LOTAR

LONG TERM ARCHIVING AND RETRIEVAL

Recent progresses of the LOTAR international project to support long term archiving and retrieval of model based design information for the Aerospace and Defence industries

Jean-Yves DELAUNAY
Airbus

AIA AEROSPACE INDUSTRIES ASSOCIATION ASD-STAN Standardization

ProSTEP iViP PDES, Inc.

LOTAR – Goal

- 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, independent of changes in the IT application environment originally used for creation.

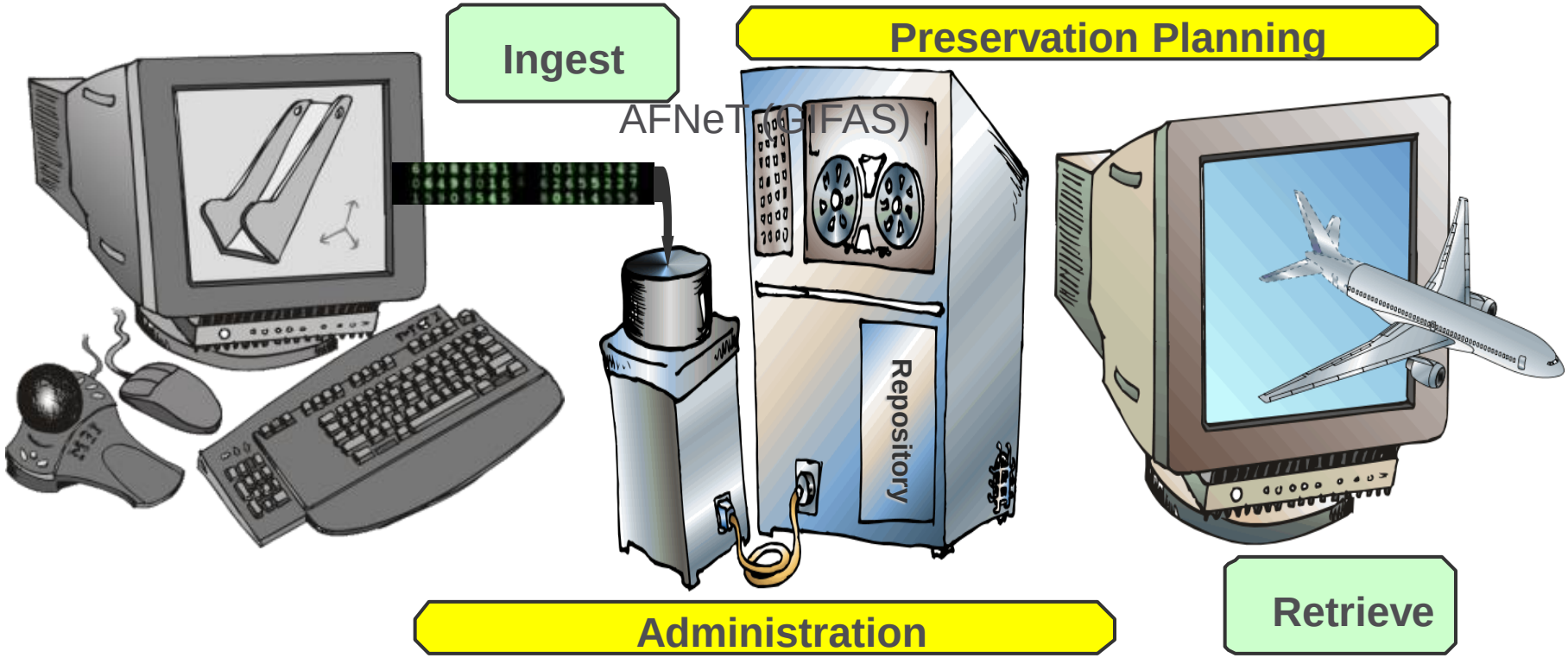
- The standards are published as EN/NAS(*) 9300 series and cover both the information content as well as the processes required to ingest, store, administer, manage and access the information.

(*): EN – European Standard (Norm); NAS – National Aerospace Standard

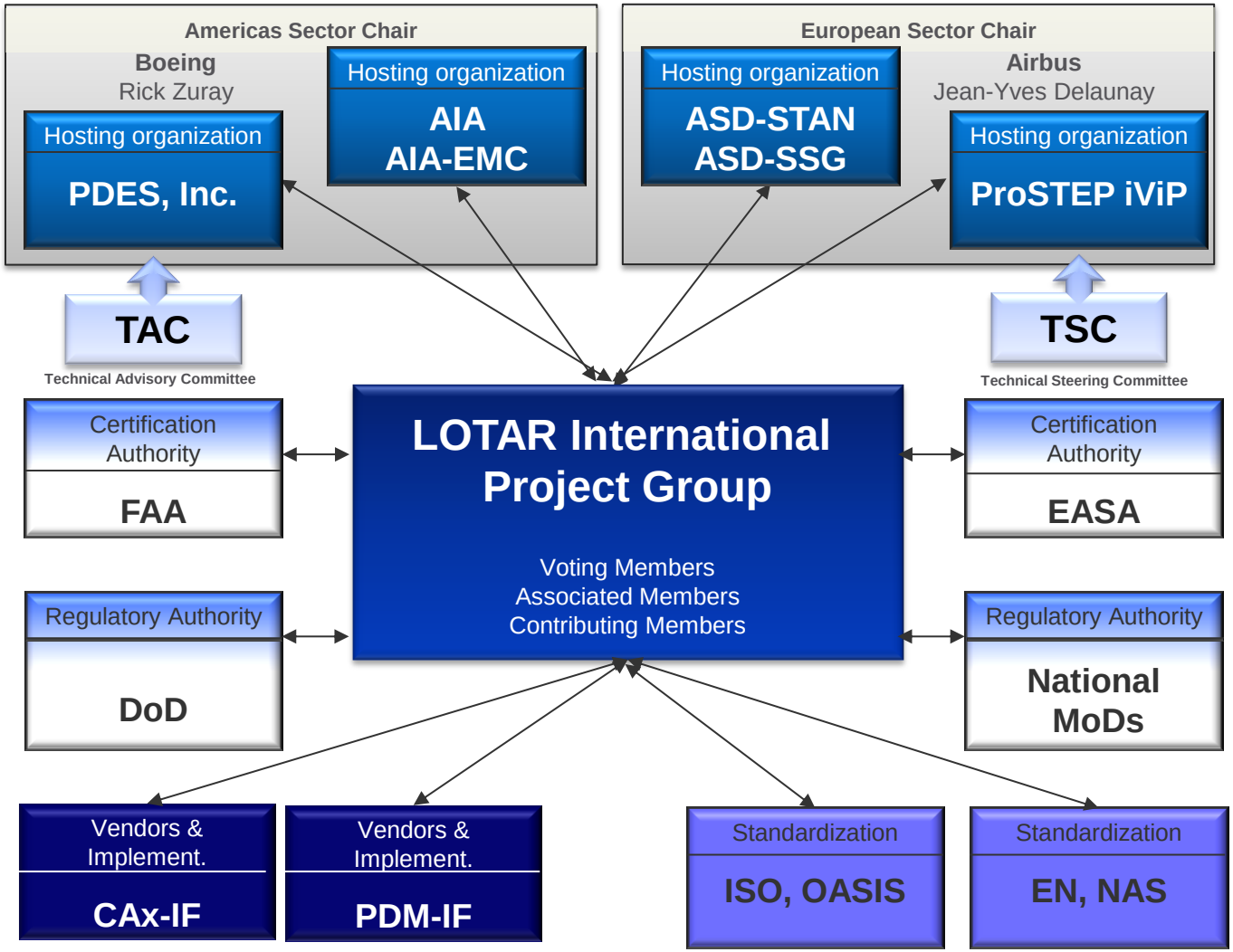
The LOTAR project: To support the **longevity** of Aerospace & Defense 3 D Model based definition

