Long Term archiving and retrieval of aerospace product data:
Overview of EN9300 LOTAR, status of use, 5 years roadmap

AFNeT Standardization Days
19 - 20 April 2017

Jean-Yves DELAUNAY: Airbus
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 3D Model based definition

- 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, ...)

Ingest  
Preservation Planning  
Repository  
AFNeT (GIFAS)  
Administration  
Retrieve
LOTAR Member Companies in 2017

Europe
- Airbus Commercial Aircraft
- Airbus Helicopter
- Airbus Defence & Space
- AFNeT (GIFAS)
- SAFRAN

Americas
- BAE Systems
- Boeing
- Embraer
- GE
- Goodrich
- Gulfstream
- Honeywell
- Lockheed Martin
- Sandia National Labs
Motivation for LOTAR

- Meeting the **legal and business requirements** of the aerospace and defense industry:
  
  ![Legal Requirements and Business Requirements Diagram](image)

- 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.
Expected benefits of the use of LOTAR standards

- 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

The development and the use of LOTAR standards by the A&D industries allow decreasing the cost and the risks of LT archiving of aerospace product data
## Status of use of NAS/EN 9300 by LOTAR members

<table>
<thead>
<tr>
<th>A&amp;D company</th>
<th>Area of application</th>
<th>Scope</th>
<th>CAD 3D exact geometry</th>
<th>CAD 3D tessellated geometry</th>
<th>CAD 3D PMI</th>
<th>CAD Assembly structure</th>
<th>ISO formats</th>
<th>Project status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airbus</td>
<td>A350</td>
<td>3D electrical harness installation</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>AP 214 ed3 (*) + AP 242 ed1</td>
<td>PROD</td>
</tr>
<tr>
<td>EADS</td>
<td>&quot;Full 3D&quot; model based</td>
<td>complete definition of the aircraft (airframe, brackets, pipes, harness)</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>AP 214 ed3 (*)</td>
<td>PROD</td>
</tr>
<tr>
<td>Dassault-Aviation</td>
<td>Falcon 7X</td>
<td>3D definition with PMI of new mechanical part</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>AP 214 ed3 (*)</td>
<td>PROD</td>
</tr>
<tr>
<td>Snecma</td>
<td>New parts of engines</td>
<td>3D definition with PMI with assemblies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>AP 203 ed2 (*) + U3D PDF</td>
<td>DEV</td>
</tr>
<tr>
<td>Boeing</td>
<td>787</td>
<td>3D mBD mechanical, electrical and composite</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td></td>
<td>AP 203 ed2 (*)</td>
<td>PROD</td>
</tr>
<tr>
<td>Gulfstream</td>
<td>G650</td>
<td>complete definition of the aircraft</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td></td>
<td>AP 203 ed2</td>
<td>PROD</td>
</tr>
<tr>
<td>Lockheed-Martin</td>
<td>F35</td>
<td>3D mBD mechanical, electrical and composite</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>AP 203 ed2 + AP242 ed1</td>
<td>DEV</td>
</tr>
<tr>
<td>EMBRAER</td>
<td>Legacy 450 &amp; Legacy 500</td>
<td>complete definition of the aircraft</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>AP 242 ed1</td>
<td>PROD</td>
</tr>
</tbody>
</table>

**Legend:**
- **PLANNED**: project planned
- **DEV**: project in development
- **PROD**: project on production

(*) Plan to migrate to STEP AP 242 ed1 when possible
“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.
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.
LOTAR standards overview organized per technical disciplines

Process & Use Cases
- CAD Mechanical 3D Geometry
- Product Management Data
- Composite Design & Manufacturing
- Electrical Harness
- Systems Engineering (Not Started)
- Engineering Analysis & Simulation
- Electronic (Not yet started)

ISO Information Models
- AP242 E1&2
- AP239
- AP242
- AP203
- AP242 E1&2
- AP242 E2
- AP233
- Target
- AP209
- E2
- Target
- AP210
- E3
- Target
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

http://www.lotar-international.org/lotar-workgroups.html
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.)
- 126 (Assembly PMI Semantic Representation)

(*) : Accomplished or in work; more planned

© LOTAR 2013 All rights reserved • 4 May 2017 • Page 13

Comprehensive suite of test models
Numerous pilot projects in cooperation with the CAx-IF
Support of STEP AP242 development and associated Recommended Practices
The Intelligent Manufacturing Systems Program is an industry-led, global, collaborative business innovation program focused on manufacturing processes.

