

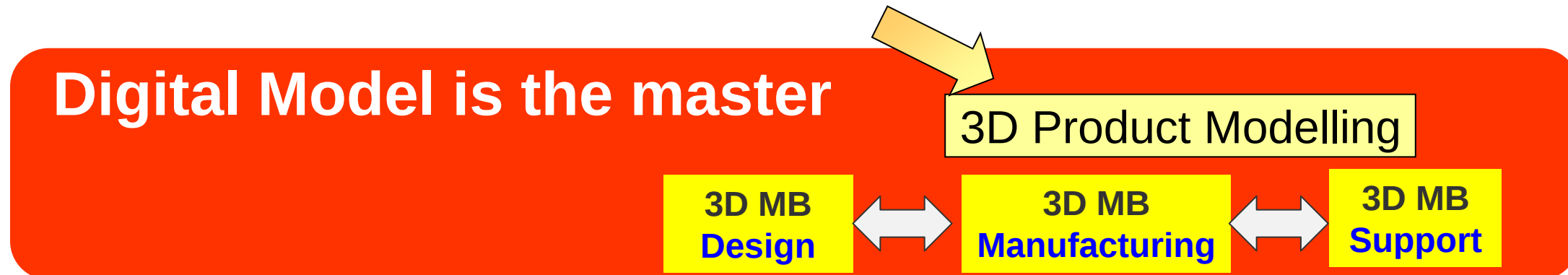
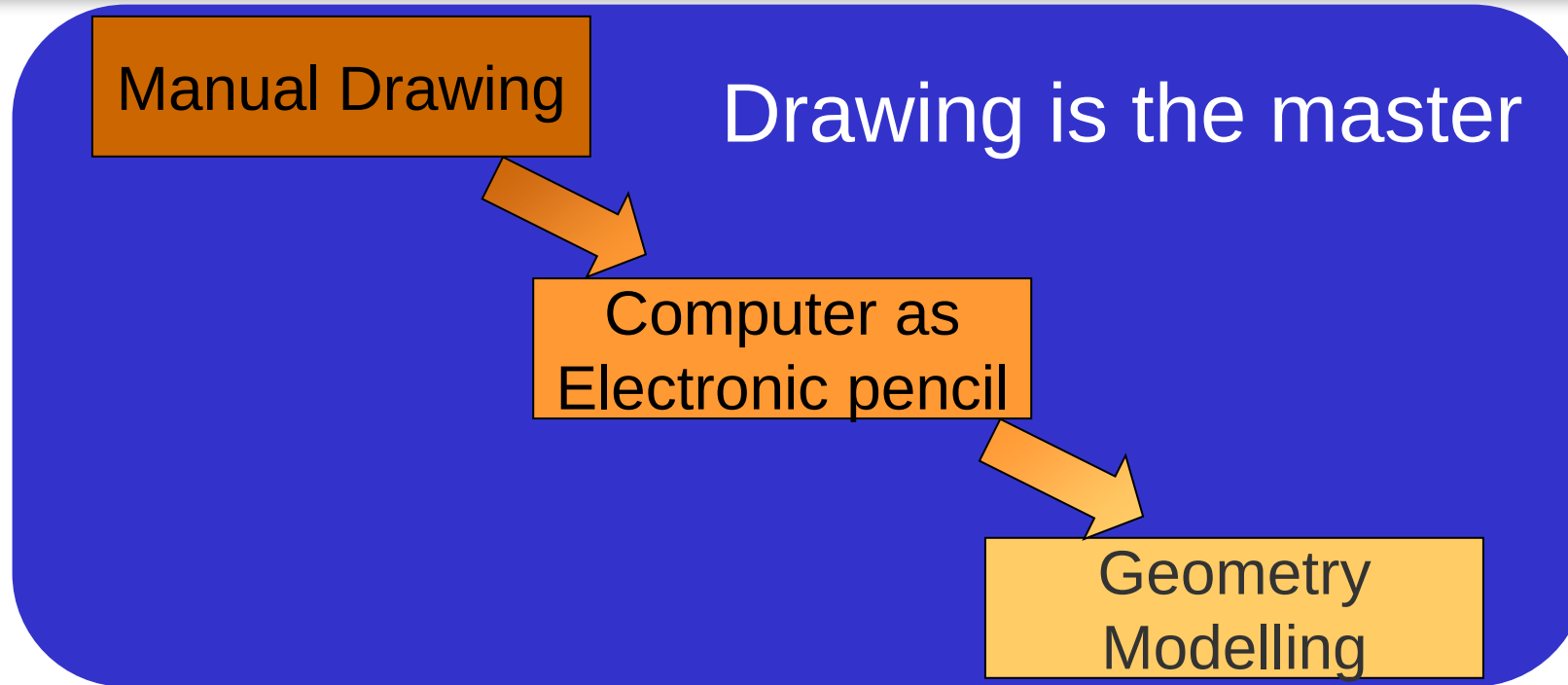
INDEX 2018
International Nuclear Digital Experience
25 – 26 June 2018 , Paris France

**Overview of EN 9300 LOTAR standards for
long term archiving and retrieval of
digital technical product information**

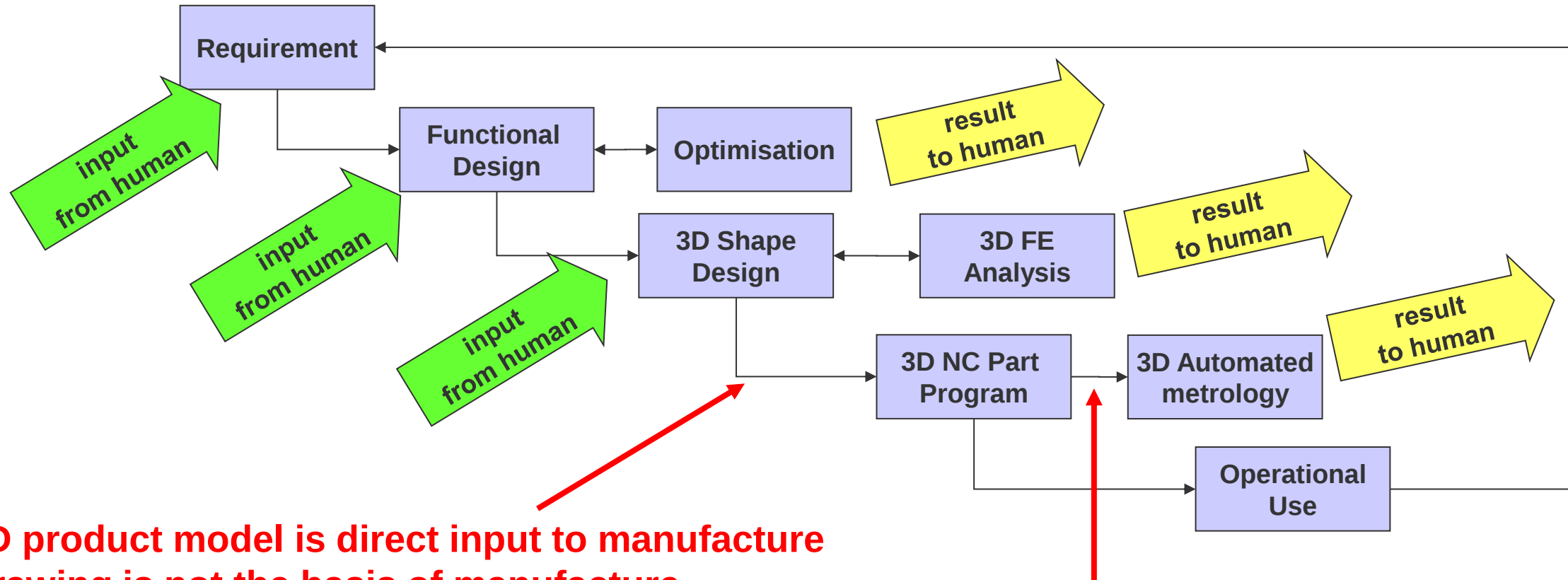
By Jean-Yves DELAUNAY: Airbus

The problem:

