GPDIS MBSE and Manufacturing Workshop

The Industry Call: Workshop history, Needs & Enablers for a Common Collaboration Data Model.

GLOBAL PRODUCT DATA

INTEROPERABILITY

SUMMIT 2025

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

Juan C Mendo (Boeing)
Kyle Hall (Airbus)

September 23rd, 2025, Phoenix, AZ

The Industry Call - agenda

1. GPDIS Workshop history: The “new era” of SysML
2. The need for MBSE “pivot” framework, ADF.
3. The need for connectivity with the “Physical”: Digital Data Package (CASCaDE)

EXTRA: What are ***your needs*** for data interoperability standards?

GPDIS – MBSE Workshop History

- **2014 - The first Systems Engineering Track for MBSE**

  The impact on PLM, Contributions/Suggestions from Multiple Industries
- **2015 - The first MBSE Workshop - OEM to Supplier Interoperability**

  Prioritized Industry Data Standards: SysML, OSLC, FMI, ReqIF
- **2016 MBSE Workshop - the Roadmap outline**

  Implementation issues - where/how to start, the role of the PLM Vendors
- **2017 MBSE Workshop - Gaps in the Roadmap**

  Interoperability Issues, the need for Leadership
- **2018 Improving/Integrating our Models with meta-data**

  The State of the Industry, opportunities, update our Roadmap, upgrade a Bicycle
- **2019 Managing Supplier Requirements**

  Evaluate a collaboration space and create a procurement specification for a box
- **2022 MBSE Workshop – MBSE Assessment**

  MBSE Capability Industry Assessment
- **2023 MBSE Workshop – MoSSEC Workshop**

  Demonstrating Value of MoSSEC by examples
- **2024 MBSE Workshop – Digital Engineering Challenges**

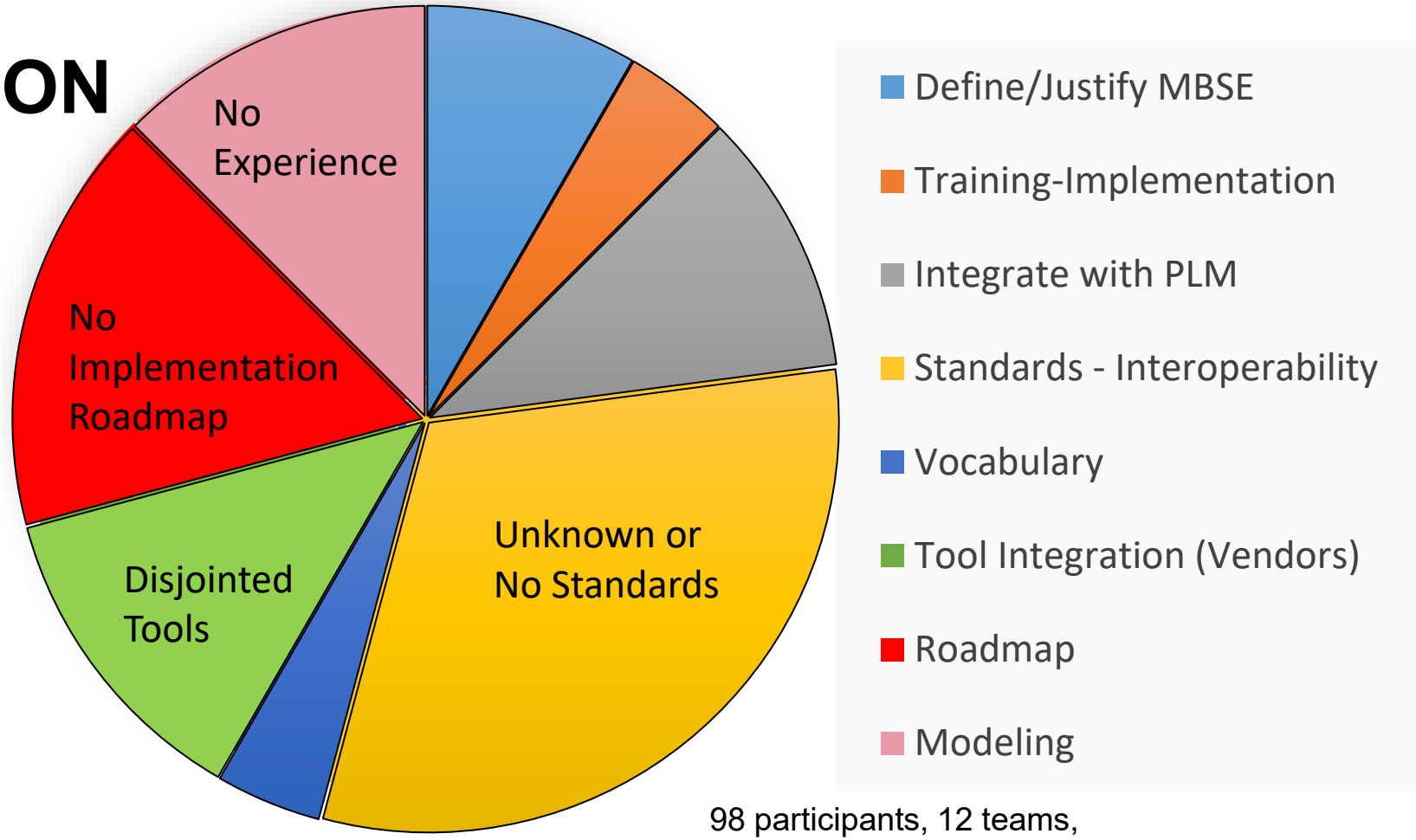
  Industry Challenges towards Digital Thread and Digital Twin
- **2025 GPDIS Workshop – MBSE and Manufacturing**

  Do Systems Engineers belong to the factory?

