AEROSPACE & DEFENSE PLM ACTION GROUP

Discussion of "A&D PLM Action Group Multi-view BOM Solution Evaluation Benchmarks Report"

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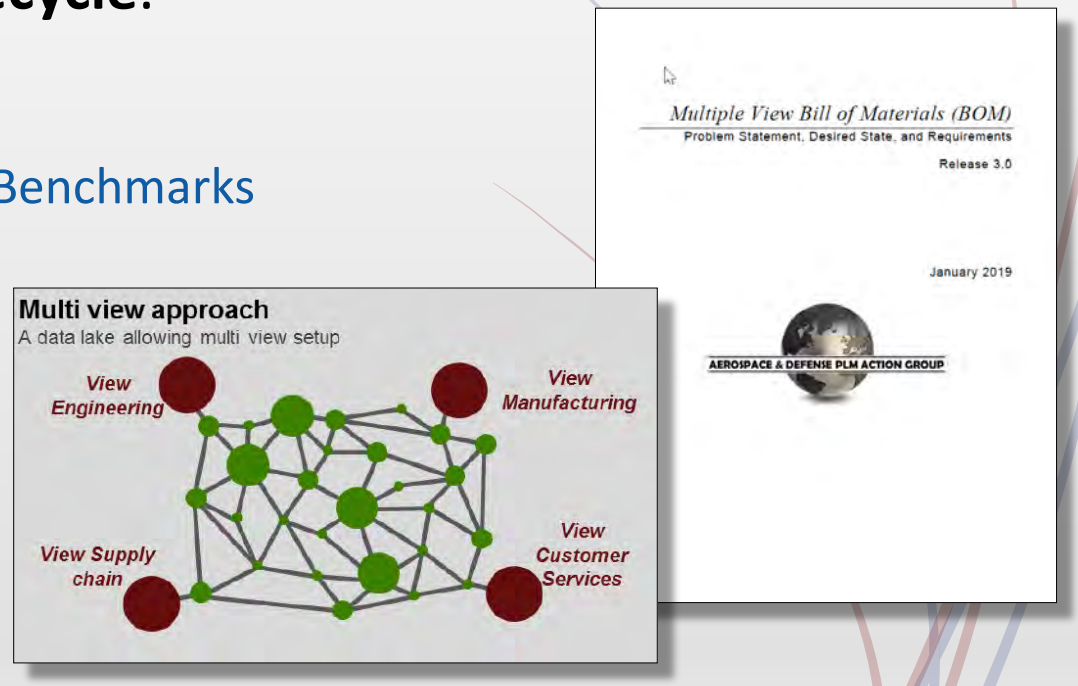
A&D PLM Action Group Multi-view BOM Team

- The following AD PAG member companies and invited Tier 1 suppliers provided subject matter experts (SMEs) to participate as benchmark demonstration evaluators. Those who were assigned had decades of aerospace PLM and configuration management experience.

Multi-view BOM Team publications

The **Multi-view BOM** Team has published papers, examples and test cases that provide an in-depth view of the **difficulties** that Aerospace and Defense companies have in **managing multiple bills of material through our products lifecycle**.

- Multiple View Bill of Materials (BOM) Solution Evaluation Benchmarks
- Multiple View Bill of Materials - Position Paper
- Multiple View Bill of Materials - Appendix A
- Multiple View Bill of Materials - Appendix B



Papers are available for download at www.ad-pag.com

Software Solutions included

- Aras - Innovator
- Dassault Systèmes - 3DExperience
- PTC - Windchill
- Siemens - Digital Industries Software (Teamcenter)

- Boeing contributed the Model-Based Engineering Demonstrator Reference Model, an aircraft data set consisting of 900+ parts in hierarchical view, in CATIA v5 and AP242 formats.

