Geometric Validation Check Long Term Archiving and Retrieval

David Selliman
PDES Inc Board Member and Membership Director
d.selliman@us.coretechnologie.com

GLOBAL PRODUCT DATA INTEROPERABILITY SUMMIT 2024

BOEING ELYSIUM NORTHROP GRUMMAN Parker PDES, Inc. Connecting the Digital Enterprise

Agenda/Statement of Need

- **Understanding Requirements**
  - **FAA and standards**
  - **CADx translation and communication**

- **Geometric Validation Properties – Geometry, Composite, Assembly, Semantic PMI**

- **Geometry Compare Master – Derived geometrical comparison with recognition of basic shapes**

- **ITAR Protection – Develop various levels of representations for internal and external usage**

- **About CoreTechnologie**

Questions to the Audience

- **Why does a company need to validate its CADx files?**
- **How many companies with a show of hands have a validation process?**
  - **STEP242 GVP (Geometric Validation Properties)**
- **How many companies understand the LOTAR (Long Term Archival and Retrieval)**
  - **https://lotar-international.org/**
  - **https://pdesinc.org/**
- **How many companies in the room have a Digital Twin process in place?**

FAA Regulations

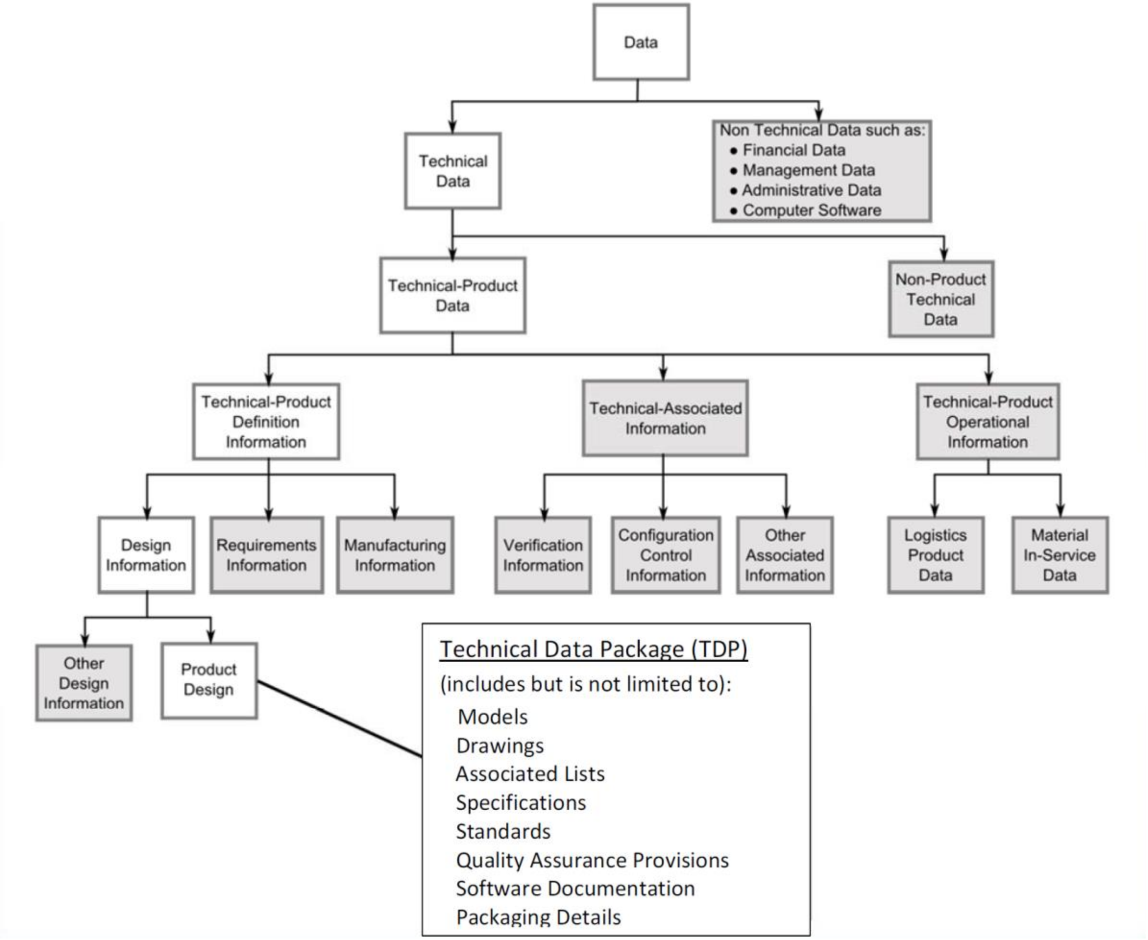
- Some regulations require certain types of CAD records to be retained indefinitely.
- For example, 14 CFR Part 25.1529 requires that records of structural repairs and alterations to large transport-category airplanes be retained for the airplane's life.
- It is important to note that these requirements apply to all individuals and organizations that maintain, operate, or certify aircraft within the United States.
- Failure to comply with these regulations can result in civil penalties, criminal charges, or the revocation of FAA certificates or authorizations.

ISO 10303-242:2020

- **Industrial automation systems and integration — Product data representation and exchange — Part 242: Application protocol: Managed model-based 3D engineering.**
  - https://www.iso.org/standard/66654.html

- **ISO 10303-242:2014/COR 1:2016**
  - **Industrial automation systems and integration — Product data representation and exchange**
    - **Part 242: Application protocol: Managed model-based 3D engineering**
    - **Technical Corrigendum 1**
  - https://www.iso.org/standard/72059.html
- **ISO 10303-242:2014**
  - **Industrial automation systems and integration — Product data representation and exchange — Part 242: Application protocol: Managed model-based 3D engineering**
  - HTTPS://WWW.ISO.ORG/STANDARD/57620.HTML

MIL – STD – 3100 Standard



The US Department of Defense (DoD) MIL-STD-31000 standard prescribes the requirements for preparing a technical data package (TDP), which is composed of one or more TDP elements and related TDP data management products. The purpose of the TDP is to provide an authoritative technical description of an item which is clear, complete and accurate, and in a form and format adequate for its intended use. A TDP contains elements, is described by a level and type, and may have associated metadata and supplementary technical data.

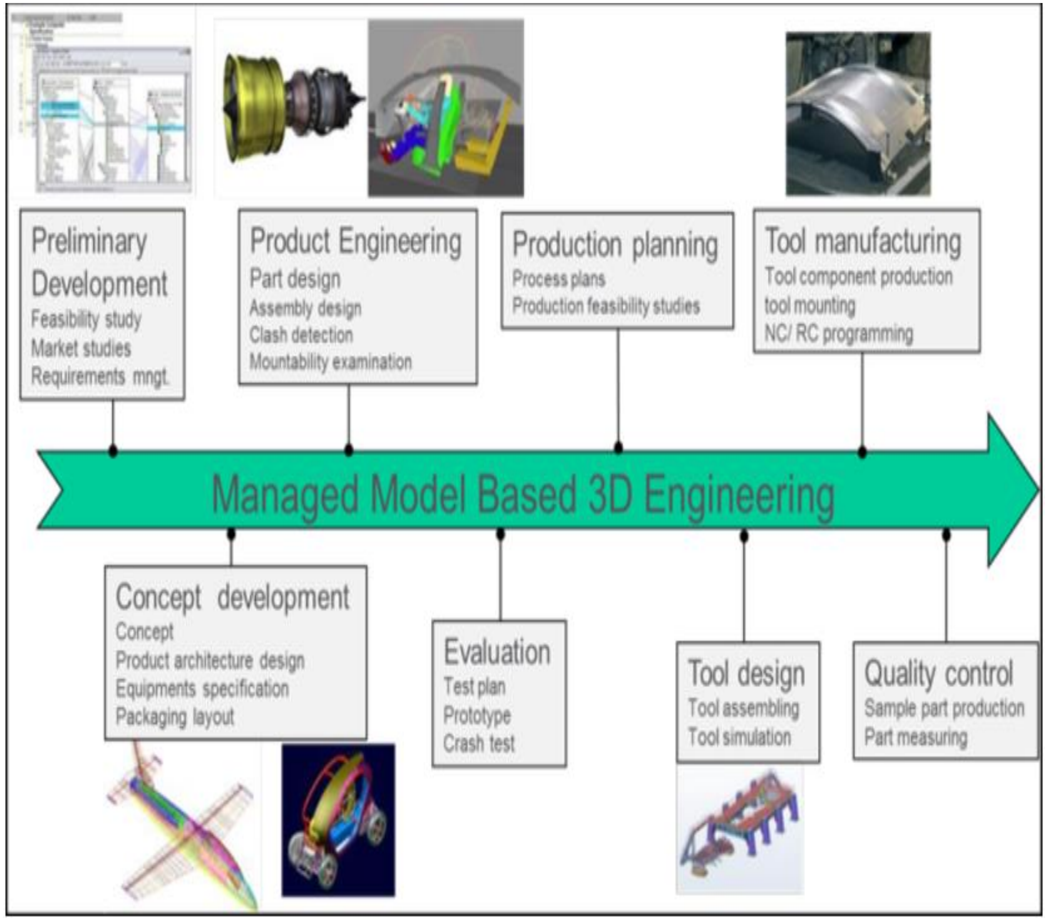
Success Story: Validation of Neutral file format