Today's topic

2016 GPDIS MBSE Workshop: Participant Survey

IMPLEMENTATION ISSUES

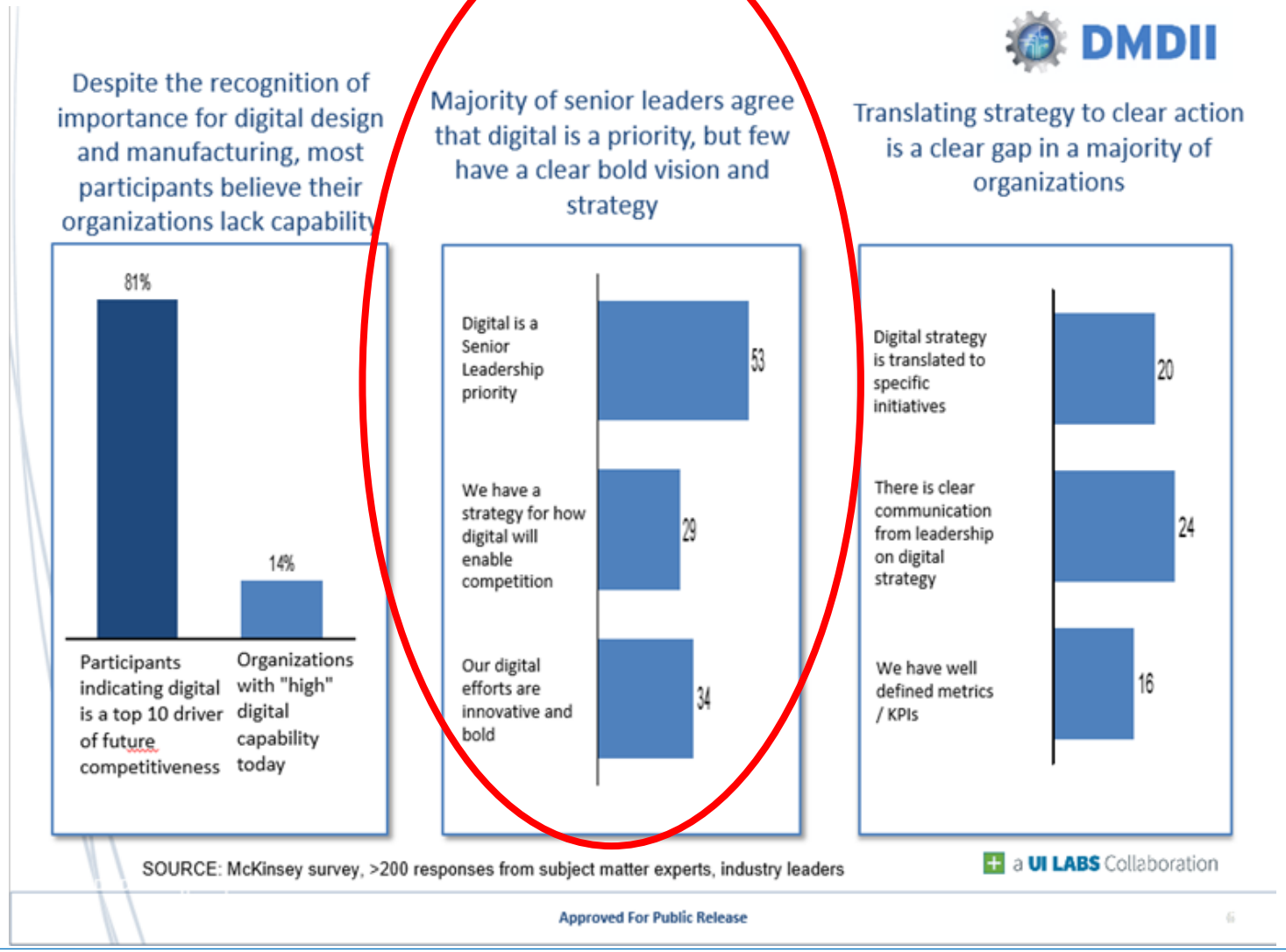


98 participants, 12 teams,
33 written submissions and 104 comments

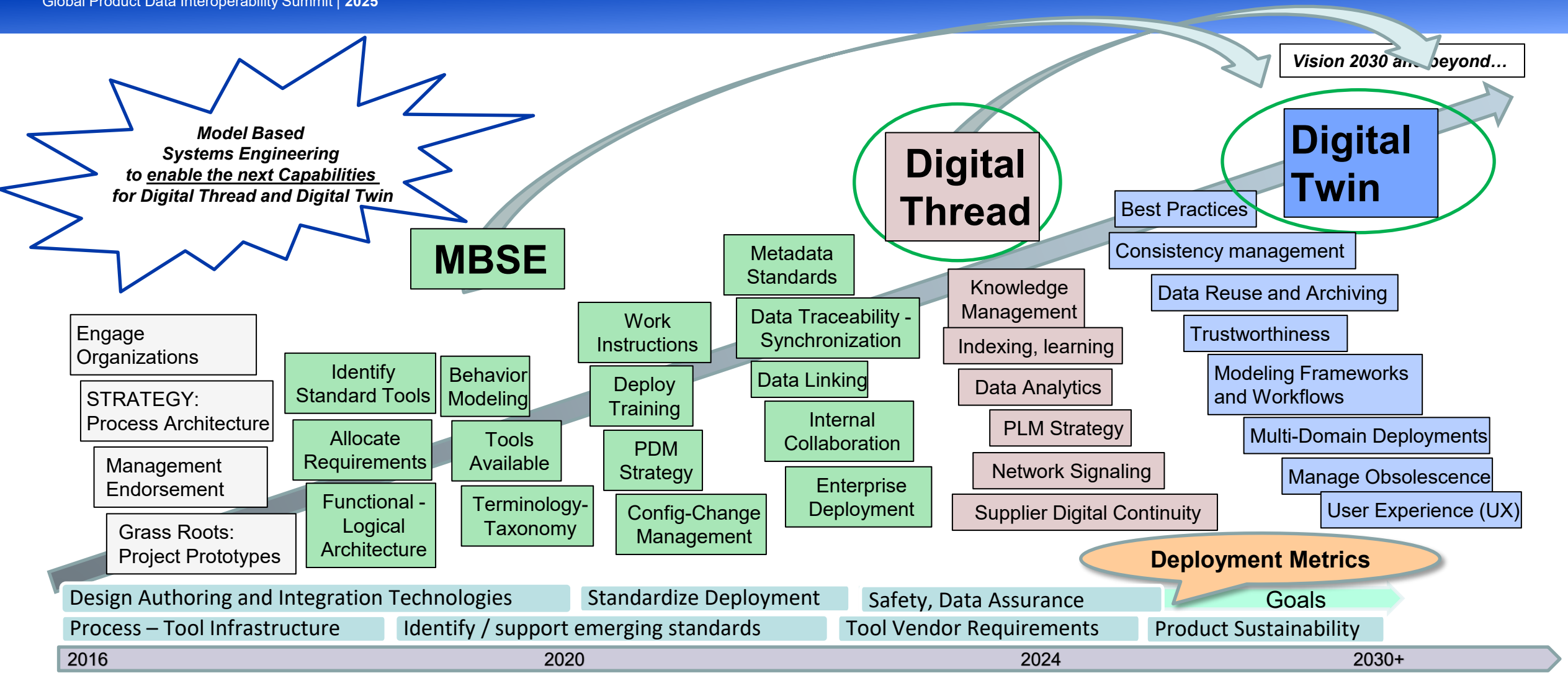
2018 GPDIS MBSE Workshop: Participant Survey

The implementation of digital capabilities in the product realization process, such as early consideration of manufacturability during the development of the science & technology and the design & acquisition phases, is essential to dealing with this complexity and succeeding in this 4th industrial revolution.