LOTAR
LONG TERM ARCHIVING AND RETRIEVAL

- 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 defence system (nuclear missile, ...)



LOTAR Organization – External View



LOTAR Member Companies in 2015

LOTAR
LONG TERM ARCHIVING AND RETRIEVAL

Europe

- Airbus
- Airbus Helicopter
- Airbus Defence & Space
- AFNeT (GIFAS)
- IAI Israel Aerospace Industries
- SAFRAN

Americas

- BAE Systems
- Boeing
- Embraer
- GE
- Goodrich
- Gulfstream
- Honeywell
- Lockheed Martin
- Sandia National Labs

Objectives & Benefits of LOTAR

- Objectives include:
  - Developing a standard for preserving, managing and retrieving product data throughout its lifecycle.
  - Providing methods, process modules and data model(s), to enable long term archiving of CAD, PDM and additional technical data
  - Developing recommendations for practical introduction of long term archiving of product data, such as 3D CAD and PDM data, in the industry

- Benefits include:
  - Process security achieved through implementation of archival systems compliant to international accepted standards
  - Aerospace and Defense authorities accept workflow due to intense collaboration during standards creation
  - Applicable archiving workflow supported by STEP interfaces & functionalities
  - By solving the challenges of long term data retention, issues of data exchange are addressed

Motivation for LOTAR

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

- EN/NAS 9300 considers requirements coming from:
  - Legal and certification rules
  - Regulations on long term archiving of technical documentation
  - Reuse
  - Support in operation
- Additional to legal demands, there are industry established standards, company specific rules and recommendations.
- The standard defines architecture, processes and data formats to fulfill these requirements.

Status of use of NAS/EN 9300 by LOTAR members

LOTAR
LONG TERM ARCHIVING AND RETRIEVAL

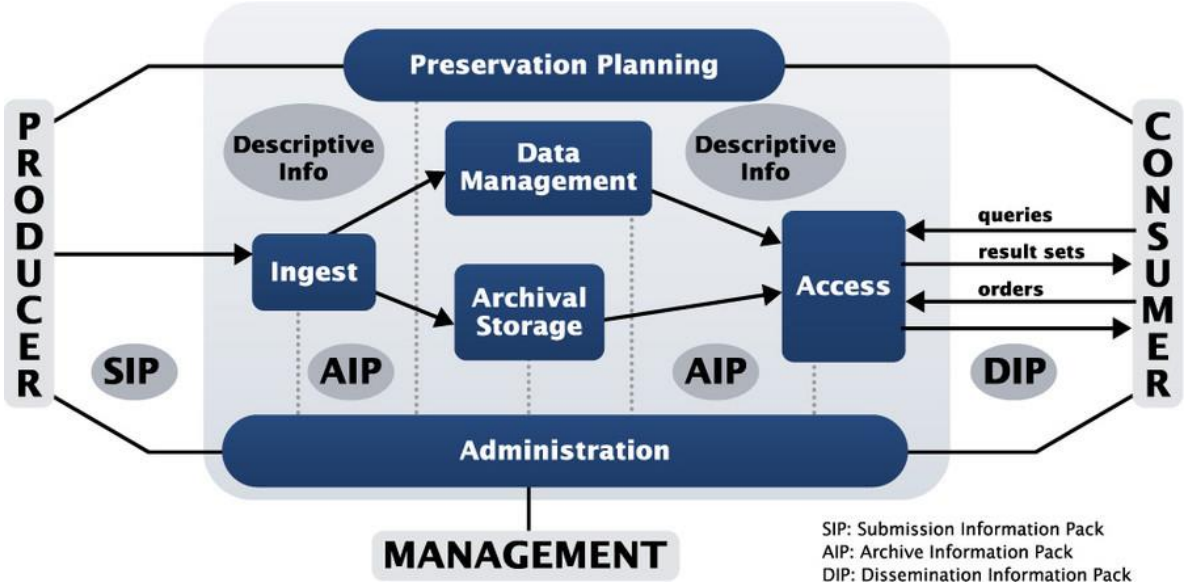
			NAS / EN 9300 LOTAR parts (CAD)					
A&D company	**Area of application**	**Scope**	CAD 3D exact geometry	CAD 3D tessellated geometry	CAD 3D PMI	CAD Assembly structure	**ISO formats**	**Project status**
			Part 110	**Part 100**	**Part 120**	**Part P115**	**ISO 10303 "STEP"**	
Airbus	A350	3D electrical harness installation	Yes	Yes	Yes	Yes	AP 214 ed3 (*) + AP 242 ed1	PROD
EADS		"Full 3D" model based	Yes	Yes	Yes	Yes	AP 242 ed1	PROD
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	Yes	Yes	Yes	AP 203 ed2 (*) + U3D PDF	DEV
Gulfstream	G650	3D mBD mechanical, electrical and composite	Yes	No	Yes		AP 203 ed2 (*)	PROD
Lockheed-Martin	F35	3D mBD mechanical, electrical and composite	Yes	No	Yes	Yes	AP 203 ed2 + AP242 ed1	DEV
EMBRAER	Legacy 450 & Legacy 500	complete definition of the aircraft	Yes	No	Yes	Yes	AP 242 ed1	PROD