Business: Aerospace

Challenge: Airbus 380 engineers in Germany and Spain were on an earlier version of CATIA V4 and the French and British offices had upgraded to CAITA V5. That meant the German teams couldn't add their design changes for the electrical wiring back into the common three-dimensional digital mockup being produced in Toulouse.

Solution: CoreTechnologie developed a validation check (GVP) for the standard consortium ISO standard STEP242 of assembly, geometry, PMI, composites and saved views. The validation of data that is shared within the Airbus team now shows consistent results with the standard requirements of the government bodies globally.

Value: Airbus was able to use the STEP242 for downstream applications in CAE, and CAM. Moreover, the semantic representation is used in the model-based definition of the digital twin.



Success Story: Engineering Change

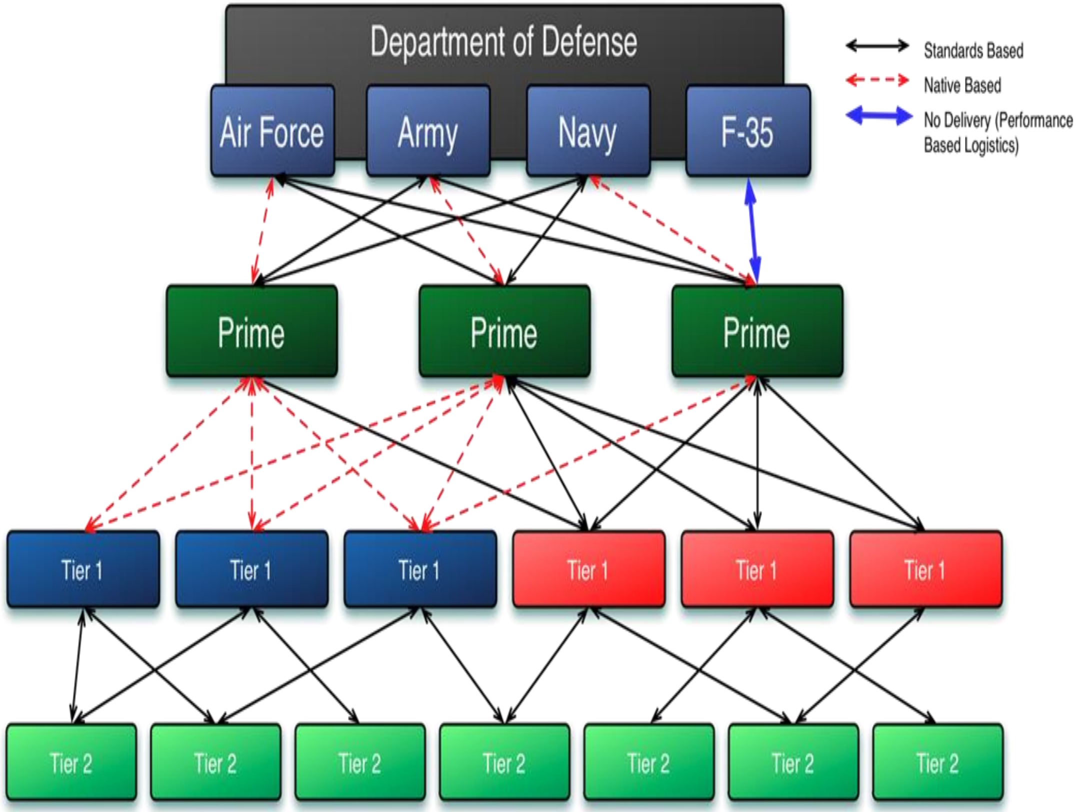
Honeywell

Business: Aerospace and Defense

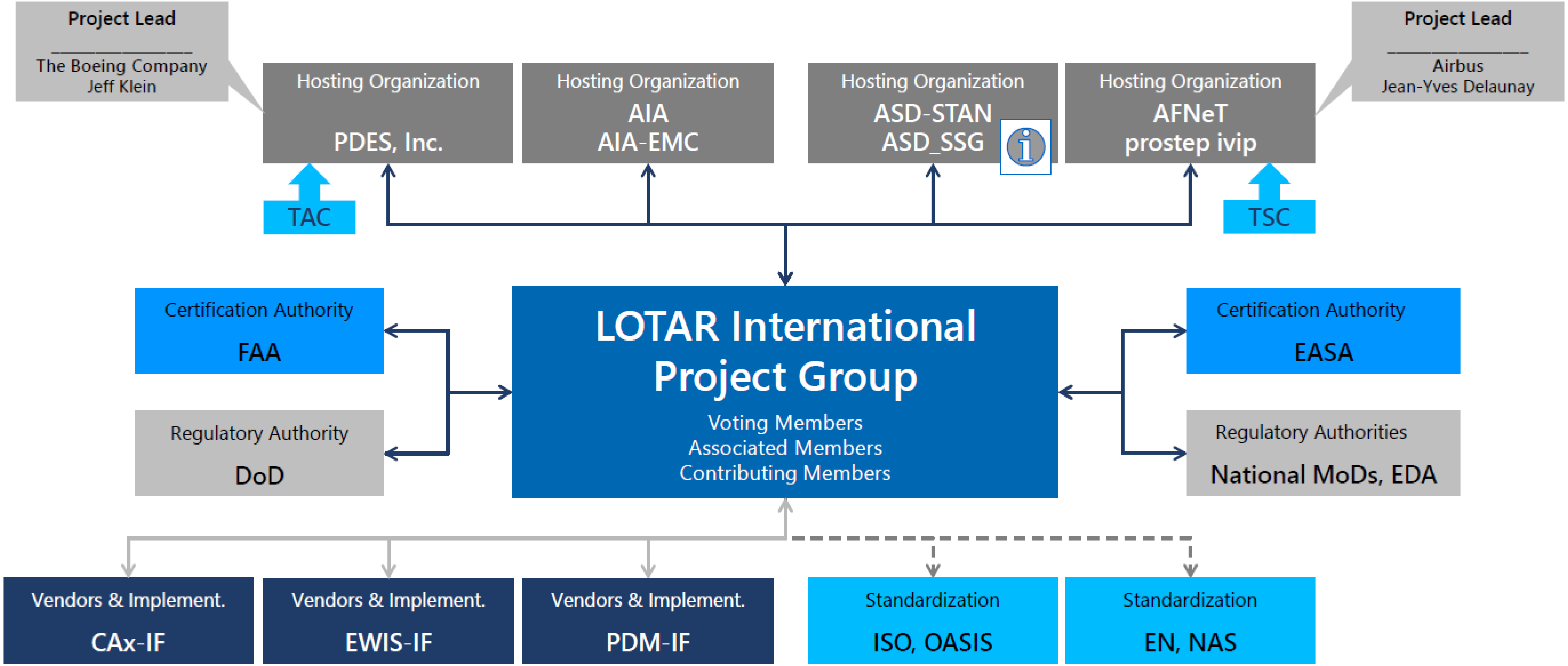
Challenge: Honeywell, has a vast enterprise of product and services to which it provides to countless customers and suppliers. It has a gap in collaboration of CAD files for downstream communications with its enterprise in providing the right CADx information at the right time while documenting the validation of accuracy of the engineering change.

