



LONG-TERM ARCHIVING AND RETRIEVAL (LOTAR)/DISPOSAL

Seshadri Venkatadri (Collins Aerospace)
P A Aswatha Narayana (Jain University)

5th December 2023

CONTENTS

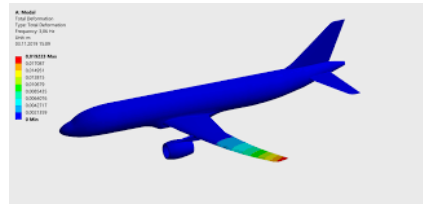
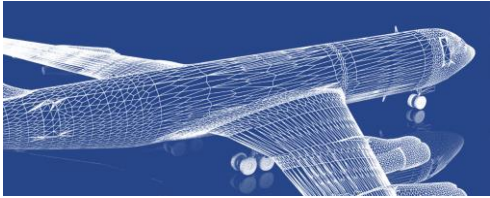
- References
- Need for long-term storage of Aircraft Data
- History of Storage of Aircraft Data
- Challenges in aircraft data
- LOTAR International Mission & Objectives, Goals, Member companies, Roadmap
- Benefits of LOTAR Standards
- Status of use of LOTAR standards by LOTAR members
- Being with LOTAR International
- Industry Experience
- Disposal
- Conclusions & Summary

REFERENCES

- Airbus presentation on LOTAR: https://lotar-international.org/wp-content/uploads/2020/05/0301_Presentation_Delaunay_Airbus.pdf
- LOTAR Standard: <https://lotar-international.org/lotar-standard/>
- Collins site: <https://home.rtx.com/BUs/Collins-Aerospace/Our-Culture/DPLC?tab=tabs-6-B54FEA31-2AB5-4E69-A24A-8A5DEA52ABA9>
- https://www.icao.int/environmental-protection/Documents/EnvironmentalReports/2019/ENVReport2019_pg279-284.pdf
- <https://www.faa.gov/documentlibrary/media/order/8120.11.pdf>

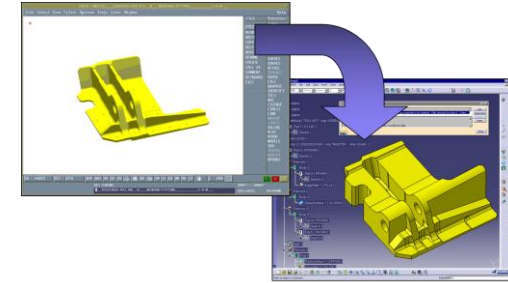
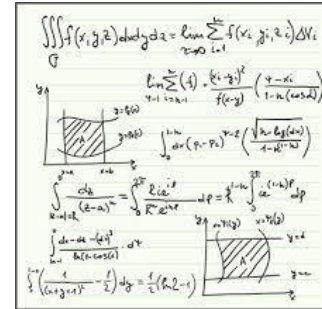
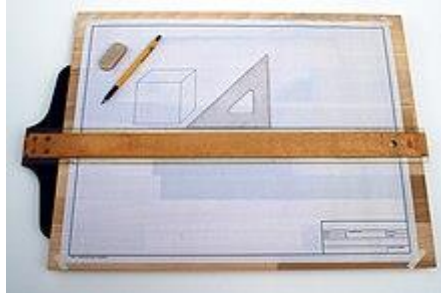
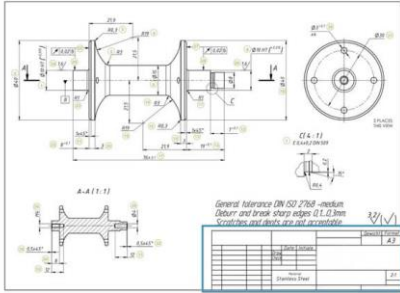


NEED FOR LONG TERM STORAGE OF AIRCRAFT DATA



- **Maintenance and Sustainment:** Aircraft can remain in operation for many years, and during this time, maintenance and repairs are required,
- **Data Exchange:** Exchange between different parties involved in the aircraft lifecycle, such as manufacturers, suppliers, and maintenance organizations.
- **Risk Mitigation:** Critical information may be lost or rendered unusable, potentially leading to safety issues and increased costs.
- **Compliance:** The aerospace industry is subject to strict regulations and standards, and LOTAR helps organizations comply with these requirements by providing a standardized approach to data archiving and retrieval.
- **Cost Savings:** Maintaining accurate and accessible data can lead to cost savings over the long term.
- **Data to be Preserved:** Digital product data, including 3D models, technical documentation, and associated metadata, for aircraft and aerospace systems.

