LOTAR 101

Jeff Klein - The Boeing Company
Bernd Feldvoss - Airbus Commercial Aircraft

GLOBAL PRODUCT DATA INTEROPERABILITY SUMMIT 2024

Presenters Bio

Bernd Feldvoss is PLM Interoperability Standards Specialist at Airbus in Hamburg, Germany. Bernd joined Airbus in 1998 and worked as a Systems Engineer where he was involved in the development of Data Exchange Methods. During this time he participated in international working groups and made a contribution to the “Airbus Concurrent Engineering (ACE)” project. He was involved in projects including the launching of the A380 and establishing cDMU between the UK, Spain, France, and Germany. Additionally,
In 2006, Bernd was appointed as the Team leader for Product Data Exchange at Airbus Germany where he managed 15 internal and external employees.
He was appointed to his current role in 2022. As part of his professional life, Bernd represents Airbus on numerous committees including; the prostep ivipTechnical Steering Committee and the JT Open Technical Review Board.
He is also a member of the Global Collaboration Working Group in the CIMdata managed PLM Aerospace & Defense Action Group.
Bernd studied Computer Science at the University of Hamburg, where his focus was on Computer Aided Engineering.

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Presenters Bio

Jeff Klein is a current co-leader of the Long Term Archiving and Retrieval (LOTAR) consortium for the development of the EN/NAS 9300 series of process standards, which are for the long term archiving and retrieval of digital design data. In addition, he co-leads the Basic and Common WG and participates on the PDM Implementor Forum User Group. Prior to these roles he was a participant and former leader of the PDM WG within LOTAR. Prior to the formation of LOTAR, he was a participant on an AIA committee, which published SAE ARP 9034, A Process Standard for the Storage, Retrieval and Use of Three-Dimensional Type Design Data.

He began his career at Boeing in 1989 as an electrical engineer on the 747/767 programs. He has worked on the development of the 777 program, in Electrical Systems, in Systems Engineering, and in Engineering Operations. His work on implementation of loadable software led to roles in configuration management and industry standards development.

He is now the lead of a core engineering group which supports all aspects of Configuration Management for commercial and derivative programs from Systems to Structures, and all points in the product lifecycle, from development to production certification to in service support. He has been involved in the implementation of multiple product lifecycle management systems and associated process and data standards. He has supported and led activities to flow down and verify implementation of CM process and tool requirements to design and build suppliers. He has coordinated with the FAA on Boeing's implementation of CM.

In addition to LOTAR, he is a voting member on the SAE G-33 Committee, Configuration Management, and has contributed to the development of SAE EIA 649 and related standards for implementation of Configuration Management (CM). He is the SME for internal Boeing procedures which implement EIA-649 principles across the Boeing enterprise.

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LOTAR Project “On A Page” www.lotar-international.org

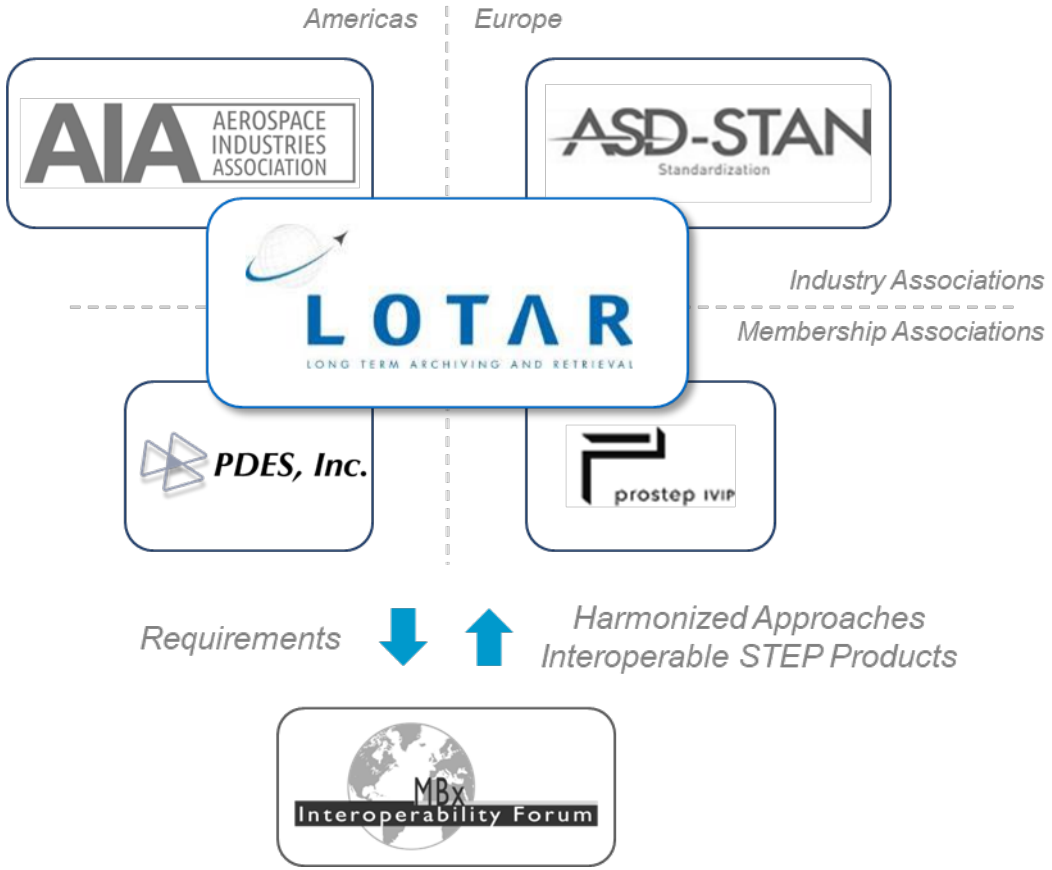
- LOTAR is an international consortium of Aerospace manufacturers
- Prime objective is creation and deployment of the EN/NAS 9300 series of standards for long-term archiving and retrieval of digital data, based on standardized approaches and solutions.
- Integration of LOTAR requirements in software tools ensured by close cooperation with:

  MBx Interoperability Forum (MBx-IF):

  – Facilitated by AFNeT, PDES, Inc., and prostep ivip

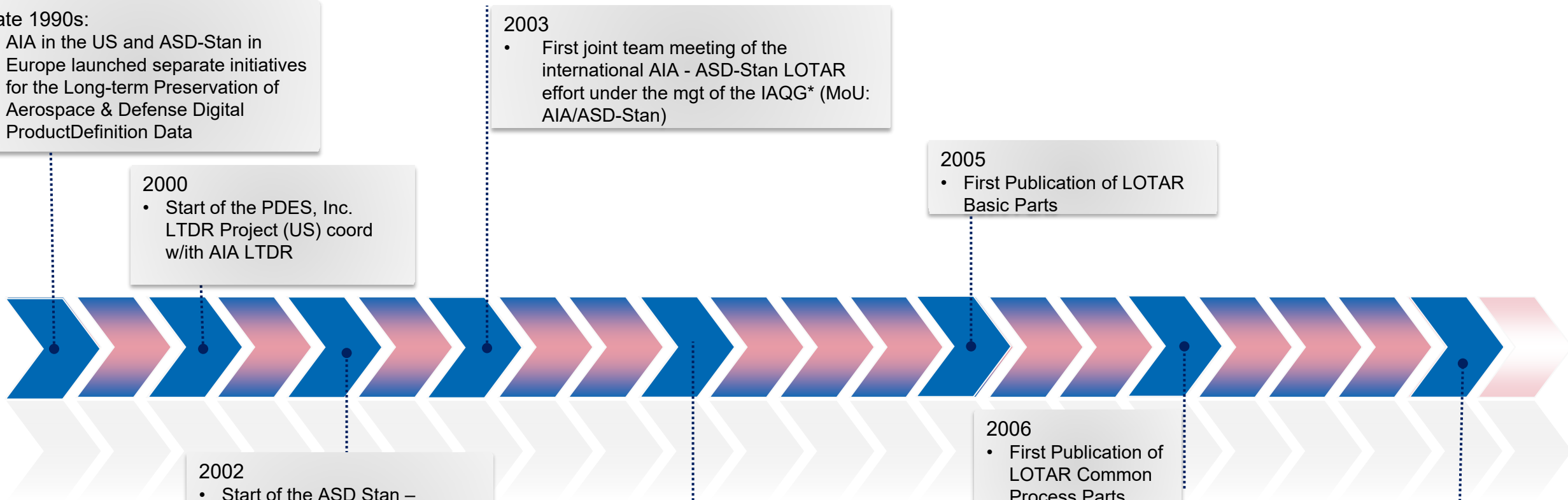
  – Consists STEP Translator & Validation Tool vendors for of CAD, CAE, EWIS and PDM

  – Supports AP203, AP209, AP214, AP239, AP242, AP243
  Supports AP242 Business Object Model XML



LOTAR TIMELINE

LOTAR Timeline



Late 1990s:
- AIA in the US and ASD-Stan in Europe launched separate initiatives for the Long-term Preservation of Aerospace & Defense Digital ProductDefinition Data

2000
- Start of the PDES, Inc. LTDR Project (US) coord w/ith AIA LTDR

2002
- Start of the ASD Stan – prostep ivip LOTAR Project (Europe)
- IAQG* approved charter for AIA/ASD Stan Joint Project
- AIA LTDR Published ARP9034

2003
- First joint team meeting of the international AIA - ASD-Stan LOTAR effort under the mgt of the IAQG* (MoU: AIA/ASD-Stan)

2004
- Launch of the 3D CAD and PDM Workgroups

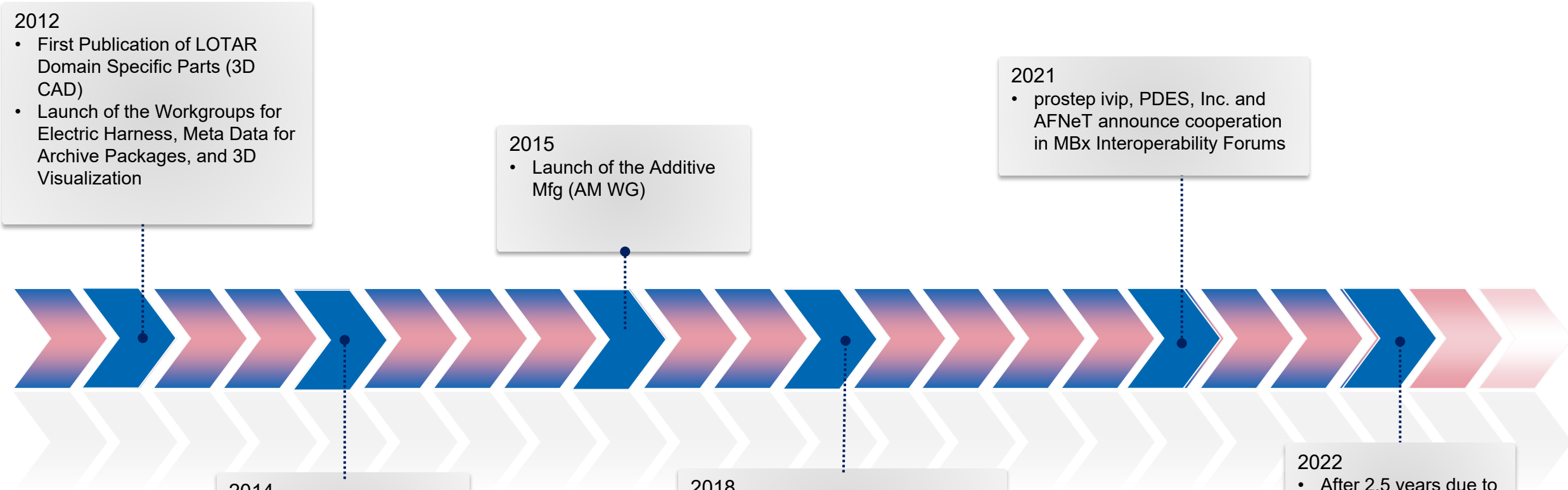
2005
- First Publication of LOTAR Basic Parts

2006
- First Publication of LOTAR Common Process Parts

2009
- Creation of the joint LOTAR International consortium (AIA / ASD-Stan / PDES, Inc. / prostep ivip)
- Launch of the Composites WG