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

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

LOTAR Standard Foundation
ISO 14721:2003 (OAIS)

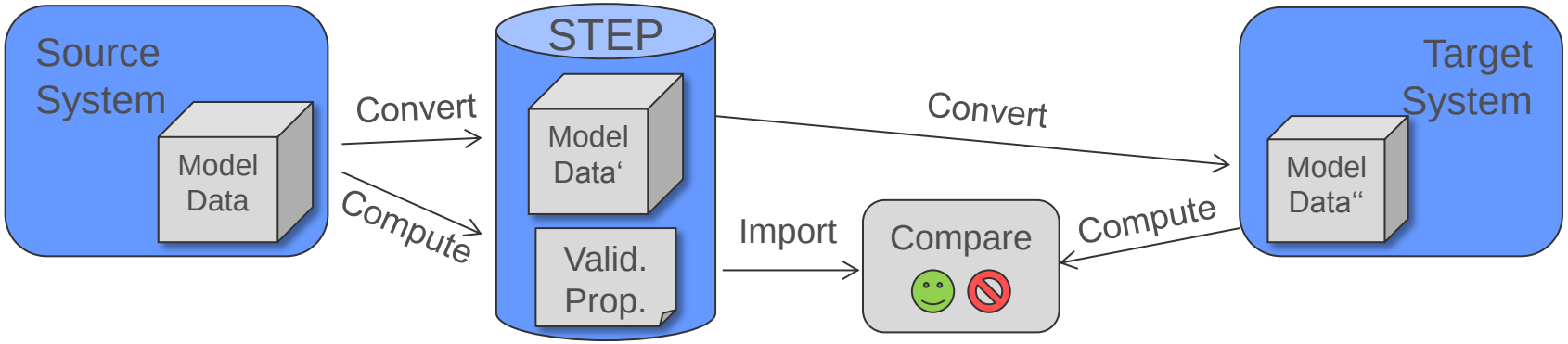
- „Open Archive Information System“ (OAIS) Reference Model is basis for LOTAR processes
- Developed by Aerospace and Defense Industry
- Extended to meet the specific requirements of LOTAR



- As neutral data format for the archives, ISO 10303 (STEP) has been chosen since it is the most advanced open format.