HISTORY OF STORAGE OF AIRCRAFT DATA



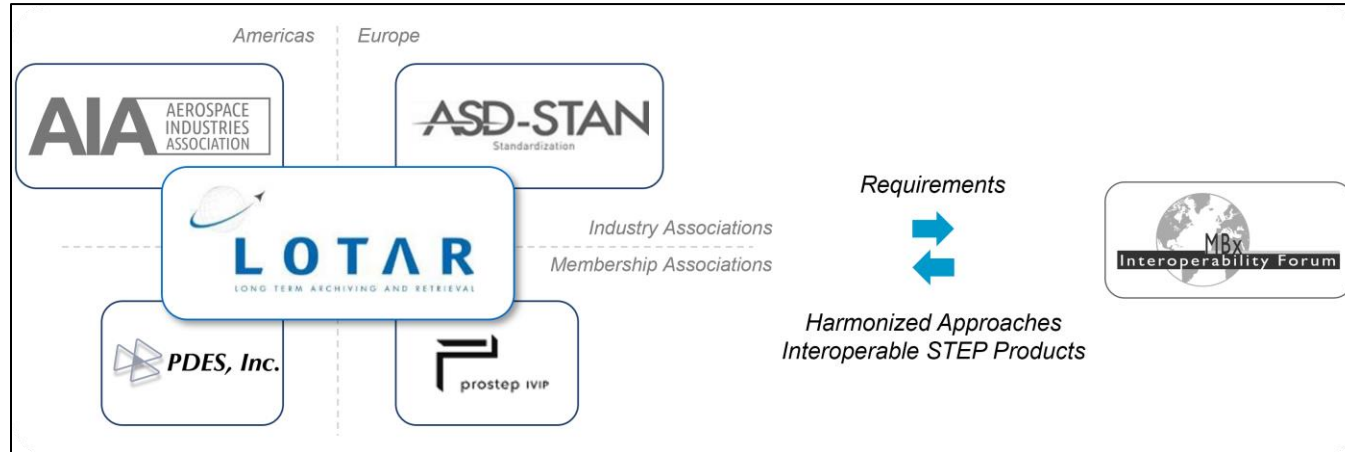
- before 1980: Mainly manual paper drawings and a minor number of 2D CAD drawings
- 1980-1995: Mainly 2D CAD drawings, a minor number of manual paper drawings, and additionally 3D surface CAD design
- 1995-2006: The usage of 3D solid & assembly CAD design, generated 2D drawings from 3D master models used
- Post-2006: Continuing change in CAD technology (3D solid & assemblies with extended GD&T design information) and many CAD vendors, conversion of native product data into a more stable format has become essential.
- 2008: the creation of the LOTAR International project

CHALLENGES IN AIRCRAFT DATA

- Challenges:
 - CAD S/W versions change every 2-4 years
 - Aircraft lifecycle of 30 - 50 years
 - The Lifecycle of software & hardware is short compared to the lifecycle of an aircraft or a defense system
- LOTAR (Long-term Archiving and Retrieval) is a standard in the aerospace and defense industries that aims to address the challenges of long-term data retention and retrieval for digital product data, particularly in the context of aircraft manufacturing and maintenance.
- Purpose: **Integrity, Availability, and Usability** of digital design and product data throughout the entire lifecycle of an aircraft, which can span several decades.
- LOTAR International formed



LOTAR INTERNATIONAL MISSION & OBJECTIVES



Standards

- The prime objective is the creation and deployment of the **EN/NAS 9300 series of standards** for long-term archiving and retrieval of digital data, based on standardized approaches and solutions.
- The integration of LOTAR requirements into software tools is ensured by close cooperation with the [MBx Interoperability Forum](#) and the [PDM Implementor Forum](#).

