation even demanding situations. Care should be taken to adapt training to the background of trainees. On the other hand, manoeuvres not relevant to Gen 3 and 4 should be eliminated from checking. Whilst using automation pilots continue to have difficulties detecting deviations from desired energy states and trajectories.	Intentionall Blank	The FAA 1996 automation report strongly emphasizes the effect of training and recommends major changes specifically in order to enhance operational safety. The report firstly promotes education regarding what it calls hazardous states of awareness in automated aircraft and promotes training to identify these states and stresses countermeasures to maintain vigilance. Training should include automation management including transitioning between levels of automation, basic airmanship, CRM, decision making including unexpected events, and workload and task management. The elements learned should also be practiced in LOFT type scenarios including unanticipated events taken from actual operational situations. The report goes on to recommend that training provide and accurate operational model of the automation for pilots so as to be able to cope with its management particularly in terms of levels of appropriate usage.
Automation Training Practitioners' Guide 4.10	Intentionall Blank	Intentionall Blank	The Automation Training Practitioners' Guide advocates a new training concept for the new generations of aircraft, gen 3 and gen 4. Specifically it recommends training in blocks, adapting to individual trainees, integrating CRM throughout training, being able to fly the aircraft without automation and major emphasis on the 'need to know' items. In addition it recommends using multiple assessment techniques, confirming that pilots understand the logic, design purpose and limitations of the automation. Lastly it recommends practice in operational setting of managing automation throughout the various levels all the way to reversion to manual flight.	Intentionall Blank	The Automation Training Practitioners' Guide specifies certain training to effect improved operational safety with regard to automation. The guide begins by pointing out that automation safety depends on teaching flight crews to effectively fly manually. CRM should be integrated throughout training and monitoring of the automation does not come automatically, it must be taught. Pilots need to have hands on experience using the autoflight and should be given practice, particularly in mode transitions and reversions. Finally the pilots must understand the logic, design and the limitations of the automation in order to respond appropriately in various situations.
TAWS 'Saves' 4.11	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank	Intentionall Blank
Accident Study using CAST+ Data 4.12	Even though the accident rate has decreased in the last 20 years, the rate of accidents due to mismanaged aircraft has increased. Runway excursions and landing short exemplify this trend.	Upset still ranks as a major cause of accidents. its percentage of total accidents has remained steady at around 13% in the last two decades	Intentionall Blank	88% of all accidents occur in the APR/LDG phases of flight or in the TO/CLB with the leading phase being APR at almost 40%. The phases of flight, which show an increasing trend in terms of percentage of total accidents, are LDG and TAXI.	Intentionall Blank

Figure 13.1 (cont.)

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13.2 ANALYSIS WORKSHEET FOR TOPIC

13.2.1 Unstable Approach

Summary Analysis - Unstable Approach

Sources	Summaries
LOSA	Unstable approaches remain a consistent problem at a rate of approximately 4%. They almost always result in an uneventful landing. The crews in most cases have mismanaged the situation but are willing to continue the approach, violate SOPs and/or are unsure of the appropriate stabilized approach criteria. Landings are often performed in the wrong aircraft configuration.
FDA EBT	The FDA unstable approach rate is around 3.5%. This is consistent across aircraft types and geographical regions. There are as many flights that have landing events following stable approaches as there are following unstable approaches. Solving the unstable approach problem will not address all landing issues. The increased risk associated with unstable approaches becomes evident when examining event rates and event severity. Landings from unstable approaches have a higher event rate and as the events themselves become more severe, the event rate becomes even higher. Unstable approaches can be viewed as a barometer of the flight itself; flights with unstable approaches generally have more FDA events all in-flight phases, including phases not associated with the approach.
ATQP	Unstable approaches were closely monitored during the transition to ATQP and the rate of unstable approach remained constant, indicating that a major change in training can be performed without increasing risk as far as approaches are concerned. Approximately 50% of go-arounds during this transition resulted from unstable approaches. The causes of unstable approaches in order of importance were poor decisions in accepting ATC clearances, mismanaged visual approaches, mismanaged energy, and poor manual aircraft control.
Pilot Survey	The pilot survey shows that unstable approaches are a consistent problem, with rates similar to those from LOSA and FDA data. The fact that pilots believe that they can and in most case do make a successful landing when unstable reinforces the continuation of this problem. (82% cite belief that landing can be safely made even though approach is not stable.) Other reasons that pilots continue to land are that they admit to a psychological barrier inhibiting a go-around (37%); it is operationally inconvenient (35%); it is professionally embarrassing (24%); 17% admit that they are unfamiliar with the stable approach criteria and others simply do not want to write the mandatory report. From this information it is clear that there are issues of knowledge, skills and particularly attitudes that foster an unstable approach culture, which needs to be treated on several levels, one certainly being training.
IATA Safety	The IATA accident reports generally support the LOSA finding with regard to automation. Specifically, flight crews were found reluctant to revert to manual flying even when the situation required it. In addition, crosschecking is promoted to be the best countermeasure to mitigate automations errors and further finds that gross error checks should be made when imputing data into the FMS to trap errors easily made with this function.
Incident Study	According to pilot reporting, not only do the unstable approaches rank high in reported incidents; but also the percentage of reports is twice as high during training flights
Skill Decay	The skill decay study shows that skill losses can be substantial and decay without practice, making the case for including energy management and recoveries from unstable approaches as part of a training curriculum

Outline	Excerpts
Problem	Unstable approaches remain a consistent problem at a rate of approximately 4%. - **LOSA**
	The crews in most cases have mismanaged the situation but are willing to continue the approach, violate SOPs and/or are unsure of the appropriate stabilized approach criteria. - **LOSA**
	The FDA unstable approach rate is around 3.5%. This is consistent across aircraft types and geographical regions. - **FDA-EBT**
	The increased risk associated with unstable approaches becomes evident when examining event rates and event severity. Landings from unstable approaches have a higher event rate and as the events themselves become more severe, the event rate becomes even higher. - **FDA-EBT**
	The pilot survey shows that unstable approaches are a consistent problem, with rates similar to those from LOSA and FDA data. - **Pilot Survey**
	The IATA Accident Reports find unstable approaches to be a concern and a frequent error. - **IATA Safety Reports**
	Input from bullets
	Input from EBT Accident-Incident Study
Specifics	Landings are often performed in the wrong aircraft configuration. - LOSA
	There are as many flights that have landing events following stable approaches as there are following unstable approaches. Solving the unstable approach problem will not address all landing issues. - **FDA-EBT**
	Approximately 50% of go-arounds during this transition resulted from unstable approaches. The causes of unstable approaches in order of importance were poor decisions in accepting ATC clearances, mismanaged visual approaches, mismanaged energy, and poor manual aircraft control. - **ATQP**
	The fact that pilots believe that they can and in most case do make a successful landing when unstable reinforces the continuation of this problem. (82% cite belief that landing can be safely made even though approach is not stable.) - Pilot Survey
	Other reasons that pilots continue to land are that they admit to a psychological barrier inhibiting a go-around (37%); it is operationally inconvenient (35%); it is professionally embarrassing (24%); 17% admit that they are unfamiliar with the stable approach criteria and others simply do not want to write the mandatory report - **Pilot Survey**
	Input from bullets
	Input from EBT Accident-Incident Study
Training Effect	Unstable approaches can be viewed as a barometer of the flight itself; flights with unstable approaches generally have more FDA events all in-flight phases, including phases not associated with the approach - **FDA-EBT**
	Unstable approaches were closely monitored during the transition to ATQP and the rate of unstable approach remained constant, indicating that a major change in training can be performed without increasing risk as far as approaches are concerned - **ATQP**
	Input from bullets
	Input from EBT Accident-Incident Study
Criticality	From the pilot response it is clear that there are issues of knowledge, skills and particularly attitudes that foster an unstable approach culture, which needs to be treated on several levels, one certainly being training. - **Pilot Survey**
	The report recommends FTSD training in order to reduce the problem. - **IATA Safety Reports**
	Input from bullets
	Input from EBT Accident-Incident Study

Narrative

The unstable approach rate remain a consistent problem at a rate of approximately between 3 - 4% across generations of aircraft and geographical areas. Increased risk is associated with unstable approaches becomes evident when examining event rates and event severity. Landings from unstable approaches have a higher risk and as the events themselves become more severe, the risk escalates at an accelerated rate.
As pilots continue to make unstable approaches they continue to land from them instead of performing the mandated go-around. The pilots themselves admit to this violation, as they prefer not to go-around for many and various reasons, one very important reason is that they feel less comfortable with the go-around than the subsequent landing. The data support that go-arounds are usually not well performed.
Unstable approaches can be viewed as a barometer of the flight itself; flights with unstable approaches generally have more FDA risk events all in-flight phases, including phases not associated with the approach.
Training must clearly be implemented to mitigate this issue, not only for the approach, but the go-around as well. Associated issues of non-compliance and pilot confidence must also be addressed to effectively treat the continuing problem of the unstable approach.

13.2.2 Automation

Summary Analysis - Automation

Sources	Summaries
LOSA	The overarching problem with automation for the flight crews is monitoring and cross checking. 28% of the flights have at least one automation error with almost half of them not detected or acted upon by the crew. In addition there is a basic problem with understanding the system, mode confusion and using the automation and/or flying manually at inappropriate times.
AQP	Automation is an issue of concern regarding assessments in AQP in both the planning and execution phases of flight. The phases most concerned are CRZ and DES.
ATQP	Mismanaged auto-flight is a major factor, contributing to unstable approaches and go-around errors, both in training and line operations. This remains constant, whether in the all engines operating, or engine-out case.
Pilot Survey	The pilot survey was heavily critical of automation training during the initial type rating. Only 25% of the pilots felt prepared to utilize the automation when released to line operations. In reality 61% had multiple encounters on the line during their first 6 months of flying where they reported being involved in uncomfortable situations. Over 60% felt that the operational aspect of FMS training was missing during training requiring them to learn to use the system effectively during the first year after training. When asked how the training could be improved, the majority felt that automation surprises was the most important issue followed by hands on use in operational situations; while about a third recommended better training in transitioning between levels. The prevailing sentiment was that the operational aspect of the FMS was seriously lacking in training, the focus being on the functional, such as basic knowledge and programming
IATA Safety	The IATA accident reports generally support the LOSA finding with regard to automation. Specifically, flight crews were found reluctant to revert to manual flying even when the situation required it. In addition, crosschecking is promoted to be the best countermeasure to mitigate automations errors and further finds that gross error checks should be made when imputing data into the FMS to trap errors easily made with this function
UK CAA Accident Study	The ranking of automation as a causal factor is generally low in accident reporting and the CAA accident reporting is no exception at 1.9%. The prevailing opinion by many analysts is that because mismanaged automation is further upstream in the error chain and under reported in causal accident investigation
Skill Decay	The skill decay study shows that skill losses can be substantial and decay without practice. This deterioration is much greater for skilled tasks, such as certain automation skills making it important to assess these skills in training particularly for pilots that do on operate routinely.
FAA HF Report	The FAA automation report found that pilots have various situation awareness issues with automation. They are vulnerable to lack of flight path and energy awareness when using autoflight. In addition they are surprised by the subtleties and complexities of automation and the training courses fail to focus on operation principles of the autoflight architecture. Many pilots use the autoflight when inappropriate and fail to revert to manual flight. The training courses at the time of the study tended to be checking rather than learning oriented and had not kept pace with human factor issues in regard to automation. The report recommends that training enhance mode and position awareness when using automation, particularly with regard to terrain, energy and upset. In addition, the report recommends that there be adequate training content to insure airmanship, CRM, decision-making, workload/task management when utilizing automation especially in demanding situations
Automation Practitioners Guide	The Automation Training Practitioners' Guide advocates a new training concept. Specifically it recommends training in blocks, adapting to individual trainees, integrating CRM throughout training, and major emphasis on the "need to know" items. In addition it recommends using multiple assessment techniques, confirming that pilots understand the logic, design purpose and limitations of the automation. Lastly it recommends practice in operational setting of managing automation throughout the various levels including eversion to manual flight

Outline	Excerpts
Problem	28% of the flights have at least one automation error with almost half of them not detected or acted upon by the crew. - LOSA
	Automation is an issue of concern regarding assessments in AQP in both the planning and execution phases of flight - AQP
	Mismanaged auto-flight is a major factor, contributing to unstable approaches and go-around errors, both in training and line operations. This remains constant, whether in the all engines operating, or engine-out case. - ATQP
	In reality 61% [of survey pilots] had multiple encounters on the line during their first 6 months of flying where they reported being involved in uncomfortable situations. - Pilot Survey
	The IATA accident reports generally support the LOSA finding with regard to automation. Specifically, flight crews were found reluctant to revert to manual flying even when the situation required it. - IATA Safety
	The ranking of automation as a causal factor is generally low in accident reporting and the CAA accident reporting is no exception at 1.9%. - CAA Accident Reports
	The FAA automation report found that pilots have various situation awareness issues with automation. - FAA HF Report
	Many pilots use the autoflight when inappropriate and fail to revert to manual flight. - FAA HF Report
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Specifics	The overarching problem with automation for the flight crews is monitoring and cross checking - LOSA
	The phases most concerned are CRZ and DES. - AQP
	The prevailing opinion by many analysts is that because mismanaged automation is further upstream in the error chain, it is under reported in causal accident investigation. - CAA Accident Reports
	They [Flight crews] are vulnerable to lack of flight path and energy awareness when using autoflight. In addition they are surprised by the subtleties and complexities of automation and the training courses fail to focus on operation principles of the autoflight architecture. - FAA HF Report
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Training Effect	When asked how the training could be improved, the majority felt that automation surprises was the most important issue followed by hands on use in operational situations; while about a third recommended better training in transitioning between levels. - Pilot Survey
	In addition, crosschecking is promoted to be the best countermeasure to mitigate automations errors. - IATA Safety
	The training courses at the time of the study tended to be checking rather than learning oriented and had not kept pace with human factor issues in regard to automation. - FAA HF Report
	The Automation Training Practitioners' Guide advocates a new training concept. Specifically it recommends training in blocks, adapting to individual trainees, integrating CRM throughout training, and major emphasis on the "need to know" items. - AUTO PRACT GUIDE
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Criticality	The pilot survey was heavily critical of automation training during the initial type rating. Only 25% of the pilots felt prepared to utilize the automation when released to line operations. - Pilot Survey
	Over 60% felt that the operational aspect of FMS training was missing during training requiring them to learn to use the system effectively during the first year after training. - Pilot Survey
	The prevailing sentiment was that the operational aspect of the FMS was seriously lacking in training, the focus being on the functional, such as basic knowledge and programming - Pilot Survey
	The skill decay study shows that skill losses can be substantial and decay without practice. This deterioration is much greater for skilled tasks, such as certain automation skills making it important to assess these skills in training particularly for pilots that do on operate routinely. - Skill Decay
	The report recommends that training enhance mode and position awareness when using automation, particularly with regard to terrain, energy and upset. In addition, the report recommends that there be adequate training content to insure airmanship, CRM, decision-making, workload/task management when utilizing automation especially in demanding situations. - FAA HF Report
	In addition it recommends using multiple assessment techniques, confirming that pilots understand the logic, design purpose and limitations of the automation. Lastly it recommends practice in operational setting of managing automation throughout the various levels including eversion to manual flight. - AUTO PRACT GUIDE
	Input from Evidence Table
	Input from EBT Accident-Incident Study

Narrative
According to LOSA almost 30% of the flights have at least one automation error with almost half of them not detected or acted upon by the crew. Training reports that automation is an issue of concern regarding assessments in both the planning and execution phases of flight. Pilots themselves are heavily critical of automation training during the initial type rating with only 25% of the pilots feeling prepared to utilize the automation when released to line operations. A major accident investigation agency believes that because mismanaged automation is further upstream in the error chain, it is under reported in causal accident investigation. Another authority states that many pilots use the autoflight when inappropriate and fail to revert to manual flight when required. The skill decay study shows that skill losses can be substantial and decay without practice. This deterioration is much greater for skilled tasks, such as certain automation skills making it important to assess these skills in training particularly for pilots that do on operate routinely. All of this points to a need to change the way current training is accomplished. A total of 60% of pilots reported that operational FMS training was not provided during initial training, and that they were left to self-learn during line operations.. Recommendations to improve training include that training enhances mode and position awareness when using automation, particularly with regard to terrain, energy and upset. In addition, there should be adequate training content to ensure airmanship, CRM, decision-making and workload management when utilising automation, especially in demanding situations. Training should also include multiple assessment techniques, confirming that pilots understand the logic, design purpose and limitations of the automation. Practice and reinforcement should be accomplished in an operational setting, managing automation at all levels and including reversions to manual flight.

13.2.3 Error Management

Summary Analysis Error Management

Sources	Summaries
LOSA	A key strategy for managing flight crew errors is monitoring and crosschecking. The situation is critical as just over 25% of the errors made by the flight crews are detected and rectified. The highest risk is crosschecking errors (e.g. omitted deviations as they result 65% of UAS). The flight phase with the most threats is pre-departure, while the most mismanaged errors occur in DES, APP and LDG. Error detection is generally better in the early phases of flight with automation error capture being the best overall (53%) and procedure (16%) being the poorest. The Captain detects more errors than the First Officer (27% versus 18%) but neither rates highly at detecting their own errors (5-6%).
AQP	In all AQP evaluations, whether type rating courses (IQ) or recurrent training (CQ), policy and procedural error types are ranked 1st and 2nd, accounting for the majority of all errors. Crews operating Gen 3 jet aircraft show proportionally a greater percentage of errors relating to proficiency, situation awareness, non-compliance and decision making when compared with crews operating Gen 4 jets. This trend increases as the training cycle progresses from the type rating to recurrent line checks.
ATQP	Both operational and training data confirm that crews have problems with manoeuvres that are not routinely practiced. Procedural and manual control skills need reinforcement, as these areas are where most of the errors occur. In addition, descent planning and energy management also need specific training.
Pilot Survey	Almost all pilots believe that the most important strategy in error management is monitoring and crosschecking and that it is emphasized most of the time in training and taught explicitly about half of the time. There are however, problems in error management that are not so well addressed. Non-compliance with procedures is too high, for example, 21% of pilots admit to call out deviations on virtually every flight, cross checking is particularly bad in the CLB phase because of complacency and too many secondary duties. Intentional non-compliance on a fairly regular basis was reported by 13% of those surveyed. The issue of assertiveness was questioned and while the monitoring pilot almost invariably intervenes there is a flight path deviation (90%), but less than half of the respondents (49%) reported that they would be willing to take control from the flying pilot.
IATA Safety	Error management results from the IATA studies echo the LOSA findings. Error management is listed as being the most important countermeasure to accident prevention. In addition, training is recommended to reinforce go-around in appropriate situations. Manual aircraft handling is also cited as an area to be improved by training in addition to automation management i.e. flight path management. The other specific area noted is gross error checks when inputting FMS data as well as dealing with pilot reluctance to revert to manual flying when appropriate.
Incident Study	Comparing the subjects of the incident reports for the training flights with the main ASR database, provides some insight into the evolution of pilots as they acquire more experience on the line. The training flight database is heavily populated with errors, rather than threats, but this is not the case for the main database. This is not only true for the rankings of the incidents, but also for the percentages of actual reports with similar rankings across the two groupings of flights.
UK CAA Accident Study	The UK CAA accident reports (CAP 776 & CAP 780) cite human factors as the major concern in accident causation. The top five HF issues with their percentage rate of occurrence in accidents are inappropriate actions or omissions (38%), flight mishandling (28%), lack of positional awareness (25%) and failure of CRM (22%).
Skill Decay	Error management is cognitive in nature implying that its rate of decay is greater than for many other the tasks that pilot perform. This decay aspect makes it important that error management be assessed and reinforced as necessary.
FAA HF Report	The report recognized that monitoring and awareness skills were lacking in the automation environment at the time the report was issued. It begins by recommending education of the "hazardous states of awareness", a term it uses to denote a certain phenomenon with respect to situation awareness. It recommends sharing operational information in order to learn from crew errors, followed by proposing to improve the training of operational understanding of the automated systems in order to improve performance. Finally the report recognizes that the evaluation process simply does not address automation skill and should be modified.
Automation Practitioners Guide	The Automation Training Practitioners' Guide stresses that good CRM is particularly important with automation. It espouses monitoring of automation and notes that this skill must be taught and practiced. Finally it points that in order to deal with unexpected situations, including crew errors, pilots must be skilled in managing the transition between the various levels of automation including reversion to manual flight.

Outline	Excerpts	Narrative
Problem	The situation is critical as 75% of the errors made by the flight crews are either not detected or if detected, not rectified - **LOSA**	Effective monitoring and error detection are increasingly important when operating highly reliable, automated aircraft. Multiple data sources illustrate substantial rates of undetected error. Error management is reported as a very significant countermeasure in current operations with one accident study espousing that it is the most significant tool available to pilots for the prevention of accidents. Multiple sources of data show that there is a high level of intentional non-compliance and so any error management strategy must include greatly reducing its incidence. Error management skills are subject to decay. Error management currently does not form part of any strategy developed through the regulation of flight crew training so consequently it is lacking in most training programmes. It is a key topic and needs to be incorporated into training strategies in order to raise flight crew situation awareness and further develop and the professional capabilities of pilots.
	There are however, problems in error management that are not so well addressed. Non-compliance with procedures is too high - **Pilot Survey**	
	The issue of assertiveness was questioned and while the monitoring pilot almost always speaks up if there is a flight path deviation (90%), but less than half of the respondents (49%) reported that they would be willing to take control from the flying pilot - **Pilot Survey**	
	Error management results from the IATA studies echo the LOSA findings. - **IATA Safety**	
	The CAA accident reports (CAP 776 & CAP 780) cite human factors as the major concern in accident causation - **CAA Reports**	
	The report recognized that monitoring and awareness skills were lacking in the automation environment at the time the report was issued - **FAA HF**	
	Input from Evidence Table	
	Input from EBT Accident-Incident Study	
Specifics	The highest risk is crosschecking errors (e.g. omitted deviations as they result 65% of UAS - **LOSA**	
	The flight phase with the most threats is pre-departure, while the most mismanaged errors occur in DES, APP and LDG. - **LOSA**	
	Error detection is generally better in the early phases of flight with automation error captured being the best overall (53%) and procedure (16%) being the poorest. The Captain detects more errors than the First Officer (27% versus 18%) but neither rates highly at detecting their own errors (5-6%) - **LOSA**	
	Procedural and manual control skills need reinforcement, as these areas are where most of the errors occur. - **ATQP**	
	21% of pilots admit to call out deviations on virtually every flight, cross checking is particularly bad in the CLB phase because of complacency and too many secondary duties. Intentional non-compliance on a fairly regular basis was reported by 13% of those surveyed. -**Pilot Survey**	
	Other specific areas noted are gross error checks when inputting FMS data as well as dealing with pilot reluctance to revert to manual flying when appropriate - **IATA Safety**	
	The top five HF issues with their percentage rate of occurrence in accidents are inappropriate actions or omissions (38%), flight mishandling (28%), lack of positional awareness (25%) and failure of CRM (22%). - **CAA Reports**	
	Input from Evidence Table	
	Input from EBT Accident-Incident Study	
Training Effect	In all AQP evaluations, whether type rating courses (IQ) or recurrent training (CQ), policy and procedural error types are ranked 1st and 2nd, accounting for the majority of all errors - **AQP**	
	Both operational and training data confirm that crews have problems with manoeuvres that are not routinely practiced - **ATQP**	
	Almost all pilots believe that the most important strategy in error management is monitoring and crosschecking and that it is emphasized most of the time in training and taught explicitly about half of the time - **Pilot Survey**	
	Manual aircraft handling is also cited as an area to be improved by training in addition to automation management i.e. flight path management - I**ATA Safety**	
	Input from Evidence Table	
	Input from EBT Accident-Incident Study	
Criticality	Crews operating Gen 3 jet aircraft show proportionally a greater percentage of errors relating to proficiency, situation awareness, non-compliance and decision making when compared with crews operating Gen 4 jets. This trend increases as the training cycle progresses from the type rating to recurrent line checks. - **AQP**	
	In addition, descent planning and energy management also need specific training - **ATQP**	
	Error management is listed as being the most important countermeasure to accident prevention. In addition, training is recommended to reinforce go-around in appropriate situations. - **IATA Safety**	
	Error management is cognitive in nature implying that its rate of decay is greater than for many other the tasks that pilot perform. This decay aspect makes it important that error management be assessed and reinforced as necessary - **Skill Decay**	
	It [FAA HF report] begins by recommending education of the "hazardous states of awareness", a term it uses to denote a certain phenomenon with rest to situation awareness. - **FAA HF**	
	Next it recommends sharing operational information to learn from crew errors, followed by proposing to improve the training of operational understanding of the automated systems in order to improve performance - **FAA HF**	
	The Automation Training Practitioners' Guide stresses that good CRM is particularly important with automation. It espouses monitoring of automation and notes that this skill must be taught and practiced. - **Auto Pract Guide**	
	Finally it points that in order to deal with unexpected situations, including crew errors, pilots must be skilled in managing the transition between the various levels of automation including reversion to manual flight - **Auto Pract Guide**	
	Input from Evidence Table	
	Input from EBT Accident-Incident Study	

13.2.4 Manual Aircraft Control

Summary Analysis - Manual Aircraft Control

Sources	Summaries
LOSA	According to LOSA, manual control errors, while not the most frequent type of error (41% occurrence by flight), are only exceeded by automation errors. Many manual control errors result from the improper technique, flight crews ignoring or "flying through" the indicated flight guidance. Manual control problems are exacerbated in adverse weather. The leading error type is unintentional vertical deviation (32%) followed closely by deviations in landing, lateral, speed and improper thrust.mproper technique, flight crews ignoring or "flying through" the indicated flight guidance. Manual control problems are exacerbated in adverse weather. The leading error type is unintentional vertical deviation (32%) followed closely by deviations in landing, lateral, speed and improper thrust.
FDA Long Body	Long body aircraft are more prone to high "G" landings. Because of geometric considerations, perspectives from the cockpit are slightly different laterally and vertically and tend to produce steeper approach gradients just prior to flare as well as centreline displacement in crosswinds. To compensate for this crews should be attentive to landings in crosswind, avoid last minute pitch-down and a tendency to under-flare. There is a tendency to under-rotate in long body aircraft, which degrades take-off performance; pilots should make smooth accurate rotations avoiding "pilot induced oscillations.
AQP	In all AQP evaluations, whether type rating courses (IQ) or recurrent training (CQ), policy and procedural error types are ranked 1st and 2nd, accounting for the majority of all errors. Crews operating Gen 3 jet aircraft show proportionally a greater percentage of errors relating to proficiency, situation awareness, non-compliance and decision making when compared with crews operating Gen 4 jets. This trend increases as the training cycle progresses from the type rating to recurrent line checks.
ATQP	The evidence gathered during ATQP shows that manual aircraft control is a problem on modern aircraft and more practice in training is needed
Pilot Survey	The pilots were allowed to make whatever comments on any training subject and these comments were subsequently analysed and added to the results from the formal survey questions. There were a significant number of comments on training needs and these needs were prioritized according to the analysis of the comments. Two categories referred to manual aircraft control, manual handling and manoeuvres. Together they indicated that pilots feel quite strongly that manual aircraft control is a high priority item in training.
IATA Safety	The IATA report recommends reinforcing manual aircraft control skills through training and notes that crews are reluctant to revert to manual flying from automation. Poor manual aircraft control ranks as the number 1 error in their accident reports. The report cites problems during landing in addition to go-arounds.
Incident Study	Reported incidents show manual aircraft control is a concern, as it is 3.4% of the total incidents reported. However it is three times more likely to be reported when the flight is a training flight and it is the 2nd most reported incident for the set of training flights.
UK CAA Accident Study	Flight mishandling is ranked second in percentage of occurrences in accidents (28%) by the UK Accident Report CAP 780.
Skill Decay	Flight mishandling is ranked second in percentage of occurrences in accidents (28%) by the UK Accident Report CAP 780.
FAA HF Report	The FAA 1996 automation report found that pilots who utilized automation frequently and/or flew long haul flights experienced a degradation in manual aircraft control and recommended explicit instruction and practice in reverting to manual flight path control
Automation Practitioners Guide	The Automation Training Practitioners' Guide explicitly states that flight crews need to be able to fly manually in automated aircraft. It continues by saying that trainees should receive instruction on when and how to revert to manual flight and practice accordingly in training.
CAST	When looking at accident data for over twenty years from the CAST archives augmented with data from 2009 and 2010 from the NTSB, it is clear that accidents where it is highly likely that the pilots are hand flying the aircraft, such as takeoff, landing and taxing; the data show a very significant percentage increase in these types of accidents. While this does not definitively confirm that manual aircraft control skills are decreasing, the trend is consistent with that hypothesis supported by other very different kinds of sources that this is indeed the case.

Outline	Excerpts
Problem	According to LOSA, manual control errors, while not the most frequent type of error (41% occurrence by flight). - LOSA
	Poor manual aircraft control ranks as the number 1 error in their accident reports. The report cites problems during landing in addition to go-arounds. – IATA
	it is the 2nd most reported incident for the set of training flights. – STEADES
	Flight mishandling is ranked second in percentage of occurrences in accidents (28%) by the UK Accident Report CAP 780. – CAA
	it is clear that accidents where it is highly likely that the pilots are hand flying the aircraft, such as takeoff, landing and taxing; the data show a very significant percentage increase in these types of accidents. – CAST
	Input from Evidence Table
	Manual Aircraft Control is the most important competency issue in all accidents. In addition it ranks very highly as one of the 40 factors in the analysis. The effect is even more exaggerated in accidents with high training effect emphasising the importance of training.
	The trend for manual aircraft control issues in fatal accidents is very concerning in recent years in all generations of aircraft but the biggest problems occur in older aircraft where the occurrence rate is around 50%.
	Input from EBT Accident-Incident Study
Specifics	flight crews ignoring or "flying through" the indicated flight guidance. - LOSA
	Manual control problems are exacerbated in adverse weather. - LOSA
	The leading error type is unintentional vertical deviation (32%) followed closely by deviations in landing, lateral, speed and improper thrust. - LOSA
	Long body aircraft are more prone to high "G" landings -FDA
	To compensate for this crews should be attentive to landings in crosswind, avoid last minute pitch-down and a tendency to under-flare. - FDA
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Training Effect	Training results in AQP show quicker mastery of manual handling skills in initial training, particularly the case in gen 4 aircraft and while Gen 3 improves with experience it remains below Gen 4. AQP
	This advantage is minimized in recurrent training – AQP
	The guide begins by pointing out that automation safety depends on teaching flight crews to effectively fly manually - **Automation Training Practitioners' Guide**
	Input from Evidence Table
	The number 1 ranking of Manual aircraft control is even more exaggerated in accidents with high training effect emphasising the importance of training
	Input from EBT Accident-Incident Study
Criticality	Two categories referred to manual aircraft control, manual handling and manoeuvres. Together they indicated that pilots feel quite strongly that manual aircraft control is a high priority item in training. Pilot Survey
	Manual aircraft control shows greater resistance to skill decay over time than other competencies – Skill Decay and Retention studies
	The FAA 1996 automation report found that pilots who utilized automation frequently and/or flew long haul flights experienced a degradation in manual aircraft control and recommended explicit instruction and practice in reverting to manual flight path control – FAA Automation Study
	The Automation Training Practitioners' Guide explicitly states that flight crews need to be able to fly manually in automated aircraft. - Automation Training Practitioners' Guide
	It continues by saying that trainees should receive instruction on when and how to revert to manual flight and practice accordingly in training. -. Automation Training Practitioners' Guide
	Input from Evidence Table
	Input from EBT Accident-Incident Study

Narrative
Manual aircraft control is one of the most important topics in operations and training. It ranks very highly as a competency issue in accident reports. Various sources of flight operations data show substantial competency issues associated with manual control. The phases of flight that routinely involve manual aircraft control such as take-off, landing and taxing show a very significant percentage increase in accidents over the last decade. Unintentional deviations and failure to follow flight guidance, plus speed and thrust errors, exacerbated by adverse weather, are some of the issues being observed. Landings with high vertical acceleration, difficulties in crosswinds, long touchdowns and substantial handling errors during go-arounds are amongst the problems revealed by flight data. While training data indicate rapid mastery of manual control especially in Gen 4 jets, this effect may be undermined in complex and unexpected situations. Results show that safety while using automation depends on flight crews having the confidence to fly manually. Data across the EBT study highlight the importance of training to mitigate an obvious deterioration in manual aircraft control skills. Pilots are well aware of the need for manual aircraft control training and clearly expressed this need when responding to the Airline Pilot Perceptions of Training Effectiveness Survey. Training data effectively shows that the trend can be reversed providing the skill is mastered. Skill retention data in two independent reports show that manual aircraft control skills are resistant to decay as long as they are practised. Good manual control skills include transitioning in and out of automation, with attendant and realistic distractions and threats from the environment, aircraft systems and ATC. Simply to continue practicing only traditional and rote manoeuvres is insufficient for crew confidence and proficiency required for modern aircraft in today's environment.

13,2,5 Go-Around

Summary Analysis Go-Around

Sources	Summaries
LOSA	According to LOSA, go-around from unstable approaches occur only 3% of the time (contrary to SOP's). Landings from unstable approaches rank in the top 5 UAS during the LDG phase and are the number 3 non-compliance item in the LOSA database). When a go-around from an unstable approach is performed it is usually a surprise to the crew and poorly executed.
FDA EBT	Only 1.4% of unstable approaches lead to a go-around, with an FDA all event rate of 1.6 occurrences in the immediate phases after go-around (GA, CLB). The high-risk event rate for the same period is 0.24. Both these rates are conservative because the flight recorder cannot capture many of the crew errors that could occur. Go-around initiation heights overwhelmingly occur at heights different from those briefed.
ATQP	Mismanagement of auto-flight systems, resulting in unstable approaches, are the biggest cause for go-arounds in operations. A significant percentage of go-arounds result in flap over-speeds and violations of SOP. Engine out go-arounds form part of the regulated training programme, but still result in a significant percentage of unacceptable performance grades. Surprise go-arounds do not form part of the training programme, and are not well executed by crews in line operations. Consequently, the all –engines go-around is a target for improvement in ATQP.
Pilot Survey	The survey shows as pilots readily admit that they are not going around per the airline SOP. The reason most often cited is a feeling that the landing can be successful despite the unstable condition. In the majority of the cases the prospect of a go-around is not discussed during an unstable approach. Pilots report a psychological barrier to performing a go-around.
IATA Safety	The results from IATA accident statistics support the LOSA findings in terms of the high degree of failure to go-around when the approach is unstable. This crew error is ranked high in IATA accident analysis and the report recommends training in go-arounds with regard to decision-making and execution of any type of go-around, at any point during the approach.

Outline	Excerpts
Problem	According to LOSA, go-around from unstable approaches occur only 3% of the time (contrary to SOP's). - **LOSA**
	When a go-around from an unstable approach is performed it is usually a surprise to the crew and poorly executed - **LOSA**
	Only 1.4% of unstable approaches lead to a go-around - **FDA/EBT**
	A significant percentage of go-arounds result in flap over-speeds and violations of SOP. - **ATQP**
	The survey shows as pilots readily admit that they are not going around per the airline SOP. - **Pilot Survey**
	The results from IATA accident statistics support the LOSA findings in terms of the high degree of failure to go-around when the approach is unstable. - I**ATA Safety**
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Specifics	Landings from unstable approaches rank in the top 5 UAS during the LDG phase and are the number 3 non-compliance item in the LOSA database). - **LOSA**
	[Unstable approaches leading] to a go-around have an FDA all event rate of 1.6 occurrences in the immediate phases after go-around (GA, CLB). - **FDA/EBT**
	The high-risk event rate for the same period is 0.24 [24% for go-arounds from unstable approaches]. Both these rates are conservative because the flight recorder cannot capture many of the crew errors that could occur. - **FDA/EBT**
	Go-around initiation heights overwhelmingly occur at heights different from those briefed - **FDA/EBT**
	Mismanagement of auto-flight systems, resulting in unstable approaches, are the biggest cause for go-arounds in operations. - **ATQP**
	The reason most often cited is a feeling that the landing can be successful despite the unstable condition. In the majority of the cases the prospect of a go-around is not discussed during an unstable approach. Pilots report a psychological barrier to performing a go-around. - **Pilot Survey**
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Training Effect	This crew error is ranked high in IATA accident analysis and the report recommends training in go-arounds with regard to decision-making and execution of any type of go-around, at any point during the approach. - **IATA Safety**
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Criticality	Engine out go-arounds form part of the regulated training programme, but still result in a significant percentage of unacceptable performance grades. - **ATQP**
	Surprise go-arounds do not form part of the training programme, and are not well executed by crews in line operations. Consequently, the all –engines go-around is a target for improvement in ATQP. - **ATQP**
	Input from Evidence Table
	Input from EBT Accident-Incident Study

Narrative
Despite efforts to eradicate unstable approaches and to mandate go-arounds should an unstable approach occur, the occurrence rate of unstable approaches remains significant as well as the fact that flight crews simply do not go around as mandated. A major concern of unstable approaches is the disregard of the SOP's, in addition to the efficacy of threat and error management during the entire flight. According to the LOSA report, there is a "90% (SOP) violation factor" in terms of not executing a go-around from an unstable approach. Unstable approaches are often a barometer for the flight itself. If an approach is poorly executed, there are strong indications from the data that the rate of errors and risk events will be higher across the entire flight, according to FDA and LOSA. Data from multiple operational and training sources indicate that crews almost universality have problems with the go-around. This is because it is not usually expected, and may have to be executed under demanding conditions, from altitudes and energy states other than those practiced in training. When unravelling the unstable approach paradox, one issue remained clear throughout; flight crews must acquire the necessary capability to execute a go-around from any situation, utilising automation and/or manual control skills as appropriate. The multi-source data are quite compelling on the current state of the go-around in operations and training today. Yet variable Go Around management with all engines operating does not form part of any strategy developed through the regulation of flight crew training. It is a key topic and needs a training strategy to raise awareness develop the necessary capabilities of pilots.

13.2.6 Weather

Summary Analysis Weather (WX)

Sources	Summaries
LOSA	Weather is the number 1 threat in the LOSA database and significant in all flight phases. 8% of all flights encounter thunderstorms with over 6% of these encounters resulting in UAS. Less than 3% of unstable approaches are due to weather. Turbulence exacerbates other common errors, specifically manual aircraft control. Weather avoidance errors are associated with SOP non-compliance (25%), poor planning and radar misuse. The number 1 error associated with ice and snow is failure to select the anti-ice system on.
FDA Long Body	In low visibility and/or crosswind conditions common errors such as "duck under" and misalignment with the runway centreline are more critical in long body aircraft - **FDA**
Pilot Survey	The survey showed that in the opinion of the pilots, WX is the most important training need. This result came from the analysis of voluntary comments made by the pilots. - **Pilot Survey**
IATA Safety	The top threat in the IATA accident reports is weather - **IATA**
Incident Study	Weather is a major threat for flight crews, and this source continues to corroborate the threat. The fact that it is ranked so low according to the training flight ASR data (4.8% versus 17,8% in all-flight database), indicates that new pilots are absorbed with other concerns, related to errors. - **Incident Study**

Outline	Excerpts
Problem	Weather is the number 1 threat in the LOSA database and significant in all flight phases - **LOSA**
	The top threat in the IATA accident reports is weather. - **IATA**
	Weather is a major threat for flight crews, and this source continues to corroborate the threat. - **Incident Study**
	Weather is the number 1 threat or in top three in all phases of flight. - **LOSA**
	Weather threats are reported at 17.8% in the all-flight database - **Incident Study**
	Input from Evidence Table
	Averse weather is the number 1 factor in all accidents in recent years for all generations with the exception of Gen 2 jets where it is 2nd. It has decreased along with the accident rate but not nearly to the same extent.
	Input from EBT Accident-Incident Study
Specifics	8% of all flights encounter thunderstorms with over 6% of these encounters resulting in UAS. - **LOSA**
	Turbulence exacerbates other common errors, specifically manual aircraft control. - **LOSA**
	Weather avoidance errors are associated with SOP non-compliance (25%), poor planning and radar misuse. - **LOSA**
	In low visibility and/or crosswind conditions common errors such as "duck under" and misalignment with the runway centreline are more critical in long body aircraft. **FDA/LB**
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Training Effect	**Input from Evidence Table**
	Input from EBT Accident-Incident Study
Criticality	The survey showed that in the opinion of the pilots, WX is the most important training need. - **Pilot Survey**
	Input from Evidence Table
	Input from EBT Accident-Incident Study

Narrative
Despite improvements in aircraft design and automation systems, it is clear from multi-source data that adverse weather is still a very substantial threat to the safety of commercial air transport operations. Accident and serious incident data indicate a strong presence of adverse weather as a factor, and this is corroborated by operations data. The trend is particularly concerning in Gen 2 aircraft where the percentage of fatal accidents in which weather has been a factor has doubled in the last 15 years. Adverse weather increases workload, distracts the crew from normal tasks, including monitoring, and increases the risk of mismanagement of crew error. The data indicate that operations in adverse weather should be effectively trainable, and that the creation of training scenarios should include dynamic and variable weather conditions, forcing crews to consider and manage, avoid and react as conditions require. This EBT study is rich with data about adverse weather from many sources offering the opportunity to create realistic training to mitigate the seemingly ever-present threats to flight crews from adverse weather.

13.2.7 System Malfunction

Summary Analysis System Malfunction

Sources	Summaries
LOSA	There is a high degree of intentional non-compliance associated with procedures during the management of unexpected system malfunctions. In addition, unexpected system malfunction is in the top 5 threats as well as in the top 5 mismanaged threats in LOSA database. System malfunction ranks 3rd as a contributory factor in UAS.
ATQP	Procedures and handling associated with manoeuvres after engine failure result in the highest rates of unacceptable performance in training. Despite the emphasis in training on engine failure, its effects continue to be problematic to crews in terms of procedures and manual aircraft control.
Pilot Survey	The survey showed that in the opinion of the pilots, Sys Mal is an important training need in terms of the non-normal checklists (ranked 3rd). This result came from the analysis of voluntary comments made by the pilots.
Skill Decay	The FAA skill decay study tends to support the notion that system malfunction proficiency is resistant to skill decay over time. The skill retention study conclusions are consistent with this finding. Management of the majority of malfunctions involves following defined procedures and checklists, the exception being a malfunction not anticipated by procedure and checklist design, or one with unexpected consequences. It is likely that skills required to deal with a less defined problem or malfunction will be more vulnerable to decay.
CAST	While system malfunctions still rank as a major cause of accidents (11%) their percentage of total accidents has decreased more than 20% when comparing the last ten-years to the previous ten year-period.

Outline	Excerpts
Problem	unexpected system malfunction is in the top 5 threats as well as in the top 5 mismanaged threats in LOSA database. System malfunction ranks 3rd as a contributory factor in UAS - **LOSA**
	Procedures and handling associated with manoeuvres after engine failure result in the highest rates of unacceptable performance in training. - **ATQP**
	Sys Mal is an important training need in terms of the non-normal checklists (ranked 3rd). Result is from the analysis of voluntary comments made by the pilots. **Sys Mal**
	system malfunctions still rank as a major cause of accidents (11%) their percentage of total accidents. - **CAST**
	Input from Evidence Table
	System Malfunction is much less of a factor in newer generation aircraft as compared to older generation aircraft by about 3 to 1. However the trend for all aircraft is rising and aircraft malufunctions remain important in air crew training.
	Input from EBT Accident-Incident Study
Specifics	There is a high degree of intentional non-compliance associated with procedures during the management of unexpected system malfunctions. - **LOSA**
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Training Effect	Despite the emphasis in training on engine failure, its effects continue to be problematic to crews in terms of procedures and manual aircraft control. - **ATQP**
	The FAA skill decay study tends to support the notion that system malfunction proficiency is resistant to skill decay over time. The skill retention study conclusions are consistent with this finding - **Skill Decay**
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Criticality	It is likely that skills required to deal with a less defined problem or malfunction will be more vulnerable to decay. - **Skill Decay**
	[The percentage of total accidents [attributed to system malfunctions] has decreased approximately 20% when comparing the last ten-years to the previous ten year-period. - **CAST**
	Input from Evidence Table
	Input from EBT Accident-Incident Study

Narrative

According to EBT accident-incident data, systems malfunction has reduced as a factor in accidents and major incidents as design and reliability of modern aircrafts have evolved. However, this is not the case for generation 2 aircraft and system malfunctions are a significant contributor to undesired aircraft states, which are a pre-cursor to incidents and accidents. The management of an unexpected malfunction induces crew error, and according to operations data, remains a threat partly due to the distraction from normal duties, intentional noncompliance with procedures and the vulnerability of closed loop tasks.
Improvements in engine reliability are well documented and understood, and the rate of engine failures has reduced substantially. However, training data indicate that handling the aircraft in unexpected engine-out situations still presents difficulty to crews, and there remains a clear need to continue to practice the psychomotor skills based capability to fly the aircraft with an engine inoperative as part of an EBT programme.

13.2.8 Terrain

Summary Analysis - Terrain

Sources	Summaries
LOSA	LOSA indicates that proper altimeter use should be emphasized during training and that terrain is one of the most important mismanaged threats in LOSA database. In addition, Airlines that operate in high terrain environment tend to be complaisant to terrain threat.
FAA HF Report	The FAA Automation report found disturbing occurrences of lack of situation awareness in regards to flight path proximity to terrain. It recommends increasing the understanding of the crews with regard to this deficiency and the potential risks involved.
TAWS	The TAWS Saves report is essentially an accident report without an accident. Five incidents that the writers of the report felt would probably have resulted in accidents are studied in an accident-investigation format. Two major points emerge from this report. Firstly, a proper EGPWS is an effective tool in reducing CFIT accidents and secondly, that no matter how good the warning system is, terrain avoidance still depends on a properly trained reaction of the flight crew.
CAST	While terrain still rank as a major cause of accidents (9%) their percentage of total accidents has decreased approximately 50% when comparing the last ten-years to the previous ten year-period.

Outline	Excerpts
Problem	LOSA indicates ...that terrain is one of the most important mismanaged threats in LOSA database. - **LOSA**
	While terrain still rank as a major cause of accidents (9%) their percentage of total accidents has decreased approximately 50% when comparing the last ten-years to the previous ten year-period. - **CAST**
	Input from Evidence Table
	Terrain as a factor generally ranks lower in recent years and that effect is much more pronounced in newer aircraft.
	Input from EBT Accident-Incident Study
Specifics	Airlines that operate in high terrain environment tend to be complaisant to terrain threat. - **LOSA**
	The FAA Automation report found disturbing occurrences of lack of situation awareness in regards to flight path proximity to terrain - **FAA HF**
	Pilot vulnerabilities are flight path, terrain and energy awareness. - **FAA HF**
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Training Effect	**Input from Evidence Table**
	Input from EBT Accident-Incident Study
Criticality	It recommends increasing the understanding of the crews with regard to this deficiency and the potential risks involved . - FAA HF
	Firstly, a proper EGPWS is an effective tool in reducing CFIT accidents and secondly, that no matter how good the warning system is, terrain avoidance still depends on a properly trained reaction of the flight crew. - TAWS
	Input from Evidence Table
	Input from EBT Accident-Incident Study

Narrative
There has a been a significant reduction in accidents and incidents with terrain as a factor since the inception of recent TAWS regulation. However, the data from several sources indicate a decline in flight crew situation awareness with regard to and terrain and terrain remains one of the most important mismanaged threats in the cockpit. Whilst advancing technology has provided a very effective alerting system, attention needs to be placed on the need to ensure crews are vigilant and maintain at a high level of SA and not become complaisant with regards to terrain.

13.2.9 Surprise

Summary Analysis - Surprise

Sources	Summaries
LOSA	GA is generally a surprise to crew and not well performed. An unexpected malfunction is number 4 threat as well as number 4 mismanaged threat in LOSA database.
ATQP	Surprises need to be incorporated in training particularly with respect to automation and engine failure situations both from a proactive and reactive perspective
Pilot Survey	A high percentage of pilots found themselves in a 'surprise' situation after initial training. These uncomfortable situations continued in despite experience on type. Automation surprises are particularly problematic as the majority of respondents report this issue as the number 1 topic for automation training improvement. It is clear from what the pilots are saying that current training does not deal adequately with unexpected operational situations.
IATA Safety	Maintaining situation awareness by specific briefings as well as monitoring and cross checking are effective countermeasures for dealing with all operational situations, including surprises. The IATA accident reports recommend training to deal with unusual "edge of the envelope" situations as well as specific training to cope with surprise go-arounds.
FAA HF Report	The report found that pilots could be surprised by subtle behaviour and overwhelmed by complexity of current systems operated in current flight environment. The evidence shows vulnerabilities to surprise because of incomplete system understanding as well as the lack of appropriate responses in terms of utilizing the appropriate responses in dealing with the situations. The report recommends dedicated LOFT type training to give pilots practice in responding to system surprises, promoting better system understanding through training and developing good decisions and proper execution regarding reversion to appropriate levels of automation when surprises occur.

Outline	Excerpts
Problem	A high percentage of pilots found themselves in a 'surprise' situation after initial training. These uncomfortable situations continued in despite experience on type. - **Pilot Survey**
	It is clear from what the pilots are saying that current training does not deal adequately with unexpected operational situations. - **Pilot Survey**
	The report found that pilots could be surprised by subtle behaviour and overwhelmed by complexity of current systems operated in current flight environment. - **FAA HF**
	Input from Evidence Table
	The trend for situational awareness as a competency issue is improving slightly or remaining stabe for older aircraft but becoming worse for newer aircraft. It is ranked 2nd in occurrence after manual aircraft control for all accidents and serious incidents.
	Input from EBT Accident-Incident Study
Specifics	GA is generally a surprise to crew and not well performed. An unexpected malfunction is number 4 threat as well as number 4 mismanaged threat in LOSA database. - **LOSA**
	Automation surprises are particularly problematic as the majority of respondents report this issue as the number 1 topic for automation training improvement - **Pilot Survey**
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Training Effect	Maintaining situation awareness by specific briefings as well as monitoring and cross checking are effective countermeasures for dealing with all operational situations, including surprises. - **IATA Safety**
	The IATA accident reports recommend training to deal with unusual "edge of the envelope" situations as well as specific training to cope with surprise go-arounds. - **IATA Safety**
	The evidence shows vulnerabilities to surprise because of incomplete system understanding as well as the lack of appropriate responses in terms of utilizing the appropriate responses in dealing with the situations. - **FAA HF**
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Criticality	Surprises need to be incorporated in training particularly with respect to automation and engine failure situations both from a proactive and reactive perspective - **ATQP**
	The report recommends dedicated LOFT type training to give pilots practice in responding to system surprises, promoting better system understanding through training and developing good decisions and proper execution regarding reversion to appropriate levels of automation when surprises occur. **FAA HF**
	Input from Evidence Table
	Input from EBT Accident-Incident Study

Narrative
As design and reliability improve, the likelihood of crews facing specific malfunctions and events reduces. Isolated and unexpected events become more problematic as reliability is improved but attending to the overall system becomes more complex. A lack of effective procedural and conceptual knowledge of automation often leads to surprises in operations. Data indicate that cognitive tasks have potential for skills decay and flight path control in dynamic situations is often more demanding especially where there are attendant distractions from the environment, system or ATC. Pilots reported that they often face operational surprises for which they have not been trained. In modern generation aircraft, the accident and serious incident data show an increase in poor situation awareness when things go wrong. Despite all the data, current training is driven by highly prescriptive regulatory requirements based on evidence from early jets and training programmes contain many elements, most of which are highly predictable. Data from operations and training indicate crews face substantial problems when dealing with unexpected events for example executing an unanticipated all engine operative go-around, simply because they are unexpected and often performed in conditions not experienced in training.

13.2.10 Landing Issues

Summary Analysis - Landing Issues

Sources	Summaries
LOSA	1% of all landings in LOSA database result in an abnormal landing. The number 3 non-compliance item in the database is landing from an unstable approach. Aircraft handling errors on landing are not well detected as they rank 2nd in least detected error during landing phase. The early commencement of after landing and taxi-in during the landing rollout is prevalent and ranked 5 overall in non-compliance.
FDA Long body	Landing events are statistically more likely with long body aircraft, especially with respect to heavy landings. Pilots need to be especially cognizant of not 'ducking under' the glideslope. In addition, pilots need to understand the and differences in ground speed and momentum as well as perceptual differences both laterally and vertically resulting from the extended length between the main gear and cockpit.
Landing Study	FDA statistical analysis on a large sample of Gen 3 and 4 jet aircraft indicated that automation (autoland and autothrottle/autothrust) provide greater touchdown accuracy, with Gen 4 jet aircraft being more accurate than Gen 3 jet aircraft. The two parameters most affecting airborne distance are threshold crossing height and airspeed over-speed at threshold, in that order.
IATA Safety	According to the IATA accident reports, the number 1 UAS is improper landing. Training should reinforce GA from abnormal landings.
Incident Study	Reported landing incidents account for 13% of reports in the main ASR database. This coupled with the fact that manual handling is ranked 2nd implies that there is still a considerable amount of learning skills are not fully acquired prior to IOE.
Skill Decay	Landings are generally practiced in the interval between training cycles and so not generally a problem for skill decay. This is indicated in the the FAA skill decay study. Skill decay is a problem for pilots without landing practice, and this may affect those involved in ultra long haul operations.
CAST	Landing issues are a major component of all aircraft accidents and are increasing as shown by the data in the last 20 years. 41% of all accidents happen in the landing phase, the leading phase in which accidents occur. In the last two decades the statistics show a significant increase in the proportion of accidents related to various landing issues particularly with regard to runway excursions and landing short.