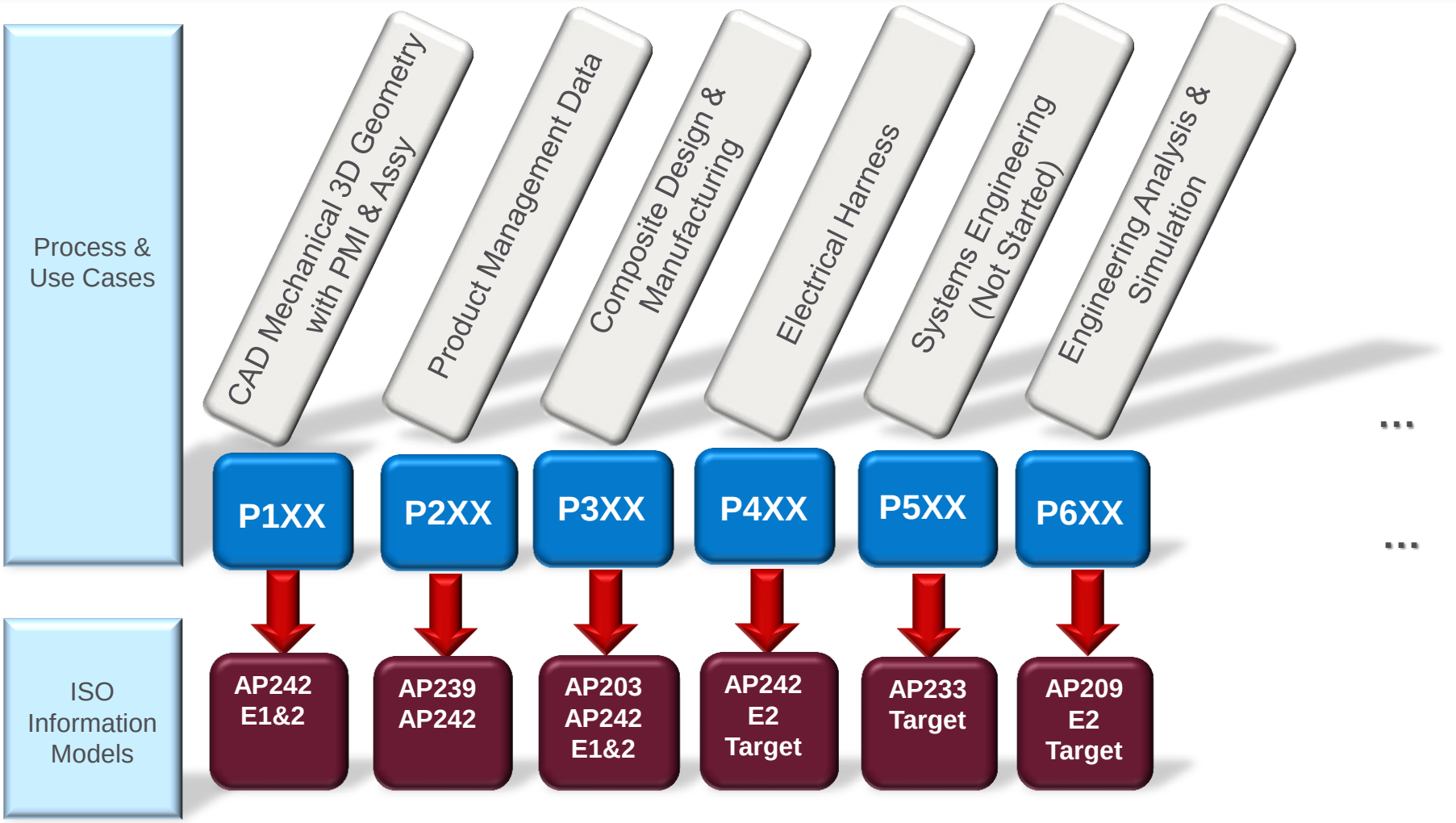
Validation of LOTAR STEP Data

- 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



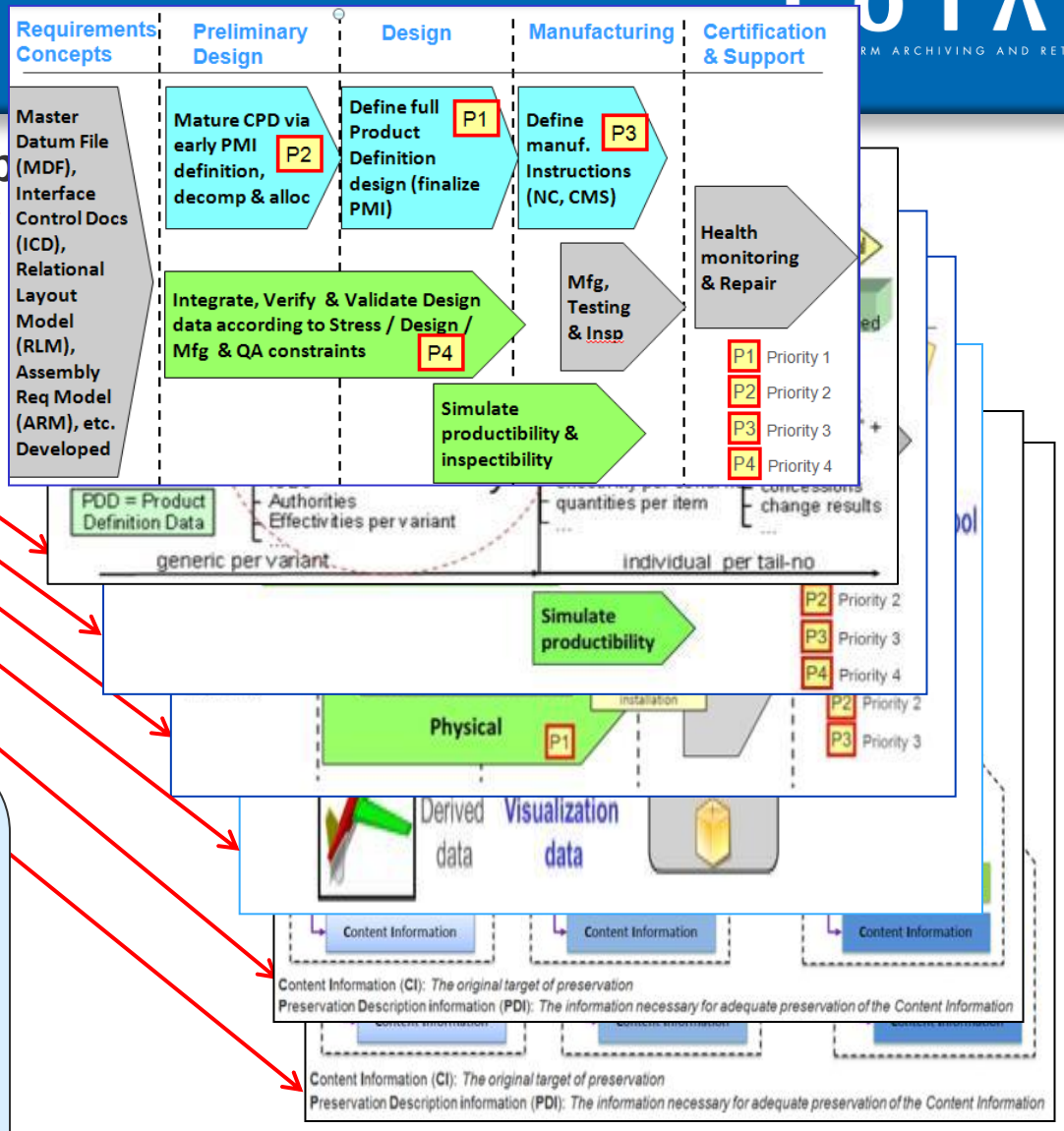
- They are computed by the exporting system and included as key-value pairs in the STEP file
- Any importing system will compare its import results with these properties and thus determine success of the data transfer.

Standards (5) year vision



LOTAR International

- 7 Technical Working Groups
  - 3D Mechanical / PMI
  - PDM / PLM
  - Adv. Mfg & Composite
  - Electrical
  - 3D Visualization
  - Meta data for archive packages
  - Engineering Analysis & Simulation

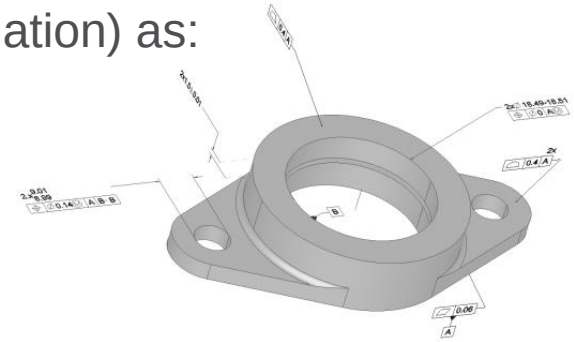


Description of a LOTAR WG web page

- Goals and Objectives
- Associated LOTAR use cases
- LOTAR Family of Standards
- Associated ISO 10303 Information Models
- Meetings & teleconferences
- Accomplishments
- Related standardization projects

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

- Scope:
  - Exchange and archiving of 3D Geometry via STEP
  - Provision of Validation Properties and User Defined Attributes
  - Transfer of PMI (Product & Manufacturing Information) as:
    - Representation (machine-consumable, reusable)
    - Graphic Presentation (human-readable)

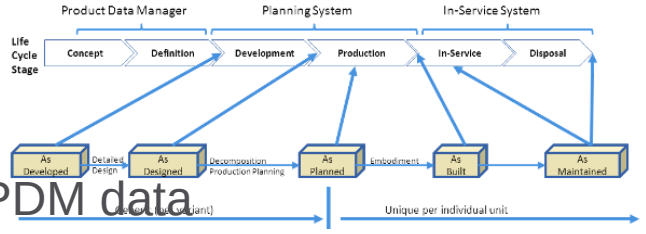


- Deliverables(*):
- Parts:
  - 100 (Common Concepts)
  - 110 (Explicit 3D Geometry),
  - 115 (CAD Assembly Structure),
  - 120 (PMI Graphic Presentation),
  - 121 (PMI Semantic Representation),
  - 122 (Machining Features),
  - 125 (Assembly PMI Graphic Pres.)
- Comprehensive suite of test models
- Numerous pilot projects in cooperation with the CAx-IF
- Support of STEP AP242 development and associated Recommended Practices

