A Solid “STEP” Forward to Model Based System Engineering (MBSE) using STEP AP242

David Selliman - CoreTechnologie
Agenda

Corporate Overview of CoreTechnologie
Understanding the birth of STEP AP242 and its future
Case Study – How Airbus implemented STEP AP242
Technical Packages
Demo - How CoreTechnologie fits into STEP AP242 implementation
Q & A

What you will learn?
• Creating established views of what was known as pages of 2D drawings
• Allowing the STEP AP242 format to be used from in the Product Lifecycle
• Why not STEP AP203 as it is widely used in the interoperability space?
• Assist in Technical Packaging
• STEP AP242 Converges with AP203 and 214
Company Outline

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- **Name**: CoreTechnologie Group
- **Headquarters**: Frankfurt, Germany
- **Founded in**: 1997
- **Key resources**: Dominique Arnault, COO
  Armin Brüning, President
  Gauthier Wahu, CTO
  David Selliman, Vice President of North America
- **Business**: Products
  - 3D_Evolution - 3D CAD Interoperability Suite
  - 3D_Analyzer - 3D CAD Viewing & Analysis Tool
  - 3D_Kernel_IO - Software Development Kit
  - Data conversion service
  - Client-specific process integration
- **CoreTechnologie prides itself as a private corporation which is 100% debt free**
Mission and Vision

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• CoreTechnologie Vision:

✓ Keep innovating to offer the latest and the most sophisticated CAx 3D products and services
✓ Take the CAx 3D interoperability field to a new dimension through value added modules and services

• CoreTechnologie Mission:

✓ Effortless Interoperability: Enable a flexible and easy data Exchange for partners at all levels
✓ Help organizations streamline their PLM process
✓ Shape the technology to optimize CAx 3D
Product Outline

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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
- 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

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- CATIA V4
- CATIA V5
- CATIA V6
- PRO/E / CREO
- Siemens NX
- IDEAS NX
- SolidWorks
- Inventor
- STEP
- ACIS
- XT – Format
- JT – Format

- CADDS
- IGES
- DWG
- 3D PDF
- 3D XML
- Rhino
- VRML
- FBX
- PLMXML
- STL
- DGN
- STEP242

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.
Why a standard format?
The birth of STEP AP242

- **AP 233** Systems Engineering
- **AP 238** Integrated Machining
- **AP 242** (N1) Managed Model Based 3D Engineering
- **AP 209** Multi-disciplinary Analysis & design
- **AP 210** (N2) Electronic assembly, interconnect & packaging design.
- **AP 235** (N2) Engineering Properties for product design & verification
- **AP 239** Product Life Cycle Support (PLCS)

- Suite of AIA - ASD ILS Specs (SX000)
- Based on PLCS

**N1:** STEP AP 242: Convergence of AP 203 and AP 214
**N2:** study not started
CAx Implementor Forum: V & V of Use Cases

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- CAx Implementor Companies
  - Requirements
  - Issues
  - Test Models
- ISO 10303 Standardization Working Groups
- New and updated STEP Parts
- Result Summaries
  - Improved STEP Processors
- Interaction with other project groups
- ProSTEP IViP, AFNeT, and PDES, Inc. Working Groups
- Recommended Practices
  - Improved Data Exchange Quality
  - Interoperability
  - Widened STEP Scope
- Standardization Issues
- Improved STEP Processors
- Interaction with other project groups
PDES, Inc./LOTAR
Participation Overview
with Boeing
Building the Digital and Sustainable Enterprise

Do we recognize how much value we generate when we do this right?

- 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
PDES, Inc. Organizational Structure

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PDDES, Inc. Executive Board
Dr. Michael Jahadi, Chair

Governance & Compliance

Oversight & Communications

Finance

Executive Board Committees

Participation
Audit
Strategic Planning
Contracts
Information Standards

Operations
Jack Harris, General Manager

Tech Advisory Committee
Tom Bluhm, Chair

AP242e2
T. Bluhm, Boeing
J. Brange, Boost

AP239e3
R. Zuray, Boeing
Y. Baudier, Airbus

CAx-IF
P. Rosche, ACCR
J. Boy, prostep

LOTAR Int'l
R. Zuray, Boeing
J. Holmlund, LHM

Model-Based System Eng
M. Williams, Boeing
A. Murton, Airbus

STEP Ext Arch
J. Brange, Boost

Architecture
Mech/PMI
Composites
PDM
3D Geom.