Gregory A. Harris, PH.D. – Auburn University



2024 GPDIS MBSE Workshop: MBSE enabling Digital Engineering Capabilities

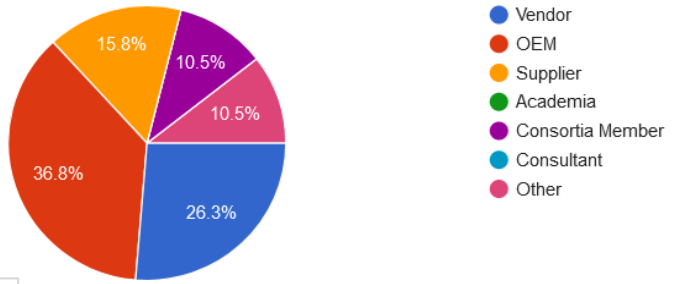


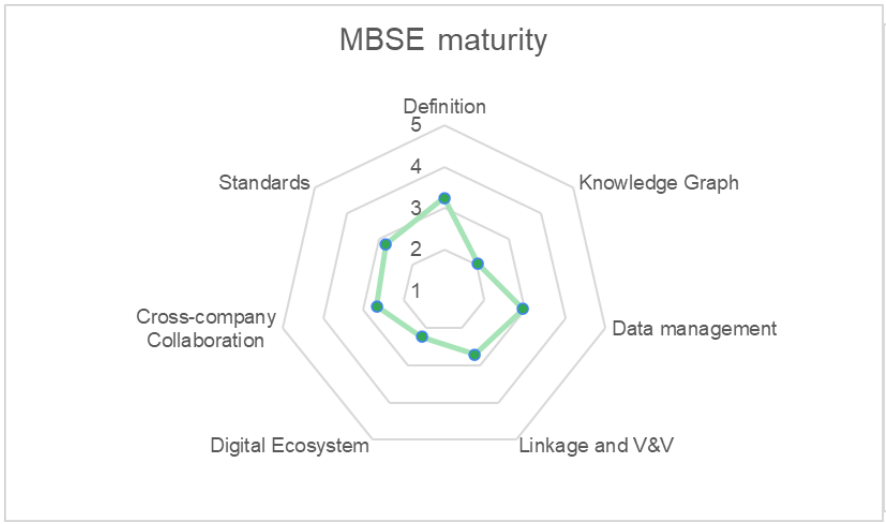
from PDES-LOTAR MBSE Teams to INCOSE, Jan 2021, updated September 2024

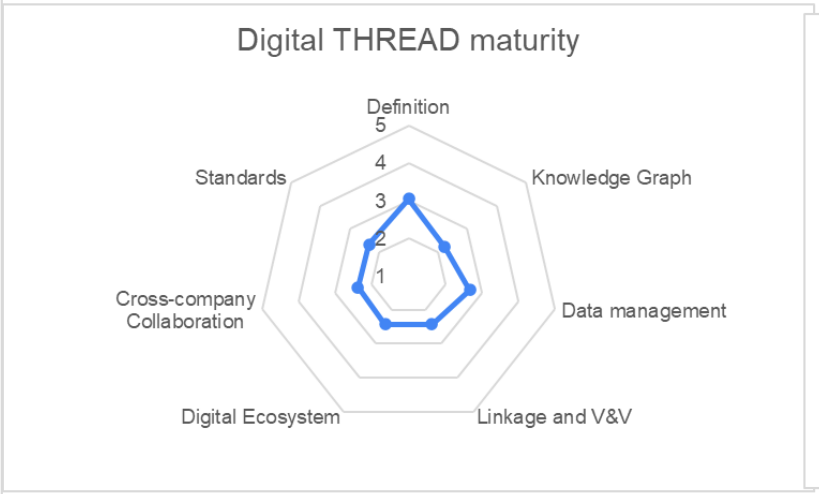
2024 MBSE Workshop – Results

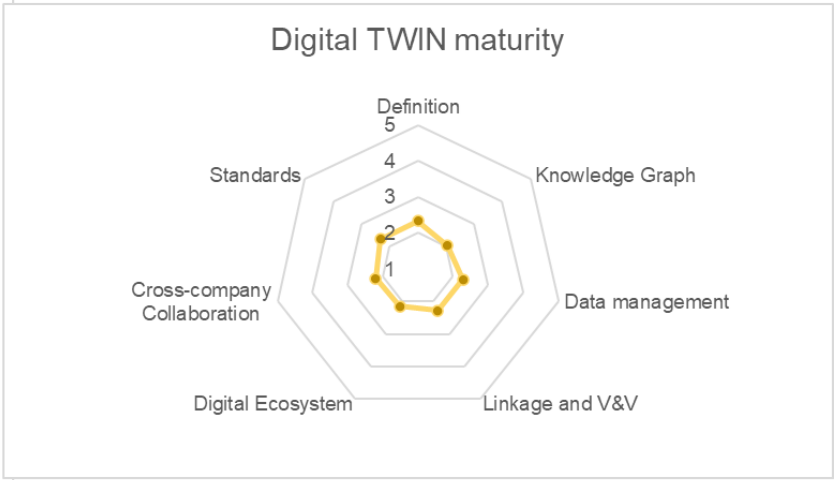
- MBSE value is understood by leadership
- MBSE tools, processes and standards are more mature
- Need additional Digital Engineering Capabilities to extend into Digital Thread and Digital Twin
- MBSE is a foundation and enabler for Digital Engineering

How would you best describe your role in the Industry?









Digital Engineering maturity

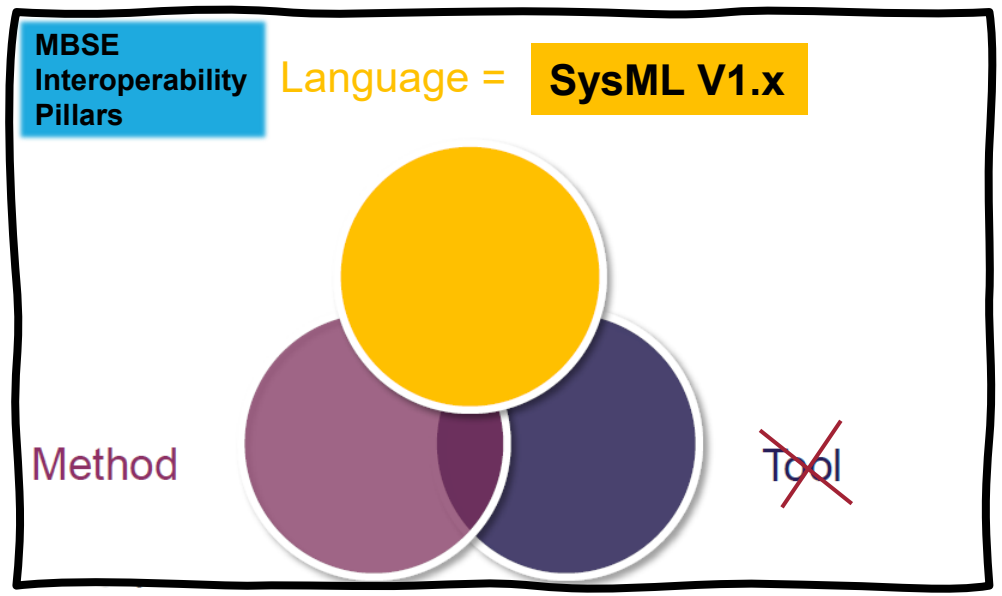
OMG adopts SysML V2,in July 2025 and now what?