Solution: Utilization of batch functions within the PLM created with 3D Evolution, that is not dependent on the access of the CAD API's within Teamcenter. Furthermore, with easy to edit scripts.

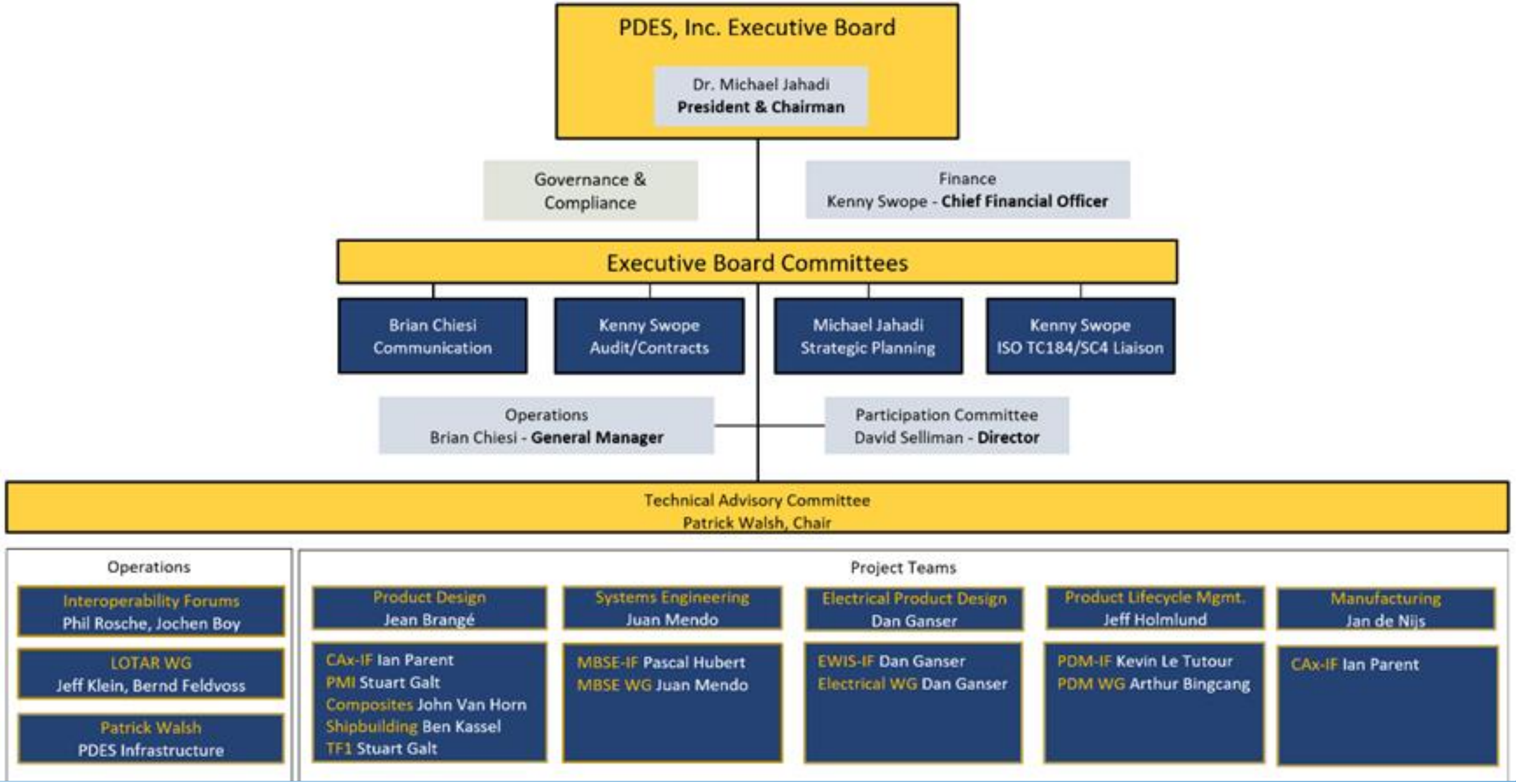
Value: Having CADx in the target format prior to the customer, employee and supply chain prior to asking, was able to allow better and quicker down time in the Product Cycle Management process.



