Use of ISO 10303 AP242 in the European A&D industries

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PLM interoperability standards Expert
Airbus

- **Jean-Yves Delaunay**
  Airbus Engineering,
  Based in Toulouse, France
  Joined Airbus in 1990
- Before Airbus:
  - Automotive: Peugeot SA (1985 – 1987)
  - Ship Building: DCN (1987 – 1989)
  - Engineer diplomas in Mechanical Engineering (HEI) and in Computer Aided Design (ENSIMAG)
- 3 great daughters
- Hobbies: walking, swimming, history and movies.

Table

- **Overview of ISO 10303 AP242**
  "Managed model based 3D engineering"

- **Recommendations of use of ISO 10303 AP242 by the European Aerospace and Defense Industries**

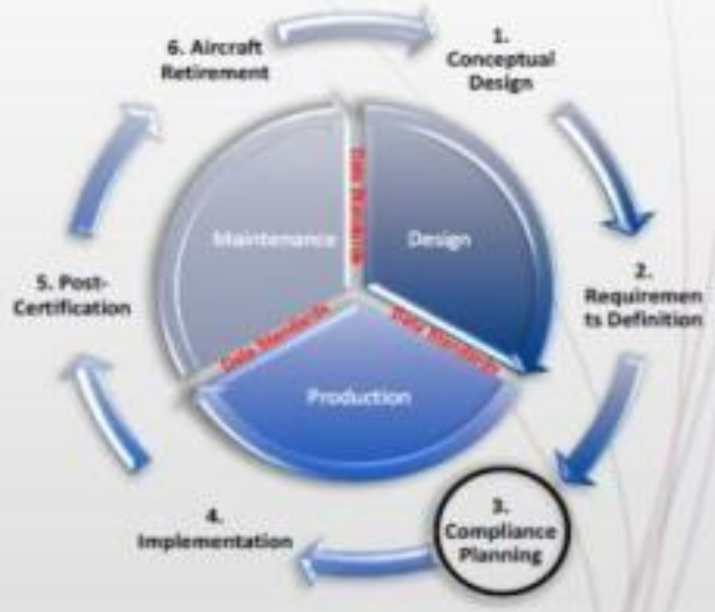
- **Use of ISO 10303 AP242 by Airbus**

ISO 10303 AP242: the recognized Aerospace & Defense standard for 3D Model Based Definition interoperability

The Digital Thread for Aerospace & Defense

Project Activities

- What is the **minimum MBD** content to support the **digital thread** for the industry?
  - Design
  - Manufacture
  - Certification
- Interoperability based on **industry data standards** is a key to the **digital thread**.
- **AP242** is the recognized majority direction for enabling this **interoperability.**



Administered by CIMdata

AEROSPACE & DEFENSE PLM ACTION GROUP

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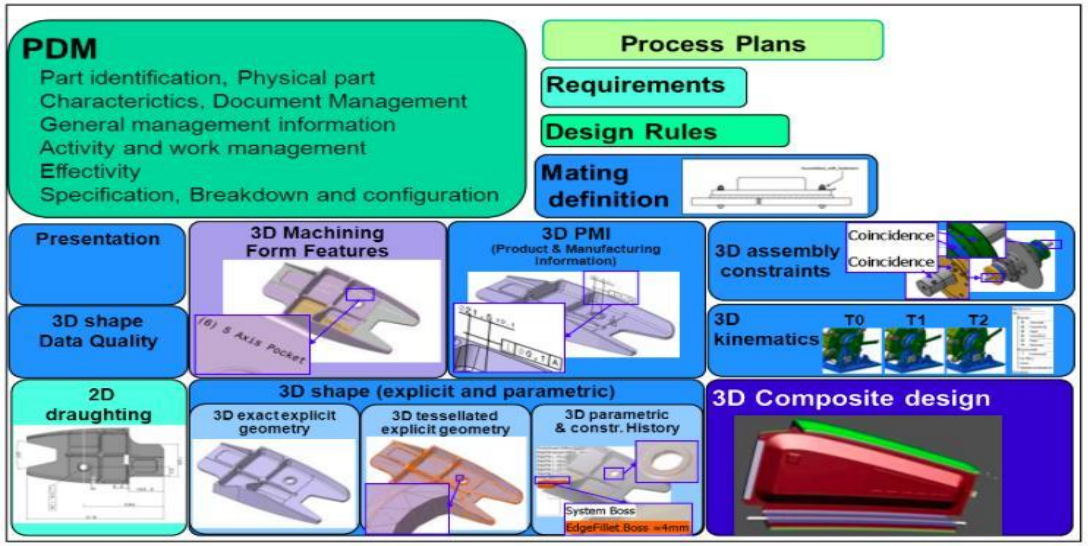
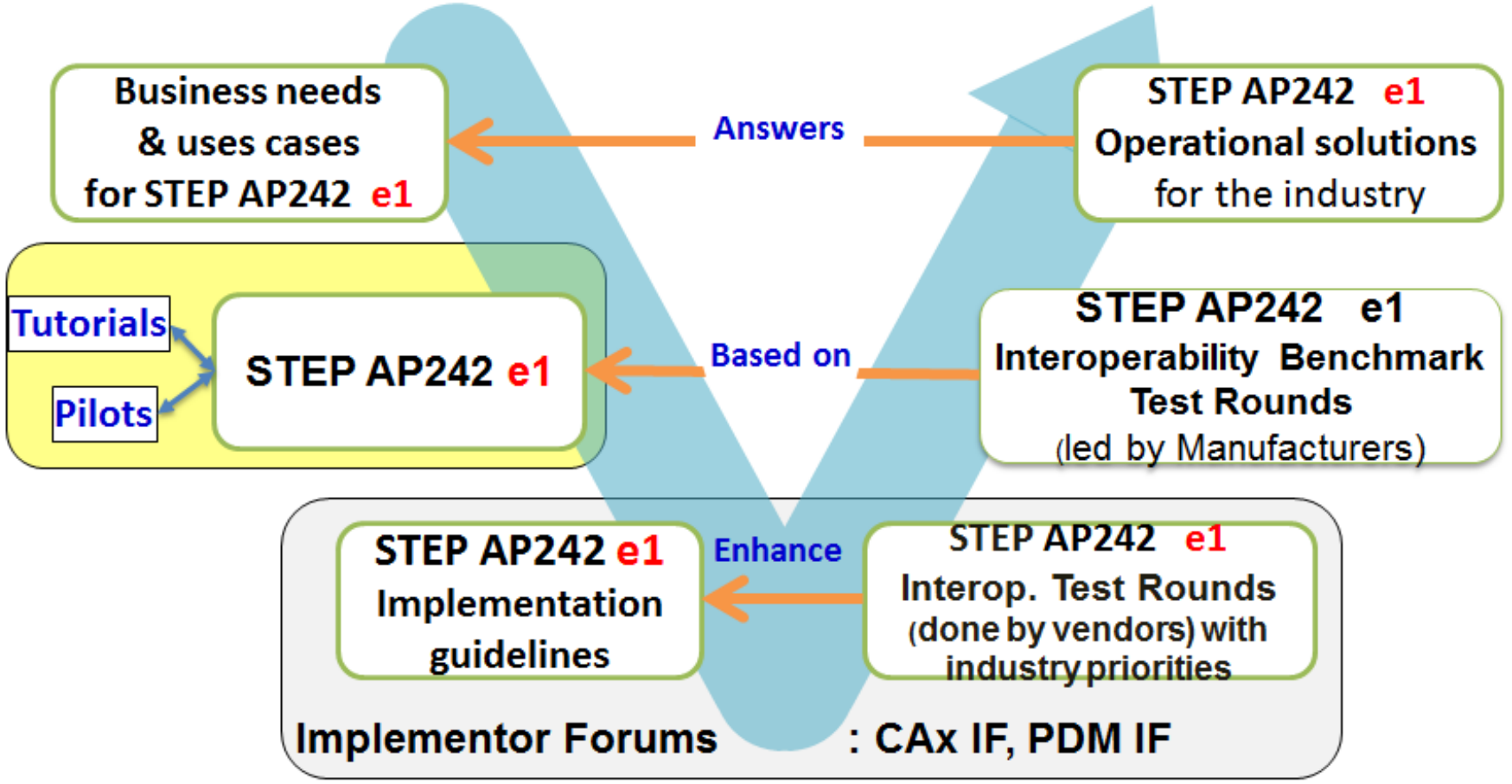