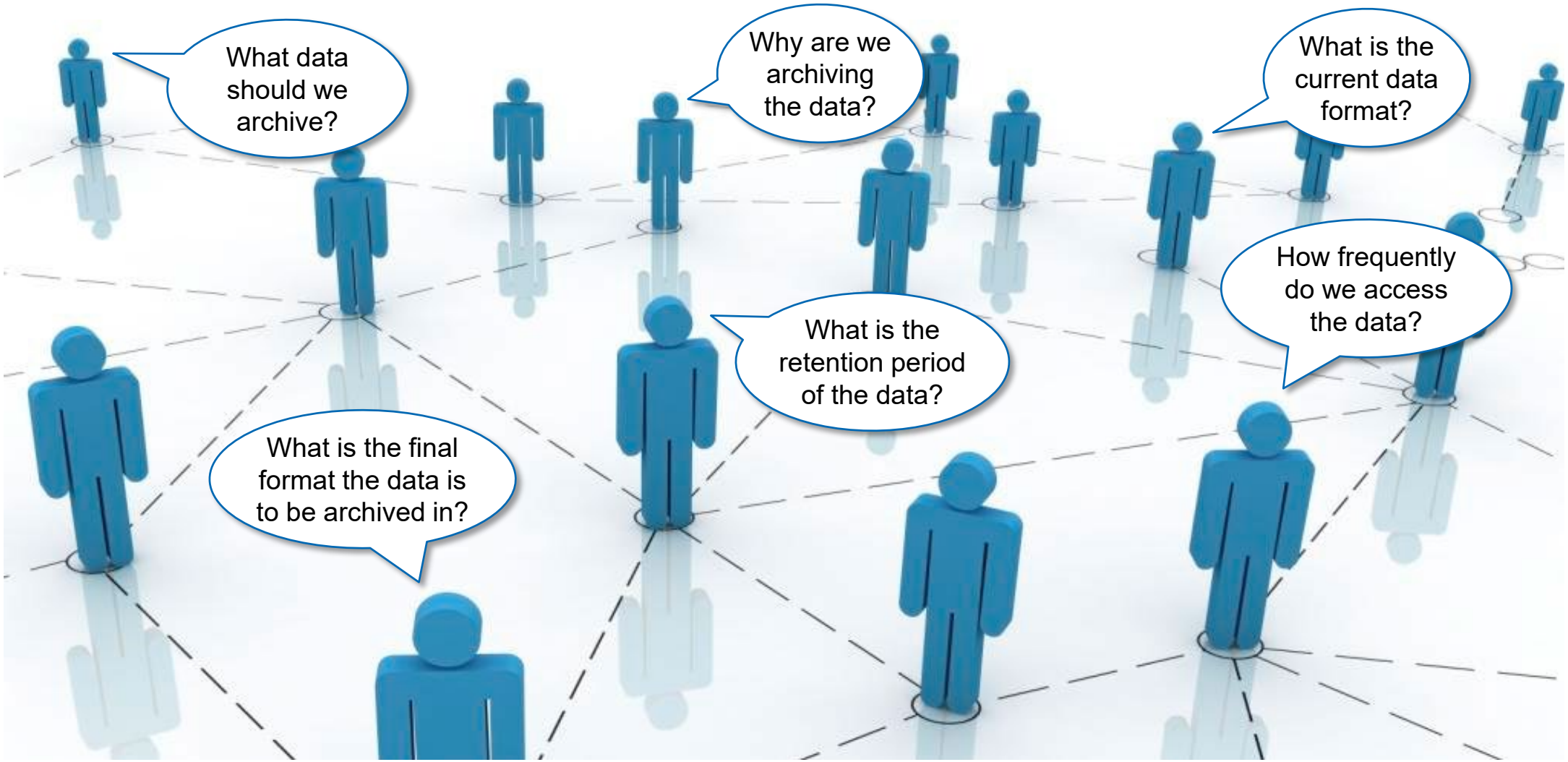
* IAGQ: International Aerospace Quality Group

LOTAR Timeline



LOTAR DRIVERS

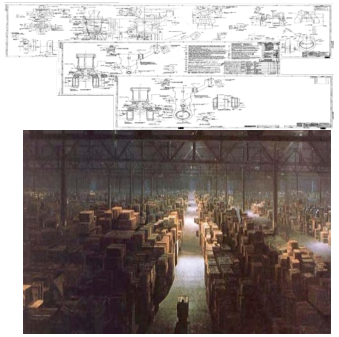
Driving Questions



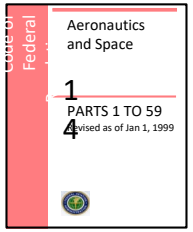
LOTAR Problem Statement

With the emergence of digital data-based processes, including model-based definition, requirements were identified which predicate the need for a long-term data retention solution(s) to meet the regulatory and business requirements. Traditional legacy retention and retrieval methods do not support complex digital product definition data.

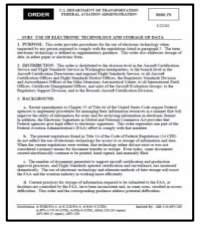
Past



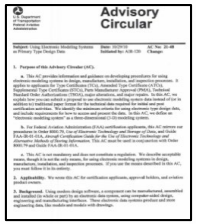
Paper-based process



Code of Federal Regulations

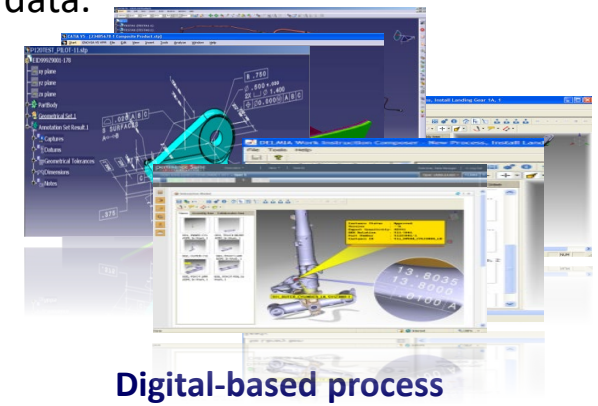


FAA Orders 8000.79, 8110.4



AC21-48

Requirements



Digital-based process

Future

Project Description

The project goal is to *develop, publish and maintain standards* designed to provide the capability *to archive and retrieve* digital product and technical information, including 3D CAD and PDM data, in *a standard neutral form* that can be read and reused throughout the product lifecycle.
The standards are published as NAS 9300 US (EN 9300 Europe), series and cover both the information content as well as the processes required to ingest, store, administer, manage and access the information.

Key Team Members:

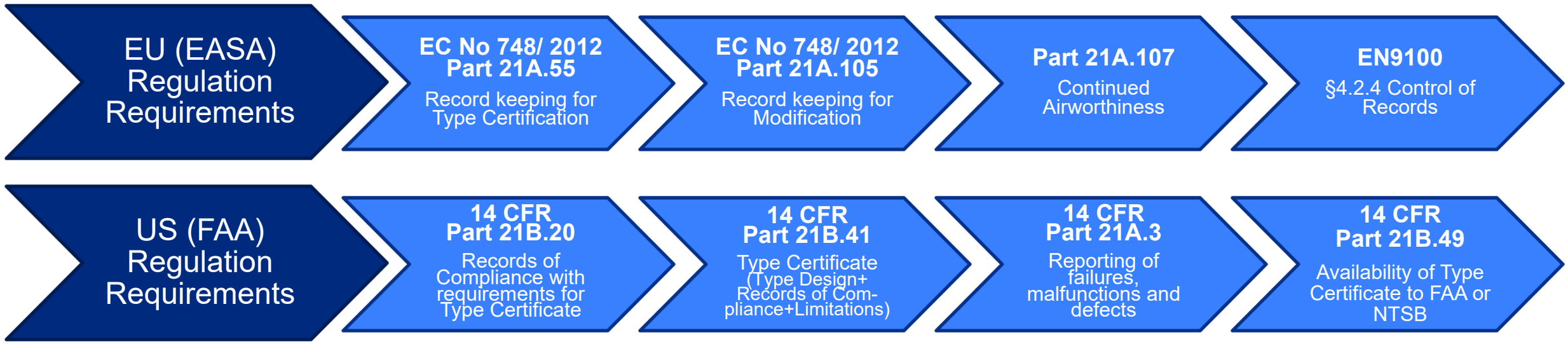
Team Leads and Represented Companies:

- **Boeing**: J. Klein, J.C. Mendo, S. Galt, A. Bingcang, J. VanHorne
- **Lockheed Martin**: J. Holmlund, M. Jahadi, C. Simpson
- **GE**: Xuefeng Zhang
- **Gulfstream**: D. Ganser, L. Nash
- **Raytheon**: J. Ganguli, I. Parent
- **Airbus**: B. Feldvoss, P. Duchier, F. Darre, K. Hall, T. Lindemann

BOEING
LOCKHEED MARTIN
GE Aviation
Gulfstream
A GENERAL DYNAMICS COMPANY
Raytheon
AIRBUS

Regulatory requirements for LOTAR

Document & Data Archiving is a legal obligation defined by external requirements such as the FAA and by internal company policies.



The FAA and EASA have promoted efforts to harmonize the regulations, so there are many similarities between them.

FAA Advisory Circular (AC)

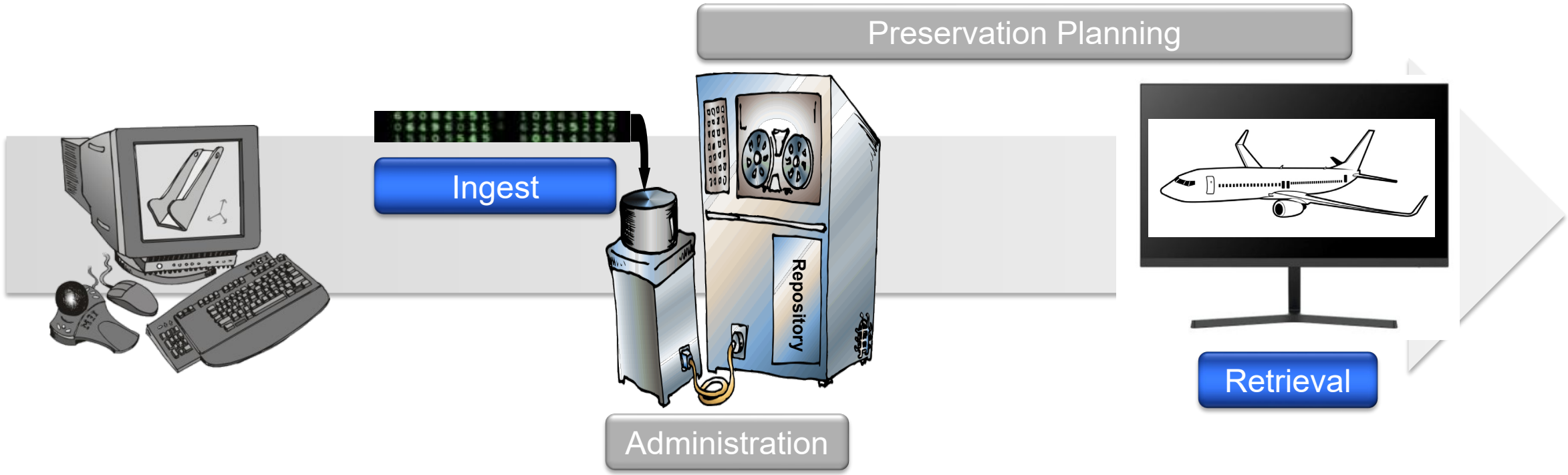
- **FAA AC 21-48, Using Electronic Modeling Systems as Primary Type Design Data**
- …
- 6.b. To use a 3-D modeling system, you must include answers to the following questions in your procedures manual. These extra procedures ensure that the data created by a 3-D modeling system continue to meet all the minimum requirements for using a paper format for the data, including access and usability.
  - (1) How will the data integrity be assured throughout its life cycle?
  - (2) How will users access the electronic data at the point of use?
  - (3) How will the user determine the approval status of the electronic type design data?
  - (4) How will the configuration of the final product be established?
  - (5) How will the 3-D modeling system ensure that the FAA approved data and released data available to manufacturing and inspection personnel are easily distinguished from other data?
  - (6) How will the electronic type design data be transferred to the FAA when the certificate is surrendered or the holder ceases to operate?
  - (7) How will the electronic type design data be transferred to suppliers and other outside users?
  - (8) How will the electronic type design data be used to support continued airworthiness?
  - (9) How will FAA, National Transportation Safety Board (NTSB), and other regulatory agency personnel get access to the electronic type design data?
  - (10) How does the characteristics of the electronics type design data correspond to the original paper format?
  - (11) How will users be trained in using the 3-D modeling system?
  - (12) What attributes are required in the data file?