The model is available as open source from github: MBE-Demonstrator-RM

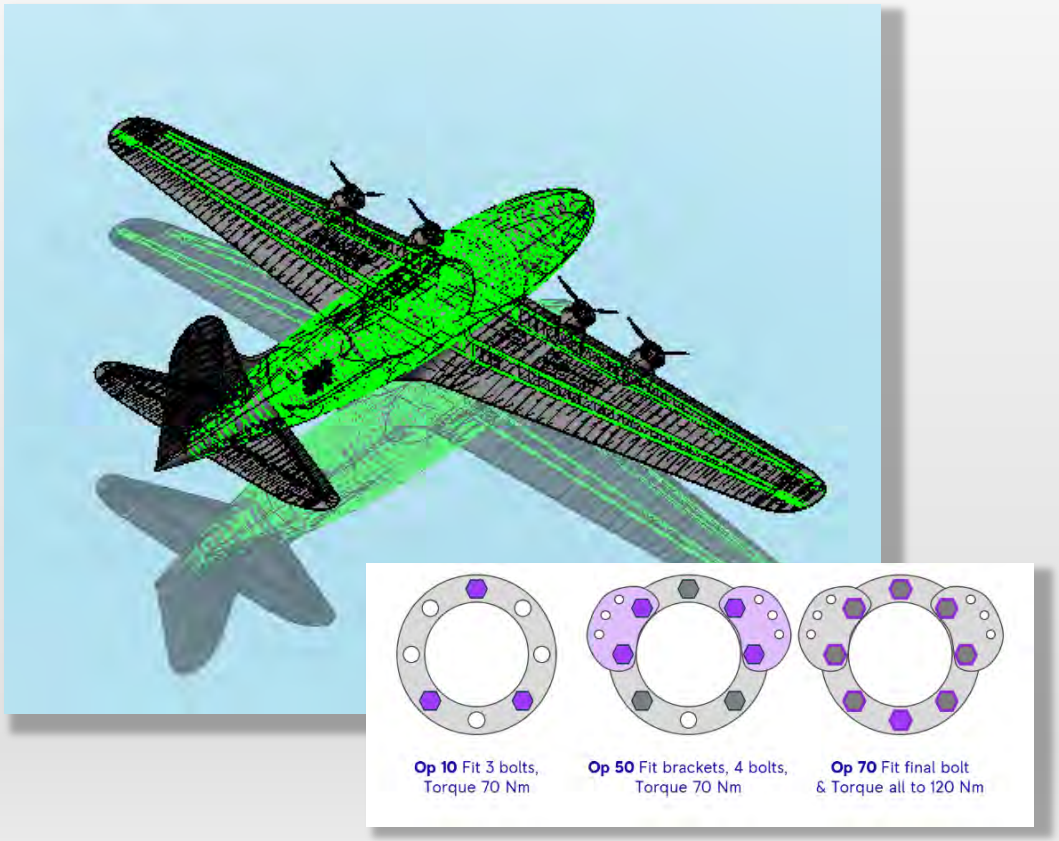
Benchmark focus

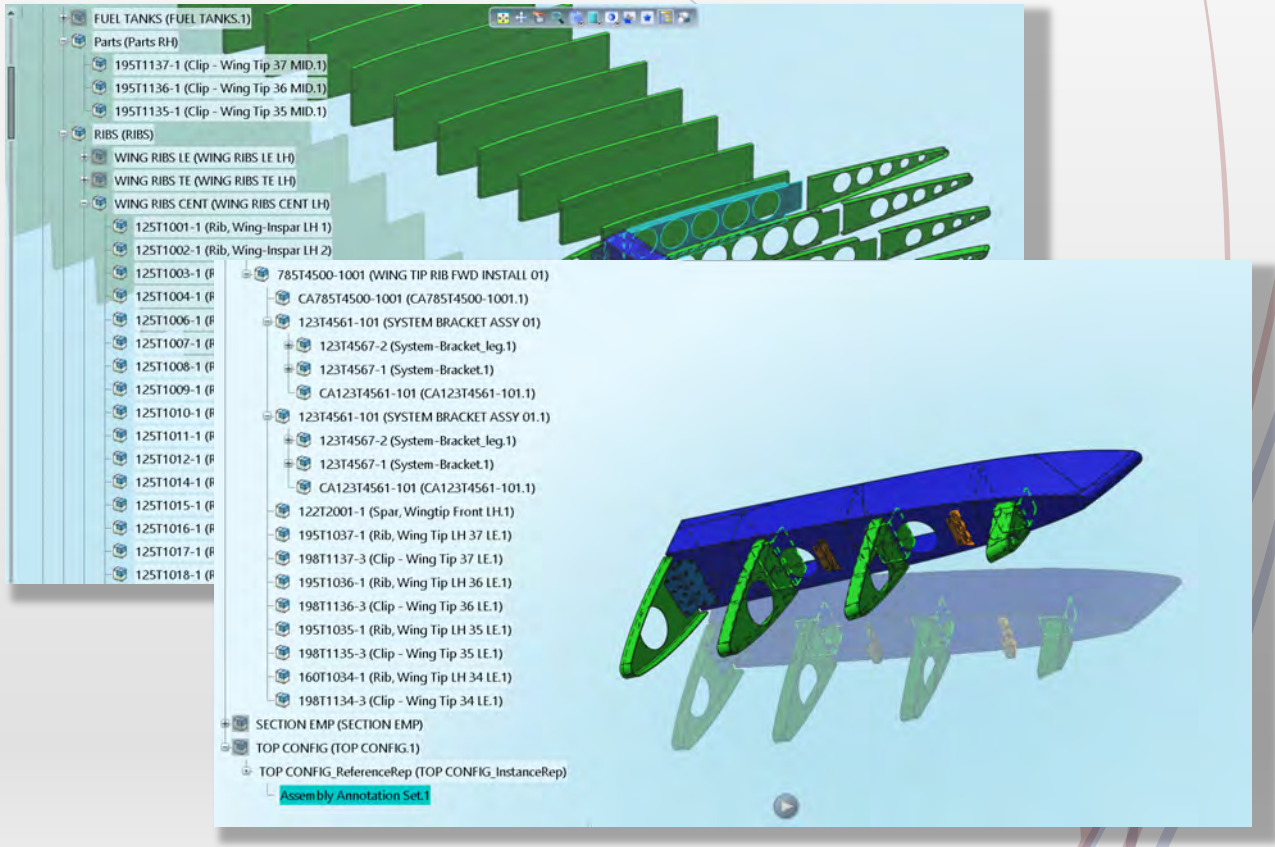
- The use cases required traceability of requirements from one structure to a second structure. Many of the use cases required identification of specific usages of a part or requirement, not changes to all usages of the item.
- Test Case Descriptions and Results
  - Focus Area 1 – Engineering Release
  - Focus Area 2 – Supplier Collaboration
  - Focus Area 3 – Bolted Join
  - Focus Area 4 – Engineering to Manufacturing
- Solutions were evaluated for their ability to trace requirements through the scenarios, including identification of changes, communication of change and resolution of changes.

Note: The Test cases are included in the published paper

Vendor evaluation methodology – Data Sets

- Open source Model-Based Engineering Demonstrator Reference Model: common source for tests