(*): Accomplished or in work; more planned

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 for LTA of PDM data
  - Part 210 as designed (ed. 2 incl. effectivities)
  - Part 220 as planned (cancelled)
  - Part 230 as built (dependency on Part 210)
  - Part 240 Product Management Data In-development (including prelim design review, critical design review, FAI, etc.),
  - Part 250 Change documentation

(*): Accomplished or in work, more planned

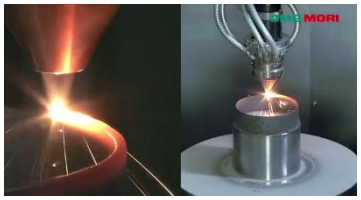
LOTAR WG: Advanced Manufacturing
(Composite Design, Additive Manufacturing, etc) (EN/NAS 9300-3xx)

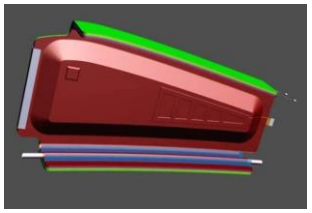
LOTAR
LONG TERM ARCHIVING AND RETRIEVAL

- **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**

Full shape freedom

➔ Cost independent from shape





- **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 in order to demonstrate concepts
  - Independent tests of CAD tools for the purpose of interoperability

(*): Accomplished or in work; more planned

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

- Scope:
  - Preservation of digital electrical harness mode
    - Design
    - Certification
    - Manufacturing
    - Support

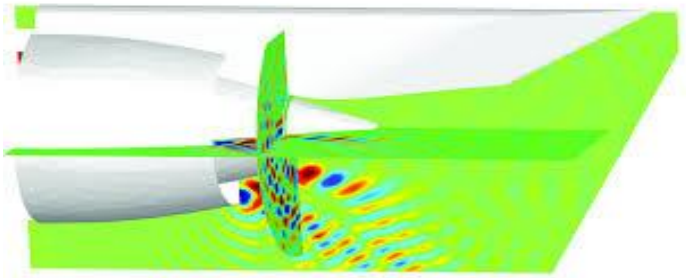
- Deliverables(*):
  - Part 400 (Common Concepts),
  - Part 410 (Physical harness definition for design & construction)
  - Preparation of test cases for physical electrical harness definition
  - Preparation of business requirements and use cases for extension of STEP AP 242 ED2 to include Electrical Harness Data
  - Coordination with other standardization projects related to electrical harness (STEP AP 210, AP239, VDA VEC specification, ...)

(*): Accomplished or in work; more planned

LOTAR WG "Engineering Analysis & Simulation" (EN/NAS 9300-5xx)

LOTAR
LONG TERM ARCHIVING AND RETRIEVAL

- Start of the LOTAR working group for "Engineering Analysis and Simulation" in 2014
  - Scope: Preservation of Simulation and Analysis information
  - Deliverables(*):
    - Parts 600 (Fund. & Concepts),
    - Part 610 "LTA & R. of "Simulation Data Management"
    - Part 620 "LTA & R. of Structural Analysis information"
  - Coordination with other standardization projects related to S & A (ISO STEP AP209)



- Scope of ISO STEP AP 209 ed2 "Multi-Disciplinary Analysis and Design"
  - Structural analysis
  - Computational Fluid Dynamic

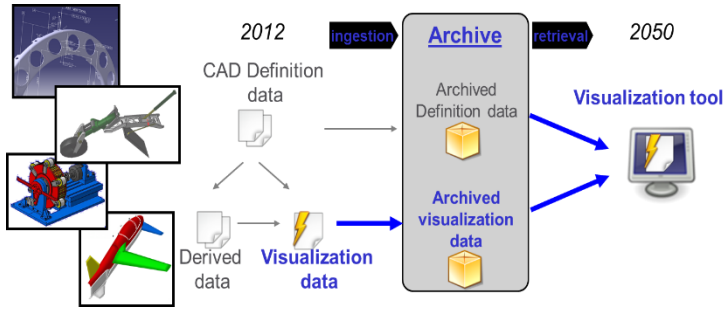
http://www.ap209.org/

- Preparation of the launch of the CAE IF in Q3 2016, part of the CAx Implementer Forum

- Regular coordinations with NAFEMS (USA, Europe)

LOTAR WG: 3D Visualization (Technical Specification/Rec Practice)

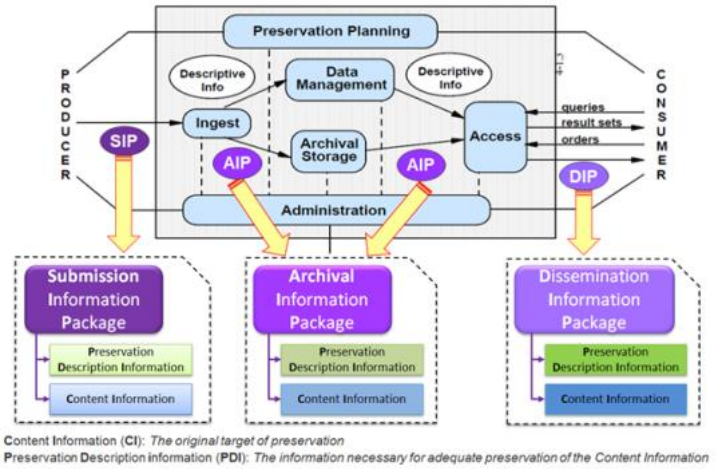
- Scope:
  - To define common recommendations for LT Archiving and Retrieval of 3D Visualization information being consistent with LT Archiving and Retrieval of information concerning CAD models and related information, throughout the full product life cycle.
- Deliverables(*):
  - To define the characteristics of the Visualization information to be archived.
  - To prepare recommended practices for implementing available 3D Visualization standards by the LOTAR community.
  - To describe to the recommended processes to ensure the consistency between the archived CAD 3D (authoring) data and the archived 3D Visualization (derived) data



(*): Accomplished or in work; more planned

LOTAR WG: Meta-Data for Archiving (Technical Specification/Rec Practice)

- Scope:
  - Define processes, UCs and standard information model to manage meta-data for:
    - Submission Information Package
    - Archival Information Package
    - Dissemination Information Package
    - Define processes, UCs and standard information model to manage meta-data for:
  - Define the information model and the corresponding STEP AP 239 PLCS subset



- Deliverables(*):
  - Parts 021 (Meta-data for Archiving),
  - Processes, use cases and test cases
  - STEP AP 239 information model subset
  - STEP AP 239 LOTAR DEX / Rec. Practices for meta data for AP
  - Test round reports and prototypes of PLM vendors