2006 — **OMG adopts SysML V1**

2025 — **OMG adopts SysML V2**

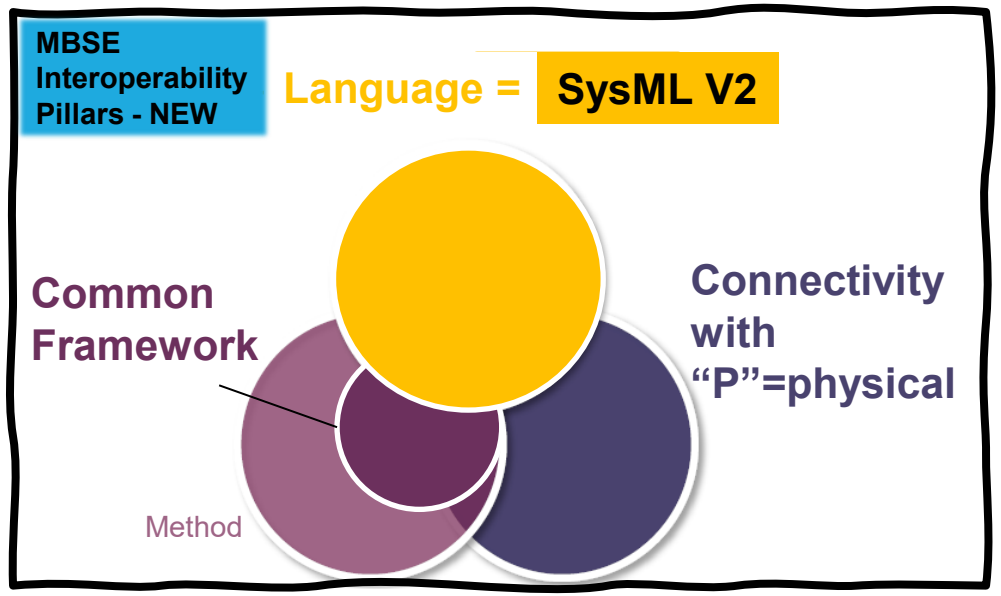
MBSE Interoperability Pillars

Language = **SysML V1.x**



MBSE Interoperability Pillars - NEW

Language = **SysML V2**



Interoperability success (2025) =

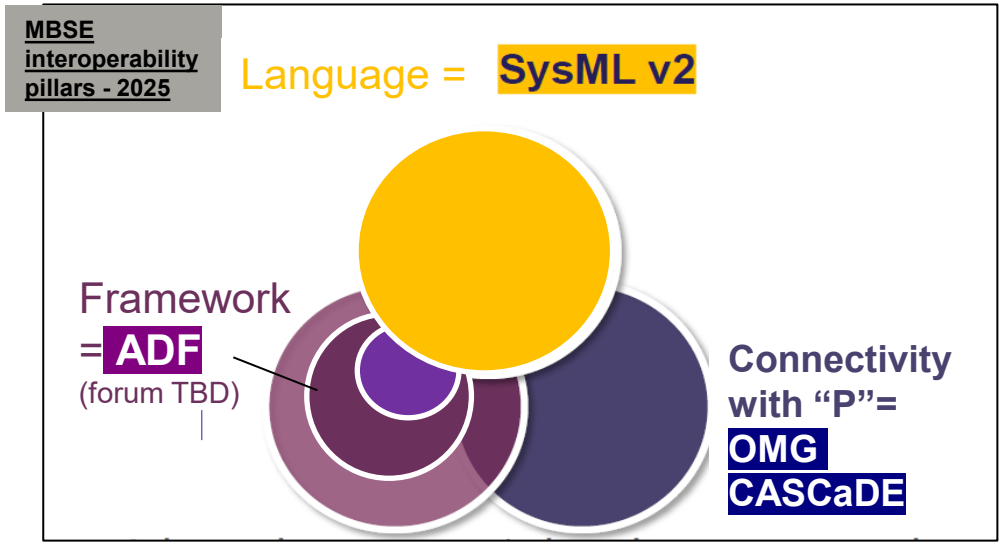
Common language: **SysML V2** +

Common framework: **ADF** Architecture Description Framework +

Common connectivity: **CASCaDE** Digital Data Package

MBSE interoperability – The missing gaps in 2025

FINALLY!
Good syntactic interoperability thanks to SysML V2 API and metamodel.



BUT…

1. Missing semantic interoperability: The Architecture Description Framework (ISO 42010)

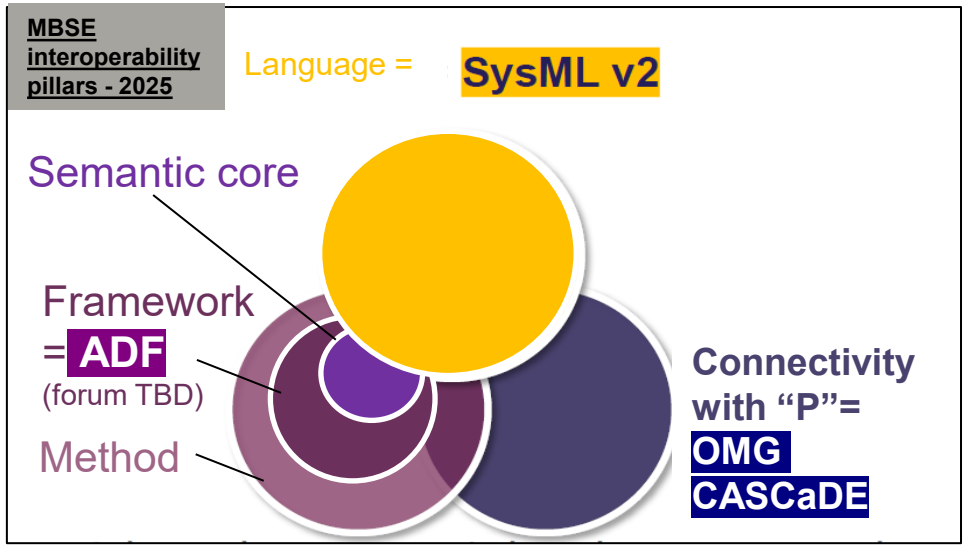
   solution → ADF for "*insert here your design process*".

2. Missing the connectivity with simulation models used for V&V, and with the physical models

   solution → Digital Data Package defined by CASCaDE

SysML V2: need to standardize the Framework

Framework= **ADF**



- Framework: concepts, assumptions, viewpoints, foundation for the architecture development.
- Method: specific practices and procedures to guide and constraint the architecture development

+ abstract

Semantic core/basics examples:
- Overall Semantic Modelling for System Engineering OSMOSE
- OMG CASCaDE "MBSE domain" subontology

ADF: This is an Industry Need!

