The Minimum Digital Thread for Aircraft Certification

PLM Road Map 2019 – Dr. Ken Versprille

PLM Road Map™ & PDT North America 2019
PLM for Professionals – Product Lifecycle Innovation
CIMdata® May 29-30, Tysons Corner, VA -eurostep-

AEROSPACE & DEFENSE PLM ACTION GROUP

The Minimum Digital Thread for Aircraft Certification

A&D PLM Action Group – MBD & BOM Project Team

May 2019

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1

Our Mission...

Strategic management consulting for competitive advantage in global markets

CIMdata is the leading independent global strategic management consulting and research authority focused exclusively on PLM and the digital transformation it enables.

We are dedicated to maximizing our clients' ability to design, deliver, and support innovative products and services through the application of PLM.

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2

2

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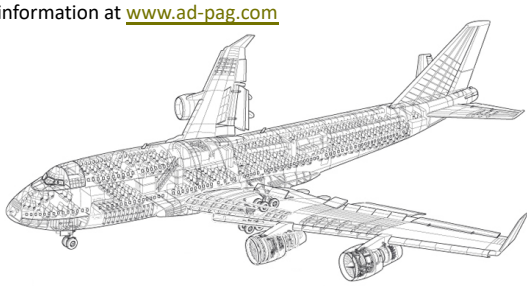
Aerospace & Defense PLM Action Group

Mission

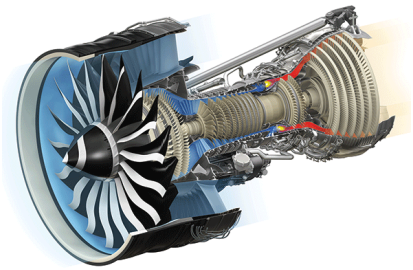
An association of aerospace & defense companies within CIMdata's globally recognized PLM Community Program, which functions as a ***PLM advocacy group*** to:

- Set the direction for the aerospace & defense industry on PLM-related topics that matter to members
- Promote common industry PLM processes and practices
- Define requirements for common interest PLM-related capabilities
- Communicate with a unified voice to PLM solution providers
- Sponsor collaborative PLM research on member-prioritized industry and technology topics

More information at www.ad-pag.com



http://www.rjc-technical.co.uk/Pages/Boeing-747.htm



http://www.machinedesign.com

3

2017-18 Plan

Members prioritize topics and fund research and team projects annually

- Number and scope of projects has increased year over year due to increase of available funds from larger membership

Topic / Members	2014-15 4	2015-16 4 -> 5	2016-17 5 -> 7	2017-18 8 -> 10+	2019 10
Global Collaboration	Research Phase 1	Research Phase 2		Team Project 3	Team Project 3
Obsolescence Management	Research Phase 1	Research Phase 2	Team Project	Project Close Out	
Model-based Definition (MBD) and BoM Definition			Team Project Phase 1	Team Project Phase 2	Team Project Phase 2
Multiple-view Bill of Material (Multi-BoM)			Team Project Phase 1	Team Project Phase 2	Team Project Phase 2
Model-based Systems Engineering (MBSE)				Team Project Phase 1	Team Project Phase 1

4

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A&D MBD & BoM Project Team

Mission & Vision

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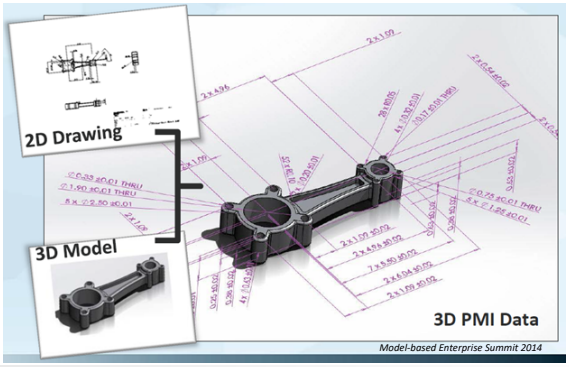
Mission:

- Define A&D common MBD definition
- Define minimum MBD data elements for the digital thread (design, manufacture, certification)
- Evaluate the ability of data standards to support that digital thread
- Evaluate the ability of Solution Providers to support the needed data standards

Vision:

- A&D Industry standard for 3D MBD
- Standardized Regulatory "Technical Data Package"
- Requirements to PLM Vendors & Standard Bodies



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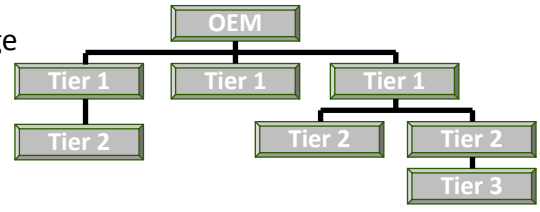
5

MBD and BoM Definition with Data Exchange

Today's Pain Points

Causal Analysis of Problems

- In a multi-CAD and same CAD multi-revision environment, not all data items are supported in Standards for exchange throughout supply chain
  - Pushing for semantic definitions, not visual
- Solution provider exchange software does not fully comply with existing Standards
  - ISO STEP AP242 + others, ISO JT, ISO PRC in 3DPDF
  - Need for multiple Viewers
- Models not properly validated before exchange
- Data exchanges and requests not tracked
- Data exchange mechanisms all custom
  - Each OEM-Supplier contract negotiated separately
  - Varied architectures



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6

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A&D MBD Team Phase 1

2017 Activities

Data item recommendations
from one A&D PAG member company
and test of their software exchange solution
based on ISO 10303 AP242 data exchange capabilities for composite design