(*): Accomplished or in work; more planned

LOTAR International public web site : Overview

Why Lotar?
- ►Mission, Objectives & Scope
- ►Hosting Organizations
- ►Legal & Business Motivation

LOTAR organization
- ►External View
- ►Internal View
- ►Working together

LOTAR Workgroups
- ►3D CAD with PMI
- ►PDM
- ►Composite
- ►Electrical Harness
- ►Engineering Analysis & Simulation
- ►3D visualization
- ►(Meta data for archive packages)

Communication
- ►Public presentations
- ►Progress Reports
- ►Dates

LOTAR standards
- ►Overview on parts
- ►Industry use
- ►Next steps

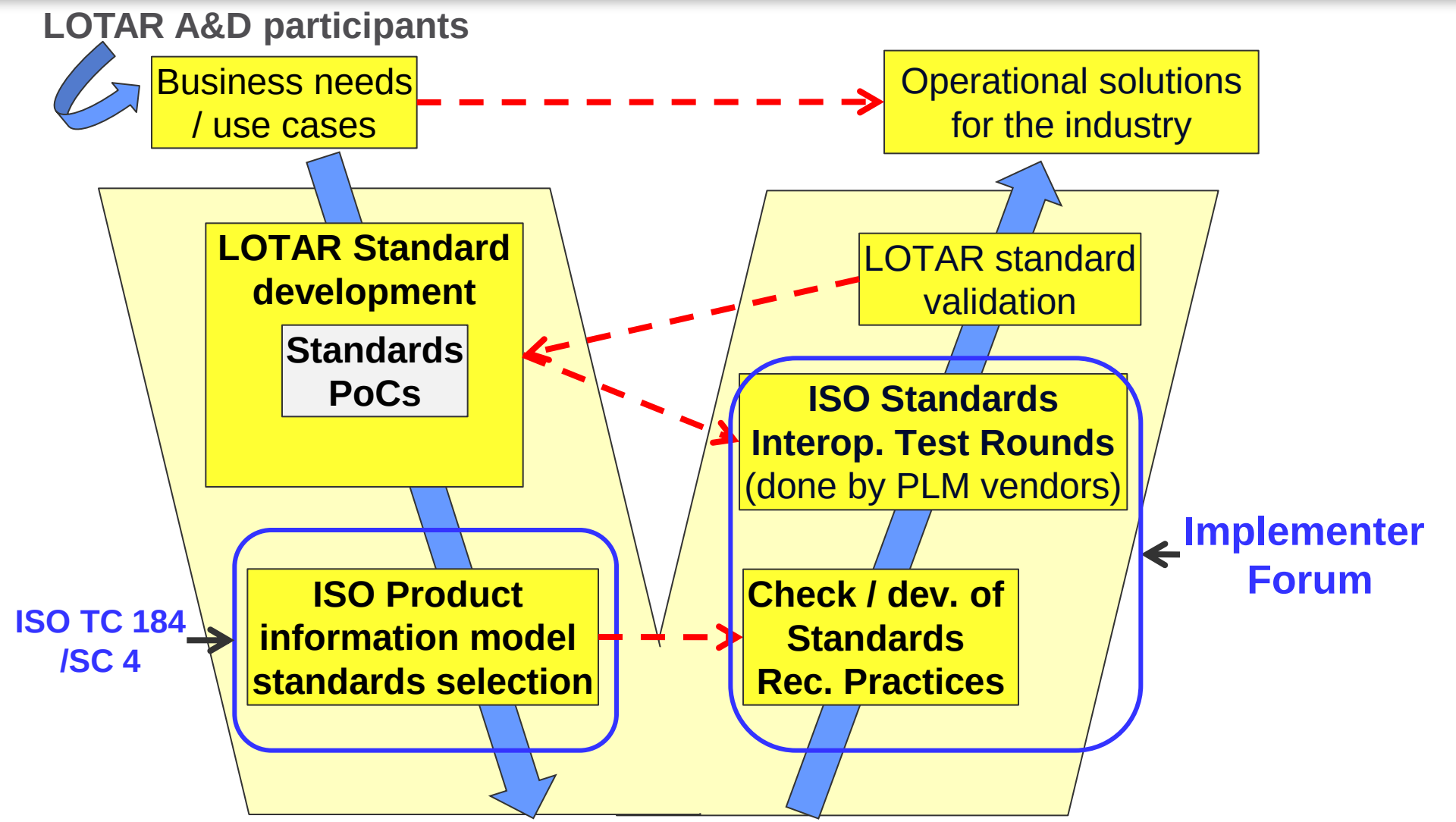
News

Links

Contact

http://www.lotar-international.org

« V cycle » for development and validation of LOTAR standards



LOTAR Involvement in the development of ISO 10303-242

LOTAR
LONG TERM ARCHIVING AND RETRIEVAL

PDM

Part Identification. Physical Part Characteristics, Document Management
General management information
Activity and work management
Effectivity, Specification, Breakdown and Configuration

Process Plans

Requirements

Design Rules

Electrical Wire Harness

AP242 Domain Support

Presentation

3D Shape Data Quality

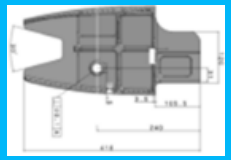
3D Machining Form Features

3D PMI (Product & Manufacturing Information)