**User Standards**
- ISO TC 213, TC 10 (e.g. 1101, 16792)

**Users**
- **Requirements & Use Cases**
- **End Users**
  - Producers create requirements for archiving Mechanical, Product & Manufacturing information.
  - Consumers retrieve data with the associated methods, tools, and standards which are verified and validated prior to being disseminated.

**Standards, Software & Methods**
- **Providers**
  - LOTAR PMI WG
  - LOTAR PMI WG develops, publish and maintain standards for archiving and retrieval of Mechanical, Product & Manufacturing Information.
  - **International Organization for Standardization (ISO)**
    - Develop and publish international standards, in particular
      - ISO 10303 STEP
      - ISO 14721 OAIS (Open Archival Information System)
      - ISO 14739 (PRC); ISO 24517 (PDF-E)
  - PDES, Inc., ProSTEP iViP & AFNeT
    - Develop data models, standard data representations, including AP242 ed2, and common approaches through standards.
  - CAX-Implementers Forum (CAX-IF) & CAM vendors
    - Develop software capabilities and recommended practices by implementing standards and validating them through testing the associated codes.
  - **Quality Information Framework (QIF)**
    - Developing the digital product verification package with initial emphasis on dimensional metrology; from product design to inspection planning, planning to programming, and inspection execution to results.
  - **National Institute of Standards and Technology (NIST)**
    - Promote the use of standards. Support various Working Groups.
  - **AIAG LTDR**
    - Automotive Industries Action Group Long Term Data Retention project. Collaborative effort with Equivalent Validation activity.

**Quality Information Framework (QIF)**
- PDES, Inc., ProSTEP iViP & AFNeT
  - Develop data models, standard data representations, including AP242 ed2, and common approaches through standards.

**National Institute of Standards and Technology (NIST)**
- Promote the use of standards. Support various Working Groups.

**LOTAR**
- **Mechanical & Manufacturing Information Workgroup and Related Entities**
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)

- **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 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 models
    - 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
The Intelligent Manufacturing Systems Program is an industry-led, global, collaborative business innovation program focused on manufacturing processes.

End Users
- **Producers** create requirements for archiving Electrical harness information.
- **Consumers** retrieve data with the associated methods, tools, and standards which are verified and validated prior to being disseminated.

**Users**
**Requirements & Use Cases**

**Standards, Software & Methods**

**Providers**
- **International Organization for Standardization (ISO)**
  - Develop and publish international standards, in particular
    - ISO 10303 STEP, ISO 14721 OAIS
    - ISO/TC20/SC1: Aerospace electrical requirements

- **International Electrotechnical Commission (IEC)**
  - Develop and publish international standards, for electrical, electronic, and related technologies
  - Define glossary for electrical terms

- **PDES, Inc., ProSTEP iViP & AFNet**
  - Develop data models, standard data representations, including STEP AP242 ed2, and common approaches through standards.
  - Support implementer forums: CAx IF, etc.

**LOTAR Electrical Harness Information Workgroup**
- Develop, publish and maintain standards for archiving and retrieval of Electrical harness Information.

**IMS**

**National Institute of Standards and Technology (NIST)**
- Promote the use of standards.
- Develop STEP file checker and analyzer to assess the maturity of implementation of STEP standards by PLM application vendors.