Outline	Excerpts
Problem	1% of all landings in LOSA database result in an abnormal landing.- **LOSA**
	According to the IATA accident reports, the number 1 UAS is improper landing. - **IATA Safety**
	Landing issues are a major component of all aircraft accidents and are increasing as shown by the data in the last 20 years. - **CAST**
	Reported landing incidents account for 13% of reports in the main ASR database. - **Incidents**
	In the last two decades the statistics show a significant increase in the proportion of accidents related to various landing issues particularly with regard to runway excursions and landing short. - **CAST**
	The phase with the highest percentage of accidents is the landing phase at 41% - **CAST**
	In the last decade landing short (undershoots) were 6%, more than double the previous decade - **CAST**
	The top UAS in the IATA accident reports is improper landings at 21%. - **IATA Safety**
	Input from Evidence Table
	The landing phase is ranked number 1 or 2 in terms of accidents for all aircraft generations. The newer generation aircraft seem to have less problems than the earlier aircraft with the exception of gen 2 props where mechanical issues greatly affect the results.
	Input from EBT Accident-Incident Study
Specifics	Landing events are statistically more likely with long body aircraft, especially with respect to heavy landings - **FDA LB**
	41% of all accidents happen in the landing phase, by far the leading phase in which accidents occur. - **CAST**
	there are landing problems with stable approaches as well as unstable approaches. - **EBT FDA**
	Speed control is major error. - **LOSA**
	Low error detection rates relating to specific aircraft handling issues. - **LOSA**
	Input from Evidence Table
	Interestingly, the factors in landing have the greatest clustering factor.
	Input from EBT Accident-Incident Study
Training Effect	FDA statistical analysis on a large sample of Gen 3 and 4 jet aircraft indicated that automation (autoland and autothrottle/autothrust) provide greater touchdown accuracy, with Gen 4 jet aircraft being more accurate than Gen 3 jet aircraft. -**Landing Study**
	The two parameters most affecting airborne distance are threshold crossing height and airspeed over-speed at threshold, in that order. - **Landing Study**
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Criticality	Pilots need to be especially cognizant of not 'ducking under' the glideslope. - **FDA LB**
	In addition, pilots need to understand the and differences in ground speed and momentum as well as perceptual differences both laterally and vertically resulting from the extended length between the main gear and cockpit. - **FDA LB**
	Training should reinforce GA from abnormal landings. - **IATA Safety**
	This [13% report rate] coupled with the fact that manual handling is ranked 2nd implies that there is still a considerable amount of learning skills are not fully acquired prior to IOE. - **Incidence Study**
	Skill decay is a problem for pilots without landing practice, and this may affect those involved in ultra long haul operations. - **Skill Decay**
	Input from Evidence Table
	Input from EBT Accident-Incident Study

Narrative
According to multiple accident studies the landing phase ranks first or second as the phase with the highest percentage of accidents and this trend is increasing. One study shows that accidents involving a landing short of the runway have doubled in the last decade. Landing problems are complex, as the accident-Incident data ranks landings accidents number 1 in the clustering of factors. According to operational data the third most frequent non-compliance item is landing from an unstable approach; the same study also indicated that handling errors on landing are not well detected. Training data indicates that landing skills take time to develop, while other studies show deterioration in the skills necessary in landing without practice, as well as the need for emphasis on training to better understand environmental and aerodynamic effects associated with landing. Most importantly realistic training should continually emphasise when and how to apply the go – around as a landing escape manoeuvre.

13.2.11 Compliance

Summary Analysis - Compliance

Sources	Summaries
LOSA	There is a significant positive correlation between non-compliance and UAS, while there is a negative correlation between non-compliance and error. 25% of all errors are non-compliance errors. The top ranked non-compliance error is checklist protocol, followed by omitted call-outs. Omitted call-outs results have highest risk (65% lead to UAS). The 3rd ranked non-compliance issue is failure to execute a missed approach when required. The 4th and 5th ranked non-compliances are PF making their own changes and PM commencing taxi duties before leaving runway respectively. With respect to weather avoidance errors, 25% result from deviations without ATC clearances. Paradoxically, the fact that most errors are inconsequential reinforces crew inaction, creating additional non-compliance with associated negative effects.
FDA Long body	In long aircraft, following the recommendations of the manufacturer provided in SOP's and training mitigates the tendency toward high "G" landings. Application of take-off procedures is equally important in the prevention of "pilot induced oscillations" during take-off
AQP	The biggest problem with NCGs (non-conforming grades) throughout all operational evaluations is non-compliance with airline policy, amounting to 50% of errors committed. In addition, non-compliance with international procedures is also substantial. The flight phase where the crews have the most difficulty in following procedures is DES. Data from international flights show that the CRZ phase has significantly more NCGs than domestic flights.
Pilot Survey	The pilot survey is probably most revealing in the subject of compliance. If what LOSA postulates is true i.e. that the error rate is multiplicative when non compliance is involved, then the following statistics speak for themselves: • 21% of pilots admit to call out Intentional deviations on virtually every flight. • 13% if pilots admit to intentional deviations from checklists on a frequent basis. • In a go around situation 71% of time neither pilot mentioned a go-around.
IATA Safety	The IATA reports echo LOSA findings. Compliance is rated as one of the top errors and specific training is recommended particularly with respect to following SOPs (i.e. to go-around) when an approach is not stable, and when the landing is improper.
Incident Study	STEADES data draws little distinction between the two groupings of flights (training and all flights). Most of the training flights are for the purpose of IOE, and data indicates issues with checklists and SOPs, which are similar despite varying experience levels.
UK CAA Accident Study	Part of the team that authored CAA CAP 780 Report analysed the fatal accidents set used in the CAP 780 Report (i.e. occurring during the period between 1 January 1997 and 31 December 2008 (inclusive)) for the EBT Data Report. The analysis was made in terms of the threats and errors defined in the EBT Training Criticality Survey (TCS) and the study determined that compliance failure ranked number 2 at a 19.1% rate of occurrence

Outline	Excerpts
Problem	There is a significant positive correlation between non-compliance and UAS, while there is a negative correlation between non-compliance and error. - **LOSA**
	25% of all errors are non-compliance errors. - **LOSA**
	The biggest problem with NCGs (non-conforming grades) throughout all operational evaluations is non-compliance with airline policy, amounting to 50% of errors committed - **AQP**
	21% of pilots admit to call out Intentional deviations on virtually every flight - **Pilot Survey**
	13% if pilots admit to intentional deviations from checklists on a frequent basis. - **Pilot Survey**
	The IATA reports echo LOSA findings. Compliance is rated as one of the top errors - **IATA Safety**
	The 1st ranked non-compliance issue is checklist protocol with 50% occurring on the ground - **LOSA**
	18% of pilots admit that they deviate from checklists frequently - **Pilot Survey**
	Input from Evidence Table
	The issue of compliance in accidents has been decreasing in the last 15 years as opposed to the previous time period. A notable exception to this are the Gen 2 aircraft, both jet and prop where the trend is reversed.
	Input from EBT Accident-Incident Study
Specifics	The top ranked non-compliance error is checklist protocol, followed by omitted call-outs. Omitted call-outs results have highest risk (65% lead to UAS). - **LOSA**
	The 3rd ranked non-compliance issue is failure to execute a missed approach when required -**LOSA**
	With respect to weather avoidance errors, 25% result from deviations without ATC clearances. - **LOSA**
	The flight phase where the crews have the most difficulty in following procedures is DES - **AQP**
	In a go around situation 71% of time, neither pilot mentioned a go-around - **Pilot Survey**
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Training Effect	In long aircraft, following the recommendations of the manufacturer provided in SOP's and training mitigates the tendency toward high "G" landings. **FDA LB**
	Data indicate issues with checklists and SOPs, which are similar despite varying experience levels - **Incident Study**
	Input from Evidence Table
	For accidents with high training effect the rate of compliance as an issue is significantly higher.
	Input from EBT Accident-Incident Study
Criticality	the fact that most errors are inconsequential reinforces crew inaction, creating additional non-compliance with associated negative effects. - **LOSA**
	specific training is recommended particularly with respect to following SOPs (i.e. to go-around) when an approach is not stable, and when the landing is improper - **IATA Safety**
	LOSA advocates TEM for intentional non-compliance - **LOSA** (4.1.15)
	Crews operating Gen 3 jet aircraft show a greater percentage of intentional non-compliance and decision making errors than crews operating Gen 4.jet aircraft. This difference increases as the training cycle progresses. - **AQP** (4.3.1.2)
	Input from Evidence Table
	Input from EBT Accident-Incident Study

Narrative
Intentional non-compliance remains a substantial problem, and whilst the level of crew non-technical competency has shown signs of improvement over the most recent periods examined, intentional non - compliance remains a serious weakness in current operations. It has decreased somewhat in the last 15 years but not at the same rate as has accidents. A notable exception to this is generation 2 where the rate has actually increased. There are many potential reasons for crews to deviate routinely from SOP's and these include attempts to optimise the operation, particularly in time constrained situations. Complacency due to familiarity may be another factor. However, the data show significant correlation between non – compliance and large increases in risk of undetected errors and undesired aircraft states. Checklist and call-out protocols show substantial signs of weakness. The failure of crews to execute a Go-round under conditions when SOP requires is a very significant area of intentional non-compliance. Pilots admit to call-out and checklist deviations on a regular basis, as well as the failure to adhere to approach procedures and execute Go-rounds when required. Crew discipline has always been assumed to be a pillar supporting operational safety and now the data show its breakdown. Crews must understand that intentional non-compliance, correlates highly with errors resulting in undesired aircraft states and that compliance failures also rank highly in accident data. Crews are currently trained to comply and demonstrate adherence to SOP, but detecting and addressing non-compliance is not a feature of existing training programmes. Data indicate that effective training and appropriate focus on areas such as leadership can address non-compliance.

13.2.12 Leadership

Summary Analysis - Leadership

Sources	Summaries
LOSA	Leadership is an effective positive catalyst in terms of reducing errors per flight, provided that it is accompanied by good communications.
ATQP	ATQP training and operational data provide encouraging results showing that leadership showed remarkable improvement in training as well as better performance on the line.
Pilot Survey	The pilot survey provided both encouraging and discouraging results with regard to leadership. On the one hand most pilots are willing to make appropriate decisions to promote safety. However, there is too often a casual attitude indicated by significant intentional disregard for procedural compliance.
FAA HF Report	The report found that leadership in the complex automated airline environment is especially important. The traits involved relate to understanding the process as well as making good decisions as a team, particularly in unfamiliar situations.

Outline	Excerpts
Problem	The pilot survey provided both encouraging and discouraging results with regard to leadership - **Pilot Survey**
	Flights with poor ratings [in Leadership] have approximately 3 times the number of mismanaged threats to those without poor ratings. - **LOSA**
	Input from Evidence Table
	Leadership and teamwork as an competency issue has more than doubled in recent years. This is the case for all generations but it is even more pronounced for modern generation aircraft.
	Input from EBT Accident-Incident Study
Specifics	there is too often a casual attitude indicated by significant intentional disregard for procedural compliance. - **Pilot Survey**
	In cases where a GA should have been performed, 71% of the times neither pilot mentioned GA. - **Pilot Survey**
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Training Effect	ATQP training and operational data provide encouraging results showing that leadership showed remarkable improvement in training as well as better performance on the line. - **ATQP**
	The traits involved relate to understanding the process as well as making good decisions as a team, particularly in unfamiliar situations. - **FAA HF**
	Flights with outstanding ratings for “Leadership and Communication Environment” have on average 2.3 errors per flight, versus 7 Errors per flight for poor “Leadership and Communication Environment.” - **LOSA**
	Effective training encourages and enhances leadership, and this is demonstrated by improved leadership and workload management performance grades data in training, in addition to better adherence to company criteria in operations. - **ATQP**
	ATQP data shows that leadership can be effectively be improved through training. - **ATQP**
	Input from Evidence Table
	The fact that leadership and teamwork is not reported as a competency issue in serious incidents indicates the importance of it as a mitagating agent in accidents as well as its importance in training.
	Input from EBT Accident-Incident Study
Criticality	Leadership is an effective positive catalyst in terms of reducing errors per flight, provided that it is accompanied by good communications. - **LOSA**
	The report found that leadership in the complex automated airline environment is especially important - **FAA HF**
	Input from Evidence Table
	Input from EBT Accident-Incident Study

Narrative
Leadership and teamwork as an competency issue has more than doubled in recent years. This is the case for all generations but it is even more pronounced for modern generation aircraft. Additionally, the prevalence of a non-compliance culture is indicative of lack of appropriate leadership focus. Several data sources point to a well-understood need and desire for better leadership from flightcrews. Data from pilots indicate a willingness to demonstrate effective leadership and make decisions enhancing and protecting the level of operational safety. The absence of effective leadership in the cockpit adds substantially to the risk of mismanaged threats and errors leading to undesired aircraft states. Conversely, leadership when coupled with effective communication proves to be a very effective catalyst for managing threats and both reducing and managing errors. From a training perspective, data indicate that leadership can be effectively developed, when there is a strong compliance culture, which in turn necessitates the careful design of effective procedures and adherence to them. The fact that leadership and teamwork is not reported as a competency issue in serious incidents indicates the importance of it as a mitagating agent in accidents as well as its importance in training. Strengthening leadership in training improves compliance, hence risk will be reduced crews should be able to deal more effectively as a team with today’s complex environment and function more effectively when faced with unfamiliar situations.

13.2.13 Mismanaged Aircraft State

Summary Analysis - Mismanaged Aircraft State

Sources	Summaries
LOSA	Omitted callout deviations are associated with the greatest risk; 65% of omissions contribute towards UAS. Intentional non-compliances correlate positively with UAS rates. The flight phases having the most mismanaged aircraft states are DES, APP and LDG. Detected handling errors account for between 20% - 40%, but most are not detected until a mismanaged aircraft state occurs.
ATQP	Studies during ATQP highlight the need for specific training in planning and energy management to reduce mismanaged aircraft states. Go-arounds continue to be mismanaged and 50% of them result from mismanaged approaches. During the go-around, mismanaged autoflight continues to result in mismanaged aircraft states including flap over-speeds and SOP violations.
IATA Safety	Mismanaged aircraft states occur for many reasons. The IATA report recommends reinforcement training in basic flying skills such as manual handling, landings and go-arounds. Flight crews are reluctant to revert to manual flight from automation, while basic manoeuvres such as landings and go-arounds continue to be a problem. The reports propose that proficiency and confidence be fostered during training.
Incident Study	The training flight database is heavily populated with incidents that are classified as mismanaged aircraft states while this is not nearly the case for the database of all flights. This fact is not only true for the rankings of the incidents, but also true for the percentages of actual reports with similar rankings across the two groupings of flights. Examples of this are unstable approaches (16.7% versus 8.3%), landing with incident, EGPWS and manual handling.
FAA HF	The report found weakness in prevention of mismanaged aircraft states as well as in the skills to recover from them after entry. The states cited include flight path issues involving loss of control, terrain and energy awareness. Recommendations include regular training to avoid mismanage aircraft states as well as recovery from inadvertent entries.
CAST	Even though the accident rate has decreased in the last 20 years, the rate of accidents due to mismanaged aircraft has increased. Runway excursions, landing short and ground collision are all up and exemplify this trend.

Outline	Excerpts
Problem	The report found weakness in prevention of mismanaged aircraft states as well as in the skills to recover from them after entry - **FAA HF**
	Even though the accident rate has decreased in the last 20 years, the rate of accidents due to mismanaged aircraft has increased - **CAST**
	The training flight database is heavily populated with incidents that are classified as mismanaged aircraft states - **Incidents**
	Go-arounds continue to be mismanaged and 50% of them result from mismanaged approaches. - **ATQP**
	Input from Evidence Table
	Mismanaged aircraft state is a leading factor in the accident and serious incident report in all generations and during all time periods.
	Input from EBT Accident-Incident Study
Specifics	The flight phases having the most mismanaged aircraft states are DES, APP and LDG. Detected handling errors account for between 20% - 40%, but most are not detected until a mismanaged aircraft state occurs - **LOSA**
	During the go-around, mismanaged autoflight continues to result in mismanaged aircraft states including flap over-speeds and SOP violations. - **ATQP**
	Flight crews are reluctant to revert to manual flight from automation, while basic manoeuvres such as landings and go-arounds continue to be a problem. - **IATA Safety**
	The states cited include flight path issues involving loss of control, terrain and energy awareness. **FAA HF**
	Runway excursions, landing short and ground collision are all up and exemplify this trend - **CAST**
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Training Effect	Omitted callout deviations are associated with the greatest risk; 65% of omissions contribute towards UAS. Intentional non-compliances correlate positively with UAS rates - **LOSA**
	Mismanaged aircraft states occur for many reasons. The IATA report recommends reinforcement training in basic flying skills such as manual handling, landings and go-arounds - **IATA Safety**
	Input from Evidence Table
	Input from EBT Accident-Incident Study
Criticality	Studies during ATQP highlight the need for specific training in planning and energy management to reduce mismanaged aircraft states - **ATQP**
	The reports propose that proficiency and confidence be fostered during training - **IATA Safety**
	Recommendations include regular training to avoid mismanage aircraft states as well as recovery from inadvertent entries. **FAA HF**
	Input from Evidence Table
	Input from EBT Accident-Incident Study

Narrative
Mismanaged aircraft state is a leading factor in the accident and serious incident reports in all generations and during all time periods. There is a reported weakness in prevention of mismanaged aircraft states as well as in the skills to recover from them after entry. Examples are landing incidents following unstable approaches and manual aircraft control competency issues. Mismanaged aircraft states occur for many reasons, all of which are of significance from a training perspective. Aircraft states cited include flight path issues involving potential and actual loss of control, terrain and energy awareness. The flight phases having the most mismanaged aircraft states are descent, approach and landing. Effort needs to focused on detecting the errors that lead to mismanaged states as evidence shows that during these dynamic phases a large percentage are not detected until after the state becomes critical. Recommendations include regular training to avoid mismanaged aircraft states as well as recovery from inadvertent entries and reinforcement training in basic flying skills such as manual handling, landings and go-arounds. Flight crews are reluctant to revert to manual flight from automation, while basic manoeuvres such as landings and go-arounds continue to be a problem. The reports propose that proficiency, discipline and confidence be fostered during training to combat mismanaged aircraft states.

13.2.14 Upset

Summary Analysis - Upset

Sources	Summaries
IATA Safety	Training should enable pilots to respond to unexpected events throughout the flight regime at various levels of difficulties
FAA HF Report	The FAA automation report cited detection and recovery from unusual attitudes as an area of concern. It went on to recommend increasing flight crew understanding and sensitivity in maintaining situation awareness regarding potential causes and detection of upsets from wake vortex, autopilot failures, engine failures and atmospheric disturbances as well as recommending advance manoeuvre training an integral part of training.
CAST	Upset still ranks as a major cause of accidents. Its_percentage of total accidents has remained steady at around 13% in the last two decades

Outline	Excerpts	Narrative
Problem	The FAA automation report cited detection and recovery from unusual attitudes as an area of concern - **FAA HF**	While upset still ranks as a major cause of accidents when measured as a category in several accident reports, its percentage of total accidents has remained steady in the last two decades. Several reports in the meta-study list this category of accidents as a concern. Training should prepare pilots for any contingency whether expected or not. Manual aircraft skills are important as reiterated many times in this report and pilots must have the skills to execute the recoveries from the precursor states to those defined as upsets. However prevention is key, with a strong focus on the detection and early intervention to prevent upsets from occurring. This is the essential strategy that must become an integral part of training.
	Upset still ranks as a major cause of accidents. Its percentage of total accidents has remained steady at around 13% in the last two decades. - **CAST**	
	Input from Evidence Table	
	Input from EBT Accident-Incident Study	
Specifics	**Input from Evidence Table**	
	Input from EBT Accident-Incident Study	
Training Effect	**Input from Evidence Table**	
	Input from EBT Accident-Incident Study	
Criticality	Training should enable pilots to respond to unexpected events throughout the flight regime at various levels of difficulties - **IATA Safety**	
	It [FAA HF report] went on to recommend increasing flight crew understanding and sensitivity in maintaining situation awareness regarding potential causes and detection of upsets from wake vortex, autopilot failures, engine failures and atmospheric disturbances as well as recommending advance manoeuvre training an integral part of training. - **FAA HF**	
	Input from Evidence Table	
	Input from EBT Accident-Incident Study	

APPENDIX 14
GRAPHIC VISUALISATION OF EBT ACCIDENT-INCIDENT DATA

INTRODUCTION

This appendix contains and analysis of most of the accident and serious incidents from the EBT accident-incident database. There is no Generation 1 Jet aircraft events nor is there any events from Generation 2 and 3 Prop. For this reasons no results were used in Chapter 2 – Major Results nor in Chapter 4 – Analysis. The benefit of this study is two fold:

1. To provide a verification of the main analysis of the EBT Accident-Incident Analysis detailed in Chapter 3 and 4.
2. Provide an intuitive visualization of the data and the basic processes of the analysis used in the EBT Accident-Incident analysis. With very large data sets this is not an easy task and the statistician who performed this study use some very interesting techniques and pictorials to do this.

Most of the analyses done here were also completed in the main study using a more complete data set. The study shown is this appendix is not replicated in the main study as it entailed analysis of all generations, which was not the objective of the EBT Accident-Incident study. However the graphics are illustrative and so, they are shown here.

Only a small excerpt of the study is shown in this appendix. Additionally, in the entire work, there are similar sets of illustrations by generations, periods of time and severity.

Some of the techniques used here are very interesting for futures development, particularly in the area of clustering. Factors can be clustered in various ways, such as the way it is done in the main study and in the way it is done here using correlations. There are other ways as well and the interest lies in seeing similarities in the clusters themselves and how this could relate to accident types and how that could provide a breakdown of skills required to be trained.

14.1 EBT ACCIDENT-INCIDENT DATASET PARTITION

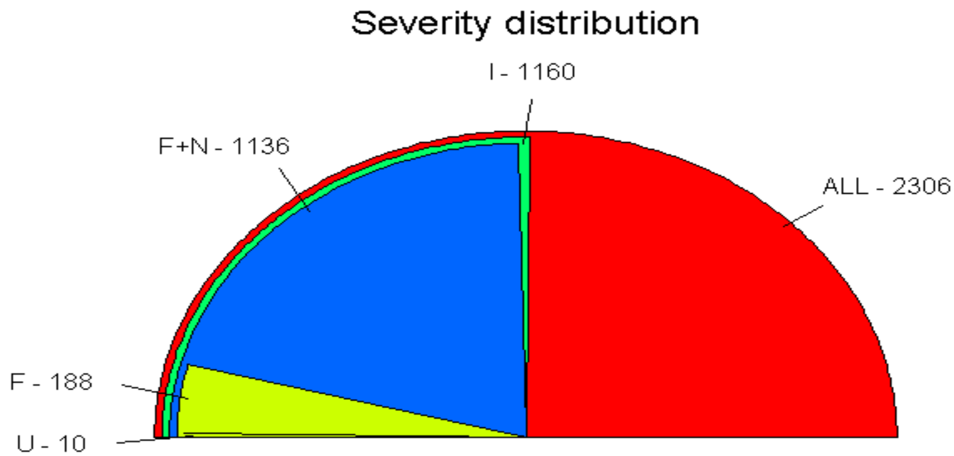


Figure A14.1 – Severity distribution of a subsample of accidents and incident from EBT study

F – represents Fatal accidents
N – represents Nonfatal accidents
I – represents Serious Incidents
U – represents unclassified

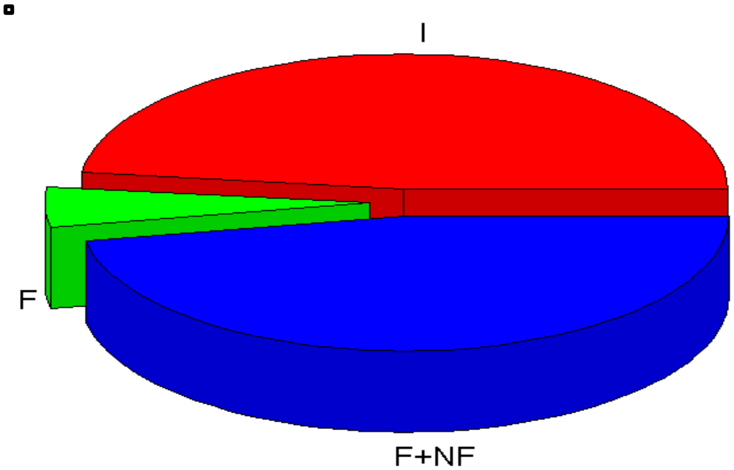


Figure A14.1a – Visual representation of Accident – incident distribution

F – Fatal accidents
F+N – All accidents
I – Incidents

DATA SET PARTITION							
ALL	2306	**INCIDENTS**	1160	**2**	675	LAST 15Y	129
						OLDER	546
				3	393	LAST 15Y	295
						OLDER	98
				4	92	LAST 11Y	76
						OLDER	16
		FATAL	188	**2**	127	LAST 15Y	70
						OLDER	57
				3	48	LAST 15Y	34
						OLDER	14
				4	13	LAST 11Y	9
						OLDER	4
		FATAL + NON FATAL	1136	**2**	636	LAST 15Y	179
						OLDER	457
				3	391	LAST 15Y	305
						OLDER	86
				4	109	LAST 11Y	87
						OLDER	22
		U	10				

Figure A14.1b – Partition of the dataset showing raw numbers

14.2 STATISTICAL BREAKDOWN OF FACTORS AND COMPETENCIES

Factor and Competency in terms of:

- Ranking by frequency of occurrence
- Number of accidents or incidents in which the factor/competency appears.
- Percentage of occurrence per event (flight with accident/incident).
- Rate of occurrence per flight in general (Normalized by 1 million Takeoffs)).
- **Note**: Rows with dotted background indicate Competencies.

Rank	Factor/ Competency Occurrence	Accidents/Incidents	%	Rate
1	Syst mal	859	37.3	1.66E-06
2	CRM	602	26.1	1.17E-06
3	Adverse Weather/Ice	585	25.4	1.13E-06
4	Mis A/C State	526	22.8	1.02E-06
5	Manual Aircraft Control	480	20.8	9.30E-07
6	Compliance	357	15.5	6.92E-07
7	SA	340	14.7	6.59E-07
8	Eng Fail	314	13.6	6.08E-07
9	Application of Procedures & Knowledge	303	13.1	5.87E-07
10	Ground manoeuvring	279	12.1	5.40E-07
11	Fire	259	11.2	5.02E-07
12	Problem Solving Decision Making	217	9.4	4.20E-07
13	ATC	180	7.8	3.49E-07
14	Poor Visibility	175	7.6	3.39E-07
15	Ground equipment	138	6.0	2.67E-07
16	Runway/Taxi condition	135	5.9	2.62E-07
17	Traffic	119	5.2	2.31E-07
18	Cabin	119	5.2	2.31E-07
19	Leadership and Teamwork	88	3.8	1.70E-07
20	Mis-Sys	79	3.4	1.53E-07
21	Crosswind	76	3.3	1.47E-07
22	Communication	75	3.3	1.45E-07
23	Ops/Type Spec	59	2.6	1.14E-07
24	R/W Incursion	57	2.5	1.10E-07
25	Workload Distraction Pressure	52	2.3	1.01E-07
26	Terrain	51	2.2	9.88E-08
27	Knowledge	45	2.0	8.72E-08
28	Windshear	41	1.8	7.94E-08
29	Def-Proc's	40	1.7	7.75E-08
30	Flight Management, Guidance and Autor	40	1.7	7.75E-08
31	Def-Ops data	39	1.7	7.56E-08
32	Upset	34	1.5	6.59E-08
33	Mis-AFS	33	1.4	6.39E-08
34	Def Manuals	29	1.3	5.62E-08
35	Workload Management	27	1.2	5.23E-08
36	Birds	26	1.1	5.04E-08
37	Pilot Incap	24	1.0	4.65E-08
38	MEL	24	1.0	4.65E-08
39	Wake Vortex	16	0.7	3.10E-08
40	Physio	16	0.7	3.10E-08
41	D.G	12	0.5	2.32E-08
42	L..F.P	12	0.5	2.32E-08
43	Fatique	10	0.4	1.94E-08
44	Def-Chk lists	9	0.4	1.74E-08
45	Loss of comms	6	0.3	1.16E-08
46	Def-Charts	5	0.2	9.69E-09
47	NAV	4	0.2	7.75E-09
48	Def-DBs	2	0.1	3.87E-09

Figure A14.2

14.3 GRAPHIC DEMONSTRATING INTUITIVE SENSE OF OCCURRENCE RANKING FOR FACTORS AND COMPETENCIES

The Histogram shows a bar graph representation of the chart in figure A14.2:

- The columns are numbered left to right according to ranking of the factors/competencies in the same figure

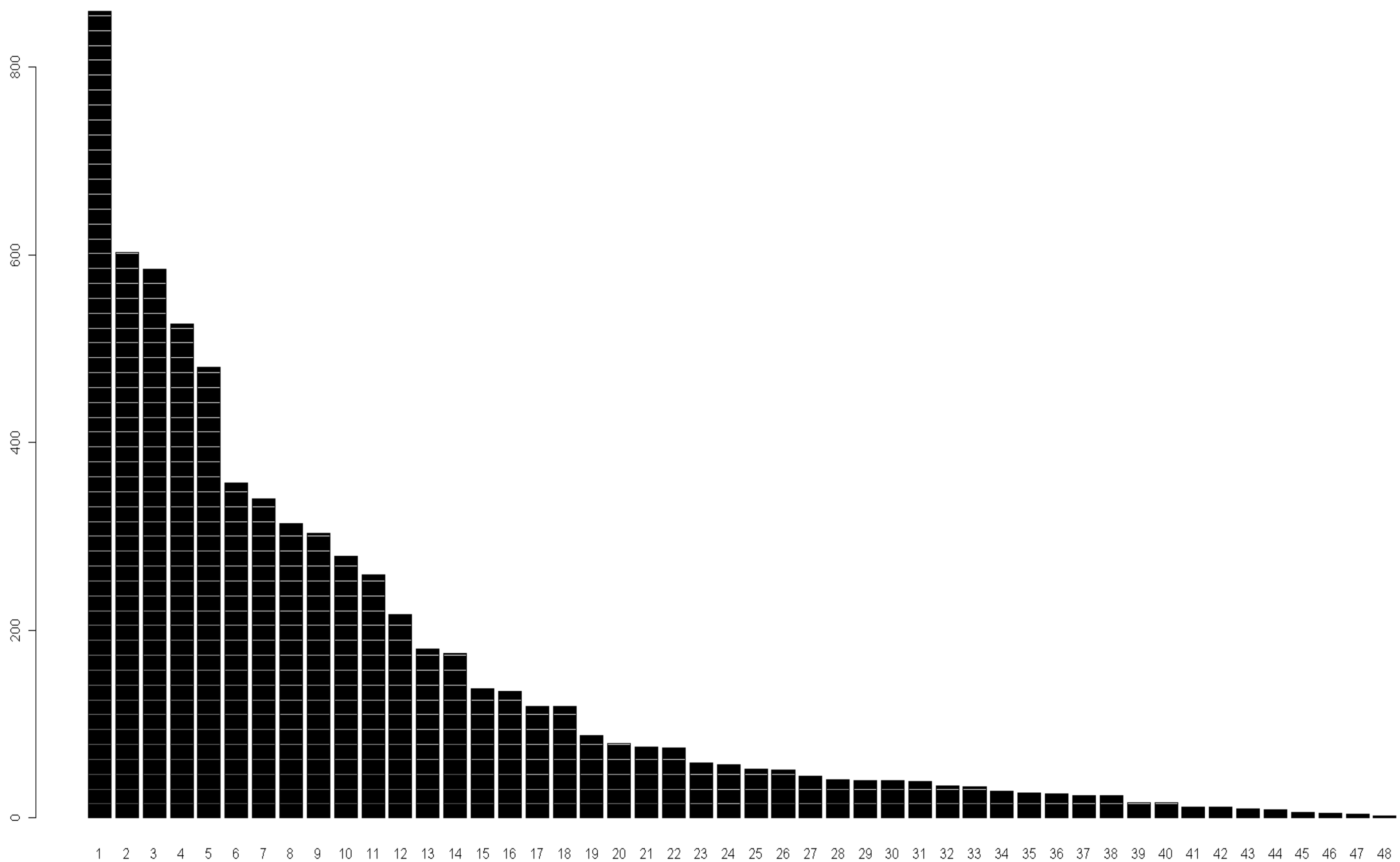


Figure A14.3

The graphic below is a 3 dimensional representation of the rankings for frequency of occurrence of the factors/competencies in all accidents and incidents for all generations. The visual effect of this representation gives a sense of the relative importance of the factors by clearly showing the steep drop of importance as the ranking progresses. The vertical and horizontal axes are mirror images of each other and are labeled in the same order as the rank in fig A14.2 (e.g. the apex being number 1 = Sys mal)

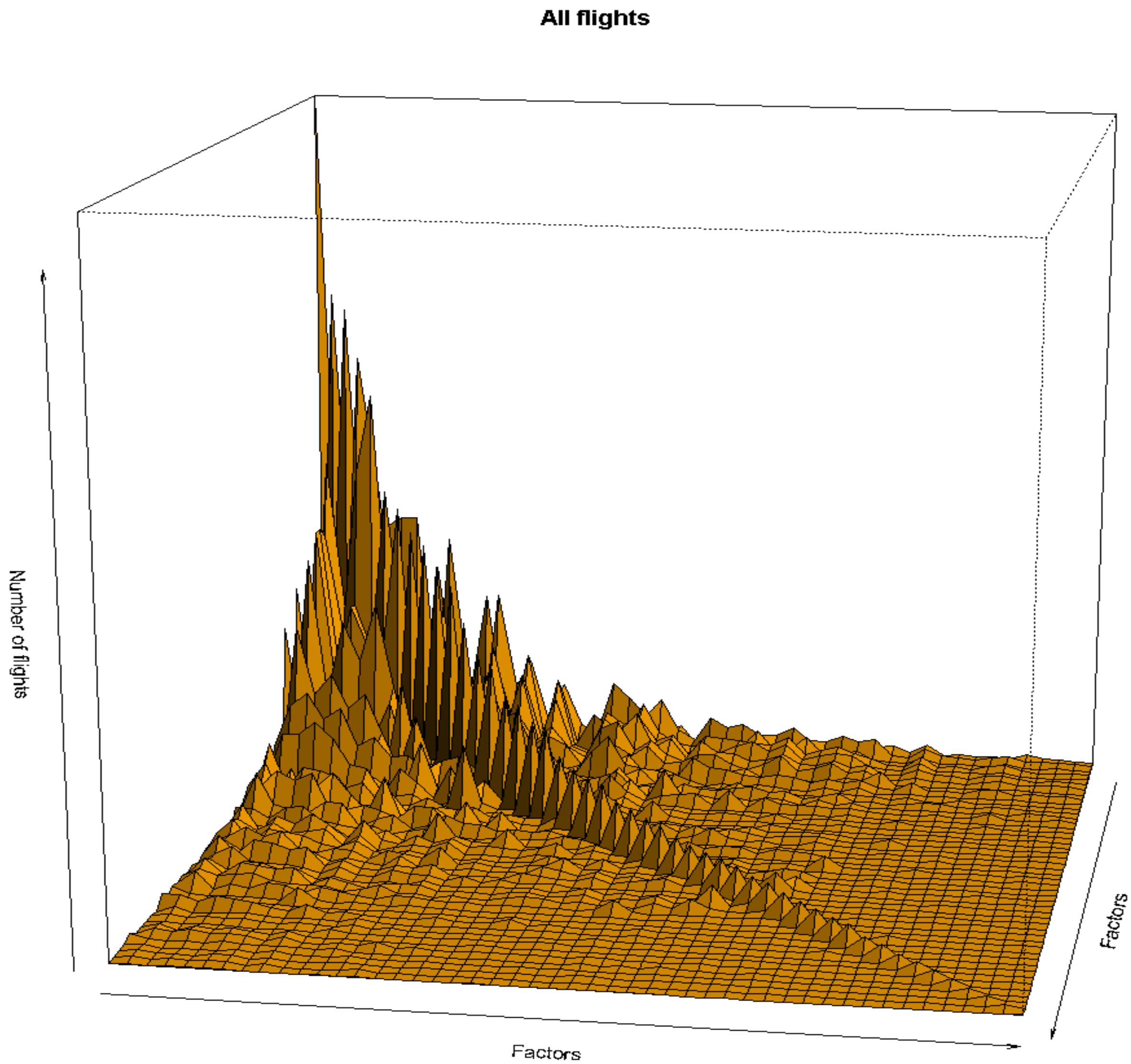


Figure A14.3a

Figure A14.3b forms a matrix of the number of factor pairings or factor/competency pairings for all accidents and serious incidents:

- Column and row numbers are titled the same as the ranking in previous graphic (e.g. 1=Sys Mal).
- Darkness of shading depicts a measure of occurrence.

Occurrence of Factor Pairings

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
1	859	116	87	82	123	69	54	232	68	66	194	40	6	53	16	20	1	29	12	37	28	12	26	0	14	8	19	15	13	10	4	11	7	11	8	11	3	15	0	3	2	2	1	8	2	2	1	0
2	116	602	209	383	289	303	304	42	276	97	40	202	79	108	31	81	29	14	86	67	43	67	26	13	44	32	38	23	25	36	19	19	28	21	25	3	2	15	7	5	3	7	9	3	4	4	4	2
3	87	209	585	170	160	116	103	60	96	32	53	113	34	126	11	82	7	48	29	19	65	27	14	10	10	18	10	36	11	14	30	7	10	13	3	1	0	8	1	2	1	0	6	1	0	2	1	0
4	82	383	170	526	377	202	205	28	194	68	22	140	44	92	15	99	10	3	57	42	52	21	30	4	31	29	27	24	23	34	12	19	25	16	10	3	2	16	2	5	2	7	10	3	1	1	3	2
5	123	289	160	377	480	142	152	68	143	70	61	96	37	108	19	79	15	7	54	39	64	18	32	6	22	16	25	33	20	31	11	18	22	19	6	3	2	13	3	4	3	4	6	1	1	0	2	2
6	69	303	116	202	142	357	153	20	220	45	18	116	38	58	27	46	19	7	47	58	19	33	15	7	37	21	21	12	14	23	11	10	18	10	14	2	2	11	4	5	1	7	7	5	1	4	3	1
7	54	304	103	205	152	153	340	18	110	94	16	64	58	70	26	40	28	3	18	31	18	32	10	13	23	25	12	7	15	27	8	12	21	8	13	1	2	5	2	2	0	4	6	2	3	4	3	1
8	232	42	60	28	68	20	18	314	23	18	127	17	3	46	10	7	0	7	5	10	25	2	8	0	6	4	8	14	3	5	2	0	2	7	5	18	1	2	0	0	1	1	1	2	0	0	0	0
9	68	276	96	194	143	220	110	23	303	33	19	89	26	48	13	43	13	5	34	56	19	14	12	3	32	19	18	12	9	13	12	6	11	7	12	3	1	12	2	3	1	7	7	2	4	2	3	0
10	66	97	32	68	70	45	94	18	33	279	26	24	33	29	73	25	15	7	5	3	9	20	1	14	7	0	5	2	5	3	1	0	5	2	8	0	1	2	1	1	0	1	1	2	0	0	0	0
11	194	40	53	22	61	18	16	127	19	26	259	18	3	43	12	6	0	18	7	5	27	3	7	0	3	5	4	14	2	3	1	0	0	5	4	3	1	5	0	0	4	0	1	1	0	0	0	0
12	40	202	113	140	96	116	64	17	89	24	18	217	21	49	5	49	6	8	13	18	26	8	10	1	15	9	9	12	15	9	11	2	7	12	1	2	0	2	5	4	1	1	3	3	1	1	0	1
13	6	79	34	44	37	38	58	3	26	33	3	21	180	35	7	13	83	0	11	3	4	24	2	39	7	8	4	7	2	8	7	0	8	3	6	0	1	0	1	0	0	0	2	0	3	3	1	0
14	53	108	126	92	108	58	70	46	48	29	43	49	35	175	13	33	9	1	16	7	35	14	2	10	13	16	1	22	1	14	7	6	7	4	6	3	1	0	0	3	0	0	7	0	0	1	3	1
15	16	31	11	15	19	27	26	10	13	73	12	5	7	13	138	6	1	3	3	1	3	13	0	4	4	0	0	1	1	1	1	0	1	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0
16	20	81	82	99	79	46	40	7	43	25	6	49	13	33	6	135	2	0	8	9	25	6	2	3	6	1	3	5	3	0	7	0	2	3	2	1	1	5	0	0	0	0	3	0	0	0	1	0
17	1	29	7	10	15	19	28	0	13	15	0	6	83	9	1	2	119	1	5	3	1	8	1	23	4	0	0	0	1	2	1	2	2	1	3	0	0	0	1	0	0	0	0	1	1	1	0	0
18	29	14	48	3	7	7	3	7	5	7	18	8	0	1	3	0	1	119	5	2	0	7	3	0	3	0	0	0	2	0	6	3	0	0	0	0	0	0	1	1	2	0	0	0	0	1	0	0
19	12	86	29	57	54	47	18	5	34	5	7	13	11	16	3	8	5	5	88	15	6	10	4	2	6	5	2	4	2	8	2	3	4	4	2	0	0	2	1	1	1	2	1	0	0	0	1	0
20	37	67	19	42	39	58	31	10	56	3	5	18	3	7	1	9	3	2	15	79	5	3	10	0	15	3	12	5	11	6	2	4	5	7	2	0	2	7	0	1	0	2	1	1	0	1	1	2
21	28	43	65	52	64	19	18	25	19	9	27	26	4	35	3	25	1	0	6	5	76	2	7	1	1	1	5	17	6	2	4	0	1	6	1	1	0	0	1	0	1	0	1	0	0	0	1	1
22	12	67	27	21	18	33	32	2	14	20	3	8	24	14	13	6	8	7	10	3	2	75	1	8	7	3	0	2	1	2	0	3	2	1	2	0	0	2	1	1	2	0	1	0	1	1	1	0
23	26	26	14	30	32	15	10	8	12	1	7	10	2	2	0	2	1	3	4	10	7	1	59	0	3	1	11	4	8	8	0	7	6	4	0	0	0	1	1	0	2	0	1	0	0	0	0	0
24	0	13	10	4	6	7	13	0	3	14	0	1	39	10	4	3	23	0	2	0	1	8	0	57	2	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	0
25	14	44	10	31	22	37	23	6	32	7	3	15	7	13	4	6	4	3	6	15	1	7	3	2	52	5	4	2	4	5	0	3	4	1	16	1	1	1	0	3	1	0	2	2	0	2	1	1
26	8	32	18	29	16	21	25	4	19	0	5	9	8	16	0	1	0	0	5	3	1	3	1	0	5	51	0	0	0	7	0	0	3	0	2	0	0	1	0	0	0	0	2	0	0	2	1	1
27	19	38	10	27	25	21	12	8	18	5	4	9	4	1	0	3	0	0	2	12	5	0	11	0	4	0	45	3	9	11	2	5	10	8	0	0	0	3	2	0	0	1	0	2	0	0	0	1
28	15	23	36	24	33	12	7	14	12	2	14	12	7	22	1	5	0	0	4	5	17	2	4	0	2	0	3	41	4	3	2	1	2	2	1	1	0	1	0	0	1	0	1	0	0	0	0	1
29	13	25	11	23	20	14	15	3	9	5	2	15	2	1	1	3	1	2	2	11	6	1	8	0	4	0	9	4	40	5	0	1	4	15	1	0	0	0	2	0	0	1	0	3	1	1	0	1
30	10	36	14	34	31	23	27	5	13	3	3	9	8	14	1	0	2	0	8	6	2	2	8	0	5	7	11	3	5	40	1	8	27	4	2	1	0	0	0	0	0	1	1	1	0	1	0	1
31	4	19	30	12	11	11	8	2	12	1	1	11	7	7	1	7	1	6	2	2	4	0	0	0	0	0	2	2	0	1	39	1	1	2	0	0	0	1	0	1	0	2	2	1	0	1	0	0
32	11	19	7	19	18	10	12	0	6	0	0	2	0	6	0	0	2	3	3	4	0	3	7	0	3	0	5	1	1	8	1	34	6	2	2	0	0	1	1	0	1	0	0	0	0	1	0	0
33	7	28	10	25	22	18	21	2	11	5	0	7	8	7	1	2	2	0	4	5	1	2	6	0	4	3	10	2	4	27	1	6	33	5	3	1	1	0	0	0	0	1	1	0	0	1	1	1
34	11	21	13	16	19	10	8	7	7	2	5	12	3	4	0	3	1	0	4	7	6	1	4	1	1	0	8	2	15	4	2	2	5	29	1	0	0	2	1	0	0	2	0	2	1	0	0	0
35	8	25	3	10	6	14	13	5	12	8	4	1	6	6	3	2	3	0	2	2	1	2	0	2	16	2	0	1	1	2	0	2	3	1	27	0	1	0	0	0	0	0	1	1	0	1	1	0
36	11	3	1	3	3	2	1	18	3	0	3	2	0	3	1	1	0	0	0	0	1	0	0	0	1	0	0	1	0	1	0	0	1	0	0	26	0	0	0	0	0	0	0	0	0	0	0	0
37	3	2	0	2	2	2	2	1	1	1	1	0	1	1	0	1	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	24	0	0	4	0	0	1	0	0	0	1	0
38	15	15	8	16	13	11	5	2	12	2	5	2	0	0	0	5	0	0	2	7	0	2	1	0	1	1	3	1	0	0	1	1	0	2	0	0	0	24	0	0	0	1	0	0	0	0	0	0
39	0	7	1	2	3	4	2	0	2	1	0	5	1	0	0	0	1	1	1	0	1	1	1	0	0	0	2	0	2	0	0	1	0	1	0	0	0	0	16	0	0	0	0	0	0	0	0	0
40	3	5	2	5	4	5	2	0	3	1	0	4	0	3	0	0	0	1	1	1	0	1	0	0	3	0	0	0	0	0	1	0	0	0	0	0	4	0	0	16	0	0	1	0	0	0	0	0
41	2	3	1	2	3	1	0	1	1	0	4	1	0	0	0	0	0	2	1	0	1	2	2	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0
42	2	7	0	7	4	7	4	1	7	1	0	1	0	0	0	0	0	0	2	2	0	0	0	0	0	0	1	0	1	1	2	0	1	2	0	0	0	1	0	0	0	12	1	0	0	0	0	0
43	1	9	6	10	6	7	6	1	7	1	1	3	2	7	0	3	0	0	1	1	1	1	1	0	2	2	0	1	0	1	2	0	1	0	1	0	1	0	0	1	0	1	10	0	0	0	1	0
44	8	3	1	3	1	5	2	2	2	2	1	3	0	0	0	0	1	0	0	1	0	0	0	0	2	0	2	0	3	1	1	0	0	2	1	0	0	0	0	0	0	0	0	9	0	0	0	0
45	2	4	0	1	1	1	3	0	4	0	0	1	3	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	6	0	0	0
46	2	4	2	1	0	4	4	0	2	0	0	1	3	1	0	0	1	1	0	1	0	1	0	0	2	2	0	0	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	5	0	0
47	1	4	1	3	2	3	3	0	3	0	0	0	1	3	0	1	0	0	1	1	1	1	0	0	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	0	4	0
48	0	2	0	2	2	1	1	0	0	0	0	1	0	1	0	0	0	0	0	2	1	0	0	0	1	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2

Figure A14.3b

The graphic below (Figure A14.3c) is a visual depiction of chart above (fig A14.3b) with the measure of pair-occurrence a function of the area size of the rectangles in the matrix. Additionally pair-occurrence is also denoted by the change of shading to emphasize the effect.

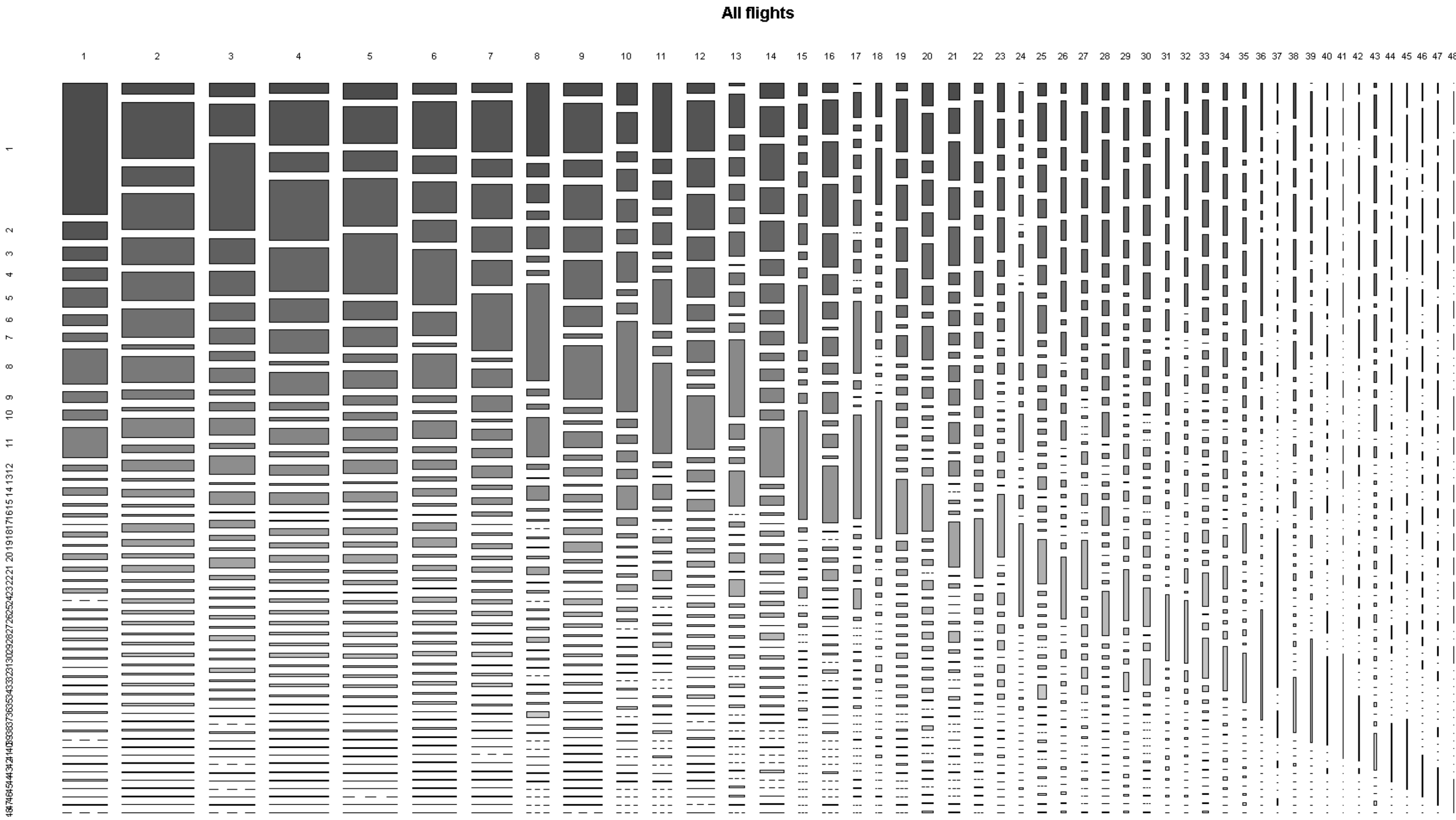


Figure A14.3c

14.4 THE TOP FOUR

The chart below denotes the leading four parameters in terms of occurrence with regard to:

- Individual factor measured in raw numbers and rates normalized by takeoffs.
- Individual competencies measured in raw numbers and rates normalized by takeoffs.
- Factor pairings measured in raw numbers and rates normalized by takeoffs.
- Factor and competency pairing measured in raw numbers and rates normalized by takeoffs.