- Published a Phase 1 Position Paper
  - Minimum set of DATA ITEMs needed for Model-based Definition

Example:

Table 4—Composite Part MBD Elements and Their Support Level

Minimum Data Element
Butt Splice Zone
Contour
Core Object
Definition Surface
Edge Of Ply
Flatten Geometry
Length Parameter
Material Object
No Splice Zone
Orientation Feature
Parameter
Plies Group
Plies Group Draping Direction Parameter
Ply
Ply Orientation
Engineering End of Ply
Manufacturing End of Ply
Rosette

Focus was on 1st Column Listing Data Items

Phase 1 Position Paper
available at www.ad-pag.com

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A&D MBD Team Phase 2 Stages

2018-2019 Activities

- Write a Phase 2 Position Paper
  - Stage 1 (Target June 2019)
    - Identify current AS IS use cases
    - Discuss problems and business impacts
    - Analyze why the current use scenarios cause issues ← **Current status: Almost complete**
  - Stage 2 (Target end of Q3 2019)
    - Specify future TO BE use cases (Desired state)
    - Indicate business benefits
  - Stage 3 (Target end of Q4 2019)
    - Detailed requirements
    - PUBLISH → **What do those requirements look like?**
- Proceed to Project Phase 3 GAP ANALYSIS in 2020
  - If not in the Standard, lobby Standards body
  - If in Standard, but not Solution provider supported, lobby Solution provider

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A&D MBD Attack Plan

Divide and Conquer

- Identify top, critical Part Types
  - Phase 1 of project identified 15 CAD Part Types of interest
  - Current Phase 2 added 2 Part Types (Deformable parts & Additive Manufacturing parts)

- Composite - Detail - Core Stiffened Bond
- Composite - Detail - Co-Cured/Co-Bonded
- Casting
- Forging
- Sheet Metal
- Machined
- Wire Harness
- Tube Assembly - Flexible
- Tube Assembly - Ridged
- Ducting - Metallic - Mechanically Fastened
- Installation
- Standard Part – Mechanical
- Standard Part - Electrical (Connector, Back Shell, etc.)
- Supplied Part - Mechanical Systems (Pump, Actuator, etc.)
- Supplied Part - E/E Systems (Battery, LRU, etc.)

- Also include category “For All Parts”
- Defined priorities
- Put together sub-teams to tackle a given Part Type
  - Priority #1 was Standard Part - Mechanical

What is the minimum set of DATA Items that must be supported by the Standards and by the Solution Provider converters in order to satisfy certification?

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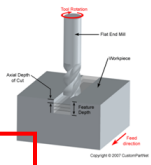
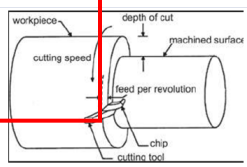
Standard Part – Mechanical

Data Items are the target

	Minimum Data Element	Priority	Comment	Definition	Example	Requirement Statement (geometric, annotation, attribute)
1				a depiction of internal or external		
2	Symbolic Feature Representation					
3	Drilling Features			A feature involving material removal using a simulated cutting process (milling) that uses a cutting tool to remove material from the surface of a CAD model. May require specifying cutting feed, speed, direction and depth in the form of attributes.		ability to represent the specific machining process requirements (e.g. depth, speed, etc.) in the source & neutral formats.
4	Milling Features					
5	Turning (Lathe) Features			A feature created in a CAD model using turning operations (e.g. lathe) used principally by holding and rotating the part while a tool bit is advanced into the part causing the material removal. May require specifying cutting feed, speed, direction and depth in the form of attributes.		ability to represent the specific machining process requirements (e.g. depth, speed, etc.) in the source & neutral formats.
6	Broached Features					
7	EDM Features (via Die Sinker, Wire or Hole					
8	Grinding Features	1		Used to produce a smooth finish on flat surfaces. It is a widely used abrasive machining process in which a spinning wheel covered in rough particles.		

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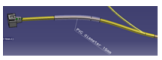
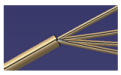
Wire Harness

Priority #3 Part Type

Harness Segment	1		An entity of a harness with the same cables content for a dedicated configuration connecting extremities or junctions		2D (stickline) or 3D geometry representation Extremities 1 and 2 Length (Measured length of the segment in the 3D.) Forced Length (Length given by user to take into account constraints not taken) Cut length Segregation code bend radius
Harness Node			Electrical extremity node Standard equipment allowing the connection of the harness to other items (equipment, other har-ness, structure…) Connection to an electrical device Segment branch point (vertex) A segment branch point is a point (vertex) where bundle segments meet.		Node type: branch, extremity, external, intermediate
Connectivity		behavior of the system, not an object	The ability to deliver a signal between 2 objects (i.e.		
Harness Segment Protection					

Splice			Opportunity to branch to the termination (can be multiple connectors) Located and internal to the bundle.	
contact		Pin contact, socket contact…		
Seals			A Cavity seal is a water tight non-electrical object to fill a populated (used electriy) Cavity. Used to seal a contact into a cavity.	

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Next Steps

- Once Position Paper published with detailed Data Item requirements
  - GAP Analysis (2020 likely)
    - Team with CAx-IF for testing STEP
    - Other groups for JT and 3D PDF
    - A&D Members to develop test models

CAx Implementor Forum

ISO STEP AFNeT, PDES, Inc., prostep IVIP

JT Implementor Forum

prostep IVIP

3DPDF CONSORTIUM

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Thank You

Questions

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13

13

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14

14