



**Guidance Material
for the implementation of
Paperless Aircraft Operations
in
Technical Operations
(PAO:TO)**

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IATA Disclaimer

NOTICE

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What's in Paperless Aircraft Operations for me?

So “What's in it for me”? A question that you will need to answer so that your organization will commit the funds and the resources necessary to commence your own journey towards Paperless Aircraft Operations in Technical Operations (PAO:TO).

Consider the following four questions when building your business case for Paperless Aircraft Operations.

Want to save costs in the longer term?

Rolling out new systems enabling electronic signature, use of tablets for point of use information, electronic storage of records, and areas like RFID for component identification, fitted location and history.

Paperless Operations can facilitate this.

Want to efficiently transfer assets – aircraft, engines, components?

Picture yourself doing this seamlessly through the electronic transfer and acceptance of records. No longer having to expend time, resources or money to search pallet loads of paper or to transfer it with the asset.

Paperless Operations can facilitate this.

Want to facilitate 100% configuration and airworthiness compliance?

Eliminate configuration and compliance breaches by efficiently and effectively ensuring: correct tracking of part fitment, maintenance performed to latest approved OEM data, all ADs and SBs correctly tracked, certifications made by appropriately approved persons. Provide your accountable manager and CEO with legitimate and objective assurance that his fleet is compliant and airworthy.

Paperless Operations can facilitate this.

Want to build & optimize your organization's knowledge management?

Think about quickly tapping in to diverse knowledge sources when confronted with technical defects, structural repairs or AOGs. Electronically and seamlessly engage colleagues, other airlines or OEMs.

Paperless Operations can facilitate this

When considering the commencement of your PAO:TO journey, use this Guidance Material together with its multiple references for guiding the analysis which is important to your circumstances and in the development of your business case. Think about the following when developing your business case(s):

- The efficiencies that will flow from it
- The alignment with industry standards
- Where other organizations and stakeholders in the aviation engineering and maintenance value-streams are in their own journeys
- The exponential growth of available technology that enables PAO:TO
- The drive by governments for e-Business through various laws and statutes

- The inevitability of PAO:TO as new generation aircraft are delivered and supported by the OEMs as paperless
- The ease of lease return or asset sale
- The ease of regulatory and airworthiness compliance and avoidance of overruns
- The assurance that Terms & Conditions as set out in commercial agreements are met. (e.g. leases, component pools etc)
- The ability to use of electronic data to facilitate the improvement of reliability and operational performance

You can actively
contribute to IATA's
PAO:TO Initiative

And, think about how you can actively contribute to IATA's initiative and assist in the development of PAO:TO for the industry rather than facing an imposed outcome at some time in the future.

1 Introduction

This Guidance Material and the accompanying “Electronic Signature & Record Keeping Regulatory Checklist”¹ has been developed for the benefit of the industry and to assist organizations in their own journeys towards paperless operations.

It provides concepts and ideas about new technology innovation and implementation. Whilst some innovations are in pilot phases, the provision of these concepts and ideas generates the exploration and further thinking of the value that can be facilitated through paperless aircraft operations.

In 2014 IATA initiated the Paperless Aircraft Operations in Technical Operations (PAO:TO) program. This initiative, modeled after the “Simplifying the Business” program, supports airlines in identifying areas and solutions for more efficient aircraft activities in all aspects that involve technical operations. These operations include aircraft maintenance activities, parts supply chain and logistics, as well as the transfer of aircraft assets.

IATA has a vision which is to:

IATA’s Vision

“Simplify maintenance operations by incorporating paperless technologies, thereby facilitating regulatory compliance and enabling new processes to reduce costs”.

This is an initiative which utilizes IATA’s unique position to be able to guide the industry towards adopting contemporary technologies and processes against defined standards. In adopting paperless operations, industry stakeholders will enhance the efficiency and effectiveness by which they contribute to engineering and maintenance throughout aircraft lifecycles and to the industry as a whole.

The road ahead can be impacted by constraints such as organizational resources, regulatory environments, contractual obligations; or not knowing how best to prioritize efforts and how to proceed.



Figure 1: The Road to 2020 & Beyond

Some organizations are well advanced and have overcome many of the problems they've encountered along the way.

The generosity of those organizations who have shared their experiences through contributions to this Guidance Material is appreciated. Their experiences do assist in understanding how to avoid or overcome the hurdles that inevitably will be encountered through the implementation of paperless operations.

¹ lataorg. [Online]. [14 September 2017]. Available from: <http://www.iata.org/whatwedo/ops-infra/Pages/paperless-ops.aspx>. In-text citation: (IATA, 2017)

2 Context

IATA has been heavily involved with the airline industry's transformation. Electronic ticketing (e-ticketing) for example, has been a cornerstone of this digital transformation occurred in just over a 4-year period (2004-2009).

Not only was paper eliminated from the customer interfacing side of the business but e-ticketing allowed for a full review of the ticketing process that led to the elimination of waste from the overall system.

Similarly, the use of various paperless technologies in the operational side will allow us to optimize airline processes within an operator and at interfaces between the operator and its stakeholders.

It should be noted, however, that paperless implementation in the airline operational areas has significantly more challenges than e-ticketing. These challenges include:

- The acceptance by regulators worldwide. Authorities (CAAs/NAAs) have to endorse and approve various activities based on new technologies
- The life span of the aircraft and its parts can be more than thirty years and regulations require records to be kept and to be available throughout that time. By comparison an e-ticket has a life span of about 2 years before it is fully cleared through the financial systems.
- The involvement of many stakeholders with significant commercial interests that rely on "paperwork" to track parts, aircraft records and asset transfers. This is arguably more complex than the e-ticketing stakeholder involvement (primarily airlines, travel agents and elements of the financial system)
- The complexity of systems necessary to track and trace parts, combined with absence and/or ignorance of standards. This adds a significant challenge to be addressed when moving forward to ensure proper transition from paper to digital processes and activities.

Figure 2 identifies the focus areas of PAO:TO and the indicative timing for the elements within the focus areas that need to be addressed. Organizations can take this "Concept and Roadmap" as an IATA reference point in developing their own PAO:TO business plans to ensure their alignment with industry direction.

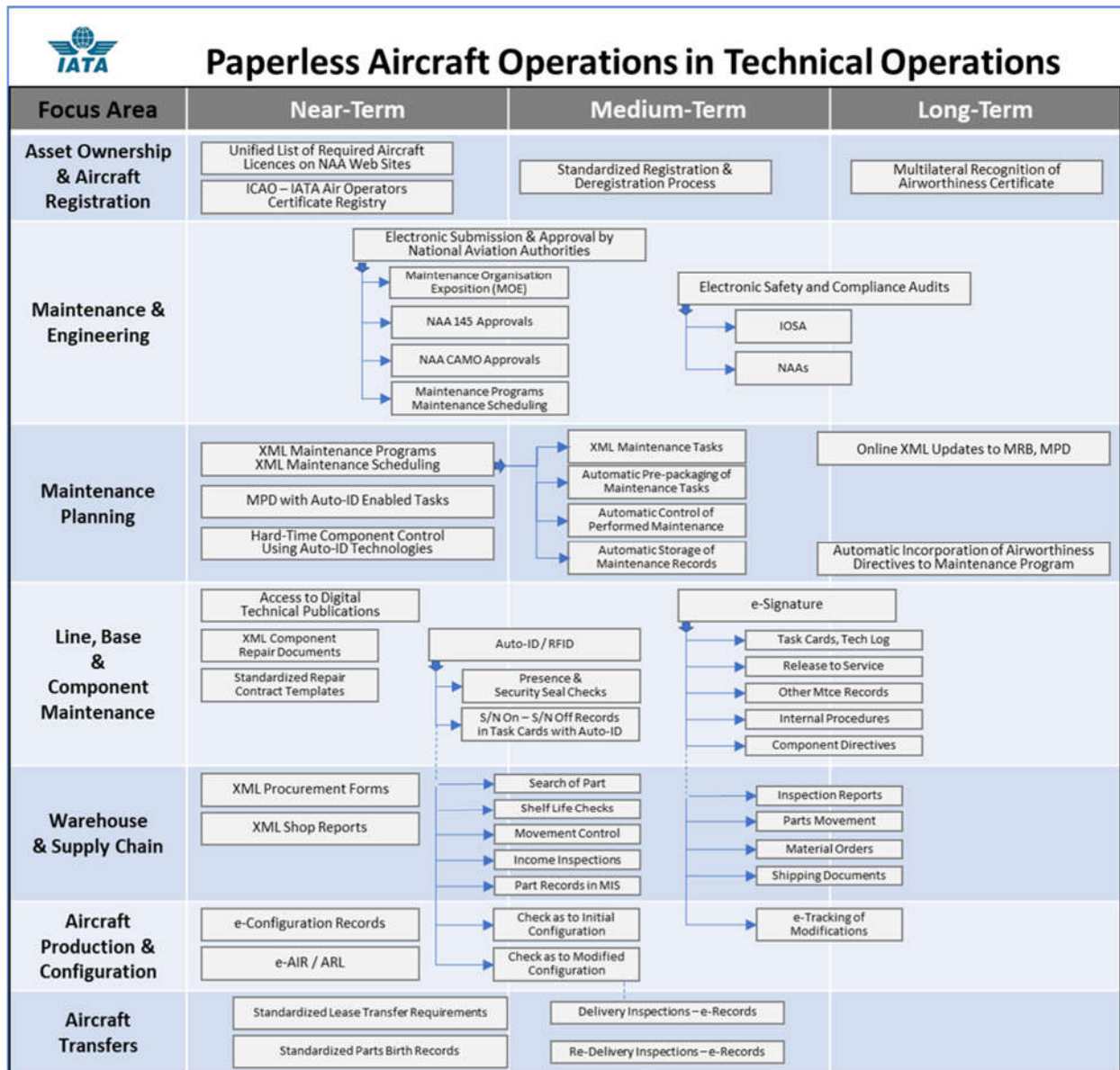


Figure 2: PAO:TO Concept and Roadmap

2.1 Implementation Targets

IATA’s implementation target is to have all new aircraft delivered paperless by 2020. OEMs are a prime driver in working towards this goal and already, they are delivering later generation aircraft as paperless.

The bigger issue is with in-service aircraft at 2020. For these, the target is to have them transitioned to paperless operations at the first major maintenance event after 2020 – typically: an Aircraft Heavy Maintenance Check, or in the case of the various components, after an Engine Shop Visit, Component Shop Visit, etc.