Elec WH.

PDES, Inc. Executive Board

Basic & Common
Mech/PMI
PDM
Composites
EAS

MBSE

Elect WH.

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- Board & TAC Initiatives
  - Technology Management Plan (TMP)
  - Web Development Team – PDES Web site recommendations
  - Education/Outreach – Educational Requirements
- STEP Extended Architecture
  - Information Technology – Development Environment Services
  - Quality & Maintenance – SMRL Quality Initiative
  - Technology Roadmap – ISO 10303 5-yr roadmap
- ISO 10303 Development
  - Part 59 Edition 3
  - AP209 Edition 3/4
  - AP239 Edition 3
  - AP242 Edition 3
  - AP243/MOSSEC
  - Part 4000
- LOTAR
  - Project Management
  - Model-Based System Engineering (MBSE) WG
  - PDM WG
  - 3D Mechanical & PMI WG
  - Engineering Analysis & Simulation (EAS) WG
  - Electrical Wire Harness (EWH) WG
- Implementor Forums
  - MBx-IF – CAD/CAE (active)
  - MBx-IF – User Group (new)
  - EWIS-IF (new)
  - EWIS-IF – User Group (new)
  - PDM-IF (new)
Memorandum of Understandings (MOUs)

- Summary of the various MOUs and expected value
- MOU:
  - NAFEMS MOU Signed on September 25, 2018.
    - PDES, Inc. signed an MOU with NAFEMS to collaborate on Engineering Analysis and simulation.
  - INCOSE MOU signed on January 10, 2018
    - INCOSE and PDES Inc. Announce Collaboration to Accelerate Data Exchange in Model-Based Systems Engineering Environments.
  - 3DPDF MOU signed on February 1, 2016
    - Support of project work through joint projects and activities
  - AFNeT
    - Supports ISO 10303 development and Implementor Forums
  - prostep, ivip
    - Supports Implementor Forums and joint projects for ISO 10303
The successful implementation of ISO STEP and LOTAR standards by the US and EU A&D industries relies on the governance through time of the suite of ISO product data exchange standards:

- ISO 10303: AP242 e2, AP209 e2, AP239 e3, AP238 e2, etc.,
- completed by other standards such as QIF, SysML, FMI, etc.

➔ need to prepare 5-year roadmap of these standards and the associated portfolio management

Need to consolidate the use of the STEP Extended Architecture, using SysML for information modeling, easing the extension to different implementation forms (services)

Extension of PDES, Inc. support to the CAx, PDM and future Implementer Forums
## Board and TAC Representatives