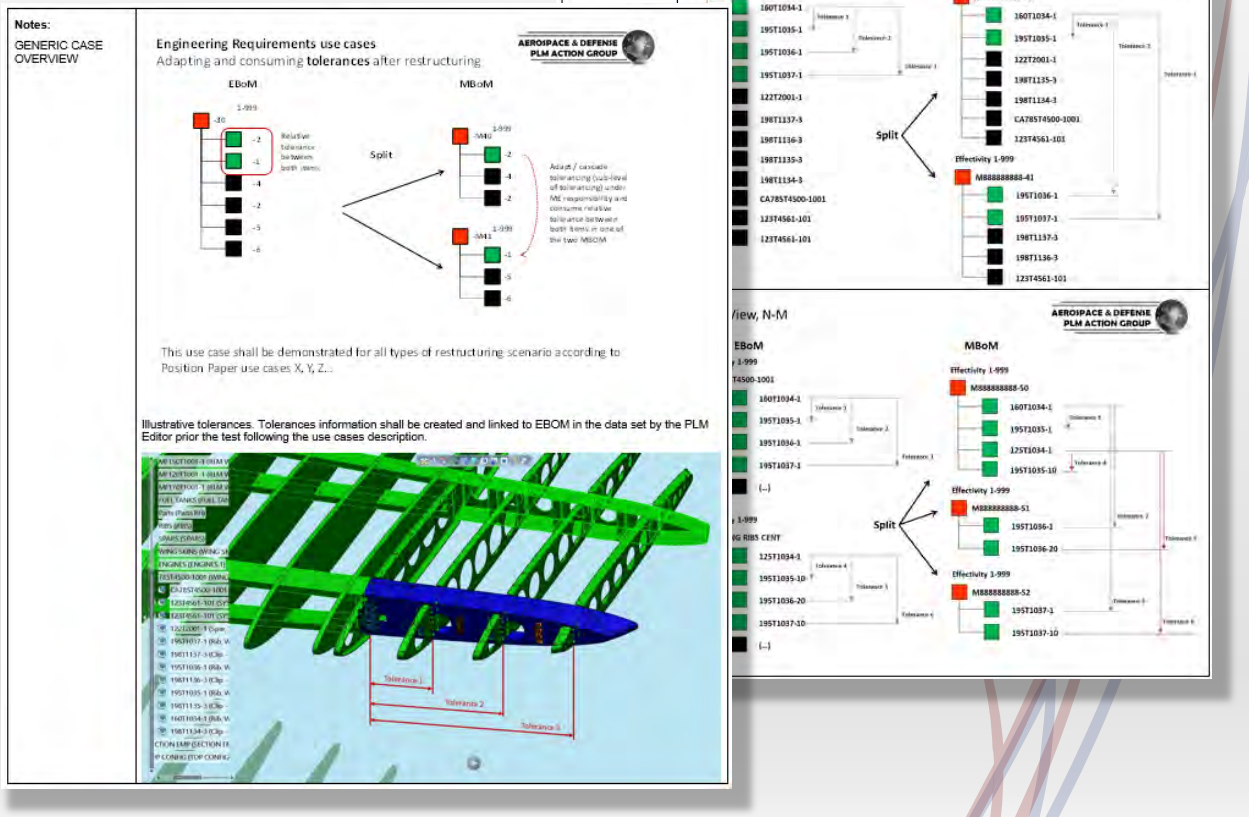
Vendor evaluation methodology – Test Cases

- Several Test Cases per Focus Area of Analysis, describing in detail actions to perform and expected output

Engineering Requirements Test Case example

USE CASE NUMBER: ER-01	**Related Work Package: Engineering Requirements**
PLM Team owner:	**Process Owner: Multi View BOM team – A&D PLM Action Group**
USE CASE TITLE: *Adapting and consuming* ***tolerances*** *after restructuring*	
Goal & Overview: (Functionality)	Demonstrate that CAD model tolerances can be traced, adapted and consumed in the proper MBOM in whatever EBOM to MBOM Restructuring use case.
User Categories:	
Preconditions:	Tolerances information shall be created and linked to EBOM in the data set by the PLM Editor prior the test following the use cases description.
Use case product scope	☒ Airframe ☐ Systems ☐ Equipment ☒ Engine
Use case frequency	☒ Daily ☐ Weekly ☐ Monthly ☐ Yearly
Impacted companies	☒ Airframer ☒ Engine Manufacturer ☒ Design & Build Supplier ☐ Built to Print Supplier ☐ Design Only Supplier
Impacted population Per event	☐ Less than 10 ☐ Between 10 and 100 ☒ Between 100 and 1000 ☐ More than 1000

Detailed description



Vendor evaluation methodology – Evaluation on 3 Levels

General Evaluation

Evaluators were instructed to assess performance of the benchmark demonstrations and assign ratings from 0 to 5 for each of several evaluation criteria on individual use case grading sheets.