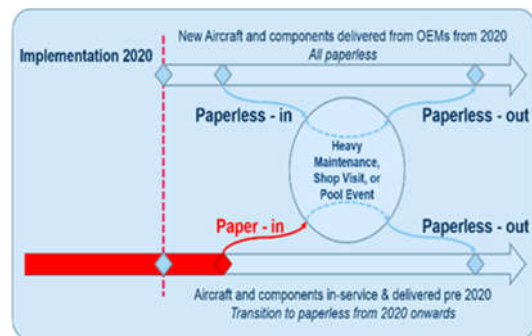


Figure 3: PAO:TO 2020 Target Implementation

These 2020 targets are aggressive and for them to be achieved, the industry needs to pull together across all the stakeholder groups that impact aircraft maintenance and engineering through the “cradle to grave” asset lifecycle.

2.2 Industry Engagement

IATA has actively engaged with and seeks continuing input from representatives of the key stakeholders of: Airlines, MROs, Lessors, OEMs, Parts Providers, Logistics Providers, Technology Providers, Aviation Authorities and Standards Authorities, together with broader industry groups.

In the development of this Guidance Material, input and learnings were drawn from the IATA Paperless Operations Working Groups, conference presentations, and on research of sectors other than commercial aviation where paperless systems are being introduced.



Figure 4: Key Stakeholder Groups

2.3 Cost, Quality & Time “Value Propositions”

The “Value Propositions” to industry for implementing PAO:TO at the highest level are relatively simple and as illustrated in Figure 5, technical operations businesses typically look to the categories of:

- Improving *Safety, Quality and Compliance*,
- While improving *Cost*,
- Through improving the *Time* taken to perform the required activity.

While Safety, Quality, Compliance and Cost are self-evident categories, Time can include many aspects:

- Aircraft Availability at the right **TIME** to meet the operating schedule
- Turnaround **TIME** – Maintenance Events, Repair Cycles
- Process **TIME**
- Response **TIME**

PAO:TO enables many value propositions under these categories and examples are provided within this Guidance Material for use in developing business plans.

The **value propositions** enabled by Paperless Operations are many...

There are challenges to overcome for those that embark on their paperless journeys. The positive news is that already there is success with organizations who have put the structure, people, processes and data in place in a way that satisfies key stakeholders of their ability to implement and deliver on paperless operations.

There are aviation industry imperatives that will drive organizations to implementing paperless operations. OEMs for example are already delivering paperless capable aircraft (B787, A350 etc) and are moving to paperless channels for the provision of approved support data (Manuals, ADs, SBs, MPD updates, Repair Approvals, etc).

More broadly, industry and commerce in general is moving towards paperless or e-Commerce systems. So, it’s not a matter of “if”, but more a matter of “when”, paperless operations will be the only option and legacy paper-based systems will not be acceptable.

By going paperless, you have the opportunity of assisting IATA in shaping the PAO:TO requirements and taking an industry-leading position.



So, what is the **Value Proposition** for Implementing PAO:TO?

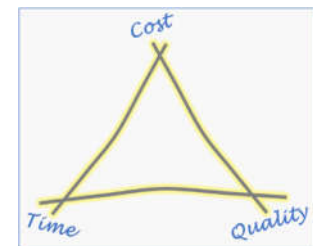


Figure 5: “The Golden Triangle”: Cost, Quality, Time

OEMs are already delivering paperless capable aircraft...

... it’s not a matter of “if” but more a matter of “when” ...

3 How to Proceed

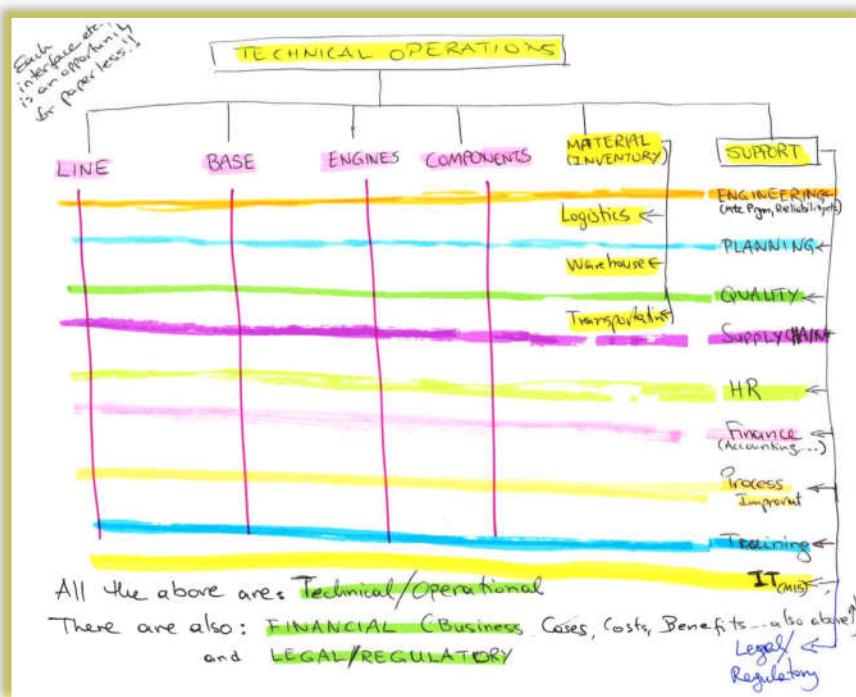
3.1 First Steps

An initial step in determining the way forward for PAO:TO is to understand the requirements of internal business plans. These will vary across organizations but in general will have similar requirements for articulating the required justification for initiating a PAO:TO implementation project.

Organizations who are already well advanced in their PAO:TO journeys offer similar tips for successful implementation. These typically are:

- Form a dedicated project team
- Engage early and often with your:
 - Internal Business Subject Matter Experts
 - Internal Training Department
 - Civil Aviation Authority
 - Technology Providers
 - Lessors
 - OEMs, and
 - Other suppliers (MROs, parts providers etc.)
- Form relationships with like-minded airlines and learn from each other (benchmarking)
- Test, Test, and Test again prior to going live

Figure 6 is taken from an internal IATA brainstorm and from this, the interfaces can be identified where PAO:TO implementation can provide value propositions for inclusion in business plans. Brainstorming such as this can form the beginnings of a PAO:TO business plan.



An IATA internal brainstorm illustrated here, identifies many of the interfaces across the Technical Operations value-streams which present paperless opportunities.

Figure 6: Interfaces & Paperless Opportunities

Justification of any business plan begins with the forecast costs and benefit to the organization before deciding whether to invest – ie:

- What is the Value Proposition?
- Why should this investment be approved?
- What is the timeframe for implementation
- Who needs to be involved and at what stage?
- etc.



Section 15 “Value Propositions – Implementation of PAO:TO”, provides value proposition examples, metric examples and how they may be measured, can be reviewed and adapted into business plans as required. Analysis can also consider the value propositions associated with potential future innovations enabled by implementing fully paperless systems.

Following are topics for consideration when developing concepts, business plans, and implementation project plans for PAO:TO.

3.2 Enabling Technology

The enabling technology is important, and businesses will need to make their own choices as to the most appropriate aviation technical management system for their needs. By searching the websites of various technology providers, key functions can be found that need to be considered when choosing a system for PAO:TO implementation.

Typical functions and features to consider in business plans are listed in Table 1.

Enabling Technology Functions for consideration	
1. Web enabled	13. Security – Encryption of Data and Signatures
2. Paperless ready	14. Scalable (business growth)
3. Electronic Signature	15. Seamless connectivity and transition/migration of data between platforms
4. Electronic Logbook	16. Interoperability across/between:
5. Mobile/PED Access	a. States (Countries)
6. Controlled Access	b. Organizations
7. Accessibility - Real-Time	c. Company Departments
8. Accessibility Point-of-Use	17. Adaptable to new technology innovations
9. Audit Trails	18. Backup/Disaster Recovery
10. RFID	19. Ability to work off-line
11. Conformance - Applicable Standards	
12. Conformance – Applicable Legal requirements	

Table 1: Typical Technology Functions for Paperless Operations

3.2.1 RFID

Adoption of RFID will assist with the implementation of PAO:TO.

IATA chairs an RFID Interest Group and further information is available from IATA conference presentations and industry white papers. These can be downloaded as required from the IATA website on;

<http://www.iata.org/whatwedo/ops-infra/Pages/paperless-ops.aspx>.



RFID (and other Auto-ID related technologies such as bar code) has the potential to provide numerous opportunities for improving efficiencies in aircraft maintenance and airline supply chain and logistics.

This RFID Snapshot from the IATA Roadmap (see Figure 2), shows that RFID cuts across many of the areas that are potential Value Propositions – these are highlighted in red text.

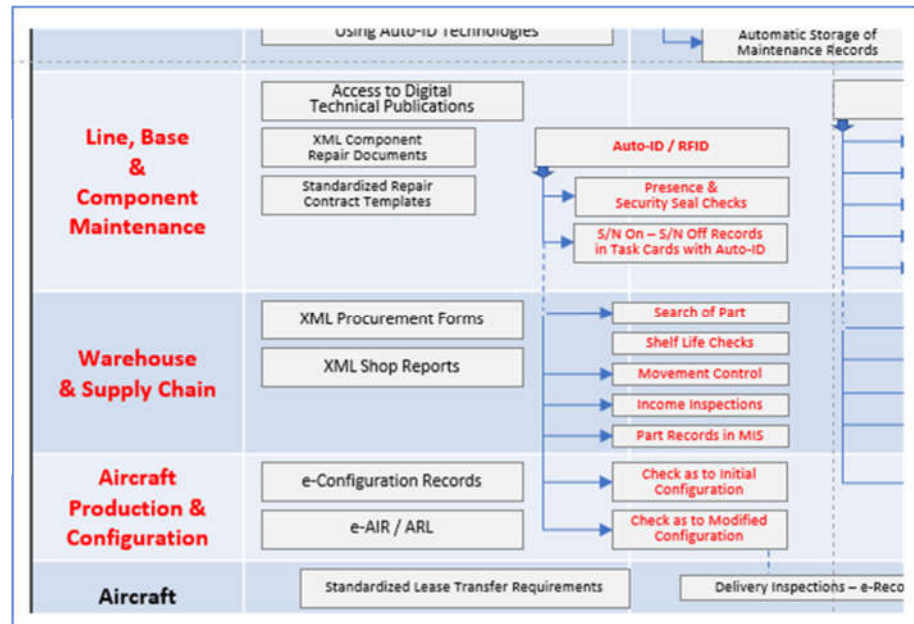


Figure 7: IATA Roadmap - RFID Snapshot

3.2.2 eSignature

eSignature will also assist in the effective implementation of PAO:TO and it cuts across many aspects of the IATA Roadmap.