<table>
<thead>
<tr>
<th>Company</th>
<th>Board member</th>
<th>TAC Member</th>
<th>Organization</th>
<th>Board member</th>
<th>TAC Member</th>
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<tbody>
<tr>
<td>Airbus</td>
<td>Jean Pierre Souzy</td>
<td>Jean-Yves Delaunay</td>
<td>NASA</td>
<td>Jon Halladay</td>
<td>Kurt Woodham</td>
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<td>Malcom Carrie</td>
<td>Malcom Carrie</td>
<td>NIST</td>
<td>Howard Harary</td>
<td>Bob Lipman</td>
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<td>Boeing</td>
<td>Brian Chiesi</td>
<td>Kenny Swope</td>
<td>Sandia</td>
<td>Ty Christie</td>
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<td>Boost Conseil</td>
<td>Jean Brange</td>
<td>Jean Brange</td>
<td>Theorem Solutions</td>
<td>Stuart Thurlby</td>
<td>Trevor Leeson</td>
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<td>CTCoreTechnologies</td>
<td>David Selliman</td>
<td>David Selliman</td>
<td>Purdue</td>
<td>N/A</td>
<td>Nate Hartman</td>
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<td>Dassault</td>
<td>Jacques Heinisch</td>
<td>Alain Roche</td>
<td>Wichita State</td>
<td>N/A</td>
<td>Shawn Erkstein</td>
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<tr>
<td>Elysium</td>
<td>Annalise Suzuki</td>
<td>A. Suzuki, Yasuhiro Asano</td>
<td>GATech</td>
<td>N/A</td>
<td>Chuck Zhang</td>
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<td>Engisis</td>
<td>Xenia Fiorentini</td>
<td>Sylvere Krima</td>
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<td>Eurostep</td>
<td>Nigel Shaw</td>
<td>Phil Spiby</td>
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<td>Jasswinder Walia</td>
<td>Julian Chultarsky</td>
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<td>Dan Ganser</td>
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<td>Don Hemmelgarn</td>
<td>Asa Trainer</td>
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<td>PTC</td>
<td>Darryn Kozak</td>
<td>Mark Fischer</td>
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Accomplishments

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- Program level accomplishments:
  - NAFEMS MoU
  - INCOSE MoU
  - Project resource requirements developed
  - Study and recommendations for moving to new development environment complete
  - Road mapping activity started
  - Four Press releases
  - Reviewed 45 proposals for TIM meetings to select best value
  - Surveys/lessons learned for two annual meetings

- TAC and Project Level accomplishments
  - Four AP242 Steering committee meetings
  - Four LOTAR Steering committee meetings
  - Two AP239 Steering Committee meetings
  - Hundreds of weekly, biweekly and monthly team meeting conference calls for LOTAR WGs, CAX-IF, AP239, AP242, MBSE
  - Hundreds of issues and comments addressed for standards under development for ISO, AIA (LOTAR)
  - Comments submitted for ISO parts
  - Two rounds of CAX-IF testing and updates to recommended practices
  - MOSSEC proposed as new project and ISO standard
  - MBSE proposes new LOTAR/AIA standard
Technical Management Plan

PDES, Inc. and LOTAR International
### LOTAR 5 Year Development Roadmap

<table>
<thead>
<tr>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
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</thead>
<tbody>
<tr>
<td><strong>Review and update Basic Parts (001-009)</strong></td>
<td><strong>Review and update Common Parts</strong></td>
<td>Solicit EASA and FAA Approval and Adoption of LOTAR Basic &amp; Common Parts to Certify MBD/E OEMs &amp; Suppliers in 2019</td>
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<tr>
<td>Dev and update Mech/PMI Parts (115e2, 126e1 Assembly PMI)</td>
<td>Dev and update Mech/Mfg. Parts (130-132 - Mach Features, Holes/Fasteners)</td>
<td>Supporting AP242e2 and e3</td>
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<tr>
<td>Dev and update Mech/QIF Parts (140-145 Quality V&amp;V, Measurement)</td>
<td>Dev and update PDM/PLM Parts (200e2, 210e1, 220e1 As-Designed, As-Built)</td>
<td>Supporting AP239e3</td>
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<td>Dev and update Composite Parts (300e1, 310e1 – Supporting AP209e2, AP242e2/e3)</td>
<td>Dev and update Advanced Mfg. Parts (350e1, 360e1 – Supporting AP242e2/e3)</td>
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<td>Dev and update Electrical WH Parts (400e1, 410e1, 420e1 – Supporting AP242e2/e3)</td>
<td>Dev and update MBSE Parts (500e1, 510e1, 520e1 – Supporting AP233e2/AP243e1)</td>
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<td>Dev and update Eng. Sim &amp; Analysis Parts (600e1, 610e1, 220e1 – Supporting AP209e2, AP242e2/e3)</td>
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Supporting AP239e3
### ISO 10303-239ed3