From 2D drawing to 3D Model Based definition



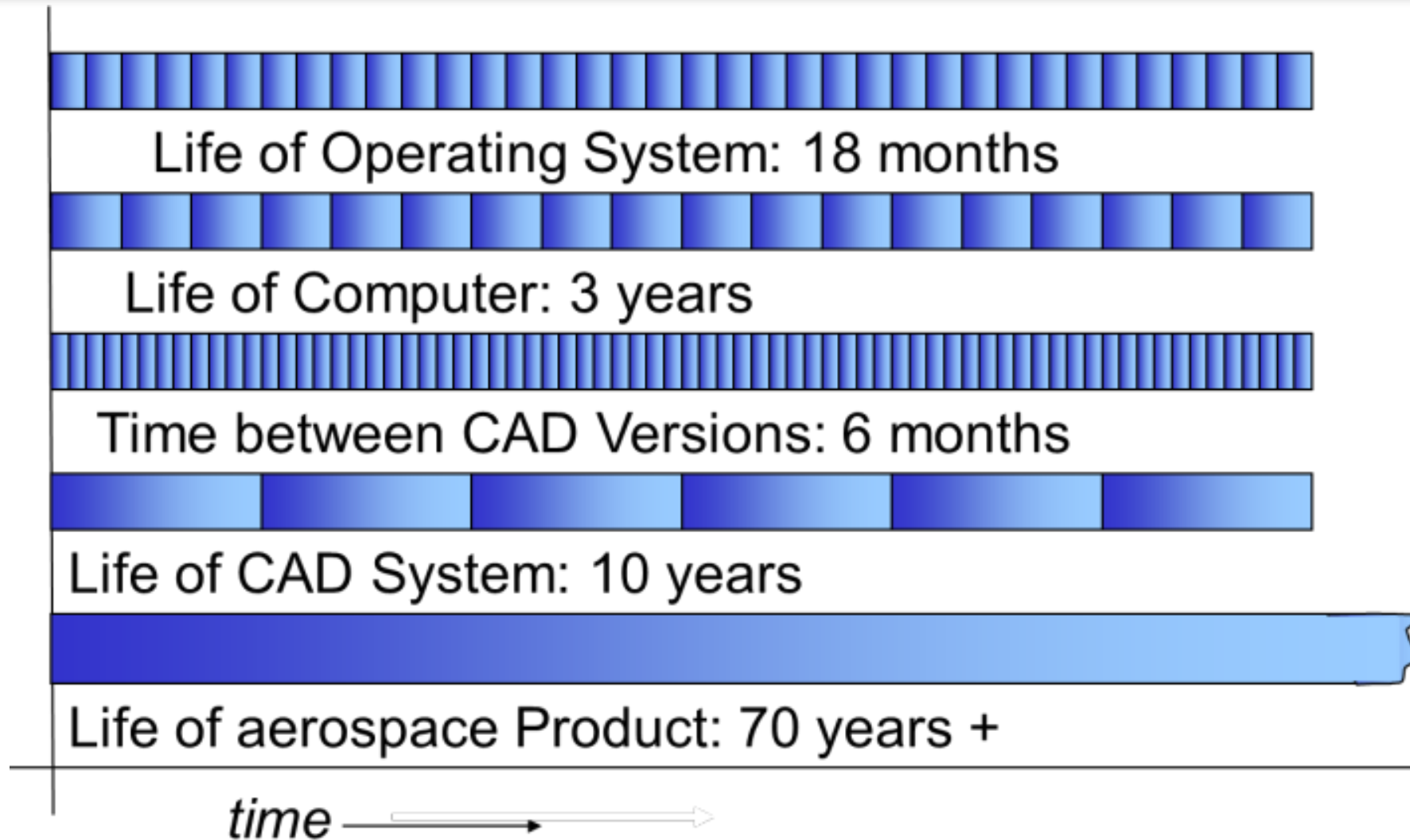
Electronic Design World : 3D Model Based (without drawings)



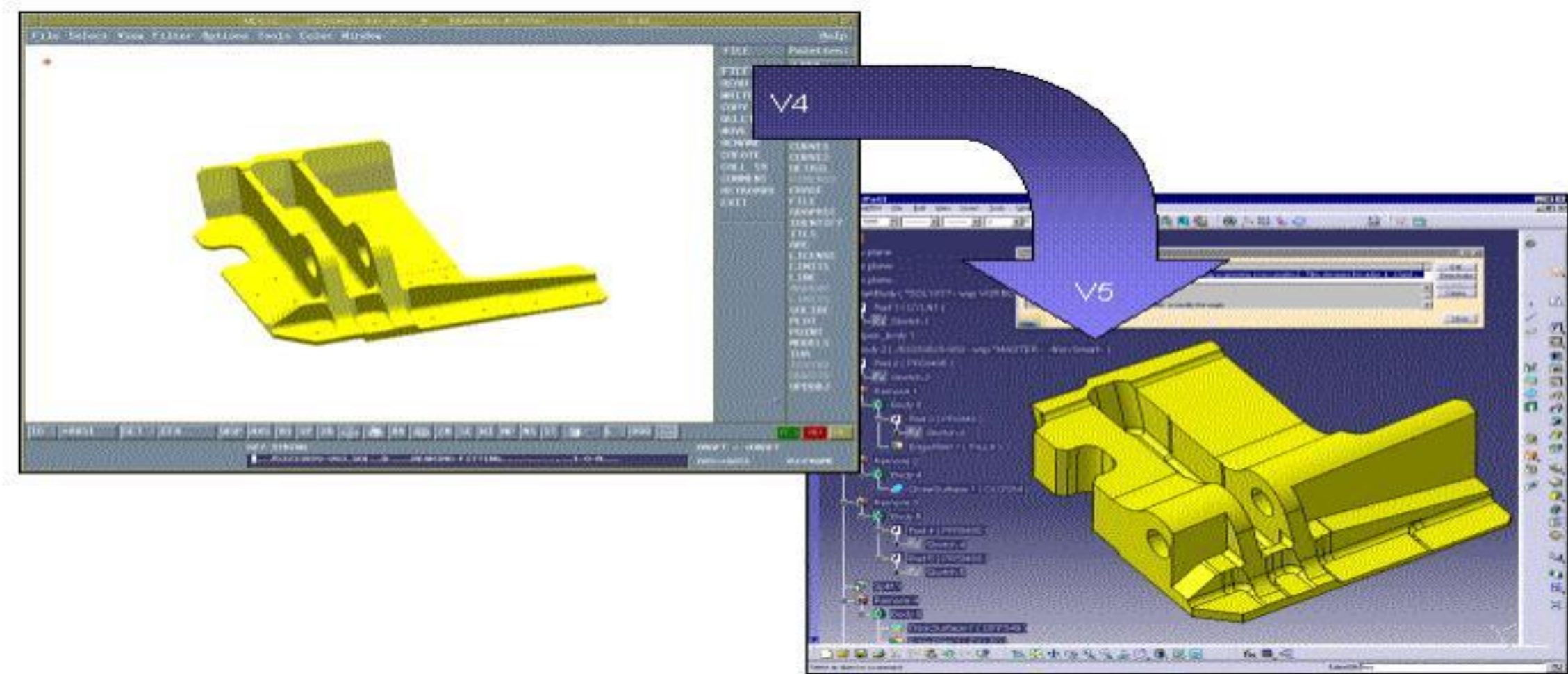
**3D product model is direct input to manufacture
Drawing is not the basis of manufacture**

**3D product model is direct input to inspection
Drawing is not the basis of inspection**

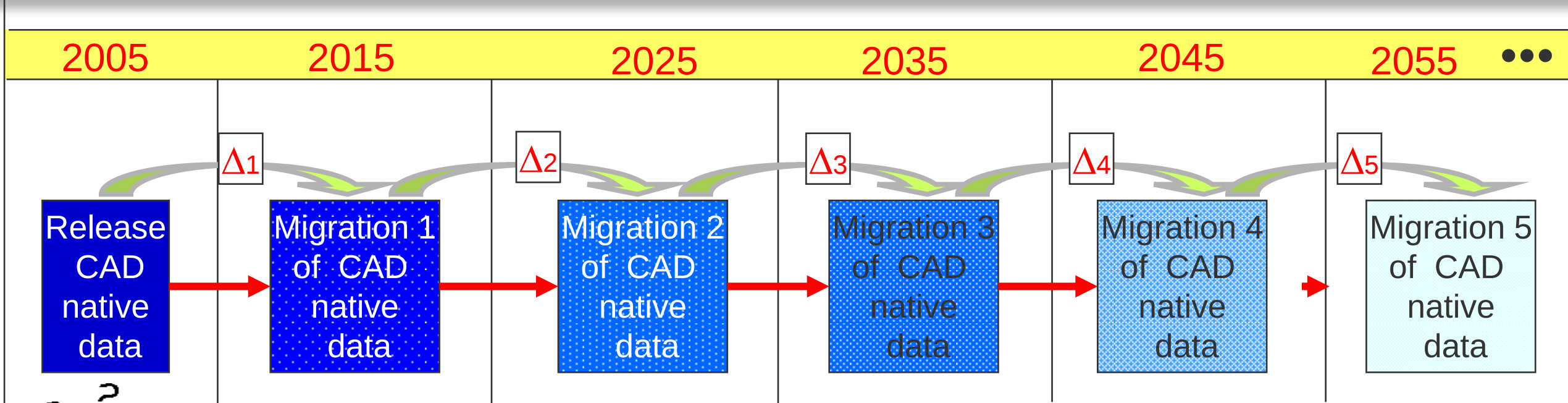
Rates of Change of technologies versus the longevity of an aerospace product



An Example of Generation Change



The question with no trusted answer



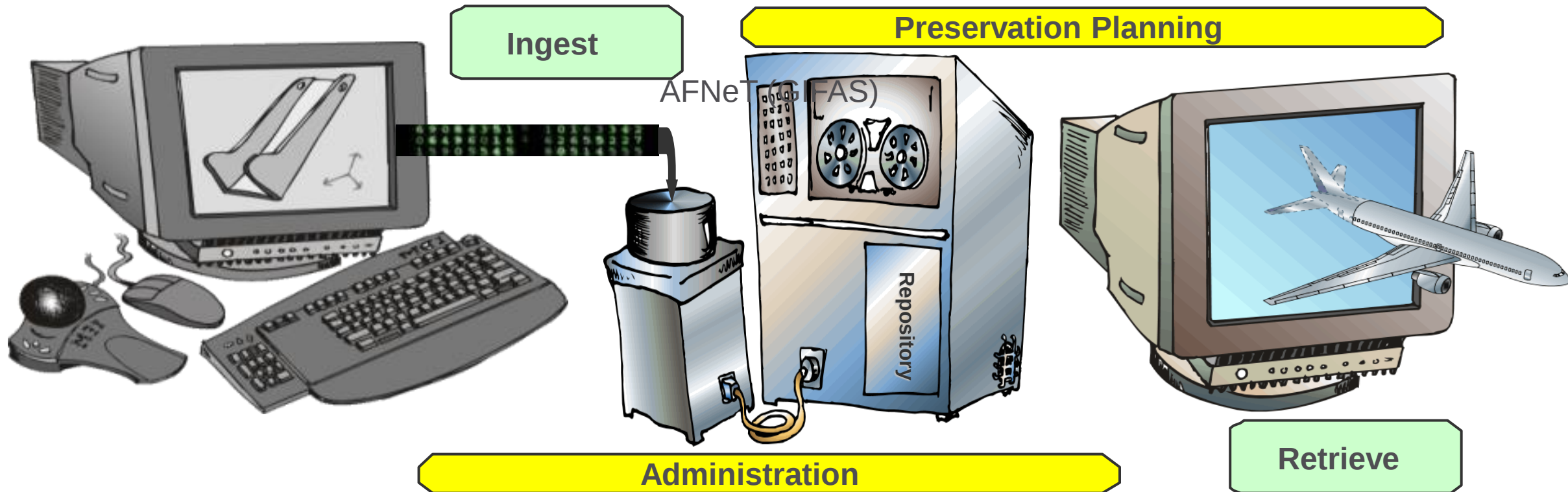
“How can I ensure there is no semantic alteration in my 3D Model Definition for decades despite obsolescence and major migration of native data every 10 years ???”