Top 4 parameters		
Top 4 factors	Accident/incidents	Normalized Rates
Syst mal	859	1.66405E-06
CRM	602	1.16619E-06
Adverse weather	585	1.13326E-06
Mis A/C state	526	1.01896E-06
Top 4 Competencies	Accident/incidents	Normalized Rates
Manual aircraft control	480	9.29854E-07
SA	340	6.58646E-07
Application of Procedures & Knowledge	303	5.8697E-07
Problem Solving Decision Making	217	4.20371E-07
Top 4 pairs of factors	Accident/incidents	Normalized Rates
Mis A/C state - CRM	383	7.41946E-07
Compliance - CRM	303	5.8697E-07
Engine failure - sys mal	232	4.49429E-07
Adverse weather - CRM	209	4.04874E-07
Top 4 pairs of factors with Competencies	Accident/incidents	Normalized Rates
Manual A/C control - Mis A/C state	377	7.30322E-07
SA - CRM	304	5.88907E-07
Manual A/C control - CRM	289	5.59849E-07
Application of procedures and knowledge	202	3.91313E-07

Figure A14.4

14.5 CORRELATIONS AMONG FACTOR/COMPETENCY PAIRINGS

The 48X48 matrix below denotes the statistical correlations among all the factors and competencies for all accidents and serious incidents:

- Column and row numbers are titled the same as the ranking in figure A14.2 (e.g. 1=Sys Mal).
- Darkness of shading depicts the strength of correlation.

Correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
1	10	2.2	2.7	2.4	1.2	1.6	1.8	3.0	1.2	1.0	2.8	1.3	2.0	0.4	1.3	1.2	1.8	0.6	1.0	0.4	0.0	0.8	0.2	1.2	0.3	0.7	0.1	0.0	0.1	0.3	0.7	0.1	0.4	0.0	0.2	0.1	0.5	0.5	0.6	0.3	0.3	0.3	0.4	0.7	0.0	0.0	0.1	0.2
2	2.2	10	1.3	5.8	4.0	5.7	6.0	1.2	5.8	0.7	0.9	4.9	1.2	2.3	0.2	1.9	0.1	0.8	3.2	2.5	1.3	2.6	0.7	0.1	2.0	1.3	1.9	0.9	1.1	1.9	0.7	0.8	1.6	1.2	1.6	0.4	0.4	0.8	0.3	0.1	0.0	0.5	1.0	0.1	0.5	0.6	0.7	0.5
3	2.7	1.3	10	0.9	0.9	0.7	0.5	0.6	0.6	1.2	0.4	2.0	0.4	3.1	1.0	2.0	1.0	0.8	0.3	0.1	2.6	0.4	0.1	0.3	0.2	0.3	0.1	1.9	0.1	0.3	1.6	0.1	0.1	0.5	0.4	0.5	0.6	0.2	0.4	0.2	0.3	0.4	0.5	0.2	0.3	0.2	0.0	0.2
4	2.4	5.8	0.9	10	6.8	3.4	3.7	1.3	3.8	0.1	1.2	3.2	0.1	2.0	0.7	3.0	0.8	1.1	2.0	1.4	2.0	0.2	1.1	0.6	1.3	1.2	1.3	1.1	1.1	2.0	0.2	1.0	1.5	0.9	0.4	0.3	0.4	1.1	0.2	0.2	0.1	0.6	1.2	0.2	0.1	0.0	0.5	0.5
5	1.2	4.0	0.9	6.8	10	2.0	2.4	0.1	2.5	0.4	0.2	1.9	0.0	2.9	0.4	2.3	0.5	0.9	2.0	1.3	2.9	0.1	1.3	0.4	0.8	0.4	1.2	2.0	1.0	1.9	0.2	1.0	1.4	1.2	0.0	0.2	0.3	0.8	0.0	0.1	0.1	0.2	0.6	0.1	0.1	0.2	0.3	0.6
6	1.6	5.7	0.7	3.4	2.0	10	3.4	1.0	6.1	0.1	0.8	3.4	0.5	1.4	0.3	1.3	0.0	0.6	2.1	3.0	0.5	1.4	0.4	0.1	2.3	1.1	1.2	0.5	0.7	1.5	0.5	0.5	1.3	0.6	1.1	0.2	0.2	0.9	0.2	0.4	0.1	0.9	1.0	0.7	0.0	0.8	0.7	0.3
7	1.8	6.0	0.5	3.7	2.4	3.4	10	1.0	2.4	2.0	0.9	1.3	1.4	2.0	0.3	1.0	0.6	0.8	0.3	1.3	0.5	1.4	0.1	0.4	1.3	1.5	0.5	0.1	0.9	2.0	0.2	0.7	1.7	0.4	1.0	0.3	0.2	0.2	0.1	0.1	0.3	0.4	0.8	0.1	0.5	0.9	0.7	0.3
8	3.0	1.2	0.6	1.3	0.1	1.0	1.0	10	0.7	0.8	3.7	0.5	1.0	1.1	0.5	0.6	0.9	0.5	0.5	0.1	1.0	0.6	0.0	0.6	0.1	0.3	0.2	0.8	0.2	0.0	0.3	0.5	0.3	0.3	0.2	1.7	0.3	0.2	0.3	0.3	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.1
9	1.2	5.8	0.6	3.8	2.5	6.1	2.4	0.7	10	0.1	0.6	2.7	0.1	1.2	0.3	1.4	0.2	0.6	1.5	3.2	0.6	0.3	0.3	0.4	2.2	1.1	1.1	0.6	0.4	0.8	0.7	0.2	0.7	0.4	1.0	0.1	0.3	1.1	0.0	0.1	0.1	1.0	1.1	0.2	0.8	0.4	0.8	0.1
10	1.0	0.7	1.2	0.1	0.4	0.1	2.0	0.8	0.1	10	0.2	0.1	0.6	0.4	3.2	0.5	0.0	0.4	0.4	0.5	0.0	0.8	0.5	0.6	0.1	0.6	0.0	0.3	0.0	0.2	0.4	0.5	0.1	0.2	0.6	0.4	0.2	0.1	0.1	0.1	0.3	0.1	0.0	0.2	0.2	0.2	0.2	0.1
11	2.8	0.9	0.4	1.2	0.2	0.8	0.9	3.7	0.6	0.2	10	0.3	0.9	1.2	0.2	0.5	0.8	0.3	0.2	0.3	1.4	0.4	0.0	0.6	0.3	0.1	0.1	1.0	0.3	0.2	0.4	0.4	0.4	0.2	0.1	0.0	0.2	0.3	0.3	0.3	0.5	0.3	0.0	0.0	0.2	0.2	0.1	0.1
12	1.3	4.9	2.0	3.2	1.9	3.4	1.3	0.5	2.7	0.1	0.3	10	0.2	1.8	0.5	2.3	0.3	0.2	0.4	0.9	1.6	0.1	0.4	0.4	1.0	0.4	0.5	0.9	1.3	0.6	0.8	0.1	0.5	1.2	0.2	0.1	0.3	0.0	0.6	0.4	0.0	0.0	0.5	0.5	0.1	0.2	0.1	0.4
13	2.0	1.2	0.4	0.1	0.0	0.5	1.4	1.0	0.1	0.6	0.9	0.2	10	1.3	0.3	0.2	5.4	0.7	0.3	0.3	0.2	1.7	0.3	3.6	0.3	0.4	0.1	0.5	0.1	0.6	0.5	0.4	0.7	0.1	0.6	0.3	0.1	0.3	0.0	0.2	0.2	0.2	0.3	0.2	0.8	0.9	0.3	0.1
14	0.4	2.3	3.1	2.0	2.9	1.4	2.0	1.1	1.2	0.4	1.2	1.8	1.3	10	0.2	1.6	0.0	0.6	0.8	0.1	2.7	0.8	0.3	0.6	1.0	1.4	0.3	2.3	0.3	1.4	0.5	0.5	0.6	0.3	0.6	0.2	0.1	0.3	0.2	0.4	0.2	0.2	1.6	0.2	0.1	0.2	1.1	0.5
15	1.3	0.2	1.0	0.7	0.4	0.3	0.3	0.5	0.3	3.2	0.2	0.5	0.3	0.2	10	0.2	0.5	0.3	0.2	0.4	0.2	0.9	0.4	0.1	0.1	0.4	0.4	0.2	0.2	0.2	0.2	0.3	0.2	0.3	0.2	0.1	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
16	1.2	1.9	2.0	3.0	2.3	1.3	1.0	0.6	1.4	0.5	0.5	2.3	0.2	1.6	0.2	10	0.4	0.6	0.3	0.4	2.1	0.2	0.2	0.0	0.4	0.2	0.0	0.4	0.1	0.3	0.7	0.3	0.0	0.2	0.1	0.1	0.1	0.7	0.2	0.2	0.2	0.2	0.7	0.2	0.1	0.1	0.3	0.1
17	1.8	0.1	1.0	0.8	0.5	0.0	0.6	0.9	0.2	0.0	0.8	0.3	5.4	0.0	0.5	0.4	10	0.5	0.0	0.1	0.3	0.5	0.3	2.5	0.2	0.4	0.3	0.3	0.2	0.0	0.2	0.0	0.0	0.1	0.3	0.2	0.2	0.2	0.0	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.1	0.1
18	0.6	0.8	0.8	1.1	0.9	0.6	0.8	0.5	0.6	0.4	0.3	0.2	0.7	0.6	0.3	0.6	0.5	10	0.0	0.2	0.4	0.3	0.0	0.4	0.0	0.4	0.3	0.3	0.0	0.3	0.6	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.0	0.0	0.4	0.2	0.2	0.1	0.1	0.3	0.1	0.1
19	1.0	3.2	0.3	2.0	2.0	2.1	0.3	0.5	1.5	0.4	0.2	0.4	0.3	0.8	0.2	0.3	0.0	0.0	10	1.5	0.4	0.9	0.3	0.0	0.6	0.5	0.0	0.4	0.1	1.1	0.1	0.3	0.5	0.6	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.5	0.2	0.1	0.1	0.1	0.5	0.1
20	0.4	2.5	0.1	1.4	1.3	3.0	1.3	0.1	3.2	0.5	0.3	0.9	0.3	0.1	0.4	0.4	0.1	0.2	1.5	10	0.3	0.1	1.2	0.3	2.1	0.2	1.8	0.6	1.8	0.8	0.1	0.6	0.8	1.3	0.2	0.2	0.3	1.5	0.2	0.1	0.1	0.5	0.2	0.3	0.1	0.4	0.5	1.6
21	0.0	1.3	2.6	2.0	2.9	0.5	0.5	1.0	0.6	0.0	1.4	1.6	0.2	2.7	0.2	2.1	0.3	0.4	0.4	0.3	10	0.1	0.8	0.1	0.1	0.1	0.6	2.9	0.9	0.1	0.5	0.2	0.0	1.1	0.0	0.0	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.5	0.8
22	0.8	2.6	0.4	0.2	0.1	1.4	1.4	0.6	0.3	0.8	0.4	0.1	1.7	0.8	0.9	0.2	0.5	0.3	0.9	0.1	0.1	10	0.1	1.0	0.9	0.2	0.3	0.1	0.1	0.1	0.2	0.4	0.2	0.0	0.3	0.2	0.2	0.3	0.1	0.1	0.5	0.1	0.3	0.1	0.4	0.4	0.5	0.1
23	0.2	0.7	0.1	1.1	1.3	0.4	0.1	0.0	0.3	0.5	0.0	0.4	0.3	0.3	0.4	0.2	0.3	0.0	0.3	1.2	0.8	0.1	10	0.3	0.3	0.1	2.0	0.6	1.5	1.5	0.2	1.4	1.2	0.8	0.2	0.2	0.2	0.1	0.2	0.1	0.6	0.1	0.3	0.1	0.1	0.1	0.1	0.0
24	1.2	0.1	0.3	0.6	0.4	0.1	0.4	0.6	0.4	0.6	0.6	0.4	3.6	0.6	0.1	0.0	2.5	0.4	0.0	0.3	0.1	1.0	0.3	10	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.1	0.1	0.0
25	0.3	2.0	0.2	1.3	0.8	2.3	1.3	0.1	2.2	0.1	0.3	1.0	0.3	1.0	0.1	0.4	0.2	0.0	0.6	2.1	0.1	0.9	0.3	0.1	10	0.8	0.6	0.2	0.7	0.9	0.2	0.5	0.8	0.1	4.2	0.1	0.1	0.1	0.1	0.9	0.3	0.1	0.8	0.8	0.1	1.2	0.6	0.9
26	0.7	1.3	0.3	1.2	0.4	1.1	1.5	0.3	1.1	0.6	0.1	0.4	0.4	1.4	0.4	0.2	0.4	0.4	0.5	0.2	0.1	0.2	0.1	0.2	0.8	10	0.2	0.2	0.2	1.4	0.2	0.2	0.6	0.2	0.4	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.8	0.1	0.1	1.2	0.6	1.0
27	0.1	1.9	0.1	1.3	1.2	1.2	0.5	0.2	1.1	0.0	0.1	0.5	0.1	0.3	0.4	0.0	0.3	0.3	0.0	1.8	0.6	0.3	2.0	0.2	0.6	0.2	10	0.5	2.0	2.5	0.3	1.1	2.5	2.1	0.2	0.2	0.1	0.8	0.6	0.1	0.1	0.3	0.1	0.9	0.1	0.1	0.1	1.0
28	0.0	0.9	1.9	1.1	2.0	0.5	0.1	0.8	0.6	0.3	1.0	0.9	0.5	2.3	0.2	0.4	0.3	0.3	0.4	0.6	2.9	0.1	0.6	0.2	0.2	0.2	0.5	10	0.8	0.6	0.3	0.1	0.4	0.4	0.2	0.2	0.1	0.2	0.1	0.1	0.4	0.1	0.4	0.1	0.1	0.1	0.1	1.1
29	0.1	1.1	0.1	1.1	1.0	0.7	0.9	0.2	0.4	0.0	0.3	1.3	0.1	0.3	0.2	0.1	0.2	0.0	0.1	1.8	0.9	0.1	1.5	0.2	0.7	0.2	2.0	0.8	10	1.1	0.2	0.1	1.0	4.3	0.2	0.1	0.1	0.1	0.7	0.1	0.1	0.4	0.1	1.5	0.6	0.7	0.1	1.1
30	0.3	1.9	0.3	2.0	1.9	1.5	2.0	0.0	0.8	0.2	0.2	0.6	0.6	1.4	0.2	0.3	0.0	0.3	1.1	0.8	0.1	0.1	1.5	0.2	0.9	1.4	2.5	0.6	1.1	10	0.1	2.0	7.4	1.0	0.5	0.2	0.1	0.1	0.1	0.1	0.1	0.4	0.4	0.4	0.1	0.7	0.1	1.1
31	0.7	0.7	1.6	0.2	0.2	0.5	0.2	0.3	0.7	0.4	0.4	0.8	0.5	0.5	0.2	0.7	0.2	0.6	0.1	0.1	0.5	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.1	10	0.1	0.1	0.5	0.1	0.1	0.1	0.2	0.1	0.3	0.1	0.8	0.9	0.5	0.1	0.7	0.1	0.0
32	0.1	0.8	0.1	1.0	1.0	0.5	0.7	0.5	0.2	0.5	0.4	0.1	0.4	0.5	0.3	0.3	0.0	0.2	0.3	0.6	0.2	0.4	1.4	0.2	0.5	0.2	1.1	0.1	0.1	2.0	0.1	10	1.7	0.5	0.5	0.1	0.1	0.2	0.3	0.1	0.4	0.1	0.1	0.1	0.1	0.7	0.1	0.0
33	0.4	1.6	0.1	1.5	1.4	1.3	1.7	0.3	0.7	0.1	0.4	0.5	0.7	0.6	0.2	0.0	0.0	0.3	0.5	0.8	0.0	0.2	1.2	0.2	0.8	0.6	2.5	0.4	1.0	7.4	0.1	1.7	10	1.5	0.9	0.2	0.2	0.1	0.1	0.1	0.1	0.4	0.5	0.1	0.1	0.7	0.8	1.2
34	0.0	1.2	0.5	0.9	1.2	0.6	0.4	0.3	0.4	0.2	0.2	1.2	0.1	0.3	0.3	0.2	0.1	0.3	0.6	1.3	1.1	0.0	0.8	0.1	0.1	0.2	2.1	0.4	4.3	1.0	0.5	0.5	1.5	10	0.2	0.1	0.1	0.7	0.4	0.1	0.1	1.0	0.1	1.2	0.7	0.1	0.0	0.0
35	0.2	1.6	0.4	0.4	0.0	1.1	1.0	0.2	1.0	0.6	0.1	0.2	0.6	0.6	0.2	0.1	0.3	0.3	0.2	0.2	0.0	0.3	0.2	0.3	4.2	0.4	0.2	0.2	0.2	0.5	0.1	0.5	0.9	0.2	10	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.5	0.6	0.1	0.8	0.9	0.0
36	0.1	0.4	0.5	0.3	0.2	0.2	0.3	1.7	0.1	0.4	0.0	0.1	0.3	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.0	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.2	0.1	0.1	0.2	0.1	0.1	10	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
37	0.5	0.4	0.6	0.4	0.3	0.2	0.2	0.3	0.3	0.2	0.2	0.3	0.1	0.1	0.3	0.1	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.3	0.1	10	0.1	0.1	2.0	0.1	0.1	0.6	0.1	0.1	0.0	1.0	0.0
38	0.5	0.8	0.2	1.1	0.8	0.9	0.2	0.2	1.1	0.1	0.3	0.0	0.3	0.3	0.3	0.7	0.2	0.2	0.2	1.5	0.2	0.3	0.1	0.2	0.1	0.1	0.8	0.2	0.1	0.1	0.2	0.2	0.1	0.7	0.1	0.1	0.1	10	0.1	0.1	0.1	0.5	0.1	0.1	0.1	0.0	0.0	0.0
39	0.6	0.3	0.4	0.2	0.0	0.2	0.1	0.3	0.0	0.1	0.3	0.6	0.0	0.2	0.2	0.2	0.0	0.0	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.6	0.1	0.7	0.1	0.1	0.3	0.1	0.4	0.1	0.1	0.1	0.1	10	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
40	0.3	0.1	0.2	0.2	0.1	0.4	0.1	0.3	0.1	0.1	0.3	0.4	0.2	0.4	0.2	0.2	0.2	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.9	0.1	0.1	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	2.0	0.1	0.1	10	0.1	0.1	0.7	0.1	0.0	0.0	0.0	0.0
41	0.3	0.0	0.3	0.1	0.1	0.1	0.3	0.1	0.1	0.3	0.5	0.0	0.2	0.2	0.2	0.2	0.2	0.4	0.2	0.1	0.2	0.5	0.6	0.1	0.3	0.1	0.1	0.4	0.1	0.1	0.1	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	10	0.1	0.0	0.0	0.0	0.0	0.0	0.0
42	0.3	0.5	0.4	0.6	0.2	0.9	0.4	0.1	1.0	0.1	0.3	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.5	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.1	0.4	0.4	0.8	0.1	0.4	1.0	0.1	0.1	0.1	0.5	0.1	0.1	0.1	10	0.9	0.0	0.0	0.0	0.0	0.0
43	0.4	1.0	0.5	1.2	0.6	1.0	0.8	0.1	1.1	0.0	0.0	0.5	0.3	1.6	0.2	0.7	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.1	0.8	0.8	0.1	0.4	0.1	0.4	0.9	0.1	0.5	0.1	0.5	0.1	0.6	0.1	0.1	0.7	0.0	0.9	10	0.0	0.0	0.0	1.6	0.0
44	0.7	0.1	0.2	0.2	0.1	0.7	0.1	0.2	0.2	0.2	0.0	0.5	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.8	0.1	0.9	0.1	1.5	0.4	0.5	0.1	0.1	1.2	0.6	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	10	0.0	0.0	0.0	0.0
45	0.0	0.5	0.3	0.1	0.1	0.0	0.5	0.2	0.8	0.2	0.2	0.1	0.8	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.4	0.1	0.5	0.1	0.1	0.1	0.1	0.6	0.1	0.1	0.1	0.1	0.7	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	10	0.0	0.0	0.0
46	0.0	0.6	0.2	0.0	0.2	0.8	0.9	0.2	0.4	0.2	0.2	0.2	0.9	0.2	0.1	0.1	0.3	0.3	0.1	0.4	0.1	0.4	0.1	0.1	1.2	1.2	0.1	0.1	0.7	0.7	0.7	0.7	0.7	0.1	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10	0.0	0.0
47	0.1	0.7	0.0	0.5	0.3	0.7	0.7	0.2	0.8	0.2	0.1	0.1	0.3	1.1	0.1	0.3	0.1	0.1	0.5	0.5	0.5	0.5	0.1	0.1	0.6	0.6	0.1	0.1	0.1	0.1	0.1	0.1	0.8	0.0	0.9	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	10	0.0
48	0.2	0.5	0.2	0.5	0.6	0.3	0.3	0.1	0.1	0.1	0.1	0.4	0.1	0.5	0.1	0.1	0.1	0.1	0.1	1.6	0.8	0.1	0.0	0.0	0.9	1.0	1.0	1.1	1.1	1.1	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10

Figure A14.5

APPENDIX 15
CAST DATA FOR JET ACCIDENTS 1987 – 2008

INTRODUCTION

This appendix contains a replication of the Jet accident database provided to EBT by CAST. It also contains certain results in graphic format from the CAST analysis as well as some further analysis by the EBT data subgroup of the aforementioned cast data (1991-2008) augmented with two more recent years (2009 & 2010) from the NTSB Accident Database.

15.1 CAST DATA FOR JET ACCIDENTS 1987 – 2008

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
1	LOC-I		0.982	0.982	38	12	50	1	39	12	0	03/01/1987	1987	Varig	Brazil	Western	Abidjan, Ivory Coast	B707	Jet	T/O Climb to Cruise	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
2	Midair		1	1.000	8	2	10	0	8	2	2	15/01/1987	1987	Skywest	USA	Western	Kearns, Ut	SA-226	TP-Small	Landing - Approach	xx	No	100	North America	NA-Car	US-Canada	2 Ground fatal	yes
3	LOC-I		0.504	0.504	7	2	9	10	16	3	0	04/03/1987	1987	Northwest Ex	USA	Western	Romulus, Mi	C-212	TP-Small	Landing - Approach	xx	No	100	North America	NA-Car	US-Canada	x	yes
4	RE-Takeoff			0.000					21			06/01/1987	1987	Braathens Sverige AB	Sweden		Stockholm	Caravelle-	Jet	TAKEOFF				Europe	EUROPE	Sweden	HULL LOSS	ASEDB
5	SCF-NP			0.000				1	167			12/02/1987	1987	Conair A/S	Denmark		SALZBURG	720-518	Jet	LANDING				Europe	EUROPE	Denmark	HULL LOSS	ASEDB
6	LOC-I		0.333	0.333	2	0	2	0	4	2	0	08/05/1987	1987	American Eagle (Exec)	USA	Western	Mayaguez	C-212	TP-Small	Landing - Approach	xx	No	100	North America	NA-Car	US-Canada	x	yes
7	ARC			0.000					102			23/02/1987	1987	SAS	Sweden		TRONDHEIM	DC-9-41	Jet	LANDING				Europe	EUROPE	Sweden	HULL LOSS	ASEDB
8	USOS		0.623	0.623	23	4	27	18	37	8	0	04/04/1987	1987	Garuda	Indonesia	Western	Medan, Sumatra, Indonesia	DC-9	Jet	Landing - Approach	T-Storm	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
9	SCF-NP			0.000								06/04/1987	1987	Conair A/S	Denmark		ROME	720-051B	Jet	LANDING				Europe	EUROPE	Denmark	HULL LOSS	ASEDB
10	CFIT		1	1.000	0	2	2	0	0	2	0	12/10/1987	1987	AeroEjecutivos SA	Colombia	Western	(near) Ocana, CO	DHC-6	TP-Large	Landing - Initial Descent?	Vis	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
11	ICE		1	1.000	34	3	37	0	34	3	0	15/10/1987	1987	Aero Transporte	Italy	Western	Mount Crezzo, italy	ATR-42	TP-Large	En Route	Icing	No	100	Europe	Europe	EU-EFTA	x	yes
12	FUEL		1	1.000	0	2	2	0	0	2	0	28/10/1987	1987	SMB Stage	USA	Western	Bartlesville Ok	Convair 640 (340D)	TP-Large	Landing - Rollout	xx	No	100	North America	NA-Car	US-Canada	x	yes
13	RE-Landing			0.000								11/04/1987	1987	Transbrasil	Brazil		MANAUS	707-330C	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Brazil	HULL LOSS	ASEDB
14	ICE		0.865	0.865	16	2	18	3	19	2	0	23/11/1987	1987	Ryan	USA	Western	Homer, Ak	BE1900	TP-Small	Landing - Approach	Icing	No	100	North America	NA-Car	US-Canada	x	yes
15	CFIT		1	1.000	0	4	4	0	0	4	0	13/04/1987	1987	Buffalo	USA	Western	KCI	B707	Jet	Landing - Approach	Fog	No	100	North America	NA-Car	US-Canada	x	yes
16	CFIT		1	1.000	13	3	16	0	13	3	0	21/12/1987	1987	Air Littoral	France	Western	Bordeaux, FR	EMB-120	TP-Small	Landing - Approach	xx	No	100	Europe	Europe	EU-EFTA	x	yes
17	ADRM		0.492	0.492	1	0	1	34	0	6	0	04/08/1987	1987	LanChile	Chile	Western	Calama, CL	B737	Jet	Landing - Rollout	xx	No	100	Latin America & Caribbean	SA/CA	Asia-Low-Mdl Income	x	yes
18	Other			0.003		1	1		324			11/08/1987	1987	All Nippon Airways	Japan		WASHINGTON	747-200	Jet	PARKED				Asia	ASIA (EX CHINA)	Japan	NONE	ASEDB
19	CFIT		0.533	0.533	7	2	9	1	15	2	0	19/01/1988	1988	Trans Colorado	USA	Western	Bayfield, Co	SA-227	TP-Small	Sabotage	Wind	No	100	North America	NA-Car	US-Canada	x	yes
20	RE-Landing	ARC	0.014	0.014	0	0	0	1	0	4	0	29/01/1988	1988	ICS - Inter Ciel Service	France	Western	Toulouse, FR	BAC Vanguard	TP-Large	T/O Aborted	xx	No	100	Europe	Europe	EU-EFTA	x	yes
21	SCF-NP		1	1.000	19	2	21	0	19	2	0	08/02/1988	1988	NFD Luftverkehrs AG	Germany	Western	Mulheim, DE	Fairchild (Swngn) Metro	TP-Small	Landing - Approach	T-Storm	No	100	Europe	Europe	EU-EFTA	x	yes
22	LOC-I		0.833	0.833	10	2	10	0	10	2	0	19/02/1988	1988	AvAir-AmEagle	USA	Western	Cary, NC	SA-227	TP-Small	T/O Initial Climb	xx	No	100	North America	NA-Car	US-Canada	x	yes
23	LOC-I		0.994	0.994	148	6	154	1	149	6	1	16/08/1987	1987	Northwest	USA	Western	Romulus	DC-9	Jet	T/O Initial Climb	xx	No	100	North America	NA-Car	US-Canada	1 Ground fatal	yes
24	SCF-NP		1	1.000	20	3	23	0	20	3	0	04/03/1988	1988	TAT European Airlines	France	Western	Fontainebleau, FR	Fairchild FH-227	TP-Small	Initial Descent	IMC	No	100	Europe	Europe	EU-EFTA	x	yes
25	LOC-I		1	1.000	74	9	83	0	74	9	0	31/08/1987	1987	Tahi Int	Thailand	Western	Phuket, Thailand	B737	Jet	Landing - Approach	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
26	ICE		0.361	0.361	25	3	28	28	77	5	0	15/11/1987	1987	Continental	USA	Western	DEN	DC-9	Jet	T/O Initial Climb	Snow	No	100	North America	NA-Car	US-Canada	x	yes
27	FIRE-NI		1	1.000	140	19	159	0	140	19	0	28/11/1987	1987	South African Airways	So Africa	Western	134nm NE of Mauritius, MU	B747	Jet	En Route	xx	No	100	Africa	Africa	Africa	x	yes
28	CFIT		1	1.000	33	3	36	0	33	3	0	06/05/1988	1988	Wideroe	Norway	Western	Bronnoysund, Norway	DHC-7	TP-Large	Landing - Approach	Cloud	No	100	Europe	Europe	EU-EFTA	x	yes
29	ARC		0	0.000	0	0	0	0	98	5	0	27/12/1987	1987	Eastern	USA	DC-9	Pensacola, Fla	B727	Jet	Landing - Rollout	Wind, Echo	No	100	North America	NA-Car	US-Canada	x	yes
30	LOC-I		0.5	0.500	0	2	2	0	2	2	0	26/05/1988	1988	Star Air	Sudan	Western	Hanover, DE	Fokker F.27	TP-Large	Landing - Approach	xx	Yes	100	Africa	Africa	Africa	x	yes
31	CFIT		1	1.000	11	5	16	0	11	5	0	02/01/1988	1988	Condor	Germany	Western	Izmir, Turkey	B737	Jet	Initial Descent	Rain	No	100	Europe	Europe	EU-EFTA	x	yes
32	CFIT		1	1.000	1	3	4	0	1	3	0	16/06/1988	1988	Myanma Airways	Myanmar	Western	Putao, BU	Fokker F.27	TP-Large	Initial Descent	Cloud	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
33	LOC-I		0.375	0.375	0	3	3	0	5	3	0	06/07/1988	1988	Lineas Aereas Suramericanas	Colombia	Western	Barranquilla, CO	Canadair CL-44	TP-Large	T/O Climb to Cruise	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
34	CFIT		1	1.000	11	4	15	0	11	4	0	27/02/1988	1988	Talia Air	Turkey	Western	No. Cyprus	B727	Jet	Landing - Approach	Fog	No	100	Europe	Europe	NoAfr/MidEast	x	yes
35	CFIT		1	1.000	137	6	143	0	137	6	0	17/03/1988	1988	Avianca	Colombia	Western	Cucuta, CO	B727	Jet	T/O Climb to Cruise	Fog	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes

Figure A15.1

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
36	LOC-I		1	1.000	0	4	4	0	0	4	0	31/03/1988	1988	ARAX Airlines	Egypt	Western	Cairo, EG	DC-8	Jet	T/O Initial Climb	xx	No	100	Africa	Africa	NoAfr/MidEast	x	yes
37	SCF-NP		0.01	0.010	0	1	1	0	96	7	0	28/04/1988	1988	Aloha	USA	Western	Maui	B737	Jet	En Route	xx	No	100	North America	NA-Car	US-Canada	x	yes
38	SCF-NP		0.5	0.500	0	2	2	0	2	2	0	15/09/1988	1988	First Air	Canada	Western	Ottawa, CA	BAE (HS) 748	TP-Large	Initial Descent	xx	No	100	North America	NA-Car	US-Canada	x	yes
39	RE-Takeoff			0.000				2	240			21/05/1988	1988	American Airlines	USA		DALLAS	DC-10	Jet	TAKEOFF				North America	NA-Car	USA	HULL LOSS	ASEDB
40	RE-Takeoff		0.002	0.002	0	0	0	1	16	9	0	23/05/1988	1988	LACSA	Honduras	Western	San Jose, CR	B727	Jet	T/O Run	xx	Yes	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
41	CFIT		1	1.000	15	7	22	0	15	7	0	12/06/1988	1988	Austral	Argentina	Western	Posadas, Argentina	MD-81	Jet	Landing - Approach	Fog	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
42	CFIT		1	1.000	0	6	6	0	0	6	0	21/07/1988	1988	TAAG (Angola Air Charter)	Angola	Western	Lagos, NG	B707	Jet	Approach	xx	xx	100	Africa	Africa	Africa	x	yes
43	SCF-PP		0	0.000	0	0	0	0	260	15	0	24/07/1988	1988	Air France	France	Western	Delhi, IN	B747	Jet	Landing - Rollout	xx	No	91	Europe	Europe	EU-EFTA	x	yes
44	CFIT		1	1.000	31	3	34	0	31	3	0	19/10/1988	1988	Vayudoot	India	Western	Gauhati, India	Fokker F.27	TP-Large	Landing - Approach	Rain	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
45	SCF-NP			0.000					7			27/08/1988	1988	TWA	USA		CHICAGO	727-100	Jet	LANDING				North America	NA-Car	USA	HULL LOSS	ASEDB
46	CFIT		0.382	0.382	4	2	6	2	14	2	0	14/11/1988	1988	Bothia Flight	Finland	Western	Seinajoki, FI	EMB-110	TP-Small	Landing - Approach	IMC	No	100	Europe	Europe	EU-EFTA	x	yes
47	CFIT		0	0.000	0	0	0	0	0	3	0	03/12/1988	1988	Air Creebec	Canada	Western	Waskaganish, CA	BAE (HS) 748	TP-Large	Landing - Approach	Snow	No	100	North America	NA-Car	US-Canada	x	yes
48	USOS		0.081	0.081	1	6	7	13	89	7	0	31/08/1988	1988	CAAC	China	Western	Hong Kong	Trident-2	Jet	Landing - Approach	Rain-Wind	No	100	Asia	**Asia**	Asia-Low-Mdl Income	x	yes
49	LOC-I		0.144	0.143	12	2	14	26	101	7	0	31/08/1988	1988	Delta	USA	Western	DFW	B727	Jet	T/O Aborted	xx	No	100	North America	NA-Car	US-Canada	x	yes
50	CFIT		1	1.000	0	2	2	0	0	2	0	12/01/1989	1989	First Air	Canada	Western	Dayton, Ohio	BAE (HS) 748	TP-Large	T/O Initial Climb	xx	No	100	North America	NA-Car	US-Canada	x	yes
51	OTHER-BIRD		0.332	0.332	35	0	35	27	104	6	0	15/09/1988	1988	Ethiopian AL	Ethiopia	Western	Bahir Dar, Ethiopia	B737	Jet	T/O Initial Climb	xx	No	100	Africa	Africa	Africa	x	yes
52	RE-Landing	ARC	0	0.000	0	0	0	0	56	6	0	26/09/1988	1988	Aerolineas Argentinas	Argentina	Western	Ushuaia, AR	B737	Jet	Landing - Rollout	Wind	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
53	ARC		0	0.000	0	0	0	0	125	7	0	15/10/1988	1988	Nigeria Airways	Nigeria	Western	Port Harcourt, NG	B737	Jet	Landing - Rollout	T-Storm	No	100	Africa	Africa	Africa	x	yes
54	CFIT		0.633	0.633	26	7	32	16	45	7	0	17/10/1988	1988	Uganada AL	Uganda	Western	Rome	B707	Jet	Landing - Approach	Fog	No	100	Africa	Africa	Africa	x	yes
55	CFIT		0.986	0.986	127	6	133	2	129	6	0	19/10/1988	1988	Indian Airlines	India	Western	Ahmedabad, India	B737	Jet	Landing - Approach	Haze	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
56	LOC-I		0.179	0.179	11	1	12	6	65	4	0	25/10/1988	1988	Aero Peru	Peru	Western	Juliaca, Peru	Fokker 28	Jet	T/O Initial Climb	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
57	FUEL		1	1.000	3	5	8	0	3	5	0	13/12/1988	1988	GAS Air Nigeria	Nigeria	Western	Luxor, EG	B707	Jet	Initial Descent	Vis	No	100	Africa	Africa	Africa	x	yes
58	SCF-PP		0.407	0.407	47	0	47	74	118	8	0	08/01/1989	1989	British Midland	UK	Western	East Midlands, UK	B737	Jet	T/O Climb to Cruise	xx	No	100	Europe	Europe	EU-EFTA	x	yes
59	LOC-I		1	1.000	14	2	16	0	14	2	0	08/05/1989	1989	Swedeways AL	Sweden	Western	Virkvams, Sweden	C99	TP-Small	Landing - Approach	xx	Yes	100	Europe	Europe	EU-EFTA	x	yes
60	CFIT		1	1.000	137	7	144	0	137	7	0	08/02/1989	1989	Independent Air	USA	Western	Azores	B707	Jet	Landing - Initial Descent	Cloud	No	100	North America	NA-Car	US-Canada	x	yes
61	RE-Landing	ARC		0.000					103			09/02/1989	1989	LAM	Mozambique		LICHINGA	737-200	Jet	LANDING				Africa	AFRICA	Mozambique	HULL LOSS	ASEDB
62	Other			0.000		1	1					09/02/1989	1989	Evergreen International A/L	USA		SALT LAKE CITY	DC-9-	Jet	CLIMB				North America	NA-Car	USA	NONE	ASEDB
63	CFIT		1	1.000	0	4	4	0	0	4	0	19/02/1989	1989	Flying Tiger	USA	Western	Malaysia	B747	Jet	Landing - Approach	Cloud-fog	No	100	North America	NA-Car	US-Canada	x	yes
64	SCF-NP		0.026	0.026	9	0	9	5	337	18	0	24/02/1989	1989	United	USA	Western	HNL	B747	Jet	T/O Climb to Cruise	xx	No	100	North America	NA-Car	US-Canada	x	yes
65	ICE		0.364	0.364	21	3	24	19	65	4	0	10/03/1989	1989	Air Ontario	Canada	Western	Dryden, Ont	Fokker 28	Jet	T/O Initial Climb	Snow	No	100	North America	NA-Car	US-Canada	x	yes
66	LOC-I		1	1.000	0	2	2	0	0	2	0	18/03/1989	1989	Evergreen	USA	Western	Saginaw, Tex	DC-9	Jet	T/O Initial Climb	xx	No	100	North America	NA-Car	US-Canada	x	yes
67	CFIT		1	1.000	0	3	3	0	0	3	#	21/03/1989	1989	Transbrasil	Brazil	Western	Sao Paulo	B707	Jet	Landing - Approach	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	22 Ground fatal	yes
68	ARC		0	0.000	0	0	0	0	133	6	0	03/04/1989	1989	Faucett	Peru	Western	Iquitos, PE	B737	Jet	Landing - Rollout	Rain, x-wind	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
69	LOC-I		1	1.000	2	3	5	0	3	2	2	26/04/1989	1989	Aerosucre Colombia	Colombia	Western	Barranquilla, CO	Caravelle	Jet	T/O Initial Climb	xx	Yes	100	Latin America & Caribbean	SA/CA	SA (Northern)	2 Ground fatal	yes
70	CFIT		1	1.000	18	2	20	0	18	2	0	28/10/1989	1989	Aloha Island Air	USA	Western	Malawi Bay	DHC-6	TP-Small	En Route	Cloud	No	100	North America	NA-Car	US-Canada	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
71	RE-Takeoff		0	0.000	0	0	0	0	69	8	0	17/05/1989	1989	Somali Airlines	Somalia	Western	Nairobi, KE	B707	Jet	T/O Aborted	Heavy Rain	No	100	Africa	Africa	Africa	x	yes
72	ICE		1	1.000	4	2	6	0	4	2	0	26/12/1989	1989	United Express	USA	Western	Pasco, Wa	BAe--31	TP-Small	Landing - Approach	Icing	No	100	North America	NA-Car	US-Canada	x	yes
73	CFIT		0.954	0.954	169	9	178	7	178	9	0	07/06/1989	1989	Surinam Awy	Surinam	Western	Paramaribo, Surinam	DC-8	Jet	Landing - Approach	xx	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
74	CFIT		1	1.000	20	3	23	0	20	3	0	15/01/1990	1990	SANSA	Costa R	Western	San Jose, CR	Casa-212	TP-Small	T/O Climb to Cruise	IMC	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
75	RE-Landing			0.000					66			11/07/1989	1989	Kenya Airways	Kenya		ADDIS ABABA	707-351B	Jet	LANDING				Africa	AFRICA	Kenya	HULL LOSS	ASEDB
76	CFIT		1	1.000	11	4	15	0	11	4	0	05/02/1990	1990	Helicol	Colombia	Western	Ibague, Colombia	G-159	TP-Large	En Route	Clouds	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
77	LOC-I		0	0.000	0	0	0	0	36	4	2	12/02/1990	1990	TAM	Brazil	Western	Bauru, Brazil	Fokker F.27	TP-Large	Go Around	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	2 Ground fatal	yes
78	SCF-PP		0.387	0.387	111	1	112	46	285	11	0	19/07/1989	1989	United	USA	Western	Sioux City	DC-10	Jet	Landing - Approach	xx	No	100	North America	NA-Car	US-Canada	x	yes
79	CFIT		1	1.000	0	3	3	0	0	3	0	21/03/1990	1990	TAN Honduras	Honduras	Western	Tegucigalpa, HN	L-188 Electra	TP-Large	Landing - Approach	Rain-Fog	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
80	RE-Landing			0.000					91			21/07/1989	1989	Philippine Airlines	Philippines		MANILA	BAC 1-11-500	Jet	LANDING				Asia	ASIA (EX CHINA)	Philippines	HULL LOSS	ASEDB
81	SCF-NP		1	1.000	3	2	5	0	3	2	0	12/04/1990	1990	Wideroe	Norway	Western	Vaeroy, Norway	DHC-6	TP-Small	T/O Initial Climb	Turb	No	100	Europe	Europe	EU-EFTA	x	yes
82	LOC-I		0.5	0.500	15	5	20	0	35	5	0	10/05/1990	1990	Noroeste	Mexico	Western	Tuxtla Gutierrez, Mex	SA-227	TP-Small	Landing - Approach	xx	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
83	CFIT		0.362	0.362	68	4	72	0	181	18	6	27/07/1989	1989	Korean Air	Korea	Western	Tripoli, Kibya	DC-10	Jet	Landing - Approach	Fog	No	100	Asia	Asia	Asia-Low-Mdl Income	6 Ground fatal	yes
84	RE-Landing			0.000	0	0	0	0				10/08/1989	1989	Apisa Air Cargo	Peru		IQUITOS	DC-8-33F	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Peru	HULL LOSS	ASEDB
85	SCF-PP		1	1.000	19	2	21	0	19	2	0	18/05/1990	1990	Aerolift	Philippines	Western	Manila	BE 1900	TP-Small	T/O Initial Climb	xx	Yes	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
86	RE-Takeoff		0.008	0.008	0	0	0	9	59	6	0	16/08/1989	1989	LADE	Argentina	Western	San Carlos de Bariloche, AR	Fokker F.28	Jet	T/O Run	Snow - Slush		100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
87	LOC-I		1	1.000	33	5	38	0	33	5	0	21/11/1990	1990	Bangkok A.W.	Thailand	Western	Koh Samui, Thailand	DHC-8	TP-Small	Go Around	Rain	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
88	CFIT			0.000					165			25/08/1989	1989	Toros Air	Turkey		ANKARA	727-247	Jet	INITIAL CLIMB				Europe	EUROPE	Turkey	HULL LOSS	ASEDB
89	FUEL		0.24	0.240	12	0	12	17	48	6	0	03/09/1989	1989	Varig	Brazil	Western	San Jose do Xingu, Brazil	B737	Jet	En Route	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
90	CFIT		0.048	0.048	1	0	1	0	18	3	0	30/01/1991	1991	Merpati Nusantara	Indonesia	Western	Gorontalo, ID	IPTN 212	TP-Small	Initial Descent	T-Storm	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
91	ICE		0.039	0.039	0	0	0	13	17	2	0	30/01/1991	1991	CCAir	USA	Western	Beckley, US	BAE 31	TP-Small	Landing - Rollout	Icing	No	100	North America	NA-Car	US-Canada	x	yes
92	ARC			0.000					88			07/09/1989	1989	Okada Air	Nigeria		PORT HARCOURT	BAC 1-11-	Jet	LANDING				Africa	AFRICA	Nigeria	HULL LOSS	ASEDB
93	RE-Takeoff		0.035	0.034	2	0	2	3	57	6	0	20/09/1989	1989	USAir	USA	Western	LGA	B737	Jet	T/O Aborted	IMC	No	100	North America	NA-Car	US-Canada	x	yes
94	FIRE-NI		0	0.000	0	0	0	0	12	7	0	14/10/1989	1989	Delta	USA	Western	SLC	B737	Jet	Ground, Parked	xx	No	100	North America	NA-Car	US-Canada	x	yes
95	CFIT		0.91	0.910	129	3	132	14	139	7	0	21/10/1989	1989	Sahsa	Honduras	Western	Tegucigalpa, HN	B727	Jet	Descent	Clouds-wind	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
96	CFIT		1	1.000	47	7	54	0	47	7	0	26/10/1989	1989	China Airlines	Taiwan	Western	Hualien, Taiwan	B737	Jet	T/O Initial Climb	IMC	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
97	ICE		0.022	0.022	1	0	1	3	47	6	0	25/11/1989	1989	Korean Air	Korea	Western	Seoul	F28	Jet	T/O Aborted	Ice	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
98	SCF-PP		1	1.000	20	3	23	0	20	3	0	05/04/1991	1991	Atlantic Southeast Airlines	USA	Western	Brunswick, US	EMB-120	TP-Small	Approach	xx	No	100	North America	NA-Car	US-Canada	x	yes
99	SCF-PP		0.51	0.510	10	1	11	4	19	3	0	19/04/1991	1991	Air Tahiti	Tahiti	Western	Marquess Islands, PF	DO 228	TP-Small	Approach	xx	No	100	Aust	Aust/asia	Pacific	x	yes
100	SCF-NP			0.000					125			30/12/1989	1989	America West Airlines	USA		TUCSON	737-200	Jet	LANDING				North America	NA-Car	USA	HULL LOSS	ASEDB
101	RE-Landing			0.000					66			30/12/1989	1989	Air Ivoire	Cote d'Ivoire		MAN	F-28	Jet	LANDING				Africa	AFRICA	Cote d'Ivoire	HULL LOSS	ASEDB
102	ARC		0	0.000	0	0	0	0	14	3	0	09/06/1991	1991	Royal Nepal Airlines	Nepal	Western	Lukla, NP	DHC-6	TP-Small	Landing - Rollout	Clouds	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
103	RE-Landing		0	0.000	0	0	0	0	85	5	0	05/01/1990	1990	Aerolineas Argentinas	Argentina	Western	Villa Gesell, AR	Fokker F.28	Jet	Landing - Rollout	Rain	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
104	LOC-I		0.874	0.874	12	1	13	2	13	2	0	10/07/1991	1991	L'Express	USA	Western	(near) Birmingham, US	BE 99	TP-Small	Approach	T-Storm-Wind	No	100	North America	NA-Car	US-Canada	x	yes
105	FUEL		0.492	0.491	65	8	73	81	149	9	0	25/01/1990	1990	Avianca	Colombia	Western	Long Is., NY	B707	Jet	Landing - Approach	Rain-Wind	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
106	USOS		0.639	0.639	88	4	92	22	139	7	0	14/02/1990	1990	Indian Airlines	India	Western	Bangalore, India	A320	Jet	Landing - Approach	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
107	SCF-NP		1	1.000	11	3	14	0	11	3	0	11/09/1991	1991	Continental Express	USA	Western	(near) Eagle Lake, US	EMB-120	TP-Small	Initial Descent	xx	No	100	North America	NA-Car	US-Canada	x	yes
108	CFIT		1	1.000	0	4	4	0	0	4	0	17/09/1991	1991	Ethiopian Airlines	Ethiopia	Western	Djibouti City, DJ	Hercules	TP-Large	Initial Descent	Clouds	No	100	Africa	Africa	Africa	x	yes
109	LOC-I		1	1.000	0	2	2	0	0	2	0	18/09/1991	1991	Canair	Canada	Western	Belvidere Centre, US	CV 580	TP-Large	En Route	xx	No	100	North America	NA-Car	US-Canada	x	yes
110	CFIT		1	1.000	13	2	15	0	13	2	0	27/09/1991	1991	Solomon Airlines	Solomon Is	Western	Avuavu, SB	DHC-6	TP-Small	Initial Descent	Rain-Cloud	No	100	Aust	Aust/asia	Pacific	x	yes
111	ARC			0.000					82			17/02/1990	1990	AVIACO	Spain		PALMA	DC-9-32	Jet	LANDING				Europe	EUROPE	Spain	HULL LOSS	ASEDB
112	USOS			0.000					3			01/03/1990	1990	Katale Aero Transport	Congo		GOMA	707-329C	Jet	FINAL APPROACH				Africa	AFRICA	Congo, The Democratic Republic of the	HULL LOSS	ASEDB
113	RE-Landing	ARC	0	0.000	0	0	0	0	102	5	0	22/03/1990	1990	Air China	China	Western	Guilin, CN	BAE (HS) Trident	Jet	Landing - Rollout	T-Storm	No	100	Asia	**Asia**	Asia-Low-Mdl Income	x	yes
114	CFIT		0.5	0.500	1	1	2	0	2	2	0	03/01/1992	1992	Commutair	USA	Western	(near) Saranac Lake, US	BE 1900	TP-Small	Approach	IMC	No	100	North America	NA-Car	US-Canada	x	yes
115	SCF-NP		1	0.000	0	0	0	0	175	20	0	07/05/1990	1990	Air India	India	Western	New Delhi	B747-200	Jet	Landing - Rollout	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
116	FIRE-NI		0.067	0.067	8	0	8	0	113	6	0	11/05/1990	1990	Philippine AL	Philippines	Western	Manila	B737	Jet	Ground, Parked	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
117	CFIT		0.562	0.562	26	4	30	26	50	6	0	09/02/1992	1992	Afrique Airlink	Sudan	Western	Kafoutine, SN	CV 640	TP-Large	Landing - Rollout	xx	No	100	Africa	Africa	Africa	x	yes
118	ARC			0.000					25			14/07/1990	1990	Trans Arabian Air Transport	Sudan		KHARTOUM	707-349C	Jet	LANDING				Africa	AFRICA	Sudan	HULL LOSS	ASEDB
119	SCF-NP			0.000					22			22/07/1990	1990	US Airways	USA		KINSTON	737-200	Jet	TAKEOFF				North America	NA-Car	USA	HULL LOSS	ASEDB
120	LOC-I		0.029	0.029	0	0	0	1	0	2	0	19/03/1992	1992	Bearskin Airlines	Canada	Western	Red Lake, CA	DHC-6	TP-Large	T/O Initial Climb	xx	xx	100	North America	NA-Car	US-Canada	x	yes
121	RE-Takeoff			0.000	0	0	0	0				25/07/1990	1990	Ethiopian Airlines	Ethiopia		ADDIS ABABA	707-300	Jet	TAKEOFF				Africa	AFRICA	Ethiopia	HULL LOSS	ASEDB
122	TURB			0.043	1		1	2	26			03/10/1990	1990	Eastern Air Lines	USA		WEST PALM BEACH	DC-9-31	Jet	CRUISE				North America	NA-Car	USA	NONE	ASEDB
123	Other			1.000	1		1		1			05/11/1990	1990	Indian Airlines	India		GOA	A300-	Jet	LOAD/UNLOAD				Asia	ASIA (EX CHINA)	India	NONE	ASEDB
124	CFIT		1	1.000	40	0	46	0	40	6	0	14/11/1990	1990	Alitalia	Italy	Western	Zurich	DC-9	Jet	Landing - Approach	Rain	No	100	Europe	Europe	EU-EFTA	x	yes
125	RI		0.097	0.195	7	1	8	10	39	5	0	03/12/1990	1990	Northwest	USA	Western	Detroit	B727-200/ DC-9-14	Jet					North America	NA-Car	US-Canada	x	yes
126	CFIT		1	1.000	3	7	10	0	3	7	0	04/12/1990	1990	Sudania Air Cargo	Sudan	Western	Nairobi	B707	Jet	Go Around	Fog	No	100	Africa	Africa	Africa	x	yes
127	SCF-PP		1	1.000	3	2	5	0	3	2	0	07/06/1992	1992	Executive Airlines	USA	Western	Mayaguez, US	CASA 212	TP-Small	Approach	xx	No	100	North America	NA-Car	US-Canada	x	yes
128	CFIT		0.529	0.529	2	1	3	3	4	2	0	08/06/1992	1992	GP Express Airlines	USA	Western	(near) Anniston, US	BE 99	TP-Small	Approach	Fog	No	100	North America	NA-Car	US-Canada	x	yes
129	RI		0.627	1.000	10	2	12	0	10	2	0	01/02/1991	1991	Skywest (USA)/ USAir (USA)	USA	Western	LAX	SA-227 (Metro)/ B737-300	Jet					North America	NA-Car	US-Canada	x	yes
130	CFIT		1	1.000	63	7	70	0	63	7	0	24/07/1992	1992	Mandala Airlines	Indonesia	Western	Ambon, ID	BAC Viscount	TP-Large	Approach	Rain	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
131	ICE		1	1.000	0	2	2	0	0	2	0	17/02/1991	1991	Ryan International Airlines	USA	Western	Cleveland, US	MD DC-9	Jet	T/O Initial Climb	Snow, icing	No	100	North America	NA-Car	US-Canada	x	yes
132	RE-Landing	ARC	0.279	0.279	20	0	20	2	65	7	0	20/02/1991	1991	LanChile	Chile	Western	Puerto Williams, CL	BAE-146	Jet	Landing - Rollout	Rain	No	100	Latin America & Caribbean	SA/CA	Asia-Low-Mdl Income	x	yes
133	LOC-I		1	1.000	20	5	25	0	20	5	0	03/03/1991	1991	United Airlines	USA	Western	Colorado Springs, US	B737	Jet	Approach	Wind	No	100	North America	NA-Car	US-Canada	x	yes
134	CFIT		1	1.000	40	5	45	0	40	5	0	05/03/1991	1991	Aeropostal	Venezuela	Western	Valesa, VE	DC-9	Jet	Initial Descent		No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
135	RE-Takeoff		0.014	0.014	0	0	0	1	0	4	0	12/03/1991	1991	Air Transport International	USA	Western	New York, US	MD DC-8	Jet	T/O Aborted	xx	Yes	100	North America	NA-Car	US-Canada	x	yes
136	SCF-NP		0	0.000	0	0	0	0	15	2	0	29/10/1992	1992	Talair	Papua NG	Western	Esa'ala, PG	DHC-6	TP-Small	Landing - Rollout	xx	No	100	Aust	Aust/asia	Pacific	x	yes
137	SCF-PP		0	0.000	0	0	0	0	0	3	0	03/05/1991	1991	Ryan International Airlines	USA	Western	Hartford, US	B727	Jet	T/O Run	xx	No	100	North America	NA-Car	US-Canada	x	yes
138	SCF-PP		1	1.000	213	10	223	0	213	10	0	26/05/1991	1991	Lauda Air	Austria	Western	94nm. NW of Bangkok, TH	B767	Jet	T/O Climb to Cruise	xx	No	100	Europe	Europe	Hi-Income Asia-Pac	x	yes
139	ARC			0.000					119			13/06/1991	1991	Korean Air	South Korea		TAEGU	727-200	Jet	LANDING				Asia	ASIA (EX CHINA)	South Korea	HULL LOSS	ASEDB
140	FUEL		0.053	0.054	4	0	3	0	53	3	0	26/06/1991	1991	Okada Air	Nigeria	Western	Sokoto, NG	BAC 1-11	Jet	Initial Descent	IMC	No	100	Africa	Africa	Africa	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
141	CFIT		1	1.000	31	6	37	0	31	6	0	13/12/1992	1992	Scibe Airlift	Congo, Zr	Western	Goma, ZR	Fokker F.27	TP-Large	Initial Descent	xx	No	100	Africa	Africa	Africa	x	yes
142	SCF-NP		1	1.000	247	14	261	0	247	14	0	11/07/1991	1991	Nationair Canada	Canada	Western	Jeddah, SA	DC-8	Jet	T/O Initial Climb	xx	No	100	North America	NA-Car	US-Canada	x	yes
143	CFIT		1	1.000	63	6	69	0	63	6	0	16/08/1991	1991	Indian Airlines	India	Western	Imphal, IN	B737	Jet	Initial Descent	Rain-Cloud	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
144	ICE		0	0.000	0	0	0	0	28	3	0	02/01/1993	1993	Express Airlines	USA	Western	Hibbing, US	Saab 340	TP-Small	Landing - Rollout	Icing	No	100	North America	NA-Car	US-Canada	x	yes
145	CFIT		0.194	0.194	4	0	4	8	19	4	0	06/01/1993	1993	Lufthansa CityLine	Germany	Western	Paris, FR	Dash 8	TP-Large	Approach	Rain-Fog	No	100	Europe	Europe	EU-EFTA	x	yes
146	SCF-PP		0.415	0.415	13	4	17	22	39	5	0	09/01/1993	1993	Bouraq Indonesia	Indonesia	Western	Surabaya, ID	BAE (HS) 748	TP-Large	T/O Initial Climb	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
147	ARC			0.000								14/09/1991	1991	Kabo Air	Nigeria		PORT HARCOURT	BAC 1-11-200	Jet	LANDING				Africa	AFRICA	Nigeria	HULL LOSS	ASEDB
148	FUEL		0	0.000	0	0	0	0	30	5	0	24/03/1993	1993	Air West Express	Sudan	Western	Addis Ababa, ET	Fokker F.27	TP-Large	En Route	xx	No	100	Africa	Africa	Africa	x	yes
149	SCF-NP			0.000								29/09/1991	1991	Aerosucre	Colombia		BOGOTA	Caravelle-	Jet	TAKEOFF				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Colombia	HULL LOSS	ASEDB
150	SCF-NP			0.000								10/11/1991	1991	AERONICA	Nicaragua		MANAGUA	727-25	Jet	PARKED				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Nicaragua	HULL LOSS	ASEDB
151	ARC			0.000					36			17/11/1991	1991	SAHSA	Honduras		SAN JOSE	737-200	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Honduras	HULL LOSS	ASEDB
152	RE-Takeoff		0	0.000	0	0	0	0	189	10	0	07/12/1991	1991	Libyan Arab Airlines	Libya	Western	Tripoli, LY	B707	Jet	T/O Run	xx	No	100	Africa	Africa	NoAfr/MidEast	x	yes
153	RE-Landing			0.000					90			17/12/1991	1991	Alitalia	Italy		WARSAW	DC-9-32	Jet	LANDING				Europe	EUROPE	Italy	HULL LOSS	ASEDB
154	RE-Landing	ARC	0	0.000	0	0	0	0	14	3	0	29/04/1993	1993	Cont Exp	USA	Western	Pine Bluff, Ark	EMB-120	TP-Small	T/O Climb to cruise	Ice - wind	No	100	North America	NA-Car	US-Canada	x	yes
155	SCF-PP		0.001	0.001	0	0	0	3	123	6	0	27/12/1991	1991	SAS	Multi-Nat	Western	Stockholm, SE	MD-80	Jet	T/O Initial Climb	xx	No	100	Europe	Europe	EU-EFTA	x	yes
156	SCF-PP		1	1.000	0	5	5	0	0	5	0	29/12/1991	1991	China Airlines	Taiwan	Western	Taipei, TW	B747	Jet	T/O Climb to Cruise	xx	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
157	ARC		0.003	0.003	0	0	0	2	36	5	0	18/01/1992	1992	US Airways	USA	Western	Elmira, US	MD DC-9	Jet	Landing - Rollout	Wind	No	100	North America	NA-Car	US-Canada	x	yes
158	CFIT		0.909	0.909	82	5	87	5	90	6	0	20/01/1992	1992	Air France Europe	France	Western	Strasbourg, FR	A320	Jet	Approach	xx	No	100	Europe	Europe	EU-EFTA	x	yes
159	CFIT		0.023	0.023	0	0	0	2	0	5	0	15/02/1992	1992	MK Airlines	Ghana	Western	Kano, NG	DC-8	Jet	Approach	xx	No	100	Africa	Africa	Africa	x	yes
160	LOC-I		1	1.000	0	4	4	0	0	4	0	15/02/1992	1992	BAX Global dba Air Transpt Int	USA	Western	Toledo, US	MD DC-8	Jet	Go Around	Rain, fog, wind	No	100	North America	NA-Car	US-Canada	x	yes
161	ICE		0.54	0.540	25	2	27	9	47	4	0	22/03/1992	1992	US Airways	USA	Western	New York, US	Fokker F.28	Jet	T/O Initial Climb	Icing	No	100	North America	NA-Car	US-Canada	x	yes
162	RE-Landing	ARC	0	0.000	0	0	0	0	38	7	0	06/10/1993	1993	Myanma Airways	Myanmar	Western	Kawthaung, BU	Fokker F.27	TP-Large	Landing - Rollout	Rain-Wind	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
163	CFIT		1	1.000	4	3	7	0	4	3	0	24/03/1992	1992	Golden Star Air Cargo	Sudan	Western	Athens, GR	B707	Jet	Approach	Cloud-Mist	No	100	Africa	Africa	Africa	x	yes
164	CFIT		0.385	0.384	4	3	7	12	17	3	0	27/10/1993	1993	Wideroe's Flyveselskap	Norway	Western	Namsos, NO	DHC-6	TP-Small	Approach	Rain-Wind	No	100	Europe	Europe	EU-EFTA	x	yes
165	ARC		0	0.000	0	0	0	0	88	4	0	26/03/1992	1992	Inter (Colombia)	Colombia	Western	Tumaco, CO	DC-9	Jet	Landing - Rollout	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
166	LOC-I		1	1.000	4	3	7	0	4	3	0	10/11/1993	1993	Air Manitoba	Canada	Western	Sandy Lake, CA	BAE (HS) 748	TP-Large	T/O Initial Climb	xx	No	100	North America	NA-Car	US-Canada	x	yes
167	SCF-NP			0.000					3			28/03/1992	1992	Export Air Leasing	USA		IQUITOS	DC-8-33AF	Jet	LANDING				North America	NA-Car	USA	HULL LOSS	ASEDB
168	ARC		0.002	0.002	0	0	0	4	94	5	0	30/03/1992	1992	Aviaco	Spain	Western	Granada, ES	DC-9	Jet	Landing - Rollout	Wind	No	100	Europe	Europe	EU-EFTA	x	yes
169	CFIT		1	1.000	16	2	18	0	16	2	0	01/12/1993	1993	Express Airlines	USA	Western	Hibbing, US	BAE 31	TP-Small	Approach	Rain, Cloud, ice	No	100	North America	NA-Car	US-Canada	x	yes
170	MIDAIR		1	1.000	1	2	3	0	1	2	0	09/12/1993	1993	Air Senegal	Senegal	Western	Dakar, SN	DHC-6	TP-Small	Approach	xx	No	100	Africa	Africa	Africa	x	yes
171	LOC-I		1	1.000	2	3	5	0	2	3	0	07/01/1994	1994	Atlantic Coast Airlines	USA	Western	(near) Columbus, US	BAE 41	TP-Small	Approach	Snow, ice	No	100	North America	NA-Car	US-Canada	x	yes
172	LOC-I		0.529	0.529	0	1	1	1	0	2	0	25/02/1994	1994	British World Airlines	UK	Western	(nr) Uttoxeter, GB	BAC Viscount	TP-Large	En Route	Icing	No	100	Europe	Europe	EU-EFTA	x	yes
173	SCF-NP		0	0.000	0	0	0	0	0	5	0	31/03/1992	1992	Kabo Air	Nigeria	Western	Orange, FR	B707	Jet	En Route	Turb	No	100	Africa	Africa	Africa	x	yes
174	SCF-NP		1	1.000	40	7	47	0	40	7	0	06/06/1992	1992	COPA Airlines	Panama	Western	Tocuti, PA	B737	Jet	En Route	xx	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
175	SCF-PP		0.147	0.147	2	1	3	9	21	3	0	04/04/1994	1994	KLM cityhopper	Nederland	Western	Amsterdam, NL	Saab 340	TP-Small	Go Around	xx	No	100	Europe	Europe	EU-EFTA	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
176	CFIT		1	1.000	1	2	3	0	1	2	0	22/06/1992	1992	VASP	Brazil	Western	Cruzeiro do Sul, BR	B737	Jet	Initial Descent	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
177	SCF-NP		0	0.000	0	0	0	1	280	12	0	30/07/1992	1992	Trans World Airlines	USA	Western	New York, US	L-1011	Jet	T/O Initial Climb	xx	No	100	North America	NA-Car	US-Canada	x	yes
178	CFIT		1	1.000	7	2	9	0	7	2	0	13/06/1994	1994	Aero Cuahonte	Mexico	Western	Uruapan, MX	Metro	TP-Small	Go Around	Rain-cloud	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
179	CFIT		1	1.000	7	5	12	0	7	5	0	18/06/1994	1994	Merpati Nusantara	Indonesia	Western	Palu, ID	Fokker F.27	TP-Large	Approach	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
180	CFIT		1	1.000	99	14	113	0	99	14	0	31/07/1992	1992	Thai Airways International	Thailand	Western	Kathmandu, NP	A310	Jet	Go Around	T-Storm	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
181	SCF-PP		0	0.000	0	0	0	0	38	4	0	05/07/1994	1994	Pakistan International	Pakistan	Western	Dera Ismail Khan, PK	Fokker F.27	TP-Large	Go Around	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
182	ARC		0	0.000	0	0	0	0	53	4	0	23/08/1992	1992	Kabo Air	Nigeria	Western	Sokoto, NG	BAC 1-11	Jet	Landing - Rollout	xx	No	100	Africa	Africa	Africa	x	yes
183	RE-Landing			0.000					66			29/08/1992	1992	Hold-Trade Air Services	Nigeria		KADUNA	BAC 1-11-200	Jet	LANDING				Africa	AFRICA	Nigeria	HULL LOSS	ASEDB
184	CFIT		1	1.000	155	12	167	0	155	12	0	28/09/1992	1992	Pakistan International	Pakistan	Western	Kathmandu, NP	A300	Jet	Approach	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
185	SCF-PP		1	1.000	1	3	4	0	1	3	0	04/10/1992	1992	El Al	Israel	Western	Amsterdam, NL	B747	Jet	T/O Climb to Cruise	xx	No	100	Middle East	**Asia**	NoAfr/MidEast	x	yes
186	RE-Landing			0.000								15/10/1992	1992	LAC Airlines	Colombia		MEDELLIN	DC-8	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Colombia	HULL LOSS	ASEDB
187	ICE		1	1.000	64	4	68	0	64	4	0	31/10/1994	1994	Simmons Airlines	USA	Western	35sm Southeast of Gary, US	ATR 72	TP-Large	Initial Descent	Icing	No	100	North America	NA-Car	US-Canada	x	yes
188	SCF-NP		0	0.000	0	0	0	0	14	2	0	20/11/1992	1992	Aerolineas Argentinas	Argentina	Western	San Luis, AR	B737	Jet	T/O Aborted	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
189	LOC-I		0.764	0.764	13	2	15	5	18	2	0	13/12/1994	1994	Flagship Airlines	USA	Western	Raleigh-Durham, US	BAE 31	TP-Small	Approach	xx	No	100	North America	NA-Car	US-Canada	x	yes
190	LOC-I		1	1.000	133	8	141	0	133	8	0	24/11/1992	1992	China Southern Airlines	China	Western	Guilin, CN	B737	Jet	Approach	IMC	No	100	Asia	**Asia**	Asia-Low-Mdl Income	x	yes
191	CFIT		0	0.000	0	0	0	0	0	4	0	25/11/1992	1992	DAS Air	Uganda	Western	Kano, NG	B707	Jet	Approach	Vis	No	100	Africa	Africa	Africa	x	yes
192	RE-Takeoff		0	0.000	0	0	0	0	36	4	0	22/12/1994	1994	Lloyd Aereo Boliviano	Bolivia	Western	Guayaramerin, BO	Fokker F.27	TP-Large	T/O Aborted	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
193	RE-Landing		0	0.000	0	0	0	0	0	4	0	26/11/1992	1992	AeroBrasil	Brazil	Western	Manaus, BR	B707	Jet	T/O Initial Climb	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
194	ARC		0.183	0.183	54	2	56	106	327	13	0	21/12/1992	1992	Martinair Holland	Nederland	Western	Faro, PT	DC-10	Jet	Landing - Rollout	Windshear	No	100	Europe	Europe	EU-EFTA	x	yes
195	RE-Takeoff		0.088	0.088	1	1	2	2	21	3	0	17/01/1995	1995	Royal Nepal Airlines	Nepal	Western	Kathmandu, NP	DHC-6	TP-Small	T/O Run	xx	Yes	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
196	MIDAIR		1	1.000	147	10	157	0	147	10	0	22/12/1992	1992	Libyan Arab Airlines	Libya	Western	Tripoli, LY	B727	Jet	Approach	xx	No	100	Africa	Africa	NoAfr/MidEast	x	yes
197	USOS			0.000								15/01/1993	1993	Air Afrique	Cote d'Ivoire		ABIDJAN	707-321C	Jet	LANDING				Africa	AFRICA	Cote d'Ivoire	HULL LOSS	ASEDB
198	MIDAIR		1	1.000	1	2	3	0	1	2	5	01/05/1995	1995	Bearskin Airlines	Canada	Western	Sioux Lookout, CA	Metro	TP-Small	Approach	xx	No	100	North America	NA-Car	US-Canada	5 fatal in other A/C	yes
199	SCF-NP		1	1.000	9	3	12	0	9	3	0	24/05/1995	1995	Knight Air	UK	Western	Leeds, GB	EMB-110	TP-Small	T/O Climb to Cruise	Rain-Turb	No	100	Europe	Europe	EU-EFTA	x	yes
200	SCF-NP			0.000					156			31/01/1993	1993	LADE	Argentina		RECIFE	707-300B	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Argentina	HULL LOSS	ASEDB
201	CFIT		0.274	0.274	4	1	5	13	18	3	0	09/06/1995	1995	Qantas New Zealand	New Zealand	Western	Palmerston North, NZ	Dash 8	TP-Large	Approach	Rain-Clouds	No	100	Aust	Aust/asia	Hi-Income Asia-Pac	x	yes
202	LOC-I		1	1.000	13	2	15	0	13	2	0	12/07/1995	1995	MBA - PNG	Papua NG	Western	Alotau, PG	DHC-6	TP-Small	En Route	xx	No	100	Aust	Aust/asia	Pacific	x	yes
203	ICE		0.863	0.863	79	4	83	13	92	5	0	05/03/1993	1993	Palair Macedonian	Macedonia	Western	Skopje, MK	Fokker 100	Jet	T/O Initial Climb	Snow	No	100	Europe	Europe	Euro Central	x	yes
204	RE-Landing		0	0.000	0	0	0	0	12	2	0	20/08/1995	1995	Haiti Air Express	Haiti	Western	Jeremie, HT	ASTA Nomad	TP-Small	Landing - Rollout	xx	No	100	Latin America & Caribbean	**NA-Car**	CA/Carib	x	yes
205	SCF-PP		0.336	0.336	8	1	9	13	26	3	0	21/08/1995	1995	Atlantic Southeast Airlines	USA	Western	40 miles SW of Atlanta, US	EMB-120	TP-Small	T/O Climb to Cruise	xx	No	100	North America	NA-Car	US-Canada	x	yes
206	CFIT		0.957	0.957	17	4	21	1	18	4	0	09/09/1995	1995	SATENA	Colombia	Western	(near) La Macarena, CO	CASA 212	TP-Small	Landing - Approach	Rain - Fog		100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
207	RE-Landing	ARC	0.642	0.642	32	2	34	0	49	4	0	15/09/1995	1995	Malaysia Airlines	Malaysia	Western	Tawau, MY	Fokker 50	TP-Large	Landing - Rollout	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
208	SCF-PP		0.076	0.076	0	1	1	1	12	2	0	03/10/1995	1995	Sabang Merauke Raya Air Charter	Indonesia	Western	Bakongan-Tapak Tuan, ID	IPTN 212	TP-Small	En Route	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
209	OTHER-BIRD		0.012	0.011	0	0	0	4	17	3	0	22/10/1995	1995	Ethiopian Airlines	Ethiopia	Western	Addis Ababa, ET	DHC-6	TP-Small	Approach	xx	No	100	Africa	Africa	Africa	x	yes
210	RE-Landing	ARC	0	0.000	0	0	0	0	227	9	0	05/04/1993	1993	TACA	Salvador	Western	Guatemala City, GT	B767	Jet	Landing - Rollout	xx	No	73	Latin America & Caribbean	SA/CA	CA/Carib	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
211	LOC-I		0.011	0.011	2	0	2	15	248	16	0	06/04/1993	1993	China Eastern Airlines	China	Western	off Shemya, US	MD MD-11	Jet	En Route	xx	xx	1	Asia	Asia	Asia-Low-Mdl Income	x	yes
212	RE-Landing	ARC	0.001	0.001	0	0	0	2	189	13	0	14/04/1993	1993	American	USA	DC-10	DFW	DC-10	Jet	Landing - Rollout	Wind (Tail)	No	100	North America	NA-Car	US-Canada	x	yes
213	LOC-I		0.98	0.980	137	4	141	3	139	5	0	18/12/1995	1995	Trans Service Airlift	Congo, Zr	Western	Jamba, AO	L-188 Electra	TP-Large	T/O Initial Climb	xx	No	100	Africa	Africa	Africa	x	yes
214	ARC		0	0.000	0	0	0	0	115	5	0	18/04/1993	1993	Japan Air System	Japan	Western	Hanamaki, Japan	MD DC-9	Jet	Approach-Landing	Windshear	No	100	Asia	Asia	Asia-High Income	x	yes
215	RAMP			0.000					314			24/04/1993	1993	Air France Europe	France		MONTPELLIER	A300-B2	Jet	TAXI				Europe	EUROPE	France	HULL LOSS	ASEDB
216	CFIT		0.482	0.482	52	4	56	15	112	6	0	26/04/1993	1993	Indian Airlines	India	Western	Aurangabad, IN	B737	Jet	T/O Initial Climb	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
217	LOC-I		0.749	0.749	9	2	11	4	13	2	0	12/02/1996	1996	Haiti Air Express	Haiti	Western	Port-au-Prince, HT	ASTA Nomad	TP-Small	T/O Initial Climb	xx	Yes	100	Latin America & Caribbean	NA-Car	CA/Carib	x	yes
218	CFIT		1	1.000	125	7	132	0	125	7	0	19/05/1993	1993	SAM Colombia	Colombia	Western	Medellin, CO	B727	Jet	Initial Descent	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
219	CFIT		0.353	0.353	6	0	6	0	15	2	0	05/04/1996	1996	Formosa Airlines	Taiwan	Western	off Matsu Island, TW	DO 228	TP-Small	Approach	Rain-Fog	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
220	ARC			0.000					72			21/06/1993	1993	Garuda Indonesia	Indonesia		DENPASAR	DC-9-32	Jet	LANDING				Asia	ASIA (EX CHINA)	Indonesia	HULL LOSS	ASEDB
221	ARC		0	0.000	0	0	0	0	11	2	0	03/05/1996	1996	Penair	USA	Western	St.George, US	Metro	TP-Small	Landing - Rollout	xx	No	100	North America	NA-Car	US-Canada	x	yes
222	CFIT		0.956	0.956	37	4	41	2	39	4	0	01/07/1993	1993	Merpati Nusantara	Indonesia	Western	Sorong, ID	Fokker F.28	Jet	Approach	Rain-Fog	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
223	ARC		0.009	0.009	0	0	0	14	88	6	0	18/07/1993	1993	SAHSA	Honduras	Western	Managua, NI	B737	Jet	Landing - Rollout	Rain	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
224	RE-Takeoff		0.495	0.495	54	1	55	16	108	5	0	23/07/1993	1993	China Northwest Airlines	China	Western	Yinchuan, CN	BAE-146	Jet	T/O Run	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
225	CFIT		0.621	0.620	64	4	68	26	106	6	0	26/07/1993	1993	Asiana Airlines	Korea	Western	Mokpo, KR	B737	Jet	Approach	Rain-Wind	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
226	LOC-I		0.058	0.057	0	0	0	3	0	3	0	18/08/1993	1993	Kitty Hawk International	USA	Western	Guantanamo Bay, CU	MD DC-8	Jet	Approach	xx	No	100	North America	NA-Car	US-Canada	x	yes
227	Fire-NI			0.000					98			05/09/1993	1993	Dominicana Airlines	Dominican Republic		SANTO DOMINGO	727-281	Jet	CRUISE				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Dominican Republic	HULL LOSS	ASEDB
228	SCF-PP		1	1.000	0	4	4	0	0	4	0	20/07/1996	1996	No Air Cargo	USA	Western	Russian Missn	DC-6	Piston	En Route	xx	No	100	North America	NA-Car	US-Canada	x	yes
229	USOS		0.182	0.182	8	0	8	16	44	5	0	24/07/1996	1996	Myanma Airways	Myanmar	Western	Myeik, BU	Fokker F.27	TP-Large	Approach	Rain-Clouds	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
230	RE-Landing	ARC	0.036	0.035	1	1	2	9	64	7	0	14/09/1993	1993	Lufthansa	Germany	Western	Warsaw	A320	Jet	Landing - Rollout	Rain-Wind	No	100	Europe	Europe	EU-EFTA	x	yes
231	SCF-PP		0	0.000	0	0	0	0	152	8	0	25/10/1993	1993	Far Eastern Air Transport	Taiwan	Western	Kaohsiung, TW	MD-80	Jet	T/O Initial Climb	xx	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
232	RE-Landing			0.039	2		2	13	71			26/10/1993	1993	China Eastern Airlines	China		FUZHOU	MD-82-	Jet	LANDING				Asia	CHINA	China	HULL LOSS	ASEDB
233	RE-Landing		0	0.000	0	0	0	1	274	22	0	04/11/1993	1993	China Airlines	Taiwan	Western	Hong Kong, HK	B747	Jet	Landing - Rollout	Typhoon	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
234	Other			0.039	1		1	1	27			08/11/1993	1993	Saudia	Saudi Arabia		MANILA	747-100	Jet	PARKED				Middle East	MIDDLE EAST	Saudi Arabia	MINOR DAMAGE	ASEDB
235	CFIT		0.122	0.122	8	4	12	7	92	10	0	13/11/1993	1993	China Northern Airlines	China	Western	Urumqi, CN	MD-80	Jet	Approach	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
236	FUEL		0	0.000	0	0	0	0	250	13	0	15/11/1993	1993	Indian Airlines	India	Western	Tirupati, IN	A300	Jet	En Route	Fog	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
237	RI		1	1.000	10	2	12	0	10	2	2	19/11/1996	1996	Great Lakes Airlines	USA	Western	Quincy, US	BE 1900	TP-Small	Landing - Rollout	xx	No	100	North America	NA-Car	US-Canada	2 fatal in other A/C	yes
238	RE-Landing			0.000					86			20/11/1993	1993	COPA Airlines	Panama		PANAMA CITY	737-100	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Panama	HULL LOSS	ASEDB
239	CFIT		0.623	0.623	2	1	3	2	3	2	0	08/01/1997	1997	Polynesian Airlines	Polynesia	Western	Apia, WS	DHC-6	TP-Small	En Route	Rain-Clouds	No	100	Aust	Aust/asia	Pacific	x	yes
240	LOC-I		1	1.000	26	3	29	0	26	3	0	09/01/1997	1997	Comair	USA	Western	25 miles S. of Detroit, US	EMB-120	TP-Small	Initial Descent	Icing	No	100	North America	NA-Car	US-Canada	x	yes
241	RE-Takeoff		0	0.000	0	0	0	0	9	2	0	10/01/1997	1997	Mesa/USAir Exp	USA	Western	Bangor, Me	BE1900	TP-Small	T/O Run	Ice - wind	No	100	North America	NA-Car	US-Canada	x	yes
242	RE-Landing			0.000					6			15/03/1994	1994	Sec Colombia	Colombia		Bogota	Caravelle-	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Colombia	HULL LOSS	ASEDB
243	USOS		0.001	0.001	0	0	0	2	110	6	0	21/03/1994	1994	Aviaco	Spain	Western	Vigo, ES	DC-9	Jet	Approach	Rain-Fog0-Wind	No	100	Europe	Europe	EU-EFTA	x	yes
244	RE-Takeoff		0.215	0.215	0	1	1	5	0	6	0	14/04/1997	1997	TAAG - Angola Airlines	Angola	Western	Brazzaville, CG	Fokker F.27	TP-Large	T/O Initial Climb	xx	Yes	100	Africa	Africa	Africa	x	yes
245	SCF-PP		0.283	0.283	11	4	15	0	48	5	0	19/04/1997	1997	Merpati Nusantara	Indonesia	Western	Tandjungpandan, ID	BAE (HS) ATP	TP-Large	Go Around	Wind	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
246	LOC-I		1	1.000	63	12	75	0	63	12	0	23/03/1994	1994	Aeroflot Russian Airlines	Russia	Western	40nm East of Novokuznetsk, RU	A310	Jet	En Route	xx	No	100	CIS	**Europe**	Euro East	x	yes
247	SCF-PP		0.6	0.600	25	5	30	0	45	5	0	17/07/1997	1997	Sempati Air	Indonesia	Western	Bandung, ID	Fokker F.27	TP-Large	T/O Climb to Cruise	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
248	LOC-I		0.976	0.976	249	15	264	7	256	15	0	26/04/1994	1994	China Airlines	Taiwan	Western	Nagoya, JP	A300	Jet	Go Around	xx	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
249	RE-Landing	ARC	0.059	0.059	0	1	1	0	14	3	0	30/07/1997	1997	Air Littoral	France	Western	Florence, IT	ATR 42	TP-Large	Landing - Rollout	xx	No	100	Europe	Europe	EU-EFTA	x	yes
250	USOS		0	0.000	0	0	0	0	0	3	7	27/04/1994	1994	TransAfrik	Sao Tome	Western	M'Banza Congo, AO	B727	Jet	Approach	xx	No	100	Africa	Africa	Africa	7 Ground fatals	yes
251	ARC			0.905	76	4	80	9	89			01/07/1994	1994	Air Mauritanie	Mauritania		TIDJIKJA	F-28	Jet	LANDING				Africa	AFRICA	Mauritania	HULL LOSS	ASEDB
252	WSTRW		0.665	0.665	37	0	37	16	52	5	0	02/07/1994	1994	US Airways	USA	Western	Charlotte, US	MD DC-9	Jet	Go Around	T-Storm-Wind	No	100	North America	NA-Car	US-Canada	x	yes
253	RE-Landing	ARC	0	0.000	0	0	0	0	140	8	0	20/07/1994	1994	China Yunnan	China	Western	Kunming, CN	B737	Jet	Landing - Rollout	xx	No	100	Asia	**Asia**	Asia-Low-Mdl Income	x	yes
254	CFIT		1	1.000	14	2	16	0	14	2	0	10/08/1997	1997	Formosa Airlines	Taiwan	Western	Matsu, TW	DO 228	TP-Small	Go Around	Rain	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
255	RE-Landing	ARC	0	0.000	0	0	0	0	152	8	0	10/08/1994	1994	Korean Air	Korea	Western	Cheju, KR	A300	Jet	Landing - Rollout	Rain-Cloud-Wind	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
256	RE-Landing	ARC	0	0.000	0	0	0	0	79	7	0	18/08/1994	1994	ADC Airlines	Nigeria	Western	Monrovia, LR	DC-9	Jet	Landing - Rollout	Rain	No	100	Africa	Africa	Africa	x	yes
257	LOC-I		1	1.000	127	5	132	0	127	5	0	08/09/1994	1994	US Airways	USA	Western	20nm NW of Pittsburgh, US	B737	Jet	Approach	xx	No	100	North America	NA-Car	US-Canada	x	yes
258	SCF-PP		0.019	0.019	0	0	0	4	10	2	0	24/11/1997	1997	Rollins Air	Honduras	Western	La Ceiba, HN	ASTA Nomad	TP-Small	Initial Descent	IMC	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
259	RE-Landing		0	0.000	0	0	0	0	50	4	0	07/12/1997	1997	KLM uk	UK	Western	St. Peter Port, GB	Fokker F.27	TP-Large	Landing - Rollout	Rain-Wind	No	100	Europe	Europe	EU-EFTA	x	yes
260	CFIT		0.279	0.279	3	1	4	13	15	2	0	09/12/1997	1997	Sowind Air	Canada	Western	Little Grand Rapids, CA	EMB-110	TP-Small	Approach	Fog	Yes	100	North America	NA-Car	US-Canada	x	yes
261	FUEL		0.178	0.178	2	3	5	34	32	7	0	18/09/1994	1994	Oriental Airlines	Nigeria	Western	Tamanrasset, DZ	BAC 1-11	Jet	Approach	Fog	No	100	Africa	Africa	Africa	x	yes
262	SCF-NP			0.000					2			09/10/1994	1994	LAB	Bolivia		SAO PAULO	707-300	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Bolivia	HULL LOSS	ASEDB
263	UNK			1.119	59	7	66		59			12/10/1994	1994	Iran Asseman Airlines	Iran		NATANZ	F-28-1000	Jet	CRUISE				Middle East	MIDDLE EAST	Iran	HULL LOSS	ASEDB
264	RI		0	0.000	0	0	0	0	132	5	2	22/11/1994	1994	TWA	USA	Western	STL	MD-82	Jet	T/O Run	xx	No	100	North America	NA-Car	US-Canada	2 Ground fatal	yes
265	RE-Landing			0.001				2	78			30/11/1994	1994	Merpati Nusantara Airlines	Indonesia		SEMARANG	F-28-4000	Jet	LANDING				Asia	ASIA (EX CHINA)	Indonesia	HULL LOSS	ASEDB
266	CFIT		0.623	0.623	0	3	3	2	0	5	0	19/12/1994	1994	Nigeria Airways	Nigeria	Western	170km. NE of Kano, NG	B707	Jet	Initial Descent	xx	No	100	Africa	Africa	Africa	x	yes
267	CFIT		1	1.000	0	5	5	0	0	5	0	21/12/1994	1994	Air Algerie	Algeria	Western	(near) Coventry, GB	B737	Jet	Landing - Approach	xx	xx	100	Africa	Africa	NoAfr/MidEast	x	yes
268	SCF-PP		1	1.000	9	2	11	0	9	2	0	18/06/1998	1998	Propair	Canada	Western	Montreal	Metro	TP-Small	T/O Climb to Cruise	xx	No	100	North America	NA-Car	US-Canada	x	yes
269	MIDAIR		1	1.000	12	2	14	0	12	2	1	30/07/1998	1998	Proteus Airlines	France	Western	Vannes, FR	BE 1900	TP-Small	En Route	xx	No	100	Europe	Europe	EU-EFTA	1 fatal in other A/C	yes
270	CFIT		0.764	0.764	52	5	57	19	69	7	0	29/12/1994	1994	THY - Turkish Airlines	Turkey	Western	Van, TR	B737	Jet	Approach	Snow	No	100	Europe	Europe	NoAfr/MidEast	x	yes
271	RE-Landing			0.000								02/01/1995	1995	LAC	Congo,		KINSHASA	737-200	Jet	LANDING				Africa	AFRICA	Congo, The Democratic Republic of the	HULL LOSS	ASEDB
272	USOS		0.061	0.061	1	0	1	6	20	2	0	28/09/1998	1998	TACV Cabo Verde	Capr Verde	Western	Praia, CV	DHC-6	TP-Small	Approach	T-Storm-Wind	No	100	Africa	Africa	Africa	x	yes
273	CFIT		0.982	0.982	46	5	51	1	47	5	0	11/01/1995	1995	Inter (Colombia)	Colombia	Western	40km. South of Cartagena, CO	DC-9	Jet	Initial Descent	Cloud	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
274	RE-Landing			0.000					52			16/01/1995	1995	Sempati Air Transport	Indonesia		YOGYAKARTA	737-200	Jet	LANDING				Asia	ASIA (EX CHINA)	Indonesia	HULL LOSS	ASEDB
275	RE-Landing			0.000								31/01/1995	1995	Angola Air Charter	Angola		Huambo Airport	727-100	Jet	LANDING				Africa	AFRICA	Angola	HULL LOSS	ASEDB
276	SCF-NP			0.001				2	121			01/02/1995	1995	VASP Airlines	Brazil		SAO PAULO	737-200	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Brazil	HULL LOSS	ASEDB
277	LOC-I		1	1.000	0	2	2	0	0	2	0	12/01/1999	1999	Channel Express	UK	Western	St. Peter Port, GB	Fokker F.27	TP-Large	Landing - Approach	xx	No	100	Europe	Europe	EU-EFTA	x	yes
278	RE-Landing	ARC	0.133	0.133	3	1	4	2	27	4	0	25/02/1999	1999	Minerva Italy	Italy	Western	Genoa, IT	Fairchild/Dornier 328	TP-Small	Landing - Rollout	Wind	No	100	Europe	Europe	EU-EFTA	x	yes
279	LOC-I		1	1.000	50	10	60	0	50	10	0	31/03/1995	1995	TAROM	Romania	Western	Bucharest, RO	A310	Jet	T/O Climb to Cruise	xx	No	100	Europe	Europe	Euro East	x	yes
280	CFIT		1	1.000	3	2	5	0	3	2	0	08/04/1999	1999	Aerotaca	Colombia	Western	Malaga, CO	DHC-6	TP-Small	Approach	Clouds-Wind	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
281	RE-Landing	ARC	0.019	0.019	0	0	0	1	0	3	6	28/04/1995	1995	Millon Air	USA	Western	Guatemala City, GT	MD DC-8	Jet	Landing - Rollout	Rain	No	100	North America	NA-Car	US-Canada	6 Ground fatal	yes
282	CFIT		0.583	0.583	6	1	7	0	11	1	0	08/05/1999	1999	Vanair	Vanuata	Western	Port Vila, NH	DHC-6	TP-Small	Approach	Rain	No	100	Aust	Aust/asia	Pacific	x	yes
283	RE-Landing			0.000					35			31/05/1995	1995	Air Niugini	Papua New Guinea		MADANG	F-28-	Jet	LANDING				Aust	Oceania	Papua New Guinea	HULL LOSS	ASEDB
284	CFIT		1	1.000	4	4	8	0	4	4	0	02/07/1999	1999	Myanma Airways	Myanmar	Western	Sittwe, BU	Fokker F.27	TP-Large	Approach	Cloud-Fog	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
285	SCF-PP		0.001	0.001	0	0	0	1	55	5	0	08/06/1995	1995	Valujet	USA	Western	Atlanta, US	MD DC-9	Jet	T/O Aborted	xx	No	100	North America	NA-Car	US-Canada	x	yes
286	CFIT		1	1.000	15	2	17	0	15	2	0	24/07/1999	1999	Air Fiji	Fiji	Western	Suva, FJ	EMB-110	TP-Small	En Route	xx	Yes	100	Aust	Aust/asia	Pacific	x	yes
287	CFIT		0.264	0.264	0	1	1	1	2	2	0	12/08/1999	1999	Regionnair	Canada	Western	Sept-Iles, CA	BE-1900	TP-Small	Landing - Approach	Fog	xx	100	North America	NA-Car	US-Canada	x	yes
288	USOS			0.000					82			26/07/1995	1995	ADC Airlines	Nigeria		MONROVIA	DC-9-	Jet	LANDING				Africa	AFRICA	Nigeria	HULL LOSS	ASEDB
289	CFIT		1	1.000	58	7	65	0	58	7	0	09/08/1995	1995	Aviateca	Mexico	Western	San Salvador, SV	B737	Jet	Approach	T-Storm	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
290	RE-Landing			0.000								17/08/1995	1995	Air Afrique	Cote d'Ivoire		N'DJAMENA	707-320C	Jet	LANDING				Africa	EUROPE	Cote d'Ivoire	HULL LOSS	ASEDB
291	CFIT		1	1.000	10	5	15	0	10	5	0	05/09/1999	1999	Necon Air	Nepal	Western	Ramkot, NP	BAE (HS) 748	TP-Large	Initial Descent	Clouds	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
292	RE-Landing	ARC	0.067	0.067	9	0	9	4	129	8	0	13/11/1995	1995	Nigeria Airways	Nigeria	Western	Kaduna, NG	B737	Jet	Landing - Rollout	xx	No	100	Africa	Africa	Africa	x	yes
293	CFIT		0.333	0.333	0	2	2	0	0	6	0	30/11/1995	1995	Azerbaijan Airlines /AZAL Avia	Azerbaijan	Western	Baku, AZ	B707	Jet	Go Around	xx	No	100	CIS	Europe	Europe - E/.SE	x	yes
294	RE-Landing	ARC	0	0.000	0	0	0	0	102	6	0	02/12/1995	1995	Indian Airlines	India	Western	Delhi, IN	B737	Jet	Landing - Rollout	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
295	LOC-I			1.005	68	4	72	6	72			03/12/1995	1995	Cameroon Airlines	Cameroon		DOUALA	737-200	Jet	CLIMB				Africa	AFRICA	Cameroon	HULL LOSS	ASEDB
296	CFIT		1	1.000	21	3	24	0	21	3	0	12/11/1999	1999	Si Fly	Italy	Western	Pristina, YU	ATR 42	TP-Large	Landing - Approach	Clouds	No	100	Europe	Europe	EU-EFTA	x	yes
297	CFIT		1	1.000	31	4	35	0	31	4	0	11/12/1999	1999	SATA	Portugal	Western	Azores	ATP	TP-Large	Descent	T-Storm	No	100	Europe	Europe	EU-EFTA	x	yes
298	CFIT		0.977	0.977	152	8	160	4	156	8	0	20/12/1995	1995	American Airlines	USA	Western	Cali, Co (Buga)	B757	Jet	Initial Descent	xx	No	100	North America	NA-Car	US-Canada	x	yes
299	LOC-G		0	0.000	0	0	0	0	477	15	0	20/12/1995	1995	Tower Air	USA	Western	New York, US	B747	Jet	T/O Aborted	xx	No	100	North America	NA-Car	US-Canada	x	yes
300	CFIT		1	1.000	7	3	10	0	7	3	0	25/12/1999	1999	Skyline Airways	Nepal	Western	Bhojpur, NP	DHC-6	TP-Small	T/O Climb to Cruise	Clouds	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
301	LOC-I		1	1.000	7	3	10	0	7	3	0	10/01/2000	2000	Crossair	Switzerland	Western	Zurich, CH	Saab 340	TP-Small	T/O Climb to Cruise	Cloud	No	100	Europe	Europe	EU-EFTA	x	yes
302	ARC			0.000					75			30/12/1995	1995	TAROM - Romanian Air Transport	Romania		ISTANBUL	BAC 1-11	Jet	LANDING				Europe	EUROPE	Romania	HULL LOSS	ASEDB
303	RE-Landing			0.000								28/01/1996	1996	AFFRETAIR	Zimbabwe		HARARE	DC-8-F55	Jet	LANDING				Africa	AFRICA	Zimbabwe	HULL LOSS	ASEDB
304	LOC-I		1	1.000	176	13	189	0	176	13	0	06/02/1996	1996	Birgenair	Turkey	Western	Puerto Plata, DO	B757	Jet	T/O Climb to Cruise	xx	No	100	Europe	Europe	NoAfr/MidEast	x	yes
305	ARC			0.000					82			19/02/1996	1996	Continental Airlines	USA		Houston	DC-9-	Jet	LANDING				North America	NA-Car	USA	HULL LOSS	ASEDB
306	CFIT		1	1.000	117	6	123	0	117	6	0	29/02/1996	1996	Faucett	Peru	Western	Arequipa, PE	B737	Jet	Approach	Cloud	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
307	SCF-PP		0	0.000	0	0	0	0	3	3	0	17/03/2000	2000	Skypower Express Airways	Nigeria	Western	Kaduna, NG	EMB-110	TP-Small	Approach	xx	No	100	Africa	Africa	Africa	x	yes
308	RE-Takeoff		0.001	0.001	0	0	0	1	77	9	0	01/05/1996	1996	Fly Lineas Aereas	Brazil	Western	Quito, EC	B727	Jet	T/O Aborted	Rain	Yes	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
309	FIRE-NI		1	1.000	105	5	110	0	105	5	0	11/05/1996	1996	Valujet	USA	Western	15 miles W of Opa Locka, US	MD DC-9	Jet	T/O Climb to Cruise	xx	No	100	North America	NA-Car	US-Canada	x	yes
310	SCF-NP		0	0.000	0	0	0	0	42	4	0	14/05/1996	1996	Allegro Air	Mexico	Western	Tampico, MX	DC-9	Jet	En Route	xx	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
311	CFIT		1	1.000	17	2	19	0	17	2	0	08/07/2000	2000	Aerocaribe	Mexico	Western	Villahermosa, MX	BAE 31	TP-Small	En Route	IMC	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
312	RE-Landing	ARC	0.013	0.013	3	0	3	12	260	15	0	13/06/1996	1996	Garuda Indonesia	Indonesia	Western	Fukuoka, JP	DC-10	Jet	T/O Aborted	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
313	WSTRW		0	0.000	0	0	0	0	0	4	0	30/06/1996	1996	DAS Air	Uganda	Western	Bamako, ML	B707	Jet	Landing - Rollout	Rain-Wind	No	100	Africa	Africa	Africa	x	yes
314	SCF-PP		0.015	0.015	2	0	2	2	137	5	0	06/07/1996	1996	Delta	USA	Western	Pensacola	MD-88	Jet	T/O Run	xx	No	100	North America	NA-Car	US-Canada	x	yes
315	FIRE-NI		1	1.000	212	18	230	0	212	18	0	17/07/1996	1996	Trans World Airlines	USA	Western	(near) Mastic Beach (Long Island), US	B747	Jet	T/O Climb to Cruise	xx	No	100	North America	NA-Car	US-Canada	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
316	CFIT		1	1.000	22	3	25	0	22	3	0	27/07/2000	2000	Royal Nepal Airlines	Nepal	Western	Dhangarhi, NP	DHC-6	TP-Small	Initial Descent	Rain-Clouds	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
317	RE-Landing		0	0.000	0	0	0	0	120	8	0	21/08/1996	1996	Egyptair	Egypt	Western	Istanbul, TR	B707	Jet	Landing - Rollout	Rain	No	100	Africa	Africa	NoAfr/MidEast	x	yes
318	FIRE-NI		0	0.000	0	0	0	0	0	5	0	05/09/1996	1996	FedEx	USA	Western	Newburgh, NY	DC-10	Jet	En Route	xx	No	100	North America	NA-Car	US-Canada	x	yes
319	CFIT		1	1.000	61	9	70	0	61	9	0	02/10/1996	1996	Aero Peru	Peru	Western	off Ancon, PE	B757	Jet	T/O Climb to Cruise	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
320	LOC-I		0	0.000	0	0	0	0	15	2	0	01/11/2000	2000	West Coast Air	Canada	Western	Vancouver, CA	DHC-6	TP-Small	T/O Initial Climb	xx	No	100	North America	NA-Car	US-Canada	x	yes
321	ARC			0.000								10/10/1996	1996	Occidental Airlines	Belgium		DJERBA	707-320C	Jet	LANDING				Europe	EUROPE	Belgium	HULL LOSS	ASEDB
322	LOC-I		1	1.000	0	4	4	0	0	4	#	22/10/1996	1996	Millon Air	USA	Western	Manta, EC	B707	Jet	T/O Initial Climb	xx	No	100	North America	NA-Car	US-Canada	30 Ground fatal	yes
323	WSTRW			0.000		2	2	6				23/10/1996	1996	LADE	Argentina		BUENOS AIRES	707-372C	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Argentina	HULL LOSS	ASEDB
324	SCF-PP		1	1.000	89	6	95	0	89	6	0	31/10/1996	1996	TAM Brasil	Brazil	Western	Sao Paulo, BR	Fokker 100	Jet	T/O Initial Climb	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
325	LOC-I		1	1.000	134	9	143	0	134	9	0	07/11/1996	1996	ADC Airlines	Nigeria	Western	40km. ENE of Lagos, NG	B727	Jet	Initial Descent	xx	No	100	Africa	Africa	Africa	x	yes
326	MIDAIR		1	1.000	289	23	312	0	289	23	#	12/11/1996	1996	Saudi Arabian Airlines/Chimkentavia	Saudi Arabia		50 miles W. of Delhi, IN	IL76/B747	Jet					Middle East	**Asia**	NoAfr/MidEast	37 fatal in other A/C	yes
327	LOC-I		1	1.000	17	2	19	0	17	2	0	24/03/2001	2001	Air Caraibes	Guadeloupe	Western	St.Barthelemy, GP	DHC-6	TP-Small	Landing - Approach	xx	No	100	Latin America & Caribbean	**NA-Car**	CA/Carib	x	yes
328	SCF-PP		0.088	0.088	3	1	4	2	44	3	0	29/08/2001	2001	Binter Mediterraneo	Spain	Western	Malaga, ES	CASA CN-235	TP-Small	Landing - Approach	xx	No	100	Europe	Europe	EU-EFTA	x	yes
329	CFIT		0	0.000	0	0	0	0	0	4	0	17/12/1996	1996	MK Airlines	Ghana	Western	Port Harcourt, NG	DC-8	Jet	Approach	xx	No	100	Africa	Africa	Africa	x	yes
330	SCF-NP			0.000								17/01/1997	1997	First International Airways	Belgium		KANANGA	707-320	Jet	LANDING				Europe	EUROPE	Belgium	HULL LOSS	ASEDB
331	ARC		0.024	0.024	0	1	1	4	46	6	0	14/02/1997	1997	VARIG	Brazil	Western	Carajas, BR	B737	Jet	Landing - Rollout	Wind-fog-rain	xx	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
332	RE-Takeoff		0.002	0.002	0	0	0	4	107	8	0	10/03/1997	1997	Gulf Air	Qatar (Multi-Nati)	Western	Abu Dhabi, AE	A320	Jet	T/O Aborted	Wind	No	100	Middle East	**Asia**	NoAfr/MidEast	x	yes
333	RE-Landing			0.000					97			12/04/1997	1997	Ghana Airways	Ghana		ABIDJAN	DC-9	Jet	LANDING				Africa	AFRICA	Ghana	HULL LOSS	ASEDB
334	ARC		0.000	0.004	0	0	0	1	10	3	0	11/30/01	2001	European Executive Express	Sweden	Western	Skien, NO	Jetstream 31	TP-Small	Landing	xx	No	100	Europe	Europe	EU-EFTA	x	yes
335	ARC		0.473	0.473	33	2	35	0	65	9	0	08/05/1997	1997	China Southern Airlines	China	Western	Shenzhen, CN	B737	Jet	Landing - Rollout	Rain-T-Storm	No	100	Asia	**Asia**	Asia-Low-Mdl Income	x	yes
336	RE-Landing			0.000					20			07/06/1997	1997	TAROM - Romanian Air Transport	Romania		STOCKHOLM	BAC 1-11	Jet	LANDING				Europe	EUROPE	Romania	HULL LOSS	ASEDB
337	LOC-I		0.000	0.000	0	0	0	0	20	4	0	02/17/02	2002	Skymaster Freight Services	Congo, Zr	Western	(near) Kananga, ZR	CL-44	TP-Large	En Route	xx	No	100	Africa	Africa	Africa	x	yes
338	ARC		0	0.000	0	0	0	0	49	6	0	29/07/1997	1997	ADC	Nigeria		Calabar	BAC-1-11	Jet	Landing - Approach	xx	No	100	Africa	Africa	Africa	x	yes
339	ARC		0	0.000	0	0	0	0	0	4	0	31/07/1997	1997	FedEx	USA	Western	Newark, US	MD MD-11	Jet	Landing - Rollout	xx	No	100	North America	NA-Car	US-Canada	x	yes
340	RE-Landing		0.000	0.000	0	0	0	0	43	5	0	04/16/02	2002	AirQuarius Aviation	So Africa	Western	Pilanesberg, ZA	HS 748	TP-Large	Landing - Rollout	xx	No	100	Africa	Africa	Africa	x	yes
341	Other			0.007	1		1		142			02/08/1997	1997	Continental Airlines	USA		LIMA	757-200	Jet	PARKED				North America	NA-Car	USA	NONE	ASEDB
342	RE-Takeoff		0	0.000	0	0	0	0	118	8	0	03/08/1997	1997	Air Afrique	Cote d Ivorie (Multi-Natl)	Western	Douala, CM	B737	Jet	T/O Aborted	xx	No	100	Africa	Africa	Africa	x	yes
343	CFIT		0.907	0.907	215	14	229	25	237	17	0	06/08/1997	1997	Korean Air	Korea	Western	Agana, GU	B747	Jet	Approach	Rain-T-Storm	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
344	LOC-I		1	1.000	0	4	4	0	0	4	0	07/08/1997	1997	Fine Air	USA	Western	Miami, US	MD DC-8	Jet	T/O Initial Climb	xx	Yes	100	North America	NA-Car	US-Canada	x	yes
345	CFIT		1.000	1.000	1	2	3	0	0	3	0	06/01/02	2002	AirQuarius Aviation	So Africa	Western	(near) George, ZA	HS 748	TP-Large	Go Around	Winds	No	100	Africa	Africa	Africa	x	yes
346	RE-Landing	ARC	0	0.000	0	0	0	0	26	9	0	12/08/1997	1997	Olympic Airways	Greece	Western	Thessaloniki, GR	B727	Jet	Landing - Rollout	Rain	No	100	Europe	Europe	EU-EFTA	x	yes
347	ARC			0.000								15/08/1997	1997	Angola Air Charter	Angola		LUKAPA	727-100	Jet	LANDING				Africa	AFRICA	Angola	HULL LOSS	ASEDB
348	USOS			0.000					42			17/08/1997	1997	SAETA S.A.	Ecuador		SAN CRISTOBAL	727-200	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Ecuador	HULL LOSS	ASEDB
349	ADRM		0.000	0.000	0	0	0	0	20	4	0	07/10/02	2002	Swiss	Suiss	Western	Werneuchen, DE	Saab 2000	TP-Large	Landing - Rollout	Rain, ceiling	No	100	Europe	Europe	EU-EFTA	Fuel Emergency	yes
350	CFIT		1.000	1.000	2	2	4	0	0	4	0	07/17/02	2002	Skyline Airways	Nepal	Western	(near) Surkhet, NP	DHC-6	TP-Small	Descent	IMC	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
351	SCF-PP		0	0.000	0	0	0	0	79	6	0	06/09/1997	1997	Saudi Arabian Airlines	Saudi Arabia	Western	Nejran, SA	B737	Jet	T/O Aborted	xx	No	100	Middle East	**Asia**	NoAfr/MidEast	x	yes
352	CFIT		1.000	1.000	15	3	18	0	15	3	0	08/22/02	2002	Shangri-La Air	Nepal	Western	(near) Pokhara, NP	DHC-6	TP-Small	Approach	Rain, Vis	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
353	CFIT		1	1.000	222	12	234	0	222	12	0	26/09/1997	1997	Garuda Indonesia	Indonesia	Western	Medan, ID	A300	Jet	Approach	Smoke	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
354	USOS		0.767	0.782	20	3	23	8	28	2	0	08/30/02	2002	RICO Linhas Aereas	Brazil	Western	(near) Rio Branco, BR	EMB-120 Brasilia	TP-Small	Approach	Heavy Rain, Wind	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
355	RE-Landing		0.000	0.000	0	0	0	0	45	4	0	09/05/02	2002	Asian Spirit	Philippines	Western	Manila, PH	DHC 7	TP-Large	Landing - Rollout	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	SCF NPP	yes
356	LOC-I		1.000	1.000	0	2	2	0	0	2	0	09/14/02	2002	Total Linhas Aereas	Brazil	Western	(near) Paranapanema, BR	ATR 42	TP-Large	En Route	Heavy Rain	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
357	RI			0.000				1				01/10/1997	1997	Ryan International Airlines	USA		DENVER	727-51C	Jet	TAXI				North America	NA-Car	USA	HULL LOSS	ASEDB
358	RE-Landing	ARC	0.000	0.000	0	0	0	0	36	4	0	11/02/02	2002	EuroCeltic Airways	UK	Western	Sligo, IE	Fokker F.27	TP-Large	Landing - Rollout	Tailwind	No	100	Europe	Europe	EU-EFTA	x	yes
359	LOC-I		0.909	0.914	18	2	20	2	19	3	0	11/06/02	2002	Luxair - Luxembourg Airlines	Luxenmbourg	Western	Niederanven, LU	Fokker 50	TP-Large	Approach	Icing?	No	100	Europe	Europe	EU-EFTA	x	yes
360	LOC-I		0.559	0.566	17	2	19	4	29	5	0	11/11/02	2002	Laoag International Airways	Philippines	Western	Manila, PH	Fokker F.27	TP-Large	T/O Initial Climb	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	Fuel Man	yes
361	USOS		0.000	0.000	0	0	0	0	6	4	0	12/06/02	2002	Aerotaxi	Cuba	Western	(near) Havana, CU	EMB-110	TP-Small	Approach	Heavy Rain	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
362	LOC-I		1.000	1.000	0	2	2	0	0	2	0	12/21/02	2002	TransAsia Airways	Taiwan	Western	15nm SW of Makung, TW	ATR 72	TP-Large	Descent	Icing	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
363	LOC-I		1.000	1.000	19	2	21	0	19	2	0	01/08/03	2003	Air Midwest	USA	Western	Charlotte, US	BE-1900	TP-Small	T/O Initial Climb	xx	Yes	100	North America	NA-Car	US-Canada	SCF Trim Tab	yes
364	LOC-I			1.072	69	5	74		69			10/10/1997	1997	AUSTRAL - Cielos del Sur S.A.	Argentina		NUEVO BERLIN	DC-9-32	Jet	CRUISE				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Argentina	HULL LOSS	ASEDB
365	ARC			0.000					67			15/10/1997	1997	Aeromexico	Mexico		MEXICO CITY	DC-9-32	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Mexico	HULL LOSS	ASEDB
366	RE-Landing		0.000	0.000	0	0	0	0	14	5	0	01/17/03	2003	Air Nostrum	Spain	Western	Melilla, ES	Fokker 50	TP-Large	Landing - Rollout	xx	No	100	Europe	Europe	EU-EFTA	x	yes
367	RE-Landing			0.000								01/11/1997	1997	Congo Airlines	Congo		KINSHASA	707-323C	Jet	LANDING				Africa	AFRICA	Congo, The Democratic Republic of the	HULL LOSS	ASEDB
368	ARC		0.012	0.012	0	0	0	9	39	3	0	16/12/1997	1997	Air Canada	Canada	Western	Fredericton, CA	Canadair CRJ	Jet	Go Around	Fog	No	100	North America	NA-Car	US-Canada	x	yes
369	LOC-I		0.000	0.000	0	0	0	0	0	5	0	03/15/03	2003	748 Air Services	Kenya	Western	Rumbek, SD	HS 748	TP-Large	T/O Initial Climb	xx	No	100	Africa	Africa	Africa	SCF PP	yes
370	CFIT			0.000					84			22/12/1997	1997	Biman Bangladesh Airlines	Bangladesh		SYLHET	F-28-	Jet	FINAL APPROACH				Asia	ASIA (EX CHINA)	Bangladesh	HULL LOSS	ASEDB
371	LOC-I		0.278	0.310	4	1	5	10	15	3	0	03/27/03	2003	Air Regional	Indonesia	Western	(near) Gunung Mulia, ID	DHC-6	TP-Small	T/O Initial Climb	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
372	SCF-NP		0.000	0.000	0	0	0	0	4	2	0	04/23/03	2003	Transwest Air	Canada	Western	6nm SW of Prince Albert, CA	BE-99	TP-Small			No	100	North America	NA-Car	US-Canada	x	yes
373	LOC-G		0.000	0.000	0	0	0	0	13	2	0	04/29/03	2003	Avirex Gabon	Gabon	Western	Kinshasa, ZR	BE-1900	TP-Small			No	100	Africa	Africa	Africa	x	yes
374	LOC-G		0.000	0.000	0	0	0	0	41	4	0	06/16/03	2003	Mid Airlines	Sudan	Western	Adaryale, SD	Fokker 50	TP-Large			No	100	Africa	Africa	Africa	x	yes
375	TURB			0.006	1		1	18	355			28/12/1997	1997	United Airlines	USA		HONOLULU	747-100	Jet	CRUISE				North America	NA-Car	USA	MINOR DAMAGE	ASEDB
376	CFIT			0.000					104			05/01/1998	1998	Iran Air	Iran		ISFAHAN	F-100	Jet	LANDING				Middle East	MIDDLE EAST	Iran	HULL LOSS	ASEDB
377	ICE		1.000	1.000	0	2	2	0	0	2	0	10/03/03	2003	Air Freight New Zealand	New Zealand	Western	off Paraparaumu, NZ	Convair 580	TP-Large	Descent	Icing	No	100	Aust	Aust/asia	Hi-Income Asia-Pac	x	yes
378	RE-Landing		0.000	0.000	0	0	0	0	20	3	0	10/20/03	2003	TAVAJ	Brazil	Western	Tarauaca, BR	Fokker F.27	TP-Large	Landing - Rollout	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
379	LOC-I		1.000	1.000	3	2	5	0	3	2	0	10/26/03	2003	CATA Linea Aerea SA	Argentina	Western	(near) Buenos Aires, AR	Fairchild FH-227	TP-Large	T/O Initial Climb	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
380	RE-Landing			0.000					68			11/01/1998	1998	Turkish Airlines (THY)	Turkey		SAMSUN	RJ100	Jet	LANDING				Europe	EUROPE	Turkey	HULL LOSS	ASEDB
381	CFIT			1.051	99	5	104		99			02/02/1998	1998	Cebu Pacific Air	Philippines		ENRT TAC-CGY	DC-9	Jet	DESCENT				Asia	ASIA (EX CHINA)	Philippines	HULL LOSS	ASEDB
382	USOS		0	0.000	0	0	0	0	115	6	0	09/02/1998	1998	American Airlines	USA	Western	Chicago, US	B727	Jet	Approach	xx	No	100	North America	NA-Car	US-Canada	x	yes
383	LOC-I		1	1.000	182	14	196	0	182	14	6	16/02/1998	1998	China Airlines	Taiwan	Western	Taipei, TW	A300	Jet	Go Around	Rain-Fog	No	100	Asia	Asia	Hi-Income Asia-Pac	6 Ground fatal	yes
384	LOC-I		1	1.000	0	6	6	0	0	6	0	10/03/1998	1998	Air Memphis	Egypt	Western	Mombasa, KE	B707	Jet	T/O Initial Climb	xx	Yes	100	Africa	Africa	NoAfr/MidEast	x	yes
385	CFIT		1	1.000	35	10	45	0	35	10	0	19/03/1998	1998	Ariana Afghan	Afghanistan	Western	Kabul, AF	B727	Jet	Approach	Rain-Clouds	No	100	Asia	Asia	ASIA CEN	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
386	RE-Landing	ARC	0.001	0.001	0	0	0	2	128	8	3	22/03/1998	1998	Philippine Airlines	Philippines	Western	Bacolod, PH	A320	Jet	Landing - Rollout	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	3 Ground fatal	yes
387	CFIT		0.200	0.223	0	1	1	2	3	2	0	01/28/04	2004	Tassili Airlines	Algeria	Western	(near) Ghardaia, DZ	BE-1900	TP-Small			No	100	Africa	Africa	NoAfr/MidEast	x	yes
388	LOC-I		0.935	0.939	37	6	43	3	40	6	0	02/10/04	2004	Kish Air	Iran	Western	(near) Sharjah, AE	Fokker 50	TP-Large			No	100	Middle East	Asia	NoAfr/MidEast	x	yes
389	RE-Landing			0.000					80			12/04/1998	1998	Orient Eagle Airways	Kazakhstan		ALMATY	737-200	Jet	LANDING				CIS	CIS	Kazakhstan	HULL LOSS	ASEDB
390	CFIT		1	1.000	43	10	53	0	10	43	0	20/04/1998	1998	TAME Ecuador	Ecuador	Western	(near) Bogota, CO	B727	Jet	T/O Climb to Cruise	Cloud	xx	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
391	ARC		0.000	0.000	0	0	0	0	0	4	0	04/03/04	2004	Central African Cargo	Cent African rep	Western	Shabunda, ZR	Convair 580	TP-Large			No	100	Africa	Africa	Africa	x	yes
392	FIRE-NI		0.000	0.000	0	0	0	0	0	3	0	04/27/04	2004	Mountain Air Cargo	USA	Western	(near) Melo, UY	Fokker F.27	TP-Large			No	100	North America	NA-Car	US-Canada	x	yes
393	CFIT			0.935	69	6	75	13	81			05/05/1998	1998	Occidental Petroleum Corp	USA		(Near) Andoas	737-200	Jet	LANDING				North America	NA-Car	USA	HULL LOSS	ASEDB
394	ARC		0.000	0.000	0	0	0	0	0	2	0	05/09/04	2004	Executive Airlines	USA	Western	San Juan, PR	ATR 72	TP-Large			No	100	North America	NA-Car	US-Canada	x	yes
395	UNK		0.524	0.524	30	3	33	0	30	33	0	05/14/04	2004	RICO Linhas Aereas	Brazil	Western	(near) Manaus, BR	EMB-120	TP-Small			No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
396	LOC-I		0.000	0.010	0	0	0	3	14	3	0	05/17/04	2004	Trans Maldivian Airways	Maldives	Western	Male, MV	DHC-6	TP-Small			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
397	LOC-I		0.633	0.654	18	1	19	11	26	4	0	06/08/04	2004	Gabon Express	Gabon	Western	off Libreville, GA	HS 748	TP-Large			No	100	Africa	Africa	Africa	x	yes
398	RE-Landing		0.000	0.000	0	0	0	0	36	4	0	06/16/04	2004	Pakistan International Airlines	Pakistan	Western	Chitral, PK	Fokker F.27	TP-Large			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
399	RE-Takeoff			0.000					57			15/05/1998	1998	Merpati Nusantara Airlines	Indonesia		KENDARI	F-28-4000	Jet	TAKEOFF				Asia	ASIA (EX CHINA)	Indonesia	HULL LOSS	ASEDB
400	RE-Landing			0.000					73			16/05/1998	1998	Manunggal Air	Indonesia		SINGAPORE	F-28	Jet	LANDING				Asia	ASIA (EX CHINA)	Indonesia	HULL LOSS	ASEDB
401	FUEL		0.500	0.529	0	1	1	1	0	2	0	08/13/04	2004	Air Tahoma	USA	Western	Cincinnati, US	Convair 580	TP-Large			Yes	100	North America	NA-Car	US-Canada	x	yes
402	RE-Landing			0.000					91			19/07/1998	1998	Sudan Airways	Sudan		KHARTOUM	737-200	Jet	LANDING				Africa	AFRICA	Sudan	HULL LOSS	ASEDB
403	SCF-NP		0.000	0.000	0	0	0	0	9	2	0	09/21/04	2004	Norcanair Airlines	Canada	Western	La Ronge, CA	Fairchild (Swearingen) Metro	TP-Small			No	100	North America	NA-Car	US-Canada	x	yes
404	RE-Landing			0.000					376			05/08/1998	1998	Korean Air	South Korea		SEOUL	747-400	Jet	LANDING				Asia	ASIA (EX CHINA)	South Korea	HULL LOSS	ASEDB
405	SCF-NP			0.000								31/08/1998	1998	DHL Airways	USA		NEW YORK	727-200	Jet	TAKEOFF				North America	NA-Car	USA	HULL LOSS	ASEDB
406	CFIT		0.867	0.874	11	2	13	2	13	2	0	10/18/04	2004	RegionsAir	USA	Western	(near) Kirksville, US	Jetstream 31	TP-Small			No	100	North America	NA-Car	US-Canada	x	yes
407	SCF-PP		0.000	0.000	0	0	0	0	8	2	0	10/22/04	2004	Southern Air Charter	Bahamas	Western	(near) Nassau, BS	BE-1900	TP-Small			No	100	Latin America & Caribbean			x	yes
408	SCF-NP		1	1.000	215	14	229	0	215	14	0	02/09/1998	1998	Swissair	Switzerland	Western	Nova Scotia	MD 11	Jet	En Route	xx	No	100	Europe	Europe	EU-EFTA	x	yes
409	RE-Landing			0.000					102			16/09/1998	1998	Continental Airlines	USA		GUADALAJARA	737-500	Jet	LANDING				North America	NA-Car	USA	HULL LOSS	ASEDB
410	RE-Landing		0.190	0.237	4	0	4	17	19	2	0	11/18/04	2004	Venezolana	Venezuela	Western	Caracas, VE	Jetstream 31	TP-Small			No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
411	CFIT		1	1.000	34	4	38	0	34	4	0	25/09/1998	1998	Paukn Air	Spain	Western	Melilla, MA	BAE-146	Jet	Approach	xx	No	100	Europe	Europe	EU-EFTA	x	yes
412	SCF-PP			0.000					97			05/10/1998	1998	LAM	Mozambique		MAPUTO	747-SP	Jet	CLIMB				Africa	AFRICA	Mozambique	HULL LOSS	ASEDB
413	RE-Landing			0.000					100			01/11/1998	1998	AirTran Airways	USA		ATLANTA	737-200	Jet	LANDING				North America	NA-Car	USA	HULL LOSS	ASEDB
414	SCF-PP		0	0.000	0	0	0	0	0	5	0	14/11/1998	1998	IAT Cargo	Nigeria	Western	Ostend, BE	B707	Jet	Landing - Rollout	Turb	No	100	Africa	Africa	Africa	x	yes
415	CFIT		0	0.000	0	0	0	0	61	11	0	10/12/1998	1998	Azerbaijan Airlines /AZAL Avia	Azerbaijan	Western	Baku, AZ	B727	Jet	Landing - Go Around	IMC	xx	100	CIS	Europe	Europe - E/.SE	x	yes
416	LOC-I		0.699	0.699	91	11	102	0	132	14	0	11/12/1998	1998	Thai Airways International	Thailand	Western	Surat Thani, TH	A310	Jet	Go Around	Rain-Wind	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
417	RE-Landing		0.000	0.000	0	0	0	0	0	2	0	02/15/05	2005	African Commuter Services	Kenya	Western	Oldfangak, SD	HS 748	TP-Large			No	100	Africa	Africa	Africa	x	yes
418	SCF-PP		0.000	0.032	0	0	0	28	45	5	0	02/22/05	2005	TAM - Transporte Aereo Militar	Bolivia	Western	Trinidad, BO	Convair 580	TP-Large			No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
419	ARC		0	0.000	0	0	0	0	36	4	0	28/12/1998	1998	Rio Sul	Brazil	Western	Curitiba, BR	EMB ERJ-145	Jet	Landing - Rollout	Clouds	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
420	ARC		0	0.000	0	0	0	0	78	6		1/28/1999	1999	Alitalia	Italy	Western	CATANIA	MD-82	Jet	LANDING	xx	xx	xx	Europe	Europe	EU-EFTA		No