Framework (ADF) for Technical Systems:
- MagicGrid (Cameo only) and
- Harmony SE (Rhapsody only)
- GfSE SAF

Framework (ADF) examples for Enterprise Architecture:
- UAF
- DoDAF

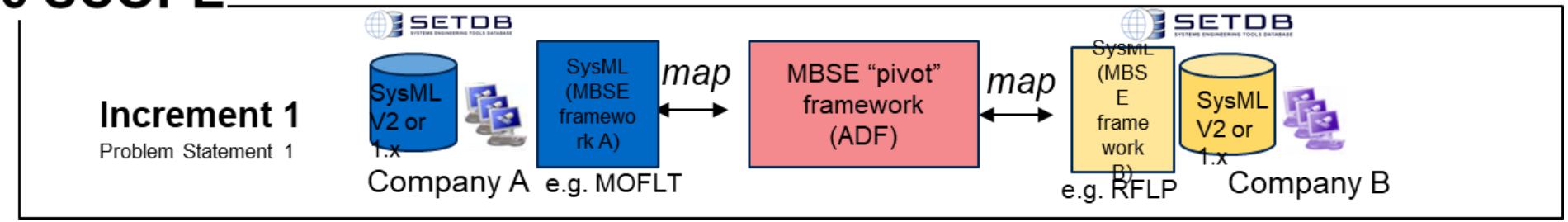
Method examples:
- SYSMOD (also with tool plugins),
- INCOSE Object Oriented Systems Engineering Method (OOSEM)

+ concrete

Specifically, for Aerospace: An Architecture Framework for Development Assurance

Framework= **ADF**

2026 SCOPE



Collaborators list (in DRAFT):

NEW S-19 DIGITAL ENGINEERING COMMITTEE

SAE INTERNATIONAL®

MBSE WORKING GROUP

PDES, Inc.®
Connecting the Digital Enterprise

CASCaDE

OMG Object Management Group®

ISO

Architecture Description Framework: ADF

Framework= **ADF**

The Three Pillars of ISO 42010		
Pillar	**Description**	**Example**
Stakeholder	An "individual or organization... having a right, share, claim, or interest in a system"	Manufacturing Process Planner or Quality Assurance Engineer
Concern	A "matter of interest or importance to a **stakeholder**"	What is the required sequence of assembly for this sub-system? What materials are specified? Are there any special handling requirements?
Architecture Viewpoint	A "specification of the conventions for constructing and using a view"	A "Manufacturing Process Viewpoint" would formally specify that any conforming view must contain the logical product structure, all associated Product and Manufacturing Information (PMI), and material specifications.

CASCaDE Project at OMG: connecting SysML with the Physical

Connectivity with "P"= OMG CASCaDE

CASCaDE Funding

GfSE · prostep ivip · VDA · PDES, Inc. Connecting the Digital Enterprise

CASCaDE Project Scope

- WP0 Leadership & Coordination
- WP1 Metamodel (Syntax)
- WP2 Ontology (Semantics)
- WP3 Operations, OpenAPI
- WP4 Transformations
- WP5 Requirements Verification
- WP6 Normative Specification
- WP7 MBSE Integration Forum

Digital Specification
Normative Specification

OMG Standards Development Organization

Specifications
Use-Cases
Best-Practice
Recommendations

Specifications
Feedback

Specifications
Feedback

Users & Workflow Forums

Project lead: BOEING

Digital Data Package project, LOTAR-PDES MBSE, INCOSE

- Business Process & Use-Cases
- Tests & Data
- Industry PoCs

Test Cases ↑ ↓ Test Data

Open Source Community

Currently looking for partners

- Reference Implementation
- Verification & Validation
- Software Qualification

Implementation Resources ↑ ↓ Source Code

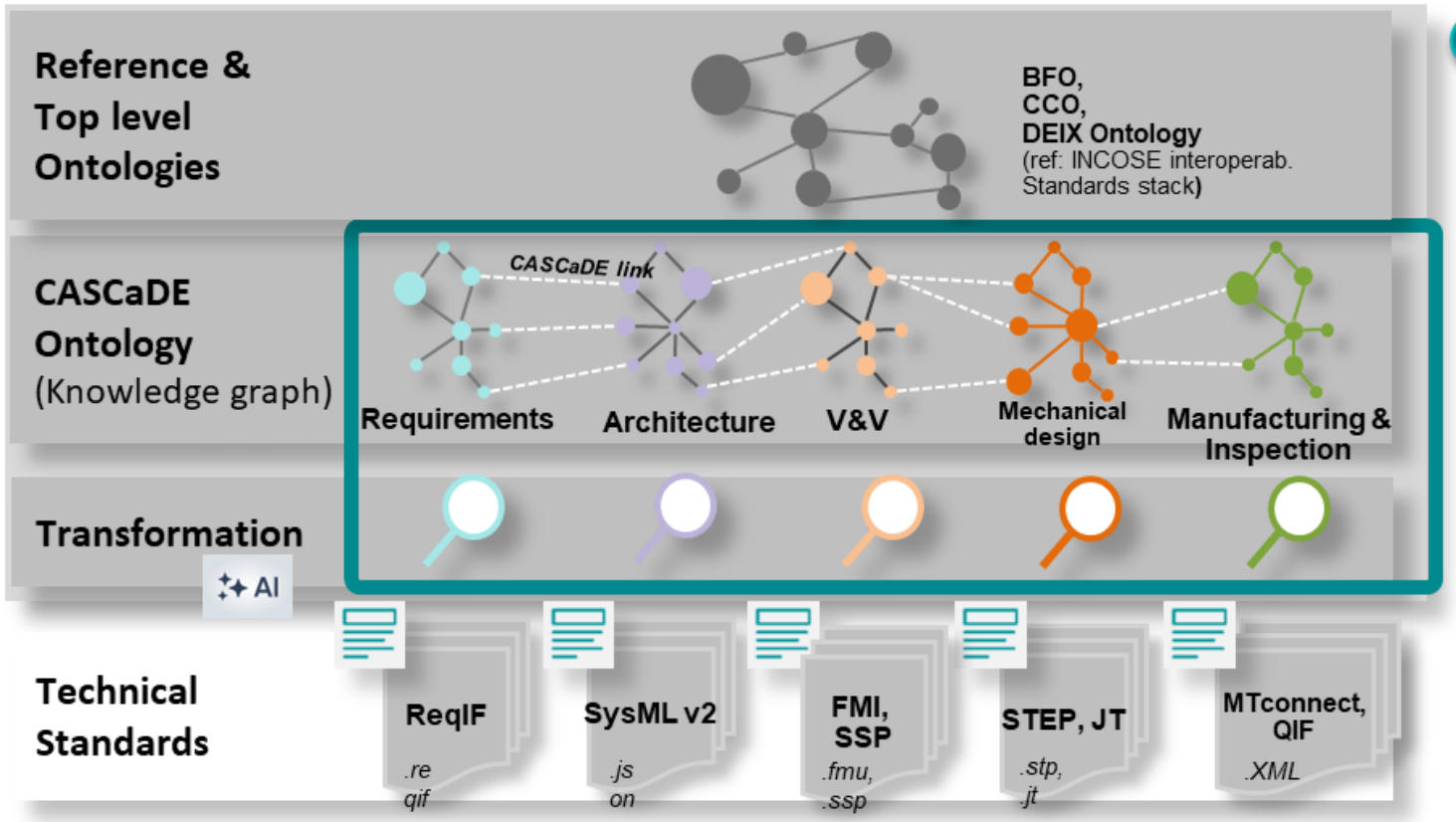
Software Vendors

PROSTEP · ANARK · ELYSIUM · CONWEAVER · […]