***Goal of the LOTAR International project,
initiated by the American and European Aerospace and Defense manufacturers***

Results can be used by other industries

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, ...)



- 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

<http://lotar-international.org>

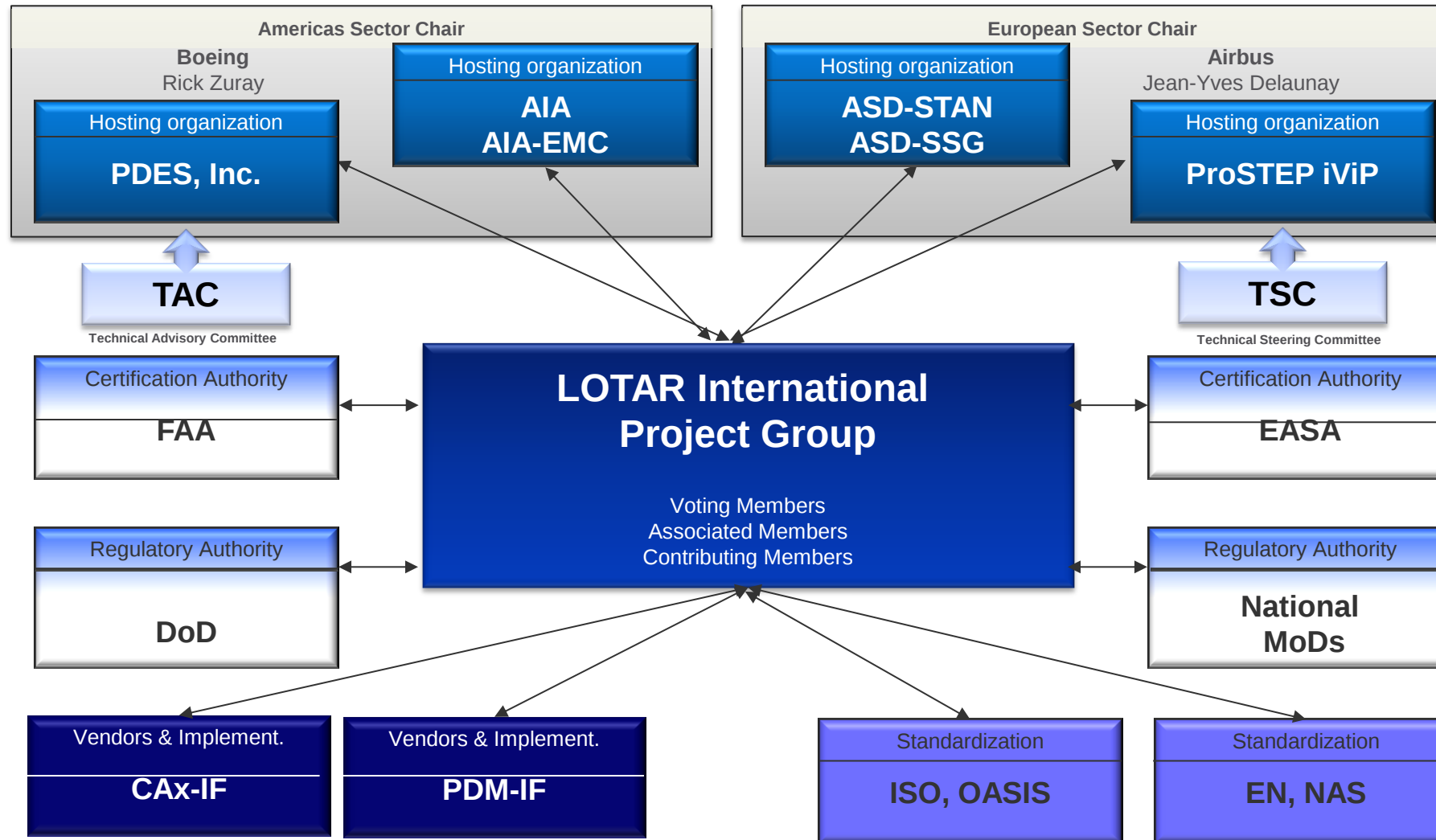


- Meeting the **legal and business requirements** of the aerospace & defense industry:



- 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 & data formats to fulfill these requirements.

LOTAR Organization – External View



LOTAR Member Companies 2018



Europe

- AFNeT
- Airbus
- Airbus Helicopter
- Airbus Defense & Space
- SAFRAN Engine
- BAE Systems (*)

Americas

- Boeing
- Embraer
- General Electric
- Goodrich
- Gulfstream
- Lockheed Martin
- Sandia National Labs

In charge of US Nuclear weapons Systems

BAE Systems LOTAR fee managed by PDES Inc

<http://www.sandia.gov/>

Status of use of NAS/EN 9300 by LOTAR members

A&D company	Area of application	Scope	NAS / EN 9300 LOTAR parts (CAD)				ISO formats	Project status
			CAD 3D exact geometry	CAD 3D tessellated geometry	CAD 3D PMI	CAD Assembly structure		
			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)

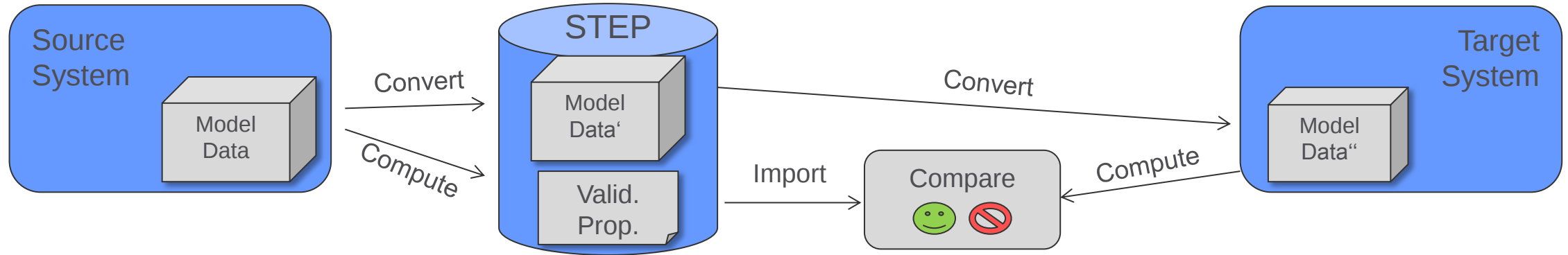
- „Open Archive Information System“ (OAIS) Reference Model is the basis of the LOTAR processes
- Developed by Aerospace and Defense Industry
- Extended to meet the specific requirements of LOTAR



- As neutral data format for the archives, ISO 10303 (STEP) has been chosen since it is the most advanced open format, completed by other formats when requested

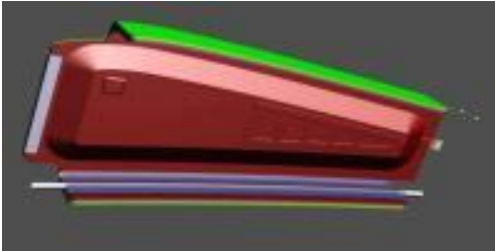
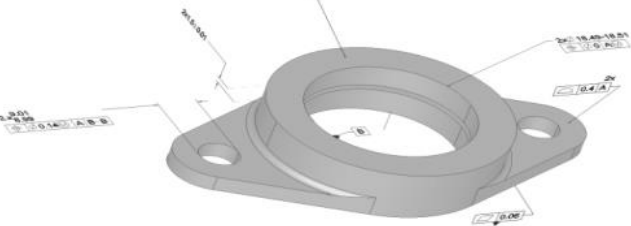
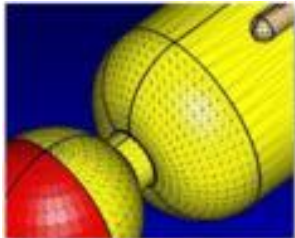
Validation of LOTAR STEP Data

- 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.