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<table>
<thead>
<tr>
<th>Scope:</th>
<th>Objectives:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Activity Model</td>
<td>• Extend and enhance the scope of AP239 to include ILS S-Series Documents</td>
</tr>
<tr>
<td>• Conceptual Model</td>
<td>• Propose and use an updated STEP architecture</td>
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<tr>
<td>• Domain Model</td>
<td>• Harmonization between AP242 ed2 and AP239 ed2.</td>
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<tr>
<td>• Core Model</td>
<td>• Resolve Gaps from harmonization activity</td>
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<tr>
<td>• Architecture</td>
<td>• Common set of Core technical Capabilities</td>
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<tr>
<td>• STEPMod Support and Enhancement</td>
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<tr>
<td>• AP242/AP239 Harmonization</td>
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<tr>
<td>• Core Technical Capabilities used by AP239 ed3, AP242 ed2 and Common CTCs</td>
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</tbody>
</table>

**Participants:**
Boeing, Airbus, Lockheed, Boost, NIST, AIA, ASD, ILS, etc. (see spreadsheet).

**Strategic Alignment:**
2. Develop and/or endorse standards that support the Digital Enterprise (DE)
   2.2 Harmonize with and support other standards focused on the DE.
   2.3 Maintain and update relevant standards
3.0 Increase the value of the PDES Organization
   3.3 Explore partnering with similar organizations

**Major Deliverables by Quarter:**

**Q3 2017**
- CD Complete Aug 31
- STEP New Architecture

**Q4 2017**
- AP239 ed3 CD Ballot
- AP239 Edition 3 DIS Started
### Scope:
Part 59 concerns the equivalence validation of two sets of product data. A NWI to develop ISO 10303-59 ed3 was approved 30 JAN 2019. Initial capabilities have been included in AP242 e2. The new edition is an intermediate step to enhance Product Data Quality capabilities. The new capabilities will become part of AP242 e3. This project support the continue development of this Product Data Quality standard.
Part 59 provides a means to define product data that can be validated and guaranteed. The next version will enhance capabilities as an intermediate step that focuses on manufacturability, quality of PMI data, and quality of polygon data.

### Potential Participants:

### Objectives:
1. Work with experts to clarify industry requirements
2. Prioritize data types to be in scope of Part 59 e3
   - Thin Solid Volume, Thick Solid Volume
   - Narrow Solid Space, Narrow Step
   - Tiny Round Faces, Tiny Hole Faces
   - Under cut, Lack of Draft Angle, etc.
3. Part 59 CD ballot, Q4 2019
4. Develop requirements for revised and new Application Modules
5. Develop AMs
6. Integrate AMs with AP242 e3

### Strategic Alignment:

### Major Deliverables by Quarter:
- **2019 Q3**: Prioritized Data Types
- **2019 Q4**: Part 59 CD
- **2020 Q4**: Revised AMs
- **2021 Q2**: New AMs
- **2022 Q1**: Part 59 capabilities integrated into AP242
### AP209 ed3/ed4

**Scope:**
- Publication of AP209 ed3
- Recommended practices for structural testing and sensor integration using AP209 ed3
- Prepare proposal for AP209 ed4
- Perform piloting with industrial test data for NASTRAN, Ansys, Abaqus and Catman/sensor for structural testing

**Objectives:**
1. Align AP209 with edition 2 of AP242
2. Improve AP209 document quality
3. Identify new industrial requirements for edition 4, like
   - Non-linear analysis and materials
   - Contacts and superelements
   - Isogeometric analysis
4. Validate in Jotne application EDMopenSimDM

**Potential Participants:**
Jotne, Lockheed Martin, Airbus (?), Boeing (?), CT Core (?)

**Strategic Alignment:**
Interoperability of engineering analysis data

**Major Deliverables by Quarter:**
- **2019 Q4:** AP242ed2 included
- **2020 Q1:** CD ballot initiated
- **2020 Q2:** Draft recommended practices for structural testing with edition 3
- **2020 Q3:** DIS document accepted for ballot
- **2020 Q4:** Proposal for edition 4
- **2021 Q1:** Publication by ISO
- **2021 Q2:** Recommended practices for structural testing with edition 3
# STEP Extended Architecture 10303 Five-year Technical Roadmap