How does it all work

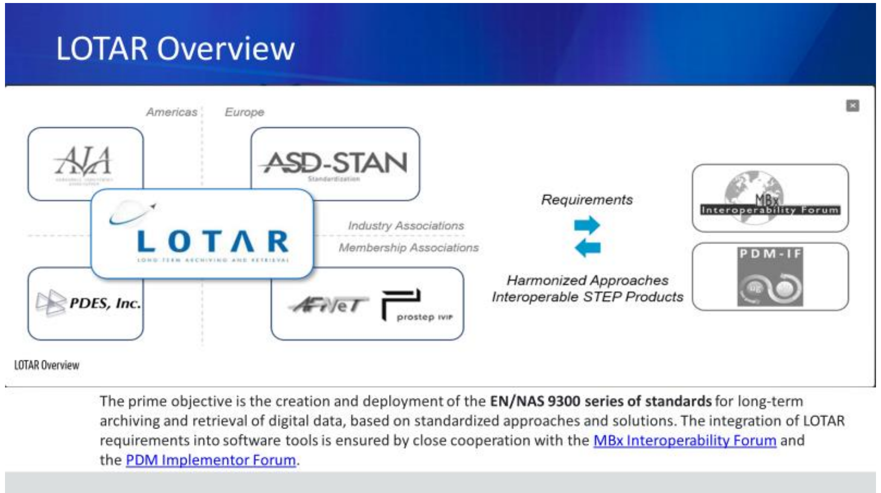


Organization Structure



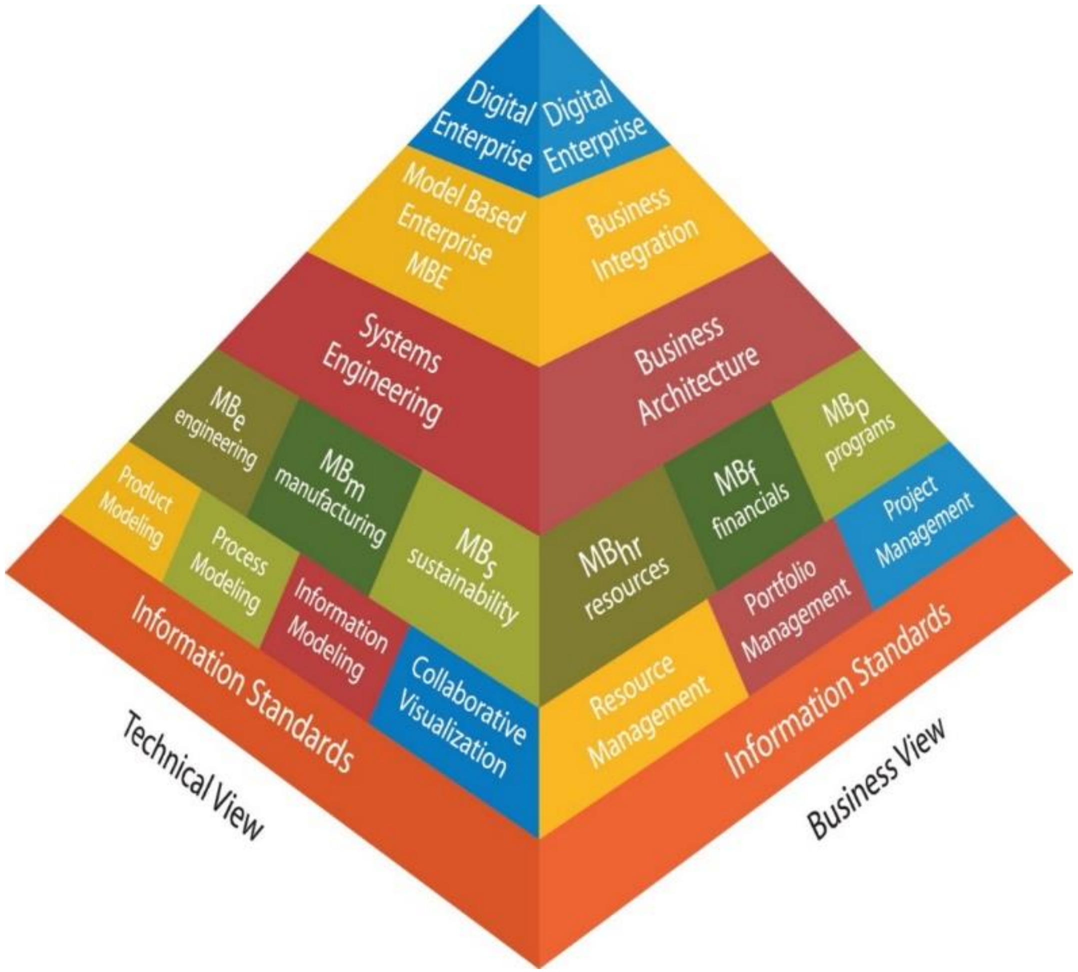
Goals of LOTAR

- **EN/NAS 9300 series of LOTAR standards**
- **Methods, processes, and data models**
- **Develop recommendations and requirements of long-term archiving**
- **Work together:**
- **Solution providers develop COTS capabilities**
- **MBx-IF – testing, feedback, capability assessment**
- **Standards teams – gaps, requirements, funded projects**

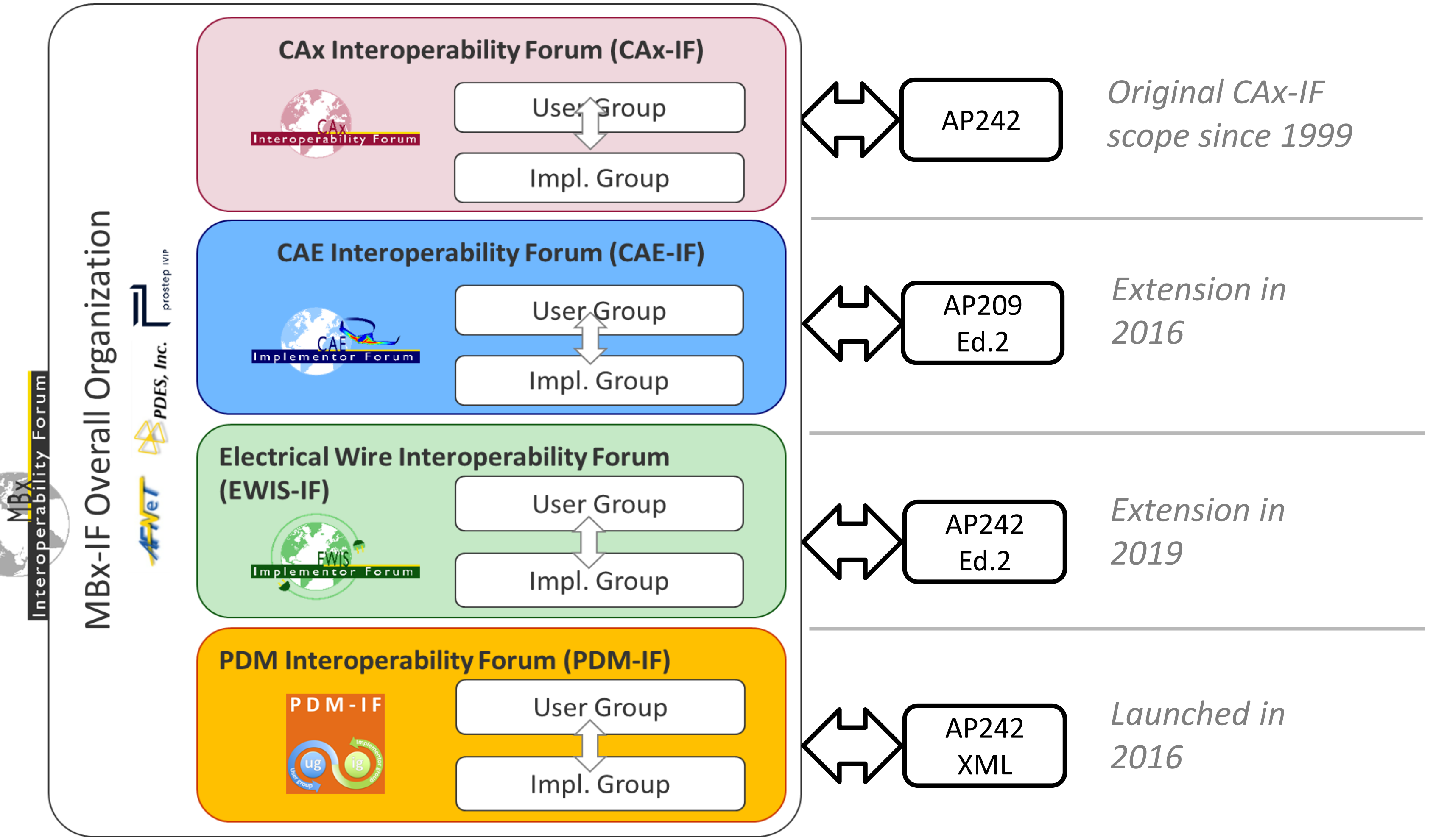


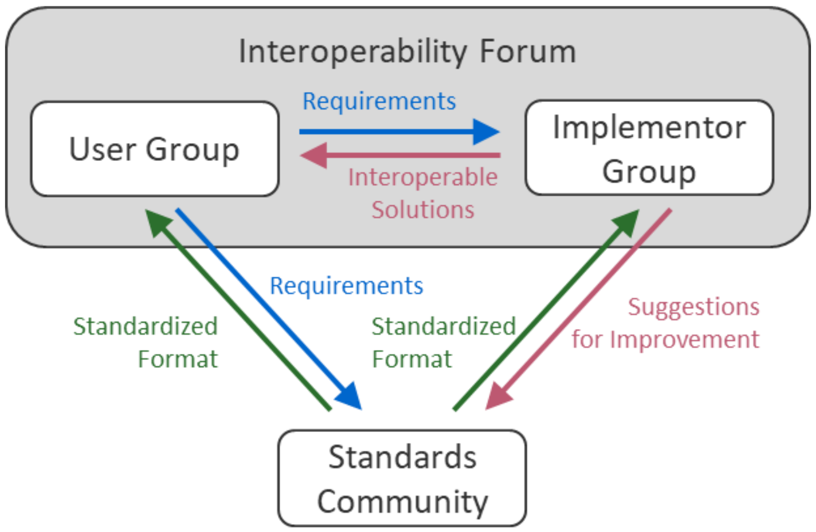
Building the Digital & Sustainable Enterprise

- Built on open standards
- Recognize multiple views of the data
- Provide data security
- Protect intellectual property
- Independent of process
- Independent of tools
- Independent of language