LOTAR International project WGs on a page

Advanced Manufacturing : composite (Additive Manuf.) NAS/EN 9300 <u>3XX</u> (ISO AP242)  Launch 2009	Wiring Harness NAS/EN 9300 <u>4XX</u> (ISO AP242 ed2)  Launch 2012	Engineering Analysis and Simulation NAS/EN 9300 <u>6XX</u> (ISO AP209 ed2)  Launch 2014	Model Based Systems Engineering NAS/EN 9300 <u>5XX</u> (ISO AP239 – AP239 MoSSEC, SysML, FMI, etc) Planned launch 2018
Mechanical CAD 3D with PMI (Product & Manufacturing Information) NAS/EN 9300 <u>1XX</u> (ISO AP242)  Launch 2004	3D visualization LOTAR recommendations (ISO AP242 ed2)  Launch 2012	Product Data Management (PDM) NAS/EN 9300 <u>2XX</u> (ISO AP242 ed2 – AP239 ed3)  Launch 2004	Meta data for archive package NAS/EN 9300 <u>4XX</u> (ISO AP242 ed2 – AP239 ed3)  Launch 2012

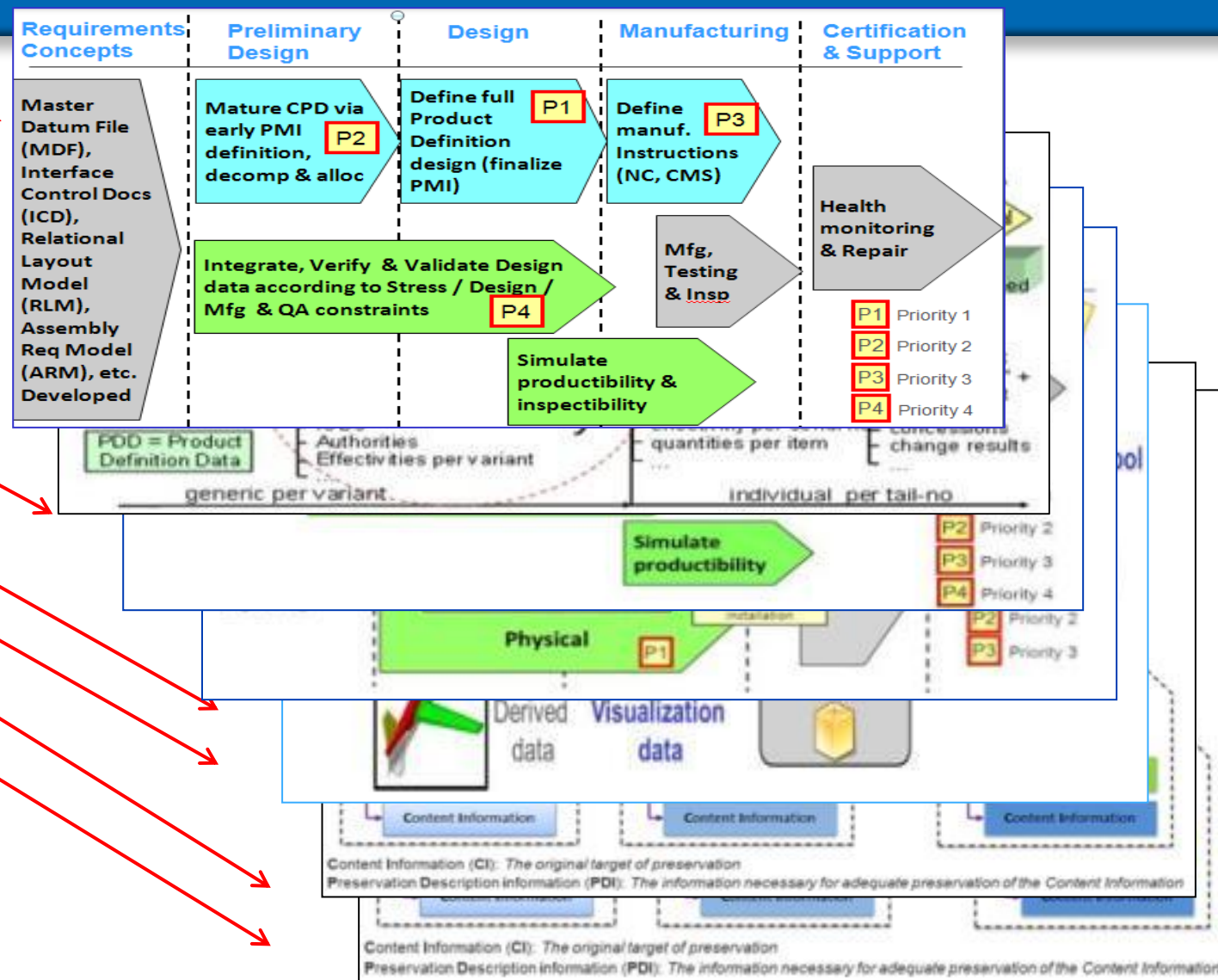
LOTAR International activities overview

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

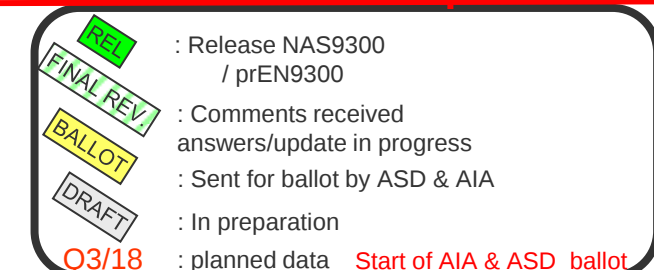
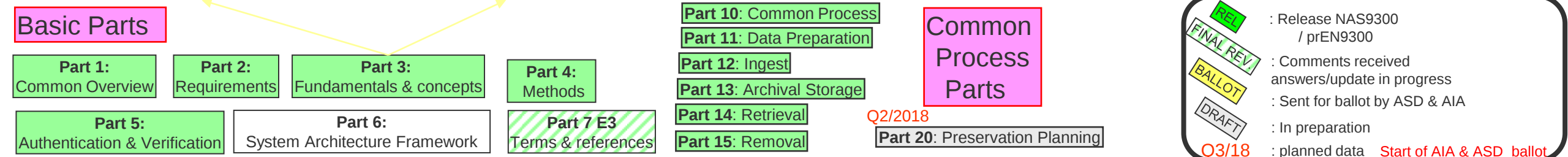
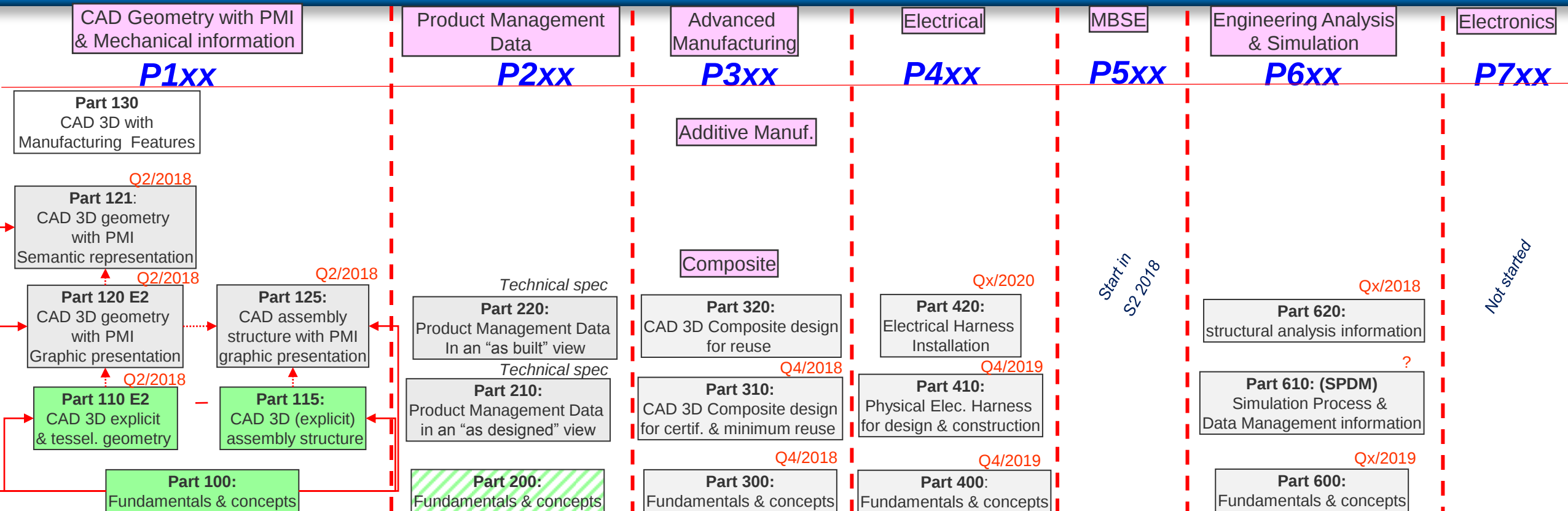
- Goals and Objectives
- Associated LOTAR use cases
- LOTAR Family of Standards
- Associated ISO 10303 Information Models
- Meetings & teleconferences
- Accomplishments
- Related standardization projects



Overview of NAS / EN 9300 LOTAR parts (Status Apr. 2018)