NASA Requirements

- **The NASA requirements come from NPD 1440.6, NASA Records Management**
- **NPR 1441.1E, NASA Records Management Program Requirements. The current version is E (with change 3)**
- **US laws drive our records requirements**
  - **Disposal of Records, 44 U.S.C. §§ 3301 et seq.**
  - **Records Management, 36 CFR, Chapter XII, Subchapter B.**

The LOTAR project: Supporting the longevity of Aerospace & Defense 3D Model based definitions

- **CAD S/W versions change every 6 to 12 months, CAD generations change every 10 years.**
- **Aircraft lifecycle of 70+ years**
- **The Lifecycle of software & hardware is short compared to the lifecycle of an aircraft or a defense system (nuclear missile...)**



Motivation for LOTAR

- **Meeting the legal and business requirements of the aerospace and defense industry:**

- **EN/NAS 9300 considers requirements from multiple sources:**
  - **Legal and certification rules**
  - **Regulations on long term archiving of technical documentation**
  - **Design reuse**
  - **Support in operation**
- **In addition to legal requirements, there are industry established standards, company specific rules and recommendations.**
- **The EN/NAS 9300 standards define architecture, process and data formats to fulfill these requirements.**

Objectives & Benefits of LOTAR

- **Objectives include:**
  - **Developing *process* standards for archiving and retrieval of product data**
  - **Providing methods, process modules and data model(s), to enable long term archiving of product data: CAD, PDM and additional technical data e.g., MBSE requirements, electronics, software, etc.**
  - **Developing recommendations for practical introduction of long-term archiving of product data**
- **Benefits include:**
  - **Process security achieved through implementation of archival systems compliant to internationally accepted standards**
  - **Aerospace and Defense authorities accept standards due to intense collaboration during standards creation**
  - **Applicable archiving workflow supported by interfaces & functionalities based on open standards**
  - **By solving the challenges of long-term data retention, issues of data exchange are addressed**

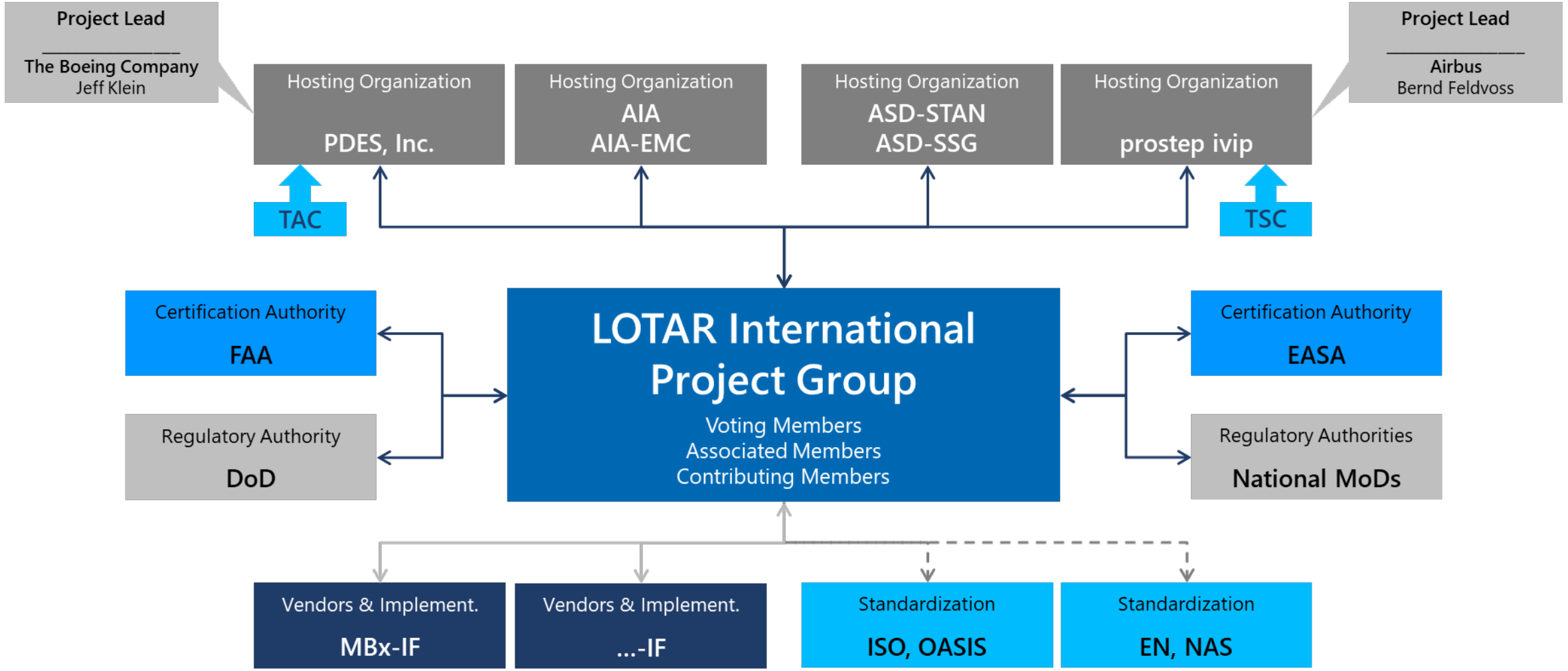
Development and use of LOTAR standards by the A&D industries allow for decreasing the costs and risks of long term archiving of aerospace product data

ORGANIZATION

Who does LOTAR work with?

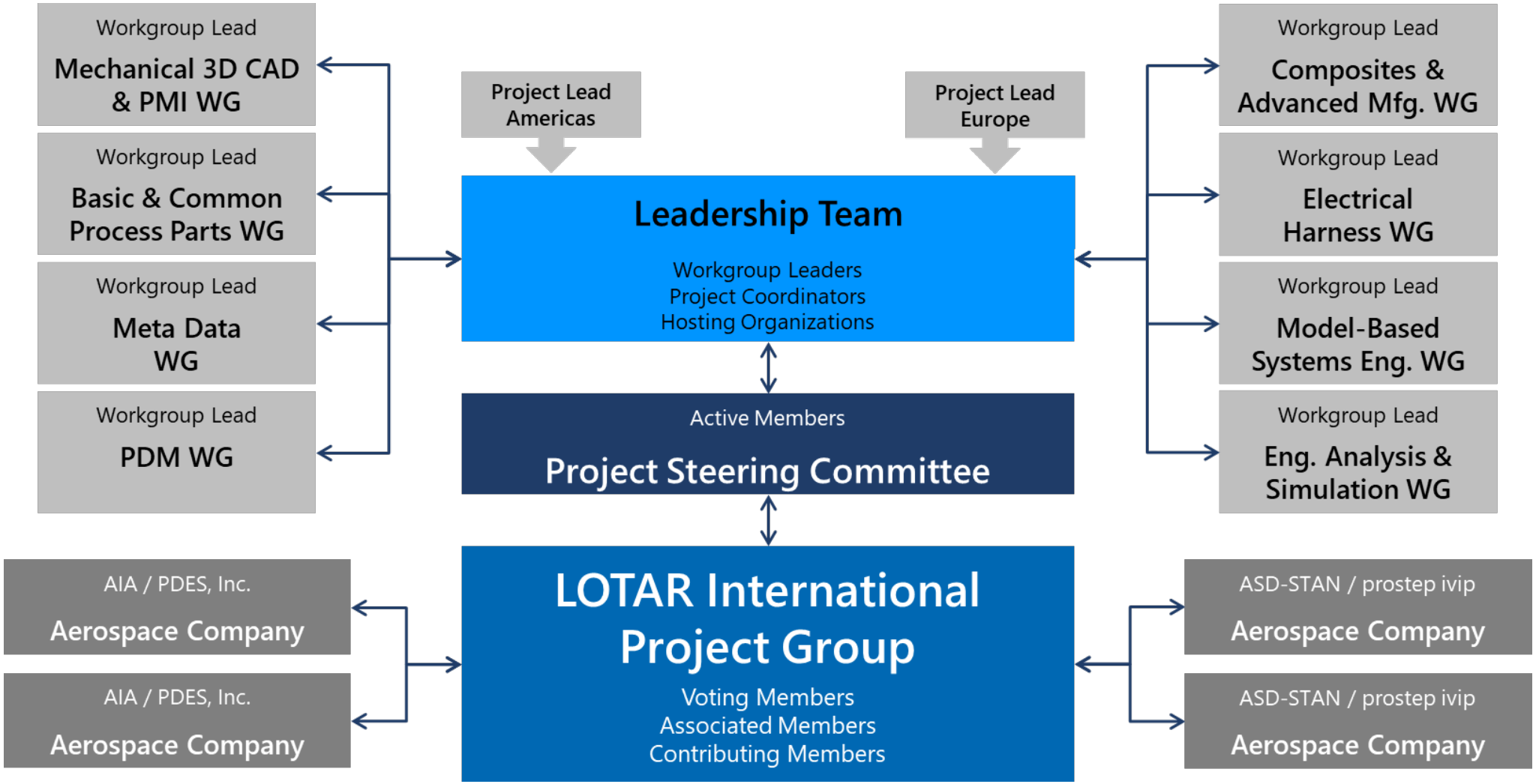
LOTAR Organization

External View



LOTAR Organization

Internal View



Industry Members

AIRBUS

BOEING

EMBRAER

GE Aviation

Gulfstream

LEONARDO

LOCKHEED MARTIN

Pratt & Whitney
An RTX Business

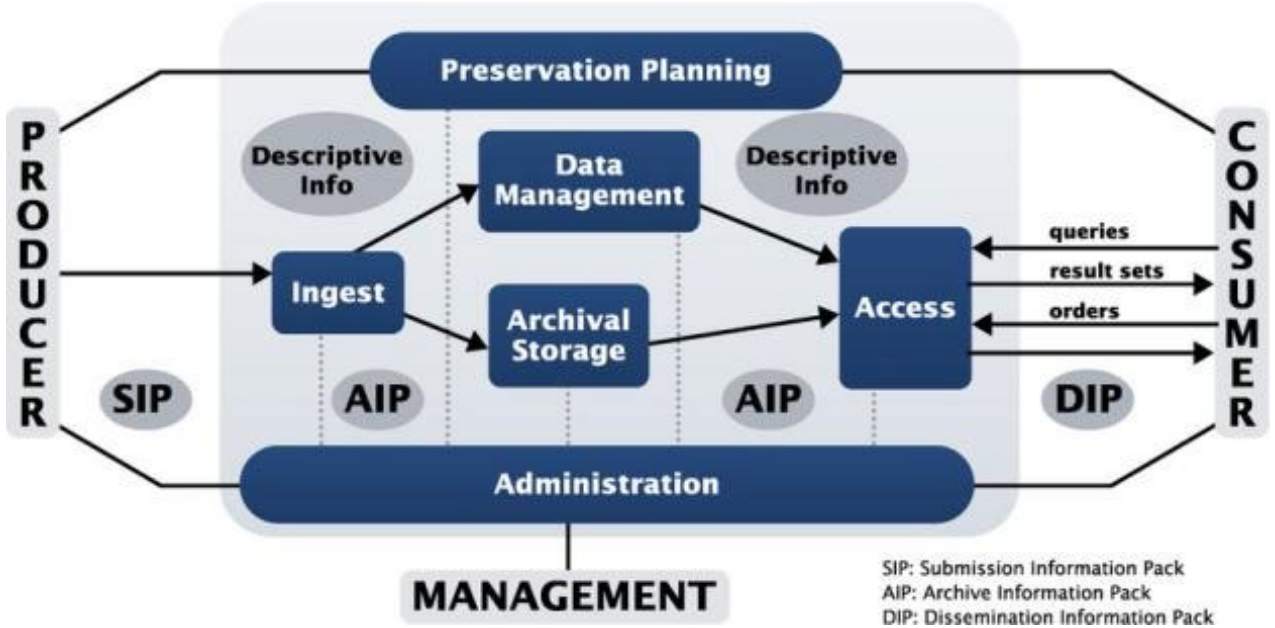
RTX

OAIS

LOTAR Baseline

LOTAR Standard Foundation ISO 14721:2012 (OAIS)