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
421	CFIT		1.000	1.000	14	3	17	0	14	3	0	04/12/05	2005	GT Air	Indonesia	Western	(near) Enarotali, ID	DHC-6	TP-Small			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
422	ARC		0.000	0.000	0	0	0	0	25	3	0	05/01/05	2005	Wideroe	Norway	Western	Hammerfest, NO	DHC 8	TP-Large			No	100	Europe	Europe	EU-EFTA	x	yes
423	CFIT		1.000	1.000	13	2	15	0	13	2	0	05/07/05	2005	Aero-Tropics Air Services	Australia	Western	(near) Lockhart River, AU	Fairchild (Swearingen) Metro	TP-Small			No	100	Aust	Aust/asia	Hi-Income Asia-Pac	x	yes
424	RE-Landing		0	0.000	0	0	0	0	92	10		1/31/1999	1999	Air Algerie	Algeria	Western	CONSTANTINE	B727-200	Jet	LANDING	xx	xx	xx	Africa	AFRICA	NoAfr/MidEast		No
425	USOS		0.000	0.000	0	0	0	0	10	3	0	06/30/05	2005	Gorkha Airlines	Nepal	Western	Lukla, NP	Fairchild/Dornier 228	TP-Small			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
426	RE-Takeoff		0	0.000	0	0	0	0	0	3		2/7/1999	1999	Clipper International	Switzerland	Western	BRATISLAVA	B707-328C	Jet	TAKEOFF	xx	xx	xx	Europe	Europe	EU-EFTA		No
427	RE-Landing		0	0.000	0	0	0	0	91	6		3/4/1999	1999	Air France	France	Western	BIARRITZ	B737-200	Jet	LANDING	xx	xx	xx	Europe	Europe	EU-EFTA		No
428	FUEL		0.410	0.426	15	1	16	11	35	4	0	08/06/05	2005	SevenAir	Tunisia	Western	12sm off Palermo, IT	ATR 72	TP-Large			No	100	Aust	Europe	NoAfr/MidEast	x	yes
429	ARC		0	0.011	0	0	0	1	0	5		3/5/1999	1999	Air France	France	Western	MADRAS	B747-200	Jet	LANDING	xx	xx	xx	Europe	Europe	EU-EFTA		No
430	RE-Landing	ARC	0.001	0.001	0	0	0	2	150	6	0	15/03/1999	1999	Korean Air	Korea	Western	Pohang, KR	MD-80	Jet	Landing - Rollout	Rain-Wind	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
431	RE-Landing		0	0.000	0	0	0	0	252	19		3/24/1999	1999	Emirates	United Arab Emirates	Western	RHODES ISLAND	A300-600	Jet	LANDING	xx	xx	xx	Middle East	MIDDLE EAST	NoAfr/MidEast		No
432	LOC-I		1	1.000	0	6	6	0	0	6		4/7/1999	1999	Turkish Airlines (THY)	Turkey	Western	ADANA	B737-400	Jet	CLIMB	xx	xx	xx	Europe	Europe	NoAfr/MidEast		No
433	SCF-PP		0.000	0.000	0	0	0	0	18	2	0	09/08/05	2005	TMK Air Commuter	Congo, Zr	Western	(near) Goma, ZR	DHC-6	TP-Small			No	100	Africa	Africa	Africa	x	yes
434	LOC-I		1	1.000	0	3	3	0	0	3	5	15/04/1999	1999	Korean Air	Korea	Western	Shanghai, CN	MD-11	Jet	T/O Climb to Cruise	Rain-Clouds	No	100	Asia	Asia	Asia-Low-Mdl Income	5 Ground fatal	yes
435	WSTRW		0	0.000	0	0	0	0	60	6		4/22/1999	1999	Million Air Charters	South Africa	Western	JOHANNESBURG	B727-200	Jet	INITIAL APPROACH	xx	xx	xx	Africa	Africa	Africa		No
436	WSTRW		0.094	0.094	10	1	11	45	139	6	0	01/06/1999	1999	American Airlines	USA	Western	Little Rock	MD-80	Jet	Landing - Approach	T-Storm	No	100	North America	NA-Car	US-Canada	x	yes
437	ARC		0	0.000	0	0	0	0	81	9		6/9/1999	1999	China Southern Airlines	China	Western	ZHANGJIANG	B737-300	Jet	LANDING	xx	xx	xx	Asia	CHINA	Asia-Low-Mdl Income		No
438	CFIT		1	1.000	0	5	5	0	0	5	0	07/07/1999	1999	Hinduja Cargo Services	India	Western	Kathmandu, NP	B727	Jet	T/O Climb to Cruise	Rain-Fog	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
439	ARC		0.000	0.000	0	0	0	0	40	4	0	12/16/05	2005	NatureAir	Costa Rica	Western	Tamarindo, CR	DHC-6	TP-Small			No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
440	SCF-NP		1.000	1.000	18	2	20	0	18	2	0	12/19/05	2005	Chalk's International Airlines	USA	Western	Miami, US	Gulfstream Mallard	TP-Small			No	100	North America	NA-Car	US-Canada	x	yes
441	FIRE-NI		0.000	0.000	0	0	0	0	0	3	0	02/07/06	2006	UPS Airlines	USA	Western	Philadelphia, US	DC-8	TP-Large			No	100	North America	NA-Car	US-Canada	x	yes
442	RE-Landing		0.000	0.000	0	0	0	0	27	3	0	03/11/06	2006	Deccan	India	Western	Bangalore, IN	ATR 72	TP-Large			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
443	RE-Landing		0.032	0.032	1	0	1	0	27	4	0	04/16/06	2006	TAM - Transporte Aereo Militar	Brazil	Western	Guayaramerin, BO	Fokker F.27	TP-Large			No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
444	SCF-NP		1.000	1.000	4	4	8	0	4	4	0	04/27/06	2006	LAC Skycongo	Congo, Zr	Western	(near) Lubutu, ZR	Convair 580	TP-Large			No	100	Africa	Africa	Africa	x	yes
445	RE-Landing	ARC	0	0.000	0	0	0	0	0	3		8/14/1999	1999	Trans Arabian Air Transport	Sudan	Western	JUBA	B707-328C	Jet	LANDING	xx	xx	xx	Africa	Africa	Africa		No
446	RE-Landing		0.000	0.006	0	0	0	2	16	4	0	06/01/06	2006	Air Panama	Panama	Western	Bocas de Toro, PA	Jetstream 31	TP-Small			No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
447	ARC		0.019	0.019	3	0	3	50	300	15	0	22/08/1999	1999	China Airlines	Taiwan	Western	Hong Kong, HK	MD-11	Jet	Landing - Rollout	Rain-Wind	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
448	RE-Landing		0.000	0.019	0	0	0	6	15	3	0	06/05/06	2006	Merpati Nusantara Airlines	Indonesia	Western	Bandanaira, ID	Indonesian Aerospace 212	TP-Small			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
449	FIRE-NI		0.018	0.018	1	0	1	13	90	6	0	24/08/1999	1999	UNI Air	Taiwan	Western	Hualien, TW	MD-90	Jet	Landing - Rollout	xx	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
450	RE-Takeoff		0.63	0.630	61	3	64	15	98	5	5	31/08/1999	1999	LAPA	Argentina	Western	Buenos Aires, AR	B737	Jet	T/O Aborted	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	5 Ground fatal	yes
451	LOC-I		1.000	1.000	6	3	9	0	6	3	0	06/21/06	2006	Yeti Airlines	Nepal	Western	(near) Jumla, NP	DHC-6	TP-Small			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
452	ARC		0	0.000	0	0	0	0	41	5		9/9/1999	1999	TWA	USA	Western	NASHVILLE	DC-9-31	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
453	SCF-PP		1.000	1.000	41	4	45	0	41	4	0	07/10/06	2006	Pakistan International Airlines	Pakistan	Western	Multan, PK	Fokker F.27	TP-Large			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
454	ARC		0.001	0.000	0	0	0	2	236	9	0	14/09/1999	1999	Britannia Airways	UK	Western	Gerona, ES	B757	Jet	Landing - Rollout	Rain-Wind	No	100	Europe	Europe	EU-EFTA	x	yes
455	LOC-I		1.000	1.000	0	3	3	0	0	3	0	08/13/06	2006	Air Algerie	Algeria	Western	(near) Piacenza, IT	Lockheed Hercules	TP-Large			No	100	Africa	Africa	NoAfr/MidEast	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
456	ARC		0	0.000	0	0	0	0	3	5	0	16/10/1999	1999	Continental Cargo Airlines	Ghana	Western	Kinshasa, ZR	DC-8	Jet	Landing - Rollout	xx	No	100	Africa	Africa	Africa	x	yes
457	RE-Landing		0	0.000	0	0	0	0	0	2	0	17/10/1999	1999	FedEx	USA		Subic Bay, Ph	MD-11	Jet	Landing - Rollout	Rain	No	100	North America	NA-Car	US-Canada	x	yes
458	LOC-I		1	1.000	13	5	18	0	13	5	0	09/11/1999	1999	TAESA	Mexico	Western	Uruapan, MX	DC-9	Jet	T/O Initial Climb	xx	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
459	RE-Landing	ARC	0.051	0.051	8	8	16	0	296	18	2	21/12/1999	1999	Cubana	Cuba	Western	Guatemala City, GT	DC-10	Jet	Landing - Rollout	Rain	No	100	Latin America & Caribbean	**NA-Car**	CA/Carib	2 Ground fatal	yes
460	RE-Landing		0.000	0.000	0	0	0	0			0	10/02/06	2006	Malu Aviation	Congo, Zr	Western	Kikwit, ZR	Nord 262	TP-Large			No	100	Africa	Africa	Africa	x	yes
461	LOC-I		1	1.000	0	4	4	0	0	4	0	22/12/1999	1999	Korean Air	Korea	Western	Bishops Stortford, GB	B747	Jet	T/O Initial Climb	Wind-Clouds	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
462	CFIT		0.944	0.944	159	10	169	0	169	10	0	30/01/2000	2000	Kenya Airways	Kenya	Western	off Abidjan, CI	A310	Jet	T/O Initial Climb	xx	No	100	Africa	Africa	Africa	x	yes
463	SCF-NP		1	1.000	83	5	88	0	83	5	0	31/01/2000	2000	Alaska	USA	Western	Point Mugu, Ca	MD-83	Jet	En Route	xx	No	100	North America	NA-Car	US-Canada	x	yes
464	RE-Landing		0.000	0.000	0	0	0	0	7	2	0	11/08/06	2006	Perimeter Airlines	Canada	Western	Norway House, CA	Fairchild (Swearingen) Metro	TP-Small			No	100	North America	NA-Car	US-Canada	x	yes
465	CFIT		0	0.000	0	0	0	0	0	5		2/3/2000	2000	Trans Arabian Air Transport	Sudan	Western	MWANZA	B707-310C	Jet	FINAL APPROACH	xx	xx	xx	Africa	Africa	Africa		No
466	Other		0	0.000	0	0	0	0	179	11		2/11/2000	2000	Air Afrique	Cote d'Ivoire	Western	DAKAR	A300B4	Jet	TAXI	xx	xx	xx	Africa	AFRICA	Africa		No
467	RE-Landing		0.000	0.000	0	0	0	0	156	6	0	12/12/06	2006	Sudan Airways	Sudan	Western	Heglig, SD	Fokker 50	TP-Large			No	100	Africa	Africa	Africa	x	yes
468	ARC		0	0.000	0	0	0	0	0	7	0	12/02/2000	2000	TransAfrik	Sao Tome	Western	Luanda, AO	B727	Jet	Landing - Rollout	Rain-Wind	No	100	Africa	Africa	Africa	x	yes
469	LOC-I		1	1.000	0	3	3	0	0	3	0	16/02/2000	2000	Emery	USA	Western	Rancho Cordova, Ca	DC-8-71	Jet	T/O Initial Climb	xx	No	100	North America	NA-Car	US-Canada	x	yes
470	USOS		0.000	0.000	0	0	0	0	10	2	0	01/09/07	2007	Peace Air	Canada	Western	Fort St John, CA	Jetstream 31	TP-Small			No	100	North America	NA-Car	US-Canada	x	yes
471	RE-Landing	ARC	0	0.000	0	0	0	0	137	5	0	05/03/2000	2000	Southwest	USA	Western	Burbank, California	B737	Jet	Landing - Rollout	xx	No	100	North America	NA-Car	US-Canada	x	yes
472	CFIT		1	1.000	124	7	131	0	124	7	0	19/04/2000	2000	Air Philippines	Philippines	Western	Davao, PH	B737	Jet	Approach	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
473	RE-Landing		0	0.000	0	0	0	0	42	4	0	22/04/2000	2000	THY - Turkish Airlines	Turkey	Western	Siirt, TR	BAE (Avro) RJ	Jet	Landing - Rollout	Wind	No	100	Europe	Europe	NoAfr/MidEast	x	yes
474	RE-Landing		0	0.000	0	0	0	0	0	7	0	30/04/2000	2000	DAS Air	Uganda	Western	Entebbe, UG	DC-10	Jet	Landing - Rollout	Rain	No	100	Africa	Africa	Africa	x	yes
475	ARC		0	0.000	0	0	0	0	0	5		6/26/2000	2000	Yemenia	Yemen	Western	KHARTOUM	B727-200	Jet	LANDING	xx	xx	xx	Middle East	MIDDLE EAST	NoAfr/MidEast		No
476	FUEL		0	0.000	0	0	0	0	142	8	0	12/07/2000	2000	Hapag-Lloyd	Germany	Western	Vienna, AT	A300	Jet	Landing - Approach	xx	No	100	Europe	Europe	EU-EFTA	x	yes
477	LOC-I		0.899	0.899	46	6	52	2	52	6	0	17/07/2000	2000	Alliance Air	India	Western	Patna, IN	B737	Jet	Approach	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
478	RE-Landing		0	0.000	0	0	0	0	84	4		7/18/2000	2000	Iran Asseman Airlines	Iran	Western	AHWAZ	F-28-4000	Jet	LANDING	xx	xx	xx	Middle East	MIDDLE EAST	NoAfr/MidEast		No
479	RE-Landing	ARC	0.000	0.000	0	0	0	0	49	4	0	07/01/07	2007	Jet Airways	India	Western	Indore, IN	ATR 72	TP-Large			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
480	SCF-PP		1	1.000	0	2	2	0	0	2	0	19/07/2000	2000	Airwave Transport	Canada	Western	(near) Linneus, US	Gulfstream I	Jet	En Route	T-Storm - Turbulence	xx	100	North America	NA-Car	US-Canada	x	yes
481	FIRE-NI		1	1.000	100	9	109	0	100	9	0	25/07/2000	2000	Air France	France	Western	Paris, FR	Concorde	Jet	T/O Initial Climb	xx	No	100	Europe	Europe	EU-EFTA	x	yes
482	LOC-I		1.000	1.000	19	1	20	0	19	1	0	08/09/07	2007	Air Moorea	France (Tahiti)	Western	Moorea, PF	DHC-6	TP-Small			No	100	Aust			x	yes
483	RE-Landing		0.000	0.000	0	0	0	0	74	5	0	08/12/07	2007	Jeju Air	Korea	Western	Pusan, KR	DHC 8	TP-Large			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
484	ARC		0	0.000	0	0	0	0	0	3		8/7/2000	2000	Air Memphis	Egypt	Western	CAIRO	707-328C	Jet	LANDING	xx	xx	xx	Africa	AFRICA	NoAfr/MidEast		No
485	SCF-NP		0.000	0.000	0	0	0	0	69	4	0	09/09/07	2007	SAS	Denmark	Western	Aalborg, DK	DHC 8	TP-Large			No	100	Europe	Europe	EU-EFTA	x	yes
486	SCF-NP		0	0.000	0	0	0	0	58	5		8/8/2000	2000	AirTran Airways	USA	Western	GREENSBORO	DC-9-32	Jet	CLIMB	xx	xx	xx	North America	NA-Car	US-Canada		No
487	LOC-I		1	1.000	135	8	143	0	135	8	0	23/08/2000	2000	Gulf Air	Qatar (Multi-Nati)	Western	Manama, BH	A320	Jet	Go Around	xx	No	100	Middle East	**Asia**	NoAfr/MidEast	x	yes
488	ARC			0.000					2			21/09/2000	2000	Republic of Togo	Togo		NIAMEY	707-312B	Jet	INITIAL APPROACH				Africa	AFRICA	Togo	HULL LOSS	ASEDB
489	RE-Takeoff		0.000	0.000	0	0	0	0	9	4	0	10/31/07	2007	Air Panama	Panama	Western	Panama City, PA	Fokker F.27	TP-Large			No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
490	RE-Landing	ARC	0	0.000	0	0	0	0	83	5	4	06/10/2000	2000	Aeromexico	Mexico	Western	Reynosa, MX	DC-9	Jet	Landing - Rollout	Rain	No	100	Latin America & Caribbean	SA/CA	CA/Carib	4 Ground fatal	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
491	RI		0.479	0.479	79	4	83	48	159	20	0	31/10/2000	2000	Singapore Airlines	Singapore	Western	Taipei, TW	B747	Jet	T/O Run	Typhoon	No	100	Asia	Asia	Asia	x	yes
492	RE-Landing		0	0.000	0	0	0	0	183	16	0	05/11/2000	2000	Cameroon Airlines	Cameroon	Western	Paris, FR	B747	Jet	Landing - Rollout	Rain-Wind	No	100	Africa	Africa	Africa	x	yes
493	RE-Takeoff		0.000	0.000	0	0	0	0	31	3	0	12/16/07	2007	Atlantic Airlines De Honduras	Honduras	Western	La Ceiba, HN	Fairchild F-27	TP-Small			No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
494	ARC		0	0.000	0	0	0	0	42	8		11/13/2000	2000	Ghana Airways	Ghana	Western	CONAKRY	DC-9-51	Jet	LANDING	xx	xx	100	Africa	Africa	Africa		No
495	SCF-NP		0.009	0.009	0	1	1	0	106	10	0	20/11/2000	2000	American	USA	Western	Miami	A300	Jet	Ground, taxi		No	100	North America	NA-Car	US-Canada	x	yes
496	USOS		0	0.000	0	0	0	0	6	4	1	05/01/2001	2001	Air Gemini	Angola	Western	Dundo, AO	B727	Jet	Landing - Approach	xx	No	100	Africa	Africa	Africa	1 Ground fatal	yes
497	SCF-NP		0	0.000	0	0	0	0	138	8		1/9/2001	2001	LAB	Bolivia	Western	BUENOS AIRES	B727-200	Jet	TAKEOFF	xx	xx	xx	Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	SA Mercosur		No
498	LOC-I		0.529	0.529	2	1	3	3	3	3	0	31/01/2001	2001	Lineas Aereas Suramericanas	Colombia	Western	El Yopal, CO	Caravelle	Jet	Landing - Approach	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
499	ARC		0	0.000	0	0	0	0	136	6		2/7/2001	2001	Iberia Airlines	Spain	Western	BILBAO	A320-210	Jet	LANDING	xx	xx	xx	Europe	Europe	EU-EFTA		No
500	FIRE-NI		0.2	0.200	0	1	1	0	0	5	0	03/03/2001	2001	Thai Airways International	Thailand	Western	Bangkok, TH	B737	Jet	Ground, Parked	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
501	USOS		0	0.000	0	0	0	0	0	3		3/7/2001	2001	Skymaster Air Lines	Brazil	Western	SAO PAULO	B707-300	Jet	LANDING	xx	xx	xx	Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	SA Mercosur		No
502	USOS		0	0.000	0	0	0	0	0	3		3/11/2001	2001	Express One International	USA	Western	PONAPE	B727-200	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
503	ARC		0	0.000	0	0	0	0	175	7	0	23/03/2001	2001	Luxor Air	Egypt	Western	Monrovia, LR	B707	Jet	Landing - Rollout	Fog	No	100	Africa	Africa	NoAfr/MidEast	x	yes
504	RE-Landing		0	0.000	0	0	0	0	0	2		4/4/2001	2001	Canada 3000 Airlines	Canada	Western	ST. JOHNS	B737-200	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
505	USOS		0	0.000	0	0	0	0	6	5		5/10/2001	2001	Angola Air Charter	Angola	Western	NZAGI	B727-100	Jet	LANDING	xx	xx	xx	Africa	AFRICA	Africa		No
506	ARC		0	0.000	0	0	0	0	98	6		5/22/2001	2001	First Air	Canada	Western	YELLOWKNIFE	B737-200	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
507	SCF-NP		0	0.000	0	0	0	0	88	4		5/23/2001	2001	American Airlines	USA	Western	DALLAS	F-100	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
508	RE-Landing		0	0.000	0	0	0	0	132	8		8/1/2001	2001	Yemenia	Yemen	Western	ASMARA	B727-200	Jet	LANDING	xx	xx	xx	Middle East	MIDDLE EAST	NoAfr/MidEast		No
509	RE-Landing		0	0.000	0	0	0	0	4	6		8/28/2001	2001	Eagle Aviation	Kenya	Western	LIBREVILLE	BAC 1-11-400	Jet	LANDING	xx	xx	xx	Africa	Africa	Africa		No
510	SCF-PP		0.011364	0.011	1	0	1	0	82	6		9/15/2001	2001	TAME	Ecuador	Western	BELO HORIZONTE	F-100	Jet	CRUISE	xx	xx	xx	Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	SA (Northern)		No
511	ARC		0	0.000	0	0	0	0	62	5	0	16/09/2001	2001	VARIG	Brazil	Western	Goiania, BR	B737	Jet	Landing - Rollout	Rain	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
512	RI		1	1.000	104	6	110	0	104	6	0	08/10/2001	2001	SAS	Sweden (Multi-Nat)	Western	Milan, IT	MD-80	Jet	T/O Run	Fog	No	100	Europe	Europe	EU-EFTA	x	yes
513	SCF-NP		0	0.000	0	0	0	0	193	12		10/17/2001	2001	Pakistan Int'l Airlines	Pakistan	Western	DUBAI	A300B4	Jet	LANDING	xx	xx	xx	Asia	Asia	Asia-Low-Mdl Income		No
514	Other		0.006757	0.007	0	1	1	1	134	14		10/20/2001	2001	TunisAir	Tunisia	Western	DJERBA	A300-600	Jet	PARKED	xx	xx	xx	Africa	AFRICA	NoAfr/MidEast		No
515	LOC-I		1	1.000	251	9	260	0	243	17	5	12/11/2001	2001	American Airlines	USA	Western	Belle Harbor, NY	A300-600	Jet	T/O Climb to cruise	xx	No	100	North America	NA-Car	US-Canada	5 Ground fatal	yes
516	CFIT		0.727	0.727	21	3	24	0	28	5	0	24/11/2001	2001	Crossair	Switzerland	Western	(near) Zurich, CH	BAE (Avro) RJ	Jet	Landing - Approach	Snow	No	100	Europe	Europe	EU-EFTA	x	yes
517	USOS		0.077	0.077	1	0	1	0	8	5	0	11/27/01	2001	British Global	UK	Western	(near) Port Harcourt, NG	B747	Jet	Landing - Approach	xx	No	100	Europe	Europe	EU-EFTA	x	yes
518	RE-Takeoff		0.000	0.001	0	0	0	1	96	7	0	01/14/02	2002	Lion Air	Indonesia	Western	Pekanbaru, ID	B737 (JT8D)	Jet	T/O Run	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
519	SCF-PP		0.042	0.042	0	1	1	0	20	4	0	01/16/02	2002	Garuda Indonesia	Indonesia	Western	(near) Yogyakarta, ID	B737 (CFMI)	Jet	Descent	Heavy Rain, Hail	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
520	CFIT		1	1.000	83	9	92	0	83	9		1/28/2002	2002	TAME	Ecuador	Western	(near) Ipiales	B727-100	Jet	INITIAL APPROACH	xx	xx	xx	Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	SA (Northern)		No
521	Other		0	0.000	0	0	0	0	0	3		2/28/2002	2002	Fine Air	USA	Western	SINGAPORE	DC-8-62C	Jet	TAXI	xx	xx	xx	North America	NA-Car	US-Canada		No
522	RE-Landing		0.000	0.000	0	0	0	0	0	3	0	03/18/02	2002	VARIG	Brazil	Western	Belo Horizonte, BR	B727	Jet	Landing - Rollout	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
523	Fuel		xx	0.000	0	0	0	0	29	3		9/6/2001	2001	Aeromexico Connect	Mexico	Western	(near) Tijuana, MX	Saab 340	TP-Small					Latin America & Caribbean	SA/CA	CA/Carib		No
524	CFIT		0.771	0.781	120	8	128	28	155	11	0	04/15/02	2002	Air China	China	Western	Pusan, KR	B767	Jet	Approach	Rain, mist, vis	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
525	RE-Landing		0.000	0.000	0	0	0	0	0	4	0	04/26/02	2002	Hewa Bora Airways	Congo, Zr	Western	Kinshasa, ZR	B707	Jet	Landing - Rollout	Wind, vis	No	100	Africa	Africa	Africa	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
526	LOC-I		0.948	0.950	67	6	73	2	70	7	#	05/04/02	2002	Nicon Airways	Nigeria	Western	Kano, NG	BAC-1-11	Jet	T/O Initial Climb	xx	Yes	100	Africa	Africa	Africa	30 Ground fatal	yes
527	CFIT		0.226	0.237	11	3	14	12	56	6	0	05/07/02	2002	Egyptair	Egypt	Western	(near) Tunis, TN	B737 (CFMI)	Jet	Approach	Rain - T-Storm	No	100	Africa	Africa	NoAfr/MidEast	x	yes
528	SCF-NP		1.000	1.000	206	19	225	0	206	19	0	05/25/02	2002	China Airlines	Taiwan	Western	20nm. N. of Penghu Islands, TW	B747	Jet	En Route	xx	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
529	RI		xx	0.000	0	0	0	0	16	4		6/10/2002	2002	Swiss	Switzerland	Western	Werneuchen, DE	Saab 2000	TP-Large					Europe	Europe	EU-EFTA		No
530	RE-Landing		0.000	0.000	0	0	0	0	63	5	0	06/14/02	2002	Inter (Colombia)	Colombia	Western	Neiva, CO	DC-9	Jet	Landing - Rollout	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
531	MIDAIR		1.000	1.000	0	2	2	0	0	2	#	07/01/02	2002	DHL International B.S.C.	Bahrain	Western	(near) Uberlingen, DE	B757	Jet	En Route	xx	No	100	Middle East	Asia	NoAfr/MidEast	69 fatal in other A/C	yes
532	Fuel		0.920	0.925	16	7	23	2	17	8	0	07/04/02	2002	New Gomair	Congo, Zr	Western	(near) Bangui, CF	B707	Jet	Approach	xx	No	100	Africa	Africa	Africa	Fuel Exh	yes
533	CFIT		0.000	0.000	0	0	0	0	0	3	0	07/26/02	2002	FedEx	USA	Western	Tallahasse, US	B727	Jet	Approach	xx	No	100	North America	NA-Car	US-Canada	Color-blind	yes
534	RE-Landing		0	0.000	0	0	0	1	154	5		8/28/2002	2002	America West Airlines	USA	Western	PHOENIX	A320-231	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
535	Fuel		0.000	0.000	0	0	0	0	24	9	0	08/30/02	2002	TAM Linhas Aereas	Brazil	Western	Birigui, BR	Fokker 100	Jet	Landing	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	Fuel Pump	yes
536	RE-Landing		0.000	0.000	0	0	0	0	86	4	0	10/31/02	2002	Aeromexico	Mexico	Western	Monterrey, MX	DC-9	Jet	Landing - Rollout	Rain & ceiling	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
537	RE-Landing		0	0.000	0	0	0	0	0	4		12/13/2002	2002	Arrow Air	USA	Western	SINGAPORE	DC-8-62C	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
538	USOS		0.938	0.941	70	5	75	5	75	5	0	01/08/03	2003	Turkish Airlines (THY)	Turkey	Western	Diyarbakir, TR	Avro RJ Avroliner	Jet	Approach	Fog	No	100	Europe	Europe	NoAfr/MidEast	x	yes
539	CFIT		1.000	1.000	41	5	46	0	41	5	0	01/09/03	2003	TANS	Peru	Western	(near) Chachapoyas, PE	Fokker F.28	Jet	Approach	Visibility	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
540	USOS		0.000	0.000	0	0	0	0	87	6	0	01/26/03	2003	VASP	Brazil	Western	Rio Branco, BR	B737 (JT8D)	Jet	Landing - Approach	Mist	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
541	LOC-I		0.990	0.991	97	6	103	1	98	6	0	03/06/03	2003	Air Algerie	Algeria	Western	Tamanrasset, DZ	B737 (JT8D)	Jet	T/O Initial Climb	xx	No	100	Africa	Africa	NoAfr/MidEast	SCF PP	yes
542	RI		0	0.000	0	0	0	0	170	5		3/21/2003	2003	Transasia Airways	Taiwan	Western	TAINAN	A321-131	Jet	LANDING	xx	xx	xx	Asia	Asia	Hi-Income Asia-Pac		No
543	USOS		0.000	0.000	0	0	0	0	53	7	0	03/26/03	2003	Royal Air Maroc	Morrocco	Western	Oujda, MA	B737 (CFMI)	Jet	Approach	Fog	No	100	Africa	Africa	NoAfr/MidEast	x	yes
544	CFIT		0.042	0.046	0	1	1	2	21	3	0	06/22/03	2003	Brit Air	France	Western	Brest, FR	CRJ Regional Jet	Jet			No	100	Europe	Europe	EU-EFTA	x	yes
545	LOC-I		0.991	0.992	105	11	116	1	106	11	0	07/08/03	2003	Sudan Airways	Sudan	Western	(near) Port Sudan, SD	B737 (JT8D)	Jet			No	100	Africa	Africa	Africa	x	yes
546	Ramp		xx	0.000	0	0	0	0	0	3		3/29/2007	2007	Vigo Jet	Mexico	Western	Panama City, PA	L-188 Electra	TP-Large					Latin America & Caribbean	SA/CA	CA/Carib		No
547	SCF-NP		xx	0.000	0	0	0	0	44	4		4/20/2007	2007	Bahamasair	Bahamas	Western	Governors Harbour, BS	Dash-8-300	TP-Large					Latin America & Caribbean	SA/CA	CA/Carib		No
548	SCF-NP		xx	0.000	0	0	0	0	0	2		6/15/2007	2007	First Flight Couriers	India	Western	Chennai, IN	BAE ATP	TP-Large					Asia	Asia	Asia-Low-Mdl Income		No
549	SCF-NP		xx	0.000	0	0	0	0	24	4		8/11/2003	2003	Garuda Indonesia	Indonesia	Western	JAKARTA	F-28-3000	Jet	LANDING	xx	xx	xx	Asia	Asia	Asia-Low-Mdl Income		No
550	RI		0	0.000	0	0	0	0	2	7		11/29/2003	2003	Hydro Air	South Africa	Western	LAGOS	B747-200	Jet	LANDING	xx	xx	xx	Africa	Africa	Africa		No
551	RE-Landing		xx	0.000	0	0	0	0	37	3		1/28/2008	2008	Aires Colombia	Colombia	Western	Bogota, CO	Dash 8-200	TP-Large			xx	xx	Latin America & Caribbean	SA/CA	SA (Northern)		No
552	Ramp		xx	0.000	0	0	0	0	0	2		2/1/2008	2008	Atlantic Airlines	UK	Western	Edinburgh, GB	F.27-500	TP-Large					Europe	Europe	EU-EFTA		No
553	RE-Landing		0.000	0.000	0	0	0	0	40	4	0	12/07/03	2003	East African Safari Air Express	Kenya	Western	Lokichogio, KE	Fokker F.28	Jet	Landing - Rollout	xx	No	100	Africa	Africa	Africa	ADRM	yes
554	ARC		0.000	0.000	0	0	0	0	94	4	0	12/13/03	2003	Nuevo Continente	Peru	Western	Lima, PE	B737 (JT8D)	Jet	Landing	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
555	LOC-I		1.000	1.000	0	3	3	0	0	3	0	12/18/03	2003	Lineas Aereas Suramericanas	Colombia	Western	(near) Mitu, CO	DC-9	Jet	Descent	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
556	RE-Takeoff		xx	0.000	0	0	0	0	57	3		2/19/2008	2008	Air Bagan	Myanmar	Western	Putao, MM	ATR-72-210	TP-Large					Asia	Asia	Asia-Low-Mdl Income		No
557	CFIT		xx	1.000	43	3	46	0	43	3		2/21/2008	2008	Santa Barbara Airlines	Venezuela	Western	(near) Merida, VE	ATR-42-300	TP-Large					Latin America & Caribbean	SA/CA	SA (Northern)		No
558	ARC		0.000	0.000	0	0	0	0	0	9	0	12/18/03	2003	FedEx	USA	Western	Memphis, US	DC-10	Jet	Landing	Crosswind	No	100	North America	NA-Car	US-Canada	x	yes
559	RE-Landing		0.000	0.000	0	0	0	0	125	6	0	12/19/03	2003	Air Gabon	Gabon	Western	Libreville, GA	B737 (CFMI)	Jet	Landing - Rollout	Rain - T-Storm	Yes	100	Africa	Africa	Africa	x	yes
560	RE-Landing		xx	0.000	0	0	0	0	24	3		3/19/2008	2008	Cirrus Airlines	Germany	Western	Mannheim, DE	Dornier 328	100				100	Europe	Europe	EU-EFTA		No