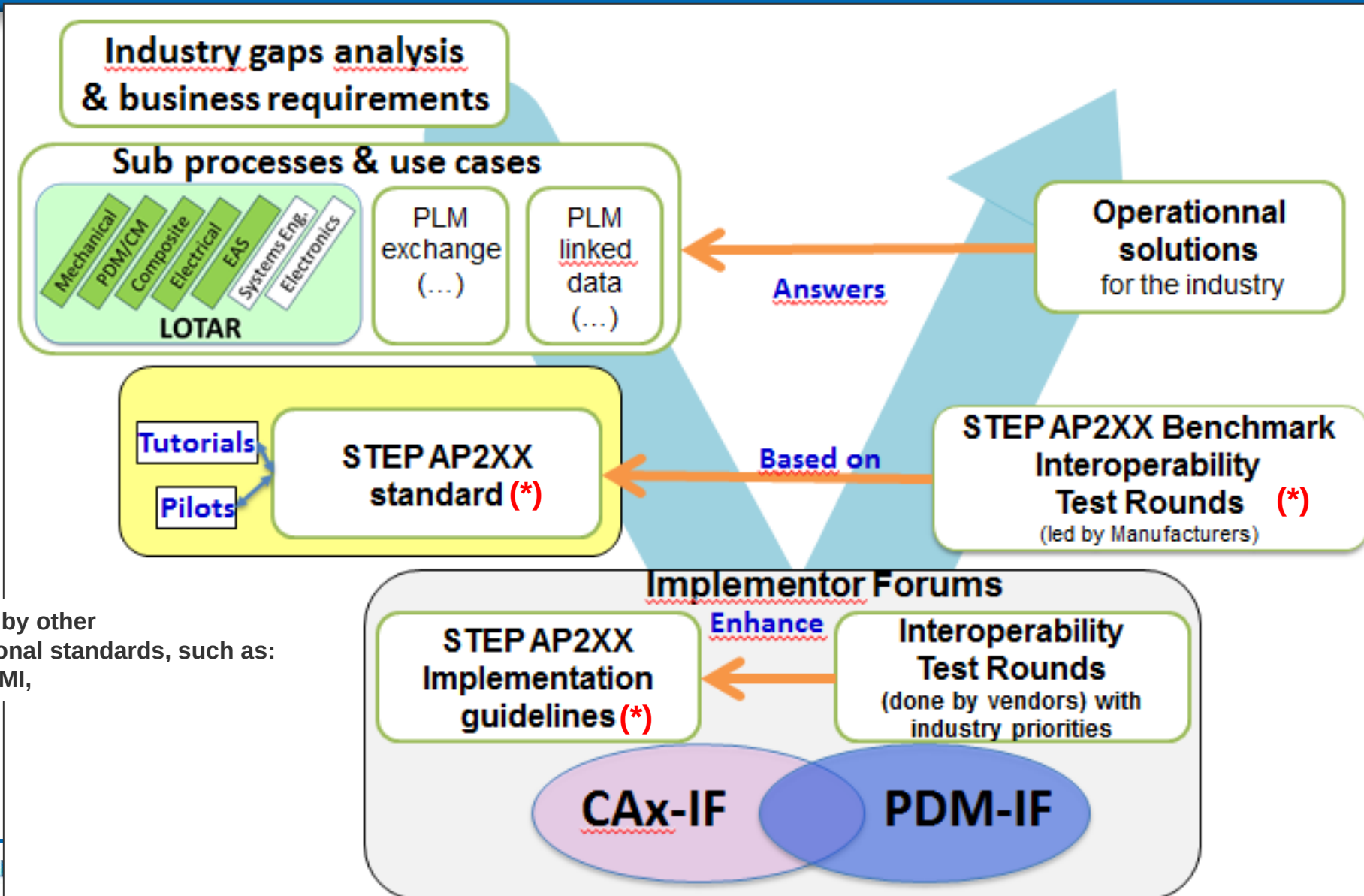
Data Domain Specific Parts



Start of 3 ballots in Q1 2018: part 120 ed2, part 121 ed1, part 125 ed1

- 1st meeting: (11) 12th – 15th of March, Asheville – NC, USA
- 2nd meeting: (18) 19th – 21st of June, Toulouse, France
- 3rd meeting: (23) 24th – 27th of September, USA
- 4th meeting: (10) 11th – 13th of December, Darmstadt, Germany

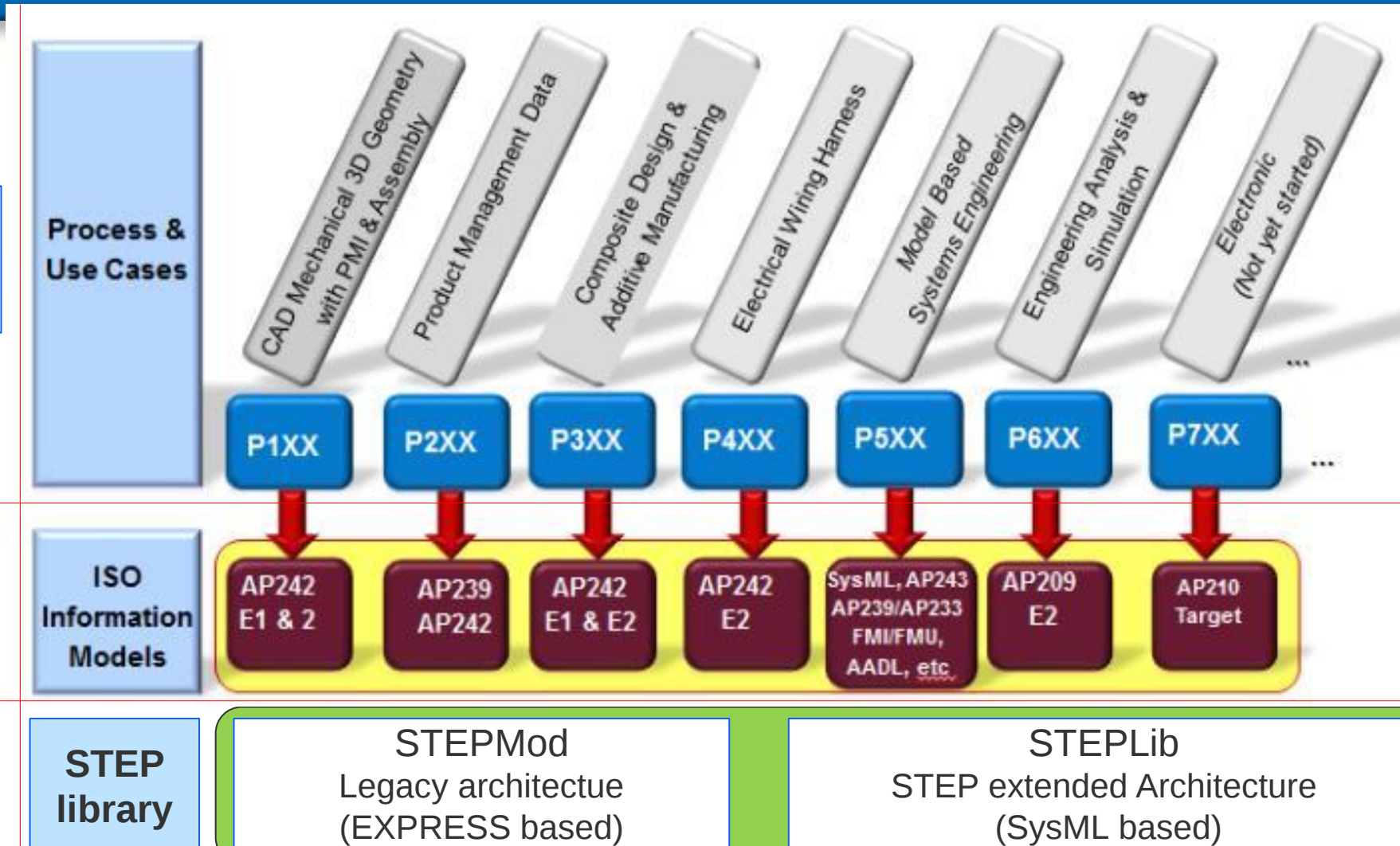
Interdependancies between PLM interoperability Business requirements, LOTAR standards, STEP standards, and associated Implementer Forums



(*): completed by other open international standards, such as: SysML, FMU/FMI,

Overview of LOTAR standards & links with associated ISO standards for information models

NAS / EN 9300
LOTAR standards
per technical domains



Need to ensure the longevity / enhancement of the STEP standards development infrastructure as part of the preservation plan

Overview of ISO 10303 STEP AP242 edition 2

“Managed Model Based 3D Engineering”



PDM – Configuration Management

Part identification, Physical part Characteristics, Document Management
General management information
Activity & work management, Delta change
Approval and certification
Effectivity, Specification, Breakdown, configuration
Project Management, Contract Management.

Requirements,
Validation &
Verification

Message

Mating definition



Production Rules

Process Planning

Analysis management

3D kinematics



Interface management

Electrical
Wiring Harness



Presentation
Colours, layers,
visibility, etc.

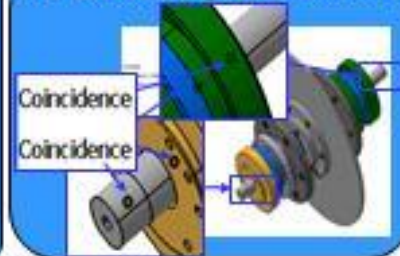
3D Machining
Form Features



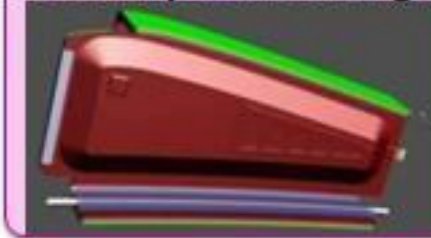
3D PMI
(Product & Manufacturing Information)



3D assembly constraints



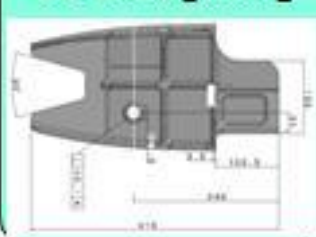
3D Composite design



Additive
Manufacturing



2D draughting

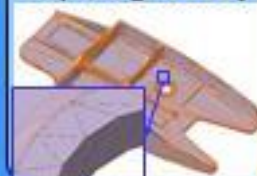


3D shape (explicit and parametric)

3D exact explicit
geometry



3D tessellated
explicit geometry



3D tessellated
explicit geometry



Surface texture



3D parametric
& construction History



3D scan



Summary – next actions

- The longevity of digital A&D product information for the duration of the products life is complex and has to fulfil regulations authorities. It may exceed 50 to 70 years.
- US and EU A&D industries develop the LOTAR standard to answer to this needs. The fundamental principles are: use of ISO OAIS, use of neutral information models, with the appropriate rules of valid. & verification of conversion in the neutral format
- NAS/EN9300 standards are organized by technical disciplines, and cover: - Mechanical, - PDM-CM, - Composite, - Elec. Wiring Systems, - MBSE, - Eng. Analysis & Simulation,
- They reference ISO 10303 STEP standards: [AP242](#), [AP239 “Product Life Cycle Support”](#), [AP209 “Multidisciplinary Analysis”](#), etc, completed by other open standards when necessary
- Importance for the manufacturing industries to participate to the Implementer Forums in charge of PLM interoperability test rounds of COTS PLM providers interfaces
- Opportunities for cooperation of LOTAR international with other industries sharing the same challenges and approaches.