Currently, a number of organizations are using various forms of e-signature. These are mainly to facilitate internal processes and tasks. To our knowledge, to this date no organizations are using e-signature to transfer regulated documents electronically (such as EASA or TC Form 1, FAA 8130-3 etc.). Note that these forms do exist in a digital standard under Spec 2000 (<http://www.spec2000.com>).

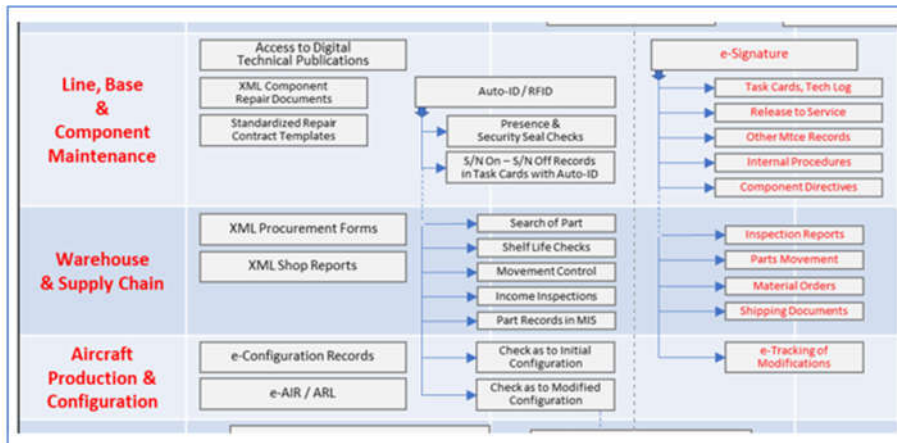


Figure 8: IATA Roadmap - eSignature Snapshot

This eSignature Snapshot from the IATA Roadmap (see Figure 2), shows areas for consideration in the development of Value Propositions – these are highlighted in red text.

As with RFID, further information is available from IATA conference presentations and industry white papers. These can be downloaded as necessary from the IATA website on: <http://www.iata.org/whatwedo/ops-infra/Pages/paperless-ops.aspx>.



3.2.3 Mobile Technology

Mobile technology via tablets is also being rolled out by organizations as a part of PAO:TO which allows maintenance and engineering personnel to have on-line access to all pertinent data and manuals, as well as the ability to perform electronic sign-offs and certifications.

Organizations need to make their own choices as to which system to adopt. Already there are several options being used including:

1. Distributing tablets or other devices to applicable personnel for both business and personal use. Updates are typically pushed when connected to wifi.
2. Tablets only being available when on shift where they are checked-out from docking stations where updates are downloaded, and batteries charged.



When using these mobile systems, data upload/download transmission costs may increase, particularly if 3G/4G cards are used and this needs to be considered in any business case.

3.2.4 Mobile Technology Innovation

When developing business cases/plans, consider the innovations of one airline with mobile technology. Within their Line Maintenance transit and overnight environments, plans are in place to push information to tablets for engineers/mechanics.

Mobile Technology Initiatives

Consider how the following initiatives can be adapted into Base Maintenance, CAMO, Leasing Activities and other parts of engineering and maintenance to improve the “Cost, Quality & Turn-time” equation.

1. Arrival/Departure Information
 - Scheduled/Estimated Time of Arrival (STA/ETA)
 - Arrival Gate
 - Scheduled/Estimated Time of Departure (STD/ETD)
 - Fuel Loads
 - Number of outbound passengers
 - Ground Support requirements (Ground Power, Airstart, etc)
 - Tow-on/Tow-off requirements
2. Defect Information
 - Inbound defect notification
 - Repetitive Inspection requirements
 - MEL application
3. Support Mechanisms
 - Electronic Manuals (OEM and Operator Specific)
 - Remote connectivity with Maintenance Operations (MOC), Engineering and other peer support using mechanisms such as Skype and Facetime
 - Access to training videos if more information is required as to “how” to address a defect
4. Alerts
 - The proposed system collects information from various sources
 - The information is consolidated onto a single platform
 - The system then pushes alerts for any changes to requirements (Gates, Fuel, ETA, ETD, Passengers, Defects, MELs, Towing, etc)
 - All the above enhances efficiency as information is provided via alerts and pushed, rather than having to spend time to gather the information (and updates) from multiple sources
5. Productivity Efficiencies during Maintenance Events
 - The proposed system will bring all required tasks together and pushed to assigned tablets for execution of those tasks by assigned engineers/mechanics. Individuals are to be automatically checked for compliance with training, license certifications and other limitations
 - Tasks will be acquitted and signed-off via electronic signature
 - Auto-demands on Rotables and other required parts (Repairables, expendables and consumables) will be made
 - Push notifications will advise of tooling and test equipment availability and location

An industry technology provider is working on developing an app solution to connect all the various departments involved with daily operations in order to synchronize their communications and activities prior to push back of the aircraft.

3.3 Civil Aviation Authority Approval

Civil Aviation Authority approval is necessary prior to implementing PAO:TO. Unfortunately, there are voids in regulations in many regulatory environments.

IATA is working with the ICAO Airworthiness Panel ...

IATA is working with the ICAO Airworthiness Panel (AIRP) in developing recommendations for criteria to be considered in the development and/or adoption of Electronic Aircraft Maintenance Records (EAMR). These criteria should ensure a globally harmonized approach of the regulations governing EAMR.² Release of these recommendations is expected by mid-November 2017.



3.3.1 IATA Electronic Signature & Record Keeping Regulatory Checklist

Several Aviation Authorities have published Guidance Material supporting the use of PAO:TO.

IATA has taken some of these and developed an “Electronic Signature & Record Keeping Regulatory Checklist” tool that is available for download¹ and will assist organizations in setting themselves up for the implementation of PAO:TO. Search functionality and hyperlinks within the tool allow searching for key words as applicable to each authority so that comparisons can be made.

Details of where to download the checklist and how to use it can be found in Annex B. Table 2 below identifies the sources of the material used as the basis of the Checklist – noting that while the format and the language used within these source materials varies, the intent of each is essentially the same.

Aviation Authority	Source Material	Description
FAA	AC 120-78A	Electronic Signatures, Electronic Recordkeeping, and Electronic Manuals
Transport Canada	AC 571-006	Electronic Signatures and Electronic Exchange of the Authorized Release Certificate – Form One
CASA	AC 11-3(1)	Electronically Formatted Certifications, Records & Management Systems
EASA	AMC Appendix II to Part-M para 2	Electronic Signature and Electronic Exchange of the EASA Form 1

Table 2: IATA Electronic Signature & Record Keeping Regulatory Checklist Sources

With EASA, the material available within a consolidated advisory circular (or equivalent) is limited. For organizations operating within the EASA regulatory environment, consideration of compliance to broader EU Regulation pertaining to e-Business and Electronic Signatures may be required.

The Checklist takes the source documents and from them, questionnaires have been developed. Satisfactory completion of the checklist/questionnaire, provides the basis for companies to submit detailed applications to their Aviation Authority for review and approval decisions relating to PAO:TO.

Anecdotally, utilizing the guidance provided by the FAA has satisfied the requirements for approval by other authorities.

IMPORTANT: Refer to IATA Disclaimer on Page ii.

² ICAO Airworthiness Panel, Job-Card AIRP.009.01.EAMR

3.4 The Importance of Standards

The International Organization for Standardization (ISO) provides detailed material on the benefits of standards.

“... the private and public sector... see standardization as directly linked to their core business strategy. Some approach standardization in a highly organized way and have a clear perception of the impact of standards on their activities and performance. Most... realize that standards bring benefits to their organization...”³

“Standards provide people and organizations with a basis for mutual understanding, and are used as tools to facilitate communication, measurement, commerce and manufacturing.

Standards are everywhere and play an important role in the economy, by:

- facilitating business interaction
- enabling companies to comply with relevant laws and regulations
- speeding up the introduction of innovative products to market
- providing interoperability between new and existing products, services and processes.

Standards form the basis for the introduction of new technologies and innovations, and ensure that products, components and services supplied by different companies will be mutually compatible.

Standards also disseminate knowledge in industries where products and processes supplied by various providers must interact with one another. Standardization is a voluntary cooperation among industry, consumers, public authorities, researchers and other interested parties for the development of technical specifications based on consensus.”⁴

In the absence of standards significant inefficiencies occur. They arise from manual work that has to be done in order to transfer data and information from one system's format to another (including paper, scanned documents or simple copy-paste). In certain cases, "translators" exist to facilitate the data transfer between IT systems. These translators may improve processes; however certain inconveniences and inefficiencies remain.

³ Isoorg. [Online]. [14 September 2017]. Available from: https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/ebs_plan_studies_factsheets.pdf
In-text citation: (Isoorg, 2017)

⁴ Cencenelecu. [Online]. [14 September 2017]. Available from: <https://www.cencenelec.eu/research/tools/ImportanceENs/Pages/default.aspx>
In-text citation: (Cencenelecu, 2017)

3.4.1 ISO Standards Impact Map

ISO provide a Methodology Toolbox⁵ where various methodologies, templates and plan studies can be sourced and considered for use in PAO:TO business plans. For example; a “Standards Impact Map” can be downloaded.

Table 3 provides an adaptation to aviation.

ISO Standards Impact Map (<i>Adaptation of extract</i>)			
Functions	Activities	Impacts	Description
Production/ Operations	All activities	Better internal information transfer	Using standardized documents and specifications makes passing on internal information about products and services more efficient
		Better training of personnel	Production/Operations staff can be trained better because relevant specifications are standardized, for both products and services
		More efficient processing	Due to the reduced number of types of non-standardized products, Production/ Operations can become more efficient
	Processing	More efficient work flow	Work flows are more efficient due to standardized architecture
		Better quality of equipment and supplies	Higher quality of equipment and supplies based on standards reduces the failure rate and related correction costs
	Quality Assurance	Better quality management	Quality management based on standards can be implemented more effectively
	Regulatory & Airworthiness Compliance	Reduced disadvantages from regulations	Influence in standard-setting process helps to reduce disadvantages from regulations
		Improved compliance	Compliance management based on standards can be implemented more effectively

Table 3: Adaptation of Extract - ISO Standards Impact Map

⁵ Isoorg. [Online]. [14 September 2017]. Available from: <http://isotc.iso.org/livelink/livelink?func=I>. In-text citation: (Isoorg, 2017)

3.4.2 ATA e-Business Standards

The development and implementation of PAO:TO should be in accordance with standards to ensure on-going alignment across the aviation industry.