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
561	RE-Takeoff		0.865	0.873	136	5	141	22	153	10	0	12/25/03	2003	UTA Guinee	Guinee	Western	Cotonou, BJ	B727	Jet	T/O Run	xx	No	100	Africa	Africa	Africa	x	yes
562	LOC-I		1.000	1.000	141	7	148	0	141	7	0	01/03/04	2004	Flash Airlines	Egypt	Western	off Sharm-el-Sheikh, EG	B737 (CFMI)	Jet	T/O Initial Climb	xx	No	100	Africa	Africa	NoAfr/MidEast	Automation	yes
563	SCF-NP		0	0.000	0	0	0	0	154	26		1/15/2004	2004	Iran Air	Iran	Western	BEIJING	B747-SP	Jet	LANDING	xx	xx	xx	Middle East	MIDDLE EAST	NoAfr/MidEast		No
564	RE-Landing		xx	0.000	0	0	0	0	0	4		4/29/2008	2008	Blue Bird Aviation	Kenya	Western	Wajir, KE	Fokker 50	TP-Large					Africa	Africa	Africa		No
565	LOC-I		1	1.000	19	2	21	0	19	2		5/2/2008	2008	Southern Sudan Air Connection	Sudan	Western	(near) Rumbek, SD	BE-1900C	TP-Small					Africa	Africa	Africa		No
566	SCF-NP		0.000	0.000	0	0	0	0	261	12	0	03/01/04	2004	Pakistan International Airlines	Pakistan	Western	Jeddah, SA	Airbus A300	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
567	SCF-NP		0.000	0.000	0	0	0	0	0	7	0	04/02/04	2004	Air Memphis	Egypt	Western	Cairo, EG	B707	Jet			No	100	Africa	Africa	NoAfr/MidEast	x	yes
568	RI		0	0.000	0	0	0	0	82	6		4/20/2004	2004	Alitalia	Italy	Western	TRIESTE	MD-82	Jet	TAXI	xx	xx	xx	Europe	Europe	EU-EFTA		No
569	RE-Landing	ARC	0.000	0.000	0	0	0	0	0	3	0	04/28/04	2004	Centurion Air Cargo	USA	Western	Bogota, CO	DC-10	Jet			No	100	North America	NA-Car	US-Canada	x	yes
570	WSTRW		0.000	0.001	0	0	0	1	53	4	0	07/21/04	2004	Aerocalifornia	Mexico	Western	Mexico City, MX	DC-9	Jet			No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
571	RE-Takeoff		0.000	0.000	0	0	0	0	116	8	0	08/11/04	2004	Air Guinee Express	Guinee	Western	Freetown, SL	B737 (JT8D)	Jet			No	100	Africa	Africa	Africa	x	yes
572	RE-Landing		0.000	0.000	0	0	0	0	0	3	0	08/28/04	2004	Trans Air Cargo Services	Swaziland	Western	Gisenyi, RW	Aerospatiale Caravelle	Jet			No	100	Africa	Africa	Africa	x	yes
573	SCF-PP		xx	0.028	1	0	1	0	32	4		7/23/2008	2008	TAM - Transporte Aereo Militar	Bolivia	Western	70nm from Guayaramerin, BO	F.27-400	TP-Large	CLIMB				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	SA Mercosur		No
574	CFIT		xx	1.000	0	3	3	0	0	3		8/13/2008	2008	Fly540	Sudan	Western	Mogadishu, SO	F.27-500RF	TP-Large	Approach				Africa	Africa	Africa		No
575	RE-Landing	ARC	0.000	0.003	0	0	0	4	83	4	0	10/08/04	2004	Biman Bangladesh Airlines	Bangladesh	Western	Sylhet, BD	Fokker F.28	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
576	RE-Takeoff		1.000	1.000	0	7	7	0	0	7	0	10/14/04	2004	MK dba British Global	Ghana	Western	Halifax, CA	B747	Jet			No	100	Africa	Africa	Africa	x	yes
577	SCF-NP		0.000	0.000	0	0	0	0	0	3	0	10/23/04	2004	Beta Cargo	Brazil	Western	Manaus, BR	B707	Jet			No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
578	USOS		xx	0.000	0	0	0	0	12	2		9/13/2008	2008	MASWings	Malaysia	Western	Ba Kelalan, MY	DHC-6-300	TP-Small	Approach				Asia				No
579	RE-Takeoff		0.000	0.000	0	0	0	0	0	4	0	11/07/04	2004	Lufthansa Cargo	Germany	Western	Sharjah, AE	B747	Jet			No	100	Europe	Europe	EU-EFTA	x	yes
580	LOC-I		1.000	1.000	47	6	53	0	47	6	2	11/21/04	2004	China Yunnan Airlines	China	Western	Baotou, CN	CRJ Regional Jet	Jet			No	100	Asia	**Asia**	Asia-Low-Mdl Income	2 ground fatal	yes
581	SCF-NP		0.000	0.000	0	0	0	0	140	6	0	11/28/04	2004	KLM Royal Dutch Airlines	Neder	Western	Barcelona, ES	B737 (CFMI)	Jet			No	100	Europe	Europe	EU-EFTA	x	yes
582	USOS		xx	0.950	16	2	18	1	16	3		10/8/2008	2008	Yeti Airlines	Nepal	Western	Lukla, NP	DHC-6-300	TP-Small	Approach				Asia	Asia	Asia-Low-Mdl Income		No
583	RE-Landing	ARC	0.153	0.174	23	2	25	59	156	7	0	11/30/04	2004	Lion Air	Indonesia	Western	Solo, ID	MD-80	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
584	USOS		xx	0.000	0	0	0	0	32	4		11/6/2008	2008	Express Air	Indonesia	Western	Fak Fak, ID	Dornier 328	TP-Small					Asia	Asia	Asia-Low-Mdl Income		No
585	RI-A		0	0.000	0	0	0	0	0	4		1/3/2005	2005	Asia Airlines	Indonesia	Western	BANDA ACEH	B737-200	Jet	LANDING	xx	xx	xx	Asia	Asia	Asia-Low-Mdl Income		No
586	ARC		xx	0.000	0	0	0	0	4	2		11/27/2008	2008	Northwestern Air	Canada	Western	Fort Smith, CA	Jetstream 31	TP-Small			xx	xx	North America	NA-Car	US-Canada		No
587	RI-A		0.000	0.000	0	0	0	0	0	4	0	01/04/05	2005	Tri MG Airlines	Indonesia	Western	Banda Aceh, ID	B737 (JT8D)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
588	ARC		0.000	0.000	0	0	0	0	106	6	0	01/08/05	2005	AeroRepublica Colombia	Colombia	Western	Cali, CO	MD-80	Jet			No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
589	RE-Landing		0	0.000	0	0	0	0	0	3		1/24/2005	2005	Atlas Air	USA	Western	DUSSELDORF	B747-200	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
590	Ramp		0.01	0.000	0	1	1	0				2/1/2005	2005	Air France	France	Western	PARIS	A319	Jet	PARKED	xx	xx	xx	Europe	Europe	EU-EFTA		No
591	CFIT		1.000	1.000	98	6	104	0	98	6	0	02/03/05	2005	Kam Air	Afghanistan	Western	Afghanistan	B737 (JT8D)	Jet			No	100	Asia	Asia	ASIA CEN	x	yes
592	CFIT		0.000	0.000	0	0	0	0	0	5	0	03/19/05	2005	Cargo Plus Aviation dba Rainbow Air Cargo	Ethiopia	Western	(near) Kampala, UG	B707	Jet			No	100	Africa	Africa	Africa	x	yes
593	USOS		0.000	0.001	0	0	0	1	61	4	0	04/07/05	2005	ICARO Air	Ecuador	Western	Coca, EC	Fokker F.28	Jet			No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
594	GCOL		0.000	0.001	0	0	0	1	5	94	0	05/10/05	2005	Northwest	USA	Western	Minneapolis, US	DC-9	Jet			No	100	North America	NA-Car	US-Canada	x	yes
595	RE-Landing		0.000	0.000	0	0	0	0	201	14	0	07/01/05	2005	Biman Bangladesh Airlines	Bangladesh	Western	Chittagong, BD	DC-10	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
596	RE-Landing	ARC	0.000	0.000	0	0	0	0	297	12	0	08/02/05	2005	Air France	France	Western	Toronto, CA	Airbus A340	Jet			No	100	Europe	Europe	EU-EFTA	x	yes
597	OTHER		1.000	1.000	115	6	121	0	115	6	0	08/14/05	2005	Helios	Greece	Western	(near) Grammatikos, GR	B737 (CFMI)	Jet			No	100	Europe	Europe	EU-EFTA	x	yes
598	LOC-I		1.000	1.000	152	8	160	0	152	8	0	08/16/05	2005	West Caribbean Airways	Colombia	Western	(near) Machiques, VE	MD-80	Jet			No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
599	SCF-NP		0	0.000	0	0	0	0	318	16		8/19/2005	2005	Northwest Airlines	USA	Western	GUAM	B747-200	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
600	CFIT		0.408	0.408	35	5	40	0	91	7	0	08/23/05	2005	TANS	Peru	Western	(near) Pucallpa, PE	B737 (JT8D)	Jet	Approach	T-Storm	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
601	LOC-I		1.000	1.000	99	5	104	0	99	5	#	09/05/05	2005	Mandala Airlines	Indonesia	Western	Medan, ID	B737 (JT8D)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	44 Ground fatal	yes
602	RE-Landing	ARC	0	0.000	0	0	0	0	113	8		10/9/2005	2005	Sahara India Airlines	India	Western	BOMBAY	B737-400	Jet	LANDING	xx	xx	xx	Asia	Asia	Asia-Low-Mdl Income		No
603	UNK		1.000	1.000	111	6	117	0	111	6	0	10/22/05	2005	Bellview Airlines	Nigeria	Western	(near) Lissa, NG	B737 (JT8D)	Jet			No	100	Africa	Africa	Africa	x	yes
604	RE-Landing		0.000	0.000	0	0	0	0	0	3	0	10/31/05	2005	MIBA Aviation	Congo, Zr	Western	Kindu, ZR	B727	Jet			No	100	Africa	Africa	Africa	x	yes
605	RE-Landing		0.000	0.000	0	0	0	0	32	6	0	11/14/05	2005	Asian Spirit	Philippines	Western	Catarman, PH	HS 146	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
606	RE-Landing		0.000	0.000	0	0	0	0	98	5	1	08/12/2005	2005	Southwest	USA	Western	Chicago Midway	B737-700	Jet	Landing - Rollout	Snow, freezing fog	No	70	North America	NA-Car	US-Canada	ADRM	yes
607	USOS		0.991	0.991	101	7	108	1	102	7	0	12/10/05	2005	Sosoliso Airlines	Nigeria	Western	Port Harcourt, NG	DC-9	Jet			No	100	Africa	Africa	Africa	x	yes
608	RE-Landing		0	0.000	0	0	0	0	138	6		3/4/2006	2006	Lion Air	Indonesia	Western	SURABAYA	MD-82	Jet	LANDING	xx	xx	xx	Asia	Asia	Asia-Low-Mdl Income		No
609	LOC-I		1.000	1.000	105	8	113	0	105	8	0	05/03/06	2006	Armavia	Armenia	Western	off Sochi, RU	Airbus A320	Jet			No	100	CIS	Europe	Euro East	x	yes
610	RE-Landing		0.000	0.000	0	0	0	0	0	3	0	06/04/06	2006	Arrow Cargo	USA	Western	Managua, NI	DC-10	Jet			No	100	North America	NA-Car	US-Canada	x	yes
611	RE-Takeoff		0.000	0.000	0	0	0	0	0	5	0	06/07/06	2006	TradeWinds Airlines	USA	Western	Medellin, CO	B747	Jet			No	100	North America	NA-Car	US-Canada	x	yes
612	USOS		0.000	0.000	0	0	0	0	0	2	0	06/15/06	2006	TNT Airways	Belgium	Western	Birmingham, GB	B737 (CFMI)	Jet			No	100	Europe	Europe	EU-EFTA	x	yes
613	RE-Landing		0	0.000	0	0	0	0	14	10		6/23/2006	2006	AMC Aviation	Egypt	Western	JUBA	MD-83	Jet	LANDING	xx	xx	xx	Africa	AFRICA	NoAfr/MidEast		No
614	RE-Landing		0.616	0.627	120	5	125	41	195	8	0	07/09/06	2006	S7 Airlines	Russia	Western	Irkutsk, RU	Airbus A310	Jet			No	100	CIS	Europe	Euro East	x	yes
615	SCF-NP		0.000	0.000	0	0	0	0	0	3	0	07/28/06	2006	FedEx	USA	Western	Memphis, US	DC-10	Jet			No	100	North America	NA-Car	US-Canada	x	yes
616	SCF-NP		0.000	0.000	0	0	0	0	0	3	0	08/17/06	2006	Aerosucre Colombia	Colombia	Western	Bogota, CO	B727	Jet			No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
617	RE-Takeoff		0.980	0.981	47	2	49	1	47	3	0	08/27/06	2006	Comair	USA	Western	Lexington, US	CRJ Regional Jet	Jet			No	100	North America	NA-Car	US-Canada	x	yes
618	RE-Landing		0.000	0.000	0	0	0	0	0	3	0	09/07/06	2006	DHL Aviation	So Africa	Western	Lagos, NG	B727	Jet			No	100	Africa	Africa	Africa	x	yes
619	MIDAIR		1.000	1.000	148	6	154	0	148	6	0	09/29/06	2006	GOL Linhas Aereas	Brazil	Western	(near) Peixote Azevedo, BR	B737 (NG)	Jet			No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
620	RE-Landing		0.000	0.000	0	0	0	0	104	6	0	10/03/06	2006	Mandala Airlines	Indonesia	Western	Tarakan, ID	B737 (JT8D)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
621	RE-Landing		0.250	0.272	3	1	4	6	13	3	0	10/10/06	2006	Atlantic Airways (Faroe Islands)	Faroe Islands	Western	Stord, NO	HS 146	Jet			No	100	Europe	Europe	EU-EFTA	x	yes
622	WSTRW		0.914	0.919	92	4	96	8	100	5	0	10/29/06	2006	ADC Airlines	Nigeria	Western	Abuja, NG	B737 (JT8D)	Jet			No	100	Africa	Africa	Africa	x	yes
623	RE-Landing		0.000	0.000	0	0	0	0	4	3	0	11/17/06	2006	Cielos Airlines	Peru	Western	Barranquilla, CO	DC-10	Jet			No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
624	CFIT		1.000	1.000	2	3	5	0	2	3	0	11/18/06	2006	Aerosucre Colombia	Colombia	Western	(near) Leticia, CO	B727	Jet			No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
625	ARC		0.000	0.000	0	0	0	0	157	7	0	12/24/06	2006	Lion Air	Indonesia	Western	Ujung Pandang, ID	B737 (CFMI)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
626	LOC-I		1.000	1.000	96	6	102	0	96	6	0	01/01/07	2007	Adam Air	Indonesia	Western	off Makassar, ID	B737 (CFMI)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
627	USOS		0.000	0.000	0	0	0	0	0	4	0	01/13/07	2007	Gading Sari Aviation Services	Malaysia	Western	Kuching, MY	B737 (JT8D)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
628	RE-Takeoff		0.000	0.000	0	0	0	0	50	4	1	01/25/07	2007	Regional	France	Western	Pau, FR	Fokker 100	Jet			No	100	Europe	Europe	EU-EFTA	1 Ground fatal	yes
629	SCF-NP		0	0.000	0	0	0	0	0	3		2/4/2007	2007	Tampa Cargo	Colombia	Western	MIAMI	DC-8-71F	Jet	LANDING	xx	xx	xx	Latin America & Caribbean	SA/CA	SA (Northern)		No
630	ARC		0.000	0.000	0	0	0	0	148	6	0	02/21/07	2007	Adam Air	Indonesia	Western	Surabaya, ID	B737 (CFMI)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
631	RE-Landing	ARC	0.150	0.155	20	1	21	12	133	7	0	03/07/07	2007	Garuda Indonesia	Indonesia	Western	Yogyakarta, ID	B737 (CFMI)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
632	Other		0	0.000	0	0	0	0	236	14		3/12/2007	2007	Biman Bangladesh Airlines	Bangladesh	Western	DUBAI	A310-325	Jet	TAKEOFF	xx	xx	xx	Asia	Asia	Asia-Low-Mdl Income		No
633	RE-Landing		0.000	0.000	0	0	0	0	30	20	0	03/23/07	2007	Ariana Afghan Airlines	Afghanistan	Western	Istanbul, TR	Airbus A300	Jet			No	100	Asia	Asia	ASIA CEN	x	yes
634	LOC-I		1.000	1.000	105	9	114	0	105	9	0	05/05/07	2007	Kenya Airways	Kenya	Western	(near) Douala, CM	B737 (NG)	Jet			No	100	Africa	Africa	Africa	x	yes
635	ARC		0.000	0.000	0	0	0	0	37	3	0	05/20/07	2007	Air Canada Jazz	Canada	Western	Toronto, CA	CRJ Regional Jet	Jet			No	100	North America	NA-Car	US-Canada	x	yes
636	USOS		0.063	0.063	4	1	5	0	74	6	1	06/28/07	2007	TAAG - Angola Airlines	Angola	Western	M'Banza Congo, AO	B737 (JT8D)	Jet			No	100	Africa	Africa	Africa	1 Ground fatal	yes
637	RE-Landing		1.000	1.000	181	6	187	0	181	6	#	07/17/07	2007	TAM Linhas Aereas	Brazil	Western	Sao Paulo, BR	Airbus A320	Jet			No	100	Latin America & Caribbean	SA/CA	SA Mercosur	12 Ground fatal	yes
638	RE-Landing		0.000	0.000	0	0	0	0	54	5	0	07/17/07	2007	AeroRepublica Colombia	Colombia	Western	Santa Marta, CO	EMB 190	Jet			No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
639	SCF-NP		0.000	0.000	0	0	0	0	157	8	0	08/20/07	2007	China Airlines	Taiwan	Western	Naha, JP	B737 (NG)	Jet			No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
640	ARC		0.529	0.529	85	5	90	0	40	##	0	09/16/07	2007	One-Two-Go	Thailand	Western	Phuket, TH	MD-80	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
641	SCF-NP		0.000	0.000	0	0	0	0	156	7	0	10/11/07	2007	AMC Airlines	Turkey	Western	Istanbul, TR	MD-80	Jet			No	100	Europe	Europe	NoAfr/MidEast	x	yes
642	RE-Landing	ARC	0.000	0.000	0	0	0	0	148	6	0	10/26/07	2007	Philippine Airlines	Philippines	Western	Butuan City, PH	Airbus A320	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
643	ARC		0.000	0.000	0	0	0	0	89	5	0	11/01/07	2007	Mandala Airlines	Indonesia	Western	Malang, ID	B737 (JT8D)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
644	ARC		0.000	0.000	0	0	0	0	335	14	0	11/09/07	2007	Iberia	Spain	Western	Quito, EC	Airbus A340	Jet			No	100	Europe	Europe	EU-EFTA	x	yes
645	CFIT		1.000	1.000	50	7	57	0	50	7	0	11/30/07	2007	World Focus Airlines dba Atlasjet Airlines	Turkey	Western	(near) Isparta, TR	MD-80	Jet			No	100	Europe	Europe	NoAfr/MidEast	x	yes
646	RI		0.000	0.000	0	0	0	0	117	6	0	12/30/07	2007	TAROM	Romania	Western	Bucharest, RO	B737 (CFMI)	Jet			No	100	Europe	Europe	Euro East	x	yes
647	LOC-I		xx	0.000	0	0	0	0	107	6		1/2/2008	2008	Iran Air	Iran	Western	TEHRAN	F-100	Jet	TAKEOFF	xx	xx	xx	Middle East	MIDDLE EAST	NoAfr/MidEast		No
648	FUEL		0	0.000	0	0	0	1	137	16		1/17/2008	2008	British Airways	United Kingdom	Western	LONDON	B777-200	Jet	FINAL APPROACH	xx	xx	xx	Europe	Europe	EU-EFTA		No
649	FUEL		0	0.000	0	0	0	0	159	8		2/1/2008	2008	LAB	Bolivia	Western	Near Trinidad	B727-200	Jet	FINAL APPROACH	xx	xx	xx	Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	SA Mercosur		No
650	Other		0	0.000	0	0	0	0	0			2/2/2008	2008	Atlas Air	USA	Western	LOME	B747-200FM	Jet	INITIAL CLIMB	xx	xx	xx	North America	NA-Car	US-Canada		No
651	ICE		xx	0.027	0	0	0	10	18	3		2/14/2008	2008	Belavia	Belarus	Western	Yerevan, AM	CRJ-100	Jet					CIS	CIS	Euro East		No
652	SCF-NP		0	0.000	0	0	0	0	5	3		3/6/2008	2008	Manunggal Air	Indonesia	Western	Wamena, ID	Transall C-160	Jet					Asia	Asia	Asia-Low-Mdl Income		No
653	ARC		0	0.000	0	0	0	0	169	5		3/10/2008	2008	Adam Air	Indonesia	Western	BATAM, BATU BESAR	B737-400	Jet	LANDING	xx	xx	xx	Asia	Asia	Asia-Low-Mdl Income		No
654	SCF-NP		0	0.000	0	0	0	0	307	19		3/25/2008	2008	Saudia	Saudi Arabia	Western	DACCA	B747-300	Jet	LANDING	xx	xx	xx	Middle East	MIDDLE EAST	NoAfr/MidEast		No
655	RE-Takeoff		0.174419	0.215	15	0	15	60	79	7		4/15/2008	2008	Hewa Bora Airways	Congo, ZR	Western	GOMA	DC-9-51	Jet	TAKEOFF	xx	xx	xx	Africa	Africa	Africa		No
656	RE-Landing		0	0.000	0	0	0	0	67	6		4/22/2008	2008	Carpatair	Romania	Western	BUCHAREST	BAe 146-200	Jet	LANDING	xx	xx	xx	Europe	Europe	Euro East		No
657	RE-Takeoff		0	0.000	0	0	0	0	0	5		5/25/2008	2008	Kalitta Air	USA	Western	BRUSSELS	B747-200FM	Jet	TAKEOFF	xx	xx	xx	North America	NA-Car	US-Canada		No
658	RE-Landing	ARC	0.021739	0.047	2	1	3	60	131	7		5/30/2008	2008	TACA International Airlines	El Salvador	Western	TEGUCIGALPA	A320-200	Jet	LANDING	xx	xx	xx	Latin America & Caribbean	SA/CA	CA/Carib		No
659	RE-Landing	ARC	0.125	0.131	32	1	33	27	252	12		6/10/2008	2008	Sudan Airways	Sudan	Western	KHARTOUM	A310-300	Jet	LANDING	xx	xx	xx	Africa	Africa	Africa		No
660	SCF-NP		0	0.000	0	0	0	0	0	2		6/28/2008	2008	ABX Air	USA	Western	SAN FRANCISCO	B767-200	Jet	PARKED	xx	xx	xx	North America	NA-Car	US-Canada		No
661	CFIT		0.5	0.529	0	1	1	1	0	2		7/6/2008	2008	U.S.A. Jet Airlines	USA	Western	SALTILLO	DC-9-15	Jet	FINAL APPROACH	xx	xx	xx	North America	NA-Car	US-Canada		No
662	SCF-PP		0	0.022	0	0	0	3	0	8		7/7/2008	2008	Kallitta as Centurion Air Cargo	USA	Western	(near) BOGOTA	747-200FM	Jet	INITIAL CLIMB	xx	xx	xx	North America	NA-Car	US-Canada		No
663	RE-Landing	ARC	xx	0.000	0	0	0	0	41	6		7/14/2008	2008	Chanchangi Airlines	Nigeria	Western	Port Harcourt, NG	B737-200	Jet					Africa	Africa	Africa		No
664	LOC-I		0.895349	0.901	148	6	154	18	166	6		8/20/2008	2008	Spanair	Spain	Western	MADRID	MD-82	Jet	TAKEOFF	xx	xx	xx	Europe	Europe	EU-EFTA		No
665	CFIT		0.722222	0.738	65	0	65	25	84	6		8/24/2008	2008	"ITEK AIR" AirCompany	Kyrgyzstan	Western	Near Bishkek-Manas International Airport	B737-200	Jet	FINAL APPROACH	xx	xx	xx	CIS	CIS	ASIA CEN		No

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
666	RE-Landing		0	0.007	0	0	0	16	123	6		8/27/2008	2008	Sriwijaya Air	Indonesia	Western	JAMBI	B737-200	Jet	LANDING	xx	xx	xx	Asia	Asia	Asia-Low-Mdl Income		No
667	LOC-I		1	1.000	82	6	88	0	82	6		9/14/2008	2008	Aeroflot-Nord	Russia	Western	Near Perm, Russia	B737-500	Jet	INITIAL APPROACH	xx	xx	xx	CIS	CIS	Euro East		No
668	RE-Takeoff		xx	0.003	0	0	0	3	62	4		9/22/2008	2008	ICARO	Ecuador	Western	QUITO	F-28-4000	Jet	TAKEOFF	xx	xx	xx	Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	SA (Northern)		No
669	ARC		0	0.000	0	0	0	0	138	6		10/1/2008	2008	Kaliningradavia	Russia	Western	KALININGRAD	B737-300	Jet	LANDING	xx	xx	xx	CIS	CIS	Euro East		No
670	RE-Landing	ARC	0	0.000	0	0	0	0	47	7		10/16/2008	2008	Rutaca	Venezuela	Western	CARACAS	B737-200	Jet	LANDING	xx	xx	xx	Latin America & Caribbean	SA/CA	SA (Northern)		No
671	Other-Bird		0	0.000	0	0	0	0	166	6		11/10/2008	2008	Ryanair	Ireland	Western	ROME	B737-800	Jet	FINAL APPROACH	xx	xx	xx	Europe	Europe	EU-EFTA		No
672	RE-Takeoff		0	0.002	0	0	0	5	110	5		12/20/2008	2008	Continental Airlines	USA	Western	DENVER	B737-500	Jet	TAKEOFF	xx	xx	xx	North America	NA-Car	US-Canada		No

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	eviously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Fatal (onBd)	-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
680	LOC-I		0.982	0.982	38	12	50	1	39	12	0	03/01/1987	1987	Varig	Brazil	Western	Abidjan, Ivory Coast	B707	Jet	T/O Climb to Cruise	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
681	RE-Takeoff			0.000					21			06/01/1987	1987	Braathens Sverige AB	Sweden		Stockholm	Caravelle-	Jet	TAKEOFF				Europe	EUROPE	Sweden	HULL LOSS	ASEDB
682	SCF-NP			0.000				1	167			12/02/1987	1987	Conair A/S	Denmark		SALZBURG	720-518	Jet	LANDING				Europe	EUROPE	Denmark	HULL LOSS	ASEDB
683	ARC			0.000					102			23/02/1987	1987	SAS	Sweden		TRONDHEIM	DC-9-41	Jet	LANDING				Europe	EUROPE	Sweden	HULL LOSS	ASEDB
684	USOS		0.623	0.623	23	4	27	18	37	8	0	04/04/1987	1987	Garuda	Indonesia	Western	Medan, Sumatra, Indonesia	DC-9	Jet	Landing - Approach	T-Storm	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
685	SCF-NP			0.000								06/04/1987	1987	Conair A/S	Denmark		ROME	720-051B	Jet	LANDING				Europe	EUROPE	Denmark	HULL LOSS	ASEDB
686	RE-Landing			0.000								11/04/1987	1987	Transbrasil	Brazil		MANAUS	707-330C	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Brazil	HULL LOSS	ASEDB
687	CFIT		1	1.000	0	4	4	0	0	4	0	13/04/1987	1987	Buffalo	USA	Western	KCI	B707	Jet	Landing - Approach	Fog	No	100	North America	NA-Car	US-Canada	x	yes
688	ADRM		0.492	0.492	1	0	1	34	0	6	0	04/08/1987	1987	LanChile	Chile	Western	Calama, CL	B737	Jet	Landing - Rollout	xx	No	100	Latin America & Caribbean	SA/CA	Asia-Low-Mdl Income	x	yes
689	Other			0.003		1	1		324			11/08/1987	1987	All Nippon Airways	Japan		WASHINGTON	747-200	Jet	PARKED				Asia	ASIA (EX CHINA)	Japan	NONE	ASEDB
690	LOC-I		0.994	0.994	148	6	154	1	149	6	1	16/08/1987	1987	Northwest	USA	Western	Romulus	DC-9	Jet	T/O Initial Climb	xx	No	100	North America	NA-Car	US-Canada	1 Ground fatal	yes
691	LOC-I		1	1.000	74	9	83	0	74	9	0	31/08/1987	1987	Tahi Int	Thailand	Western	Phuket, Thailand	B737	Jet	Landing - Approach	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
692	ICE		0.361	0.361	25	3	28	28	77	5	0	15/11/1987	1987	Continental	USA	Western	DEN	DC-9	Jet	T/O Initial Climb	Snow	No	100	North America	NA-Car	US-Canada	x	yes
693	FIRE-NI		1	1.000	140	19	159	0	140	19	0	28/11/1987	1987	South African Airways	So Africa	Western	134nm NE of Mauritius, MU	B747	Jet	En Route	xx	No	100	Africa	Africa	Africa	x	yes
694	ARC		0	0.000	0	0	0	0	98	5	0	27/12/1987	1987	Eastern	USA	DC-9	Pensacola, Fla	B727	Jet	Landing - Rollout	Wind, Echo	No	100	North America	NA-Car	US-Canada	x	yes
695	CFIT		1	1.000	11	5	16	0	11	5	0	02/01/1988	1988	Condor	Germany	Western	Izmir, Turkey	B737	Jet	Initial Descent	Rain	No	100	Europe	Europe	EU-EFTA	x	yes
696	CFIT		1	1.000	11	4	15	0	11	4	0	27/02/1988	1988	Talia Air	Turkey	Western	No. Cyprus	B727	Jet	Landing - Approach	Fog	No	100	Europe	Europe	NoAfr/MidEast	x	yes
697	CFIT		1	1.000	137	6	143	0	137	6	0	17/03/1988	1988	Avianca	Colombia	Western	Cucuta, CO	B727	Jet	T/O Climb to Cruise	Fog	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
698	LOC-I		1	1.000	0	4	4	0	0	4	0	31/03/1988	1988	ARAX Airlines	Egypt	Western	Cairo, EG	DC-8	Jet	T/O Initial Climb	xx	No	100	Africa	Africa	NoAfr/MidEast	x	yes
699	SCF-NP		0.01	0.010	0	1	1	0	96	7	0	28/04/1988	1988	Aloha	USA	Western	Maui	B737	Jet	En Route	xx	No	100	North America	NA-Car	US-Canada	x	yes
700	RE-Takeoff			0.000				2	240			21/05/1988	1988	American Airlines	USA		DALLAS	DC-10	Jet	TAKEOFF				North America	NA-Car	USA	HULL LOSS	ASEDB

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
701	RE-Takeoff		0.002	0.002	0	0	0	1	16	9	0	23/05/1988	1988	LACSA	Honduras	Western	San Jose, CR	B727	Jet	T/O Run	xx	Yes	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
702	CFIT		1	1.000	15	7	22	0	15	7	0	12/06/1988	1988	Austral	Argentina	Western	Posadas, Argentina	MD-81	Jet	Landing - Approach	Fog	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
703	CFIT		1	1.000	0	6	6	0	0	6	0	21/07/1988	1988	TAAG (Angola Air Charter)	Angola	Western	Lagos, NG	B707	Jet	Approach	xx	xx	100	Africa	Africa	Africa	x	yes
704	SCF-PP		0	0.000	0	0	0	0	260	15	0	24/07/1988	1988	Air France	France	Western	Delhi, IN	B747	Jet	Landing - Rollout	xx	No	91	Europe	Europe	EU-EFTA	x	yes
705	SCF-NP			0.000					7			27/08/1988	1988	TWA	USA		CHICAGO	727-100	Jet	LANDING				North America	NA-Car	USA	HULL LOSS	ASEDB
706	USOS		0.081	0.081	1	6	7	13	89	7	0	31/08/1988	1988	CAAC	China	Western	Hong Kong	Trident-2	Jet	Landing - Approach	Rain-Wind	No	100	Asia	**Asia**	Asia-Low-Mdl Income	x	yes
707	LOC-I		0.144	0.143	12	2	14	26	101	7	0	31/08/1988	1988	Delta	USA	Western	DFW	B727	Jet	T/O Aborted	xx	No	100	North America	NA-Car	US-Canada	x	yes
708	OTHER-BIRD		0.332	0.332	35	0	35	27	104	6	0	15/09/1988	1988	Ethiopian AL	Ethiopia	Western	Bahir Dar, Ethiopia	B737	Jet	T/O Initial Climb	xx	No	100	Africa	Africa	Africa	x	yes
709	RE-Landing	ARC	0	0.000	0	0	0	0	56	6	0	26/09/1988	1988	Aerolineas Argentinas	Argentina	Western	Ushuaia, AR	B737	Jet	Landing - Rollout	Wind	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
710	ARC		0	0.000	0	0	0	0	125	7	0	15/10/1988	1988	Nigeria Airways	Nigeria	Western	Port Harcourt, NG	B737	Jet	Landing - Rollout	T-Storm	No	100	Africa	Africa	Africa	x	yes
711	CFIT		0.633	0.633	26	7	32	16	45	7	0	17/10/1988	1988	Uganada AL	Uganda	Western	Rome	B707	Jet	Landing - Approach	Fog	No	100	Africa	Africa	Africa	x	yes
712	CFIT		0.986	0.986	127	6	133	2	129	6	0	19/10/1988	1988	Indian Airlines	India	Western	Ahmedabad, India	B737	Jet	Landing - Approach	Haze	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
713	LOC-I		0.179	0.179	11	1	12	6	65	4	0	25/10/1988	1988	Aero Peru	Peru	Western	Juliaca, Peru	Fokker 28	Jet	T/O Initial Climb	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
714	FUEL		1	1.000	3	5	8	0	3	5	0	13/12/1988	1988	GAS Air Nigeria	Nigeria	Western	Luxor, EG	B707	Jet	Initial Descent	Vis	No	100	Africa	Africa	Africa	x	yes
715	SCF-PP		0.407	0.407	47	0	47	74	118	8	0	08/01/1989	1989	British Midland	UK	Western	East Midlands, UK	B737	Jet	T/O Climb to Cruise	xx	No	100	Europe	Europe	EU-EFTA	x	yes
716	CFIT		1	1.000	137	7	144	0	137	7	0	08/02/1989	1989	Independent Air	USA	Western	Azores	B707	Jet	Landing - Initial Descent	Cloud	No	100	North America	NA-Car	US-Canada	x	yes
717	RE-Landing	ARC		0.000					103			09/02/1989	1989	LAM	Mozambique		LICHINGA	737-200	Jet	LANDING				Africa	AFRICA	Mozambique	HULL LOSS	ASEDB
718	Other			0.000		1	1					09/02/1989	1989	Evergreen International A/L	USA		SALT LAKE CITY	DC-9-	Jet	CLIMB				North America	NA-Car	USA	NONE	ASEDB
719	CFIT		1	1.000	0	4	4	0	0	4	0	19/02/1989	1989	Flying Tiger	USA	Western	Malaysia	B747	Jet	Landing - Approach	Cloud-fog	No	100	North America	NA-Car	US-Canada	x	yes
720	SCF-NP		0.026	0.026	9	0	9	5	337	18	0	24/02/1989	1989	United	USA	Western	HNL	B747	Jet	T/O Climb to Cruise	xx	No	100	North America	NA-Car	US-Canada	x	yes
721	ICE		0.364	0.364	21	3	24	19	65	4	0	10/03/1989	1989	Air Ontario	Canada	Western	Dryden, Ont	Fokker 28	Jet	T/O Initial Climb	Snow	No	100	North America	NA-Car	US-Canada	x	yes
722	LOC-I		1	1.000	0	2	2	0	0	2	0	18/03/1989	1989	Evergreen	USA	Western	Saginaw, Tex	DC-9	Jet	T/O Initial Climb	xx	No	100	North America	NA-Car	US-Canada	x	yes
723	CFIT		1	1.000	0	3	3	0	0	3	#	21/03/1989	1989	Transbrasil	Brazil	Western	Sao Paulo	B707	Jet	Landing - Approach	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	22 Ground fatal	yes
724	ARC		0	0.000	0	0	0	0	133	6	0	03/04/1989	1989	Faucett	Peru	Western	Iquitos, PE	B737	Jet	Landing - Rollout	Rain, x-wind	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
725	LOC-I		1	1.000	2	3	5	0	3	2	2	26/04/1989	1989	Aerosucre Colombia	Colombia	Western	Barranquilla, CO	Caravelle	Jet	T/O Initial Climb	xx	Yes	100	Latin America & Caribbean	SA/CA	SA (Northern)	2 Ground fatal	yes
726	RE-Takeoff		0	0.000	0	0	0	0	69	8	0	17/05/1989	1989	Somali Airlines	Somalia	Western	Nairobi, KE	B707	Jet	T/O Aborted	Heavy Rain	No	100	Africa	Africa	Africa	x	yes
727	CFIT		0.954	0.954	169	9	178	7	178	9	0	07/06/1989	1989	Surinam Awy	Surinam	Western	Paramaribo, Surinam	DC-8	Jet	Landing - Approach	xx	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
728	RE-Landing			0.000					66			11/07/1989	1989	Kenya Airways	Kenya		ADDIS ABABA	707-351B	Jet	LANDING				Africa	AFRICA	Kenya	HULL LOSS	ASEDB
729	SCF-PP		0.387	0.387	111	1	112	46	285	11	0	19/07/1989	1989	United	USA	Western	Sioux City	DC-10	Jet	Landing - Approach	xx	No	100	North America	NA-Car	US-Canada	x	yes
730	RE-Landing			0.000					91			21/07/1989	1989	Philippine Airlines	Philippines		MANILA	BAC 1-11-500	Jet	LANDING				Asia	ASIA (EX CHINA)	Philippines	HULL LOSS	ASEDB
731	CFIT		0.362	0.362	68	4	72	0	181	18	6	27/07/1989	1989	Korean Air	Korea	Western	Tripoli, Kibya	DC-10	Jet	Landing - Approach	Fog	No	100	Asia	Asia	Asia-Low-Mdl Income	6 Ground fatal	yes
732	RE-Landing			0.000	0	0	0	0				10/08/1989	1989	Apisa Air Cargo	Peru		IQUITOS	DC-8-33F	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Peru	HULL LOSS	ASEDB
733	RE-Takeoff		0.008	0.008	0	0	0	9	59	6	0	16/08/1989	1989	LADE	Argentina	Western	San Carlos de Bariloche, AR	Fokker F.28	Jet	T/O Run	Snow - Slush		100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
734	CFIT			0.000					165			25/08/1989	1989	Toros Air	Turkey		ANKARA	727-247	Jet	INITIAL CLIMB				Europe	EUROPE	Turkey	HULL LOSS	ASEDB
735	FUEL		0.24	0.240	12	0	12	17	48	6	0	03/09/1989	1989	Varig	Brazil	Western	San Jose do Xingu, Brazil	B737	Jet	En Route	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
736	ARC			0.000					88			07/09/1989	1989	Okada Air	Nigeria		PORT HARCOURT	BAC 1-11-	Jet	LANDING				Africa	AFRICA	Nigeria	HULL LOSS	ASEDB
737	RE-Takeoff		0.035	0.034	2	0	2	3	57	6	0	20/09/1989	1989	USAir	USA	Western	LGA	B737	Jet	T/O Aborted	IMC	No	100	North America	NA-Car	US-Canada	x	yes
738	FIRE-NI		0	0.000	0	0	0	0	12	7	0	14/10/1989	1989	Delta	USA	Western	SLC	B737	Jet	Ground, Parked	xx	No	100	North America	NA-Car	US-Canada	x	yes
739	CFIT		0.91	0.910	129	3	132	14	139	7	0	21/10/1989	1989	Sahsa	Honduras	Western	Tegucigalpa, HN	B727	Jet	Descent	Clouds-wind	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
740	CFIT		1	1.000	47	7	54	0	47	7	0	26/10/1989	1989	China Airlines	Taiwan	Western	Hualien, Taiwan	B737	Jet	T/O Initial Climb	IMC	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
741	ICE		0.022	0.022	1	0	1	3	47	6	0	25/11/1989	1989	Korean Air	Korea	Western	Seoul	F28	Jet	T/O Aborted	Ice	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
742	SCF-NP			0.000					125			30/12/1989	1989	America West Airlines	USA		TUCSON	737-200	Jet	LANDING				North America	NA-Car	USA	HULL LOSS	ASEDB
743	RE-Landing			0.000					66			30/12/1989	1989	Air Ivoire	Cote d'Ivoire		MAN	F-28	Jet	LANDING				Africa	AFRICA	Cote d'Ivoire	HULL LOSS	ASEDB
744	RE-Landing		0	0.000	0	0	0	0	85	5	0	05/01/1990	1990	Aerolineas Argentinas	Argentina	Western	Villa Gesell, AR	Fokker F.28	Jet	Landing - Rollout	Rain	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
745	FUEL		0.492	0.491	65	8	73	81	149	9	0	25/01/1990	1990	Avianca	Colombia	Western	Long Is., NY	B707	Jet	Landing - Approach	Rain-Wind	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
746	USOS		0.639	0.639	88	4	92	22	139	7	0	14/02/1990	1990	Indian Airlines	India	Western	Bangalore, India	A320	Jet	Landing - Approach	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
747	ARC			0.000					82			17/02/1990	1990	AVIACO	Spain		PALMA	DC-9-32	Jet	LANDING				Europe	EUROPE	Spain	HULL LOSS	ASEDB
748	USOS			0.000					3			01/03/1990	1990	Katale Aero Transport	Congo,		GOMA	707-329C	Jet	FINAL APPROACH				Africa	AFRICA	Congo, The Democratic Republic of the	HULL LOSS	ASEDB
749	RE-Landing	ARC	0	0.000	0	0	0	0	102	5	0	22/03/1990	1990	Air China	China	Western	Guilin, CN	BAE (HS) Trident	Jet	Landing - Rollout	T-Storm	No	100	Asia	**Asia**	Asia-Low-Mdl Income	x	yes
750	SCF-NP		1	0.000	0	0	0	0	175	20	0	07/05/1990	1990	Air India	India	Western	New Delhi	B747-200	Jet	Landing - Rollout	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
751	FIRE-NI		0.067	0.067	8	0	8	0	113	6	0	11/05/1990	1990	Philippine AL	Philippines	Western	Manila	B737	Jet	Ground, Parked	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
752	ARC			0.000					25			14/07/1990	1990	Trans Arabian Air Transport	Sudan		KHARTOUM	707-349C	Jet	LANDING				Africa	AFRICA	Sudan	HULL LOSS	ASEDB
753	SCF-NP			0.000					22			22/07/1990	1990	US Airways	USA		KINSTON	737-200	Jet	TAKEOFF				North America	NA-Car	USA	HULL LOSS	ASEDB
754	RE-Takeoff			0.000	0	0	0	0				25/07/1990	1990	Ethiopian Airlines	Ethiopia		ADDIS ABABA	707-300	Jet	TAKEOFF				Africa	AFRICA	Ethiopia	HULL LOSS	ASEDB
755	TURB			0.043	1		1	2	26			03/10/1990	1990	Eastern Air Lines	USA		WEST PALM BEACH	DC-9-31	Jet	CRUISE				North America	NA-Car	USA	NONE	ASEDB
756	Other			1.000	1		1		1			05/11/1990	1990	Indian Airlines	India		GOA	A300-	Jet	LOAD/UNLOAD				Asia	ASIA (EX CHINA)	India	NONE	ASEDB
757	CFIT		1	1.000	40	0	46	0	40	6	0	14/11/1990	1990	Alitalia	Italy	Western	Zurich	DC-9	Jet	Landing - Approach	Rain	No	100	Europe	Europe	EU-EFTA	x	yes
758	RI		0.097	0.195	7	1	8	10	39	5	0	03/12/1990	1990	Northwest	USA	Western	Detroit	B727-200/ DC-9-14	Jet					North America	NA-Car	US-Canada	x	yes
759	CFIT		1	1.000	3	7	10	0	3	7	0	04/12/1990	1990	Sudania Air Cargo	Sudan	Western	Nairobi	B707	Jet	Go Around	Fog	No	100	Africa	Africa	Africa	x	yes
760	RI		0.627	1.000	10	2	12	0	10	2	0	01/02/1991	1991	Skywest (USA)/ USAir (USA)	USA	Western	LAX	SA-227 (Metro)/ B737-300	Jet					North America	NA-Car	US-Canada	x	yes
761	ICE		1	1.000	0	2	2	0	0	2	0	17/02/1991	1991	Ryan International Airlines	USA	Western	Cleveland, US	MD DC-9	Jet	T/O Initial Climb	Snow, icing	No	100	North America	NA-Car	US-Canada	x	yes
762	RE-Landing	ARC	0.279	0.279	20	0	20	2	65	7	0	20/02/1991	1991	LanChile	Chile	Western	Puerto Williams, CL	BAE-146	Jet	Landing - Rollout	Rain	No	100	Latin America & Caribbean	SA/CA	Asia-Low-Mdl Income	x	yes
763	LOC-I		1	1.000	20	5	25	0	20	5	0	03/03/1991	1991	United Airlines	USA	Western	Colorado Springs, US	B737	Jet	Approach	Wind	No	100	North America	NA-Car	US-Canada	x	yes
764	CFIT		1	1.000	40	5	45	0	40	5	0	05/03/1991	1991	Aeropostal	Venezuela	Western	Valesa, VE	DC-9	Jet	Initial Descent		No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
765	RE-Takeoff		0.014	0.014	0	0	0	1	0	4	0	12/03/1991	1991	Air Transport International	USA	Western	New York, US	MD DC-8	Jet	T/O Aborted	xx	Yes	100	North America	NA-Car	US-Canada	x	yes
766	SCF-PP		0	0.000	0	0	0	0	0	3	0	03/05/1991	1991	Ryan International Airlines	USA	Western	Hartford, US	B727	Jet	T/O Run	xx	No	100	North America	NA-Car	US-Canada	x	yes
767	SCF-PP		1	1.000	213	10	223	0	213	10	0	26/05/1991	1991	Lauda Air	Austria	Western	94nm. NW of Bangkok, TH	B767	Jet	T/O Climb to Cruise	xx	No	100	Europe	Europe	Hi-Income Asia-Pac	x	yes
768	ARC			0.000					119			13/06/1991	1991	Korean Air	South Korea		TAEGU	727-200	Jet	LANDING				Asia	ASIA (EX CHINA)	South Korea	HULL LOSS	ASEDB
769	FUEL		0.053	0.054	4	0	3	0	53	3	0	26/06/1991	1991	Okada Air	Nigeria	Western	Sokoto, NG	BAC 1-11	Jet	Initial Descent	IMC	No	100	Africa	Africa	Africa	x	yes
770	SCF-NP		1	1.000	247	14	261	0	247	14	0	11/07/1991	1991	Nationair Canada	Canada	Western	Jeddah, SA	DC-8	Jet	T/O Initial Climb	xx	No	100	North America	NA-Car	US-Canada	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
771	CFIT		1	1.000	63	6	69	0	63	6	0	16/08/1991	1991	Indian Airlines	India	Western	Imphal, IN	B737	Jet	Initial Descent	Rain-Cloud	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
772	ARC			0.000								14/09/1991	1991	Kabo Air	Nigeria		PORT HARCOURT	BAC 1-11-200	Jet	LANDING				Africa	AFRICA	Nigeria	HULL LOSS	ASEDB
773	SCF-NP			0.000								29/09/1991	1991	Aerosucre	Colombia		BOGOTA	Caravelle-	Jet	TAKEOFF				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Colombia	HULL LOSS	ASEDB
774	SCF-NP			0.000								10/11/1991	1991	AERONICA	Nicaragua		MANAGUA	727-25	Jet	PARKED				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Nicaragua	HULL LOSS	ASEDB
775	ARC			0.000					36			17/11/1991	1991	SAHSA	Honduras		SAN JOSE	737-200	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Honduras	HULL LOSS	ASEDB
776	RE-Takeoff		0	0.000	0	0	0	0	189	10	0	07/12/1991	1991	Libyan Arab Airlines	Libya	Western	Tripoli, LY	B707	Jet	T/O Run	xx	No	100	Africa	Africa	NoAfr/MidEast	x	yes
777	RE-Landing			0.000					90			17/12/1991	1991	Alitalia	Italy		WARSAW	DC-9-32	Jet	LANDING				Europe	EUROPE	Italy	HULL LOSS	ASEDB
778	SCF-PP		0.001	0.001	0	0	0	3	123	6	0	27/12/1991	1991	SAS	Multi-Nat	Western	Stockholm, SE	MD-80	Jet	T/O Initial Climb	xx	No	100	Europe	Europe	EU-EFTA	x	yes
779	SCF-PP		1	1.000	0	5	5	0	0	5	0	29/12/1991	1991	China Airlines	Taiwan	Western	Taipei, TW	B747	Jet	T/O Climb to Cruise	xx	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
780	ARC		0.003	0.003	0	0	0	2	36	5	0	18/01/1992	1992	US Airways	USA	Western	Elmira, US	MD DC-9	Jet	Landing - Rollout	Wind	No	100	North America	NA-Car	US-Canada	x	yes
781	CFIT		0.909	0.909	82	5	87	5	90	6	0	20/01/1992	1992	Air France Europe	France	Western	Strasbourg, FR	A320	Jet	Approach	xx	No	100	Europe	Europe	EU-EFTA	x	yes
782	CFIT		0.023	0.023	0	0	0	2	0	5	0	15/02/1992	1992	MK Airlines	Ghana	Western	Kano, NG	DC-8	Jet	Approach	xx	No	100	Africa	Africa	Africa	x	yes
783	LOC-I		1	1.000	0	4	4	0	0	4	0	15/02/1992	1992	BAX Global dba Air Transpt Int	USA	Western	Toledo, US	MD DC-8	Jet	Go Around	Rain, fog, wind	No	100	North America	NA-Car	US-Canada	x	yes
784	ICE		0.54	0.540	25	2	27	9	47	4	0	22/03/1992	1992	US Airways	USA	Western	New York, US	Fokker F.28	Jet	T/O Initial Climb	Icing	No	100	North America	NA-Car	US-Canada	x	yes
785	CFIT		1	1.000	4	3	7	0	4	3	0	24/03/1992	1992	Golden Star Air Cargo	Sudan	Western	Athens, GR	B707	Jet	Approach	Cloud-Mist	No	100	Africa	Africa	Africa	x	yes
786	ARC		0	0.000	0	0	0	0	88	4	0	26/03/1992	1992	Inter (Colombia)	Colombia	Western	Tumaco, CO	DC-9	Jet	Landing - Rollout	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
787	SCF-NP			0.000					3			28/03/1992	1992	Export Air Leasing	USA		IQUITOS	DC-8-33AF	Jet	LANDING				North America	NA-Car	USA	HULL LOSS	ASEDB
788	ARC		0.002	0.002	0	0	0	4	94	5	0	30/03/1992	1992	Aviaco	Spain	Western	Granada, ES	DC-9	Jet	Landing - Rollout	Wind	No	100	Europe	Europe	EU-EFTA	x	yes
789	SCF-NP		0	0.000	0	0	0	0	0	5	0	31/03/1992	1992	Kabo Air	Nigeria	Western	Orange, FR	B707	Jet	En Route	Turb	No	100	Africa	Africa	Africa	x	yes
790	SCF-NP		1	1.000	40	7	47	0	40	7	0	06/06/1992	1992	COPA Airlines	Panama	Western	Tocuti, PA	B737	Jet	En Route	xx	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
791	CFIT		1	1.000	1	2	3	0	1	2	0	22/06/1992	1992	VASP	Brazil	Western	Cruzeiro do Sul, BR	B737	Jet	Initial Descent	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
792	SCF-NP		0	0.000	0	0	0	1	280	12	0	30/07/1992	1992	Trans World Airlines	USA	Western	New York, US	L-1011	Jet	T/O Initial Climb	xx	No	100	North America	NA-Car	US-Canada	x	yes
793	CFIT		1	1.000	99	14	113	0	99	14	0	31/07/1992	1992	Thai Airways International	Thailand	Western	Kathmandu, NP	A310	Jet	Go Around	T-Storm	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
794	ARC		0	0.000	0	0	0	0	53	4	0	23/08/1992	1992	Kabo Air	Nigeria	Western	Sokoto, NG	BAC 1-11	Jet	Landing - Rollout	xx	No	100	Africa	Africa	Africa	x	yes
795	RE-Landing			0.000					66			29/08/1992	1992	Hold-Trade Air Services	Nigeria		KADUNA	BAC 1-11-200	Jet	LANDING				Africa	AFRICA	Nigeria	HULL LOSS	ASEDB
796	CFIT		1	1.000	155	12	167	0	155	12	0	28/09/1992	1992	Pakistan International	Pakistan	Western	Kathmandu, NP	A300	Jet	Approach	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
797	SCF-PP		1	1.000	1	3	4	0	1	3	0	04/10/1992	1992	El Al	Israel	Western	Amsterdam, NL	B747	Jet	T/O Climb to Cruise	xx	No	100	Middle East	Asia	NoAfr/MidEast	x	yes
798	RE-Landing			0.000								15/10/1992	1992	LAC Airlines	Colombia		MEDELLIN	DC-8	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Colombia	HULL LOSS	ASEDB
799	SCF-NP		0	0.000	0	0	0	0	14	2	0	20/11/1992	1992	Aerolineas Argentinas	Argentina	Western	San Luis, AR	B737	Jet	T/O Aborted	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
800	LOC-I		1	1.000	133	8	141	0	133	8	0	24/11/1992	1992	China Southern Airlines	China	Western	Guilin, CN	B737	Jet	Approach	IMC	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
801	CFIT		0	0.000	0	0	0	0	0	4	0	25/11/1992	1992	DAS Air	Uganda	Western	Kano, NG	B707	Jet	Approach	Vis	No	100	Africa	Africa	Africa	x	yes
802	RE-Landing		0	0.000	0	0	0	0	0	4	0	26/11/1992	1992	AeroBrasil	Brazil	Western	Manaus, BR	B707	Jet	T/O Initial Climb	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
803	ARC		0.183	0.183	54	2	56	106	327	13	0	21/12/1992	1992	Martinair Holland	Nederland	Western	Faro, PT	DC-10	Jet	Landing - Rollout	Windshear	No	100	Europe	Europe	EU-EFTA	x	yes
804	MIDAIR		1	1.000	147	10	157	0	147	10	0	22/12/1992	1992	Libyan Arab Airlines	Libya	Western	Tripoli, LY	B727	Jet	Approach	xx	No	100	Africa	Africa	NoAfr/MidEast	x	yes
805	USOS			0.000								15/01/1993	1993	Air Afrique	Cote d'Ivoire		ABIDJAN	707-321C	Jet	LANDING				Africa	AFRICA	Cote d'Ivoire	HULL LOSS	ASEDB