Scope of STEP AP242 edition 1 (International Standard (2014)

➔STEP AP242 is the **unique ISO standard** which:

- covers the main MBD Digital Technological Processes
- Is integrated with:
  - STEP AP209, for Multi Disciplinary simulation
  - STEP AP238 – STEP-NC, for 3D NC Machining:
- includes PDM – CM interoperability capabilities, harmonized with AP239 for through life cycle support

STEP AP242 ed1: COTS solutions available, supported by the CAx and PDM Implementer Forums



The development of STEP AP242 interoperability capabilities relies on Systems Engineering principles, covering the full life cycle, from Business Requirements to Deployment, with Validation & Verif. methods

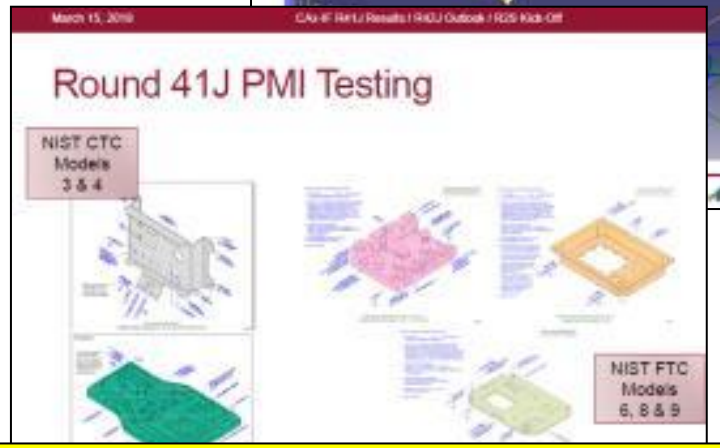
CAx Implementer Forum: March 15, 2018 Round Table, Asheville, NC, USA

Hosted by PDES Inc., AFNeT, & prostep ivip

https://www.cax-if.org/

- Continuation of tests of AP242 ed1 functionalities:
  - 3D PMI semantic
  - Composite
  - Kinematics

- Status of STEP AP242 interfaces by the main PLM editors:
  - **NIST tools update** (STEP 3D PMI analyser, STEP AP209 analyser)
  - **Dassault Systèmes** (Catia V5, 3DEXPERIENCE, SolidWorks, etc.)
  - **Siemens PLM** (NX, NJT2GO, Femap, SolidEdge, TCVis, etc.)
  - **CT CoreTechnologie** (3D_Evolution, 3D_Analyzer)
  - **Datakit** (CrossCAD converter)
  - **Elysium** (Asfalis converter)
  - **Jotne EPM** (EXPRESS Data Manager, status of AP242 and AP209 IFs)
  - **International TechneGroup - ITI** (PDE Lib, CAD IQ, CAD Fix, etc.)



The CAx IF improves STEP AP242 translators quality and decrease translators time-to-market
Launch of the CAx IF “3D MBD User Group” in 2019 to define industry 3D MBD use cases & test cases

PDM Impl. Forum: Implementor Group 2018 scope

User Group ⟷ Implementer Group

Start of CONF3 tests, based on the bicycle test case
- Occurrence Effectivities and Revision Effectivities
- Specifications (based on the “mountain bike” test case)

Full-loop test of a PDM “As Designed” product structure
- CAD A -> AP242 XML -> CAD B -> AP242 XML -> CAD A
- Management of supplier IDs at OEM
- Covered by VDA Test Case (“toy car”)

Customization Test Case
- With PDM Properties as defined by the User Group

Additional Topics & Ideas
- Using several geometric representations for the same part (e.g., native & neutral)
- Several versions of one part in the same file
- Sending of partial PDM product structures

Two test rounds in 2018

Full-loop test, based on VDA test case
- CAD A -> AP242 XML -> CAD B -> AP242 XML -> CAD A
- Has highlighted the need of recommended practices, since COTS PDM systems have sometimes different internal rules

Exchange of basic configuration management data
- Test case based on specifications documented
- Interests of the PDM editors to have industry requirements

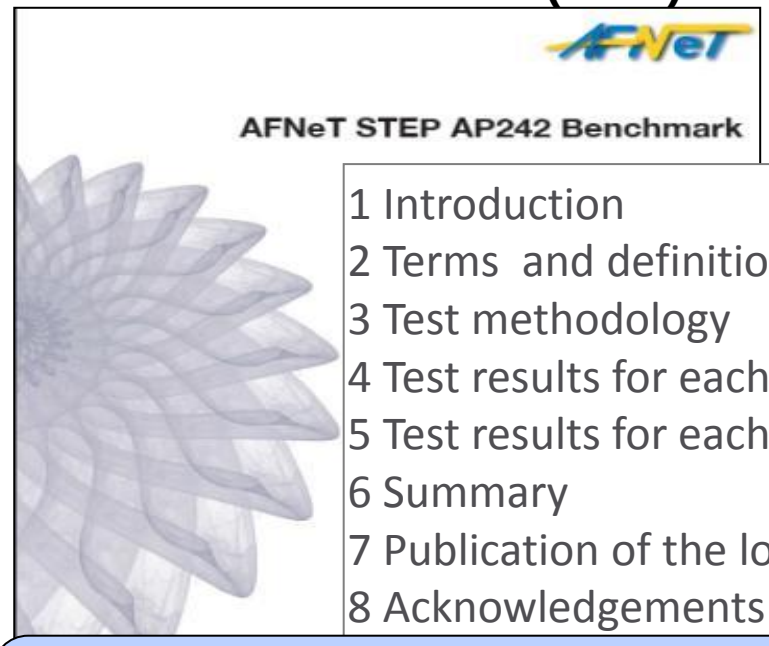
Results Topics & Ideas
- Updates of the AP242 PDM XML Recommended Practices
  - Product & Assembly Structure (PAS): V1.99 available
  - Configuration Management: Current working draft: V0.5
- Enhancement of the testing criteria + new evaluation Sheet

Project supported by AFNeT, & prostep ivip : http://www.pdm-if.org/

Good involvement of the EU manufacturers in the User Group to define common use cases and priorities
Good progress of the participating PLM editors, but still need to continue to involve missing PLM editors

Publication of AFNeT – prostep ivip STEP AP242 ed1 benchmarks done for the main CAD and PDM COTS : http://benchmark.ap242.org/