**CAX-Implementers Forum (CAx-IF)**
- Develop CAD software capabilities and recommended practices by implementing standards and validating them through testing the associated codes.
- WG for electrical planned in 2017

**PDM-Implementers Forum (PDM-IF)**
- Develop PDM software capabilities and recommended practices by implementing standards and validating them through testing the associated codes.
• 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

• Start of pilots for exchange / LTA of structural analysis models
• Preparation of the launch of the CAE IF in Q3 2017, part of the CAx Implementer Forum
• Preparation of a permanent MoU with NAFEMS (USA, Europe)
LOTAR “Engineering Analysis and Simulation” Overview on a page

**Why:** Business Need
In an environment of rapidly changing software and hardware, a general requirement exists for access to and viability of digitally formatted engineering assets over the life of the product.

- Legal drivers
  - Cover certification needs
  - Support litigation
  - Support accident investigations
- Engineering, design & customer support drivers
  - Evaluate changes/improvements
  - Engineer derivatives/conversions
  - Extend payload/range/performance
  - Address customer questions
- Evaluate damage
- Capture knowledge
- Increase business capability

**How:** Primary Technical Approach
ISO STEP AP209 ed2
“Multi-disciplinary analysis and design” 5, 10, 15, 20, 30,…, or more years

**When & What:**
Phase 1 Schedule: 2015-2018
Phase 1 Scope: Vehicle-level model & loads employing linear static FEA

<table>
<thead>
<tr>
<th>Year</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify Business reqts &amp; Use cases</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare test cases</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dev. AP209 rec. practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct Pilot Studies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Launch CAE IF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create LOTAR Parts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Who:** Players & Roles

- **Users & Member companies**
  - Requirements

- **PDES, Inc., ProSTEP iViP, AFNeT**
  - AP209 ed2 development

- **CAx-IF & CAE vendors**
  - Translator development & testing

- **NAFEMS, NIST, more**
  - Additional collaboration

**LOTAR International EAS Working Group**
Overall project orchestration; User requirements; Test models; LOTAR EAS standard development (NAS/EN 9300-6xx)

*EAS scope is broad. Other analysis types and disciplines to be addressed in subsequent phases*
Preparation of the launch of the LOTAR MBSE WG in 2018

- In 2017, bi weekly conference of the PDES inc MBSE WG, covering the overall MBSE interoperability picture
- Start to take into account the specific activities to prepare the LOTAR MBSE WG
- Target to prepare the NWI for June or Sept. 2017
  - To allow the start of the LOTAR MBSE WG in 2018
  - Prerequisite: Target ISO standard supporting the MBSE information for exchange and long term archiving:
    - AP233 ed2 as candidate
    - Closely related to other STEP modular APs: AP239, AP209, AP242, AP210, etc
- Project Mngt.: conf. American and European LOTAR MBSE co-leaders
- Define a roadmap and structure of the LOTAR P5XX
  - P500: Fundamental and concepts, P510, P520
- Contribute to the roadmap of STEP standards for MBSE
Objectives of the LOTAR 5 years roadmap

- To identify the main « standards components » to be taken into account for planning of LOTAR capabilities with a target date of delivery and main associated dependancies.

- The LOTAR 5 years roadmap has to take into account:
  - the priorities of the A&D LOTAR members
    - business requirements, use cases
  - The LOTAR domains / technical disciplines to be covered:
    - P1XX, P2XX, P3XX, P4XX, P5XX (in prep.), P6XX
    - Their associated product life cycles:
      - Conceptual design, simulation, design, manufacturing
  - The underlying standardization projects (« V » model):
    - Dev. of ISO information models (STEP APs, etc)
    - Dev. of Rec. Practices, Interoperability test rounds - Implementer Forums
    - The STEP infrastructure to be maintained
LOTAR A&D participants

Business needs / use cases

LOTAR Standard development
Standards PoCs

LOTAR Standard validation

ISO Standards
Interop. Test Rounds (done by PLM vendors)