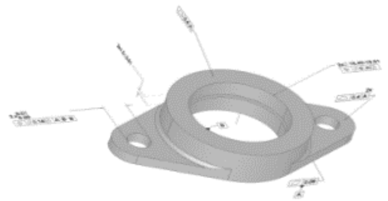


MBx-IF Project Framework





EIGHT LOTAR WORKING GROUPS AT PRESENT

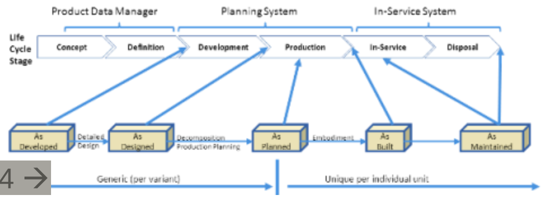


2004 →

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

EN/NAS 9300-1xx series

STEP AP203 Ed.2, AP214 Ed.3, AP242

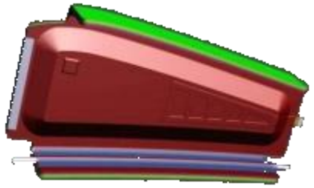


2004 →

Product Data Management (PDM)

EN/NAS 9300-2xx series

STEP AP239, AP242



2009 →

Composites and Advanced Manufacturing

EN/NAS 9300-3xx series

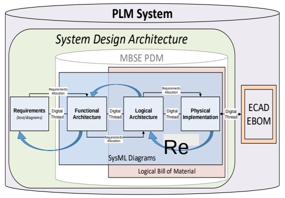
STEP AP203 Ed.2, AP242

2012 →

Electrical Wiring Harness

EN/NAS 9300-4xx series

STEP AP242 Ed.2

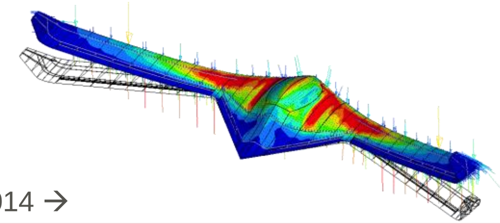


2018 →

Model-Bases Systems Engineering (MBSE)

EN/NAS 9300-5xx series

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



2014 →

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

EN/NAS 9300-6xx series

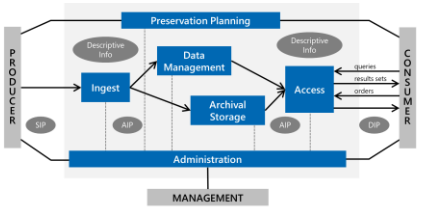
STEP AP209 Ed.2

2021 →

Meta Data for Archiving (*Cross-Domain WG*)

EN/NAS 9300-21 & Domain Parts

STEP AP239, AP242, AP243



2018 →

Basic & Common Process Parts

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

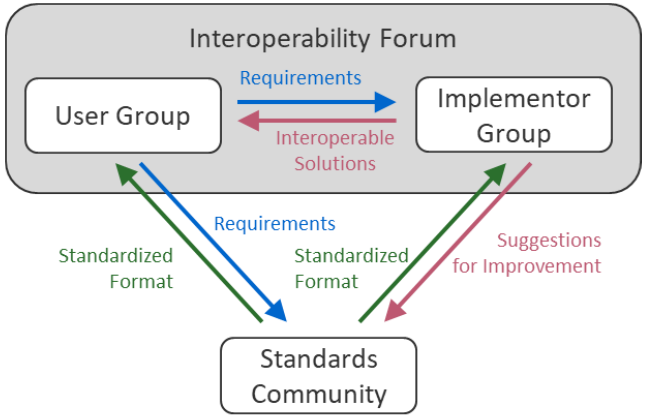
How the Industry benefits from the MBx-IF