AP242 benchmark #2 (2017): CAD Work Package

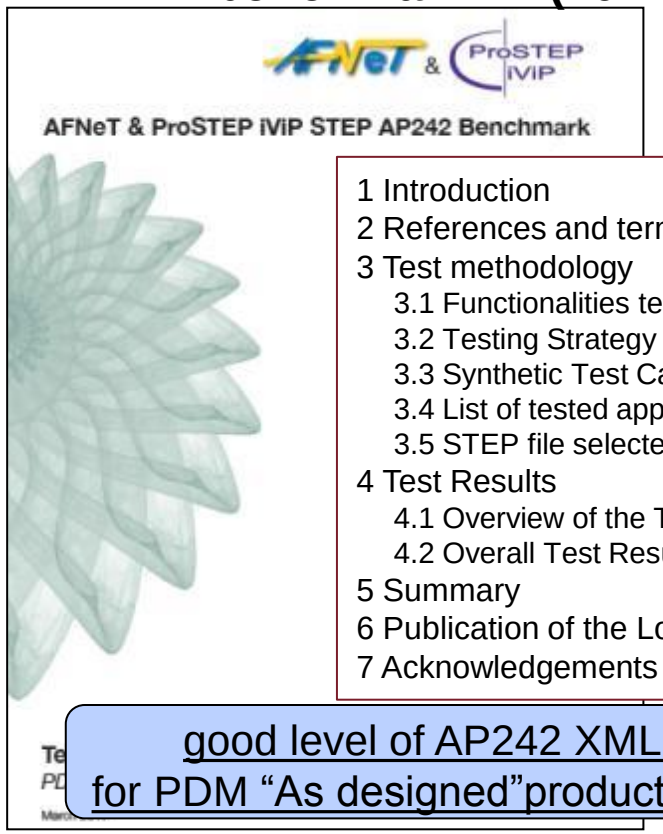


Public report

1 Introduction
2 Terms and definitions
3 Test methodology
4 Test results for each tool
5 Test results for each test case
6 Summary
7 Publication of the long report
8 Acknowledgements

- 3D geometry and assembly structure : high level of quality
- 3D geometry with 3D PMI graphic presentation: promising results
- 3D geometry with 3D PMI semantic: limited implementations, but promising results, announcement of support by main CAD editors

AP242 benchmark #2 (2017): PDM Work Package



Public report

1 Introduction
2 References and terms
3 Test methodology
  3.1 Functionalities tested in this Benchmark
  3.2 Testing Strategy
  3.3 Synthetic Test Case Specifications
  3.4 List of tested applications
  3.5 STEP file selected as reference for phase 3
4 Test Results
  4.1 Overview of the Test Results
  4.2 Overall Test Results
5 Summary
6 Publication of the Long Report of PDM test case
7 Acknowledgements

good level of AP242 XML implementation for PDM "As designed"product structure exchange.

Public status of STEP AP242 functionalities available for operational use, tested by the industry, with identification of limitations of the tested PLM COTS STEP AP242 applications.

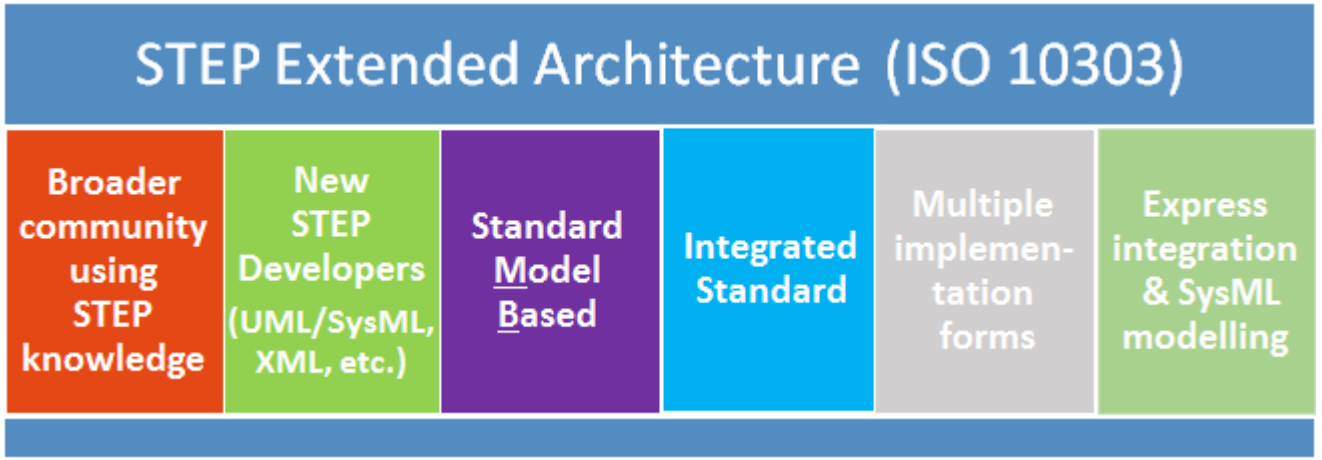
STEP Extended Architecture: upward compatibility with STEP legacy + support of new industry requirements

- Context
  - Product Life Cycle ➔ Systems Life Cycle
  - Systems Engineering ➔ MBSE

  : Increasing use of SysML!
  - Increasing importance of electronics and electrical simulation, as part of mechatronics

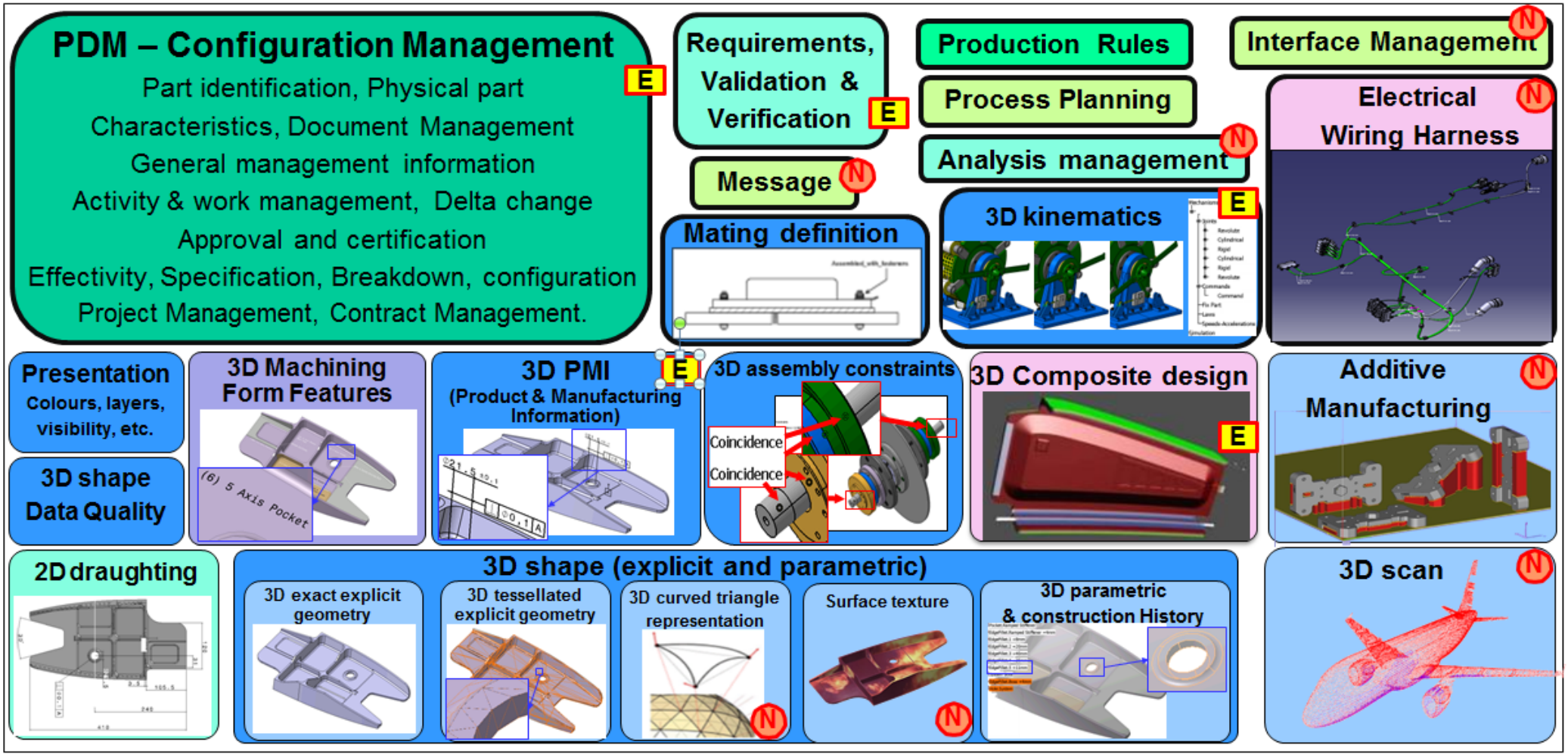
    : SysML extension to support Physical Interaction and Signal Flow Simulation specification