- **“Open Archive Information System” (OAIS) Reference Model is basis for LOTAR processes**
- **Developed by Aerospace and Defense Industry**
- **Extended to meet the specific requirements of LOTAR**



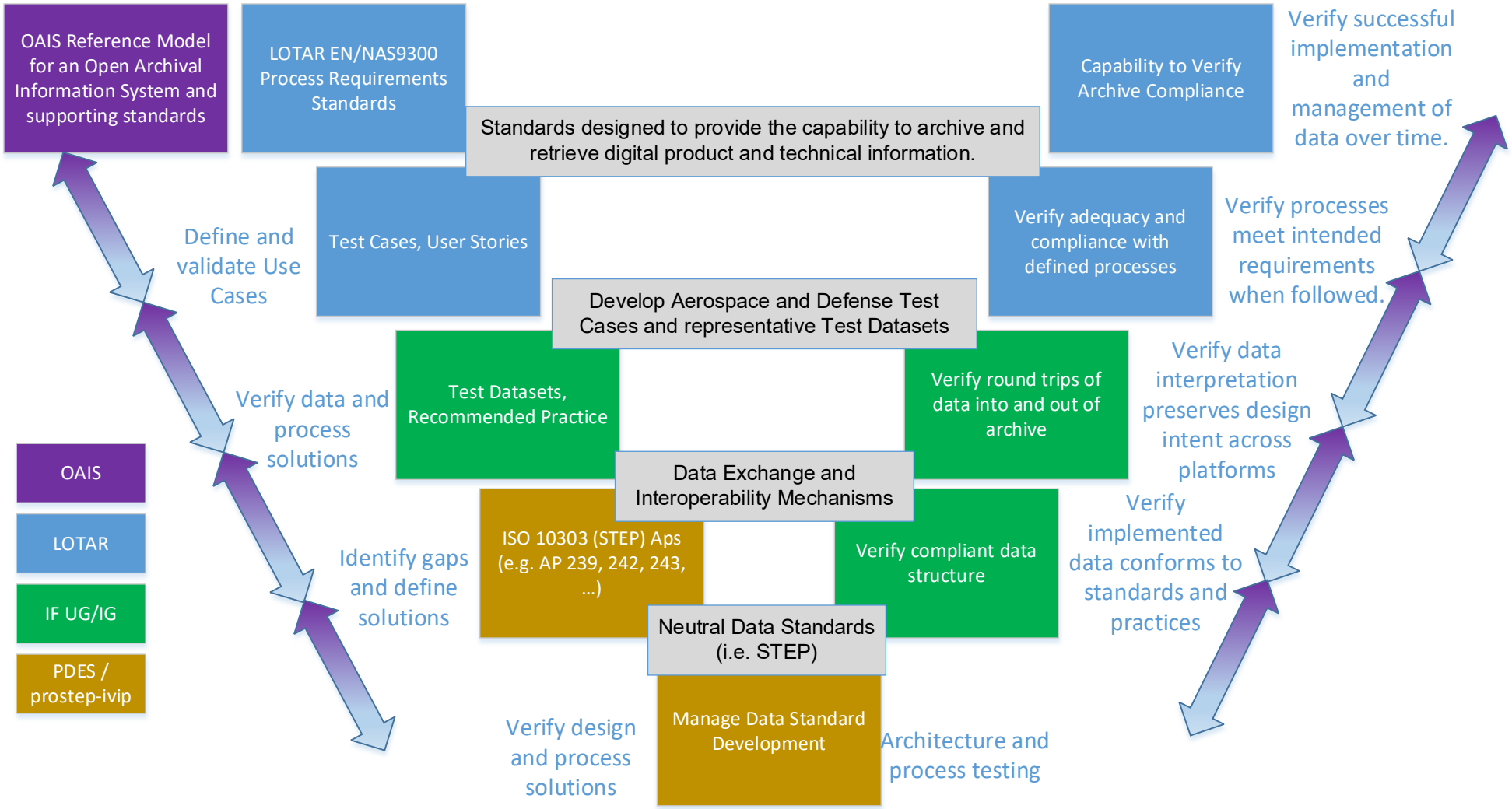
- **As neutral data format for the archives has been chosen (STEP and other standards)**

LOTAR V MODEL

LOTAR to IF to PDES (STEP)

- The consortium of organizations involved with LOTAR take a systems engineering approach to validate requirements and verify they can be implemented.
  - The LOTAR (EN/NAS 9300) process standards are based on the Open Archive Information System standard (ISO 14721).
  - The Interoperability Forums, consisting of User Groups (e.g. Boeing, Airbus, Gulfstream, Raytheon, …, as well as automotive OEMs) and Implementer Groups (e.g. Dassault Systems, prostep, …) develop recommended practices based on LOTAR (and other) use cases; using ISO 10303 as an exchange format.
  - The ISO 10303 (STEP) and other data standards are used to verify the ability to implement LOTAR use cases, and in turn are refined and developed to address identified gaps.

LOTAR Conceptual “V” Model



LOTAR STATUS

Highlights and Challenges
LOTAR Project – 2024, Q3

Highlights and Updates

- Part 7 published
- Part 10 in editing at AIA and ASD-STAN
- Part 100 revision and Part 210 first edition in final editing.
- Others in internal and external ballot.
- Using Redmine with CAX-IF to manage use case development.

Status

- 5 year roadmap and project plans developing updates for 2025
- Working to ensure integration of basic and common with domain parts.
- Supporting STEP AP239, AP242, P4000, AP243 / MoSSEC projects.
- Alternating in person and virtual quarterly workshops.
- Continuing to engage potential new members and developing ways to collaborate with other SDOs and associated organizations.

Key Project Milestones

- Collaborating with Interoperability Forums and associated User Groups to support various product domains: MBx-IF, PDM-IF, MoSSEC etc.
- Expanding the number of Use Cases and Recommended Practices with the Implementor Forums.
- Common datasets for testing in development – MBE Demonstrator and Mars Rover.
- Multiple LOTAR parts in pipeline for review and initial release.

Challenges/Help Needed

- With the emphasis on types of digital engineering, digital thread, there are increasing efforts to develop data exchange methods.
    - Opportunity is to develop standards to support both exchange and **preservation**.
- Need Subject Matter Experts (SME) and succession planning to develop and grow sustainable experience base.
- European co-leader needed for Electrical Harness and EA&S
- Establishing charter for an Electronics WG

5-year Roadmap

Upcoming Standard Publications

- **Part 001, Structure, Ed 2**
- **Part 002, Requirements Ed 2**
- **Part 003, Fundamentals and Concepts Ed 2 (incorp 004) Ed 2**
- **Part 005, Authentication and Verification Ed 2**
- **Part 007, Terms and References Ed 3**
- **Part 010, Overview Data Flow Ed 2**
- **Part 100, 3D Mechanical CAD with PMI, Common Concepts Ed 2**
- **Part 115, Explicit CAD Assembly Structure Ed 2**
- **Part 120, Explicit CAD Geometry with Graphic PMI Ed 3**
- **Part 200, PDM, Common Concepts Ed 1**
- **Part 210, "As Designed" Product Structure Ed 1**
- **Part 205, Product Data Validation Properties, Ed 1**
- **Part 230, "As Built" Product Structure Ed 1**
- **Part 300, Composites, Fundamentals and Concepts Ed 2**
- **Part 310, 3D Composite Exact Implicit & Approximate Implicit Ed 1**
- **Part 400, Elect. Harness Fund. & Conc. Ed 1**
- **Part 410, Elect. Harness Design & Constr. Ed 1**
- **Part 500, MBSE Fundamentals and Concepts Ed 1**
- **Part 520, MBSE Analytical Model Ed 1**

LOTAR 5-Year Roadmap

LOTAR

Last Update: 2023-12-05

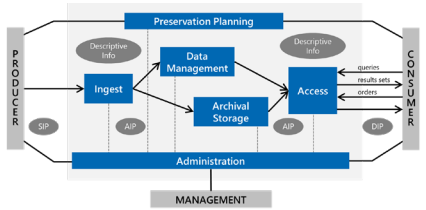
Fx = Edition x | R = Review / Release | = Activity | = Planned/Preparation

WP	###	Title	2024 Q1	2024 Q2	2024 Q3	2024 Q4	2025 Q1	2025 Q2	2025 Q3	2025 Q4	2026 Q1	2026 Q2	2026 Q3	2026 Q4	2027 Q1	2027 Q2	2027 Q3	2027 Q4	2028 Q1	2028 Q2	2028 Q3	2028 Q4
1		*Basic Parts*																				
1.1	001	Structure		R																		
1.2	002	Requirements		R																		
1.3	003	Fundamentals and Concepts				R																
1.4	005	Authentication and Verification																				
1.5	006	Functional Architecture				R																
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					R															
2.4	013	Archival Storage						R														
2.5	014	Retrieval							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 F3																	
3.1.3	115	Explicit CAD Assembly Structure			F2																	
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																				
3.1.9	132	Structural Joins for Assembly & Installation						F1														
3.1.10	14x	Kinematics							E1													
3.1.11	1xx	Sheet Metal												E1								
3.1.12	1xx	Welding												E1								
3.2		PDM																				
3.2.1	200	Common Concepts				F2																
3.2.2	205	Product Data Validation Properties	R																			
3.2.3	210	"As Designed" Product Data	E1																			
3.2.4	220	"As Planned" Product Data																				
3.2.5	230	"As Built / As Maintained" Product Data		E1										E2								
3.2.6	240	"In Development" Product Data								E1												
3.2.7	250	"Unaccepted Changes"																				
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		E1							E2											
3.4.2	410	Physical Electrical Harness for Design & Construction		E1																		
3.4.3	420	Electric Wiring Interconnection System Installation						F1														
3.4.4	430	Electric Wiring Interconnection System Logical Information														F1						
3.5		MBSE																				
3.5.1	500	Fundamentals and Concepts	E1			E2 or R																
3.5.2	510	Requirements				L1																
3.5.3	515	(Requirements), Validation & Verification					E1															
3.5.5	520	Analytical model		E1				F2														
3.5.5	530	Architecture models								F1												
3.5.6	540	LBOM									E1											
3.6		Engineering Analysis & Simulation																				
3.6.1	600	Fundamentals and Concepts (Draft exists)																				
3.6.2	610	Simulation & Process Data Management	*The LOTAR Engineering & Analysis Workgroup is currently on hold. Next steps will be planned when activities in this domain are resumed.*																			
3.6.3	620	Structural Finite Element Analysis (Draft exists)																				
WP	###	Title	2024 Q1	2024 Q2	2024 Q3	2024 Q4	2025 Q1	2025 Q2	2025 Q3	2025 Q4	2026 Q1	2026 Q2	2026 Q3	2026 Q4	2027 Q1	2027 Q2	2027 Q3	2027 Q4	2028 Q1	2028 Q2	2028 Q3	2028 Q4

In Review

LOTAR WORKING GROUPS

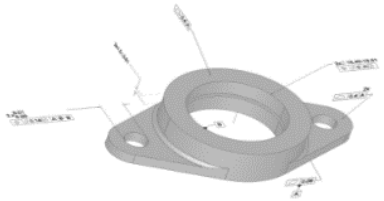
LOTAR Working Groups



2018

Basic & Common Process Parts

EN/NAS 9300-00x & -01x series

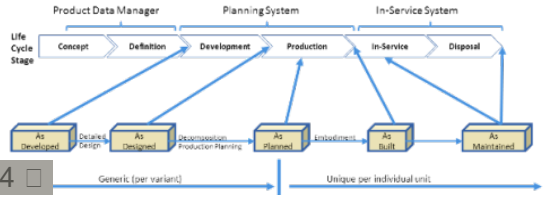


2004

Mechanical 3D CAD with Product and Manufacturing Information (PMI)

EN/NAS 9300-1xx series

STEP AP203, AP214, AP242

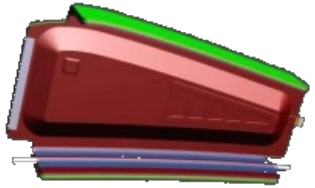


2004

Product Data Management (PDM)