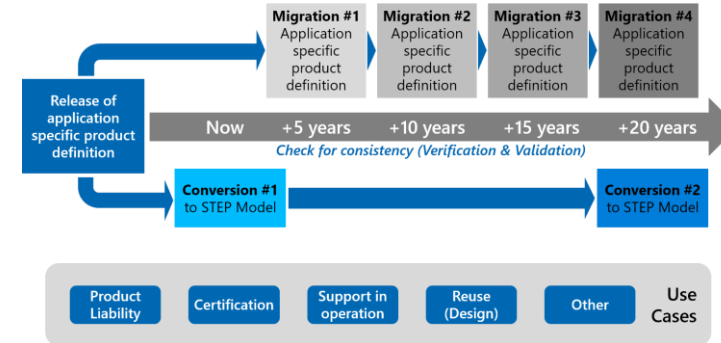
Mission, Objective & Principles

- The mission of LOTAR International is to develop global standard-based archival and retrieval mechanisms for digital products and technical information.
- The project will achieve this through the ongoing harmonization and standardization efforts of Aerospace and Defense organizational affiliations.
- As part of the goals for archival and retrieval, the project will seek to enable data exchange and interoperability mechanisms to ensure the long-term use of digital products and technical information.

LOTAR INTERNATIONAL GOALS & MEMBER COMPANIES

Goals

- Developing, publishing, and maintaining a standard series for archiving and retrieval of product & technical data
- Standardization of referred and required methods, process modules and data models
- Providing methods, process modules, and data model(s), to enable long-term archiving and retrieval of CAD and PDM data, electrical, composite design, model-based systems engineering, and engineering analysis & simulation data, etc.
- Development of recommendations for practical introduction of long-term archiving of relevant data within the Aerospace and defense industry as well as other industries
- Enabling commercial solutions based on user requirements in cooperation with MBx-IF testing and funded pilot projects



Member Organizations

- Airbus Commercial Aircraft
- Airbus Defense & Space
- Airbus Helicopter
- The Boeing Company
- Embraer
- GE
- Gulfstream
- Leonardo
- Lockheed Martin
- Raytheon Technologies



Solution & Service Providers

- ACCR, LLC.
- Autodesk
- CT CoreTechnologie
- Dassault Systèmes
- Datakit
- Elysium
- Eurostep
- ITI Global
- Jotne EPM Technology
- Kubotek Kosmos
- Open Design Alliance
- PROSTEP AG
- PTC
- Siemens PLM
- Tech Soft 3D
- Theorem Solutions

Contributing Members

- NIST
- Purdue University

LOTAR INTERNATIONAL ROADMAP & WORK GROUPS

ROADMAP

Phase 1: Create EN / NAS standard documents and recommended practices regarding fundamentals & and concepts, processes and the first data domain explicit 3D CAD.

Phase 2: Create EN / NAS standard documents and recommended practices of 3D CAD with PMI, PDM, 3D CAD composite, 3D CAD electrical harness, 3D Light Visualization, governance and planning, functional architecture, security and LOTAR certification for aerospace and defense companies to be measured against.

Phase 3: Create EN / NAS standard documents and recommended practices regarding system engineering, simulation, 3D CAD with parametric & and form features, PLM (as extended PDM), and analysis.

WORK GROUPS

- Basic & Common Process Parts (EN/NAS 9300-00x and -01x series)
- Meta Data for Archive Package (EN/NAS 9300-021)
- 3D Mechanical CAD with PMI (EN/NAS 9300-1xx series)
- PDM (EN/NAS 9300-2xx series)
- Composites (EN/NAS 9300-3xx series)
- Electrical (EN/NAS 9300-4xx series)
- Model-Based Systems Engineering (EN/NAS 9300-5xx series)
- Engineering Analysis & Simulation (EN/NAS 9300-6xx series)
- 3D Visualization