- The answer:
  - To **extend the modelling framework of ISO 10303 in order to support;**
    - new industrial needs and
    - evolutions of Information Technologies



The development of ISO AP242 ed2, AP239 ed3 PLCS and AP243 MoSSEC relies on the implementation of the STEP Extended Architecture, in a phased approach

Finalization of STEP AP242 edition 2: Planned publication of the "International Standard" (IS) in May 2019



Enhancement E New (Extension) N Domain model + AP model

Other main ENHANCEMENTS:

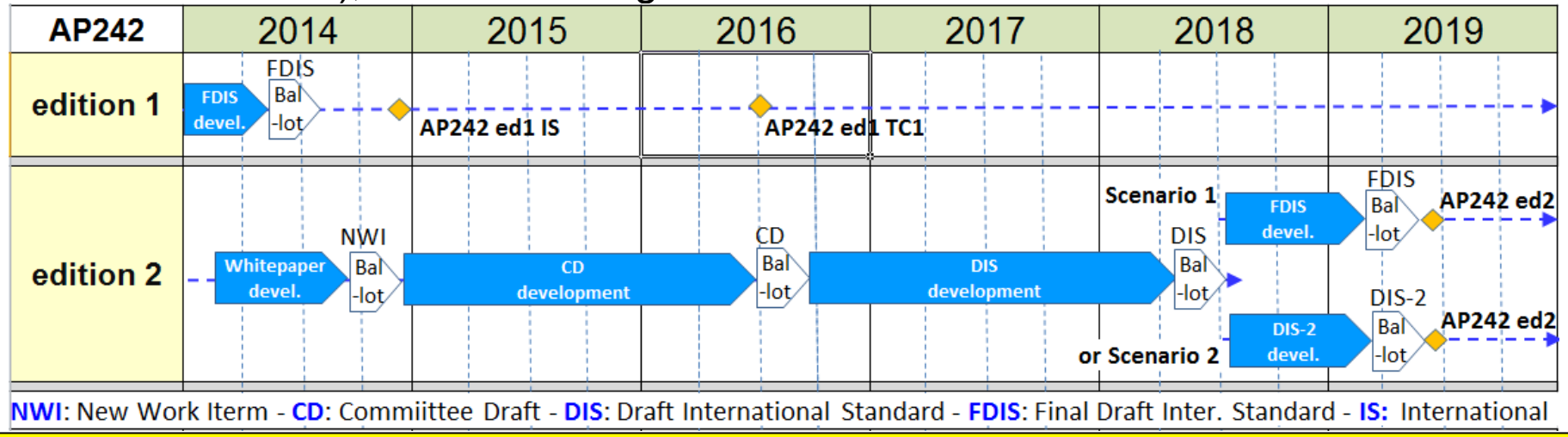
- Harmonization with AP239 ed3 for:
  - PDM / Conf. Management
  - Requirement, Validation & Verification
- Easier navigation in the HTML documentation of the Domain model

Finalization of STEP AP242 edition 2: Two scenarios resulting of the AP242 ed2 DIS ballot

- AP242 ed2 DIS ballot results on the 6 Sept. 2018 (6 “YES with comments” – 4 ““NO with comments”)
- Org. of a ISO /TC 184/SC 4 Project Planning Committee (PPC) confcal on the 12 Sept.

➔ **Recommendations to secure the publication of AP242 ed2,** with 2 main scenarios:

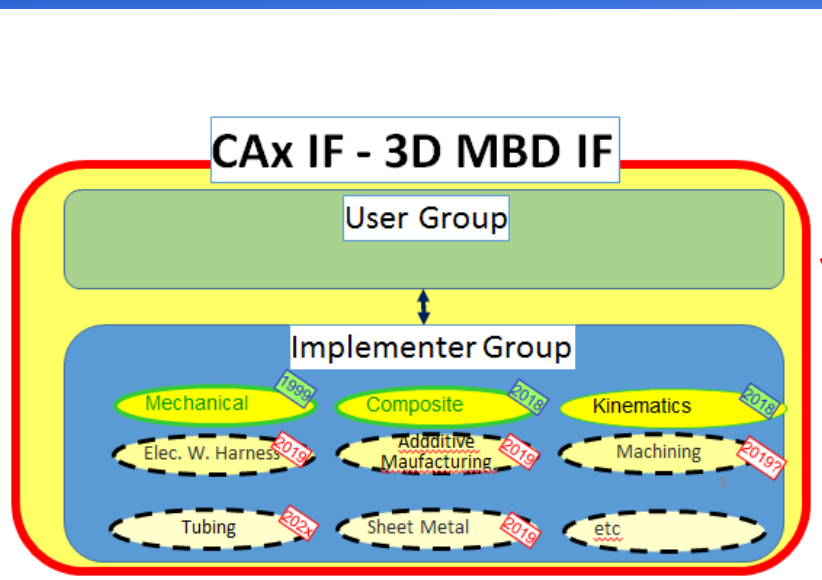
- Scenario 1: to review with the national bodies having balloted “NO” their technical comments and the possibility to obtain a “YES with comments”: in progress
- Scenario 2: to prepare a DIS-2 in the timeframe agreed during the May 2018 SC4 meeting (resolution “9 months extension”), AND answering to all technical comments of the DIS ballot