The system of ratings and the assessment at each level are as follows:

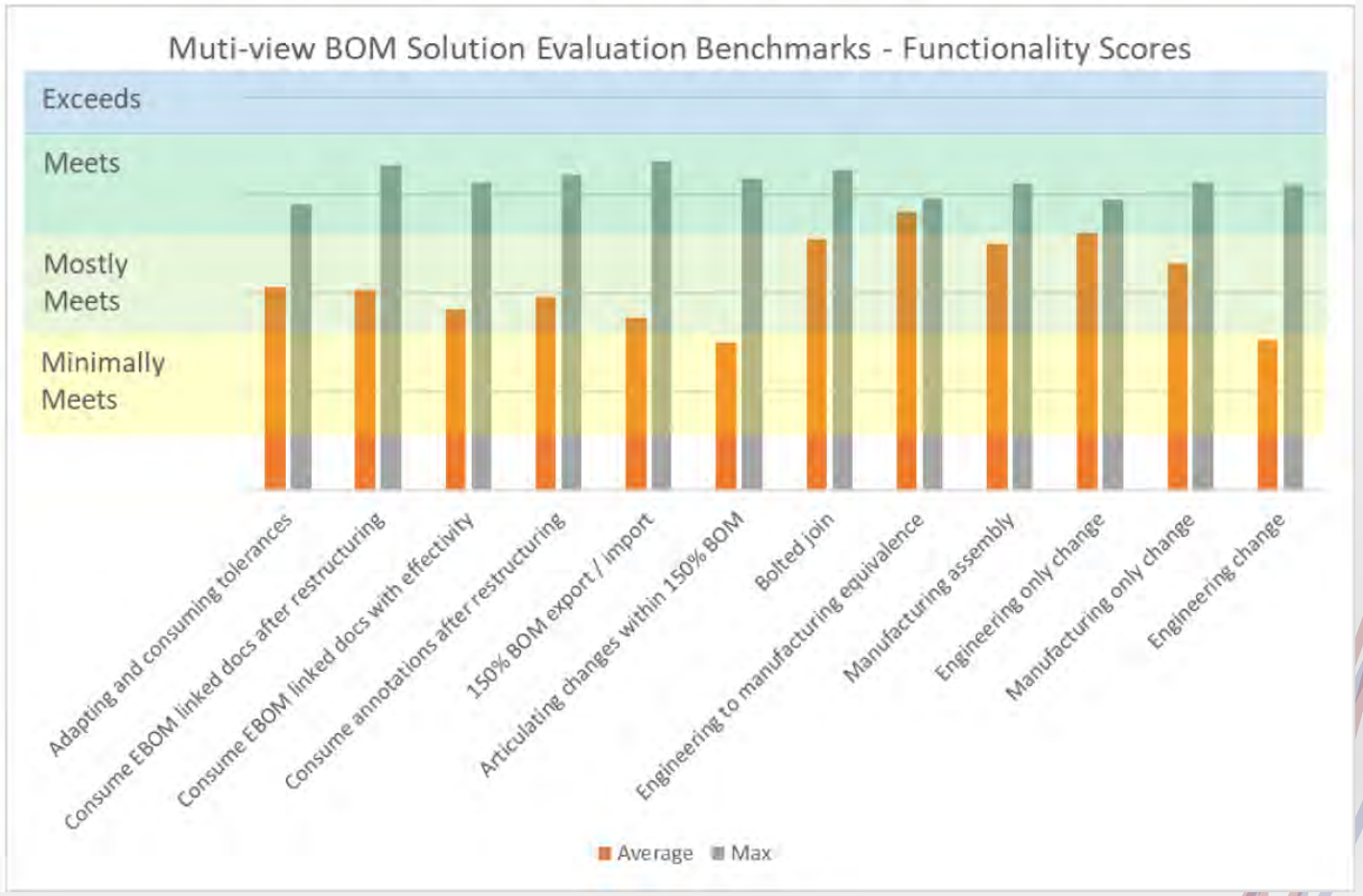
- 5 – Far exceeds requirement
- 4 – Exceeds requirement
- 3 – Meets requirement
- 2 – Mostly meets requirement
- 1 – Minimally meets requirement
- 0 – Not shown