WP	###	Title	2023				2024				2025				2026				2027			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1		Basic Parts																				
1.1	001	Structure																				
1.2	002	Requirements	R																			
1.3	003	Fundamentals and Concepts	R																			
1.4	005	Authentication and Verification		R																		
1.5	006	Functional Architecture																				
1.6	007	Terms and References							R													
2		Common Process Parts																				
2.1	010	Overview Data Flow		R																		
2.2	011	Data Preparation		R																		
2.3	012	Ingest																				
2.4	013	Archival Storage							R													
2.5	014	Retrieval							R	R												
2.6	015	Removal							R													
2.7	020	Governance & Planning									R											
2.8	021	Meta Data for Information Package							R													
3		Data Domain Specific Parts																				
3.1		3D Mechanical CAD with PMI																				
3.1.1	100	Common Concepts																				
3.1.2	110	Explicit CAD Geometry									R or E3											
3.1.3	115	Explicit CAD Assembly Structure	R or E2																			
3.1.4	120	Explicit CAD Geometry with Graphic PMI					R or E3															
3.1.5	121	Explicit CAD Geometry with Semantic PMI					R or E2															
3.1.6	125	Explicit CAD Assembly Structure with Graphic PMI									R or E2											
3.1.7	126	Explicit CAD Assembly Structure with Semantic PMI									E1											
3.1.8	131	Explicit CAD Geometry and Machining Form Features																		E1		
3.1.9	132	Structural Joins for Assembly & Installation									E1											
3.1.10	14x	Kinematics																		E1		
3.2		PDM																				
3.2.1	200	Common Concepts								E2												
3.2.2	205	Product Data Validation Properties					E1															
3.2.3	210	"As Designed" Product Data	E1																			
3.2.4	220	"As Planned" Product Data																			E1	
3.2.5	230	"As Built / As Maintained" Product Data			E1																E2	
3.2.6	240	Product Development															E1					
3.3		Composites																				
3.3.1	300	Fundamentals and Concepts						E1														
3.3.2	310	3D Composite Exact Implicit & Approximate Implicit									E1											
3.4		Electrical																				
3.4.1	400	Fundamentals and Concepts																			E2	
3.4.2	410	Physical Electrical Harness for Design & Construction		E1																		
3.4.3	420	Electric Wiring Interconnection System Installation		E1						E1												
3.4.4	430	Electric Wiring Interconnection System Logical Information																				E1
3.5		MBSE																				
3.5.1	500	Fundamentals and Concepts																				
3.5.2	510	Requirements									E2											
3.5.3	515	(Requirements), Validation & Verification									E1											
3.5.5	520	Analytical model																			E2	
3.5.5	530	Architecture models																			R	
3.5.6	540	LBOM																				
3.6		Engineering Analysis & Simulation																				
3.6.1	600	Fundamentals and Concepts																				
3.6.2	610	Simulation & Process Data Management																				
3.6.3	620	Structural Finite Element Analysis																				
<i>The LOTAR Engineering & Analysis Workgroup is currently on hold. Next steps will be planned when activities in this domain are resumed.</i>																						
WP	###	Title	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
			2023				2024				2025				2026				2027			

BEING WITH LOTAR

As an Industrial User Company

If your company is interested in joining the LOTAR project to share your requirements and to contribute to the development of the standard, then:

- Be an **Industrial User Company**
 - Note: The LOTAR project is not strictly limited to Aerospace industry. However, the EN/NAS 9300 series of standards are primarily targeting EASA and FAA requirements and are published by the Aerospace industry associations. If the Aerospace-driven requirements documented in the LOTAR standards apply to your industry branch as well, you are more than welcome to join.
- Be a **Member** of one of the four [Hosting Organizations](#) (ASD; AIA; PDES, Inc.; prostep ivip).
- **Contribute** to the overall project budget by paying an annual fee
 - The project budget is used to contract service providers for administrative work securing the goals of the project, as well as for supporting interoperability forums and pilot activities validating the requirements documented in the LOTAR standards.
- Actively **participate** in the project, i.e.,
 - Engage in one or more of the [LOTAR Workgroups](#).
 - Participate in the regular conference calls.
 - Attend the [Quarterly Meetings](#).