Strong effort of the AP242 ed2 project team to answer to DIS ballot comments

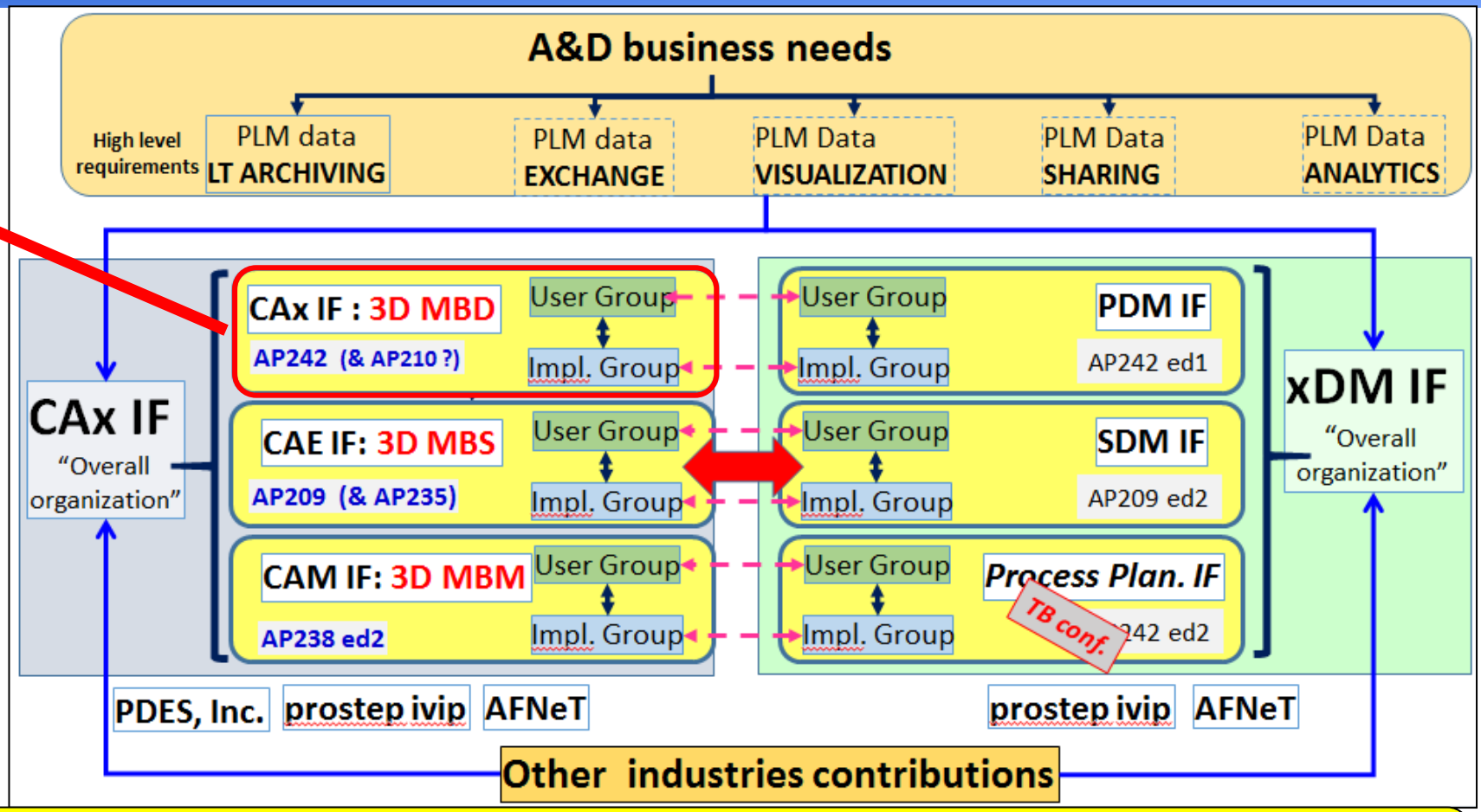
➔Will demonstrate the capability to reach ISO consensus according to industry needs

Industries requirements for the CAx and xDM Implementer Forums : preparation of the launch of the CAx IF ”3D MBD WG” in 2019



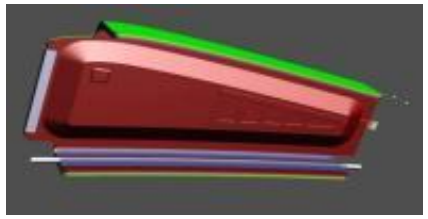
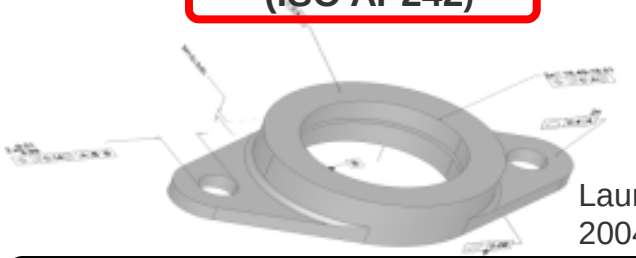
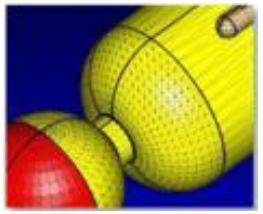
Editions of ISO STEP AP242:

- **AP242 ed1** — International Standard (IS) in 2014
- **AP242 ed1** — In development - Planned IS end S1 2019
- **AP242 ed1** — In preparation - Target IS S1 2022



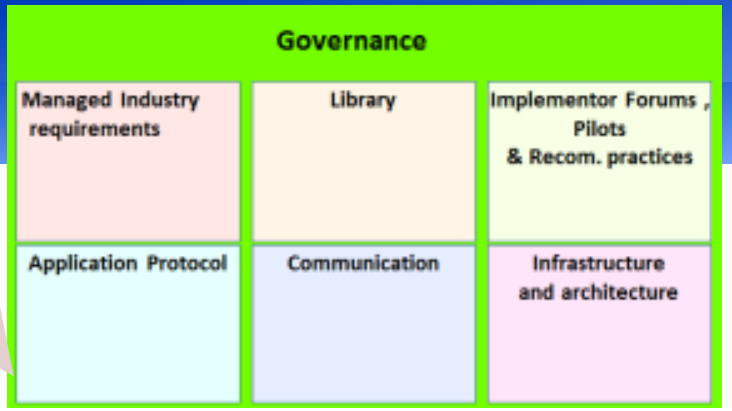
Industry has benefits to prioritize its PLM interoperability requirements and to participate into the Implementer Forum, which organizes interoperability test rounds by the main PLM editors

LOTAR and the link to ISO STEP AP242

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

The LOTAR standards rely mainly on ISO 10303 product data exchange standard, which includes AP242

Preparation of STEP AP242 edition 3 project in 2018 : planned to start in 2019



ISO /TC184 /SC 4 gouvernance

ISO 10303 Roadmap V(1)

STEP AP242 5 years roadmap Version 1

Requirements & uses cases for STEP AP242 edition 3

STEP AP242 edition 3 Interoperability Benchmark Test Rounds (led by Manufacturers)

Based on

Tutorials

Pilots

Development of STEP AP242 edition 3

AP242 ed3 Implementation guidelines

Enhance

STEP AP242 ed3 Interop. Test Rounds done by vendors with industry priorities

Implementor Forum

STEP Architecture and infrastructure

STEP Librairies

Needs for the industries to identify their priorities and plan resources for the contribution to the development of AP242 e3 : meeting on the 21 Sept. 2018, Jacksonville, USA

Table

- **Overview of ISO 10303 AP242**
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- **Recommendations of use of ISO 10303 AP242 by the European Aerospace and Defense Industries**

- **Use of ISO 10303 AP242 by Airbus**

Main European Aerospace and Defense (A&D) organizations related to A&D digital standardization, including STEP AP242

Aerospace and Defense Industries Association of Europe (ASD)