Standards applicable to PAO:TO can be sourced and reviewed via the ATA e-Business Program website.

A listing of these is shown in Table 4 - noting that not all are applicable to PAO:TO⁶.

Standards	Chapter	Description	Standards	Chapter	Description
CSDD	-	Common Support Data Dictionary	Spec 101	-	Ground Equipment Technical Data
iSpec 2200 Extract	-	ATA Standard Numbering System	iSpec 2200	-	Information Standards for Aviation Maintenance
S1000BR	-	Civil Aviation S1000D Business Rules	S1000D	-	International Specification for Technical Publications
S2000	1	Provisioning	S2000	2	Procurement Planning
S2000	3, 4, 6	Materiel Management	S2000	5	Information and Data Exchange
S2000	7	Repair Order Administration	S2000	8	Repair/Overhaul Planning
S2000	9	Automated Identification and Data Capture	S2000	10	ASC X12 Implementation Guide
S2000	11	Reliability Data Collection and Exchange	S2000	12	Airline Inventory Redistribution System – AIRS
S2000	13	Industry Metrics	S2000	14	Warranty Claims
S2000	15	Aircraft Transfer Parts List	S2000	16	Authorized Release Certificate
S2000	17	Electronic Logbook	S2300	-	Data Exchange Standard for Flight Operations
S2500	-	Aircraft Transfer Records	Spec42	-	Aviation Industry Standards for Digital Information Security
WASG	-	World Airlines and Suppliers Guide	Spec 100	-	Manufacturers Technical Data

Table 4: ATA e-Business Program Standards

⁶ Ataebizorg. [Online]. [14 September 2017]. Available from: <http://www.ataebiz.org/Pages/standards.aspx>. In-text citation: (Ataebizorg, 2017)

4 Value Propositions – Implementation of PAO:TO

Organizations have their own policies and procedures for the preparation and approval of business plans which may vary to some degree. As requirements for going paperless can require significant investment, this Guidance Material suggests what can be considered when determining the cost/benefit or value propositions for implementing paperless operations.

Each of the value propositions included has tables that identify metrics that can be used for setting targets and for tracking performance. These are provided from industry research and from our stakeholders who have embarked on their own paperless journeys.



Consideration will need to be given as to how the metrics are adapted by users for their own purposes.

Commercially sensitive information is not included...

Commercially sensitive information is not included within this document. If actual hard detail is required for your paperless operations business plans, you may need to arrange bi-lateral agreements with other organizations and ensure your compliance with policies and legal requirements for the exchange of business sensitive information.

4.1 Safety, Quality and Compliance

Safety, Quality and Airworthiness Compliance can be key drivers of value propositions derived from paperless operations.

The transfer of paper-based records to and from maintenance information systems and other data bases, can engender an environment whereby human error can occur in the transactions and lead to errors in configuration control and airworthiness compliance.

Examples could include:

- AD non-compliance
- Incorrect parts fitted
- Inspections not carried out at required intervals
- Parts not changed at required intervals
- Work not performed by properly licensed/certified mechanics/engineers



If these examples are identified within an airline's operation, the business plan for PAO:TO could be premised on non-financial aspects such as Airworthiness Compliance.

4.1.1 Safety, Quality & Compliance Metrics

Metrics that could be considered in the compliance and safety aspects of a business plan can include the examples provided in Table 5.

Safety, Quality & Compliance Key Result Areas	Measures
Enforced workflow compliance	<ul style="list-style-type: none"> Reduction in number of missing or unsigned records (Technical Logs, Task Cards, etc) Forced data entry of mandatory fields in electronic documents
Correct MEL Usage	<ul style="list-style-type: none"> Reduction in number of incorrectly applied MELs
Accurate Signature Capture (eSignature)	<ul style="list-style-type: none"> Reduced effort in correcting errors
Enhanced Auditing (Internal & External)	<ul style="list-style-type: none"> Improvements in tagging of approved data and records Improvements in audit trail generation Reduced auditing times Reduced auditing personnel
Error Reduction	<ul style="list-style-type: none"> Reduction in re-works due to manual transactional errors Reduction in maintenance errors
Access to real-time aircraft configuration data (IPC / Mask / software and parts configuration data)	<ul style="list-style-type: none"> Enhanced configuration management and control Reduction in maintenance errors arising from incorrect configuration Reduce the likelihood of human error incidents affected by timely access to approved data was a contributing factor Auto reporting of configuration changes to the OEM for automated manual revision
Alignment with Industry Standards	<ul style="list-style-type: none"> Reduction in auditing and compliance effort required to align across Business, Organizational, and Aviation Authority environments
Timely and effective promulgation of safety and other alerts	<ul style="list-style-type: none"> Promulgation of alerts to all personnel Reduction in time between promulgation and return receipt

Table 5: Safety, Quality and Compliance Safety Metrics

4.2 Operational Performance

On-Time Performance (OTP) is one of the primary key metrics for an airline. Anything that technical divisions can do to better support operational scheduling of airline fleets need to be key considerations of PAO:TO business plans.



4.2.1 On-Time Performance Metrics

Metrics that could be considered in the on-time performance aspects of a business plan can include the following categories identified in Table 6.

OTP Key Result Areas	Measures
Reduction in number of maintenance deferrals	<ul style="list-style-type: none"> Reduction in number of maintenance deferrals
Reduction in number of maintenance related delays	<ul style="list-style-type: none"> Reduction in number of maintenance delays
No requirement for manual log entries	<ul style="list-style-type: none"> Elimination of data entry errors
Improved identification of repetitive defects	<ul style="list-style-type: none"> Reduction in repetitive defects Reduction in rework
Improved quality of data entry from outstations where English is not first language	<ul style="list-style-type: none"> Reduction in rework
Improved access to aircraft and fleet in-service data	<ul style="list-style-type: none"> Improvement in first-time fix rate and reduction in deferrals

Table 6: On-Time Performance Metrics

4.3 Financial Considerations

Each organization will have its own financial policies for the development of business plans. Typically, each business plan will be required to forecast Return on Investment (ROI) and to provide a positive return within a period which is commensurate with the size of the required capital investment.



Table 7 below identifies typical capital investment and operating expense categories.

Capital Investment Categories	Operating Expense Categories
<ul style="list-style-type: none"> • Infrastructure • Hardware and Software • Initial Training • Regulatory Approval and Compliance • Transition (from paper systems) and, • Implementation costs 	<ul style="list-style-type: none"> • License Fees • Data Transmission • On-going training • Updates and upgrades to equipment and software • System maintenance fees • Labor related costs • Materials consumed (if applicable)

Table 7: Cost Categories

The business plan should identify categories applicable to each organization and provide forecasts and ROIs based on objective data as available. To calculate the ROI, the financial benefit needs to be determined, and for paperless operations this will generally be through improved efficiencies that will translate into cost savings.

Value propositions also include categories that appear to be other than financial, however successful implementation of non-financial aspects can eventually flow through and have an impact on financial results. For example, airworthiness enhancements through paperless operations may directly relate to improved safety and compliance which can be used as a non-financial benefit within the business plan. However, these enhancements may lead to reductions in rework and other efficiencies that will translate directly to the bottom line.

Improved safety and compliance can translate directly to the bottom line.....

There will be increases in some costs which should be considered (eg: data transmission), some of which are identified within this Guidance Material.

4.3.1 Cost Reduction Metrics

Metrics that could be considered in the cost reduction aspects of a business plan include those in Table 8.

Cost Reduction Key Result Areas	Measures
Reductions in purchasing of stock required to support paper-based systems - such as forms, log books, task cards, manuals, etc	<ul style="list-style-type: none"> • Variance in before and after paper purchase costs
Error reduction (rework) driven by paper-based transactions when entering paper-based records into data bases	<ul style="list-style-type: none"> • Variance in before and after labour cost attributed to re-work
Savings associated with historical records retrieval	<ul style="list-style-type: none"> • Variance in before and after labour cost attributed to records retrieval
Savings associated with new aircraft introductions	<ul style="list-style-type: none"> • Variance in before and after labour cost attributed to aircraft introductions
Savings associated with processing of records at end-of-life (sale, disposal, end-of-lease, re-delivery)	<ul style="list-style-type: none"> • Variance in before and after labour cost attributed to aircraft disposal or re-delivery
Savings associated with annual airworthiness reviews	<ul style="list-style-type: none"> • Variance in before and after labour cost attributed to annual airworthiness reviews
Savings associated with effective management of airworthiness configuration and compliance reviews	<ul style="list-style-type: none"> • Variance in before and after labour cost attributed to airworthiness requirements
Savings associated with the reduction in paper usage by storing records electronically	<ul style="list-style-type: none"> • Reduction in: <ul style="list-style-type: none"> ○ volume of hard-copy records ○ archiving and storage costs ○ record retrieval costs ○ record search costs
Enhanced corporate reputation	<ul style="list-style-type: none"> • Political, environmental and customer satisfaction at adoption of carbon reduction strategies
Cost associated with non-compliances	<ul style="list-style-type: none"> • Avoidance of CAA penalties • Avoidance of difficult to measure damage to brand and company image