Member / Vendor Benefits

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

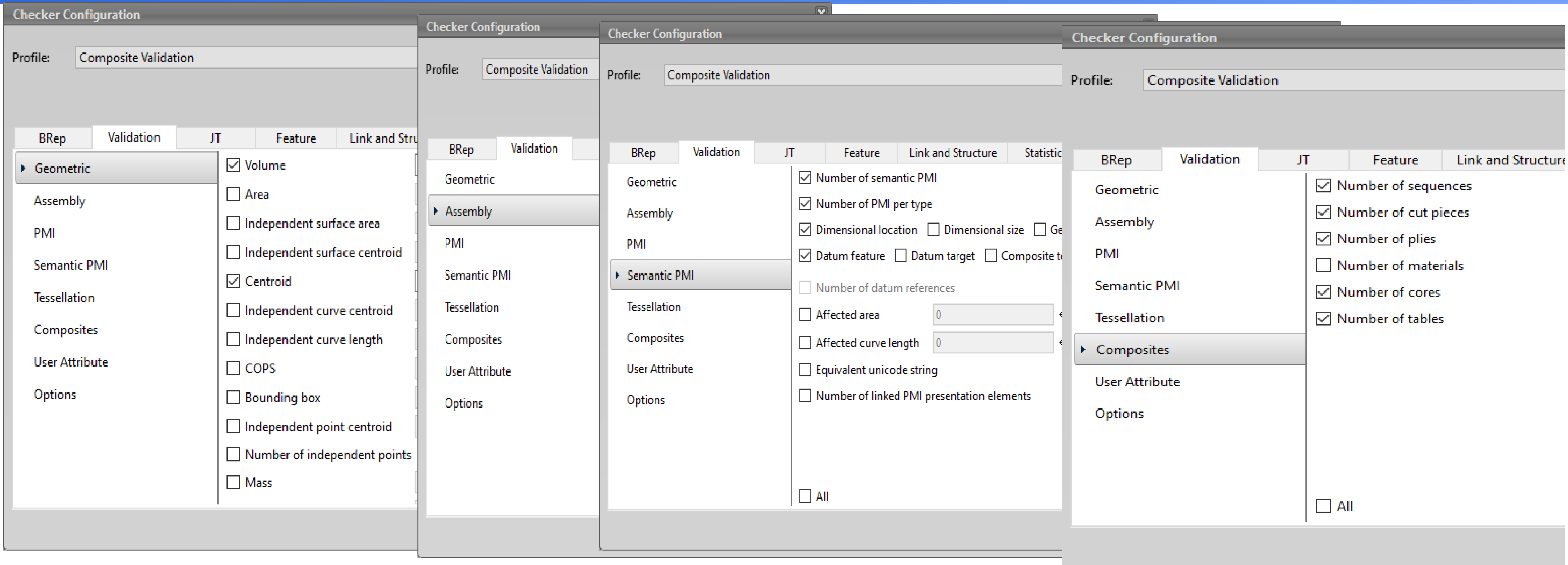
User / Customer Benefits

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



STEP242, VALIDATION AND LOTAR

Validation configuration



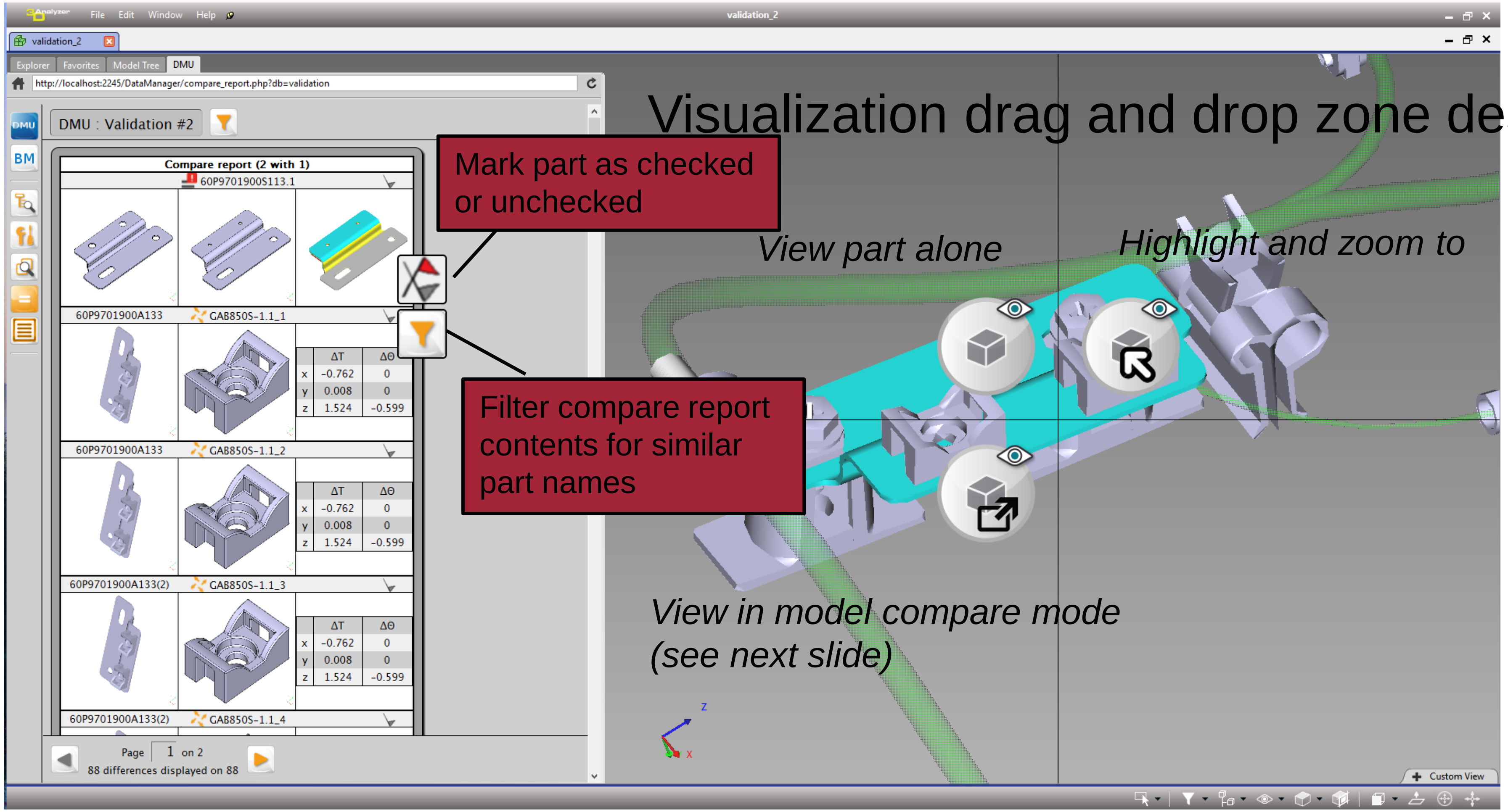
Attribute Validation use case

Existence validation:
Using a seed file as a baseline, we can compare parts and determine which and how many attributes are included in it.

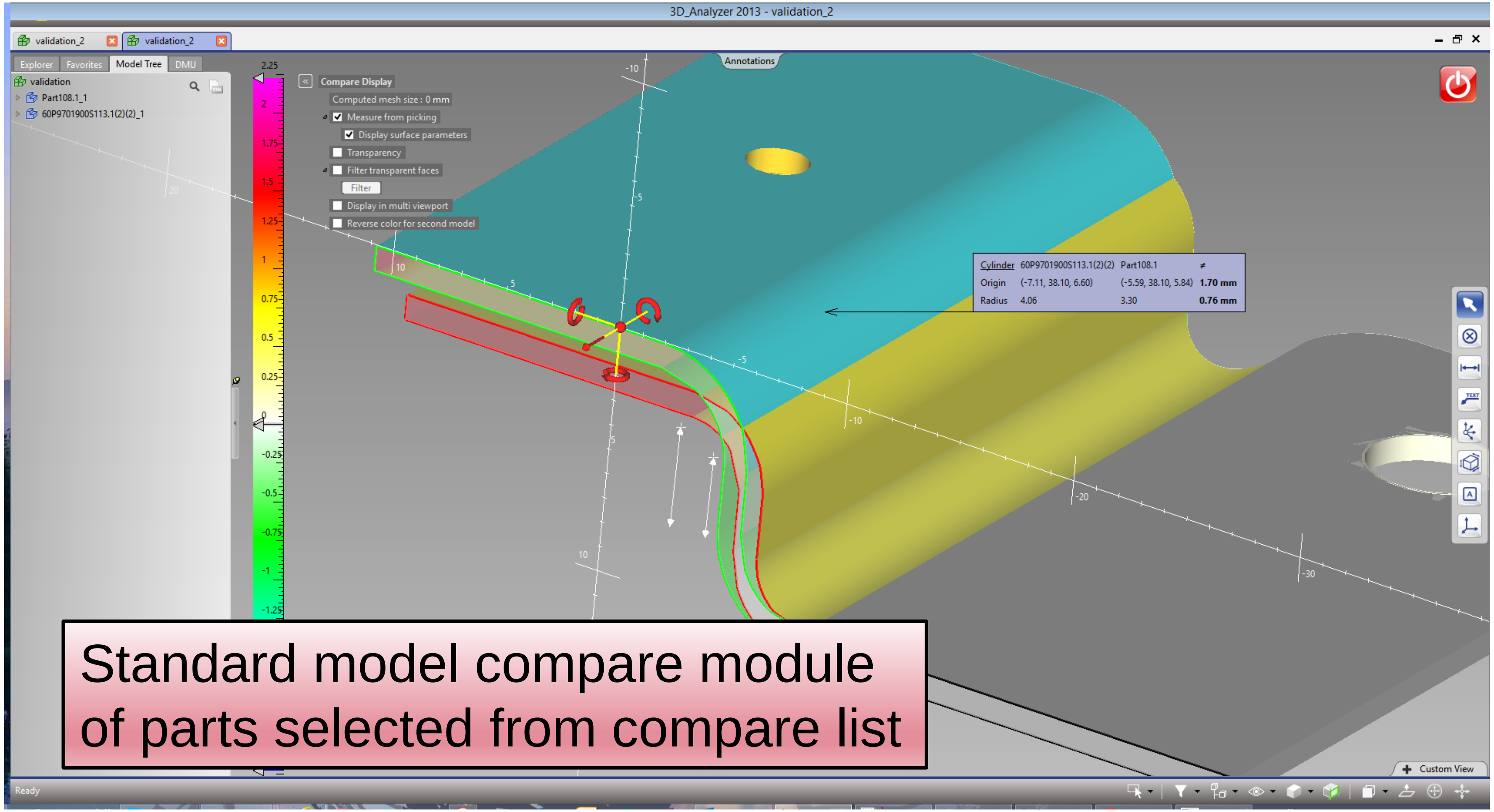
Attribute	Field	First Assembly	Second Assembly
StringMetaData	CHECKER_NAME	Only in first object	Not in second object
StringMetaData	CONTRACT_NUMBER	Only in first object	Not in second object
StringMetaData	MATERIAL_ENGINEER	Only in first object	Not in second object
StringMetaData	DOC_TYPE	Only in first object	Not in second object
Original Name	Value	12600527_A1.PRT	19207_12600527.PRT
Input Format and Emitter	Value	Creo Parametric 5.0.0.4	Creo Parametric 4.0
Analyze Id	Id	2	3
StringMetaData	PROI_REVISION	Not in first object	Only in second object

Conical Compare

DMU COMPARISON



DMU VALIDATION



Standard model compare module of parts selected from compare list

Canonical Model Comparison

- Identification of differences between revisions
- Exact mathematical calculation

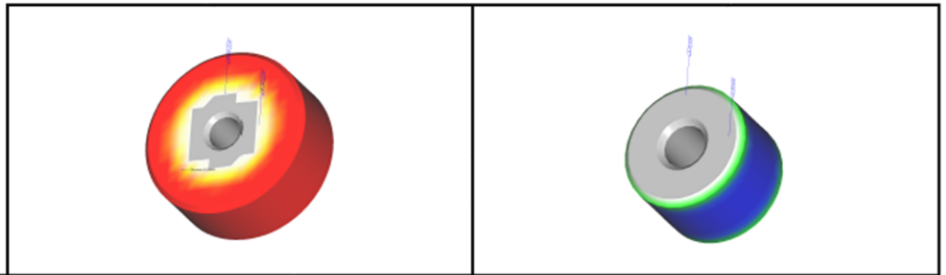
Compare for:

- Geometry of parts and assemblies
- Canonical surface identification
- *Assembly structure?*
- *PMI?*

1. Differences

1.1. 12600527_A1.PRT - 19207_12600527.PRT

Differences between
12600527_A1.PRT
and
19207_12600527.PRT

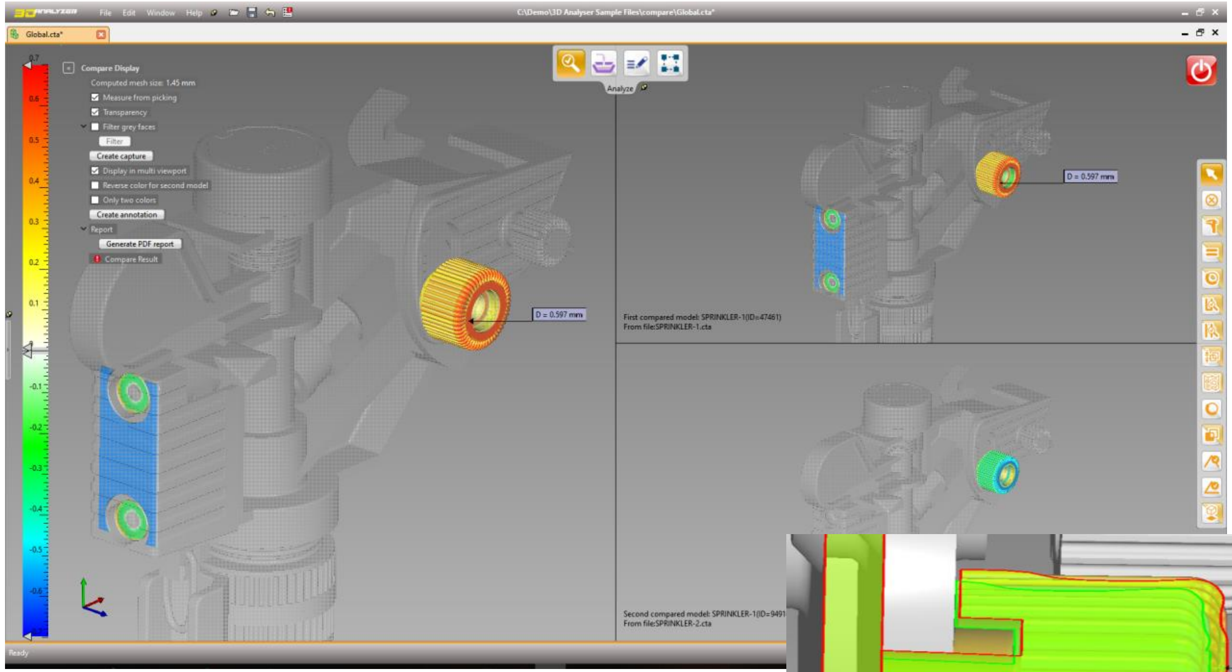


From file	12600527_a1.prt.1	19207_12600527.prt.1
Number of faces	14	14
Number of curve	0	0
Number of faces	8	6
Maximum distance for face	3.03947	3.03947

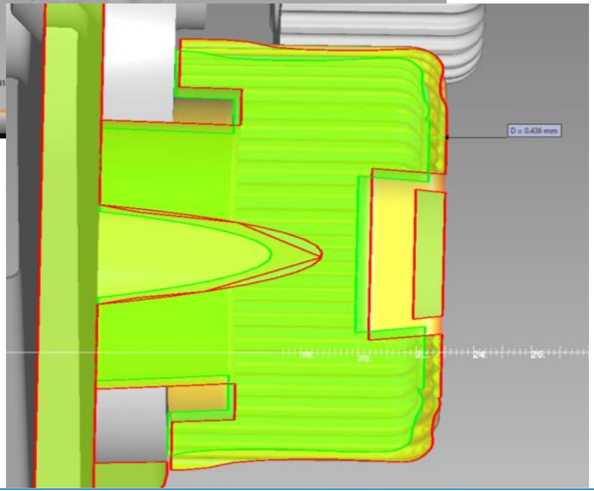
Number of compared points	Mesh size	Maximum computed distance
2502	2.03552 mm	3.03947 mm

Model Comparison

- Identification of differences between revisions
- Exact mathematical calculation
- Compare for:
  - Geometry of parts and assemblies
  - Assembly structure
  - PMI
  - Features
  - Attributes



Shown with the "transparency" option to easily identify internal changes



CORPORATE OVERVIEW

Company Overview and History

- Founded in 1998
- Privately held company
- 85 employees
- Head office in Germany
- Offices in Germany, France, Ireland, Japan, Italy, India, Korea and the USA
- Development center in France and Morocco
- Over 800 software customers and 30 software partners

Product Offering

CAD API Libraries

- Feature Based Reading
- Native reading of all CAD systems: B-Rep, PMI, Metadata
- Software Development Kit for reading CAD Interfaces
- All major CAD formats
- C++ Data Structure
- Simple Integration

CAD Data Conversion

- Native reading of all CAD systems: Feature based, B-Rep, PMI, Metadata
- Feature-based conversions
- VDA Checker with healing
- Geometry simplification
  - Plant Layout
  - File Size Reduction
  - IP Protection
- All 3D Analyzer Modules
- Batch Processing
- FEM Tools suite
  - De-featuring
  - Meta-face
  - Mid-face

3D Viewer

- Enables viewing of Feature based models
- Native reading for all CAD systems: Feature based, B-Rep, PMI, Metadata
- Markup with Measurements
- 3D Analyzer Modules
  - VDA Checker
  - Collision Detection
  - Model Comparison
  - Wall Thickness Checker
  - Backlash

4D Additive

- Data import and repair
- Metal printing
- Lattice structures options (honeycomb, octet or centerpoints)
- Nesting and smooth surface
- Direct modeling
- De-featuring
- Wall Thickness Checker
- Backlash