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
806	SCF-NP			0.000					156			31/01/1993	1993	LADE	Argentina		RECIFE	707-300B	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Argentina	HULL LOSS	ASEDB
807	ICE		0.863	0.863	79	4	83	13	92	5	0	05/03/1993	1993	Palair Macedonian	Macedonia	Western	Skopje, MK	Fokker 100	Jet	T/O Initial Climb	Snow	No	100	Europe	Europe	Euro Central	x	yes
808	RE-Landing	ARC	0	0.000	0	0	0	0	227	9	0	05/04/1993	1993	TACA	Salvador	Western	Guatemala City, GT	B767	Jet	Landing - Rollout	xx	No	73	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
809	LOC-I		0.011	0.011	2	0	2	15	248	16	0	06/04/1993	1993	China Eastern Airlines	China	Western	off Shemya, US	MD MD-11	Jet	En Route	xx	xx	1	Asia	**Asia**	Asia-Low-Mdl Income	x	yes
810	RE-Landing	ARC	0.001	0.001	0	0	0	2	189	13	0	14/04/1993	1993	American	USA	DC-10	DFW	DC-10	Jet	Landing - Rollout	Wind (Tail)	No	100	North America	NA-Car	US-Canada	x	yes
811	ARC		0	0.000	0	0	0	0	115	5	0	18/04/1993	1993	Japan Air System	Japan	Western	Hanamaki, Japan	MD DC-9	Jet	Approach-Landing	Windshear	No	100	Asia	Asia	Asia-High Income	x	yes
812	RAMP			0.000					314			24/04/1993	1993	Air France Europe	France		MONTPELLIER	A300-B2	Jet	TAXI				Europe	EUROPE	France	HULL LOSS	ASEDB
813	CFIT		0.482	0.482	52	4	56	15	112	6	0	26/04/1993	1993	Indian Airlines	India	Western	Aurangabad, IN	B737	Jet	T/O Initial Climb	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
814	CFIT		1	1.000	125	7	132	0	125	7	0	19/05/1993	1993	SAM Colombia	Colombia	Western	Medellin, CO	B727	Jet	Initial Descent	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
815	ARC			0.000					72			21/06/1993	1993	Garuda Indonesia	Indonesia		DENPASAR	DC-9-32	Jet	LANDING				Asia	ASIA (EX CHINA)	Indonesia	HULL LOSS	ASEDB
816	CFIT		0.956	0.956	37	4	41	2	39	4	0	01/07/1993	1993	Merpati Nusantara	Indonesia	Western	Sorong, ID	Fokker F.28	Jet	Approach	Rain-Fog	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
817	ARC		0.009	0.009	0	0	0	14	88	6	0	18/07/1993	1993	SAHSA	Honduras	Western	Managua, NI	B737	Jet	Landing - Rollout	Rain	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
818	RE-Takeoff		0.495	0.495	54	1	55	16	108	5	0	23/07/1993	1993	China Northwest Airlines	China	Western	Yinchuan, CN	BAE-146	Jet	T/O Run	xx	No	100	Asia	**Asia**	Asia-Low-Mdl Income	x	yes
819	CFIT		0.621	0.620	64	4	68	26	106	6	0	26/07/1993	1993	Asiana Airlines	Korea	Western	Mokpo, KR	B737	Jet	Approach	Rain-Wind	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
820	LOC-I		0.058	0.057	0	0	0	3	0	3	0	18/08/1993	1993	Kitty Hawk International	USA	Western	Guantanamo Bay, CU	MD DC-8	Jet	Approach	xx	No	100	North America	NA-Car	US-Canada	x	yes
821	Fire-NI			0.000					98			05/09/1993	1993	Dominicana Airlines	Dominican Republic		SANTO DOMINGO	727-281	Jet	CRUISE				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Dominican Republic	HULL LOSS	ASEDB
822	RE-Landing	ARC	0.036	0.035	1	1	2	9	64	7	0	14/09/1993	1993	Lufthansa	Germany	Western	Warsaw	A320	Jet	Landing - Rollout	Rain-Wind	No	100	Europe	Europe	EU-EFTA	x	yes
823	SCF-PP		0	0.000	0	0	0	0	152	8	0	25/10/1993	1993	Far Eastern Air Transport	Taiwan	Western	Kaohsiung, TW	MD-80	Jet	T/O Initial Climb	xx	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
824	RE-Landing			0.039	2		2	13	71			26/10/1993	1993	China Eastern Airlines	China		FUZHOU	MD-82-	Jet	LANDING				Asia	CHINA	China	HULL LOSS	ASEDB
825	RE-Landing		0	0.000	0	0	0	1	274	22	0	04/11/1993	1993	China Airlines	Taiwan	Western	Hong Kong, HK	B747	Jet	Landing - Rollout	Typhoon	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
826	Other			0.039	1		1	1	27			08/11/1993	1993	Saudia	Saudi Arabia		MANILA	747-100	Jet	PARKED				Middle East	MIDDLE EAST	Saudi Arabia	MINOR DAMAGE	ASEDB
827	CFIT		0.122	0.122	8	4	12	7	92	10	0	13/11/1993	1993	China Northern Airlines	China	Western	Urumqi, CN	MD-80	Jet	Approach	xx	No	100	Asia	**Asia**	Asia-Low-Mdl Income	x	yes
828	FUEL		0	0.000	0	0	0	0	250	13	0	15/11/1993	1993	Indian Airlines	India	Western	Tirupati, IN	A300	Jet	En Route	Fog	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
829	RE-Landing			0.000					86			20/11/1993	1993	COPA Airlines	Panama		PANAMA CITY	737-100	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Panama	HULL LOSS	ASEDB
830	RE-Landing			0.000					6			15/03/1994	1994	Sec Colombia	Colombia		Bogota	Caravelle-	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Colombia	HULL LOSS	ASEDB
831	USOS		0.001	0.001	0	0	0	2	110	6	0	21/03/1994	1994	Aviaco	Spain	Western	Vigo, ES	DC-9	Jet	Approach	Rain-Fog0-Wind	No	100	Europe	Europe	EU-EFTA	x	yes
832	LOC-I		1	1.000	63	12	75	0	63	12	0	23/03/1994	1994	Aeroflot Russian Airlines	Russia	Western	40nm East of Novokuznetsk, RU	A310	Jet	En Route	xx	No	100	CIS	**Europe**	Euro East	x	yes
833	LOC-I		0.976	0.976	249	15	264	7	256	15	0	26/04/1994	1994	China Airlines	Taiwan	Western	Nagoya, JP	A300	Jet	Go Around	xx	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
834	USOS		0	0.000	0	0	0	0	0	3	7	27/04/1994	1994	TransAfrik	Sao Tome	Western	M'Banza Congo, AO	B727	Jet	Approach	xx	No	100	Africa	Africa	Africa	7 Ground fatals	yes
835	ARC			0.905	76	4	80	9	89			01/07/1994	1994	Air Mauritanie	Mauritania		TIDJIKJA	F-28	Jet	LANDING				Africa	AFRICA	Mauritania	HULL LOSS	ASEDB
836	WSTRW		0.665	0.665	37	0	37	16	52	5	0	02/07/1994	1994	US Airways	USA	Western	Charlotte, US	MD DC-9	Jet	Go Around	T-Storm-Wind	No	100	North America	NA-Car	US-Canada	x	yes
837	RE-Landing	ARC	0	0.000	0	0	0	0	140	8	0	20/07/1994	1994	China Yunnan	China	Western	Kunming, CN	B737	Jet	Landing - Rollout	xx	No	100	Asia	**Asia**	Asia-Low-Mdl Income	x	yes
838	RE-Landing	ARC	0	0.000	0	0	0	0	152	8	0	10/08/1994	1994	Korean Air	Korea	Western	Cheju, KR	A300	Jet	Landing - Rollout	Rain-Cloud-Wind	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
839	RE-Landing	ARC	0	0.000	0	0	0	0	79	7	0	18/08/1994	1994	ADC Airlines	Nigeria	Western	Monrovia, LR	DC-9	Jet	Landing - Rollout	Rain	No	100	Africa	Africa	Africa	x	yes
840	LOC-I		1	1.000	127	5	132	0	127	5	0	08/09/1994	1994	US Airways	USA	Western	20nm NW of Pittsburgh, US	B737	Jet	Approach	xx	No	100	North America	NA-Car	US-Canada	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
841	FUEL		0.178	0.178	2	3	5	34	32	7	0	18/09/1994	1994	Oriental Airlines	Nigeria	Western	Tamanrasset, DZ	BAC 1-11	Jet	Approach	Fog	No	100	Africa	Africa	Africa	x	yes
842	SCF-NP			0.000					2			09/10/1994	1994	LAB	Bolivia		SAO PAULO	707-300	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Bolivia	HULL LOSS	ASEDB
843	UNK			1.119	59	7	66		59			12/10/1994	1994	Iran Asseman Airlines	Iran		NATANZ	F-28-1000	Jet	CRUISE				Middle East	MIDDLE EAST	Iran	HULL LOSS	ASEDB
844	RI		0	0.000	0	0	0	0	132	5	2	22/11/1994	1994	TWA	USA	Western	STL	MD-82	Jet	T/O Run	xx	No	100	North America	NA-Car	US-Canada	2 Ground fatal	yes
845	RE-Landing			0.001				2	78			30/11/1994	1994	Merpati Nusantara Airlines	Indonesia		SEMARANG	F-28-4000	Jet	LANDING				Asia	ASIA (EX CHINA)	Indonesia	HULL LOSS	ASEDB
846	CFIT		0.623	0.623	0	3	3	2	0	5	0	19/12/1994	1994	Nigeria Airways	Nigeria	Western	170km. NE of Kano, NG	B707	Jet	Initial Descent	xx	No	100	Africa	Africa	Africa	x	yes
847	CFIT		1	1.000	0	5	5	0	0	5	0	21/12/1994	1994	Air Algerie	Algeria	Western	(near) Coventry, GB	B737	Jet	Landing - Approach	xx	xx	100	Africa	Africa	NoAfr/MidEast	x	yes
848	CFIT		0.764	0.764	52	5	57	19	69	7	0	29/12/1994	1994	THY - Turkish Airlines	Turkey	Western	Van, TR	B737	Jet	Approach	Snow	No	100	Europe	Europe	NoAfr/MidEast	x	yes
849	RE-Landing			0.000								02/01/1995	1995	LAC	Congo,		KINSHASA	737-200	Jet	LANDING				Africa	AFRICA	Congo, The Democratic Republic of the	HULL LOSS	ASEDB
850	CFIT		0.982	0.982	46	5	51	1	47	5	0	11/01/1995	1995	Inter (Colombia)	Colombia	Western	40km. South of Cartagena, CO	DC-9	Jet	Initial Descent	Cloud	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
851	RE-Landing			0.000					52			16/01/1995	1995	Sempati Air Transport	Indonesia		YOGYAKARTA	737-200	Jet	LANDING				Asia	ASIA (EX CHINA)	Indonesia	HULL LOSS	ASEDB
852	RE-Landing			0.000								31/01/1995	1995	Angola Air Charter	Angola		Huambo Airport	727-100	Jet	LANDING				Africa	AFRICA	Angola	HULL LOSS	ASEDB
853	SCF-NP			0.001				2	121			01/02/1995	1995	VASP Airlines	Brazil		SAO PAULO	737-200	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Brazil	HULL LOSS	ASEDB
854	LOC-I		1	1.000	50	10	60	0	50	10	0	31/03/1995	1995	TAROM	Romania	Western	Bucharest, RO	A310	Jet	T/O Climb to Cruise	xx	No	100	Europe	Europe	Euro East	x	yes
855	RE-Landing	ARC	0.019	0.019	0	0	0	1	0	3	6	28/04/1995	1995	Millon Air	USA	Western	Guatemala City, GT	MD DC-8	Jet	Landing - Rollout	Rain	No	100	North America	NA-Car	US-Canada	6 Ground fatal	yes
856	RE-Landing			0.000					35			31/05/1995	1995	Air Niugini	Papua New Guinea		MADANG	F-28-	Jet	LANDING				Aust	Oceania	Papua New Guinea	HULL LOSS	ASEDB
857	SCF-PP		0.001	0.001	0	0	0	1	55	5	0	08/06/1995	1995	Valujet	USA	Western	Atlanta, US	MD DC-9	Jet	T/O Aborted	xx	No	100	North America	NA-Car	US-Canada	x	yes
858	USOS			0.000					82			26/07/1995	1995	ADC Airlines	Nigeria		MONROVIA	DC-9-	Jet	LANDING				Africa	AFRICA	Nigeria	HULL LOSS	ASEDB
859	CFIT		1	1.000	58	7	65	0	58	7	0	09/08/1995	1995	Aviateca	Mexico	Western	San Salvador, SV	B737	Jet	Approach	T-Storm	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
860	RE-Landing			0.000								17/08/1995	1995	Air Afrique	Cote d'Ivoire		N'DJAMENA	707-320C	Jet	LANDING				Africa	**EUROPE**	Cote d'Ivoire	HULL LOSS	ASEDB
861	RE-Landing	ARC	0.067	0.067	9	0	9	4	129	8	0	13/11/1995	1995	Nigeria Airways	Nigeria	Western	Kaduna, NG	B737	Jet	Landing - Rollout	xx	No	100	Africa	Africa	Africa	x	yes
862	CFIT		0.333	0.333	0	2	2	0	0	6	0	30/11/1995	1995	Azerbaijan Airlines /AZAL Avia	Azerbaijan	Western	Baku, AZ	B707	Jet	Go Around	xx	No	100	CIS	**Europe**	Europe - E/.SE	x	yes
863	RE-Landing	ARC	0	0.000	0	0	0	0	102	6	0	02/12/1995	1995	Indian Airlines	India	Western	Delhi, IN	B737	Jet	Landing - Rollout	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
864	LOC-I			1.005	68	4	72	6	72			03/12/1995	1995	Cameroon Airlines	Cameroon		DOUALA	737-200	Jet	CLIMB				Africa	AFRICA	Cameroon	HULL LOSS	ASEDB
865	CFIT		0.977	0.977	152	8	160	4	156	8	0	20/12/1995	1995	American Airlines	USA	Western	Cali, Co (Buga)	B757	Jet	Initial Descent	xx	No	100	North America	NA-Car	US-Canada	x	yes
866	LOC-G		0	0.000	0	0	0	0	477	15	0	20/12/1995	1995	Tower Air	USA	Western	New York, US	B747	Jet	T/O Aborted	xx	No	100	North America	NA-Car	US-Canada	x	yes
867	ARC			0.000					75			30/12/1995	1995	TAROM - Romanian Air Transport	Romania		ISTANBUL	BAC 1-11	Jet	LANDING				Europe	EUROPE	Romania	HULL LOSS	ASEDB
868	RE-Landing			0.000								28/01/1996	1996	AFFRETAIR	Zimbabwe		HARARE	DC-8-F55	Jet	LANDING				Africa	AFRICA	Zimbabwe	HULL LOSS	ASEDB
869	LOC-I		1	1.000	176	13	189	0	176	13	0	06/02/1996	1996	Birgenair	Turkey	Western	Puerto Plata, DO	B757	Jet	T/O Climb to Cruise	xx	No	100	Europe	Europe	NoAfr/MidEast	x	yes
870	ARC			0.000					82			19/02/1996	1996	Continental Airlines	USA		Houston	DC-9-	Jet	LANDING				North America	NA-Car	USA	HULL LOSS	ASEDB
871	CFIT		1	1.000	117	6	123	0	117	6	0	29/02/1996	1996	Faucett	Peru	Western	Arequipa, PE	B737	Jet	Approach	Cloud	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
872	RE-Takeoff		0.001	0.001	0	0	0	1	77	9	0	01/05/1996	1996	Fly Lineas Aereas	Brazil	Western	Quito, EC	B727	Jet	T/O Aborted	Rain	Yes	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
873	FIRE-NI		1	1.000	105	5	110	0	105	5	0	11/05/1996	1996	Valujet	USA	Western	15 miles W of Opa Locka, US	MD DC-9	Jet	T/O Climb to Cruise	xx	No	100	North America	NA-Car	US-Canada	x	yes
874	SCF-NP		0	0.000	0	0	0	0	42	4	0	14/05/1996	1996	Allegro Air	Mexico	Western	Tampico, MX	DC-9	Jet	En Route	xx	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
875	RE-Landing	ARC	0.013	0.013	3	0	3	12	260	15	0	13/06/1996	1996	Garuda Indonesia	Indonesia	Western	Fukuoka, JP	DC-10	Jet	T/O Aborted	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
876	WSTRW		0	0.000	0	0	0	0	0	4	0	30/06/1996	1996	DAS Air	Uganda	Western	Bamako, ML	B707	Jet	Landing - Rollout	Rain-Wind	No	100	Africa	Africa	Africa	x	yes
877	SCF-PP		0.015	0.015	2	0	2	2	137	5	0	06/07/1996	1996	Delta	USA	Western	Pensacola	MD-88	Jet	T/O Run	xx	No	100	North America	NA-Car	US-Canada	x	yes
878	FIRE-NI		1	1.000	212	18	230	0	212	18	0	17/07/1996	1996	Trans World Airlines	USA	Western	(near) Mastic Beach (Long Island), US	B747	Jet	T/O Climb to Cruise	xx	No	100	North America	NA-Car	US-Canada	x	yes
879	RE-Landing		0	0.000	0	0	0	0	120	8	0	21/08/1996	1996	Egyptair	Egypt	Western	Istanbul, TR	B707	Jet	Landing - Rollout	Rain	No	100	Africa	Africa	NoAfr/MidEast	x	yes
880	FIRE-NI		0	0.000	0	0	0	0	0	5	0	05/09/1996	1996	FedEx	USA	Western	Newburgh, NY	DC-10	Jet	En Route	xx	No	100	North America	NA-Car	US-Canada	x	yes
881	CFIT		1	1.000	61	9	70	0	61	9	0	02/10/1996	1996	Aero Peru	Peru	Western	off Ancon, PE	B757	Jet	T/O Climb to Cruise	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
882	ARC			0.000								10/10/1996	1996	Occidental Airlines	Belgium		DJERBA	707-320C	Jet	LANDING				Europe	EUROPE	Belgium	HULL LOSS	ASEDB
883	LOC-I		1	1.000	0	4	4	0	0	4	#	22/10/1996	1996	Millon Air	USA	Western	Manta, EC	B707	Jet	T/O Initial Climb	xx	No	100	North America	NA-Car	US-Canada	30 Ground fatal	yes
884	WSTRW			0.000		2	2	6				23/10/1996	1996	LADE	Argentina		BUENOS AIRES	707-372C	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Argentina	HULL LOSS	ASEDB
885	SCF-PP		1	1.000	89	6	95	0	89	6	0	31/10/1996	1996	TAM Brasil	Brazil	Western	Sao Paulo, BR	Fokker 100	Jet	T/O Initial Climb	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
886	LOC-I		1	1.000	134	9	143	0	134	9	0	07/11/1996	1996	ADC Airlines	Nigeria	Western	40km. ENE of Lagos, NG	B727	Jet	Initial Descent	xx	No	100	Africa	Africa	Africa	x	yes
887	MIDAIR		1	1.000	289	23	312	0	289	23	#	12/11/1996	1996	Saudi Arabian Airlines/Chimkentavia	Saudi Arabia		50 miles W. of Delhi, IN	IL76/B747	Jet					Middle East	Asia	NoAfr/MidEast	37 fatal in other A/C	yes
888	CFIT		0	0.000	0	0	0	0	0	4	0	17/12/1996	1996	MK Airlines	Ghana	Western	Port Harcourt, NG	DC-8	Jet	Approach	xx	No	100	Africa	Africa	Africa	x	yes
889	SCF-NP			0.000								17/01/1997	1997	First International Airways	Belgium		KANANGA	707-320	Jet	LANDING				Europe	EUROPE	Belgium	HULL LOSS	ASEDB
890	ARC		0.024	0.024	0	1	1	4	46	6	0	14/02/1997	1997	VARIG	Brazil	Western	Carajas, BR	B737	Jet	Landing - Rollout	Wind-fog-rain	xx	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
891	RE-Takeoff		0.002	0.002	0	0	0	4	107	8	0	10/03/1997	1997	Gulf Air	Qatar (Multi-Nati)	Western	Abu Dhabi, AE	A320	Jet	T/O Aborted	Wind	No	100	Middle East	Asia	NoAfr/MidEast	x	yes
892	RE-Landing			0.000					97			12/04/1997	1997	Ghana Airways	Ghana		ABIDJAN	DC-9	Jet	LANDING				Africa	AFRICA	Ghana	HULL LOSS	ASEDB
893	ARC		0.473	0.473	33	2	35	0	65	9	0	08/05/1997	1997	China Southern Airlines	China	Western	Shenzhen, CN	B737	Jet	Landing - Rollout	Rain-T-Storm	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
894	RE-Landing			0.000					20			07/06/1997	1997	TAROM - Romanian Air Transport	Romania		STOCKHOLM	BAC 1-11	Jet	LANDING				Europe	EUROPE	Romania	HULL LOSS	ASEDB
895	ARC		0	0.000	0	0	0	0	49	6	0	29/07/1997	1997	ADC	Nigeria		Calabar	BAC-1-11	Jet	Landing - Approach	xx	No	100	Africa	Africa	Africa	x	yes
896	ARC		0	0.000	0	0	0	0	0	4	0	31/07/1997	1997	FedEx	USA	Western	Newark, US	MD MD-11	Jet	Landing - Rollout	xx	No	100	North America	NA-Car	US-Canada	x	yes
897	Other			0.007	1		1		142			02/08/1997	1997	Continental Airlines	USA		LIMA	757-200	Jet	PARKED				North America	NA-Car	USA	NONE	ASEDB
898	RE-Takeoff		0	0.000	0	0	0	0	118	8	0	03/08/1997	1997	Air Afrique	Cote d Ivorie (Multi-Natl)	Western	Douala, CM	B737	Jet	T/O Aborted	xx	No	100	Africa	Africa	Africa	x	yes
899	CFIT		0.907	0.907	215	14	229	25	237	17	0	06/08/1997	1997	Korean Air	Korea	Western	Agana, GU	B747	Jet	Approach	Rain-T-Storm	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
900	LOC-I		1	1.000	0	4	4	0	0	4	0	07/08/1997	1997	Fine Air	USA	Western	Miami, US	MD DC-8	Jet	T/O Initial Climb	xx	Yes	100	North America	NA-Car	US-Canada	x	yes
901	RE-Landing	ARC	0	0.000	0	0	0	0	26	9	0	12/08/1997	1997	Olympic Airways	Greece	Western	Thessaloniki, GR	B727	Jet	Landing - Rollout	Rain	No	100	Europe	Europe	EU-EFTA	x	yes
902	ARC			0.000								15/08/1997	1997	Angola Air Charter	Angola		LUKAPA	727-100	Jet	LANDING				Africa	AFRICA	Angola	HULL LOSS	ASEDB
903	USOS			0.000					42			17/08/1997	1997	SAETA S.A.	Ecuador		SAN CRISTOBAL	727-200	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Ecuador	HULL LOSS	ASEDB
904	SCF-PP		0	0.000	0	0	0	0	79	6	0	06/09/1997	1997	Saudi Arabian Airlines	Saudi Arabia	Western	Nejran, SA	B737	Jet	T/O Aborted	xx	No	100	Middle East	Asia	NoAfr/MidEast	x	yes
905	CFIT		1	1.000	222	12	234	0	222	12	0	26/09/1997	1997	Garuda Indonesia	Indonesia	Western	Medan, ID	A300	Jet	Approach	Smoke	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
906	RI			0.000				1				01/10/1997	1997	Ryan International Airlines	USA		DENVER	727-51C	Jet	TAXI				North America	NA-Car	USA	HULL LOSS	ASEDB
907	LOC-I			1.072	69	5	74		69			10/10/1997	1997	AUSTRAL - Cielos del Sur S.A.	Argentina		NUEVO BERLIN	DC-9-32	Jet	CRUISE				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Argentina	HULL LOSS	ASEDB
908	ARC			0.000					67			15/10/1997	1997	Aeromexico	Mexico		MEXICO CITY	DC-9-32	Jet	LANDING				Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	Mexico	HULL LOSS	ASEDB
909	RE-Landing			0.000								01/11/1997	1997	Congo Airlines	Congo, The Democratic Republic of the		KINSHASA	707-323C	Jet	LANDING				Africa	AFRICA	Congo, The Democratic Republic of the	HULL LOSS	ASEDB
910	ARC		0.012	0.012	0	0	0	9	39	3	0	16/12/1997	1997	Air Canada	Canada	Western	Fredericton, CA	Canadair CRJ	Jet	Go Around	Fog	No	100	North America	NA-Car	US-Canada	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
911	CFIT			0.000					84			22/12/1997	1997	Biman Bangladesh Airlines	Bangladesh		SYLHET	F-28-	Jet	FINAL APPROACH				Asia	ASIA (EX CHINA)	Bangladesh	HULL LOSS	ASEDB
912	TURB			0.006	1		1	18	355			28/12/1997	1997	United Airlines	USA		HONOLULU	747-100	Jet	CRUISE				North America	NA-Car	USA	MINOR DAMAGE	ASEDB
913	CFIT			0.000					104			05/01/1998	1998	Iran Air	Iran		ISFAHAN	F-100	Jet	LANDING				Middle East	MIDDLE EAST	Iran	HULL LOSS	ASEDB
914	RE-Landing			0.000					68			11/01/1998	1998	Turkish Airlines (THY)	Turkey		SAMSUN	RJ100	Jet	LANDING				Europe	EUROPE	Turkey	HULL LOSS	ASEDB
915	CFIT			1.051	99	5	104		99			02/02/1998	1998	Cebu Pacific Air	Philippines		ENRT TAC-CGY	DC-9	Jet	DESCENT				Asia	ASIA (EX CHINA)	Philippines	HULL LOSS	ASEDB
916	USOS		0	0.000	0	0	0	0	115	6	0	09/02/1998	1998	American Airlines	USA	Western	Chicago, US	B727	Jet	Approach	xx	No	100	North America	NA-Car	US-Canada	x	yes
917	LOC-I		1	1.000	182	14	196	0	182	14	6	16/02/1998	1998	China Airlines	Taiwan	Western	Taipei, TW	A300	Jet	Go Around	Rain-Fog	No	100	Asia	Asia	Hi-Income Asia-Pac	6 Ground fatal	yes
918	LOC-I		1	1.000	0	6	6	0	0	6	0	10/03/1998	1998	Air Memphis	Egypt	Western	Mombasa, KE	B707	Jet	T/O Initial Climb	xx	Yes	100	Africa	Africa	NoAfr/MidEast	x	yes
919	CFIT		1	1.000	35	10	45	0	35	10	0	19/03/1998	1998	Ariana Afghan	Afghanistan	Western	Kabul, AF	B727	Jet	Approach	Rain-Clouds	No	100	Asia	Asia	ASIA CEN	x	yes
920	RE-Landing	ARC	0.001	0.001	0	0	0	2	128	8	3	22/03/1998	1998	Philippine Airlines	Philippines	Western	Bacolod, PH	A320	Jet	Landing - Rollout	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	3 Ground fatal	yes
921	RE-Landing			0.000					80			12/04/1998	1998	Orient Eagle Airways	Kazakhstan		ALMATY	737-200	Jet	LANDING				CIS	CIS	Kazakhstan	HULL LOSS	ASEDB
922	CFIT		1	1.000	43	10	53	0	10	43	0	20/04/1998	1998	TAME Ecuador	Ecuador	Western	(near) Bogota, CO	B727	Jet	T/O Climb to Cruise	Cloud	xx	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
923	CFIT			0.935	69	6	75	13	81			05/05/1998	1998	Occidental Petroleum Corp	USA		(Near) Andoas	737-200	Jet	LANDING				North America	NA-Car	USA	HULL LOSS	ASEDB
924	RE-Takeoff			0.000					57			15/05/1998	1998	Merpati Nusantara Airlines	Indonesia		KENDARI	F-28-4000	Jet	TAKEOFF				Asia	ASIA (EX CHINA)	Indonesia	HULL LOSS	ASEDB
925	RE-Landing			0.000					73			16/05/1998	1998	Manunggal Air	Indonesia		SINGAPORE	F-28	Jet	LANDING				Asia	ASIA (EX CHINA)	Indonesia	HULL LOSS	ASEDB
926	RE-Landing			0.000					91			19/07/1998	1998	Sudan Airways	Sudan		KHARTOUM	737-200	Jet	LANDING				Africa	AFRICA	Sudan	HULL LOSS	ASEDB
927	RE-Landing			0.000					376			05/08/1998	1998	Korean Air	South Korea		SEOUL	747-400	Jet	LANDING				Asia	ASIA (EX CHINA)	South Korea	HULL LOSS	ASEDB
928	SCF-NP			0.000								31/08/1998	1998	DHL Airways	USA		NEW YORK	727-200	Jet	TAKEOFF				North America	NA-Car	USA	HULL LOSS	ASEDB
929	SCF-NP		1	1.000	215	14	229	0	215	14	0	02/09/1998	1998	Swissair	Switzerland	Western	Nova Scotia	MD 11	Jet	En Route	xx	No	100	Europe	Europe	EU-EFTA	x	yes
930	RE-Landing			0.000					102			16/09/1998	1998	Continental Airlines	USA		GUADALAJARA	737-500	Jet	LANDING				North America	NA-Car	USA	HULL LOSS	ASEDB
931	CFIT		1	1.000	34	4	38	0	34	4	0	25/09/1998	1998	Paukn Air	Spain	Western	Melilla, MA	BAE-146	Jet	Approach	xx	No	100	Europe	Europe	EU-EFTA	x	yes
932	SCF-PP			0.000					97			05/10/1998	1998	LAM	Mozambique		MAPUTO	747-SP	Jet	CLIMB				Africa	AFRICA	Mozambique	HULL LOSS	ASEDB
933	RE-Landing			0.000					100			01/11/1998	1998	AirTran Airways	USA		ATLANTA	737-200	Jet	LANDING				North America	NA-Car	USA	HULL LOSS	ASEDB
934	SCF-PP		0	0.000	0	0	0	0	0	5	0	14/11/1998	1998	IAT Cargo	Nigeria	Western	Ostend, BE	B707	Jet	Landing - Rollout	Turb	No	100	Africa	Africa	Africa	x	yes
935	CFIT		0	0.000	0	0	0	0	61	11	0	10/12/1998	1998	Azerbaijan Airlines /AZAL Avia	Azerbaijan	Western	Baku, AZ	B727	Jet	Landing - Go Around	IMC	xx	100	CIS	**Europe**	Europe - E/.SE	x	yes
936	LOC-I		0.699	0.699	91	11	102	0	132	14	0	11/12/1998	1998	Thai Airways International	Thailand	Western	Surat Thani, TH	A310	Jet	Go Around	Rain-Wind	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
937	ARC		0	0.000	0	0	0	0	36	4	0	28/12/1998	1998	Rio Sul	Brazil	Western	Curitiba, BR	EMB ERJ-145	Jet	Landing - Rollout	Clouds	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
938	ARC		0	0.000	0	0	0	0	78	6		1/28/1999	1999	Alitalia	Italy	Western	CATANIA	MD-82	Jet	LANDING	xx	xx	xx	Europe	Europe	EU-EFTA		No
939	RE-Landing		0	0.000	0	0	0	0	92	10		1/31/1999	1999	Air Algerie	Algeria	Western	CONSTANTINE	B727-200	Jet	LANDING	xx	xx	xx	Africa	AFRICA	NoAfr/MidEast		No
940	RE-Takeoff		0	0.000	0	0	0	0	0	3		2/7/1999	1999	Clipper International	Switzerland	Western	BRATISLAVA	B707-328C	Jet	TAKEOFF	xx	xx	xx	Europe	Europe	EU-EFTA		No
941	RE-Landing		0	0.000	0	0	0	0	91	6		3/4/1999	1999	Air France	France	Western	BIARRITZ	B737-200	Jet	LANDING	xx	xx	xx	Europe	Europe	EU-EFTA		No
942	ARC		0	0.011	0	0	0	1	0	5		3/5/1999	1999	Air France	France	Western	MADRAS	B747-200	Jet	LANDING	xx	xx	xx	Europe	Europe	EU-EFTA		No
943	RE-Landing	ARC	0.001	0.001	0	0	0	2	150	6	0	15/03/1999	1999	Korean Air	Korea	Western	Pohang, KR	MD-80	Jet	Landing - Rollout	Rain-Wind	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
944	RE-Landing		0	0.000	0	0	0	0	252	19		3/24/1999	1999	Emirates	United Arab Emirates	Western	RHODES ISLAND	A300-600	Jet	LANDING	xx	xx	xx	Middle East	MIDDLE EAST	NoAfr/MidEast		No
945	LOC-I		1	1.000	0	6	6	0	0	6		4/7/1999	1999	Turkish Airlines (THY)	Turkey	Western	ADANA	B737-400	Jet	CLIMB	xx	xx	xx	Europe	Europe	NoAfr/MidEast		No

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
946	LOC-I		1	1.000	0	3	3	0	0	3	5	15/04/1999	1999	Korean Air	Korea	Western	Shanghai, CN	MD-11	Jet	T/O Climb to Cruise	Rain-Clouds	No	100	Asia	Asia	Asia-Low-Mdl Income	5 Ground fatal	yes
947	WSTRW		0	0.000	0	0	0	0	60	6		4/22/1999	1999	Million Air Charters	South Africa	Western	JOHANNESBURG	B727-200	Jet	INITIAL APPROACH	xx	xx	xx	Africa	Africa	Africa		No
948	WSTRW		0.094	0.094	10	1	11	45	139	6	0	01/06/1999	1999	American Airlines	USA	Western	Little Rock	MD-80	Jet	Landing - Approach	T-Storm	No	100	North America	NA-Car	US-Canada	x	yes
949	ARC		0	0.000	0	0	0	0	81	9		6/9/1999	1999	China Southern Airlines	China	Western	ZHANGJIANG	B737-300	Jet	LANDING	xx	xx	xx	Asia	CHINA	Asia-Low-Mdl Income		No
950	CFIT		1	1.000	0	5	5	0	0	5	0	07/07/1999	1999	Hinduja Cargo Services	India	Western	Kathmandu, NP	B727	Jet	T/O Climb to Cruise	Rain-Fog	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
951	RE-Landing	ARC	0	0.000	0	0	0	0	0	3		8/14/1999	1999	Trans Arabian Air Transport	Sudan	Western	JUBA	B707-328C	Jet	LANDING	xx	xx	xx	Africa	Africa	Africa		No
952	ARC		0.019	0.019	3	0	3	50	300	15	0	22/08/1999	1999	China Airlines	Taiwan	Western	Hong Kong, HK	MD-11	Jet	Landing - Rollout	Rain-Wind	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
953	FIRE-NI		0.018	0.018	1	0	1	13	90	6	0	24/08/1999	1999	UNI Air	Taiwan	Western	Hualien, TW	MD-90	Jet	Landing - Rollout	xx	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
954	RE-Takeoff		0.63	0.630	61	3	64	15	98	5	5	31/08/1999	1999	LAPA	Argentina	Western	Buenos Aires, AR	B737	Jet	T/O Aborted	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	5 Ground fatal	yes
955	ARC		0	0.000	0	0	0	0	41	5		9/9/1999	1999	TWA	USA	Western	NASHVILLE	DC-9-31	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
956	ARC		0.001	0.000	0	0	0	2	236	9	0	14/09/1999	1999	Britannia Airways	UK	Western	Gerona, ES	B757	Jet	Landing - Rollout	Rain-Wind	No	100	Europe	Europe	EU-EFTA	x	yes
957	ARC		0	0.000	0	0	0	0	3	5	0	16/10/1999	1999	Continental Cargo Airlines	Ghana	Western	Kinshasa, ZR	DC-8	Jet	Landing - Rollout	xx	No	100	Africa	Africa	Africa	x	yes
958	RE-Landing		0	0.000	0	0	0	0	0	2	0	17/10/1999	1999	FedEx	USA		Subic Bay, Ph	MD-11	Jet	Landing - Rollout	Rain	No	100	North America	NA-Car	US-Canada	x	yes
959	LOC-I		1	1.000	13	5	18	0	13	5	0	09/11/1999	1999	TAESA	Mexico	Western	Uruapan, MX	DC-9	Jet	T/O Initial Climb	xx	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
960	RE-Landing	ARC	0.051	0.051	8	8	16	0	296	18	2	21/12/1999	1999	Cubana	Cuba	Western	Guatemala City, GT	DC-10	Jet	Landing - Rollout	Rain	No	100	Latin America & Caribbean	**NA-Car**	CA/Carib	2 Ground fatal	yes
961	LOC-I		1	1.000	0	4	4	0	0	4	0	22/12/1999	1999	Korean Air	Korea	Western	Bishops Stortford, GB	B747	Jet	T/O Initial Climb	Wind-Clouds	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
962	CFIT		0.944	0.944	159	10	169	0	169	10	0	30/01/2000	2000	Kenya Airways	Kenya	Western	off Abidjan, CI	A310	Jet	T/O Initial Climb	xx	No	100	Africa	Africa	Africa	x	yes
963	SCF-NP		1	1.000	83	5	88	0	83	5	0	31/01/2000	2000	Alaska	USA	Western	Point Mugu, Ca	MD-83	Jet	En Route	xx	No	100	North America	NA-Car	US-Canada	x	yes
964	CFIT		0	0.000	0	0	0	0	0	5		2/3/2000	2000	Trans Arabian Air Transport	Sudan	Western	MWANZA	B707-310C	Jet	FINAL APPROACH	xx	xx	xx	Africa	Africa	Africa		No
965	Other		0	0.000	0	0	0	0	179	11		2/11/2000	2000	Air Afrique	Cote d'Ivoire	Western	DAKAR	A300B4	Jet	TAXI	xx	xx	xx	Africa	AFRICA	Africa		No
966	ARC		0	0.000	0	0	0	0	0	7	0	12/02/2000	2000	TransAfrik	Sao Tome	Western	Luanda, AO	B727	Jet	Landing - Rollout	Rain-Wind	No	100	Africa	Africa	Africa	x	yes
967	LOC-I		1	1.000	0	3	3	0	0	3	0	16/02/2000	2000	Emery	USA	Western	Rancho Cordova, Ca	DC-8-71	Jet	T/O Initial Climb	xx	No	100	North America	NA-Car	US-Canada	x	yes
968	RE-Landing	ARC	0	0.000	0	0	0	0	137	5	0	05/03/2000	2000	Southwest	USA	Western	Burbank, California	B737	Jet	Landing - Rollout	xx	No	100	North America	NA-Car	US-Canada	x	yes
969	CFIT		1	1.000	124	7	131	0	124	7	0	19/04/2000	2000	Air Philippines	Philippines	Western	Davao, PH	B737	Jet	Approach	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
970	RE-Landing		0	0.000	0	0	0	0	42	4	0	22/04/2000	2000	THY - Turkish Airlines	Turkey	Western	Siirt, TR	BAE (Avro) RJ	Jet	Landing - Rollout	Wind	No	100	Europe	Europe	NoAfr/MidEast	x	yes
971	RE-Landing		0	0.000	0	0	0	0	0	7	0	30/04/2000	2000	DAS Air	Uganda	Western	Entebbe, UG	DC-10	Jet	Landing - Rollout	Rain	No	100	Africa	Africa	Africa	x	yes
972	ARC		0	0.000	0	0	0	0	0	5		6/26/2000	2000	Yemenia	Yemen	Western	KHARTOUM	B727-200	Jet	LANDING	xx	xx	xx	Middle East	MIDDLE EAST	NoAfr/MidEast		No
973	FUEL		0	0.000	0	0	0	0	142	8	0	12/07/2000	2000	Hapag-Lloyd	Germany	Western	Vienna, AT	A300	Jet	Landing - Approach	xx	No	100	Europe	Europe	EU-EFTA	x	yes
974	LOC-I		0.899	0.899	46	6	52	2	52	6	0	17/07/2000	2000	Alliance Air	India	Western	Patna, IN	B737	Jet	Approach	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
975	RE-Landing		0	0.000	0	0	0	0	84	4		7/18/2000	2000	Iran Asseman Airlines	Iran	Western	AHWAZ	F-28-4000	Jet	LANDING	xx	xx	xx	Middle East	MIDDLE EAST	NoAfr/MidEast		No
976	SCF-PP		1	1.000	0	2	2	0	0	2	0	19/07/2000	2000	Airwave Transport	Canada	Western	(near) Linneus, US	Gulfstream I	Jet	En Route	T-Storm - Turbulence	xx	100	North America	NA-Car	US-Canada	x	yes
977	FIRE-NI		1	1.000	100	9	109	0	100	9	0	25/07/2000	2000	Air France	France	Western	Paris, FR	Concorde	Jet	T/O Initial Climb	xx	No	100	Europe	Europe	EU-EFTA	x	yes
978	ARC		0	0.000	0	0	0	0	0	3		8/7/2000	2000	Air Memphis	Egypt	Western	CAIRO	707-328C	Jet	LANDING	xx	xx	xx	Africa	AFRICA	NoAfr/MidEast		No
979	SCF-NP		0	0.000	0	0	0	0	58	5		8/8/2000	2000	AirTran Airways	USA	Western	GREENSBORO	DC-9-32	Jet	CLIMB	xx	xx	xx	North America	NA-Car	US-Canada		No
980	LOC-I		1	1.000	135	8	143	0	135	8	0	23/08/2000	2000	Gulf Air	Qatar (Multi-Nati)	Western	Manama, BH	A320	Jet	Go Around	xx	No	100	Middle East	**Asia**	NoAfr/MidEast	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
981	ARC			0.000					2			21/09/2000	2000	Republic of Togo	Togo		NIAMEY	707-312B	Jet	INITIAL APPROACH				Africa	AFRICA	Togo	HULL LOSS	ASEDB
982	RE-Landing	ARC	0	0.000	0	0	0	0	83	5	4	06/10/2000	2000	Aeromexico	Mexico	Western	Reynosa, MX	DC-9	Jet	Landing - Rollout	Rain	No	100	Latin America & Caribbean	SA/CA	CA/Carib	4 Ground fatal	yes
983	RI		0.479	0.479	79	4	83	48	159	20	0	31/10/2000	2000	Singapore Airlines	Singapore	Western	Taipei, TW	B747	Jet	T/O Run	Typhoon	No	100	Asia	Asia	Asia	x	yes
984	RE-Landing		0	0.000	0	0	0	0	183	16	0	05/11/2000	2000	Cameroon Airlines	Cameroon	Western	Paris, FR	B747	Jet	Landing - Rollout	Rain-Wind	No	100	Africa	Africa	Africa	x	yes
985	ARC		0	0.000	0	0	0	0	42	8		11/13/2000	2000	Ghana Airways	Ghana	Western	CONAKRY	DC-9-51	Jet	LANDING	xx	xx	100	Africa	Africa	Africa		No
986	SCF-NP		0.009	0.009	0	1	1	0	106	10	0	20/11/2000	2000	American	USA	Western	Miami	A300	Jet	Ground, taxi		No	100	North America	NA-Car	US-Canada	x	yes
987	USOS		0	0.000	0	0	0	0	6	4	1	05/01/2001	2001	Air Gemini	Angola	Western	Dundo, AO	B727	Jet	Landing - Approach	xx	No	100	Africa	Africa	Africa	1 Ground fatal	yes
988	SCF-NP		0	0.000	0	0	0	0	138	8		1/9/2001	2001	LAB	Bolivia	Western	BUENOS AIRES	B727-200	Jet	TAKEOFF	xx	xx	xx	Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	SA Mercosur		No
989	LOC-I		0.529	0.529	2	1	3	3	3	3	0	31/01/2001	2001	Lineas Aereas Suramericanas	Colombia	Western	El Yopal, CO	Caravelle	Jet	Landing - Approach	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
990	ARC		0	0.000	0	0	0	0	136	6		2/7/2001	2001	Iberia Airlines	Spain	Western	BILBAO	A320-210	Jet	LANDING	xx	xx	xx	Europe	Europe	EU-EFTA		No
991	FIRE-NI		0.2	0.200	0	1	1	0	0	5	0	03/03/2001	2001	Thai Airways International	Thailand	Western	Bangkok, TH	B737	Jet	Ground, Parked	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
992	USOS		0	0.000	0	0	0	0	0	3		3/7/2001	2001	Skymaster Air Lines	Brazil	Western	SAO PAULO	B707-300	Jet	LANDING	xx	xx	xx	Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	SA Mercosur		No
993	USOS		0	0.000	0	0	0	0	0	3		3/11/2001	2001	Express One International	USA	Western	PONAPE	B727-200	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
994	ARC		0	0.000	0	0	0	0	175	7	0	23/03/2001	2001	Luxor Air	Egypt	Western	Monrovia, LR	B707	Jet	Landing - Rollout	Fog	No	100	Africa	Africa	NoAfr/MidEast	x	yes
995	RE-Landing		0	0.000	0	0	0	0	0	2		4/4/2001	2001	Canada 3000 Airlines	Canada	Western	ST. JOHNS	B737-200	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
996	USOS		0	0.000	0	0	0	0	6	5		5/10/2001	2001	Angola Air Charter	Angola	Western	NZAGI	B727-100	Jet	LANDING	xx	xx	xx	Africa	AFRICA	Africa		No
997	ARC		0	0.000	0	0	0	0	98	6		5/22/2001	2001	First Air	Canada	Western	YELLOWKNIFE	B737-200	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
998	SCF-NP		0	0.000	0	0	0	0	88	4		5/23/2001	2001	American Airlines	USA	Western	DALLAS	F-100	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
999	RE-Landing		0	0.000	0	0	0	0	132	8		8/1/2001	2001	Yemenia	Yemen	Western	ASMARA	B727-200	Jet	LANDING	xx	xx	xx	Middle East	MIDDLE EAST	NoAfr/MidEast		No
1000	RE-Landing		0	0.000	0	0	0	0	4	6		8/28/2001	2001	Eagle Aviation	Kenya	Western	LIBREVILLE	BAC 1-11-400	Jet	LANDING	xx	xx	xx	Africa	Africa	Africa		No
1001	SCF-PP		0.011364	0.011	1	0	1	0	82	6		9/15/2001	2001	TAME	Ecuador	Western	BELO HORIZONTE	F-100	Jet	CRUISE	xx	xx	xx	Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	SA (Northern)		No
1002	ARC		0	0.000	0	0	0	0	62	5	0	16/09/2001	2001	VARIG	Brazil	Western	Goiania, BR	B737	Jet	Landing - Rollout	Rain	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
1003	RI		1	1.000	104	6	110	0	104	6	0	08/10/2001	2001	SAS	Sweden (Multi-Nat)	Western	Milan, IT	MD-80	Jet	T/O Run	Fog	No	100	Europe	Europe	EU-EFTA	x	yes
1004	SCF-NP		0	0.000	0	0	0	0	193	12		10/17/2001	2001	Pakistan Int'l Airlines	Pakistan	Western	DUBAI	A300B4	Jet	LANDING	xx	xx	xx	Asia	Asia	Asia-Low-Mdl Income		No
1005	Other		0.006757	0.007	0	1	1	1	134	14		10/20/2001	2001	TunisAir	Tunisia	Western	DJERBA	A300-600	Jet	PARKED	xx	xx	xx	Africa	AFRICA	NoAfr/MidEast		No
1006	LOC-I		1	1.000	251	9	260	0	243	17	5	12/11/2001	2001	American Airlines	USA	Western	Belle Harbor, NY	A300-600	Jet	T/O Climb to cruise	xx	No	100	North America	NA-Car	US-Canada	5 Ground fatal	yes
1007	CFIT		0.727	0.727	21	3	24	0	28	5	0	24/11/2001	2001	Crossair	Switzerland	Western	(near) Zurich, CH	BAE (Avro) RJ	Jet	Landing - Approach	Snow	No	100	Europe	Europe	EU-EFTA	x	yes
1008	USOS		0.077	0.077	1	0	1	0	8	5	0	11/27/01	2001	British Global	UK	Western	(near) Port Harcourt, NG	B747	Jet	Landing - Approach	xx	No	100	Europe	Europe	EU-EFTA	x	yes
1010	RE-Takeoff		0.000	0.001	0	0	0	1	96	7	0	01/14/02	2002	Lion Air	Indonesia	Western	Pekanbaru, ID	B737 (JT8D)	Jet	T/O Run	xx	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1011	SCF-PP		0.042	0.042	0	1	1	0	20	4	0	01/16/02	2002	Garuda Indonesia	Indonesia	Western	(near) Yogyakarta, ID	B737 (CFMI)	Jet	Descent	Heavy Rain, Hail	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1012	CFIT		1	1.000	83	9	92	0	83	9		1/28/2002	2002	TAME	Ecuador	Western	(near) Ipiales	B727-100	Jet	INITIAL APPROACH	xx	xx	xx	Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	SA (Northern)		No
1013	Other		0	0.000	0	0	0	0	0	3		2/28/2002	2002	Fine Air	USA	Western	SINGAPORE	DC-8-62C	Jet	TAXI	xx	xx	xx	North America	NA-Car	US-Canada		No
1014	RE-Landing		0.000	0.000	0	0	0	0	0	3	0	03/18/02	2002	VARIG	Brazil	Western	Belo Horizonte, BR	B727	Jet	Landing - Rollout	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
1015	CFIT		0.771	0.781	120	8	128	28	155	11	0	04/15/02	2002	Air China	China	Western	Pusan, KR	B767	Jet	Approach	Rain, mist, vis	No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
1016	RE-Landing		0.000	0.000	0	0	0	0	0	4	0	04/26/02	2002	Hewa Bora Airways	Congo, Zr	Western	Kinshasa, ZR	B707	Jet	Landing - Rollout	Wind, vis	No	100	Africa	Africa	Africa	x	yes
1017	LOC-I		0.948	0.950	67	6	73	2	70	7	#	05/04/02	2002	Nicon Airways	Nigeria	Western	Kano, NG	BAC-1-11	Jet	T/O Initial Climb	xx	Yes	100	Africa	Africa	Africa	30 Ground fatal	yes
1018	CFIT		0.226	0.237	11	3	14	12	56	6	0	05/07/02	2002	Egyptair	Egypt	Western	(near) Tunis, TN	B737 (CFMI)	Jet	Approach	Rain - T-Storm	No	100	Africa	Africa	NoAfr/MidEast	x	yes
1019	SCF-NP		1.000	1.000	206	19	225	0	206	19	0	05/25/02	2002	China Airlines	Taiwan	Western	20nm. N. of Penghu Islands, TW	B747	Jet	En Route	xx	No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
1020	RE-Landing		0.000	0.000	0	0	0	0	63	5	0	06/14/02	2002	Inter (Colombia)	Colombia	Western	Neiva, CO	DC-9	Jet	Landing - Rollout	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
1021	MIDAIR		1.000	1.000	0	2	2	0	0	2	#	07/01/02	2002	DHL International B.S.C.	Bahrain	Western	(near) Uberlingen, DE	B757	Jet	En Route	xx	No	100	Middle East	**Asia**	NoAfr/MidEast	69 fatal in other A/C	yes
1022	Fuel		0.920	0.925	16	7	23	2	17	8	0	07/04/02	2002	New Gomair	Congo, Zr	Western	(near) Bangui, CF	B707	Jet	Approach	xx	No	100	Africa	Africa	Africa	Fuel Exh	yes
1023	CFIT		0.000	0.000	0	0	0	0	0	3	0	07/26/02	2002	FedEx	USA	Western	Tallahasse, US	B727	Jet	Approach	xx	No	100	North America	NA-Car	US-Canada	Color-blind	yes
1024	RE-Landing		0	0.000	0	0	0	1	154	5		8/28/2002	2002	America West Airlines	USA	Western	PHOENIX	A320-231	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
1025	Fuel		0.000	0.000	0	0	0	0	24	9	0	08/30/02	2002	TAM Linhas Aereas	Brazil	Western	Birigui, BR	Fokker 100	Jet	Landing	xx	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	Fuel Pump	yes
1026	RE-Landing		0.000	0.000	0	0	0	0	86	4	0	10/31/02	2002	Aeromexico	Mexico	Western	Monterrey, MX	DC-9	Jet	Landing - Rollout	Rain & ceiling	No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes
1027	RE-Landing		0	0.000	0	0	0	0	0	4		12/13/2002	2002	Arrow Air	USA	Western	SINGAPORE	DC-8-62C	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
1028	USOS		0.938	0.941	70	5	75	5	75	5	0	01/08/03	2003	Turkish Airlines (THY)	Turkey	Western	Diyarbakir, TR	Avro RJ Avroliner	Jet	Approach	Fog	No	100	Europe	Europe	NoAfr/MidEast	x	yes
1029	CFIT		1.000	1.000	41	5	46	0	41	5	0	01/09/03	2003	TANS	Peru	Western	(near) Chachapoyas, PE	Fokker F.28	Jet	Approach	Visibility	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
1030	USOS		0.000	0.000	0	0	0	0	87	6	0	01/26/03	2003	VASP	Brazil	Western	Rio Branco, BR	B737 (JT8D)	Jet	Landing - Approach	Mist	No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
1031	LOC-I		0.990	0.991	97	6	103	1	98	6	0	03/06/03	2003	Air Algerie	Algeria	Western	Tamanrasset, DZ	B737 (JT8D)	Jet	T/O Initial Climb	xx	No	100	Africa	Africa	NoAfr/MidEast	SCF PP	yes
1032	RI		0	0.000	0	0	0	0	170	5		3/21/2003	2003	Transasia Airways	Taiwan	Western	TAINAN	A321-131	Jet	LANDING	xx	xx	xx	Asia	Asia	Hi-Income Asia-Pac		No
1033	USOS		0.000	0.000	0	0	0	0	53	7	0	03/26/03	2003	Royal Air Maroc	Morrocco	Western	Oujda, MA	B737 (CFMI)	Jet	Approach	Fog	No	100	Africa	Africa	NoAfr/MidEast	x	yes
1034	CFIT		0.042	0.046	0	1	1	2	21	3	0	06/22/03	2003	Brit Air	France	Western	Brest, FR	CRJ Regional Jet	Jet			No	100	Europe	Europe	EU-EFTA	x	yes
1035	LOC-I		0.991	0.992	105	11	116	1	106	11	0	07/08/03	2003	Sudan Airways	Sudan	Western	(near) Port Sudan, SD	B737 (JT8D)	Jet			No	100	Africa	Africa	Africa	x	yes
1036	SCF-NP		xx	0.000	0	0	0	0	24	4		8/11/2003	2003	Garuda Indonesia	Indonesia	Western	JAKARTA	F-28-3000	Jet	LANDING	xx	xx	xx	Asia	Asia	Asia-Low-Mdl Income		No
1037	RI		0	0.000	0	0	0	0	2	7		11/29/2003	2003	Hydro Air	South Africa	Western	LAGOS	B747-200	Jet	LANDING	xx	xx	xx	Africa	Africa	Africa		No
1038	RE-Landing		0.000	0.000	0	0	0	0	40	4	0	12/07/03	2003	East African Safari Air Express	Kenya	Western	Lokichogio, KE	Fokker F.28	Jet	Landing - Rollout	xx	No	100	Africa	Africa	Africa	ADRM	yes
1039	ARC		0.000	0.000	0	0	0	0	94	4	0	12/13/03	2003	Nuevo Continente	Peru	Western	Lima, PE	B737 (JT8D)	Jet	Landing	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
1040	LOC-I		1.000	1.000	0	3	3	0	0	3	0	12/18/03	2003	Lineas Aereas Suramericanas	Colombia	Western	(near) Mitu, CO	DC-9	Jet	Descent	xx	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
1041	ARC		0.000	0.000	0	0	0	0	0	9	0	12/18/03	2003	FedEx	USA	Western	Memphis, US	DC-10	Jet	Landing	Crosswind	No	100	North America	NA-Car	US-Canada	x	yes
1042	RE-Landing		0.000	0.000	0	0	0	0	125	6	0	12/19/03	2003	Air Gabon	Gabon	Western	Libreville, GA	B737 (CFMI)	Jet	Landing - Rollout	Rain - T-Storm	Yes	100	Africa	Africa	Africa	x	yes
1043	RE-Takeoff		0.865	0.873	136	5	141	22	153	10	0	12/25/03	2003	UTA Guinee	Guinee	Western	Cotonou, BJ	B727	Jet	T/O Run	xx	No	100	Africa	Africa	Africa	x	yes
1044	LOC-I		1.000	1.000	141	7	148	0	141	7	0	01/03/04	2004	Flash Airlines	Egypt	Western	off Sharm-el-Sheikh, EG	B737 (CFMI)	Jet	T/O Initial Climb	xx	No	100	Africa	Africa	NoAfr/MidEast	Automation	yes
1045	SCF-NP		0	0.000	0	0	0	0	154	26		1/15/2004	2004	Iran Air	Iran	Western	BEIJING	B747-SP	Jet	LANDING	xx	xx	xx	Middle East	MIDDLE EAST	NoAfr/MidEast		No
1046	SCF-NP		0.000	0.000	0	0	0	0	261	12	0	03/01/04	2004	Pakistan International Airlines	Pakistan	Western	Jeddah, SA	Airbus A300	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1047	SCF-NP		0.000	0.000	0	0	0	0	0	7	0	04/02/04	2004	Air Memphis	Egypt	Western	Cairo, EG	B707	Jet			No	100	Africa	Africa	NoAfr/MidEast	x	yes
1048	RI		0	0.000	0	0	0	0	82	6		4/20/2004	2004	Alitalia	Italy	Western	TRIESTE	MD-82	Jet	TAXI	xx	xx	xx	Europe	Europe	EU-EFTA		No
1049	RE-Landing	ARC	0.000	0.000	0	0	0	0	0	3	0	04/28/04	2004	Centurion Air Cargo	USA	Western	Bogota, CO	DC-10	Jet			No	100	North America	NA-Car	US-Canada	x	yes
1050	WSTRW		0.000	0.001	0	0	0	1	53	4	0	07/21/04	2004	Aerocalifornia	Mexico	Western	Mexico City, MX	DC-9	Jet			No	100	Latin America & Caribbean	SA/CA	CA/Carib	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
1051	RE-Takeoff		0.000	0.000	0	0	0	0	116	8	0	08/11/04	2004	Air Guinee Express	Guinee	Western	Freetown, SL	B737 (JT8D)	Jet			No	100	Africa	Africa	Africa	x	yes
1052	RE-Landing		0.000	0.000	0	0	0	0	0	3	0	08/28/04	2004	Trans Air Cargo Services	Swaziland	Western	Gisenyi, RW	Aerospatiale Caravelle	Jet			No	100	Africa	Africa	Africa	x	yes
1053	RE-Landing	ARC	0.000	0.003	0	0	0	4	83	4	0	10/08/04	2004	Biman Bangladesh Airlines	Bangladesh	Western	Sylhet, BD	Fokker F.28	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1054	RE-Takeoff		1.000	1.000	0	7	7	0	0	7	0	10/14/04	2004	MK dba British Global	Ghana	Western	Halifax, CA	B747	Jet			No	100	Africa	Africa	Africa	x	yes
1055	SCF-NP		0.000	0.000	0	0	0	0	0	3	0	10/23/04	2004	Beta Cargo	Brazil	Western	Manaus, BR	B707	Jet			No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
1056	RE-Takeoff		0.000	0.000	0	0	0	0	0	4	0	11/07/04	2004	Lufthansa Cargo	Germany	Western	Sharjah, AE	B747	Jet			No	100	Europe	Europe	EU-EFTA	x	yes
1057	LOC-I		1.000	1.000	47	6	53	0	47	6	2	11/21/04	2004	China Yunnan Airlines	China	Western	Baotou, CN	CRJ Regional Jet	Jet			No	100	Asia	**Asia**	Asia-Low-Mdl Income	2 ground fatal	yes
1058	SCF-NP		0.000	0.000	0	0	0	0	140	6	0	11/28/04	2004	KLM Royal Dutch Airlines	Neder	Western	Barcelona, ES	B737 (CFMI)	Jet			No	100	Europe	Europe	EU-EFTA	x	yes
1059	RE-Landing	ARC	0.153	0.174	23	2	25	59	156	7	0	11/30/04	2004	Lion Air	Indonesia	Western	Solo, ID	MD-80	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1060	RI-A		0	0.000	0	0	0	0	0	4		1/3/2005	2005	Asia Airlines	Indonesia	Western	BANDA ACEH	B737-200	Jet	LANDING	xx	xx	xx	Asia	Asia	Asia-Low-Mdl Income		No
1061	RI-A		0.000	0.000	0	0	0	0	0	4	0	01/04/05	2005	Tri MG Airlines	Indonesia	Western	Banda Aceh, ID	B737 (JT8D)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1062	ARC		0.000	0.000	0	0	0	0	106	6	0	01/08/05	2005	AeroRepublica Colombia	Colombia	Western	Cali, CO	MD-80	Jet			No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
1063	RE-Landing		0	0.000	0	0	0	0	0	3		1/24/2005	2005	Atlas Air	USA	Western	DUSSELDORF	B747-200	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
1064	Ramp		0.01	0.000	0	1	1	0				2/1/2005	2005	Air France	France	Western	PARIS	A319	Jet	PARKED	xx	xx	xx	Europe	Europe	EU-EFTA		No
1065	CFIT		1.000	1.000	98	6	104	0	98	6	0	02/03/05	2005	Kam Air	Afghanistan	Western	Afghanistan	B737 (JT8D)	Jet			No	100	Asia	Asia	ASIA CEN	x	yes
1066	CFIT		0.000	0.000	0	0	0	0	0	5	0	03/19/05	2005	Cargo Plus Aviation dba Rainbow Air Cargo	Ethiopia	Western	(near) Kampala, UG	B707	Jet			No	100	Africa	Africa	Africa	x	yes
1067	USOS		0.000	0.001	0	0	0	1	61	4	0	04/07/05	2005	ICARO Air	Ecuador	Western	Coca, EC	Fokker F.28	Jet			No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
1068	GCOL		0.000	0.001	0	0	0	1	5	94	0	05/10/05	2005	Northwest	USA	Western	Minneapolis, US	DC-9	Jet			No	100	North America	NA-Car	US-Canada	x	yes
1069	RE-Landing		0.000	0.000	0	0	0	0	201	14	0	07/01/05	2005	Biman Bangladesh Airlines	Bangladesh	Western	Chittagong, BD	DC-10	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1070	RE-Landing	ARC	0.000	0.000	0	0	0	0	297	12	0	08/02/05	2005	Air France	France	Western	Toronto, CA	Airbus A340	Jet			No	100	Europe	Europe	EU-EFTA	x	yes
1071	OTHER		1.000	1.000	115	6	121	0	115	6	0	08/14/05	2005	Helios	Greece	Western	(near) Grammatikos, GR	B737 (CFMI)	Jet			No	100	Europe	Europe	EU-EFTA	x	yes
1072	LOC-I		1.000	1.000	152	8	160	0	152	8	0	08/16/05	2005	West Caribbean Airways	Colombia	Western	(near) Machiques, VE	MD-80	Jet			No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
1073	SCF-NP		0	0.000	0	0	0	0	318	16		8/19/2005	2005	Northwest Airlines	USA	Western	GUAM	B747-200	Jet	LANDING	xx	xx	xx	North America	NA-Car	US-Canada		No
1074	CFIT		0.408	0.408	35	5	40	0	91	7	0	08/23/05	2005	TANS	Peru	Western	(near) Pucallpa, PE	B737 (JT8D)	Jet	Approach	T-Storm	No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
1075	LOC-I		1.000	1.000	99	5	104	0	99	5	#	09/05/05	2005	Mandala Airlines	Indonesia	Western	Medan, ID	B737 (JT8D)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	44 Ground fatal	yes
1076	RE-Landing	ARC	0	0.000	0	0	0	0	113	8		10/9/2005	2005	Sahara India Airlines	India	Western	BOMBAY	B737-400	Jet	LANDING	xx	xx	xx	Asia	Asia	Asia-Low-Mdl Income		No
1077	UNK		1.000	1.000	111	6	117	0	111	6	0	10/22/05	2005	Bellview Airlines	Nigeria	Western	(near) Lissa, NG	B737 (JT8D)	Jet			No	100	Africa	Africa	Africa	x	yes
1078	RE-Landing		0.000	0.000	0	0	0	0	0	3	0	10/31/05	2005	MIBA Aviation	Congo, Zr	Western	Kindu, ZR	B727	Jet			No	100	Africa	Africa	Africa	x	yes
1079	RE-Landing		0.000	0.000	0	0	0	0	32	6	0	11/14/05	2005	Asian Spirit	Philippines	Western	Catarman, PH	HS 146	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1080	RE-Landing		0.000	0.000	0	0	0	0	98	5	1	08/12/2005	2005	Southwest	USA	Western	Chicago Midway	B737-700	Jet	Landing - Rollout	Snow, freezing fog	No	70	North America	NA-Car	US-Canada	ADRM	yes
1081	USOS		0.991	0.991	101	7	108	1	102	7	0	12/10/05	2005	Sosoliso Airlines	Nigeria	Western	Port Harcourt, NG	DC-9	Jet			No	100	Africa	Africa	Africa	x	yes
1082	RE-Landing		0	0.000	0	0	0	0	138	6		3/4/2006	2006	Lion Air	Indonesia	Western	SURABAYA	MD-82	Jet	LANDING	xx	xx	xx	Asia	Asia	Asia-Low-Mdl Income		No
1083	LOC-I		1.000	1.000	105	8	113	0	105	8	0	05/03/06	2006	Armavia	Armenia	Western	off Sochi, RU	Airbus A320	Jet			No	100	CIS	**Europe**	Euro East	x	yes
1084	RE-Landing		0.000	0.000	0	0	0	0	0	3	0	06/04/06	2006	Arrow Cargo	USA	Western	Managua, NI	DC-10	Jet			No	100	North America	NA-Car	US-Canada	x	yes
1085	RE-Takeoff		0.000	0.000	0	0	0	0	0	5	0	06/07/06	2006	TradeWinds Airlines	USA	Western	Medellin, CO	B747	Jet			No	100	North America	NA-Car	US-Canada	x	yes