Table 8: Cost Reduction Metrics



4.3.2 Cost Increases

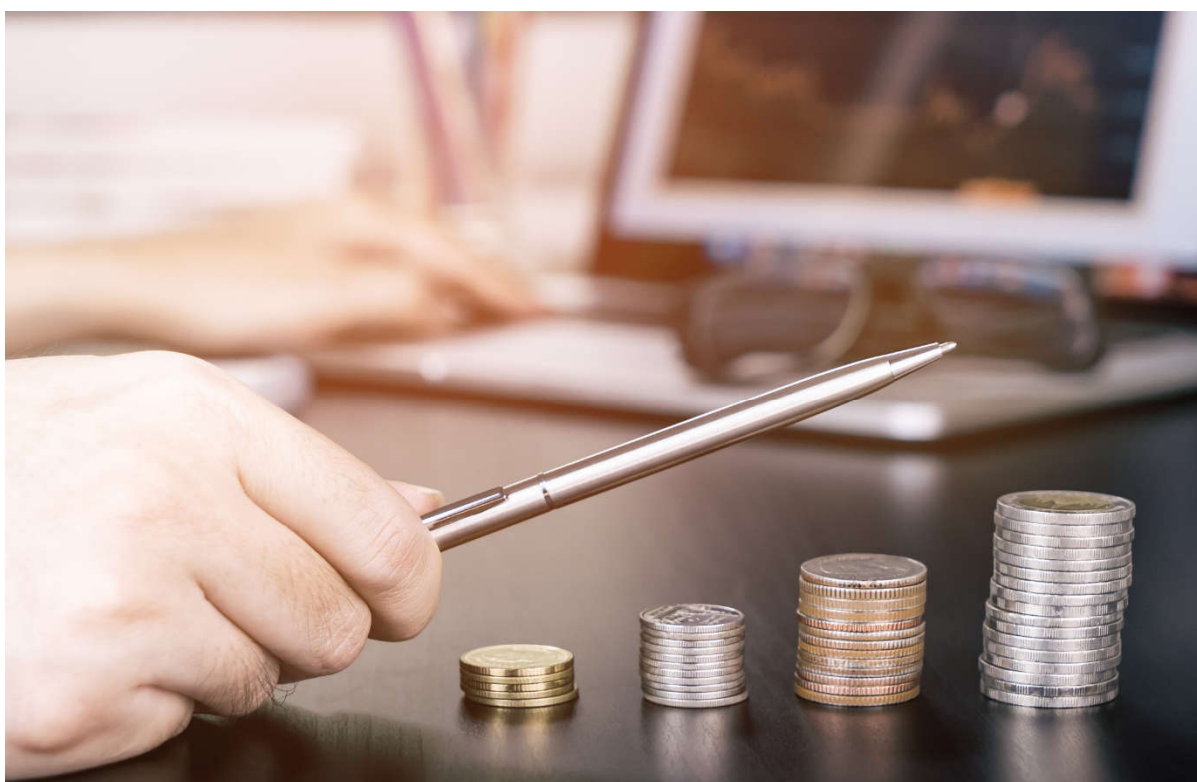
There will be areas where costs will increase, either as a one-off or in annual operating expenses. The value proposition derived from paperless operations should outweigh these cost increases and where appropriate, it is suggested that notes to this effect be included in relevant sections of business plans and in annual budget builds.

Some costs will increase...

Metrics that could be considered in areas where costs may increase are shown in Table 9.

Areas of Cost Increase	Why
Data transmission costs	<ul style="list-style-type: none"> • Paperless operations require the electronic transmission of data over satellite, Wi-Fi, and telecommunication networks (4G etc). • Commensurate with the amount of data increases there may be corresponding increases in the costs associated with carrying that data, which should be quantified and identified within business plans.
IT Infrastructure	<ul style="list-style-type: none"> • Investment may be required in IT infrastructure to support PAO:TO

Table 9: Areas of Cost Increase



4.4 Maintenance & Engineering

Maintenance and Engineering cuts across many aspects of the IATA Roadmap as highlighted in red text in Figure 9. Each of these can be explored for potential Value Propositions within organizational business plans

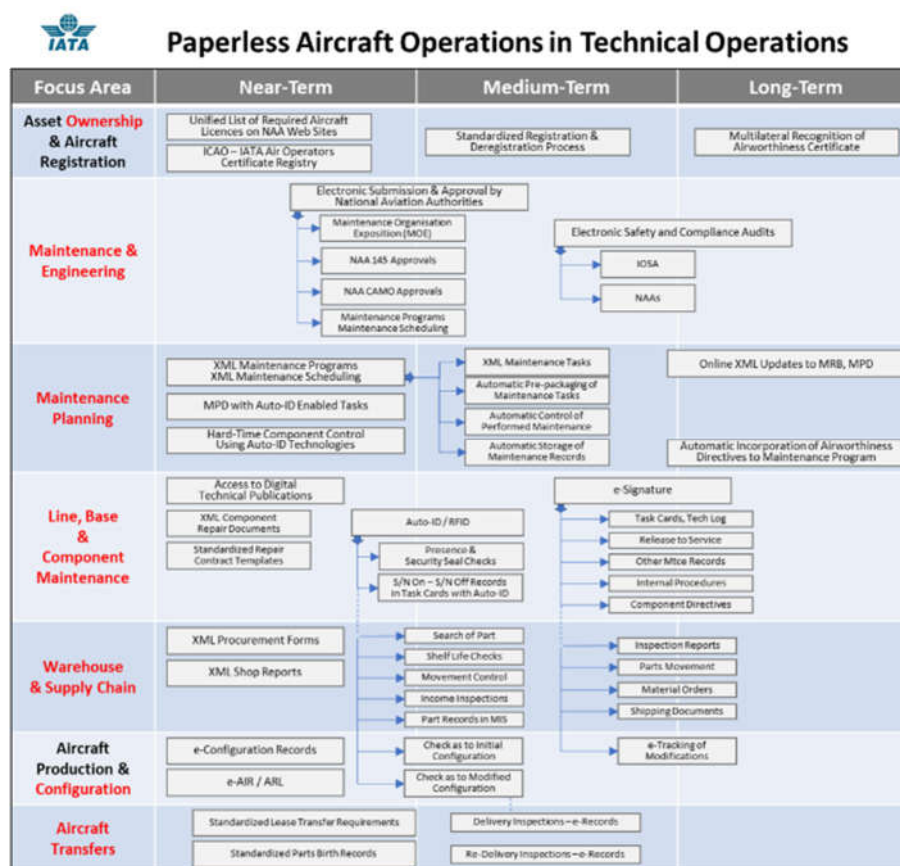


Figure 9: IATA Roadmap - Maintenance & Engineering Aspects

Many of these functions have interfaces with: OEMs, Lessors, MROs, Parts Providers and Logistics organizations.

There are value propositions in maintenance and engineering to be had through the introduction of Paperless Operations which include:

- Optimized integration between engineering, maintenance and operations
- Real-time visibility of aircraft performance
- Real-time tracking and reporting of aircraft status
- Real-time monitoring of airworthiness compliance
- Real-time record keeping (for regulatory compliance and contractual requirements)
- Visibility of maintenance task and work order progress against plan
- Quick and easy access to:
 - Real-time fleet data
 - Defect reporting and history
 - Approved data (Manuals, SBs, Task Cards etc)
 - Troubleshooting information
- Increased data accuracy and integrity – supporting informed decision-making

4.4.1 Production Control Metrics

Effective paperless operations will provide optimization of production control through real time visibility and driving of accountabilities. There are savings on paper, but this may be the smallest of the value propositions when compared with increases in productivity associated with access to real-time data and information required to support the required maintenance activity.

Metrics that could be considered in Production Control are shown in Table 10.

Production Control Key Result Areas	Measures
Workflow Optimization	<ul style="list-style-type: none"> • Improved task card completion rates • Optimal utilization of manpower • Reduced aircraft downtime • Reduced labor costs per check • Real time data capture • Improved quality through data-driven process improvement
Real Time Visibility	<ul style="list-style-type: none"> • Measures for visibility of: <ul style="list-style-type: none"> ○ Labor and Skill Mixes ○ Work Loads ○ Work in Progress

Table 10: Production Control Metrics

4.4.2 Productivity

Labour productivity is defined as real value added per hour worked.⁷

In many plans, undue delays in productivity are a direct result of paper-based systems whereby records can be misplaced or destroyed. Some of the biggest productivity bottlenecks involve duplicate data whereby having more than one system in place can create unnecessary data storage that adds to the time and cost required to support business operations.

Productivity value propositions can be derived throughout the aviation maintenance and engineering value-stream with the implementation of PAO:TO. In general, it can minimize the effort required to organize, manage, and access information and to facilitate agility, when responding to operational needs through quick access to the information needed for making decisions.

Speaking about EasyJet’s Stream paperless engineering project, Swaran Sidhu, head of fleet technical management at the airline, says that it has allowed EasyJet to “develop process-driven workflows that have supported growth of the fleet from 166 aircraft in 2010 to 248 aircraft in 2016, with no associated increase in direct headcount within the records department.”⁸

As adapted from ICT (Information, Communications and Technology) papers, examples follow of product, process and organizational innovation enabled by paperless technical operations.

There are many gains to be made in cost and effectiveness dimensions such as accuracy, timeliness, sophistication, storage, access and transmission. Companies can also use paperless technologies as a platform for their own innovations.



⁷ Doiorg. [Online]. [14 September 2017]. Available from: <http://dx.doi.org/10.1787/pdty-2016-en>. In-text citation: (Doiorg, 2017)

⁸ MRO Network. [Online]. [14 September 2017]. Available from: <http://www.mro-network.com/maintenance-repair-overhaul/easyjet-s-next-steps-toward-paperless-maintenance-environment>. In-text citation: (Mro-networkcom, 2016)

The possible user innovations are innumerable and following, are a few illustrative examples.

Product Innovation

- Development of more information-hungry products
- Customization of products to different customer requirements, through closer contact with customers and greater production flexibility
- Service packages enabled by easier access to more comprehensive information
- Greater convenience in purchasing through lower electronic transactions costs

Process innovation

- Improved quality, efficiency and timeliness of production, through better monitoring and quality control and improved management information that identifies scope for, and enables 're-engineering' of processes
- Reduction in inventories and waste, through better coordination with suppliers and customers, less uncertainty about demand and quality control
- More efficient scheduling of maintenance, through better diagnostics, ease of monitoring and optimization of timing and nature of maintenance tasks.

Organizational innovation

- Changes to horizontal and vertical integration (with outsourcing enabling gains from specialization), through easier and better coordination of activities
- Flatter hierarchies, because of better internal information and communication flows and greater ease of monitoring and coordination
- More active teamwork and decentralized responsibility, because objectives can be defined on a micro scale, feedback on performance can be given quickly if not in real time and incentives can be readily aligned with the performance of individual teams

4.4.3 Productivity Metrics

Metrics that can be considered in the development of a PAO:TO business plan are shown Table 11.