EN/NAS 9300-2xx series

STEP AP239, AP242



2009

Composites and Advanced Manufacturing

EN/NAS 9300-3xx series

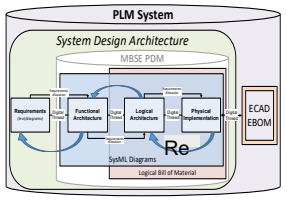
STEP AP203, AP242

2012

Electrical Wiring Harness

EN/NAS 9300-4xx series

STEP AP242

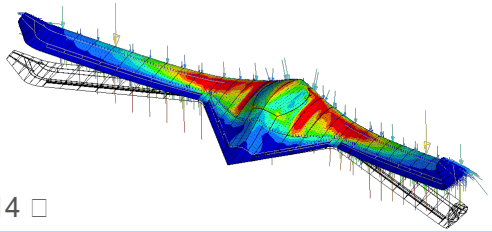


2018

Model-Bases Systems Engineering (MBSE)

EN/NAS 9300-5xx series

STEP AP233, AP239, AP242, AP243
FMI, SysML, AADL, ReqIF…



2014

Engineering Analysis and Simulation (EAS) *(on hold)*

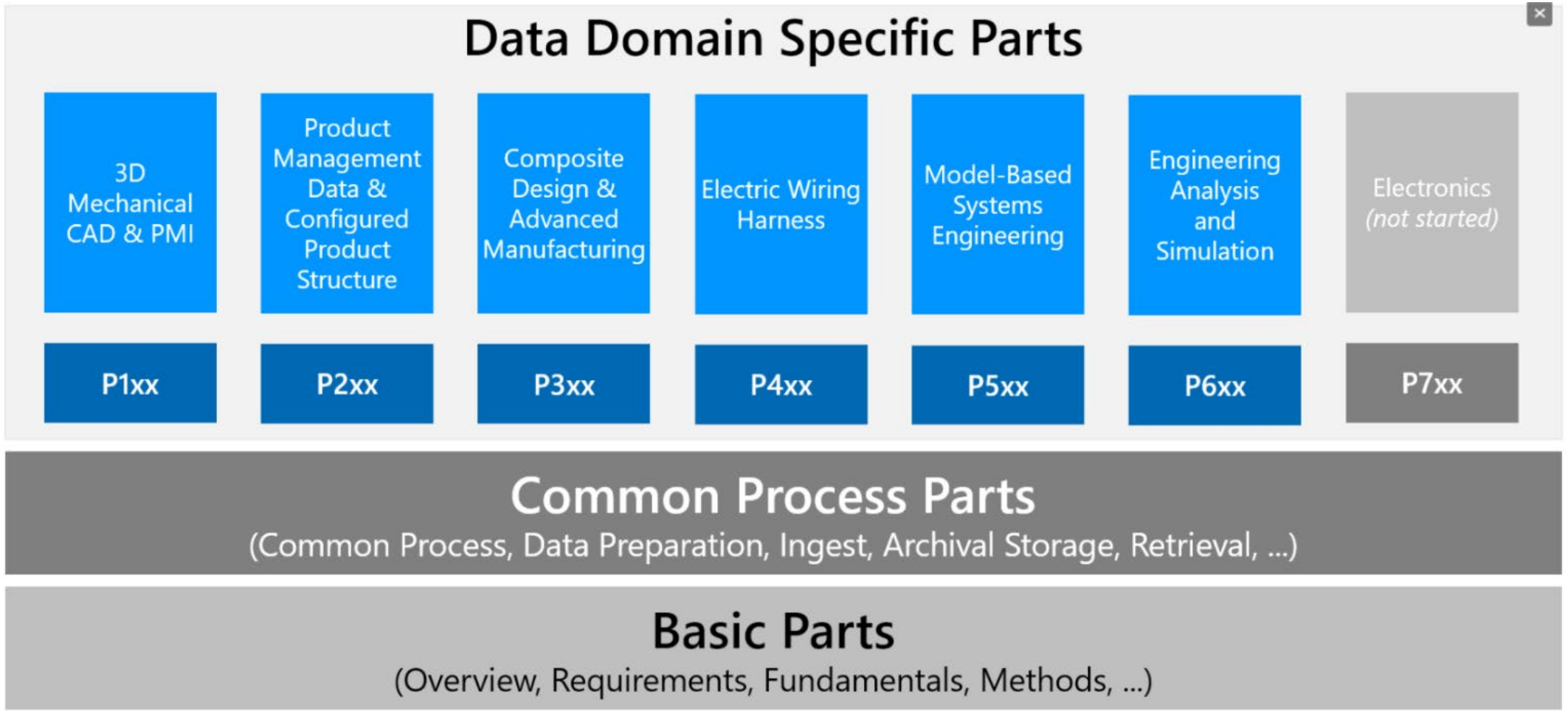
EN/NAS 9300-6xx series

STEP AP209

LOTAR EN/NAS 9300 STANDARDS

LOTAR Deliverables

LOTAR Standards Overview



BASIC & COMMON WG

Fundamental and Conceptual Process Methodologies

Basic Parts and Common Process Parts

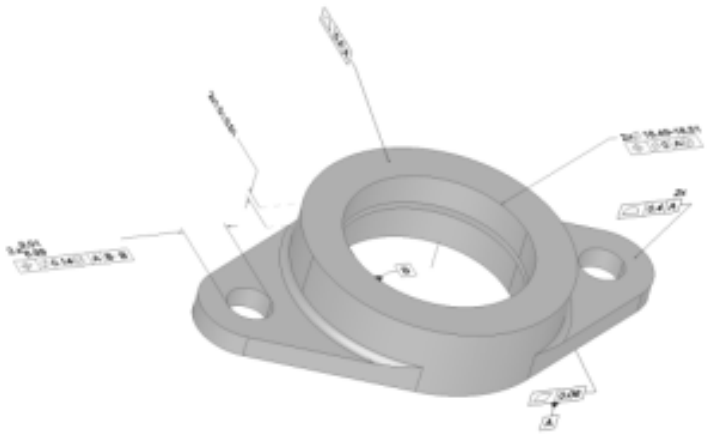
- **Basic Parts**
  - **Fundamental process requirements standards based on OAIS**
- **Common Process**
  - **Process standards derived from the basic parts, common to all domains**
- **Goals and Objectives**
  - **The specific goal of the Basic and Common Parts Working Group is focused on the fundamental and conceptual process methodologies of long-term preservation of digital product and technical data.**

3D MECHANICAL CAD & PMI WG

3D CAD with Product and Manufacturing Information (PMI) – Mechanical, PMI, Manufacturing Features

LOTAR WG: 3D Mechanical CAD with PMI (EN/NAS 9300-1xx)

- **Scope:**
  - **The specific goal of the Mechanical 3D CAD with Product and Manufacturing Information (PMI) workgroup is focused on the preservation of the explicit 3D Geometric shape representation and associated Product and Manufacturing Information. The results are documented as NAS/EN 9300-1xx parts. Deliverables(*):**



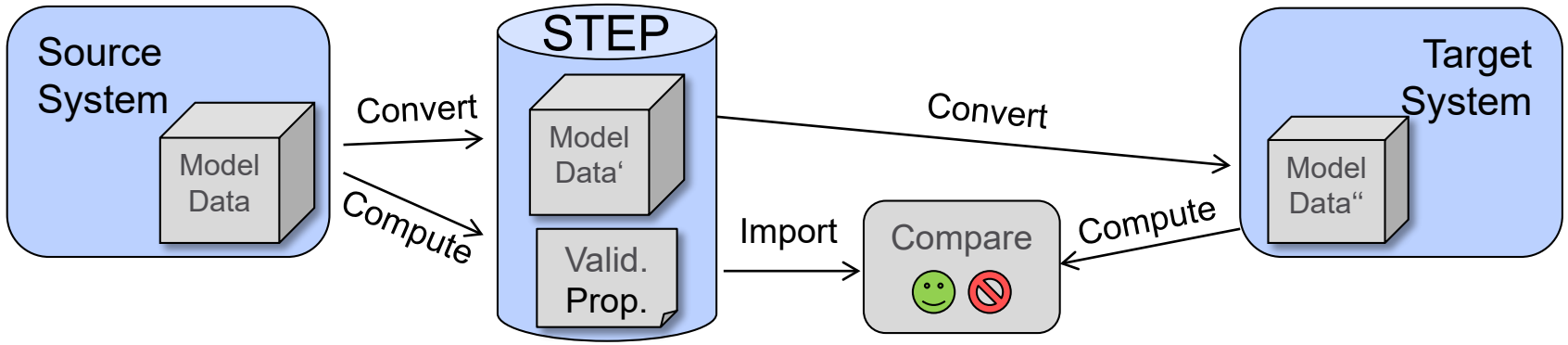
- Parts:
  - 100 (Common Concepts)
  - 110 (Explicit 3D Geometry)
  - 115 (CAD Assembly Structure)
  - 120 (PMI Graphic Presentation)
  - 121 (PMI Semantic Representation)
  - 125 (Assembly PMI Graphic Presentation)
  - 126 (Assembly PMI Semantic Representation)
  - 132 (Representation and Presentation of Holes and Fasteners)

- Comprehensive suite of test models
- Numerous pilot projects in cooperation with the MBx-IF
- Support of STEP AP242 development and associated Recommended Practices

(*): Accomplished or in work; more planned

Validation of LOTAR STEP Data

- **A distinctive feature of the combined use of LOTAR and STEP is the use of Validation Properties**
- **Validation Properties are key characteristics of a digital model that help to ensure consistency of the data**



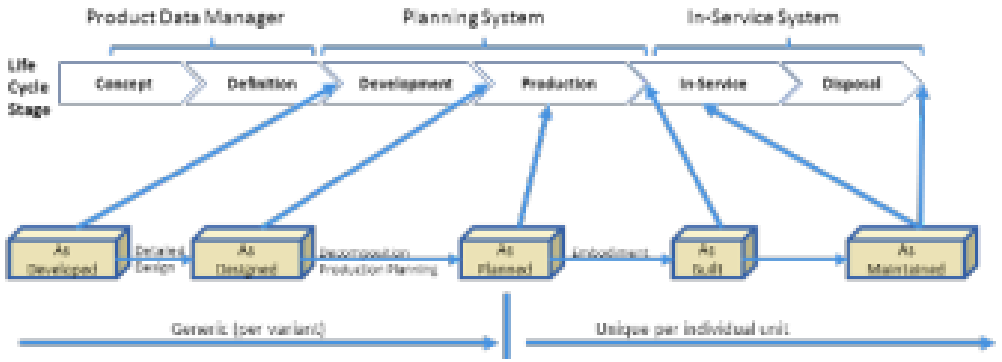
- **They are computed by the exporting system using geometric elements in the STEP file**
- **Any importing system will compare its import results with these properties and thus determine success of the data transfer.**

PDM WG

Product Data Management (PDM) / Product Lifecycle Management – Product Structure: As-Designed, As-Built and As-Maintained

LOTAR WG: PDM (EN/NAS 9300-2xx)