Any questions?



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Back up
slides

AFNeT – prostep ivip STEP AP242 Day on the 17th of Oct., 2018, hosted by Airbus, Toulouse

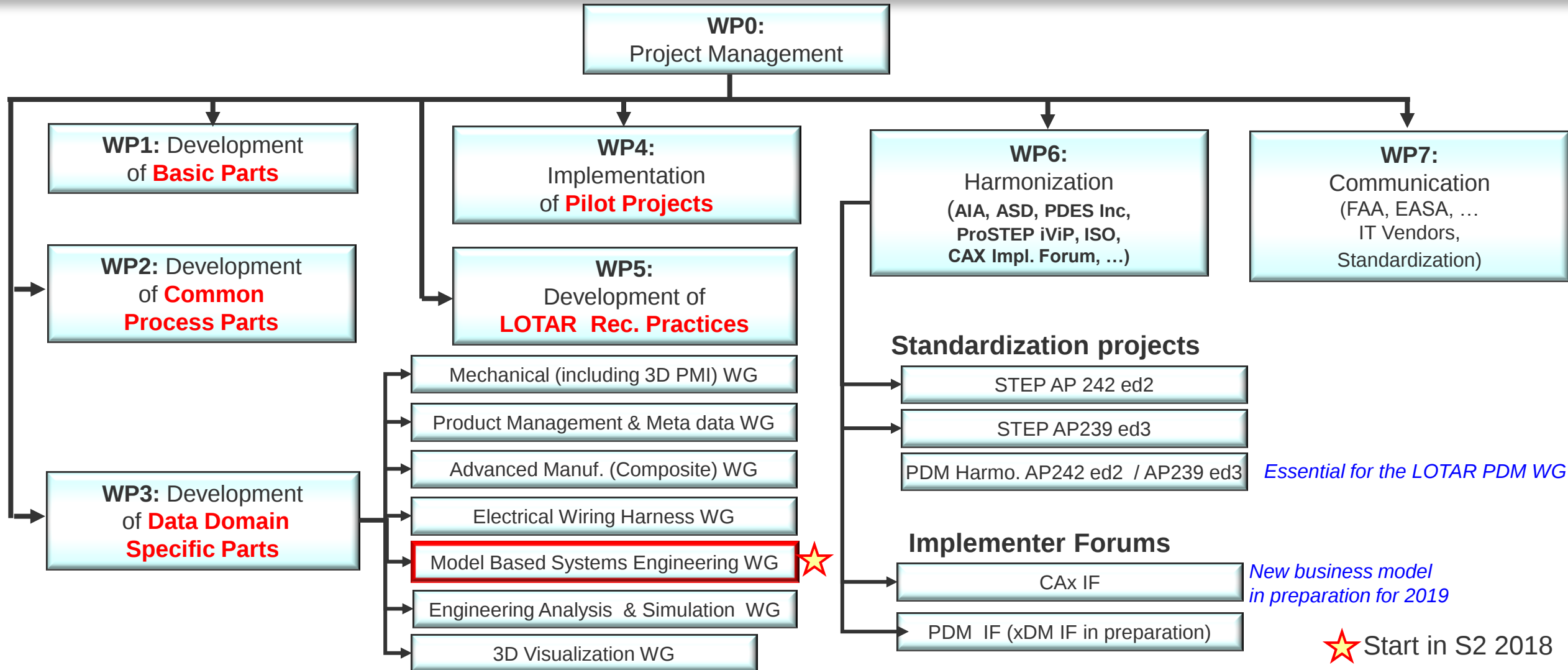


Start	End	Time	Item	Presenter/All
9:00 AM	9:30 AM	0:30	Coffee	
9:30 AM	9:40 AM	0:10	Introduction of the day	J. Brangé (AFNeT) & A. Pfouga (prostep ivip)
9:40 AM	10:05 AM	0:25	Keynotes of Airbus (Overview of A&D PLM Action Group "Minimum reqs. For 3D MBD " white paper)	Airbus (Jean Pierre SOUZY)
10:05 AM	10:35 AM	0:30	AP242 ed2 development, testing and benchmarks	JY Delaunay (Airbus) M. Nagler (BMW) (tbc)
10:35 AM	12:45 PM	2:10	Status of of vendors: 10' (AP242 coverage and roadmap + 1 highlight) - Core Technologie, Dassault Systemes, Datakit, Elysium, ITI, Jotne, Steptools, Theorem - tbc: Siemens PLM, Tsystems, Techsoft, PTC	
12:45 PM	2:15 PM	1:30	Lunch	
2:15 PM	2:35 PM	0:20	use of AP242 by Safran for 3D semantic Geometric Dimensions and Tolerances	Safran - Lenin Sevilla Garcia
2:35 PM	2:50 PM	0:15	STEP AP242 on the cloud: Boostaerospace Airdesign	P. Faure (BoostAerospace)
2:50 PM	3:05 PM	0:15	Business value & implementation roadmap of AP242 ed2 for elec. wiring harness	S. Herail (Cimpa)
3:05 PM	3:30 PM	0:25	A&D PLM Action Group recommendations on AP242 (TBC)	
3:30 PM	4:00 PM	0:30	Coffee break	
4:00 PM	4:15 PM	0:15	Kinematics based on AP242 demonstration	Rolf BOSSE - (Daimler with Tsystems)
4:15 PM	4:35 PM	0:20	New opportunities for deployment of STEP AP242 capabilities : - Capabilities for exchange of PDM "As design" ands "As built" product structure and delta change ? - 3D working instruction ? - <u>Use case for exchange and LT archiving of Req. V&V information for traceability ?</u> - Digital thread for 3D MM definition to NC machining and 3D metrology ?	
4:35 PM	4:50 PM	0:15	Industry use case (SNCF)	SNCF (tbc)
4:50 PM	5:10 PM	0:20	Digital continuity for end to end design to manufacturing	T. Chevalier (Airbus) (tbc)
5:10 PM	5:15 PM	0:05	Wrap up and end of the meeting	J. Brangé (AFNeT) & A. Pfouga (prostep ivip)

Invitations to be sent by
AFNeT and prostep ivip
before end of June 2018

LOTAR International project

2018 WBS



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

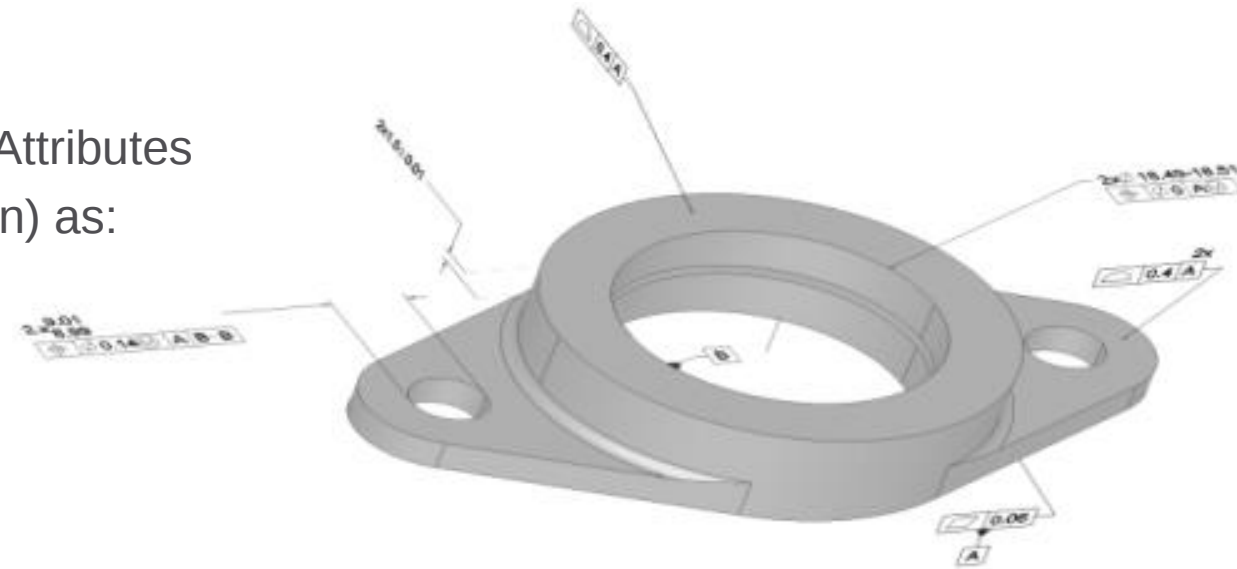
■ Scope:

- 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)



- 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 & 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

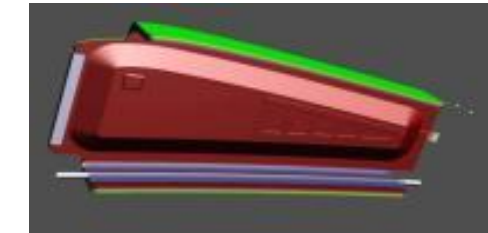
■ Organic Shapes and Surface Models

- 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

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

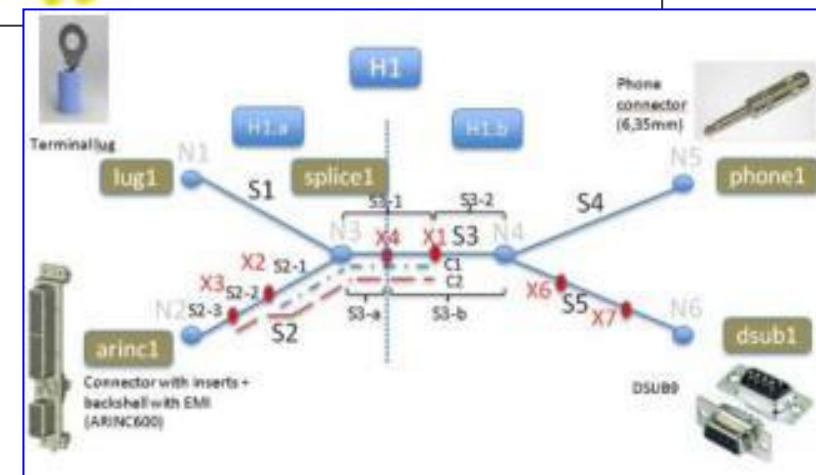
(*): Accomplished or in work; more planned

LOTAR
LONG TERM ARCHIVING AND RETRIEVAL

- Preservation of digital electrical harness models for

-

- 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, etc.

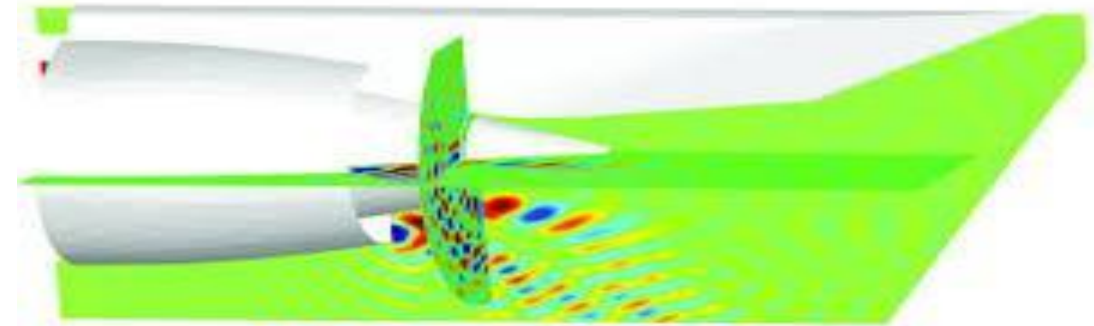


(*): Accomplished or in work; more planned

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



- 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
- Launch of the CAE IF in Q3 2017, part of the CAX Implementer Forum
- Preparation of a permanent MoU with NAFEMS (USA, Europe)



<http://www.ap209.org/>



LOTAR “Engineering Analysis and Simulation” Overview on a page



Why: *Business Need*

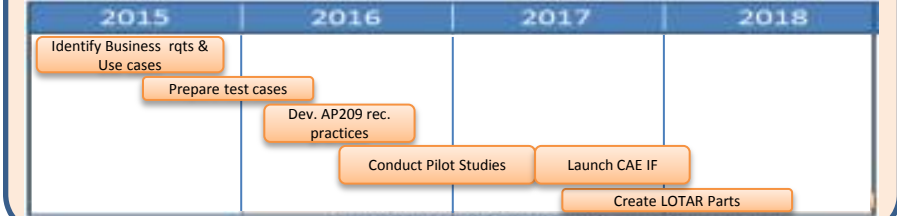
In an environment of rapidly changing software and hardware, a general requirement exists for access to and viability of digitally formatted engineering assets over the life of the product

- 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

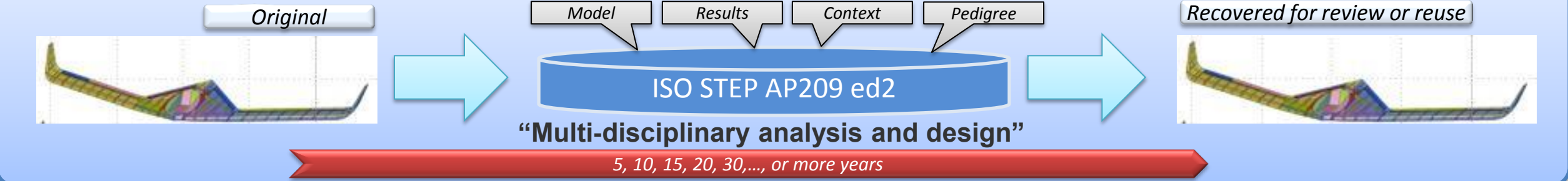
When & What*:

Phase 1 Schedule: 2015-2018

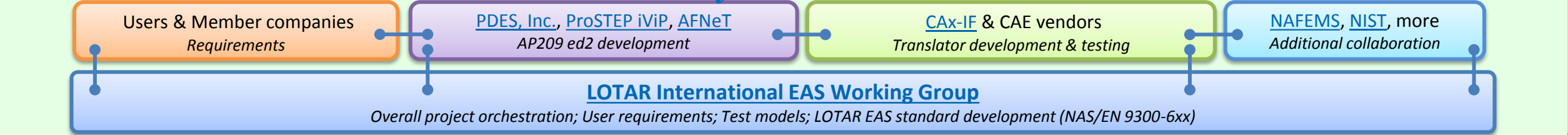
Phase 1 Scope: Vehicle-level model & loads employing linear static FEA



How: *Primary Technical Approach*



Who: *Players & Roles*



*EAS scope is broad. Other analysis types and disciplines to be addressed in subsequent phases

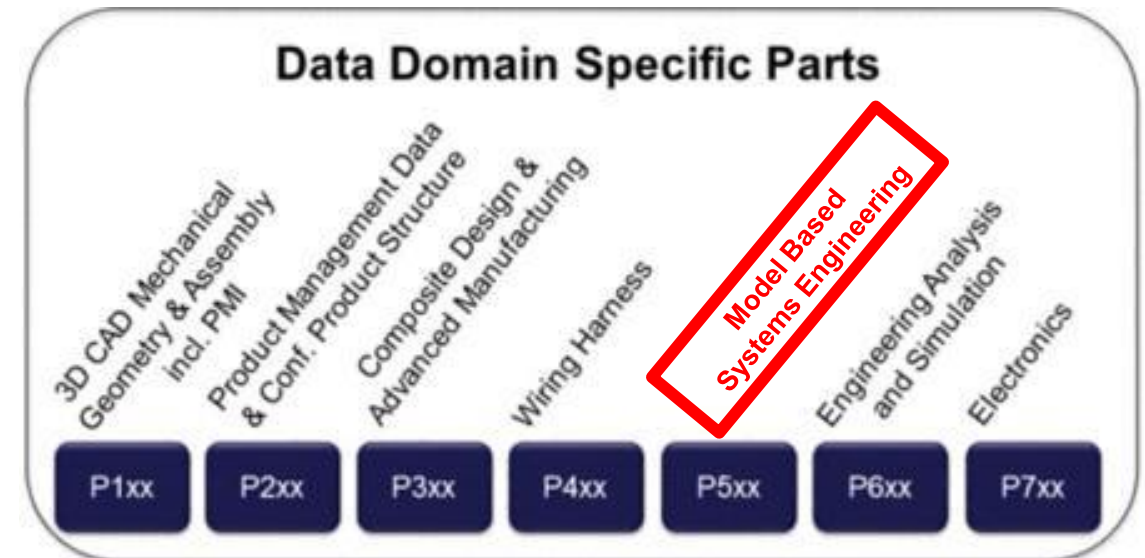
Start in S2 2018 of the LOTAR MBSE WG

Context:

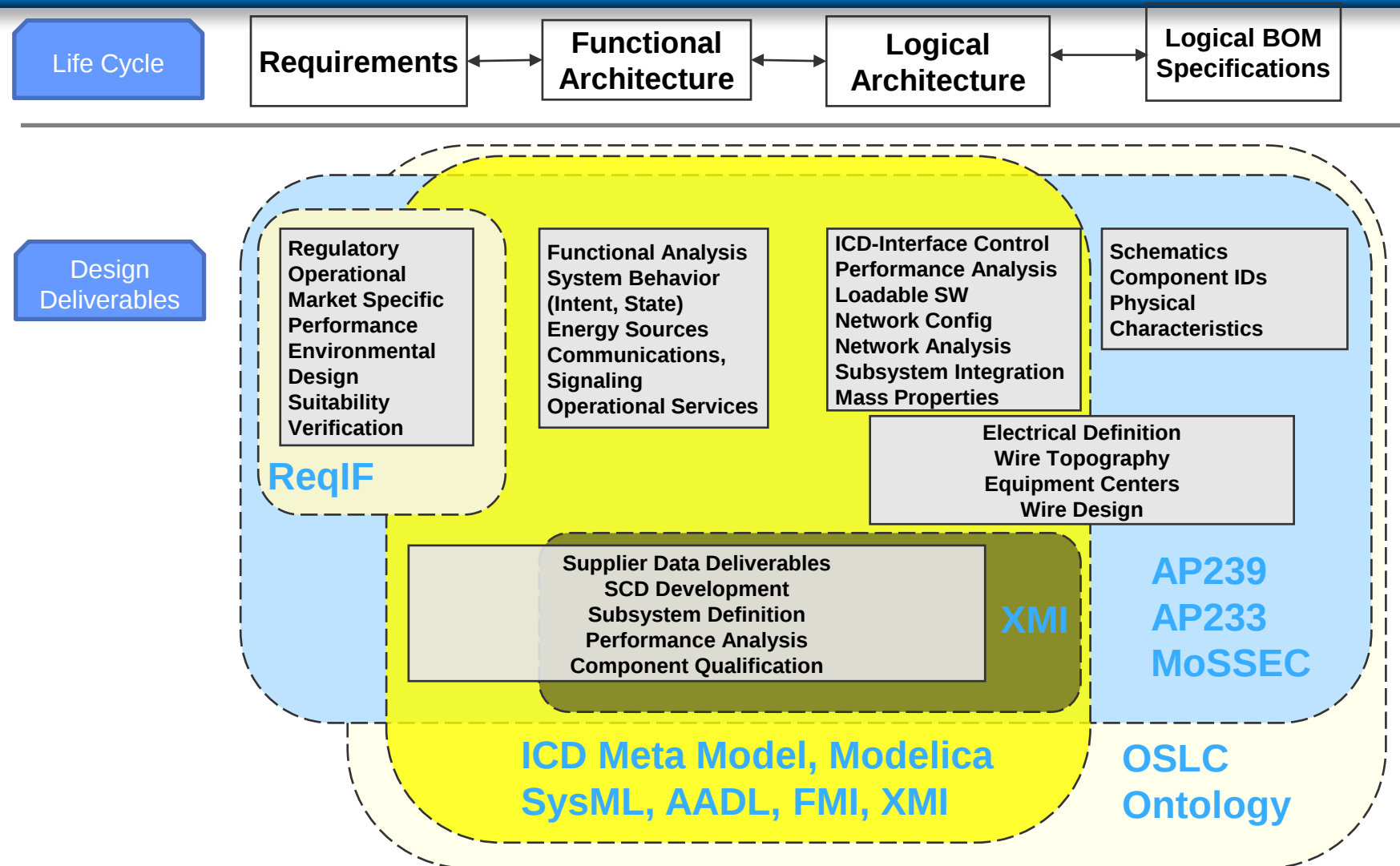
- PDES MBSE WG has developed a LOTAR NWI related to the long term archiving of Systems Engineering data (LOTAR P5XX family of specifications).
- Business value has been assessed and discussions are on-going with external groups (e.g. INCOSE, NAFEMS).
- The industry is in a phase of transition where many of the traditional documentation deliverables are best represented by models. The development and utilization of data and tool standards is also in transition resulting in widespread variation in how the models are created and preserved.
- This project will accelerate the development of common principles and supporting applications needed for implementation.

Proposed title and scope for the domain:

- Proposed title: **Model Based Systems Engineering**
- Scope: requirements, verification, validation, simulations, analysis, functional and logical architectures, software, test/qualification data, certification data (open-ended list)
- Identified use cases: see next slide



Application of Standards: To-Be-View



Access to LOTAR 2017 annual report and to LOTAR Dec. 2017 and 2018 March meeting reports

Summary of the LOTAR International Workshop March 12th to 15th, 2018 – Asheville, NC, USA

25 on-site participants plus 5 persons via teleconference. Parallel meeting with the CAx Implementer Forum.

Project Management

- Review of the status of payment of LOTAR 2018 fees by the European and American members; review of the 2018 LOTAR budget plan and start of preparation of 2019 statements of work.
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- Status of [PDM Implementer Forum](#). Overview of 2018 activities of the "User Group" and "Implementer Group", with 2 physical meetings. Continuation of preparation of public PDM test cases. Continuation of interoperability Test Round for explicit configured product structures and generic method to exchange pa-

Annual Report of LOTAR International for 2017

LOTAR is a project group managed under the AIA, ADO-Stan, PDES, Inc. and prostep ivip consortium. The project goal is to develop, test, pilot, publish and maintain standards designed to provide the capability to archive and retrieve digital product and technical information, including CAD, PDM, Composite Design, Electrical Harness, Engineering Analysis and Simulation, and 3D Visualization data, in a standard form that can be read and reused throughout the product lifecycle, independent of changes in the IT application environment originally used for creation. The multi-part standard covers the information content as well as the processes required to ingest, store, administer, manage and access the information. It is published as EN/ISO-9309.

Tasks

Goals of the project include:

- Developing a standard series (EN/ISO 9309) for archival and retrieval of product & technical data
- Standardization of methods, process modules and data models
- Providing methods, process modules and data model(s) to enable long-term archiving and retrieval of 3D CAD with PMI, PDM, 3D Composite Design, Electrical Harnesses, Engineering Analysis & Simulation, 3D Visualization and other types of data.
- Development of recommendations for practical introduction of long-term archiving of relevant data in the industry
- Advancement of commercial-off-the-shelf solutions based on user requirements by close cooperation with the CAE-IF, the PDM-IF, and conjoined funded pilot projects

Milestones 2017

- The Basic and Common Parts team completed and submitted Parts 007Ed3 "Terms and References" and P020Ed1 "Governance and Planning" for their initial two-month ballot.
- The 3D Mechanical & PMI WG completed three proof of concept pilots (POC) through the CAx Implementer Forum (CAx-IF). This allowed competing Parts 121Ed1 "Long Term Archiving & Retrieval of CAD 3D Explicit Geometry with Semantic PMI Representation" and P125Ed1 "Long Term Archiving of Explicit CAD assembly structure with PMI" and submitting them to AIA and ADO-STAN for their initial two-months ballot. Parts 118Ed2, P126Ed1 and P126Ed2 were published as International Standards. Work was completed on the relevant extensions of STEP AP242ed2, ensuring that it was ready for DIS publication. A new activity was started to define requirements, proposed and recommended practices for Holes and Fasteners. This activity will produce Part 132 "LTA of Manufacturing Features for Holes and Fasteners". A draft Recommended Practice will be reviewed internally by Q1, 2018.
- The PDM WG, which has been put their resources into work on STEP AP239ed3, will reconvene Q2, 2018, based on the completion of AP239ed3 harmonization activity. Part 300Ed1 "Fundamentals & Concepts of LTA of PDM information" was published as an International Standard.
- The Composite WG continued work on Part 300Ed1 "Fundamentals & Concepts of LTA Composite Design" and plans to submit it for initial draft Q1, 2018. The Composite WG also worked on the relevant extensions of STEP AP242ed2, ensuring that it was ready for DIS publication. Two Recommended Practices were completed and released, which supported both LOTAR and AP242ed2.
- The Electrical Wiring Harness WG had a very busy year supporting work on AP242ed2 as well as working on Part00ed1 "Fundamentals & Concepts of LTA Electrical Wiring Harness". The Electrical Wiring Harness tutorials were updated and validated in pilot activities with two vendors.
- The Engineering Analysis and Simulation WG conducted pilot studies based on STEP AP209ed2 and provided requirements for linear static structural finite element analysis to the CAx-IF. A dedicated workgroup for testing CAE data has been formed inside the CAx-IF, called the CAE-IF. Collaboration with NAREMS was intensified to raise visibility of the work in this domain. Work is being continued on a MoU with NAREMS and should be completed early next year.

Summary of the LOTAR International Workshop March 12th to 15th, 2018 – Asheville, NC, USA

25 on-site participants plus 5 persons via teleconference. Parallel meeting with the CAx Implementer Forum.

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Overview of 2018 activities

- **Preparation of the ballots:** P300 and 310 for composite design, part 500 and 520 for Structural Analysis
- **Publication of several parts of the LOTAR standard in 2018:** P7 ed3, P20, P120 ed2, P121, 125
- **Mechanical & PMI WG:** will cover LT Archiving of 3D PMI semantic data as well as assembly-related information, will prepare new parts for 3D definitions to include machining features, will continue to monitor the progress of AP242 works for holes and fasteners, with the start of a pilot in S1 2018.
- **PDM WG:** restart of the WG - dependent on the progress of development of AP239 ed3 and of its harmonization with AP242 ed2. Planned restart of the meta data WG; continuation of contributions to the PDM-IF.
- **Composites workgroup** will finish the Part 300 “Fundamental concepts” , and the part 310, to be sent for ballot before end of 2018. Work on validation properties, and conduct pilots in this domain.
- **Electric Harness WG** : will prepare the draft part 400: “Fundamental & concepts” and part 410 ” Physical Elec. Harness for design & construction”. Continuation of the spec. of validation properties, will provide public test cases for the AP242 ed2 pilot project. Support to the launch of the Electrical Implementer Forum in S2 2018 / 2019
- **EAS group:** will draft the 1st standard parts 600 and 620 for this domain, and also support broader testing of STEP AP209 ed2 CAE interfaces, first in LOTAR pilot, then in the CAE Implementor Forum. Finalization of the LOTAR EAS MoU with PDES Inc, AFNeT, prostep iViP and NAFEMS.
- **Prep. of the start of the MBSE WG:** sending of the New Work Item for creation of the MBSE WG in Apr. 2018; expected answer for the June LOTAR meeting