Productivity Key Result Areas	Measures
Improved Workflows	<ul style="list-style-type: none"> • Measure improvements in workflow attributable to the implementation of electronic workflow management systems
Paperwork Returns	<ul style="list-style-type: none"> • Measure timeliness, availability and quality of paperwork returns
Non-Value-Added Time	<ul style="list-style-type: none"> • Measure lower costs through reduced non-valued added time
End-of-Lease	<ul style="list-style-type: none"> • Measure speedier end-of-lease process in terms of timely return of aircraft
Remote Access	<ul style="list-style-type: none"> • Measure improvements attributable to remote access functionality relating to: <ul style="list-style-type: none"> ○ Lead Times ○ Response Times ○ Turnaround Times ○ AOG Responses ○ Repair Approvals ○ Record Search ○ Remote inspections and related real cost savings
On-demand Access	<ul style="list-style-type: none"> • Measure improvements attributable to on-demand access functionality relating to: <ul style="list-style-type: none"> ○ Digitized and Indexed Information ○ Validation of Airworthiness Records (Configuration and Compliance) ○ Resolution of Operational and Airworthiness Issues ○ Proactive Planning ○ Accomplishment of Maintenance ○ Enhanced internal and external business communications
e-Signature	<ul style="list-style-type: none"> • Measure improvements attributable to e-Signature functionality relating to for example: <ul style="list-style-type: none"> ○ volume reduction of the amount of paperwork ○ greater labour productivity and reduction in associated unit costs

Table 11: Productivity Metrics

4.5 Warranty & Performance Guarantee

Typically, warranties associated with the performance and maintenance of aircraft, engines, and components are set up on a contractual basis with the OEMs and other suppliers.

This is an area of much discussion within the industry, where generally it is accepted that cost offsets through warranty and performance guarantee recoveries can be significant. However, the difficulty of tracking and claiming on warrantable events can be also significant, particularly with paper-based systems.

The implementation of paperless systems may enhance the tracking and recovery of costs associated with warrantable events and performance guarantees.

This will add significant value when applied to warranties outside the initial aircraft warranty period (a period usually well monitored by operators).



4.5.1 Warranty & Performance Guarantee Metrics

Warranty and performance guarantee metrics that can be considered in the development of a PAO:TO business plan are shown in Table 12.⁹

Warranty Key Result Areas	Measures
Use of data to improve ability to identify and support warranty and performance guarantee claims	<ul style="list-style-type: none"> Improvement in the number of successful warranty and performance guarantee claims Reduction in number of required warranty personnel
Average Warranty claim response time	<ul style="list-style-type: none"> Improvements in the “Average time warranty claim is processed (accepted, denied or rejected) by warrantor in calendar days over a mutually agreed period)”
First time claim resolution rate	<ul style="list-style-type: none"> Improvements in the percentage of claims resolved by warrantor in initial response – Plot the percentage of new warranty claims that are completed on initial submittal
Disputed claims response time	<ul style="list-style-type: none"> Improvements in the processing time by a warrantor of a disputed claim – Plot the number of days required to complete the resolution of disputed claims
Warranty claim return rate	<ul style="list-style-type: none"> Improvements in the percentage of claims that are Returned due to invalid or incomplete data to identify process issues at claimant – Plot the percentage of warranty claims that are returned without action because of incomplete information or invalid content

Table 12: Warranty & Performance Guarantee Metrics

⁹ Spec2000com. [Online]. [14 September 2017]. Available from: <http://www.spec2000.com/presentations/georget.pdf>. In-text citation: (Spec2000com, 2017)

4.6 Customers (internal & external)

Each organization has both internal and external customers. An internal customer can be a co-worker, another department, or even a third party such as a supplier within each organization's value stream.

Each organization has both internal and external customers...

External customers however are those who provide revenue (eg: the flying passenger) and if they are not satisfied then they can take their business elsewhere. Accordingly, positive customer satisfaction scores generally lead to customer retention/repeat business. Engineering and Maintenance organizations within the PAO:TO value-stream can play a key role here through the provision of:

- Safe, clean and reliable aircraft
- Maintained to the right standards and
- Provided to the operation on time to meet the published schedules.



4.7 Record Storage & Environment

Paper based systems in business generally (not just aviation) are of concern, not only in terms of productivity, efficiencies, paper consumption, storage and archiving costs, but also of environmental impact. The following provides statistics for the USA and the UK but potentially are typical of what occurs in other countries around the world.



4.7.1 The Paperless Project - Statistics

“The environmental impact of paper is largely significant. Due to our history of voluminous paper consumption, serious efforts are needed to ensure that the environment is protected. The past is gone, but we still have time to change our future. With the use of modern technology such as document management software, electronic forms creators and mobile devices, we can drastically reduce our dependence on paper.”¹⁰

Consider the following statistics¹⁰ from the Paperless Project which drive paper consumption in offices within the USA.

- The average office worker continues to use a staggering 10,000 sheets of copy paper every year. 10,000 sheets per year printed
- 45% of the paper printed in offices ends up trashed by the end of the day – this daily lifespan occurs for over a trillion sheets of paper per year, worldwide. 45% of printed copy has a 1-day lifespan
- In the U.S., companies spend more than \$120 billion a year on printed forms, most of which outdate themselves within three months’ time.
- A typical employee spends 30-40% of his time looking for information locked in email and filing cabinets. Office paper growth @ 22% per year
- The average document is copied 9 to 11 times and every 12 filing cabinets require an additional employee to maintain.
- Each four-drawer file cabinet holds an average of 10,000 to 12,000 documents, takes up to 9 square feet of floor space and costs \$1,500 per year.
- Each misfiled document costs \$125. Each lost document cost \$350 to \$700 – large organizations lose a document every 12 seconds.
- More than 70% of today’s businesses would fail within three weeks if they suffered a catastrophic loss of paper-based records due to fire or flood.
- Paper in the average business grows by 22% a year, meaning your paper will double in 3.3 years

¹⁰ Thepaperlessprojectcom. [Online]. [14 September 2017]. Available from: <http://www.thepaperlessproject.com/facts-about-paper-the-impact-of-consumption/>. In-text citation: (Thepaperlessprojectcom, 2017)

4.7.2 YouGov UK - Statistics

“The survey amongst business leaders, which investigates British business practices regarding the use of paper, printing and signatures in the workplace, finds that 84% of UK businesses print documents just to get them signed while 62% print additional copies just for the purpose of obtaining “wet” signatures.”¹¹

Consider the following statistics¹¹ from YouGove which drive paper consumption in offices in the UK.

- 89% of medium-sized and 83% of large organizations print documents just to get them signed.
- 72% of UK businesses who print documents say processes are delayed because of the need to collect signatures
- 24% of large organizations who print documents lose more than one day per transaction just to collect signatures

4.7.3 Aviation Paper Records - Statistics

“If there is one trend that is making headline after headline in the past few years, that is going green. We are all concerned with the well-being of our planet... You can reduce your carbon footprint by a landslide just by going paperless. Your company becomes greener, and your reputation goes up”¹²

Organizations within the aviation maintenance and engineering value-streams have similar problems to those in other sectors regarding usage and storage of paper-based records.

Take the following presentation extracts from the then Head of Engineering Cost Management & Business Improvement at Cathay Pacific¹³ for paper-based transactions and records.

- Maintenance Programs
 - 10,552 Active Requirements
- Line Maintenance
 - 582,515 Log entries
 - 128,310 Arrivals
- Materials and Logistics
 - 280,000 Component Certifications
- Work Recorded and Stored
 - 48,772 Maintenance Projects
 - 373,759 Tasks Accomplished
- 33,000,000 paper records in storage and growing

33,000,000 paper records in storage and growing...

These statistics are for a fleet size of 180 aircraft. Consider the size of your fleet and factor these statistics up or down to see what your paper-based continuing and growing burden may be.

¹¹ YouGov: What the world thinks. [Online]. [14 September 2017]. Available from: <https://yougov.co.uk/news/2013/10/24/more-8-10-uk-companies-print-documents-just-get-th/>. In-text citation: (Yougovcouk, 2017)

¹² Wondersharecom. 2017. @PDFelement. [Online]. [14 September 2017]. Available from: <https://pdf.wondershare.com/pdf-business-tips/advantages-of-paperless-office.html>. In-text citation: (Wondersharecom, 2017)

¹³ Cited/adapted from IATA Ops Conference Papers Los Angeles 2015. “The Cost of Paper is far more than the Cost of Paper”, Saunders R, Head of Engineering Cost Management & Business Improvement - Cathay Pacific

4.7.4 Record Formats

Record formats and interpretation of definitions vary widely. Table 13¹⁴ highlights the confusion currently experienced with the differing record formats that are currently utilized across the industry.

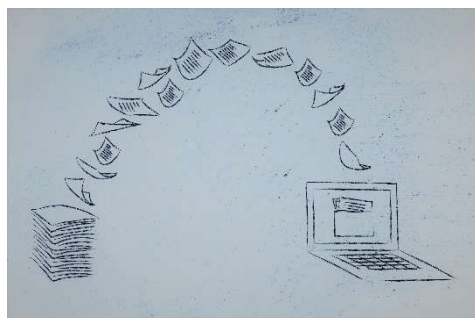
Hence it is important to adopt standards when considering PAO:TO and in the selection of enabling technology (see 3.2 Enabling Technology).

Record Formats	
1.	Signed paper copy
2.	Scan of signed paper copy in PDF with paper backup
3.	Scan of signed paper copy in PDF without paper backup
4.	Scan of non-signed paper copy in PDF with system backup
5.	Scan of non-signed paper copy in PDF without system backup
6.	Paper copy of summary printed out from the operator's MIS
7.	ePDF (e.g. summary from the operator's MIS)
8.	e-signed ePDF (PDF/A)
9.	XML Dataset
10.	Other PC file (XLS/CSV/Word/JPEG/ASCII/.txt)
11.	PKI digitally signed ePDF
12.	PKI digitally signed XML Dataset

Table 13: Different Record Formats (currently utilized)

4.7.5 Digitizing of Legacy/Historical Records

In the main legacy records are paper-based, albeit many organizations are digitizing their records via smart scanning functionality that allows rapid record search and retrieval. This is a legitimate phase that some companies are adopting in the journey towards total paperless operations.



However, there is a perception that some aviation authorities are still insisting on "Dirty Fingerprint" (DFP). This still drives lessors to require DFP so the problem of continuing to keep paper records and to ship them with aircraft re-deliveries still exists. Hence it is important to work closely with lessors and aviation authorities when developing plans for the implementation of PAO:TO.

ICAO's eAMR publication, (refer Section 3.3 - CAA Approval), will provide the basis needed for more authorities to regulate for the acceptance of electronic records.

¹⁴ Cited/adapted from AERDATA Customer & Partner Conference 2013. "Technical Records Progress", Scanlon K, Product Director, STREAM - AERDATA

4.7.6 Metrics – Record Storage and Environment

The Record Storage and Environment metrics in Table 14 can be considered in the development of a PAO:TO business plan.