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### Scope:
- New Application Protocols
- New editions of existing Application Protocols
- SMRL release cycle
- Guidelines on the Change Request release cycle
- Resource constraints on the development of STEP Parts

### Objectives:
1. Provide sponsors a long-range view of emerging capabilities planned to be covered by STEP
2. Provide a framework that supports management of critical resources and cost estimates for future work
3. Manage technical requirements for improved and new capabilities

### Participants:
Boeing, Airbus, Lockheed Martin, Boost, NIST, Eurostep

### Team:
Allison Barnard Feeney, Jean Brangé, Tom Bluhm, Judith Crockford, Nigel Shaw, Phil Spiby, Mike Ward, Sylvere Krima, Keith Hunten, Tom Thurmann, Brandon Sapp, Melissa Harvey, Tom Hedberg, Jean-Yves Delaunay

### Strategic Alignment:
2. Develop and/or endorse standards that support the Digital Enterprise (DE)

### Major Deliverables by Quarter:
- **2018**: Initiated Roadmap planning
- **2019 Q1**: Drafted capability requirements
- **2019 Q3**: Baseline initial requirements, draft proposed timelines
- **2020 Q1**: Publish the roadmap
LOTAR Composite & Advanced Mfg

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Scope:
• 300 (Common Concepts),
• 310 (Ed1 “Exact Implicit” Ply Definition),
• 310 (Ed2 “Approximate Explicit” Tessellated Solid),

Objectives:
1. Work with experts to clarify business requirements
2. Prioritize requirements to be in scope with various product domains.
3. Prepare use cases and test cases for part validation
4. Coordinate with other standardization projects related to this domain.
5. Develop, publish and maintain standards designed to provide the capability to archive and retrieve digital product and technical information.

Participants:
AFNeT, Airbus, BAE, Boeing, Embraer, GE, Gulfstream, Lockheed Martin, Safran, Sandia Labs

Strategic Alignment:
2. Develop and/or endorse standards that support the Digital Enterprise (DE)
2.2 Harmonize with and support other standards focused on the DE.
2.3 Maintain and update relevant standards
3.0 Increase the value of the PDES Organization
3.3 Explore partnering with similar organizations

Major Deliverables by Quarter:
Q1 2020
• Part 300 Draft for Internal Ballot
• Validation pilots

Q2 2020
• Part 300 Draft for External Ballot (AIA/ASD)

Q3 2020
• Part 310ed1 Draft for Internal Ballot
• Validation pilots

Q4 2020
• Part 310ed1 Draft for External Ballot (AIA/ASD)
LOTAR Electrical Wiring Harness

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Scope:
- 400 (Common Concepts),
- 410 (Physical harness definition for design & construction),

Objectives:
1. Work with experts to clarify business requirements
2. Prioritize requirements to be in scope with various product domains.
3. Prepare use cases and test cases for part validation
4. Coordinate with other standardization projects related to this domain.
5. Develop, publish and maintain standards designed to provide the capability to archive and retrieve digital product and technical information.

Participants:
AFNeT, Airbus, BAE, Boeing, Embraer, GE, Gulfstream, Lockheed Martin, Safran, Sandia Labs

Strategic Alignment:
2. Develop and/or endorse standards that support the Digital Enterprise (DE)
2.2 Harmonize with and support other standards focused on the DE
2.3 Maintain and update relevant standards
3.0 Increase the value of the PDES Organization
3.3 Explore partnering with similar organizations

Major Deliverables by Quarter:
Q1 2020
• Various Part revisions and publications
• Validation pilots
Q2 2020
• Various Part revisions and publications
• Validation pilots
Q3 2020
• Various Part revisions and publications
• Validation pilots
Q4 2020
• Various Part revisions and publications
• Validation pilots
Technical Working Groups

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- **Mechanical 3D CAD with Product and Manufacturing Information (PMI)**
  - EN/IAS 9500-1xx series
  - STEP AP203 ed2
  - STEP AP214 ed3
  - STEP AP242 ed1 & ed2
  - 2004 launch