As an illustration of the results reporting format, the evaluation summary for use case *SC-01: 150% BOM export/import* is shown here

Use Case Evaluation Criteria	Score	Criteria Satisfaction (# of Solutions at Each Level)					
	Average	Not Shown	Minimally Meets	Mostly Meets	Meets	Exceeds	Far Exceeds
2-Supplier Collaboration							
SC-01 ***150% BOM export / import***							
Goal Demonstrate that 150% BOM can be fully consumed into a supplier's PLM system and reconciled.	1.88	1	1		2		
Key Actions							
1 The 150% BOM (containing two unit configurations) is exported out of the OEM's PLM.	2.01		2		2		
2 Exported 150% BOM is imported into a second PLM system representing the supplier's PLM.	1.90	1	1		2		
3 System performs an automatic validation and reports any mismatches or fallout.	1.65	2			2		
Summary Rating							
Actions (calculated weighted average):	1.75	1	1		2		
Ease of Use:	2.20	1		1	2		
Final Grade (assigned by evaluator):	1.98	1	1		2		

Results – Functionality Scores

- Overall, most of the functionalities are met or mostly met for evaluated PLM solutions...
- Software solutions score similarly in some areas
- However, there are significant differences for some funtionalities:
  - Engineering Change
  - Articulating changes within 150% BoM



Results – Capability Gaps

- But there are areas of concern:

Use Case	Level of Concern
1-Engineering Release	
Adapting and consuming tolerances after restructuring	High
Consume documents linked to specific EBOM items after restructuring	Low-Mod
Consume documents linked to specific EBOM items with effectivity revision	Moderate
Consume annotations after restructuring	Low-Mod
2-Supplier Collaboration	
150% BOM export / import	Moderate
Articulating changes within 150% BOM	Moderate
3-Bolted Join	
Bolted join	Low-Mod
4-Engineering to Manufacturing	
Engineering to manufacturing equivalence	Low
Manufacturing assembly	Low-Mod
Engineering only change	Low-Mod
Manufacturing only change	Low-Mod
Engineering change	Moderate

Conclusions

- A&D OEM Multi-view BOM management requirements were met or mostly met by multiple commercially available PLM software solutions.
- It was possible to characterize gaps in capability and localize gaps to specific Multi-view BOM use cases as guidance to the PLM software solution providers.
- Usability of commercially available PLM software solutions' Multi-view BOM management capabilities will not inhibit adoption or efficiency.
- Initial outreach to the Interoperability Forum community was promising but inconclusive.
- The leading PLM software solution providers regard the AD PAG as an organization of importance and one worthy of their attention and support.

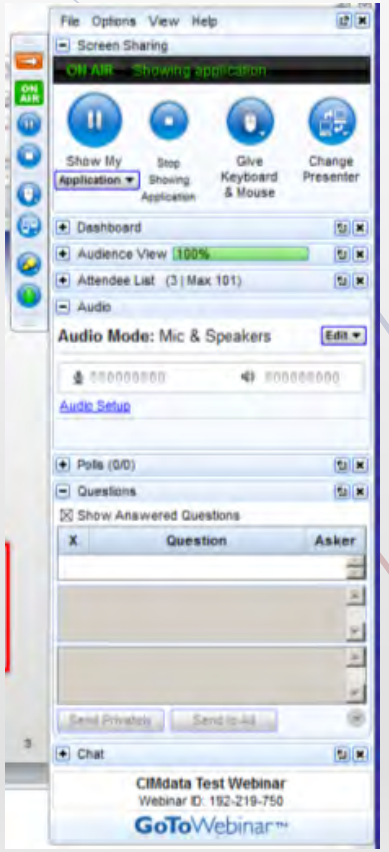
What's Next?

- We made the data available to the public so they can evaluate other solutions and see how they matchup.
  - 3D MBD Models are available
  - Test cases are available
- We made the data available so standards groups can review and show support.

- The Multi-Bom group has two new focus areas:
  1. Re-use of work instructions in alternate locations (same parts and process different context)
  2. Service Bom

Q&A

Let's hear what's on your mind?



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