- Commercial Implementation
- Extensions
- Industry PoCs

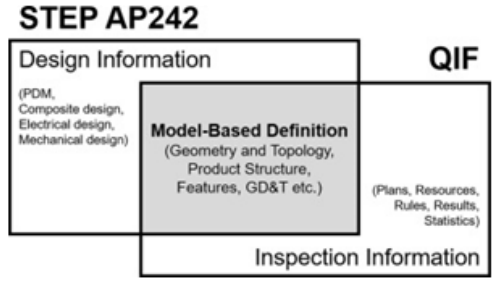
How does CASCaDE enable connectivity: Standards Based Digital Thread

Connectivity with "P"= OMG CASCaDE



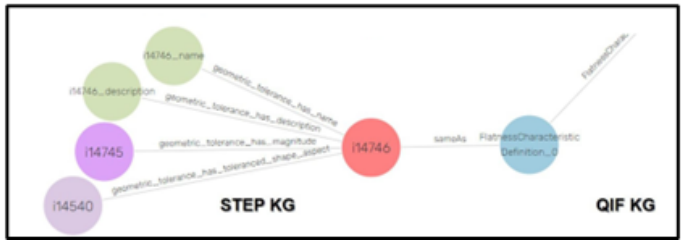
1 Expose common entities in a common knowledge base (MoSSEC concept of "*key value types*"). e.g.: AP242 - QIF intersection (Ref. here)

Common Knowledge Base



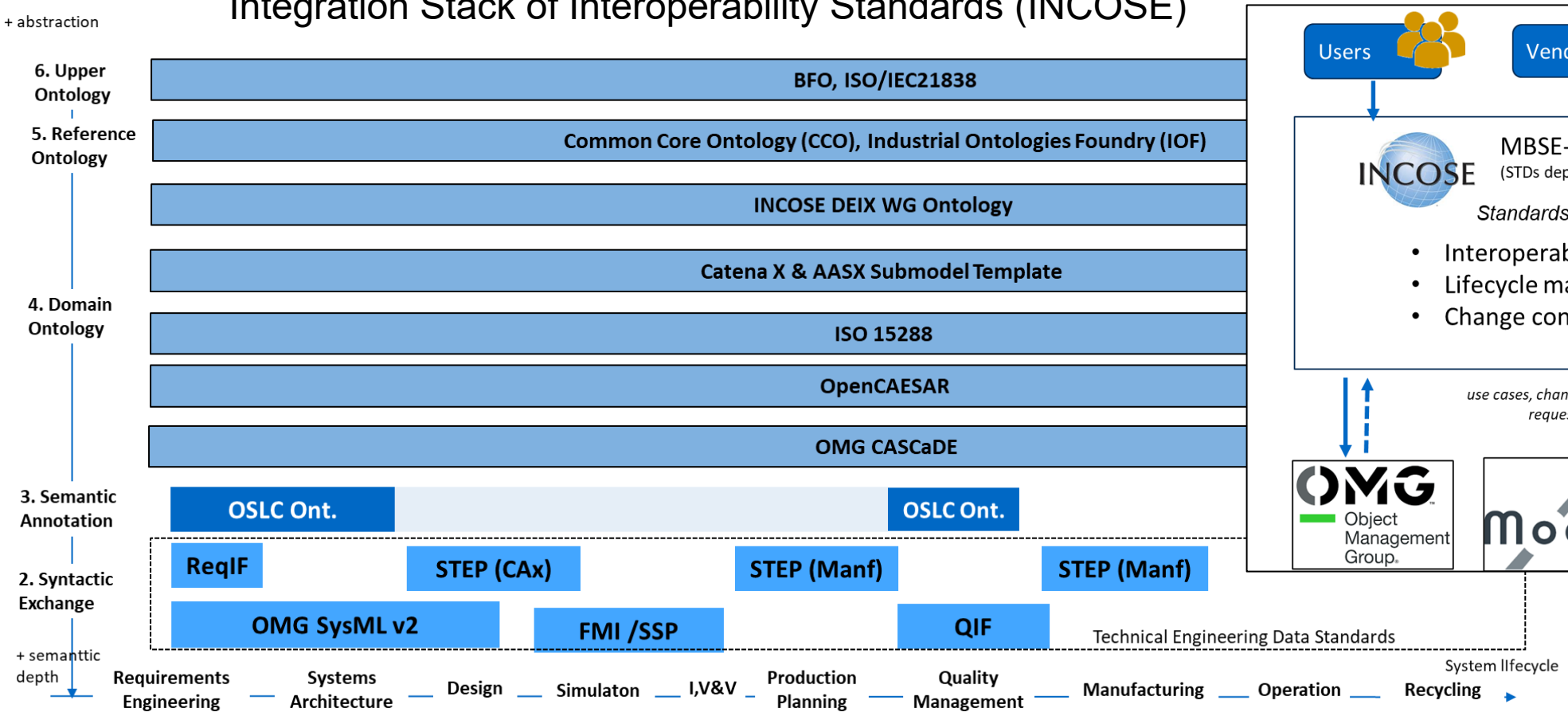
2 Define syntactic and semantic rules to constraint allowed relationships