: **https://www.asd-europe.org/**

ASD Standardization (ASD Stan)

: Domain 7 “Digital projects”

: **https://www.asd-stan.org**

ASD “Strategic Standardization Group”

: **http://www.asd-ssg.org/**

European Defence Agency (EDA)

: **https://www.eda.europa.eu/**

European Defense STAndards Reference System (EDSTAR)

https://edstar.eda.europa.eu/

European Aviation Safety Agency (EASA)

https://www.easa.europa.eu

Requirements for

- 3D digital aerospace product Long Term Retention,

- communication with the Supply Chain, Airlines and MROs

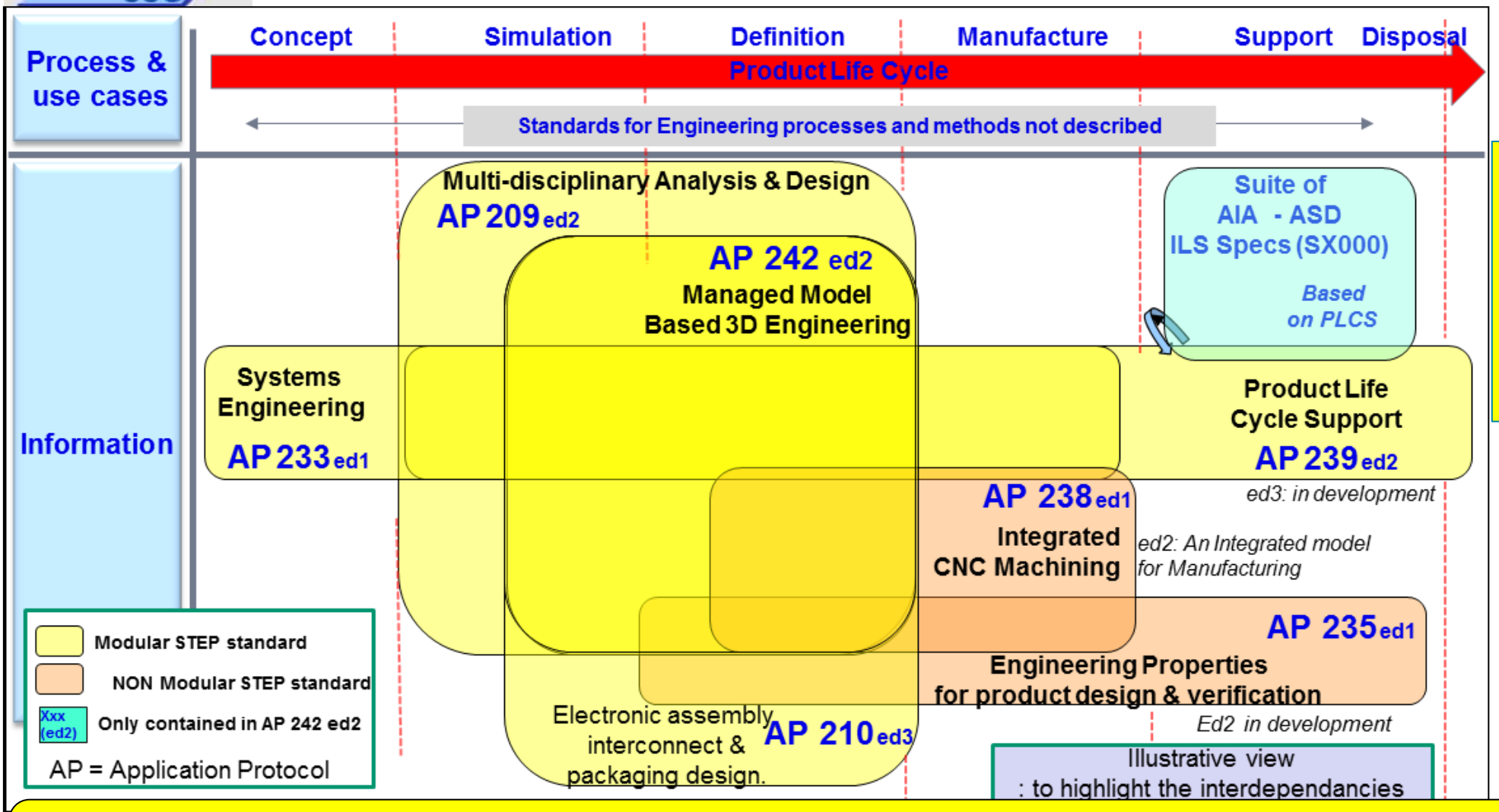
European Space Agency (ESA)

https://www.esa.int/ESA

The development and the recommendation of use in operation of STEP AP242 involve several European A&D organizations

Scope overview of the main ISO 10303 STEP standards of interest for the European Aerospace & Defense industries