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
1086	USOS		0.000	0.000	0	0	0	0	0	2	0	06/15/06	2006	TNT Airways	Belgium	Western	Birmingham, GB	B737 (CFMI)	Jet			No	100	Europe	Europe	EU-EFTA	x	yes
1087	RE-Landing		0	0.000	0	0	0	0	14	10		6/23/2006	2006	AMC Aviation	Egypt	Western	JUBA	MD-83	Jet	LANDING	xx	xx	xx	Africa	AFRICA	NoAfr/MidEast		No
1088	RE-Landing		0.616	0.627	120	5	125	41	195	8	0	07/09/06	2006	S7 Airlines	Russia	Western	Irkutsk, RU	Airbus A310	Jet			No	100	CIS	Europe	Euro East	x	yes
1089	SCF-NP		0.000	0.000	0	0	0	0	0	3	0	07/28/06	2006	FedEx	USA	Western	Memphis, US	DC-10	Jet			No	100	North America	NA-Car	US-Canada	x	yes
1090	SCF-NP		0.000	0.000	0	0	0	0	0	3	0	08/17/06	2006	Aerosucre Colombia	Colombia	Western	Bogota, CO	B727	Jet			No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
1091	RE-Takeoff		0.980	0.981	47	2	49	1	47	3	0	08/27/06	2006	Comair	USA	Western	Lexington, US	CRJ Regional Jet	Jet			No	100	North America	NA-Car	US-Canada	x	yes
1092	RE-Landing		0.000	0.000	0	0	0	0	0	3	0	09/07/06	2006	DHL Aviation	So Africa	Western	Lagos, NG	B727	Jet			No	100	Africa	Africa	Africa	x	yes
1093	MIDAIR		1.000	1.000	148	6	154	0	148	6	0	09/29/06	2006	GOL Linhas Aereas	Brazil	Western	(near) Peixote Azevedo, BR	B737 (NG)	Jet			No	100	Latin America & Caribbean	SA/CA	SA Mercosur	x	yes
1094	RE-Landing		0.000	0.000	0	0	0	0	104	6	0	10/03/06	2006	Mandala Airlines	Indonesia	Western	Tarakan, ID	B737 (JT8D)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1095	RE-Landing		0.250	0.272	3	1	4	6	13	3	0	10/10/06	2006	Atlantic Airways (Faroe Islands)	Faroe Islands	Western	Stord, NO	HS 146	Jet			No	100	Europe	Europe	EU-EFTA	x	yes
1096	WSTRW		0.914	0.919	92	4	96	8	100	5	0	10/29/06	2006	ADC Airlines	Nigeria	Western	Abuja, NG	B737 (JT8D)	Jet			No	100	Africa	Africa	Africa	x	yes
1097	RE-Landing		0.000	0.000	0	0	0	0	4	3	0	11/17/06	2006	Cielos Airlines	Peru	Western	Barranquilla, CO	DC-10	Jet			No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
1098	CFIT		1.000	1.000	2	3	5	0	2	3	0	11/18/06	2006	Aerosucre Colombia	Colombia	Western	(near) Leticia, CO	B727	Jet			No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
1099	ARC		0.000	0.000	0	0	0	0	157	7	0	12/24/06	2006	Lion Air	Indonesia	Western	Ujung Pandang, ID	B737 (CFMI)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1100	LOC-I		1.000	1.000	96	6	102	0	96	6	0	01/01/07	2007	Adam Air	Indonesia	Western	off Makassar, ID	B737 (CFMI)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1101	USOS		0.000	0.000	0	0	0	0	0	4	0	01/13/07	2007	Gading Sari Aviation Services	Malaysia	Western	Kuching, MY	B737 (JT8D)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1102	RE-Takeoff		0.000	0.000	0	0	0	0	50	4	1	01/25/07	2007	Regional	France	Western	Pau, FR	Fokker 100	Jet			No	100	Europe	Europe	EU-EFTA	1 Ground fatal	yes
1103	SCF-NP		0	0.000	0	0	0	0	0	3		2/4/2007	2007	Tampa Cargo	Colombia	Western	MIAMI	DC-8-71F	Jet	LANDING	xx	xx	xx	Latin America & Caribbean	SA/CA	SA (Northern)		No
1104	ARC		0.000	0.000	0	0	0	0	148	6	0	02/21/07	2007	Adam Air	Indonesia	Western	Surabaya, ID	B737 (CFMI)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1105	RE-Landing	ARC	0.150	0.155	20	1	21	12	133	7	0	03/07/07	2007	Garuda Indonesia	Indonesia	Western	Yogyakarta, ID	B737 (CFMI)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1106	Other		0	0.000	0	0	0	0	236	14		3/12/2007	2007	Biman Bangladesh Airlines	Bangladesh	Western	DUBAI	A310-325	Jet	TAKEOFF	xx	xx	xx	Asia	Asia	Asia-Low-Mdl Income		No
1107	RE-Landing		0.000	0.000	0	0	0	0	30	20	0	03/23/07	2007	Ariana Afghan Airlines	Afghanistan	Western	Istanbul, TR	Airbus A300	Jet			No	100	Asia	Asia	ASIA CEN	x	yes
1108	LOC-I		1.000	1.000	105	9	114	0	105	9	0	05/05/07	2007	Kenya Airways	Kenya	Western	(near) Douala, CM	B737 (NG)	Jet			No	100	Africa	Africa	Africa	x	yes
1109	ARC		0.000	0.000	0	0	0	0	37	3	0	05/20/07	2007	Air Canada Jazz	Canada	Western	Toronto, CA	CRJ Regional Jet	Jet			No	100	North America	NA-Car	US-Canada	x	yes
1110	USOS		0.063	0.063	4	1	5	0	74	6	1	06/28/07	2007	TAAG - Angola Airlines	Angola	Western	M'Banza Congo, AO	B737 (JT8D)	Jet			No	100	Africa	Africa	Africa	1 Ground fatal	yes
1111	RE-Landing		1.000	1.000	181	6	187	0	181	6	#	07/17/07	2007	TAM Linhas Aereas	Brazil	Western	Sao Paulo, BR	Airbus A320	Jet			No	100	Latin America & Caribbean	SA/CA	SA Mercosur	12 Ground fatal	yes
1112	RE-Landing		0.000	0.000	0	0	0	0	54	5	0	07/17/07	2007	AeroRepublica Colombia	Colombia	Western	Santa Marta, CO	EMB 190	Jet			No	100	Latin America & Caribbean	SA/CA	SA (Northern)	x	yes
1113	SCF-NP		0.000	0.000	0	0	0	0	157	8	0	08/20/07	2007	China Airlines	Taiwan	Western	Naha, JP	B737 (NG)	Jet			No	100	Asia	Asia	Hi-Income Asia-Pac	x	yes
1114	ARC		0.529	0.529	85	5	90	0	40	##	0	09/16/07	2007	One-Two-Go	Thailand	Western	Phuket, TH	MD-80	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1115	SCF-NP		0.000	0.000	0	0	0	0	156	7	0	10/11/07	2007	AMC Airlines	Turkey	Western	Istanbul, TR	MD-80	Jet			No	100	Europe	Europe	NoAfr/MidEast	x	yes
1116	RE-Landing	ARC	0.000	0.000	0	0	0	0	148	6	0	10/26/07	2007	Philippine Airlines	Philippines	Western	Butuan City, PH	Airbus A320	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1117	ARC		0.000	0.000	0	0	0	0	89	5	0	11/01/07	2007	Mandala Airlines	Indonesia	Western	Malang, ID	B737 (JT8D)	Jet			No	100	Asia	Asia	Asia-Low-Mdl Income	x	yes
1118	ARC		0.000	0.000	0	0	0	0	335	14	0	11/09/07	2007	Iberia	Spain	Western	Quito, EC	Airbus A340	Jet			No	100	Europe	Europe	EU-EFTA	x	yes
1119	CFIT		1.000	1.000	50	7	57	0	50	7	0	11/30/07	2007	World Focus Airlines dba Atlasjet Airlines	Turkey	Western	(near) Isparta, TR	MD-80	Jet			No	100	Europe	Europe	NoAfr/MidEast	x	yes
1120	RI		0.000	0.000	0	0	0	0	117	6	0	12/30/07	2007	TAROM	Romania	Western	Bucharest, RO	B737 (CFMI)	Jet			No	100	Europe	Europe	Euro East	x	yes

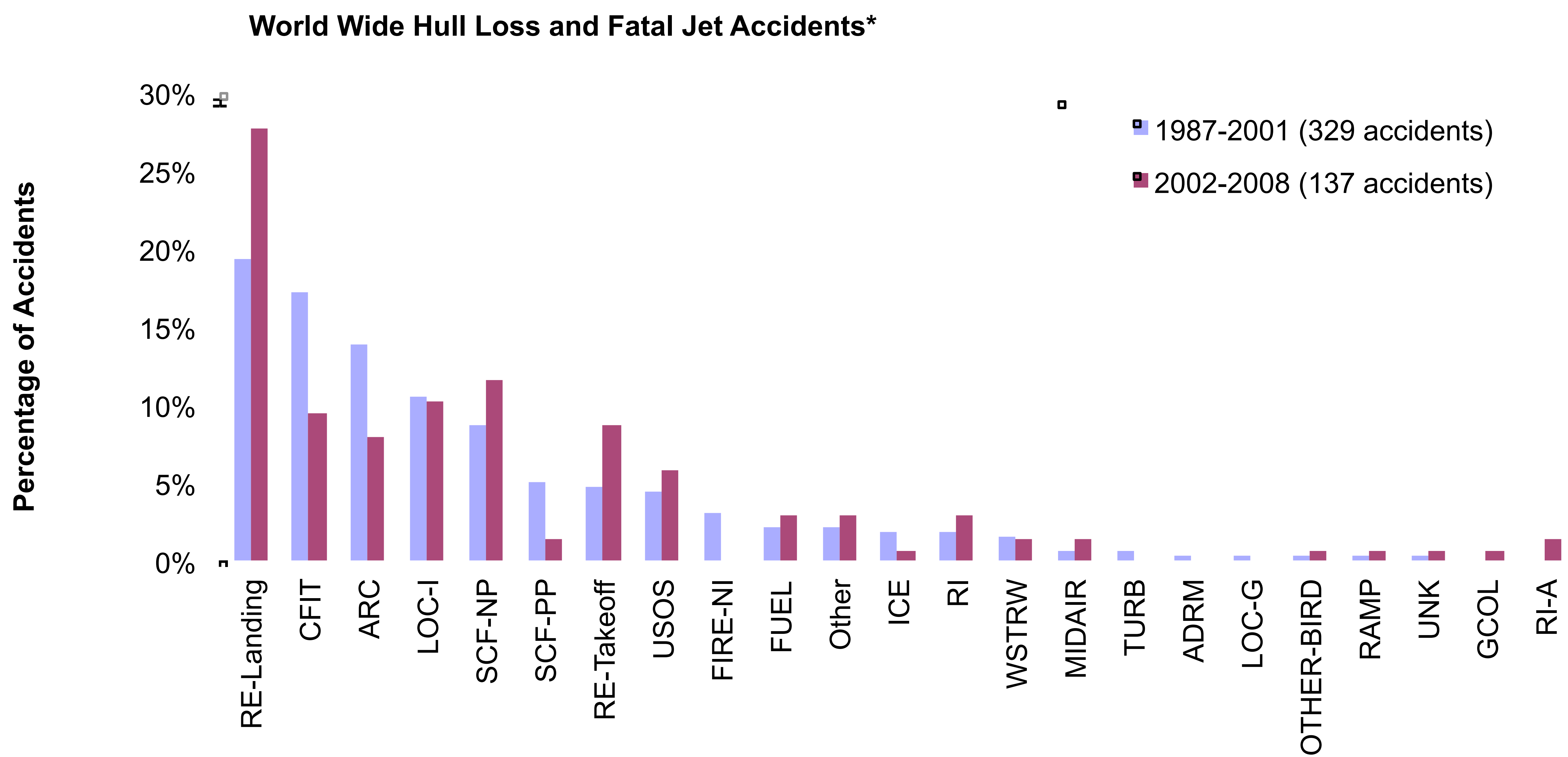
Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued

Accident ID	Category Definition	Previously ARC	Severity (Portion of People on Board Fatal)	Working Column - Serverity (Calculation)	Pax. Dead	Crew Dead	Tot Fatal (onBd)	Ser-ious (OnBd)	Pax OnBd	Crew OnBd	Other Fatal	Date	Year	Operator	Operator Country	A/C Mnf Region	Location	Aircraft	Jet?	Phase of Flight	Wx Factor?	Weight - C/G	AIR Claims Loss %	Operator Country Region (ICAO)	Operator Country Region (Airclaims)	Operator Country Sub-Region	Note	Accidents in 1987-2007 data set
1121	LOC-I		xx	0.000	0	0	0	0	107	6		1/2/2008	2008	Iran Air	Iran	Western	TEHRAN	F-100	Jet	TAKEOFF	xx	xx	xx	Middle East	MIDDLE EAST	NoAfr/MidEast		No
1122	FUEL		0	0.000	0	0	0	1	137	16		1/17/2008	2008	British Airways	United Kingdom	Western	LONDON	B777-200	Jet	FINAL APPROACH	xx	xx	xx	Europe	Europe	EU-EFTA		No
1123	FUEL		0	0.000	0	0	0	0	159	8		2/1/2008	2008	LAB	Bolivia	Western	Near Trinidad	B727-200	Jet	FINAL APPROACH	xx	xx	xx	Latin America & Caribbean	LATIN AMERICA & CARIBBEAN	SA Mercosur		No
1124	Other		0	0.000	0	0	0	0	0			2/2/2008	2008	Atlas Air	USA	Western	LOME	B747-200FM	Jet	INITIAL CLIMB	xx	xx	xx	North America	NA-Car	US-Canada		No
1125	ICE		xx	0.027	0	0	0	10	18	3		2/14/2008	2008	Belavia	Belarus	Western	Yerevan, AM	CRJ-100	Jet					CIS	**CIS**	Euro East		No
1126	SCF-NP		0	0.000	0	0	0	0	5	3		3/6/2008	2008	Manunggal Air	Indonesia	Western	Wamena, ID	Transall C-160	Jet					Asia	Asia	Asia-Low-Mdl Income		No
1127	ARC		0	0.000	0	0	0	0	169	5		3/10/2008	2008	Adam Air	Indonesia	Western	BATAM, BATU BESAR	B737-400	Jet	LANDING	xx	xx	xx	Asia	Asia	Asia-Low-Mdl Income		No
1128	SCF-NP		0	0.000	0	0	0	0	307	19		3/25/2008	2008	Saudia	Saudi Arabia	Western	DACCA	B747-300	Jet	LANDING	xx	xx	xx	Middle East	MIDDLE EAST	NoAfr/MidEast		No
1129	RE-Takeoff		0.174419	0.215	15	0	15	60	79	7		4/15/2008	2008	Hewa Bora Airways	Congo, ZR	Western	GOMA	DC-9-51	Jet	TAKEOFF	xx	xx	xx	Africa	Africa	Africa		No
1130	RE-Landing		0	0.000	0	0	0	0	67	6		4/22/2008	2008	Carpatair	Romania	Western	BUCHAREST	BAe 146-200	Jet	LANDING	xx	xx	xx	Europe	Europe	Euro East		No
1131	RE-Takeoff		0	0.000	0	0	0	0	0	5		5/25/2008	2008	Kalitta Air	USA	Western	BRUSSELS	B747-200FM	Jet	TAKEOFF	xx	xx	xx	North America	NA-Car	US-Canada		No
1132	RE-Landing	ARC	0.021739	0.047	2	1	3	60	131	7		5/30/2008	2008	TACA International Airlines	El Salvador	Western	TEGUCIGALPA	A320-200	Jet	LANDING	xx	xx	xx	Latin America & Caribbean	SA/CA	CA/Carib		No
1133	RE-Landing	ARC	0.125	0.131	32	1	33	27	252	12		6/10/2008	2008	Sudan Airways	Sudan	Western	KHARTOUM	A310-300	Jet	LANDING	xx	xx	xx	Africa	Africa	Africa		No
1134	SCF-NP		0	0.000	0	0	0	0	0	2		6/28/2008	2008	ABX Air	USA	Western	SAN FRANCISCO	B767-200	Jet	PARKED	xx	xx	xx	North America	NA-Car	US-Canada		No
1135	CFIT		0.5	0.529	0	1	1	1	0	2		7/6/2008	2008	U.S.A. Jet Airlines	USA	Western	SALTILLO	DC-9-15	Jet	FINAL APPROACH	xx	xx	xx	North America	NA-Car	US-Canada		No
1136	SCF-PP		0	0.022	0	0	0	3	0	8		7/7/2008	2008	Kallitta as Centurion Air Cargo	USA	Western	(near) BOGOTA	747-200FM	Jet	INITIAL CLIMB	xx	xx	xx	North America	NA-Car	US-Canada		No
1137	RE-Landing	ARC	xx	0.000	0	0	0	0	41	6		7/14/2008	2008	Chanchangi Airlines	Nigeria	Western	Port Harcourt, NG	B737-200	Jet					Africa	Africa	Africa		No
1138	LOC-I		0.895349	0.901	148	6	154	18	166	6		8/20/2008	2008	Spanair	Spain	Western	MADRID	MD-82	Jet	TAKEOFF	xx	xx	xx	Europe	Europe	EU-EFTA		No
1139	CFIT		0.722222	0.738	65	0	65	25	84	6		8/24/2008	2008	"ITEK AIR" AirCompany	Kyrgyzstan	Western	Near Bishkek-Manas International Airport	B737-200	Jet	FINAL APPROACH	xx	xx	xx	CIS	CIS	ASIA CEN		No
1140	RE-Landing		0	0.007	0	0	0	16	123	6		8/27/2008	2008	Sriwijaya Air	Indonesia	Western	JAMBI	B737-200	Jet	LANDING	xx	xx	xx	Asia	Asia	Asia-Low-Mdl Income		No
1141	LOC-I		1	1.000	82	6	88	0	82	6		9/14/2008	2008	Aeroflot-Nord	Russia	Western	Near Perm, Russia	B737-500	Jet	INITIAL APPROACH	xx	xx	xx	CIS	CIS	Euro East		No
1142	RE-Takeoff		xx	0.003	0	0	0	3	62	4		9/22/2008	2008	ICARO	Ecuador	Western	QUITO	F-28-4000	Jet	TAKEOFF	xx	xx	xx	Latin America & Caribbean	CARIBBEAN	SA (Northern)		No
1143	ARC		0	0.000	0	0	0	0	138	6		10/1/2008	2008	Kaliningradavia	Russia	Western	KALININGRAD	B737-300	Jet	LANDING	xx	xx	xx	CIS	CIS	Euro East		No
1144	RE-Landing	ARC	0	0.000	0	0	0	0	47	7		10/16/2008	2008	Rutaca	Venezuela	Western	CARACAS	B737-200	Jet	LANDING	xx	xx	xx	Latin America & Caribbean	SA/CA	SA (Northern)		No
1145	Other-Bird		0	0.000	0	0	0	0	166	6		11/10/2008	2008	Ryanair	Ireland	Western	ROME	B737-800	Jet	FINAL APPROACH	xx	xx	xx	Europe	Europe	EU-EFTA		No
1146	RE-Takeoff		0	0.002	0	0	0	5	110	5		12/20/2008	2008	Continental Airlines	USA	Western	DENVER	B737-500	Jet	TAKEOFF	xx	xx	xx	North America	NA-Car	US-Canada		No

Figure A15.1 (cont.)

Cast Data for Jet Accidents 1987 – 2008 Continued



*CAST Data - CICTT Categories, Western Built Jet Airplanes, Part 121 Equivalent Operations

Figure A15.1a

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15.2 EBT ANALYSIS OF CAST+ DATA

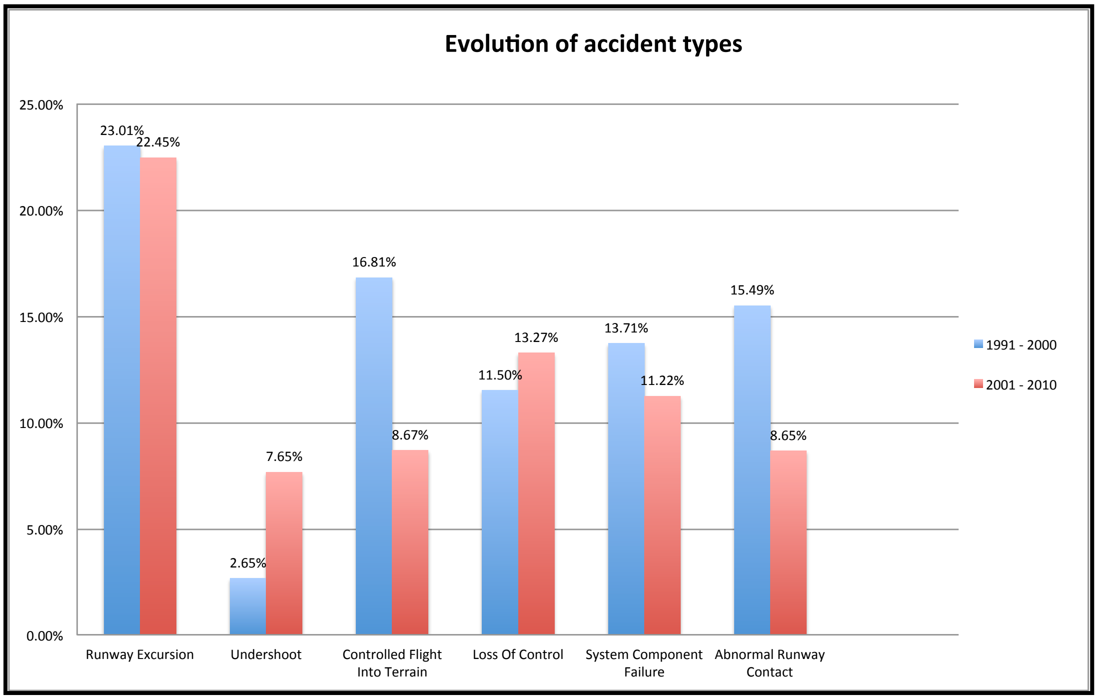

Figure 4.2.13.1 dup

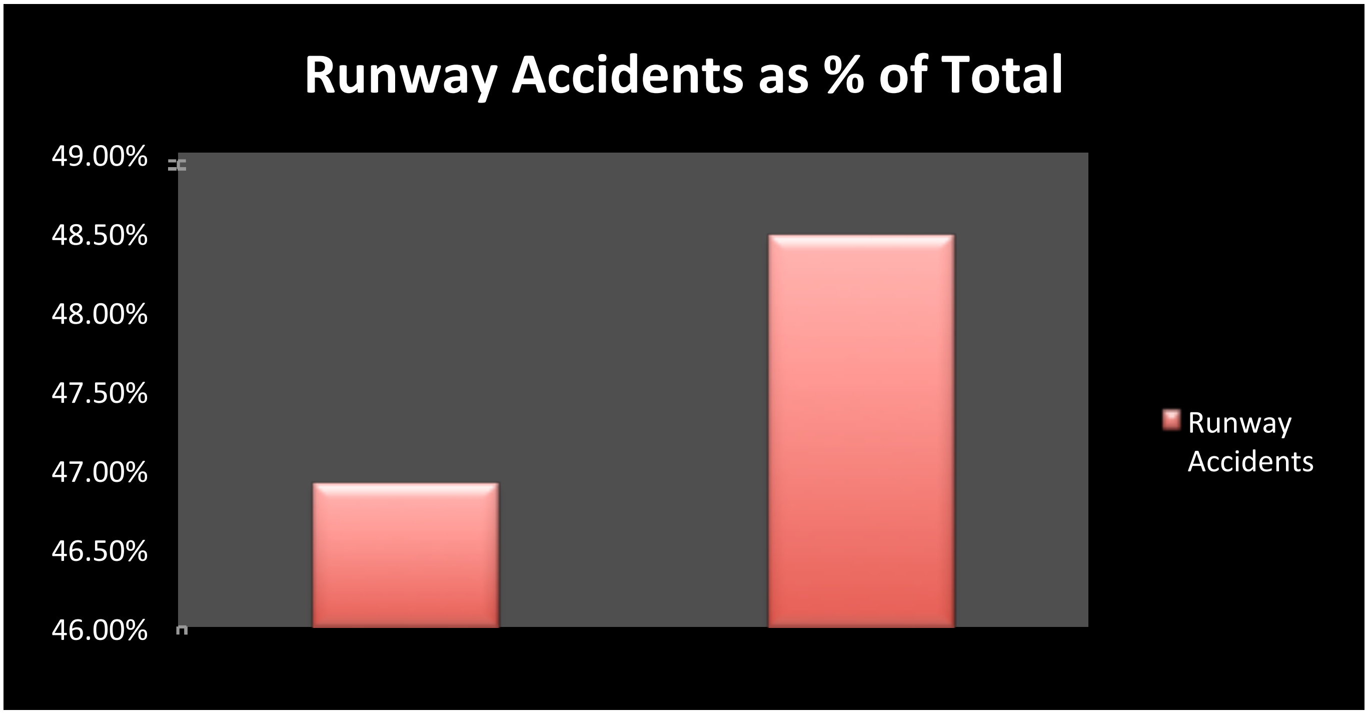

Figure 4.2.13.1a du

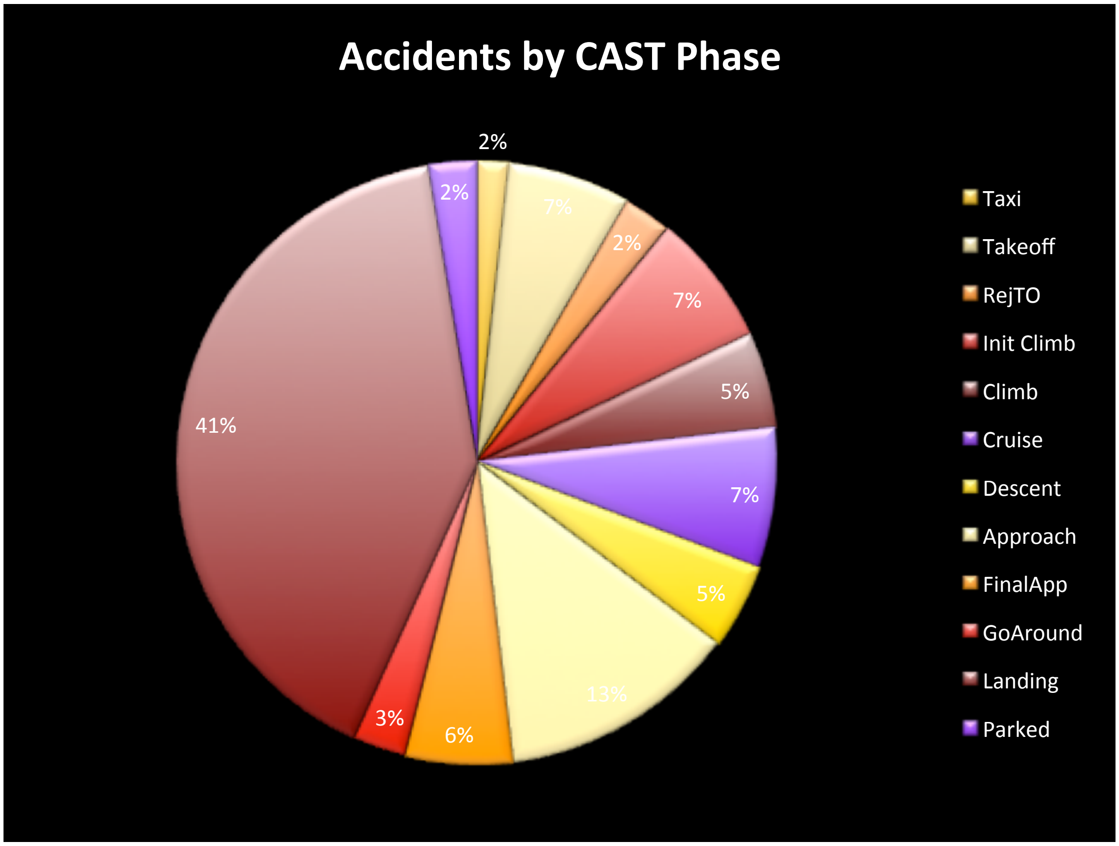

Figure 4.2.13.1b dup

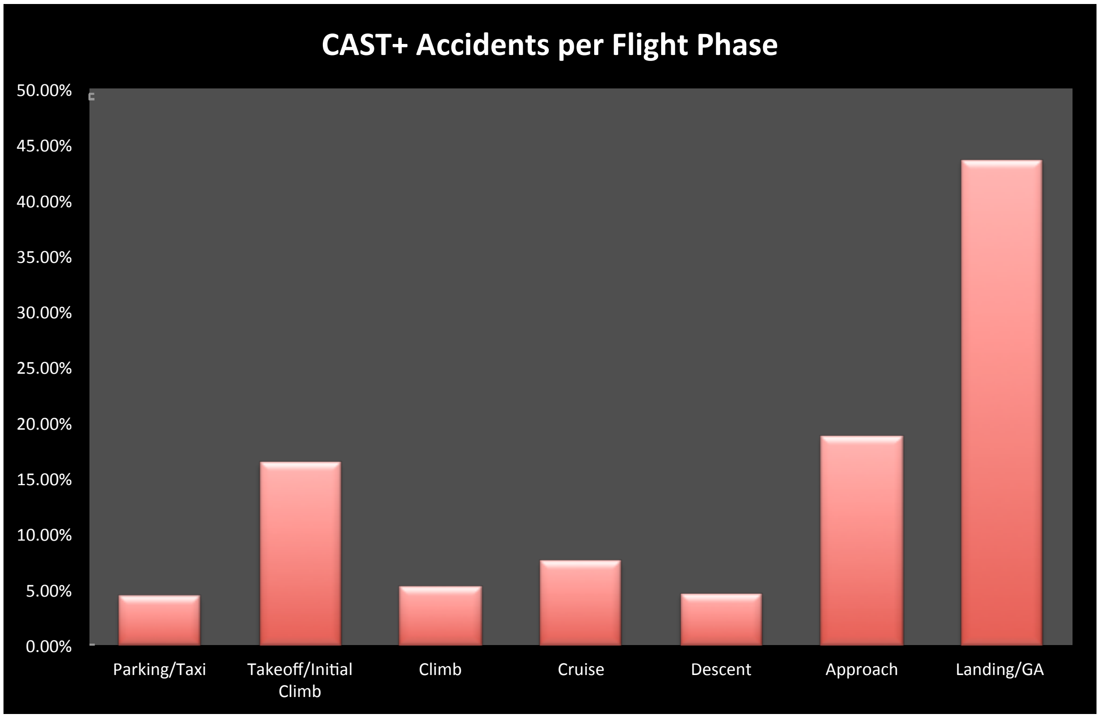

Figure 4.2.13.4 d

APPENDIX 16
SUMMARY TRAINING TOPIC DERIVATION PROCESS

RESULTS

Results of the Evidence Table analysis combined with Accident and Incident analysis:

Combine and collate threats/errors and states to develop Training Topics for Baseline Program

Critical Threats, Errors & Manoeuvres for training programme design

Training Topics for the Baseline Program, frequency as follows:
A – to be included in every module
B – to be included in every other module
C – to be included once in the 3-year cycle

EVIDENCE TABLE

The sources listed were analysed and the table complied as follows:

1. Statements that meet the objectives of the EBT Data Report
2. Statements containing evidence that is compelling in terms of convergence with other sources
3. Statements from scientifically reliable and statistically significant studies where applicable
4. Statements considering topics according to training criticality
   - LOSA Reports
   - EBT Flight Data Analysis
   - UK CAA Accident Studies
   - IATA Safety Reports
   - AQP Study
   - ATQP Study
   - STEADES Training Query
   - Airline Pilot Survey on Training Effectiveness
   - Factors that influence skill decay and retention
   - Skill retention after training
   - Automation training practitioners guide
   - The interfaces between flight crews & modern flight deck systems – FAA
   - Long aircraft type/variant difference on landing
   - A study of the normal operational landing performance on subsonic civil narrow body jet aircraft during ILS approaches – NLR
   - TAWS "Saves"
   - CAST Accident Study

Statements allocated priority A, B, C

EBT ACCIDENT INCIDENT ANALYSIS

(All reported accident, fatal and non-fatal, plus serious incidents (NTSB Database) 1962-2010, involving jet aircraft with a minimum of 50 seats, turboprop aircraft with a minimum of 30 seats) Steps are as follows:

- Factor analysis (39 factors from the TCS)
- Analysis of competency issues (coincident with factor analysis)
- Analysis of all factors
- All 6 steps taken unless otherwise indicated, or when data are statistically not relevant

Note 1 – Normalisation according to:

- All Accidents & Incidents
- Aircraft Generation & Severity (All accidents, fatal accidents only, serious incidents only)
- Number of departures (except turboprops-no normalisation data)

Note 2 – Results expressed as rates and sometimes as risk (global analysis only – likelihood times severity)

1. Filter Generation (for global analysis show also values combined across generations)
2. Filter Competency (global analysis only)
3. Trend over time (Last 15 years versus previous except Gen4 jets which is Last 11 years versus previous)
4. Clustering of factors
5. Flight phase
6. Training Effect
7. FSTD Trainability
8. Conclusion, with relative weighting, for training programme design
9. Priority allocation A, B, C

TRAINING CRITICALITY SURVEY

39 factors were considered

Step 1

For a given generation take the median of the distribution of the calculated results from the risk matrix (product of likelihood, severity and training effect) across all phases. Everything above the median should be considered provided the Training Effect is 3 or above.

Step 2

Take the median of the distribution of the risk (product of likelihood and severity) across all flight phases. Retain everything that is above this median and has not been already considered in Step 1.

Step 3

Take all items with a training benefit 4 or above. Retain everything that has not been already considered in Phase 1 or 2.

Any item evaluated to be relevant in only one flight phase needs to be considered in that specific phase. Any item evaluated to be relevant in multiple phases can be trained in any of these phases.

Step 4 – Correlation with EBT Accident and Incident Analysis

Note as a result of relatively low submission numbers it was decided not to adjust any training programme priorities or topics as a result of TCS correlations. The methodology and results are published because the process was considered very useful for future studies. Correlations in general were very strong given the limited data set.

Background – Prioritization

Prioritization of the training topics is probably the most important result from the EBT data analysis. It is a key part in the process for translating data into useful events and scenarios to assess and develop pilot performance in recurrent training programs. This result is the first rigorous attempt to rank parameters such as threats, errors and competencies, along with factors affecting accidents and serious incidents, from multiple data sources systematically to formulate a recurrent training program.

The exercise shows the feasibility of collecting an adequate set of operational and training data; developing the necessary methods to analyze that data, while corroborating results to produce a criticality ranking of training topics. The prioritization process occurs for each of the 6 generations of aircraft by ordering critical parameters so as to highlight differences and commonality. There is sufficient flexibility in the process to allow enhancement according to mission, culture and type of aircraft. The data in the process are also used as material to build scenarios for use in recurrent assessment and training conducted in an FSTD qualified for the purpose according to the *Manual of Criteria for the Qualification of Flight Simulation Training Devices* (Doc 9625), Volume I – Aeroplanes.

The process used is transparent and repeatable and results in a unique prioritization, according to aircraft generation. Three levels of priority A, B and C were used to determine the frequency of pilot exposure to the defined training topics within a 3-year rolling recurrent training program (see Section 7, paragraph 3).

Most of the data referred to in this report has been analyzed and are contained within the Evidence Table, and the EBT Accident and Incident Study. The Evidence Table consists of data from multiple sources and has the capability to sort as well as corroborate analytical results. It represents a robust set of evidence and it is a primary tool used in determining results. The EBT Accident and Incident Study has 3045 reports feeding the analysis, making it comprehensive as well as sensitive in developing prioritization of results and discriminating by aircraft generation. Prioritization of training topics by generation uses both of these tools. In some cases, depending on the data, the assessment and training topics are drawn from both sources, or from the Evidence Table alone or from the Accident and Incident Study alone. While the prioritization itself results from an algorithmic process, all analytical results were provided to the EBT Project Group comprising training experts and professionals in training scenario creation. Their utilization of the results served as an experiential validation.

Any set of historical data is necessarily finite. Using these data assumes a large set of experience will have strong predictive validity even though the environment is constantly changing. These challenges were accepted because statistical and quality control principles were adhered to and, more importantly, the results from data analysis were applied in the context of professional experience and expertise.

For the creation of the EBT recurrent training program defined in this manual, a cautious approach was taken, and the suggested frequency of training is higher than the results indicate unless the corroborating data is very strong. An example of this could be illustrated in the EBT Accident and Incident Study where the data imply different training frequency in adjacent generations. If the data are quite strong in the generation that demands more training, the training category in the adjacent generation is upgraded.

Operational and training data from multiple sources indicate that pilots operating the more modern generation aircraft take less time to achieve competence in the performance of certain maneuvers. Modern generation aircraft are also more complex, and pilots have more to learn for achieving a defined level of competency to operate. While the number of assessment and training topics is slightly fewer in early aircraft generations, the training time in the FTSD should be largely the same.

Summary of training topics

The following table represents the lists of training topics derived from data analysis, to which have been added topics that, despite not being indicated by significant data, were considered to be an important facet of a recurrent assessment and training program. These are highlighted in grey.

Generation 4 Jets

Gen4 Jet Training Topics						
	A	Adverse weather	B	Adverse wind	C	ATC
		Automation management		Aircraft system malfunction		Engine failure
		Competencies non-technical (CRM)		Aircraft System management		Fire and smoke management
		Compliance		Approach, visibility close to minimum		Loss of communications
		Error management		Landing		Managing loading, fuel, performance errors
		Go-Around management		Runway or taxiway condition		Navigation
		Manual aircraft control		Surprise		Operations or type specific
		Mismanaged aircraft state		Terrain		Pilot incapcitation
		Monitoring & cross-checking		Workload, distraction, pressure		Traffic
		Unstable approach				Upset recovery
						Windshear recovery

Generation 3 Jets

Gen3 Jet Training Topics						
	A	Adverse weather	B	Adverse wind	C	ATC
		Automation management		Aircraft system malfunction		Engine failure
		Competencies non-technical (CRM)		Aircraft system management		Fire and smoke management
		Compliance		Approach, visibility close to minimum		Loss of communications
		Error management		Landing		Managing loading, fuel, performance errors
		Go-Around management		Surprise		Navigation
		Manual aircraft control		Windshear recovery		Operations or type specific
		Mismanaged aircraft state		Workload, distraction, pressure		Pilot incapcitation
		Monitoring & cross-checking				Runway or taxiway condition
		Unstable approach				Terrain
						Traffic
						Upset recovery

Generation 3 Turboprops

Gen3 Turboprop Training Topics	A	B	C
	Adverse weather	Aircraft system malfunctions	Adverse wind
	Automation management	Aircraft system management	Engine Failure
	Competencies non-technical (CRM)	Approach, visibility close to minimum	Fire and smoke management
	Compliance	Landing	Loss of communications
	Error management	Surprise	Managing loading, fuel, performance errors
	Go-Around management	Terrain	Navigation
	Manual aircraft control	Upset recovery	Operations or type specific
	Mismanaged aircraft state	Workload, distraction, pressure	Pilot incapcitation
	Monitoring & cross-checking		Runway or taxiway condition
	Unstable approach		Traffic
			Windshear recovery

Generation 2 Jets

Gen2 Jet Training Topics	A	B	C
	Adverse weather	Adverse wind	Loss of communications
	Approach, visibility close to minimum	Aircraft system malfunction	Managing loading, fuel, performance errors
	Automation management	Compliance	Navigation
	Competencies non-technical (CRM)	Engine Failure	Operations or type specific
	Error management	Fire and smoke management	Pilot incapcitation
	Go-Around management	Landing	Runway or taxiway condition
	Manual aircraft control	Mismanaged aircraft state	Terrain
	Monitoring & cross-checking	Surprise	Traffic
	Unstable approach	Windshear recovery	Upset recovery

Generation 2 Turboprops

Gen3 Turboprop Training Topics	A	B	C
	Adverse weather	Aircraft system malfunctions	Adverse wind
	Automation management	Aircraft system management	Engine Failure
	Competencies non-technical (CRM)	Approach, visibility close to minimum	Fire and smoke management
	Compliance	Landing	Loss of communications
	Error management	Surprise	Managing loading, fuel, performance errors
	Go-Around management	Terrain	Navigation
	Manual aircraft control	Upset recovery	Operations or type specific
	Mismanaged aircraft state	Workload, distraction, pressure	Pilot incapcitation
	Monitoring & cross-checking		Runway or taxiway condition
	Unstable approach		Traffic
			Windshear recovery

APPENDIX 17
LINKS TO DATA ADDITIONAL DATA SOURCES

The following list contains links to studies referenced in this report:

UK CAA CAP 776	http://www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11&mode=detail&id=3198
UK CAA CAP 780	http://www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11&mode=detail&id=3325
FAA Factors that Influence Skill Decay and Retention	http://www.owlnet.rice.edu/~antonvillado/courses/09a_psyc630001/Arthur, Bennett, Stanush, & McNelly (1998) HP.pdf
NLR A Study of Normal Operational Landing Performance on Subsonic Civil Narrow Body Jet Aircraft during ILS Approaches	http://www.tc.faa.gov/its/worldpac/techrpt/ar077.pdf
IATA Safety Report 2008	http://www.iata.org/about/.../iata- annual- report- 2008.pdf
IATA Safety Report 2009	http://www.iata.org/pressroom/Documents/IATAAnnualReport2009.pdf

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