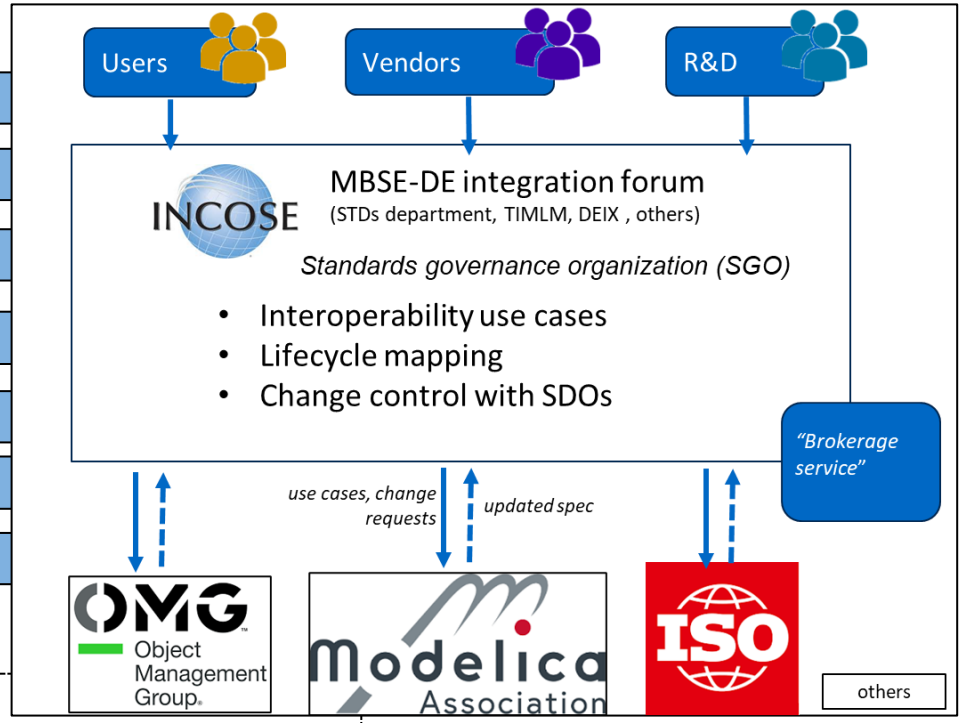
3 Identify, manage, and query "**CASCaDE links**" (link from a model entity in domain/format A to a model entity in format/domain B)



MBSE-DE integration forum, in plan in INCOSE

Integration Stack of Interoperability Standards (INCOSE)





Please participate:

1. Provide **<u>your</u>** priorities and needs for data standards in Digital Engineering.

2. We will provide the result back to you via email

Scan Me

Lunch,
Back at 12:45PM

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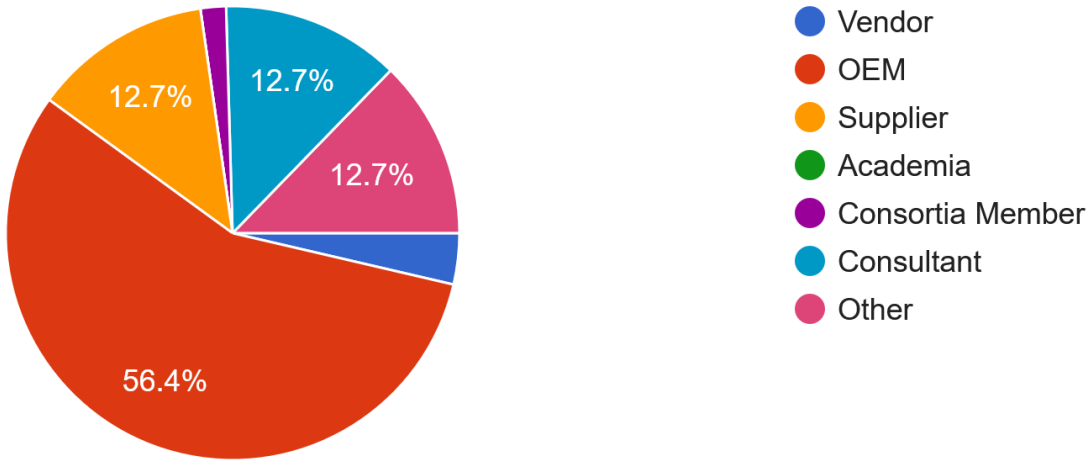
September 23rd, 2025, Phoenix, AZ

Survey – Results

How would you best describe your role in the Industry?

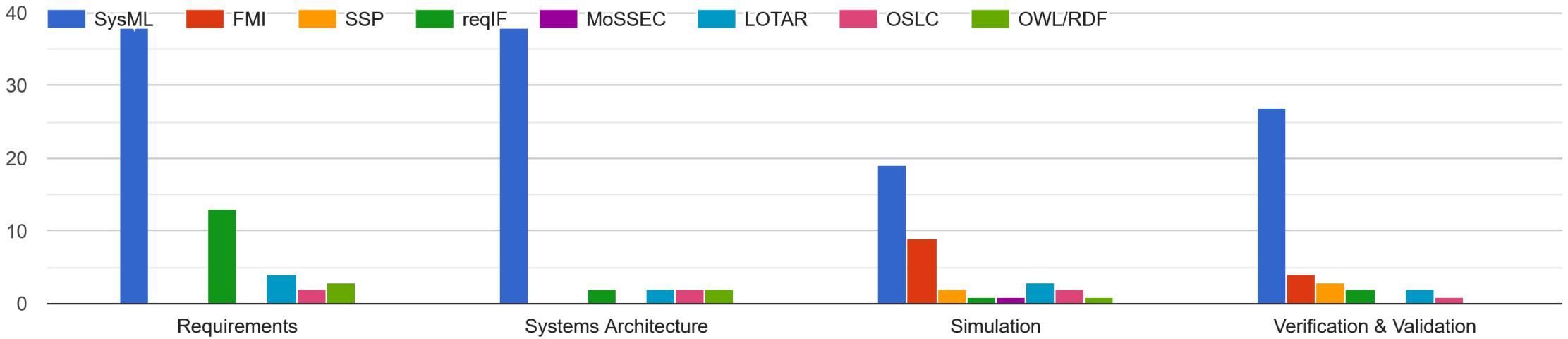
55 responses

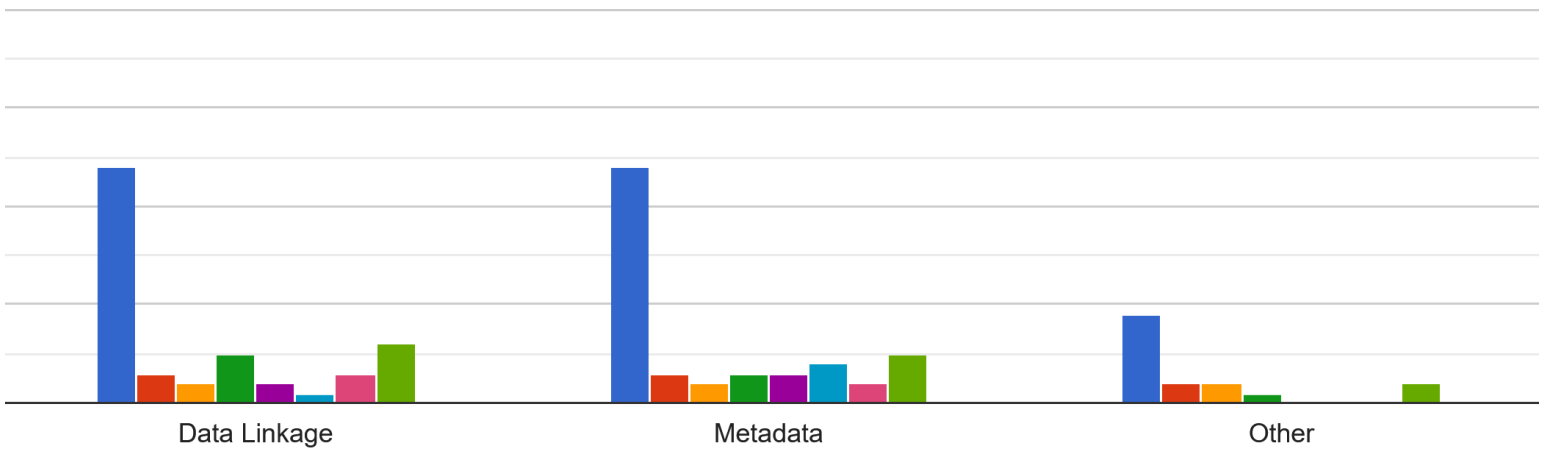


56 responses, 100+ attendees.