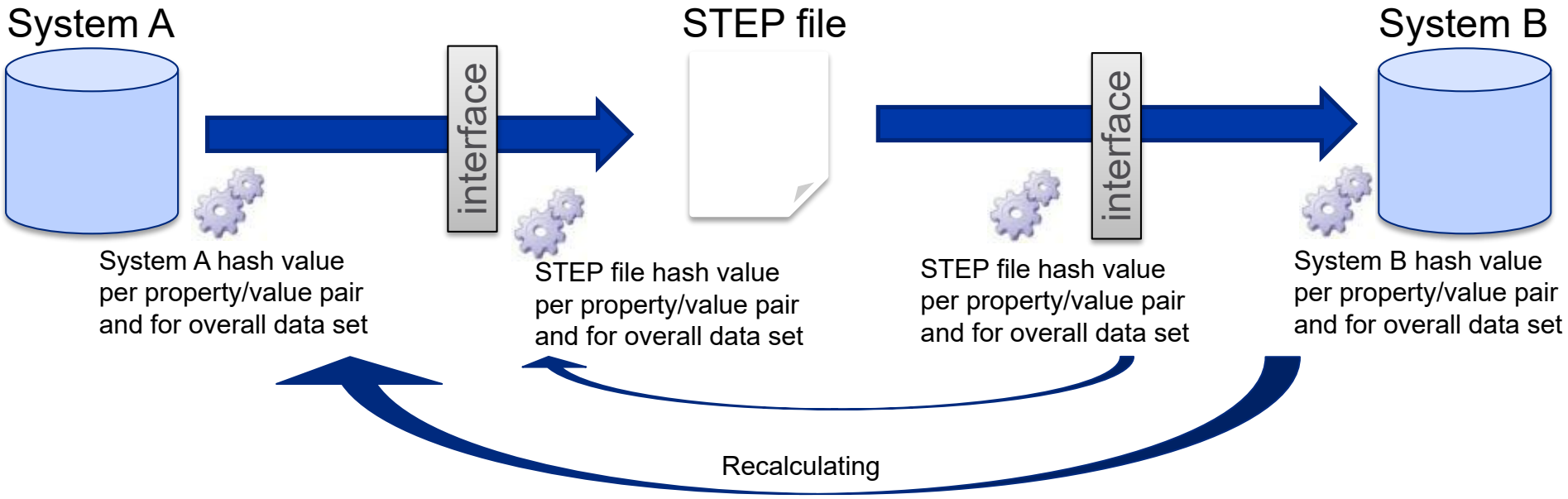
- **Scope:**
  - **Archive and retrieve Product Data Management information in a standard neutral form that can be read and reused throughout the product lifecycle**
  - **Preservation of digital PDM information along the product lifecycle: in development, as designed, as planned, as delivered and as maintained.**
- **Deliverables(*):**
  - **Part 200 Fundamentals and Concepts**
  - **Part 205 Product Structure Validation Properties**
  - **Part 210 as designed (ed. 2 incl. effectivities)**
  - **Part 230 as built (dependency on Part 210)**
  - **Part 240 Product Development (including prelim design review, critical design review, FAI, etc.),**
  - **Part 250 Change Management**



(*): Accomplished or in work; more planned

Validation of LOTAR STEP Data

- **An example application of a validation property is the LOTAR technical specification EN/NAS 9300-205 on “Product Structure Validation” using hash code to check consistency of data between systems**

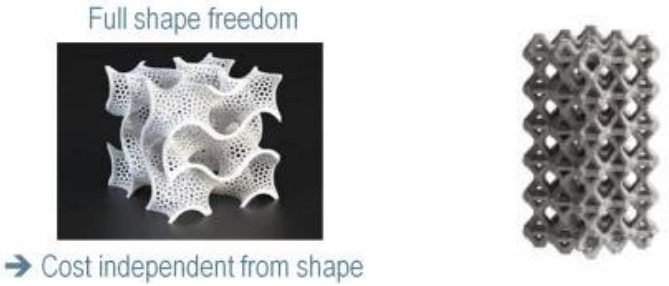


COMPOSITES (DESIGN FOR ADVANCED MANUFACTURING) WG

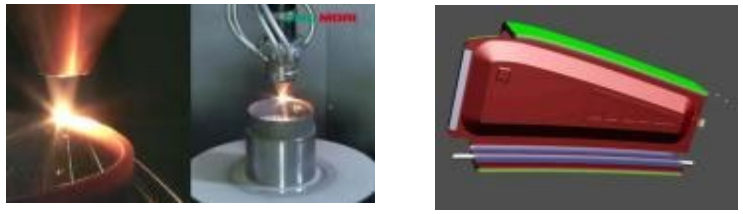
Representing design requirements for advanced manufacturing (composite, additive, etc.)

LOTAR WG: Advanced Manufacturing (EN/NAS 9300-3xx)

- **Scope:**
  - **Preservation of new information required in STEP data model for Composite design and Additive manufacturing:**
  - **Organic Shapes and Surface Models**
  - **Design Tools**
  - **Representation Formats**
  - **Preservation of CAD 3D tessellated solids**
  - **3D composite structures information such as Sequences, Plies, Cores, Material properties, Rosette, Orientation…**
  - **Preservation of CAD 3D tessellated solids**



- **Deliverables(*):**
  - **Parts 300 (Common Concepts), 310 Ed.1 (“exact implicit”–Ply Definition), 310 Ed.2 (“approximate explicit”–3D Tess. Solid)**
  - **Support of STEP AP242 Development and associated Recommended Practices**
  - **Prototype part developed to anticipate future structures to demonstrate concepts**
  - **Independent tests of CAD tools for the purpose of interoperability**



(*): Accomplished or in work; more planned

ELECTRICAL HARNESS WG

Digital electrical harness models for
design, manufacturing, and support.

LOTAR WG: Electric Harness (EN/NAS 9300-4xx)

- **Scope:**
  - **Preservation of digital electrical harness models for**
    - **Design**
    - **Certification**
    - **Manufacturing**
    - **Support**
- **Deliverables(*):**
  - **Part 400 (Common Concepts),**
  - **Part 410 (Physical harness definition for design & construction)**
  - **Preparation of test cases for physical electrical harness definition**
  - **Data model for Electrical Harness Data is fully defined in AP242 ED4**
  - **Coordination with other standardization projects related to electrical harness (STEP AP 210, AP239, VDA VEC specification, ...)**

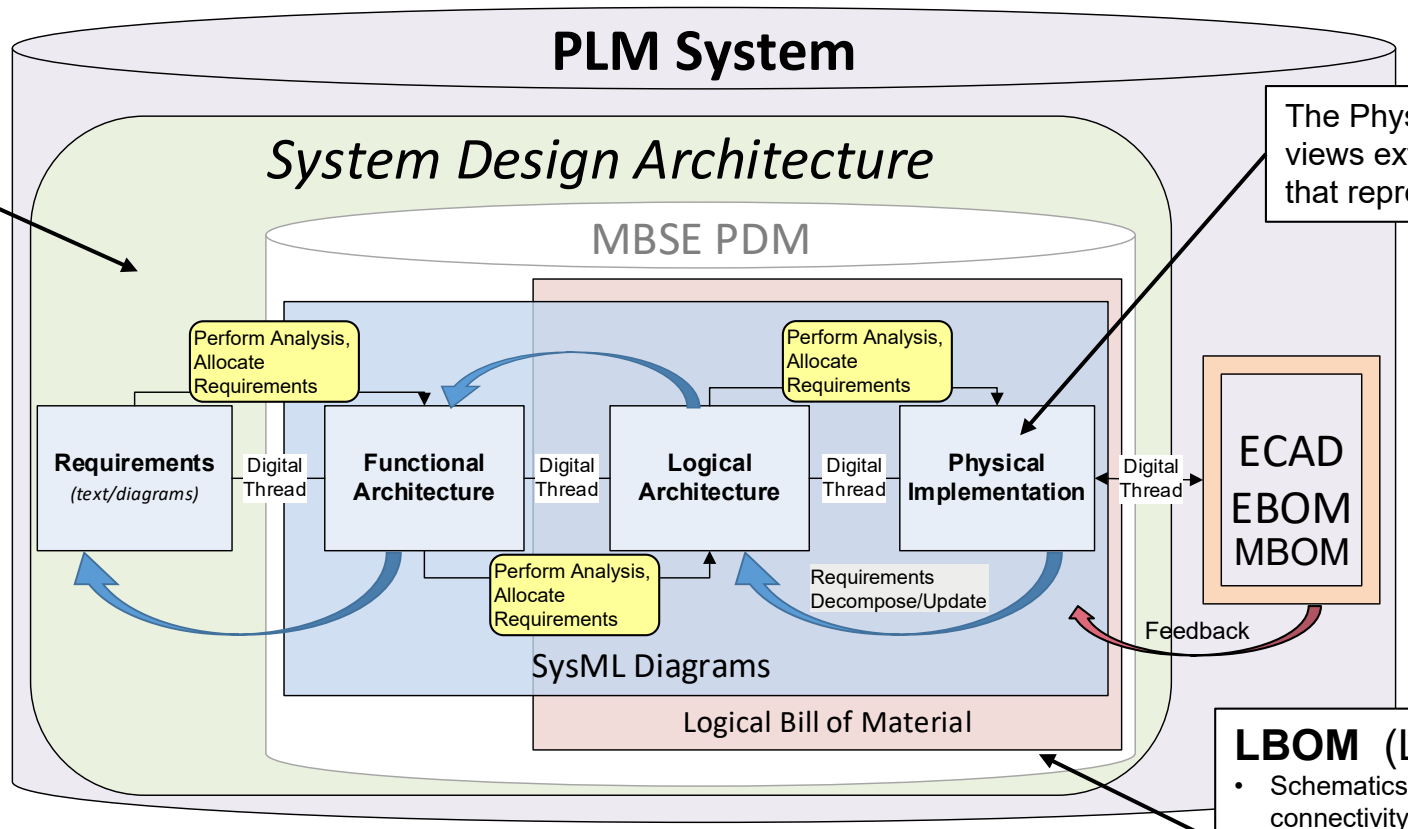
(*): Accomplished or in work; more planned

MODEL BASED SYSTEMS ENGINEERING WG

Preservation of system-descriptive and analytical models that are explicit, coherent, and consistent.

LOTAR WG: Model-Based System Eng. (EN/NAS 9300-5xx)

RFLP Process
(from an MBSE view)



The Physical Implementation represents the views extracted from the Logical Architecture that represent the LBOM.

[The Transition to MBSE – Maturing the Analysis and Simulation Process](), Credit: Hubertus Tummescheit (Modelon) and Mark Williams (Boeing)

LBOM (LOTAR potential)

- Schematics, analysis results, sizing/material specs, connectivity
- Indentured lists - parts, IDs, requirements, verification needs
- Work statement narratives - Mfg Testing Criteria
- Safety Needs - protection, containment, handling, separation, restrictions

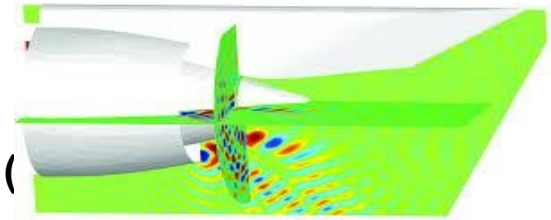
ENGINEERING ANALYSIS AND SIMULATION WG

Analysis and Simulation models, e.g. Finite Element Analysis

LOTAR WG: Engineering Analysis & Simulation (EN/NAS 9300-6xx)

RESTART

- **Start of the LOTAR working group for "Engineering Analysis and Simulation" in 2014**
  - **Scope: Preservation of Simulation and Analysis information**
  - **Deliverables(*):**
    - **Part 600 (Fund. & Concepts),**
    - **Part 610 (Simulation Data Management)**
    - **Part 620 (Structural Analysis information)**
  - **Coordination with other standardization projects related to S & A (**



www.ap209.org/

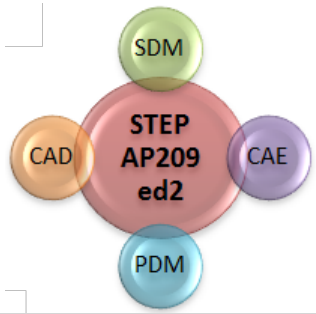
- **Scope of ISO STEP AP 209e2 "Multi-Disciplinary Analysis and Design"**
  - **Structural analysis**
  - **Computational Fluid Dynamic**
- **Launch of a "CAE IF" as part of the CAx Implementor Forum would be expected**
- **Regular coordination with NAFEMS (USA, Europe)**

(*): Accomplished or in work; more planned

STEP AP209 edition 2: Multidisciplinary analysis and design

RESTART

- **ISO 10303 STEP AP209 ed2** is the target data model for simulation data long term archiving (LOTAR)
- STEP AP209 public web site: www.ap209.org
- Governance by ISO Technical Committee 184 for Industrial Automation Systems and Integration, Subcommittee 4 for Industrial Data



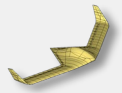
AP209 integrates 4 domains: CAD, CAE, SDM and PDM

SDM : Simulation Data Management
CAD : Computer Aided Design
CAE : Computer Aided Engineering
PDM : Product Data Management

Development History

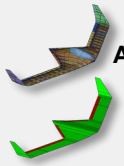
- AP209 ed1 published in 2001
- AP209 ed2 became an ISO International Standard Dec. 1st 2014
- Builds upon the full capabilities of STEP AP242 ed1 (*Managed Model Based 3D Engineering*)
- Edition 2 scope now includes:
  - *Product definition (product structure and 3D shapes)*
  - *Configuration control information*
  - *Finite element data (linear statics and modes)*
  - *Material specifications & properties*
  - *Computational Fluid Dynamics (based on CGNS Std.)*
  - *Generic structured and unstructured analysis mesh*
  - *Meshless numerical analysis*
  - *Discrete/continuous field representation*
  - *Kinematics analysis*

Computer Aided Design
3D Solids
Surface Lofts
Structural Layouts

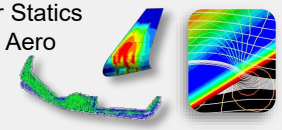


Product Data and Metadata
Product Structure
Analysis Structure
Configuration Data
Material Specification

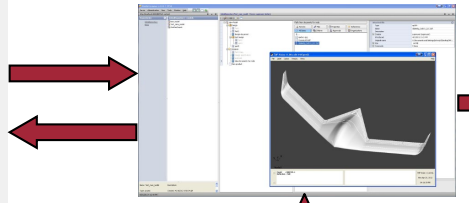
Analysis Geometry
Idealized for Loads
Idealized for Structures
Idealized for Aero



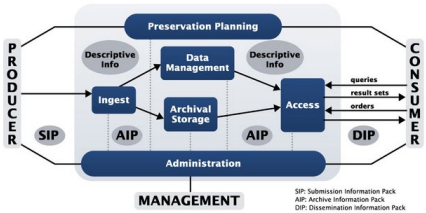
Finite Element Models and Analysis
Linear Statics
Panel Aero
CFD



Simulation Data Management



Long Term Archival and Retrieval (LOTAR)



INTEROPERABILITY FORUMS

What is the MBx-IF?