Record Storage & Environment Key Result Areas	Measures
Reduced Copy Paper Purchasing, and Consumption	<ul style="list-style-type: none"> • Reduction in purchasing costs
Reduced Storage and Filing Costs	<ul style="list-style-type: none"> • Reduction in filing cabinets or compactus units required • Reduction in office floor space required
Reduced Archiving & Retrieval Costs	<ul style="list-style-type: none"> • Reduction in cost of archiving and retrieval services, including transportation
Reduced Printing Consumables (Toner cartridges etc)	<ul style="list-style-type: none"> • Reduction in office consumable costs
Reduced Printer Operating Costs (Leasing, Maintenance, Energy)	<ul style="list-style-type: none"> • Reduction in office operating costs
Reduced Waste Disposal Costs	<ul style="list-style-type: none"> • Reduction in cost of paper waste disposal

Table 14: Record Storage and Environment Metrics

4.8 Lessors and Lessees

“Paperless Operations can have a significant impact on leasing and re-leasing of aircraft, particularly when more than 40% (in 2016) of the global fleet are now leased. Hundreds of aircraft are transferring between airlines each year which require proper maintenance and supporting documentation that meets regulatory and contractual requirements”¹⁵.

Leasing and aircraft transfers, particularly across regulatory jurisdictions, is a major undertaking for lessors and airlines.

Referring to the red text in the IATA Roadmap (Figure 10), the leasing aspects cut across several areas. Currently, retention and transition of paper documents remains a barrier to efficiency for lessors, airlines, parts traders and MROs.

Electronic records offer a vastly improved and searchable level of record keeping accountability and security, and in addition provide significant value propositions relating to environment and cost reduction. These are listed in Table 16 for Lessors and Table 17 for Lessees.

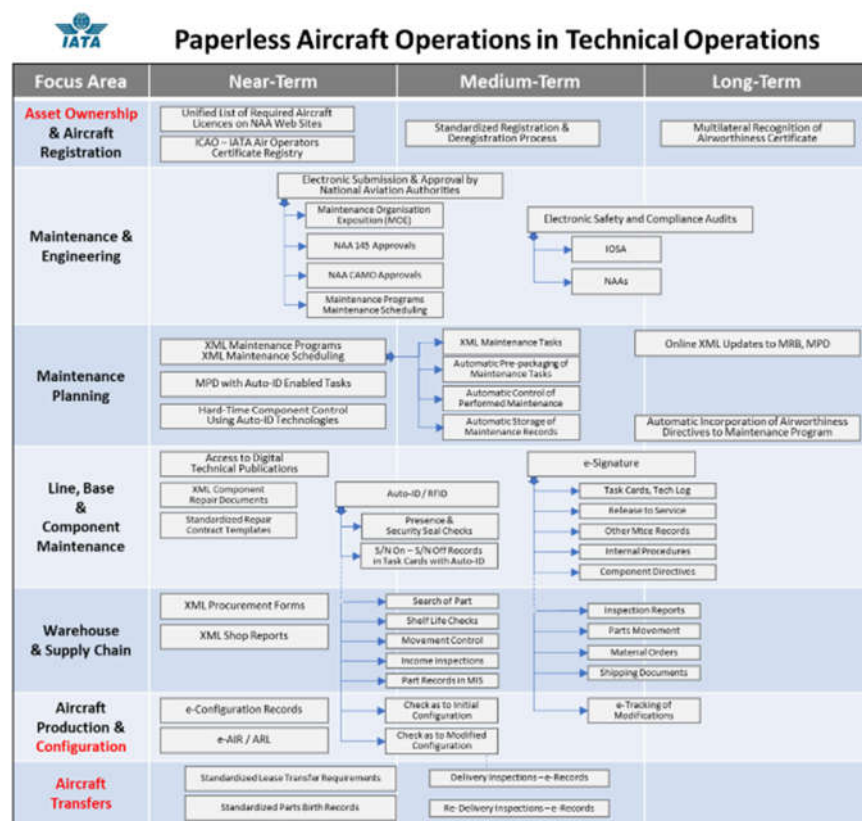


Figure 10: IATA Roadmap - Leasing Aspects

¹⁵ Cited/Adapted from IATA PAO and RFID Conference Papers Seattle 2016. “Moving to a Paperless Environment”, Walker D, Technical Vice President & Head of Americas, AerCap

4.8.1 Re-Delivery Issues

Discussions within the IATA PAO:TO Working Groups has highlighted that some lessors and aviation authorities still required original paper records. However, progress is being made and the key is to engage early with the relevant stakeholders. (See Section 3.3 re ICAO eAMR)



Operators and Lessors want paperless record systems as quite simply, the whole value-stream benefits from the improved efficiencies from PAO:TO.

Acceptance does vary and where there are issues, they are generally in relation to the downstream aviation authority and their acceptance of paperless records with the re-delivery of aircraft across borders.

Progress is being made (albeit slowly) and hence it is very important to work with Lessors and Authorities when developing PAO:TO implementation strategies and plans.

Table 15 following shows how some re-delivery issues are being resolved.

Issue	Resolution
Downstream Aviation Authority demanded original paper records or they would not put the aircraft onto the register	<ul style="list-style-type: none"> Digitized (scanned) records were printed and stamped as being original. This resolution was accepted by the Authority
Individuals within Aviation Authorities demanding paper copy when not required by regulation or in contravention of national laws	<ul style="list-style-type: none"> Briefings provided to individuals explaining requirements of regulations and national laws. For example, in the USA: <ul style="list-style-type: none"> Paperwork Reduction Act (which prohibits the US government from imposing record production or record keeping obligations without OMB approval) Electronic Signatures in Global and National Commerce (which generally says that electronic records and signatures are as valid as paper ones)
Aviation Authority regulations require paper records. New aircraft delivered (B787) with e-Logbook and e8130	<ul style="list-style-type: none"> Aviation Authority provided exemptions to regulation where paper records are not available
Airline has gone totally paperless and from point of implementation, no paper records are available. Legacy records however have been scanned and are searchable	<ul style="list-style-type: none"> Lessors and Aviation Authorities advised that only electronic or scanned legacy records will be provided at end of lease or re-delivery

Table 15: Re-Delivery Issue Resolution Examples

4.8.2 Legacy Leasing Contracts

Many current leasing contracts were written when paperless systems were not available and hence there are clauses that require DFP records at end-of-lease. Anecdotally, some lessors are insisting on DFP so again it is important to work with lessors if these issues are encountered.

4.8.3 Metrics - Lessors

The Lessor metrics in Table 16 can be considered in the development of a PAO:TO business plan.¹⁵

Lessor Key Result Areas	Measures
Improved Record Retrieval	<ul style="list-style-type: none"> Reduction in time to search for and locate critical records
Reduction in Lease Return Delays	<ul style="list-style-type: none"> Improved response times to the next airline's questions thereby reducing records disputes
Enablement of Remote Due Diligence	<ul style="list-style-type: none"> Next airlines ability to conduct remote due diligence prior to accepting aircraft Reduction in prior airline required effort allowing more focus on their business
Reduction in Consultant Costs	<ul style="list-style-type: none"> Reduction in costs associated with consultants being on-site during audits and lease returns
Elimination of Risk of Record Loss	<ul style="list-style-type: none"> Elimination of the risks associated with catastrophic loss of paper records - to include hostage taking of records
Improvements in End of Lease Preparation	<ul style="list-style-type: none"> Labour savings within leasing team to produce documentation required at end of lease

Table 16: Lessor Metrics

4.8.4 Metrics – Lessees

The Lessee metrics in Table 17 can be considered in the development of a PAO:TO business plan.¹⁵

Lessee Key Result Areas	Measures
Reduction in Lessor Audit Time	<ul style="list-style-type: none"> Decreased need for consultants to be on-site for mid-term audits and for the lease return process. (with paper-based systems, this period is typically 30 days and growing) Reduction or elimination of need for lessor "Records Related" on-site representation
Reduction in Authority Audit Time	<ul style="list-style-type: none"> Paperless systems will reduce the time aviation authorities need to be on-site performing audits during lease returns
Reduction in Hosting & Escorting	<ul style="list-style-type: none"> Minimized hosting and escorting of next airline customers and consultants Minimized need for office space to accommodate Reduction in distractions to normal business
Reduction in Aircraft Return Delays	<ul style="list-style-type: none"> Reduces the potential for delayed returns and associated exposure to continued lease payments
Improved Records Access	<ul style="list-style-type: none"> On-line record masters can be updated in real time with instant access to researchers
Improved Records Search Efficiency	<ul style="list-style-type: none"> Improved record search and filter capabilities when compared with paper-based systems
Reduction in Disputed Records	<ul style="list-style-type: none"> Reduction in disputes and cost associated with misfiled or lost records
Enablement of Remote Due Diligence	<ul style="list-style-type: none"> Reduction in travel and other costs associated with required due diligence prior to accepting aircraft
Reduction in Printing and Storage Costs	<ul style="list-style-type: none"> Paperless systems drastically decrease the cost of printing and storing paper. (Volume with paper-based systems is estimated at approximately 11,000 pages per aircraft per year)

Table 17: Lessee Metrics

5 Conclusion

These guidelines together with the accompanying checklist, provide material to assist organizations in conducting their own analysis and in developing their own business cases. This approach has been taken as the needs of organizations can be different – you may need to build a case for example; based on industry alignment, improved efficiencies and cost reductions, or improved configuration and compliance.

Many organizations will confidently embark on the PAO:TO journey, whereas others may be uncertain and feel that they need assistance. In either case, leverage the industry knowledge from the various stakeholders and like-minded organizations. Within the constraints of commercially sensitive information, or competition laws, organizations are generally willing to share information with each other.

Also stay engaged by participating in the PAO:TO Working Groups, and in IATA's annual Paperless Operations Conference. You can learn about what other people have been doing – the success stories, the mistakes made, and about the challenges that have been overcome.

IATA is also considering the development of service offerings for organizations seeking assistance from them (see Section 6) for detail.

In Conclusion

Get Started, Get Involved, and Good Luck.



GET STARTED

6 IATA Assessments *(Under Development)*

IATA is developing a concept where it will offer a service to provide independent an assessment of an organization's status for future-state Paperless Operations approval and implementation.

This will be a fee-for-service offering which provides an assessment broadly following the Electronic Signature & Recordkeeping Regulatory Checklist.

Engagement of IATA as an independent party may assist in the commencement of your journey¹⁶.

IATA can assist with independent assessments...