As a Service or Solution Provider

If your company is interested in bringing your expertise to the table, or want to support LOTAR requirements in your software products, then:

- Have **proven expertise** or a **working solution** that is relevant in the scope of the [LOTAR Workgroups](#).
- Be a **member** of one of the three membership associations ([AFNeT](#); [PDES, Inc.](#); [prostep ivip](#)).
- Be an **active** member of the applicable **Interoperability Forum(s)** for the domain(s) you support:
 - For “3D Mechanical CAD with PMI” as well as “Composites”: the [CAx Interoperability Forum](#)*
 - For “PDM”, the [PDM Interoperability Forum](#)*
 - For “Electrical”, the [EWIS Interoperability Forum](#)*
 - For “Engineering Analysis and Simulation”, the [CAE Interoperability Forum](#)* **
 - For “Model-Based Systems Engineering”, an Interoperability Forum is currently being discussed.
 - Being an active member means:
 - Participate in the testing activities by providing test data, results, and feedback to other participants.
 - Attend the respective forum’s meetings and conference calls.

BENEFITS

Aerospace and defense community

- Implement archive system compliant with a international accepted standard
- Systematic archiving of the company know-how
- Availability of documents via a logically central instance
- Minimization of individual errors, e.g. through document versions, that are not actual
- High grade of security by a secure repository and access control
- Internal legitimating of digital processes currently in use
- Economic archiving of voluminous data
- Applicable archiving workflow supported by new STEP interfaces and functionalities (conjointly developed with involved IT vendors)
- Accepted workflow by aerospace and defense authorities due to intense collaboration during standard creation (MoU, acceptance etc.)
- By solving the challenges of long-time data retention also issues of data exchange are addressed

Benefits for participants

- direct access onto project results
- the exchange of Know-how
- gaining personal expertise in Long Term Archiving and Retrieval
- addressing company-specific requirements
- The passive participation provides the opportunity to influence the standard in the ballot phase by comments and voting.

Benefits for other industry branches

- Modular concept of the Standards allows a partial implementation,
- Detailed process description is transferable on other archiving formats,
- Practical quality criteria are defined
- Close collaboration with IT-Vendors will lead to recommended practices and marketable products.

STATUS OF USE OF NAS / EN 9300 STANDARDS BY LOTAR MEMBERS

A&D company	Area of application	Scope	NAS / EN 9300 LOTAR parts (CAD)				ISO formats	Project status
			CAD 3D Exact Geometry	CAD 3D Tessellated Geometry	CAD 3D PMI Present.	CAD Assembly structure		
			Part 110	Part 110	Part 120	Part P115	ISO 10303 "STEP"	
Airbus Commercial	A350	3D Electrical Harness Installation & Definition	Yes	Yes	Yes	Yes	AP 214 ed3 (*) + AP 242 ed1	PROD
Airbus Defence & Space		"Full 3D" model based	Yes	Yes	Yes	Yes	AP 242 ed1	DEV
Dassault-Aviation	Falcon 7X	complete definition of the aircraft (airframe, brackets, pipes, harness)	Yes	No	Yes	Yes	AP 214 ed3 (*)	PROD
Snecma	New parts of engines	3D definition with PMI of new mechanical part	Yes	No	Yes	No	AP 214 ed3 (*)	PROD
Boeing	787	3D definition with PMI with assemblies	Yes	No	Yes	Yes	AP 203 ed2 (*) + U3D PDF	PROD
Gulfstream	G500, G600, G650	3D mBD mechanical, electrical and composite	Yes	No	Yes	No	AP 203 ed2 (*)	PROD
Lockheed-Martin	F35	3D mBD mechanical, electrical and composite	Yes	No	Yes	Yes	AP 203 ed2 + AP242 ed1	PLANNED
EMBRAER	Legacy 450 & Legacy 500	complete definition of the aircraft	Yes	No	Yes	Yes	AP 242 ed1	DEV
MTU Aero Engines	New parts of engines	3D definition without PMI of new mechanical part	Yes	No	No	In Prep.	AP 214 ed3	PROD

PLANNED	: project planned
DEV	: project in development
PROD	: project on production