3D Assembly Constraints

3D Kinematics

2D Draughting



3D Shape (Explicit and Parametric

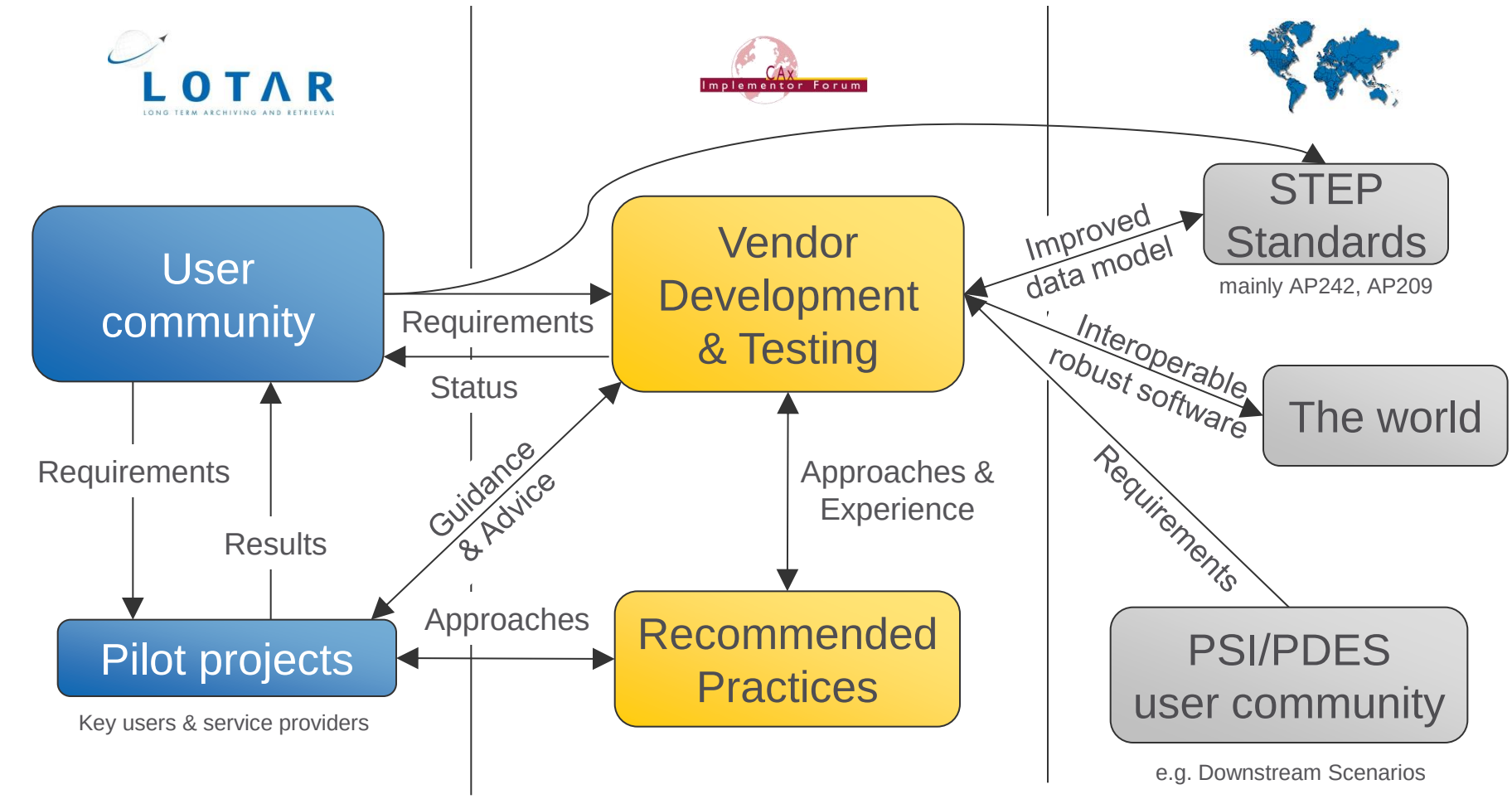
3D Exact/Explicit Geometry

3D Tessellated Geometry

3D Parametric & contr. history

3D Composite Design

LOTAR / CAx Implementor Forum Coordination



Any questions?

Rick ZURAY
LOTAR International co-chair
LOTAR Americas Sector chair
Technical Principal – Computing Architect
Technical Leadership & Innovation
The Boeing Company
Office: +1 (206) 778-6730
Mobile: +1 (206) 778-6730
Mail to:richard.s.zuray@boeing.com

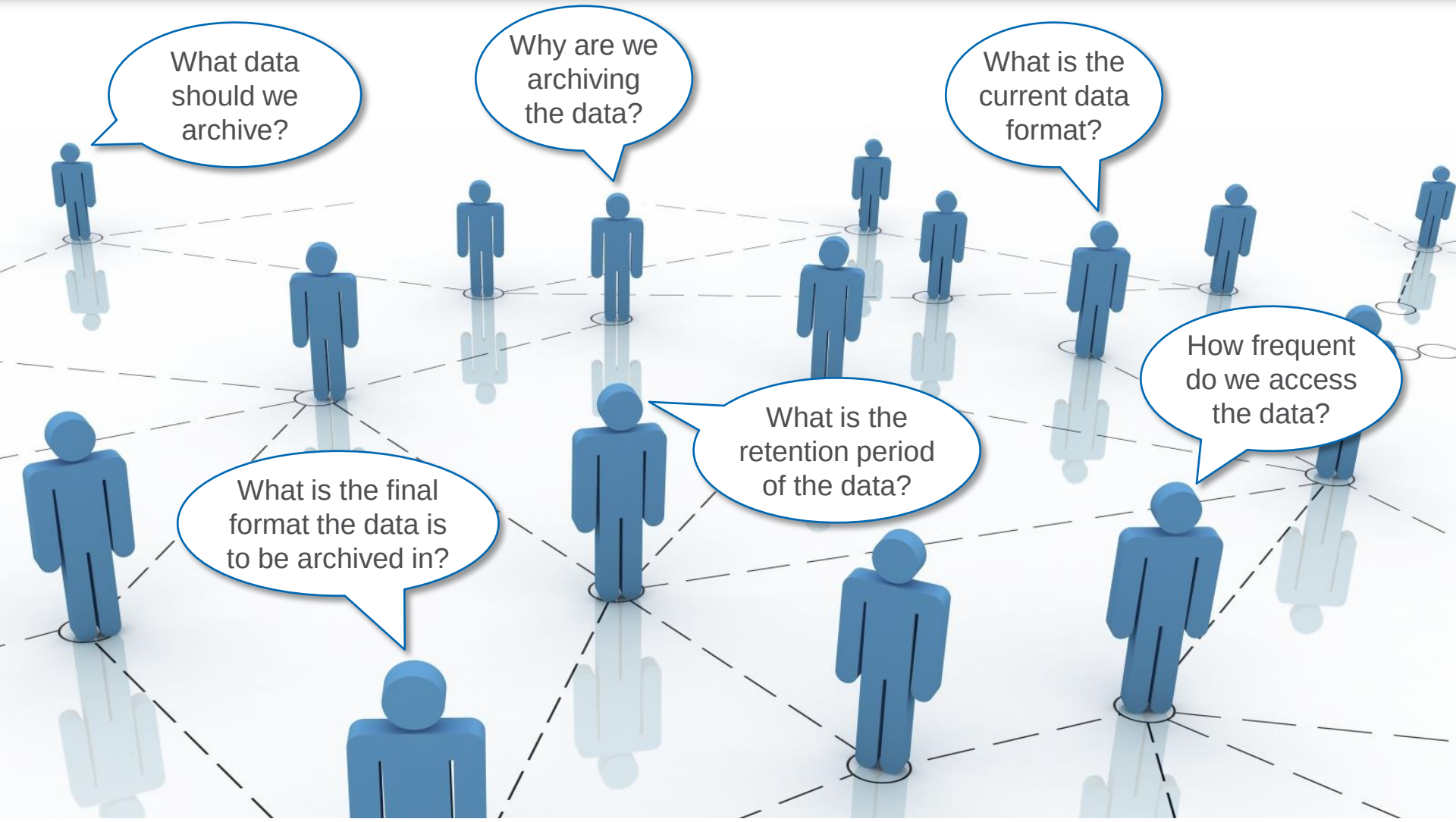
Jeff HOLMLUND
LOTAR International
Americas vice chair & Project Coordinator
CAD/CAM Enterprise Operations & Support Lead
Lockheed Martin Aeronautics Company
Office: +1 (817) 935-4457
Mobile: +1 (817) 240-8124
Mail to: jeffrey.a.holmlund@lmco.com