¹⁶ Fee for service offering, for Terms & Conditions contact Dr Chris Markou for detail – email: markouc@iata.org

Annex A Tips from an Organization already on their PAO:TO Journey

Program Governance

- Consider a cross-functional governance board to maintain strategic alignment and to ensure sharing of lessons learnt across 'silos'

Define Success Criteria

- Consider how to measure success post implementation of your PAO:TO system
- Identify what defines success and measure it.
- Re-evaluate on-going performance, check processes and adjust as necessary

Aviation Authority Engagement

- Engage with your Aviation Authorities in the conversations from the beginning
- Taking them along on your journey will bring them on board sooner and go a long way to ensuring that the understanding and buy-in is obtained from them without any delay

End-of-Lease Considerations

- At end-of-lease, some parties still require dirty finger print paperwork which can trigger additional rental payments or penalties
- Renegotiate with the aim of all parties accepting digitized (scanned) or electronic records

Areas of Cost Increase

- Para 4.3.2 Cost Increase – Need for IT capability to be enhanced
- Consider also cost increases associated with staff re-training or additional headcount with new skills required to support new infrastructure

Process Change Considerations

- Consider the impact with merging new paperless processes with existing paper processes. This can be quite complex – don't under estimate

Benefits of Company and Industry Collaboration

- The benefits of collaboration and engagement for successful implementation are many. A lot can be learnt from other operators in the industry.
- Build awareness that PAO:TO has cross functional implications within your organization. For example; electronic logbook implementation impacts across Flight Operations, Technical Crew, Cabin Crew, Engineering, Maintenance, IT, etc. Accordingly, all areas should be engaged

Technology Change Impacts

- Technology is constantly changing and the solution you implemented 3 years ago might soon be outdated with another system or software upgrade. This highlights the importance of a robust technology strategy and roadmap

Compliance Benefits

- A major benefit of PAO:TO is improved data quality and data capture which can for example, assist in the demonstration of compliance and statistical (reliability) reporting. Data quality can be defined as CACTS:
 - **C**ompleteness
 - **A**ccuracy
 - **C**onsistency
 - **T**imeliness
 - **S**tandards Based

Annex B Regulatory-Based Checklist

Checklist Overview

Download the Checklist from IATA on <http://www.iata.org/whatwedo/ops-infra/pages/paperless-ops.aspx>.

Scroll down the page to **Downloads** and click on the “Electronic Signature & Recordkeeping Regulatory Checklist”.

Error! Reference source not found. identifies the sources of the material used as the basis of the IATA Checklist. There are variations between the ACs but the intent is essentially the same.



Figure 11: Regulatory-Based Checklist Download

Aviation Authority	Source Material	Description
FAA	AC 120-78A	Electronic Signatures, Electronic Recordkeeping, and Electronic Manuals
Transport Canada	AC 571-006	Electronic Signatures and Electronic Exchange of the Authorized Release Certificate – Form One
CASA	AC 11-3(1)	Electronically Formatted Certifications, Records & Management Systems
EASA	AMC Appendix II to Part-M para 2	Electronic Signature and Electronic Exchange of the EASA Form 1

Table 18: IATA Electronic Signature & Record Keeping Regulatory Checklist Sources

With EASA, the material available within a consolidated advisory circular (or equivalent) is limited. For organizations operating within the EASA regulatory environment, consideration of compliance to broader EU Regulation pertaining to e-Business and Electronic Signatures may be required.

Noting IATA disclaimers, the Checklist takes the source documents and from them, questionnaires have been developed. Satisfactory completion of the checklist/questionnaire, provides the basis for companies to submit detailed applications to their Aviation Authority for review and approval decisions relating to PAO:TO. It also allows easy cross-reference to each of the ACs via key word search functionality – this gives understanding of the required criteria in the other regulatory jurisdictions.

Anecdotally, utilising the guidance provided by the FAA has satisfied the requirements for approval by other authorities.

IMPORTANT: Refer to IATA Disclaimer on Page ii.

Checklist User Guide

The illustrations on the following pages provide guidance on how to utilize the Checklist.

The screenshot shows a web-based checklist interface. At the top, there are search fields for 'Enter Key Word' and 'Select Key Word from Key Word List'. Below these are several columns representing different regulatory bodies: FAA, TCCA, CASA, and EASA. Each column contains a list of checklist items with radio buttons for selection and 'Cell Link' buttons. A table at the bottom lists the search results for the keyword 'Integrity', showing columns for 'select to compare', 'Heading Match', and 'Cell Link' for each regulatory body.

3 Enter a key word—use “Integrity” as example & click “Search”

5 The heading selected by Radio Button in Step 4 plus additional information shows here

6 If this is the Heading of interest, click on the link (eg: FAA Link) beside the heading selected by the radio button. This will take you straight to the AC and the applicable row – see next figure

4 The Checklist will search the ACs for all rows with “Integrity” in the text and show here. Click Radio button beside heading of interest

1 Read the IATA Disclaimer

2 Click “Key Word Search Tab”

Figure 12: Checklist User Guide 1

FAAAC Question (Q) or Sub Part Information (I)	Headings as adapted from AC (note: contractions applied to terminology - e.g. "eSignature" = "Electronic Signature")	Paperless Aircraft Operations in Technical Operations "Checklist" FAA Focus Electronic Signatures, eRecordkeeping, & Electronic Manuals IATA Disclaimer: This Checklist is for guidance only. Users must refer to their own Legal and Aviation Authority jurisdictions for latest versions of all Legal, Regulatory & Advisory Material requirements	Organisation's Policy & Procedures Reference	Organisation's Quality Dept Representative	Present?	Satisfactory?	Organisation Name: <insert name> Submission Date: <insert date>
2	Chapter 2. ELECTRONIC SIGNATURES						Insert Comment/Judification of Decisions against each question below (as applicable) Comments
32	2-1 ELECTRONIC SIGNATURE						
33	2-1a	eSignature - General - identical to handwritten	Questions: Is the purpose of the Electronic Signature described as being identical to that of a handwritten signature or any other form of signature currently accepted or approved by the FAA?		Yes	Yes	
34	2-1a	eSignature - General - Authenticity	Question: Do the Electronic Signatures possess those qualities and attributes that guarantee a handwritten signature's authenticity?		Yes	Yes	
35	2-1b	eSignature - Types - Legal Requirements	Question: Do the Electronic Signatures meet the legal requirements of electronic signing that appear in subparagraph 2-1c?		Yes	Yes	
36	2-1c	eSignature - Standards - Legally Binding	Question: Does -organisation's name- Electronic signatures meet the following criteria to be considered legally binding? That a person (the signer) uses an acceptable electronic form of signature?		Yes	Yes	
37	2-1c	eSignature - Standards - Unique to the Signatory	Question: Does -organisation's name- Electronic signatures meet the following criteria to be considered legally binding? That the signature is unique to the signatory?		Yes	Yes	
38	2-1c	eSignature - Standards - means to authenticate signer	Question: Does -organisation's name- Electronic signatures meet the following criteria to be considered legally binding? That there is a means to identify and authenticate a particular person as the signer.		Yes	Yes	
39	2-1c	eSignature - Standards - Intent to Sign	Question: Does -organisation's name- Electronic signatures meet the following criteria to be considered legally binding? That the electronic form of signature is executed or adopted by a person with the intent to sign the electronic record to indicate the person's approval or affirmation of the information contained in the electronic record?		MI	MI	
40	2-1c	eSignature - Standards - Attached or Associated with Electronic Record	Question: Does -organisation's name- Electronic signatures meet the following criteria to be considered legally binding? That the electronic form of signature is attached to or associated with the electronic record being signed?		No	No	
41	2-1c	eSignature - Standards - Permanent and Unalterable	Question: Does -organisation's name- Electronic signatures meet the following criteria to be considered legally binding? That the signature is permanent and the information to which it is attached is unalterable without a new signature?		N/A	N/A	
42	2-1c	eSignature Standards - Preserving Integrity of Signed Record	Question: Does -organisation's name- Electronic signatures meet the following criteria to be considered legally binding? That there is a means to preserve the integrity of the signed record?		Yes	Yes	
43							

7 When link clicked (Step 6) takes you to applicable AC and yellow highlights the heading

8 The actual AC wording is transposed into a "Question" for you to answer
Note: in some cases the AC wording is displayed as "Information" rather than being a question

9 The remaining columns are for you to fill as required with references to; Policy, Procedures, QA, and Comments. The columns for "Present" and "Satisfactory" have drop-downs for "Yes", "No", "N/A (Not Applicable)" and "MI" (More Information Required)

Figure 13: Checklist User Guide 2

10 When doing a word search (Step 3) you can add your word to a "Key Word List" by clicking "Add Key Word"

You can also click the "Go to Keyword List" here or click the spreadsheet tab "Key Word List" as required

11 As an alternative and once a word is in the "Key Word List" you can search by entering the key word - noting there is a drop-down here of all words in the list

12 NOTE: If using the alternative per Step 11, this box must be blank

Key Word List

1	
2	Add new Key Word to create your list
3	
4	
5	Key Words
6	Archivable
7	Authenticate
8	Authorize
9	Control
10	Definition
11	Denial
12	Discontinue
13	Electronic
14	Electronic Signature
15	eManual
16	eSignature
17	Integrity
18	Intest

Figure 14: Checklist User Guide 3

B	C	D	E
<h2>Administration Instructions</h2>			
<h3>How to ADD Rows</h3>			
<div style="border: 2px dashed red; padding: 5px; display: inline-block; background-color: #f0f0f0;">update</div>			
<p>1 End-users may wish to customise the Checklist by adding more questions against a particular element of the applicable Advisory Circular</p> <p>2 DO NOT add rows ABOVE Row 5. These are spreadsheet functionality rows and any changes in these areas will corrupt the spreadsheet coding</p> <p>3 Unprotect sheet that you wish to add row to by going to Review and then clicking "unprotect"</p> <p>4 Insert Row where desired</p> <p>5 Add text to to new row cells in Columns J and K</p> <p>6 Add AC para and sub-para in new row cells in Columns G and H</p> <p>7 For search functionality, a unique identifier needs to be put into the new row cell in Column I. If the AC Para and sub para is broken down into a series of questions, then name them Q1, Q2, etc in Column I. The combination of Columns G, H, and I will provide the unique identifier necessary for Key Word Search functionality</p> <p>8 When completed, Click the Update button above</p>			

13 If you want to customize the Checklist, go to the "Admin Instructions" tab. You can add additional rows by following these steps.

If you have problems with functionality after adding rows, contact IATA for resolution

Admin Instructions

Figure 15: Checklist User Guide 4

Annex C Acknowledgements

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