(*): Plan to migrate to STEP AP 242 ed1 when possible

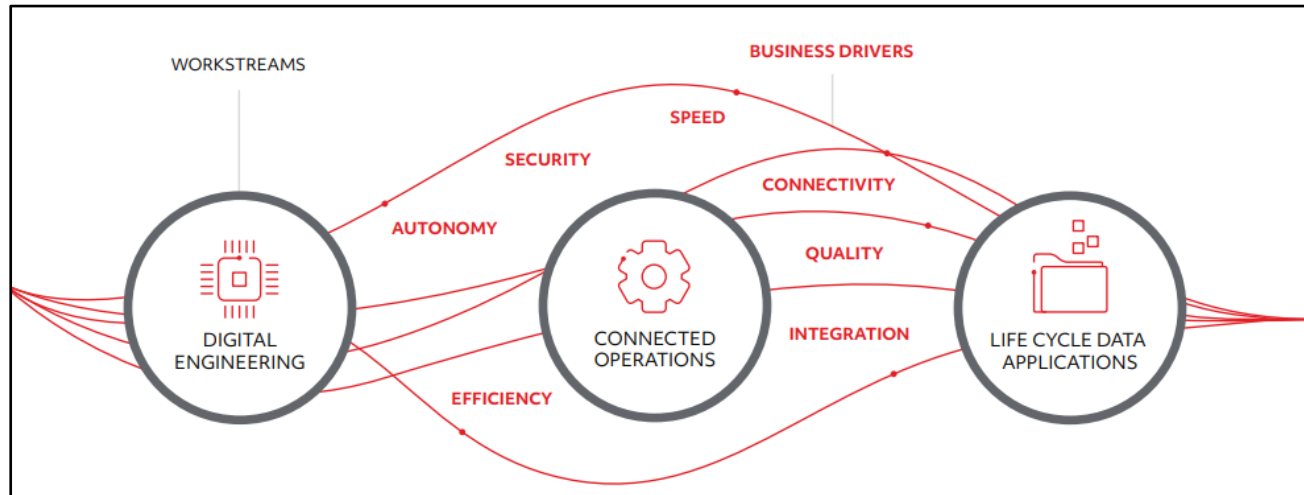
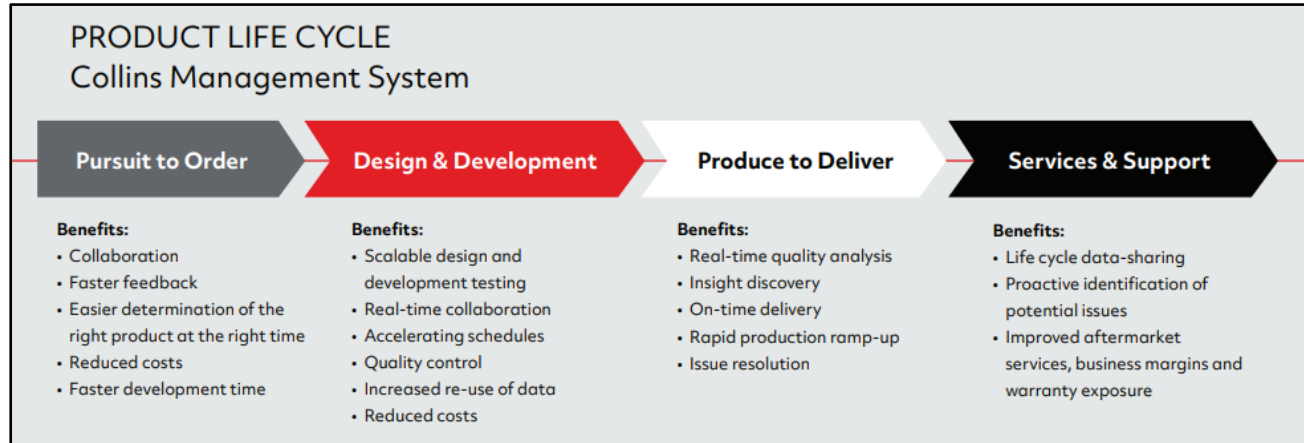
INDUSTRY STORY

- Quality Management System
- DPLC

A graphic with a black background. On the left, the letters 'DPLC' are written in a large, bold, red font. Below them, the words 'DIGITAL PRODUCT LIFE CYCLE' are written in a smaller, white, sans-serif font. On the right side of the graphic, there are several thin, red, curved lines that sweep upwards and to the right, creating a sense of motion or a digital path.