Native Interfaces

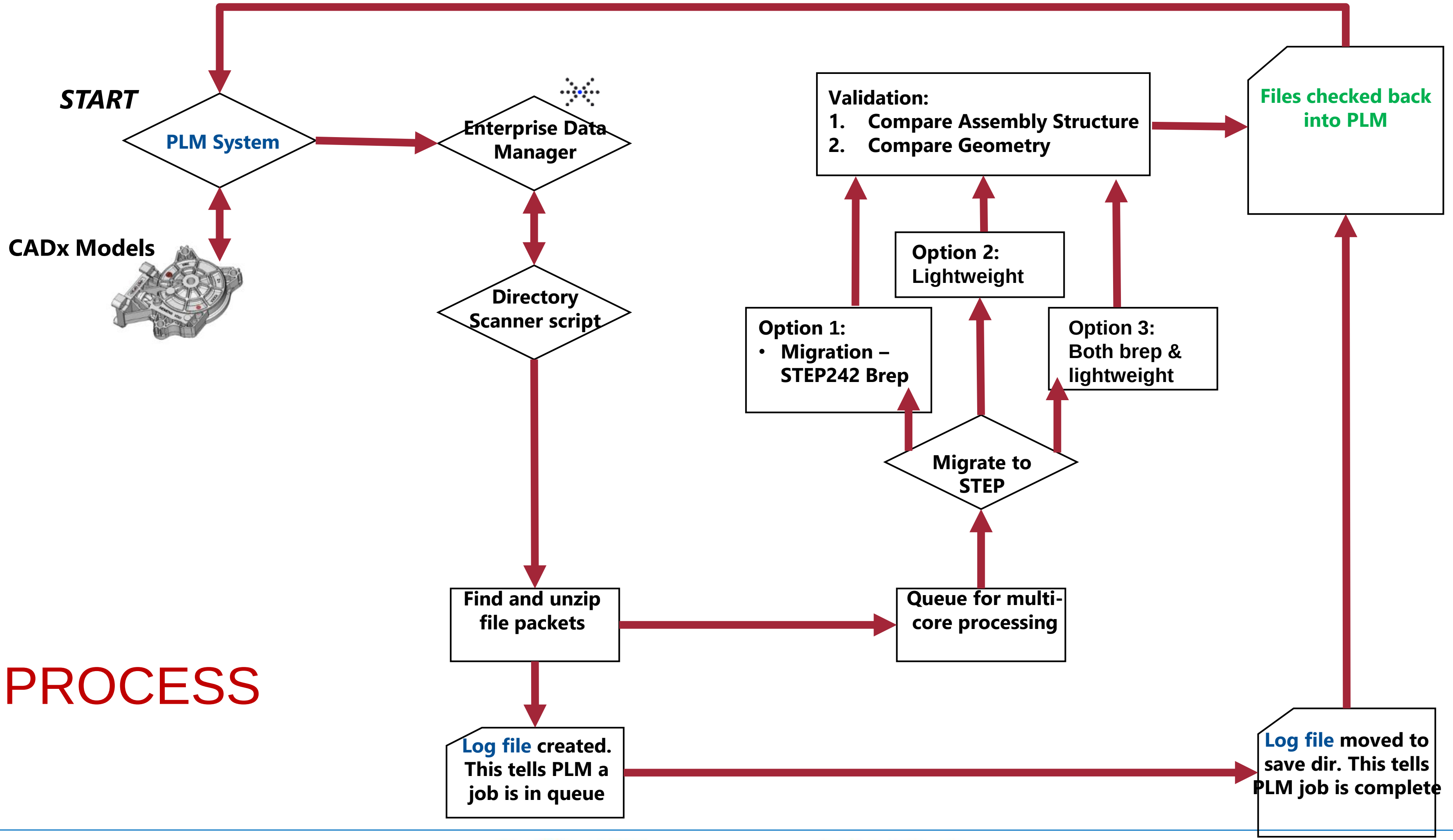
- CATIA V4, V5, V6
- PRO/E / CREO
- NX
- IDEAS NX
- Euklid
- SolidWorks
- Inventor
- STEP
- ACIS
- VDA
- XT – Format
- JT – Format
- Visi
- STEP242
- Parasolid
- Nastran

- IGES
- DWG
- 3D PDF
- 3MF
- CADDS
- 3D XML
- Rhino
- Optimizer
- VRML
- OBJ
- FBX
- PLMXML
- STL
- DGN
- X3D
- Robcad

All standard and native interfaces are developed and maintained by CoreTechnologie ensuring guaranteed support of the newest CAD format versions.

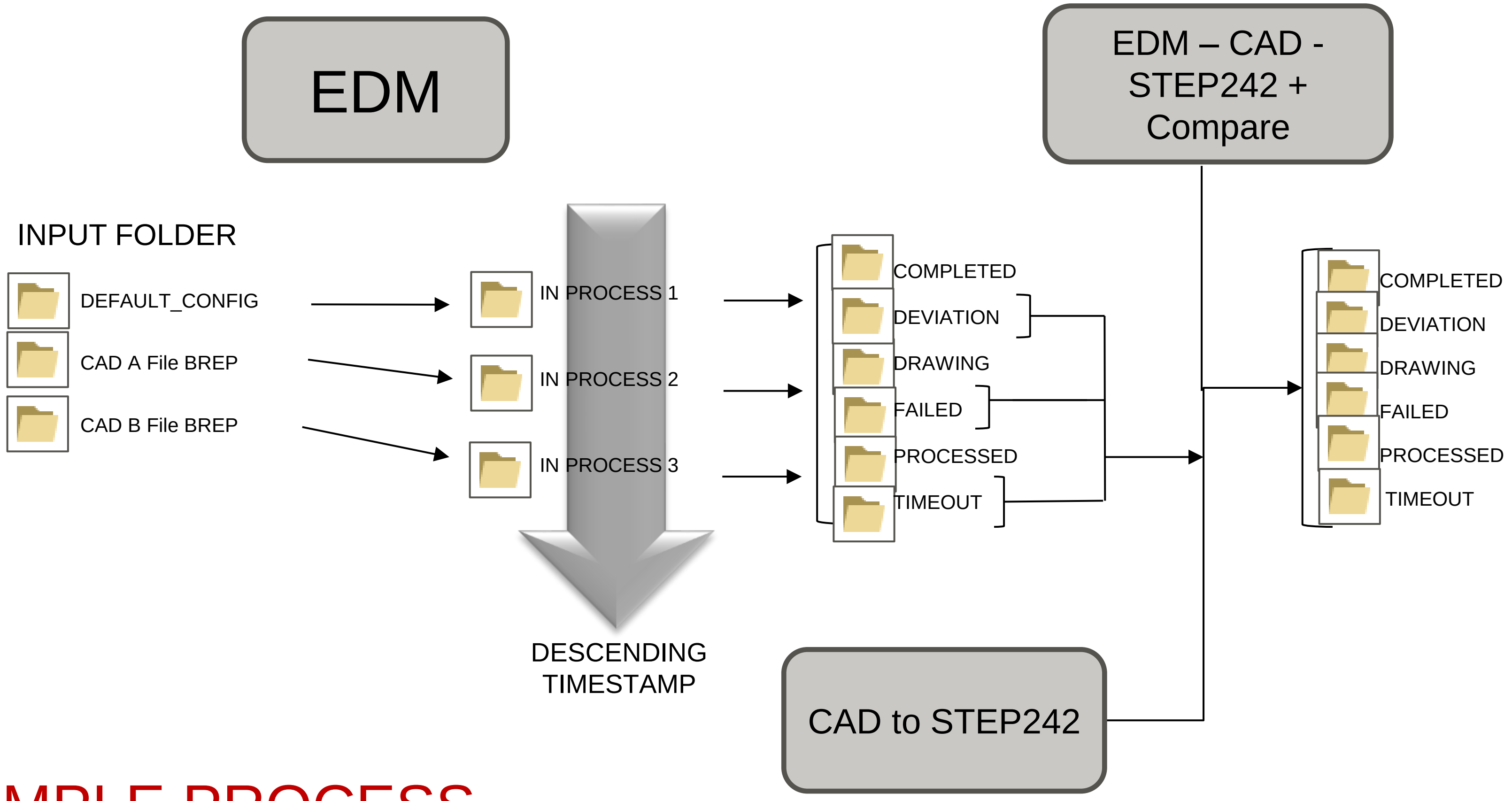
3D_Evolution reads assembly structure, attributes, B-REP solids, feature history, PMI, and skins as well as tessellated models.

Process Flow Chart: CADx to STEP



EXAMPLE PROCESS

Enterprise Data Manager (example)



EXAMPLE PROCESS

Conclusions

- **Rapidly evolving competitive, technological and regulatory environments requires businesses to create, move and store data across disparate applications and systems with minimum friction and duplication**
  - **Increased Product and Systems Complexity**
  - **Evolving Technologies and Processes**
  - Global Collaboration
  - Regulatory data retention and retrieval
- **PDES, Inc. is uniquely positioned to support members' needs in identifying requirements. developing recommended best practices, and implementation test cases for connecting the digital enterprise**
- **More information on PDES, Inc. - pdesinc.org**

Contact Us

Mike Jahadi
President/CEO
General Manager
Mike.r.jahadi@lmco.com
817.312.0607

Brian Chiesi
General Manager
bchiesi@yahoo.com
310-606-0100
www.pdesinc.org

Questions?

PDES, Inc.
Connecting the Digital Enterprise

Model Based Manufacturing
Model Based Engineering
Model Based Sustainability

Contact us

Check us out

Presenters Bio