E-Business SSG

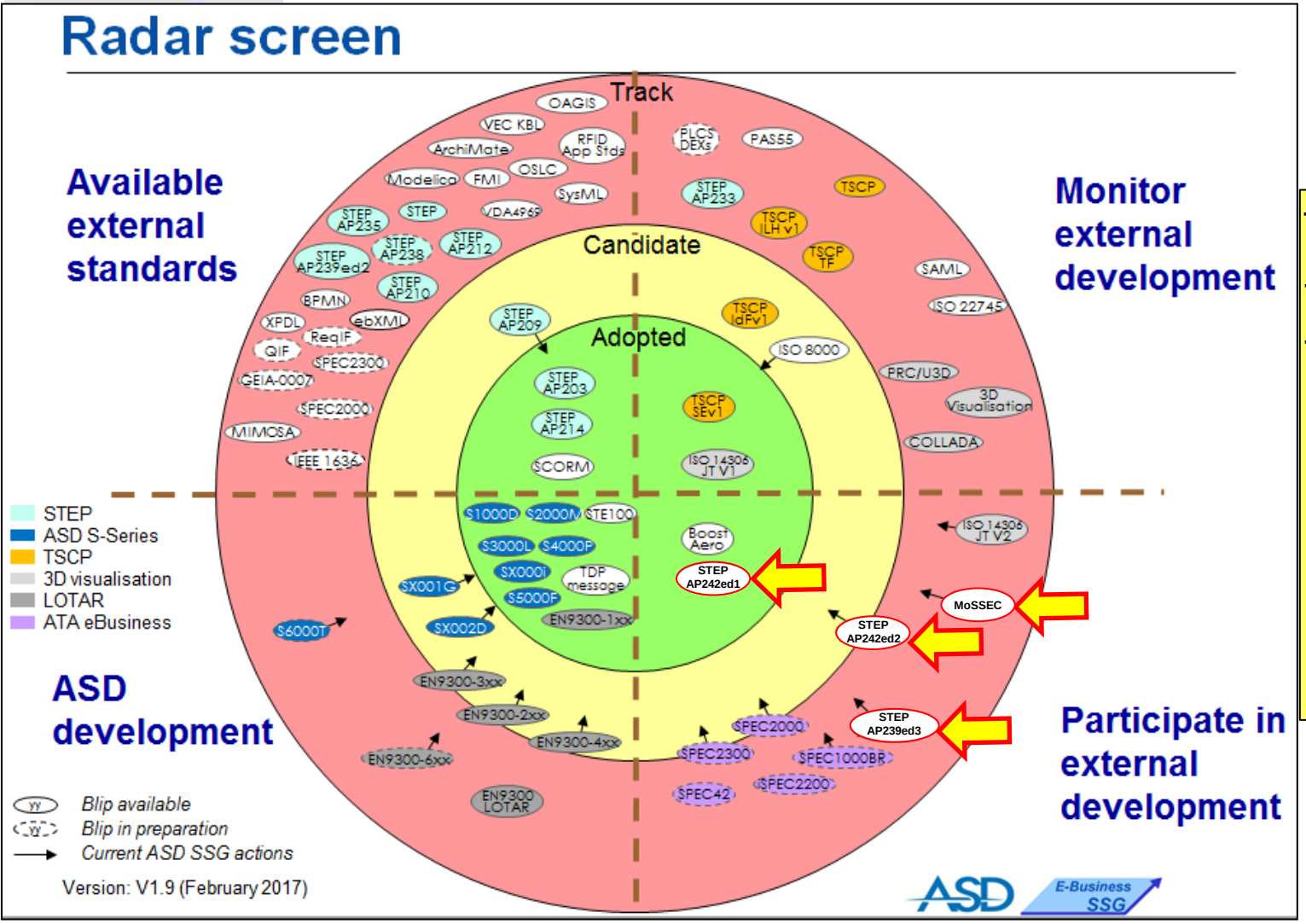


Published statement: (2014)

The ASD SSG identifies the STEP Application Protocols as cornerstone information models for PLM interoperability

AP242 is a modular Application Protocol sharing information models subsets with other STEP APs, allowing to cover key domains of the product life cycle in a consistent way

Recommendations of the European A&D industry association for adoption of AP242 ed1, dev. of AP242 e2, AP239 e3 and MoSSEC



http://www.asd-ssg.org/radar-chart

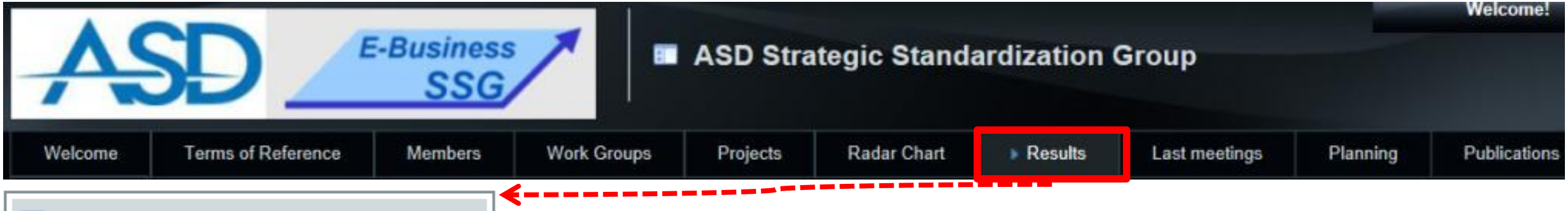
Extracts of ASD SSG statements

The ASD SSG supports:

- the adoption of STEP AP242 e1,
- the development of:
  - AP242 e2, +
  - AP239 e3 PLCS, +
  - AP243 MoSSEC,
  - A consistent AP239 ed3 and AP242 ed2 based on common core technical capabilities and STEP resources.

Coordination with AIA to identify opportunities for common actions and recommendations

Support of STEP AP242 standard by the European A&D industries : use of AP242 edition , development of AP242 edition 2



Navigation

Results » ASD Statements

Statement page

Objective of this page is to publish the statements, decisions and resolutions validated by ASD SSG.

To ASD SSG public web page

Statement on STEP AP242 for CAD/PDM exchange and long term archiving - Feb. 2015

ASD recommends the use of STEP AP242 for the **exchange**, **long term archiving** and **transfer to downstream processes** of **CAD data** (mechanical design, incl. composite) and associated **configuration (PDM) data**. The most recent editions of the standards should be used wherever possible.

ASD encourages CAD vendors and 3D viewer Vendors to develop AP242 interfaces and visualization capabilities.

ASD encourages PDM vendors to develop PDM AP 242 interfaces and to support the setting up of the PDM Implementor Forum (planned start in 2015), in charge of the development of AP 242 XML PDM recommended practices.

This strategy will also support interoperability with modular STEP standards for other parts of the lifecycle, including AP233 “Systems engineering”, AP209 “Multidisciplinary analysis and design”, AP210 “Electronic assembly, interconnect and packaging design” and AP239 “Product life cycle support”.

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- **Use of ISO 10303 AP242 by Airbus**

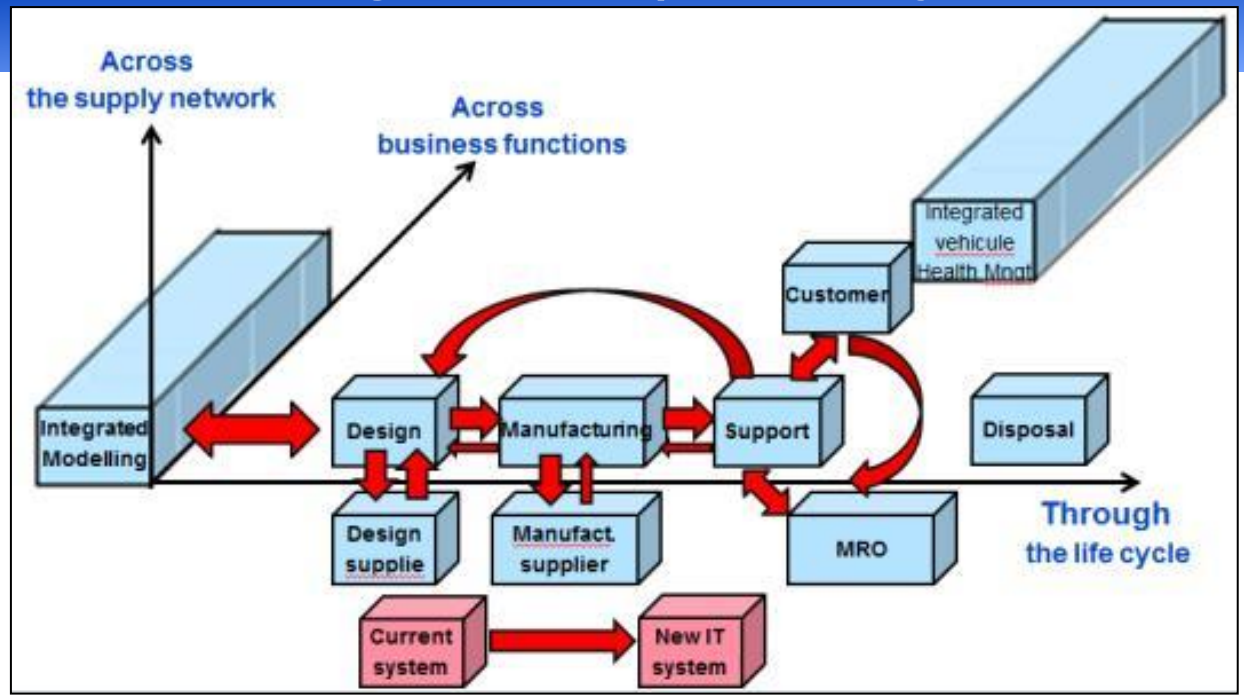
Airbus statement:
Open standards increase Business Value through Interoperability

Enable digital continuity:

- Through the life cycle.
- Across the Supply Chain EE
- Across business functions,

Key enabler for:

- E2E PLM Model Based processes
  : MB Design, MB Manufacturing, MB Support
- Model Based Enterprise
- Digital Enterprise knowledge
- Digital twins and IoTs