- **Product Data Management (PDM)**
  - EN/IAS 9500-2xx series
  - STEP AP239
  - STEP AP242 ed1 & ed2
  - 2004 launch

- **Composites and Advanced Manufacturing**
  - EN/IAS 9500-3xx series
  - STEP AP203 ed2
  - STEP AP242 ed1 & ed2
  - 2009 launch

- **3D Visualization**
  - Requirements and Compliance Documents
  - 2012 launch
  - 2017 Complete

- **Wiring Harness**
  - EN/IAS 9500-4xx series
  - STEP AP242 ed2
  - 2012 launch

- **Meta Data for Archive Packages**
  - EN/IAS 9500-21
  - STEP AP239 ed3
  - STEP AP 242 ed2
  - 2012 launch

- **Engineering Analysis and Simulation**
  - EN/IAS 9500-6xx series
  - ISO STEP AP209 ed2
  - 2014 launch

- **Model-Based System Engineering**
  - EN/IAS 9500-5xx series
  - STEP AP239 ed2
  - STEP AP239 ed3
  - FMI, SysML, etc
  - 2018 launch

- **Basic & Common Parts**
  - EN/IAS 9500-001-099 series
  - 2019 launch
Overview of LOTAR standards & links with associated ISO standards for information models

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NAS / EN 9300 LOTAR standards per technical domains

ISO Information models

STEP library & Dev. infrastructure

Need to ensure the longevity / enhancement of the STEP standards development infrastructure as part of the preservation plan, and the management of interdependencies with other standards
Airbus Case Study
Airbus Case Study

Managed Model Based 3D Engineering

- **Preliminary Development**
  - Feasibility study
  - Market studies
  - Requirements mgmt.

- **Product Engineering**
  - Part design
  - Assembly design
  - Clash detection
  - Mountability examination

- **Production planning**
  - Process plans
  - Production feasibility studies

- **Tool manufacturing**
  - Tool component production
  - Tool mounting
  - NC/RC programming

- **Concept development**
  - Concept
  - Product architecture design
  - Equipments specification
  - Packaging layout

- **Evaluation**
  - Test plan
  - Prototype
  - Crash test

- **Tool design**
  - Tool assembling
  - Tool simulation

- **Quality control**
  - Sample part production
  - Part measuring
Airbus Case Study – Incident Scenario

Conversion and Validation Process Flow Reminder

VPM VGS

Run QChecker

Convert Catia file to neutral Step file

Import neutral file to Catia format

Import neutral file to 3D Evolution format

Check validation properties

Check validation properties

Global Status

OK  VP1 = VP2 and VP3
WA  VP1 ≠ VP2 or VP3
KO  VP1 ≠ VP2 and VP3
KO  VP0 or VP1 are KO
ER  Process not complete

KO: Object cannot be released if fix is possible with current tool set.
ER: Object can only be released if not fixed after 24hrs. Object not archived

Scenario | Status | Criticality
--- | --- | ---
Tool will not run for any file | ER | High
Tool will not run for one specific file | ER | Medium
Tool unable to process a STEP file (but file is STEP compliant) | ER | Medium
Both Catia and 3D Evolution report KO incorrectly (or for unknown reason) | KO | Medium
3D Evolution reports KO but Catia does not | WA | Low
Typical System Workflow with 3D Evolution

Original CAD modeling tool

Convert

STEP Files

Fail

Valid. GVP

Validation

Check and heal

Secure storage
- STEP files
- Validation reports

Ok

Valid. GVP

Visualize

STEP AP242
CAD Viewer

New modeling tool

Valid. GVP

After x years
How are the industries addressing the obstacles to Model-Based Enterprise?