DPLC
DIGITAL PRODUCT LIFE CYCLE

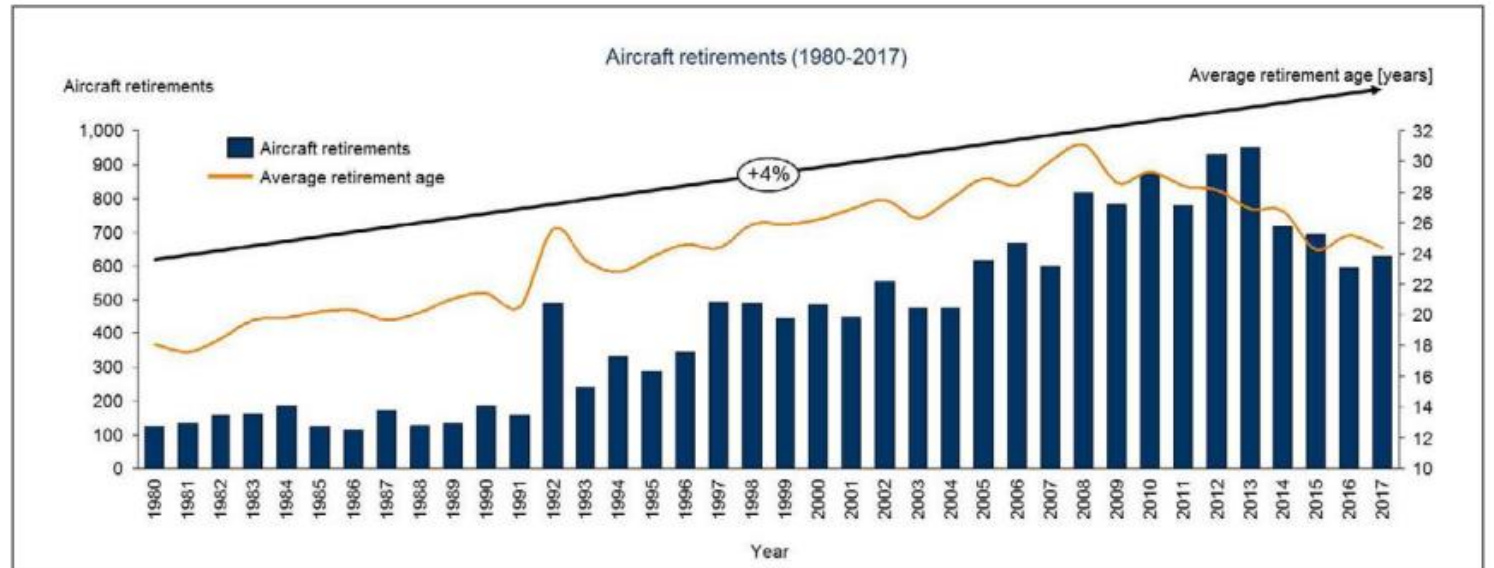
DPLC INITIATIVE



DISPOSAL



Courtesy: <https://www.airport-technology.com/features/featureaircraft-recycling-up-to-the-challenge-5710942/?cf-view>



Courtesy https://www.icao.int/environmental-protection/Documents/EnvironmentalReports/2019/ENVReport2019_pg279-284.pdf