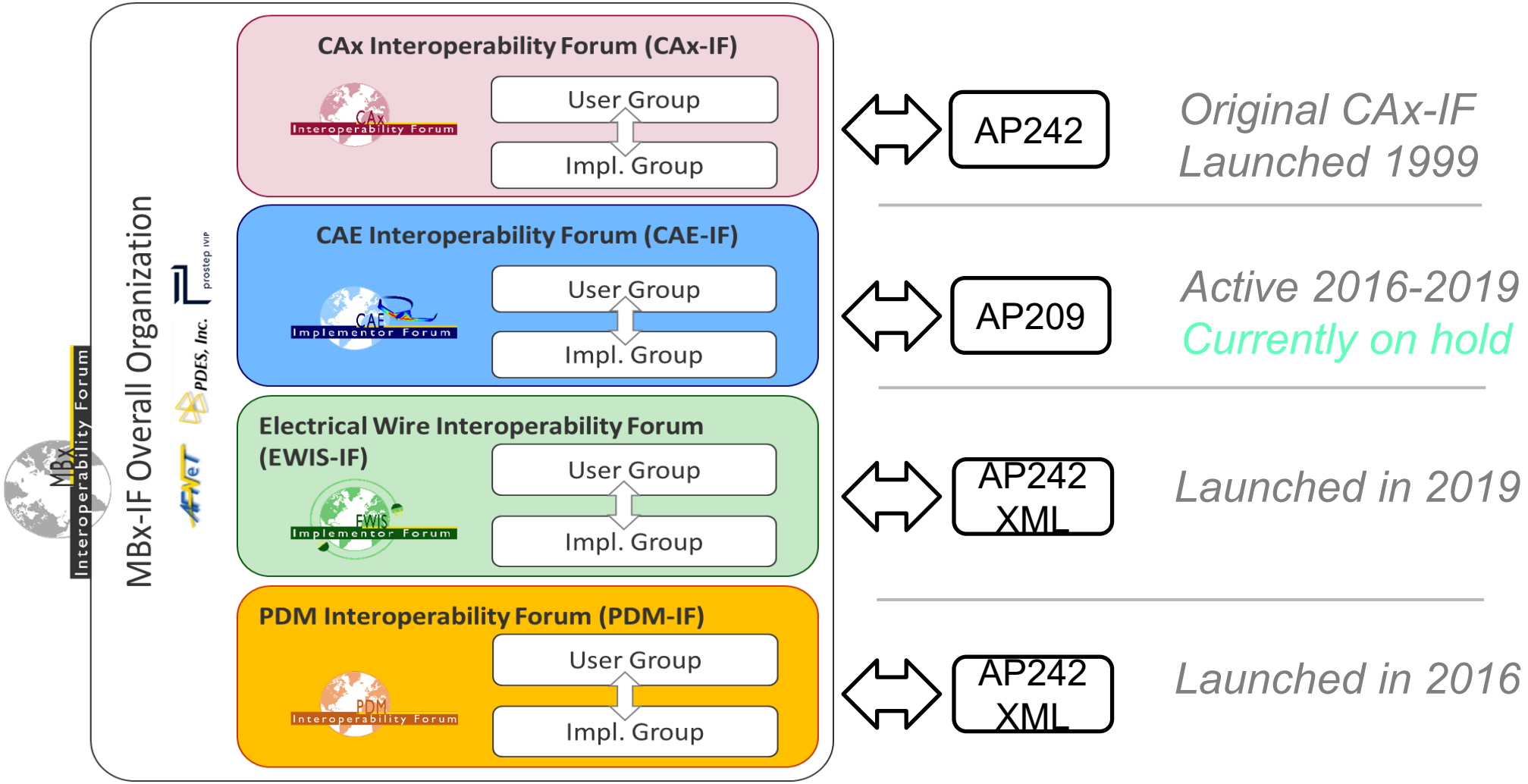
- **The Interoperability Forums bring together users and vendors from different domains to discuss common issues and approaches at the data and application level**
- **The MBx-IF is an umbrella organization over multiple Interoperability Forums**
  - **CAx-IF**
  - **EWIS-IF**
  - **PDM-IF**
  - **CAE-IF (*on hold*)**
  - **MBSE (proposed)**
- **Provides a common organization and infrastructure for the Interoperability Forums**

MBx-IF Memorandum of Understanding

Signed by AFNeT, prostep ivip & PDES, Inc.

- **MoU across sponsoring organizations enables LOTAR use cases to be evaluated and tested, resulting in recommended practices.**

MBx-IF Project Framework



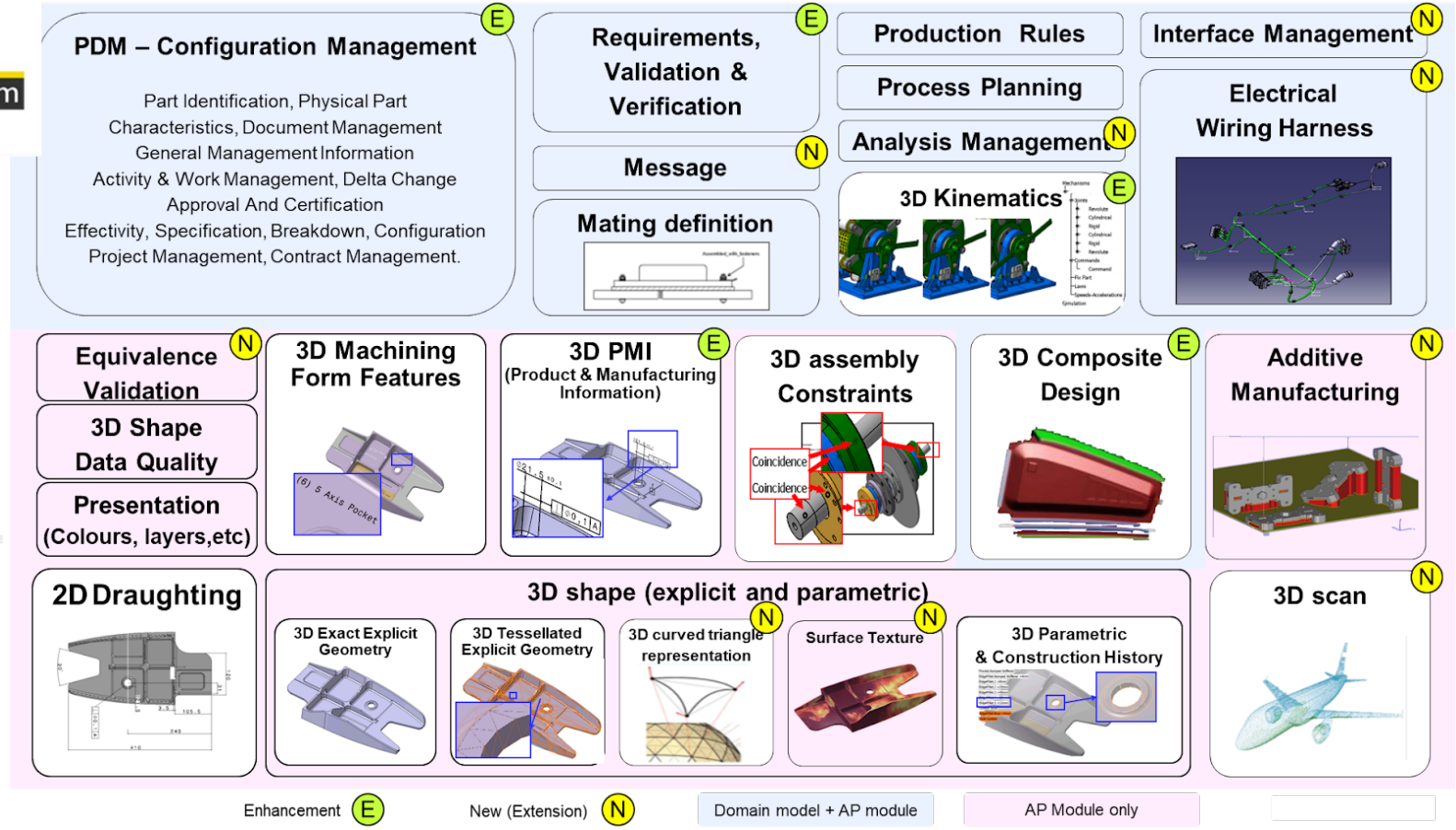
Relation of the Interoperability Forums within the MBx-IF