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**Technology**
- CAD Software
  - PMI support increasing
- CAD Translation
  - NIST results available publicly

**Cost**
- Parallel processing
  - Will recapture with efficiency gains up to 50%²
- Implementation
  - Can leverage technologies across the enterprise

**Culture**
- Resources
  - Keep resources informed
- Approach
  - Organizations need to be more flexible
CoreTechnologie 3D Data Translations

- CATIA V4
- CATIA V5
- CATIA V6
- PRO/E/ CREO
- Siemens NX
- IDEAS NX
- SolidWorks
- Inventor
- STEP
- ACIS
- XT – Format
- JT – Format
- IGES
- DWG
- Rhino

STEP AP242

Semantic PMI:
- CATIA V5
- CATIA V6
- NX
- CREO
## CoreTechnologie AP242: Implementation Details

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<table>
<thead>
<tr>
<th>Data Type</th>
<th>Implemented</th>
<th>Validation Properties</th>
<th>Implemented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assembly structure (single file)</td>
<td>YES</td>
<td>Geometric</td>
<td>YES</td>
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<tr>
<td>Assembly structure (multiple files)</td>
<td>YES</td>
<td>Annotations</td>
<td>YES</td>
</tr>
<tr>
<td>3D exact geometry</td>
<td>YES</td>
<td>Assembly</td>
<td>YES</td>
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<tr>
<td>3D tessellated geometry</td>
<td>YES</td>
<td>Saved view</td>
<td>YES</td>
</tr>
<tr>
<td>3D PMI graphical representation</td>
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<td>User defined attributes</td>
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<tr>
<td>3D PMI semantic</td>
<td>YES</td>
<td>Color</td>
<td>YES</td>
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<tr>
<td>Composites</td>
<td>YES</td>
<td>Visibility</td>
<td>YES</td>
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<tr>
<td>Kinematics</td>
<td>NO*</td>
<td>Conversion and validation reports</td>
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</tr>
<tr>
<td>Functional machining features</td>
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<td>3D parametric data</td>
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<tr>
<td>Construction history</td>
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NO*: Implementation description not available yet

### Formats

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<tr>
<td>BO model XML</td>
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<td>ISO 10303-21</td>
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CoreTechnologie STEP AP242 & JT GVP report

Summary of Results

Checker Thresholds

Details:

Part Details

Properties | Deviation | Read | Computed
---|---|---|---
Area | | | 2303.134772290000 2303.12056838262
Independent_surface_area | None | | | 292.65887057000 292.65811267400
Volume | | | 1.989961364100 1.98999201295
Centroid | 0.000000 in | | | 0.124076729340 0.124076970360
Independent_surface_centroid | None | | | 0.01110336492 0.01110352086
Independent_point_centroid | None | | | 9.3168796410420 9.316879640420
Independent_curve_length | None | | | 2.264348834500 2.264348834488
National_solid_centroid | None | | | 1.593760925900 1.59376092586
Tessellated_centroid | None | | | 4.960677623750 4.960677623749
Surface_area | None | | | 3.341401815410 3.341401576996
Length_of_segments | None | | | -2.87102654940 -2.871026549318
Tessellated_point_set_centroid | None | | | 9.044674191284 9.044674191284
Tessellated_curve_centroid | None | | | 9.728346826464 9.728346826464
Properties | Check | Read | Computed
---|---|---|---
Number_of_independent_point | 0 | 0 | 0
Number_of_children | 0 | 10 | 30
CoreTechnologie Validation – Model Compare

For:
- Conversion quality check
- Supervision of design changes
- CAD model VS CAE model comparison

Five separate modes of operation:
- Geometric comparison
- Assembly structure
- PMI – semantic annotations and dimensions
- Features
- Attributes
Multiple Configurations support

Alternative Representations in same Geometric Context

- Tesselated and B-Rep Shape
- Folded and Unfolded Part

6.1. Alternative Part Shapes with same Geometric Context

In the first case, the various shape representations are all defined in the same geometric context. This implies that all alternative shapes are positioned in the same way.
Composite Rosettes Supported
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- Type:
  - Edition 1
  - Cartesian or Standard
  - Guide Cure
  - Guide Cure – 90 Deg along the Cure

- Edition 2
  - Polar Radial
  - Points Vectors
  - Cylindrical or Translational
Thank you for your time!

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