Jean-Yves DELAUNAY
LOTAR International co-chair
LOTAR European Sector chair
Product & Process Information Interoperability
Engineering Methods & Tools Architect
Airbus Group
Office: +33 (0)5-61-18-3131
Mobile: +33 (0)6-76-36-5059
Mail to: Jean-yves.delaunay@airbus.com

Jochen BOY
LOTAR International
European Sector Project Coordinator
Senior Consultant
PROSTEP AG
Office: +49 (0) 6151-9287-382
Mobile: +49 (0) 178-9509-369
Mail to:Jochen.Boy@prostep.com

Back up slides

Information Lifecycle Planning
Driving Questions



LOTAR Timeline

LOTAR
LONG TERM ARCHIVING AND RETRIEVAL

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/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

2012
- First Publication of LOTAR Domain Specific Parts (3D CAD)
- Launch of the Workgroups for Electric Harness, Meta Data for Archive Packages, and 3D Visualization

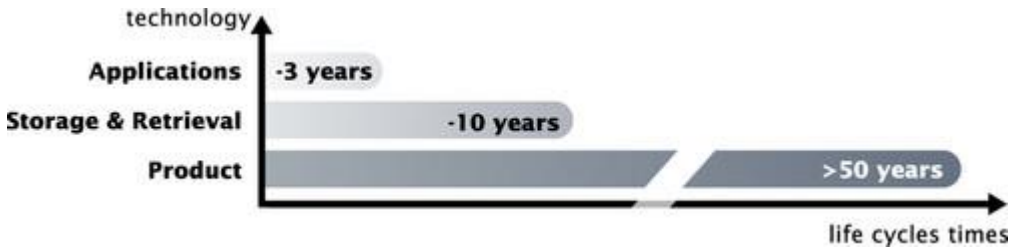
2014
- Kicked off LOTAR Eng Analysis & Sim Workgroup Sept 2014

* IAQG: International Aerospace Quality Group

AIA ASD-STAN ProSTEP iViP PDES, Inc.

Technical and IT Background

- The life cycle of applications and storage technologies has to be considered by setting up a long term archiving and retrieval standard:

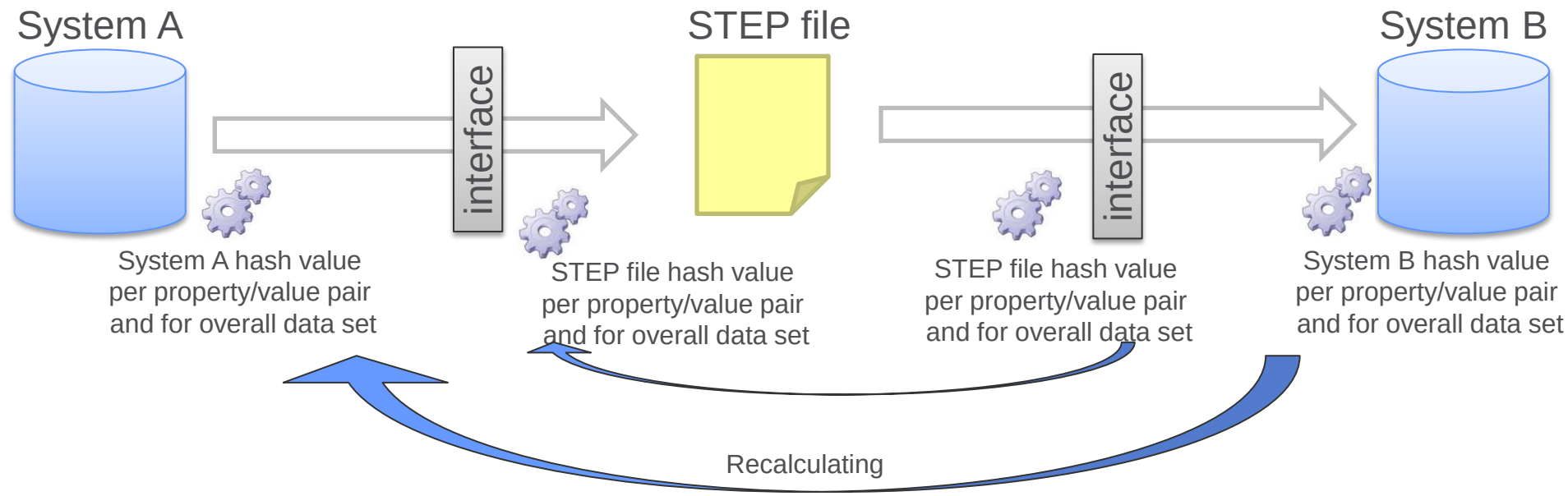


- Continuous development of technical product documentation leads to a change of methods and tools, which are used for design, manufacturing, customer support and archiving.
  - New releases of CAD / CAM / CAE / PDM / … systems offering new functionalities
  - After each migration, the data shall be checked for consistency and completeness.

  → A conversion of the native product data into a more stable format is essential.

System requirements

- Proposal to use the LOTAR technical specification TS-9300-200-1 on « Product Structure Validation » using hash code to check consistency of the data between the systems.



- Need at least two versions of the same systems in order to reflect the change of versions over the years
- The control of the test bed itself have to be defined to avoid uncontrolled modification / change during a test period