MBx Interoperability Forum

CAx Interoperability Forum

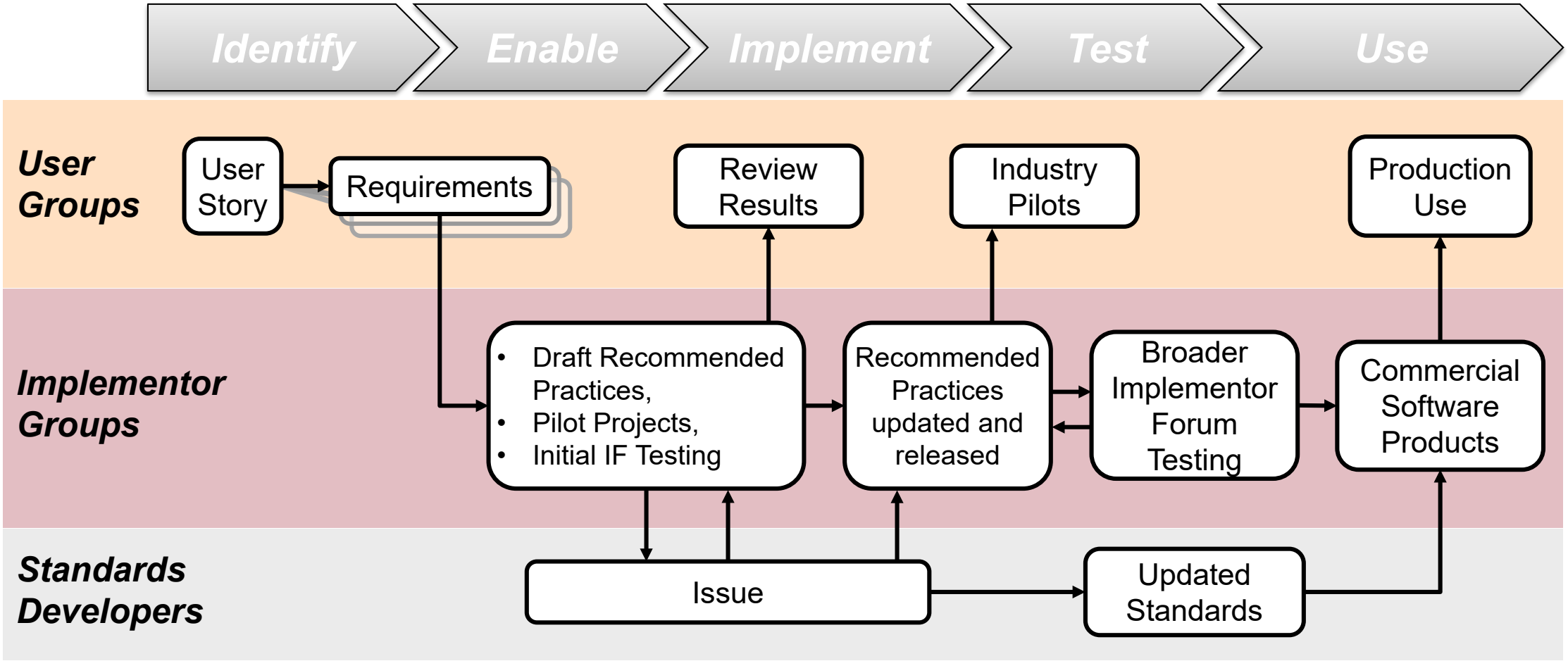
PDM Interoperability Forum

EWIS Interoperability Forum



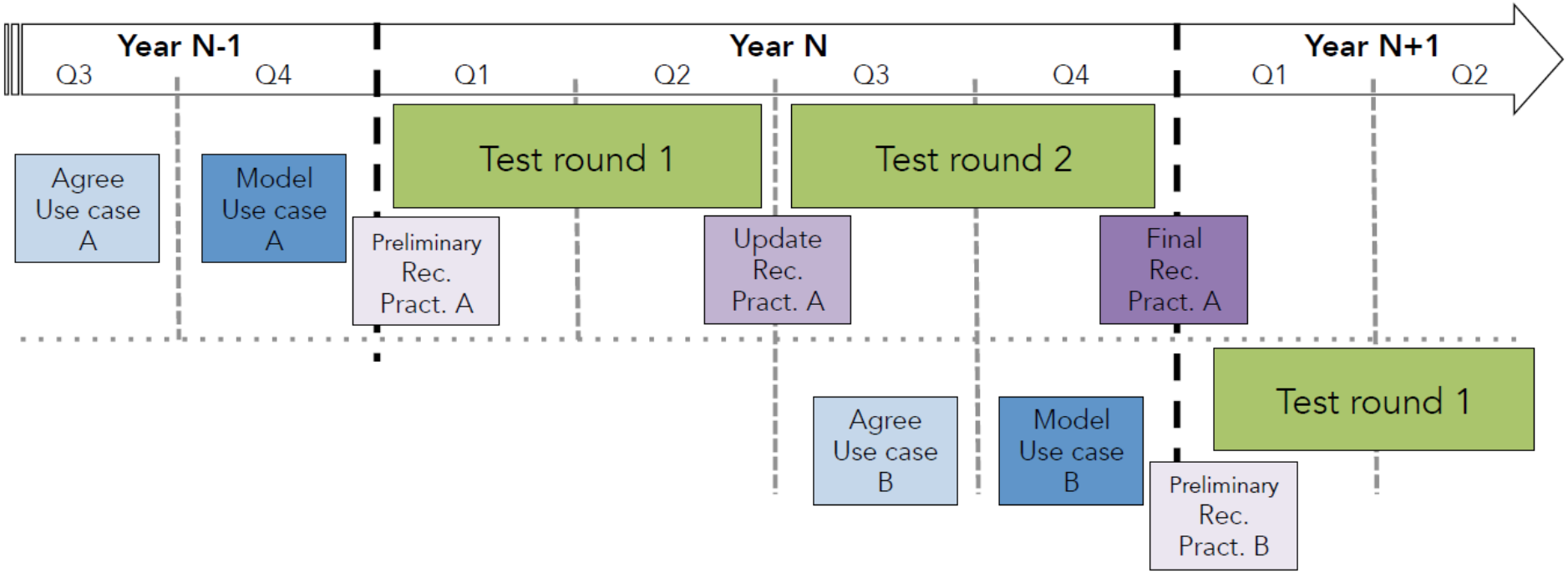
Overview of the scope of STEP AP242

Way of Working between Users, Implementors, and Standards



Typical Schedule within each IF

- **Overview**



- **Detailed testing results are kept private within the project**
- **Recommended Practices (update every year) and Benchmark testing results (every 2 years) are publicly available**

Harmonized MBx-IF Infrastructure

Shared between hosting organizations

Redmine

- For all User Groups
- Document and track
  - Capabilities
  - Features
  - User Stories
- Following SAFe (Scaled Agile Framework) approach
- Hosted by PDES, Inc.

Nextcloud

- File Sharing platform for all teams within the MBx-IF
- Private folders for closed discussions
- Shared folders for common topics
- Supports on-line editing of Office documents & diagrams
- Hosted by AFNeT

CAESAR

- For all Implementor Groups
- Online test evaluation and documentation
- Tracking of Technical Discussions
- Direct integration with Redmine, Nextcloud, and ISO SC4 Jira
- Hosted by prostep ivip

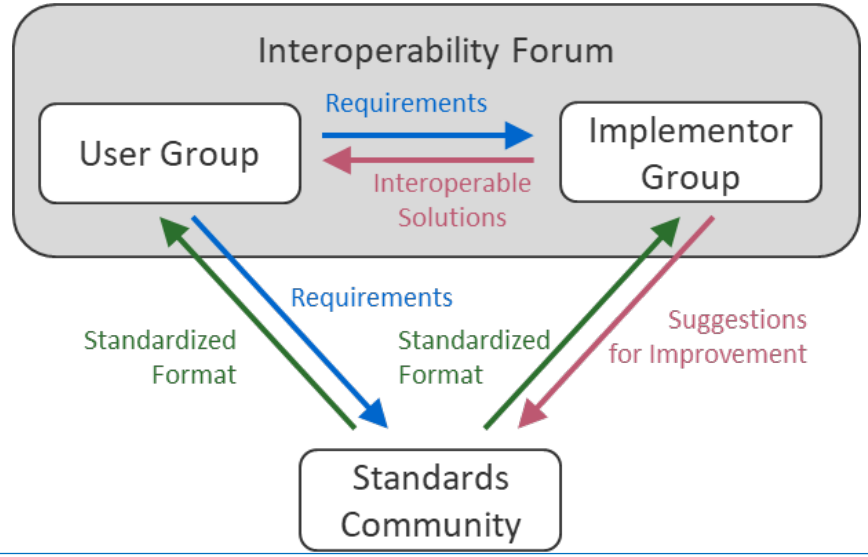
How Industry benefits from the MBx-IF

Member / Vendor Benefits

- Testing in a closed, trusted environment
- Early detection of errors leads to faster development cycles
- Beta-testing with other systems enhances product interoperability and robustness even before production release
- User requirements (including from LOTAR working groups) can be communicated, and common implementation approaches agreed.

User / Customer Benefits

- Stability of new capabilities
  - E.g., PMI Polyline Presentation: Since testing started in 2008, no major changes to implementation structure. Widely used in industry now!
- Early feedback on requirements
  - Concerning feasibility, and timeframe for support in various tools

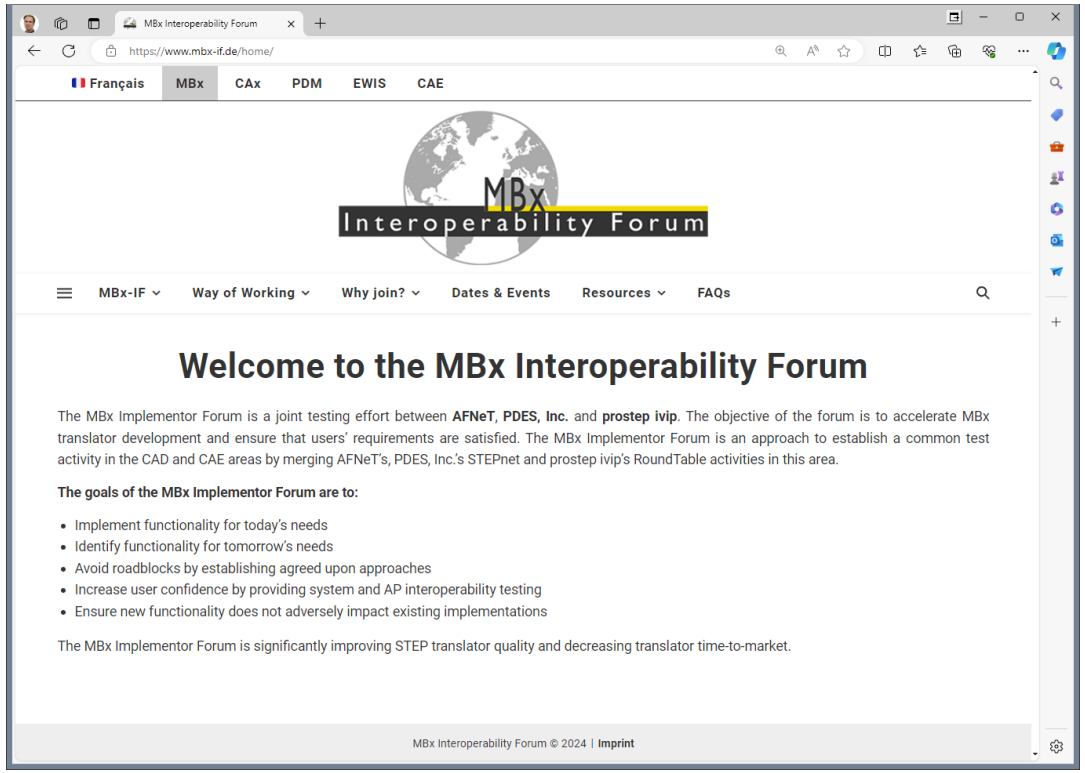


New MBx-IF Homepage

- https://www.mbx-if.org/home

- **Combines public information and resources for all MBx domains**
  - **EXPRESS and XSD Schemas**
  - **Recommended Practices**
  - **Test Suites**
  - **Implementation Coverage**

- **Bilingual (English / French)**



LOTAR WEBSITE

LOTAR Deliverables

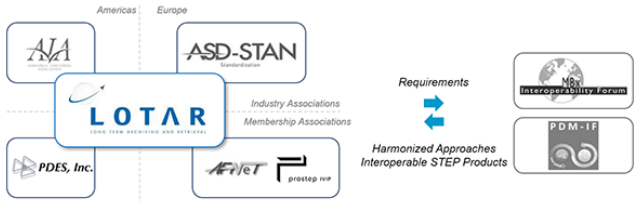
LOTAR Homepage: www.lotar-international.org

LOTAR

LONG TERM ARCHIVING AND RETRIEVAL

Welcome to LOTAR International

LOTAR is an international consortium of Aerospace manufacturers, jointly facilitated by AIA, ASD-Stan, AFNeT, prostep ivip and PDES, Inc.



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.

LOTAR Organization

The development of a worldwide accepted standard for long term archiving of a 3D master and product structure is an international collaboration of five hosting organizations. The project is conducted in a distributed manner, using regular online meetings for management tasks as well as on the working group level, combined with physical team meetings alternating between Europe and the US for joint discussions.

Learn more

NEXT STEPS

Work areas and upcoming events

Summary – Next Actions

- Leverage industry initiatives around digital engineering / digital thread
- Build on MBSE momentum
- Restart Engineering Analysis and Simulation
- Charter Electronics WG
- Consider new domains such as software
- Build on integration with Interoperability Forums
- Activities planned
  - 2024 Q4 meeting online
  - 2025 Q1 meeting in person – Hamburg, DE
  - 2025 Q2 meeting online
  - 2025 Q3 LOTAR face to face in TBD, Americas
  - 2025 Q4 meeting online

Summary

- **LOTAR is an industry consortium whose purpose is to develop process standards focused on the preservation of digital data required to be retained for long periods of time.**
- **Coordinate closely with interoperability forums to develop test cases and recommended practices.**
- **Participants are primarily from the aerospace industry.**
- **Driven by business, regulatory, and customer requirements.**
- **Working groups meet regularly online.**
- **Gather for in depth quarterly meetings. Alternate in person and online meetings.**
- **Look forward to seeing you at our next meeting.**

- **If you are interested in participating, submit your information through the LOTAR website here https://lotar-international.org/why-lotar/joining-lotar/**

- **Thanks for joining us!**

- **Questions?**