Values of PLM interoperability standards:

- Minimize customized applications & **maximize COTS capabilities**
- Increase **obsolescence resilience**
- Sustainability for long term Airbus digital assets
- Enable **Convergence on consensus information models**
- Enable better Control / **Optimization of TCO**
- Enable future technologies introduction

List of main PLM interoperability standards for Airbus Engineering V1 (Extract)

Standards	Standard name	Implementer Forum
EN9300 LOTAR	A&D PLM LTA & Retrieval	CAx & PDM IF
ISO STEP AP242	Managed model based 3D engineering	CAx & PDM IF
ISO STEP AP209	Multi Disciplinary Analysis & Design	CAx IF (& SDM IF)
ISO STEP AP235	Engineering properties for product design & verificat.	(xDM IF)
ISO STEP AP239	Product Life Cycle Support	(PDM - xDM IF)
OMG SysML	System Modeling Language	
FMI / FMU	Functional Model Interface / Functional Model Unit	
ISO MoSSEC	MOdelling & Simul. Info. in a collaborative SE Context	(xDM IF)

- Scope of the presentation :
- Other presentations done by Airbusduring GPDIS 2018 related to these standards:

Airbus recommends the use of ISO 10303 for Aerospace as the suite of consistent product information model standards, completed by other appropriate standards

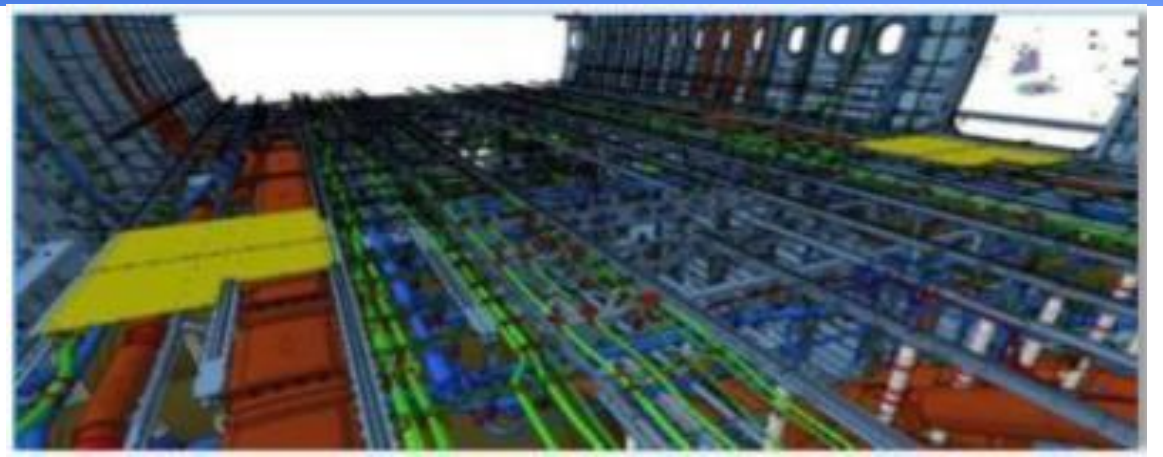
Contributions of Airbus to develop and support the implementation of STEP AP242

- Participation in related **Standardization organizations**:
  : ISO/TC 184/SC4, CEN TC310, etc
- Contributions to the **development of PLM standards:**
  - ISO STEP AP242: edition 1, edition 2, preparation of edition 3
  - Related PLM standards
    : NAS / EN9300 LOTAR, STEP AP239 ed3, MoSSEC ed1, OMG SysML, etc
- Participation in the Board and Technical Committees of **Standardization associations**:
  : PDES Inc, AFNeT, prostep ivip
- Contributions to **Implementer Forums** (IF):
  : CAx IF, PDM IF,

Airbus supports the Harmonization of STEP AP242 and AP239 PLCS
as the backbone standards for **Aerospace PLM meta data interoperability**

Examples of use of ISO 103 STEP AP 242 (and AP214) from Airbus

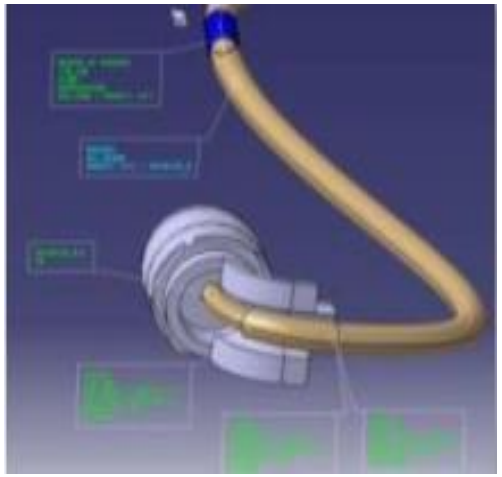
- **Past (still in use)**
  - STEP AP 214 for the conversion of legacy 3D CAD models to CatiaV5
  - STEP AP 214 for exchange of PDM product structure



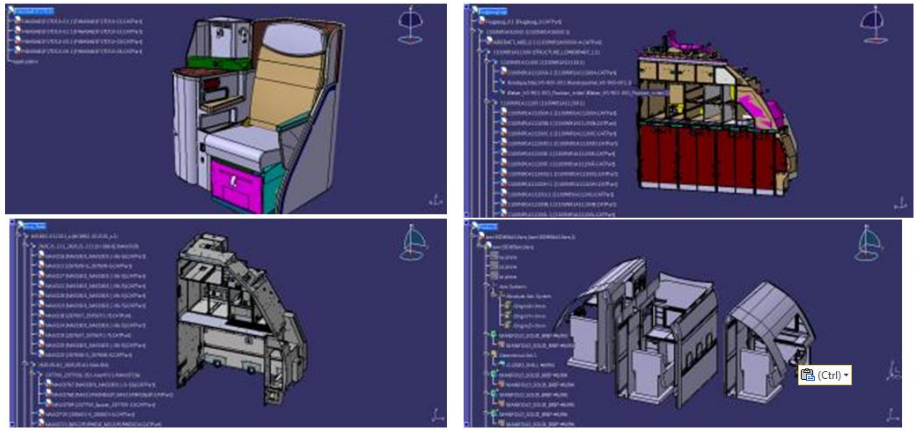
- **Present**

3D MBD Long Term Archiving

of A350 “Full 3D” definition in STEP AP 242 / AP214



3D DMU data exchange with cabin equipment suppliers in AP214 / AP242



Summary - Key messages

- **The European A&D industries:**
  - highlights the need of operational PLM interoperability capabilities for MB Engineering and for “through life cycle” integration
  - Supports the use of STEP AP242 ed1 for exchange, long term archiving and transfer to downstream processes of CAD data and associated configuration (PDM) data
  - Supports the finalization of AP242 ed2, in conjunction with AP239 ed3 and AP243 MoSSEC

  ➔ Opportunity to consolidate the coordination between AIA and ASD on standards developed jointly by American and European A&D manufacturers

- **Airbus**
  - uses in operation STEP AP242 for CAD 3D DMU exchange and for CAD 3D LT Archiving
  - supports the Harmonization of AP242 ed2 and AP239 ed3 PLCS as the backbone standards for Aerospace PLM meta data interoperability

Need to finalize the ongoing development of ISO 10303 standards co-led by American and EU A&D companies: basis for further cooperation on PLM interoperability standards