Salvageable

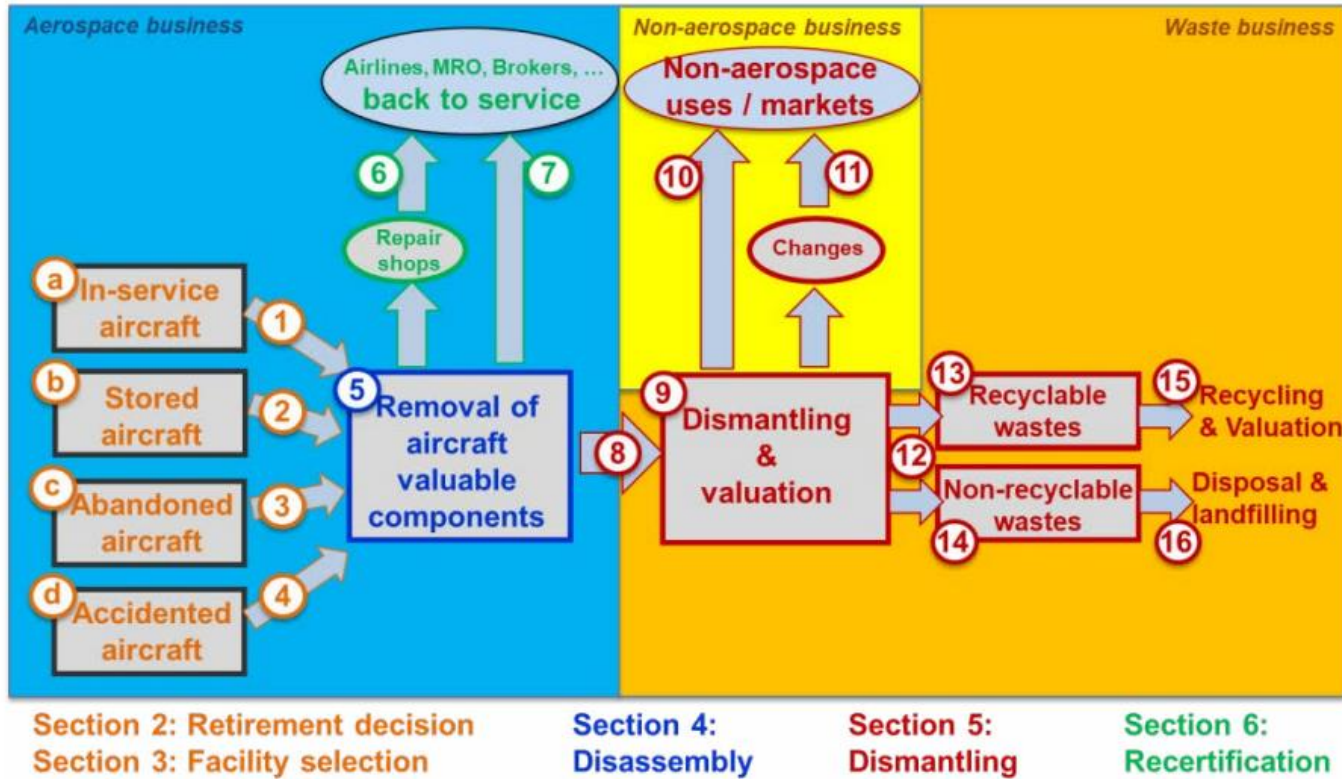
- Non-airworthy parts which may be worth storing until restored to an airworthy condition.
- Parts that cannot be found airworthy but likely to have future aviation value.

(<https://www.faa.gov/documentlibrary/media/order/8120.11.pdf>)

Scrap

- Parts which have no value except for the base material (Aluminum, Titanium, Composites)
- Parts that are typically used in safety critical aviation applications and may have future use in non-aviation applications

PROCESS OF AIRCRAFT DECOMMISSIONING



Initiatives;

- Airbus launched the project “Process for Advanced Management of End-of-Life of Aircraft” known as PAMELA.
- Boeing founded the Aircraft Fleet Recycling Association, known as AFRA.
- Southwest Airlines created a recycling and community initiative, “Repurpose with Purpose,” to upcycle the leather seat covers
- Sustainability initiatives in the Industry

Courtesy: :https://www.icao.int/environmental-protection/Documents/EnvironmentalReports/2019/ENVReport2019_pg279-284.pdf

CONCLUSIONS & SUMMARY

- Long-term Archiving and Retrieval issue has been a prolonged Industry problem.
- The Industry – both end customers and solution providers are coming together to solve the issue.
- The coming together of experts from different domains is essential for a solution.
- Each company needs to have its strategy and risk mitigation plan to be compliant and serve the industry.

THANKS