Check / dev. of Standards Rec. Practices

Operational solutions for the industry

ISO Product information model standards selection

Implementer Forums

Benchmarks

LOTAR Standard development

ISO TC 184 /SC 4

LOTAR A&D participants

« V cycle » for development and validation of LOTAR standards

© LOTAR 2010 All rights reserved • Name • 4 May 2017 • Page 23
<table>
<thead>
<tr>
<th>Title</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
</tr>
<tr>
<td>110 Ed.2: 3D CAD + Tessel. / Indep. Geo.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>115 Ed.2: P21 Assy Struct + XML Assy Struct</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>116: Kinematics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOTAR PMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120 Ed.2: 3D CAD + PMI Tessel. Presentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>121: 3D CAD + Semantic PMI Representation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>125: 3D CAD Assemblies + PMI Presentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>126: 3D CAD Assy + PMI Representation (Semantic)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOTAR Manufacturing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>130: 3D CAD + Mfg. Features</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>131: 3D CAD + Machining Features</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>132: 3D CAD + Holes &amp; Fasteners</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13k 3D CAD + ?? Features</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOTAR Quality Inspection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14k: Quality Process Information</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISO Standards</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14721 - ONS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10303 STEP - AP238 Manufacturing Ed. 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10303 STEP - AP242 3D MBD - Ed. 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISO 1101 (TC 213)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISO 16792 (TC 10)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISO 14405-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISO 10303-62 Equivalent Validation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASME Standards</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y14.41</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y14.45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y14.41.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANSI Standards</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality Information Framework (QIF)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implementor Forums</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Title of the LOTAR “electrical” WG may change and become “Electrical systems” WG
### LOTAR Overall Project Plan (2016 – 2019)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1. Project Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.2. Public Relations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Basic &amp; Common Parts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06. Functional Architecture</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>07. Terms and References</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>08. (on hold) Security</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>09. (on hold) Audit</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>021. Meta Data for Information Pkg.</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3. Data Domain: Specific Parts: LTA of...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3.1. 121: 3D CAD + Semantic PMI Representation</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3.1. 122: 3D CAD + Machining Form Features</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3.1. 125: 3D CAD Assemblies + PMI Presentation</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3.1. 13x: Machining / Manuf. Features</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3.2. 210: PDM “as designed”</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3.2. 230: PDM “as built”</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3.3. 300 CAD 3D Composites Fund. &amp; Conc.</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3.3. 310: CAD 3D Composite Design</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3.4. 400 CAD 3D Electric Fund. &amp; Conc.</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3.4. 410: Elec. Harness for Design &amp; Constr</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3.5. 600: EAS Fundamentals &amp; Concepts</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3.5. 610: SPDM</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3.5. 620: Structural Analysis</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>5. Guidelines and Recommended Practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>5.1. 3D Visualization Standards Gap Analysis</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>6. Harmonization with other Project Groups</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1. Support of CAX-IF</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>6.2. Support of PDM-IF</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>6.3. Support of AP242 Ed. 2 Development</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>6.4. Support of STEP Harmonization for PDM</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>
Summary – next actions

- Planned increasing use of LOTAR standards in the A&D industries
  - New A&D products developed on 3D Model Based Definition
    ➔ Use of 3D PMI – no more drawing!

- Need to set up a 5 years roadmap according to each company business needs

- Strong momentum for LT Archiving of Engineering Analysis and Simulation in 2017

- Opportunities for new European A&D members to join the LOTAR project
  - Next activities planned in 2018
    - Restart of PDM WG, based on AP239 ed3 – AP242 ed2 harmonized models
    - Start of LOTAR MBSE
    - Following years: LOTAR mechanical WG: holes and fasteners, 3D metrology, etc.

The development and the use of LOTAR standards by the A&D industries aim at decreasing the cost and the risks of Long Term Archiving and Retrieval of aerospace digital product information.
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

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

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

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
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
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 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
Information Lifecycle Planning

Driving Questions

- What data should we archive?
- Why are we archiving the data?
- What is the final format the data is to be archived in?
- What is the retention period of the data?
- What is the current data format?
- How frequent do we access the data?
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.