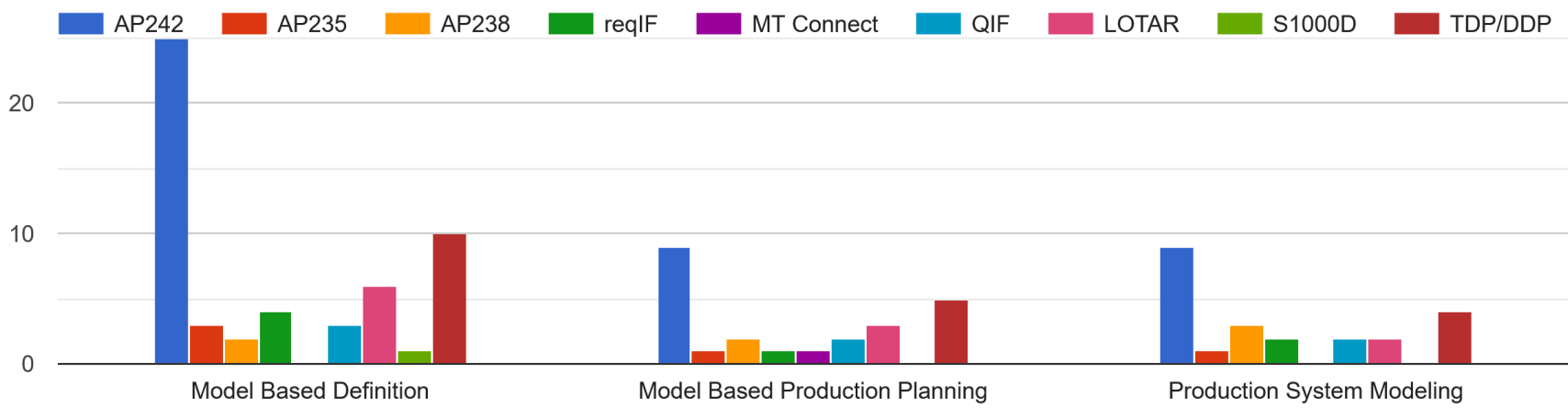
Northrop Grumman
The Boeing Company
Airbus
RTX
Gulfstream
General Dynamics
Mitsubishi Heavy Industries
JAXA
Parker
Bell
AIR FORCE Research lab
Dassault Systèmes
NEC
Beta Technologies
Afnet services
INDUSTRIAL-X
SAE
Razorleaf
KBR
SBE vision
Mastercam

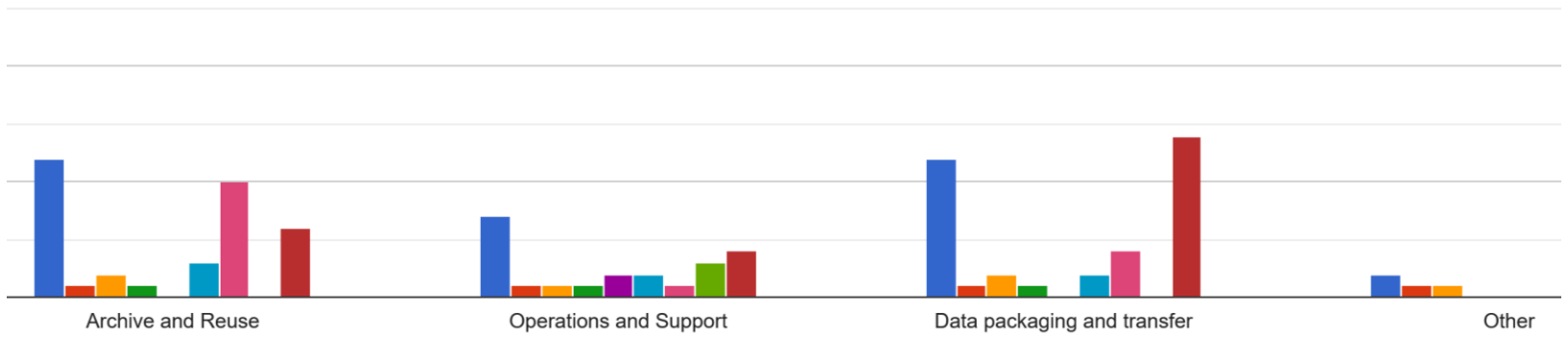
MBSE Standards usage and planned usage – Results





Digital Manufacturing Standards usage and planned usage - Results





1

STEP AP242

2

MIL-STD-31000B

Digital Data Package

3

LOTAR

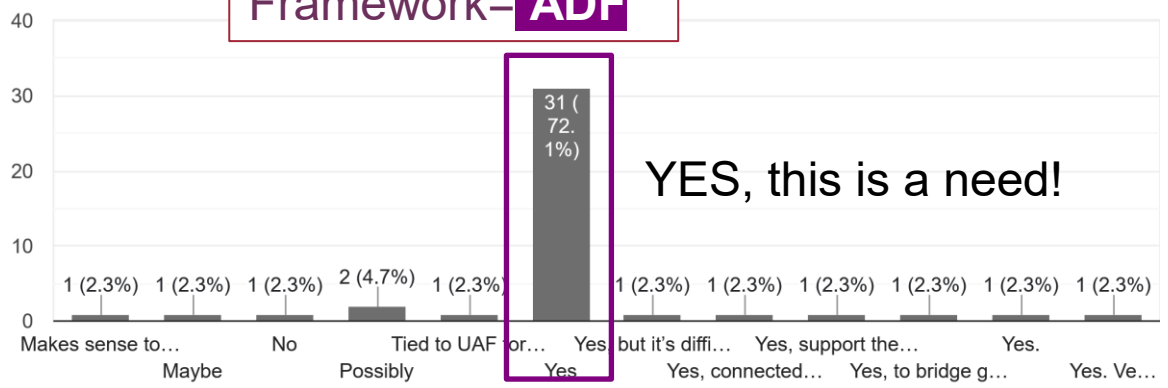
QIF

GPDIS Data Standards - Needs

[Potential GAP] Would you support the standardization of an MBSE system Architecture Description Framework (ADF) that is complementary to the SysML language?

43 responses

Framework= **ADF**

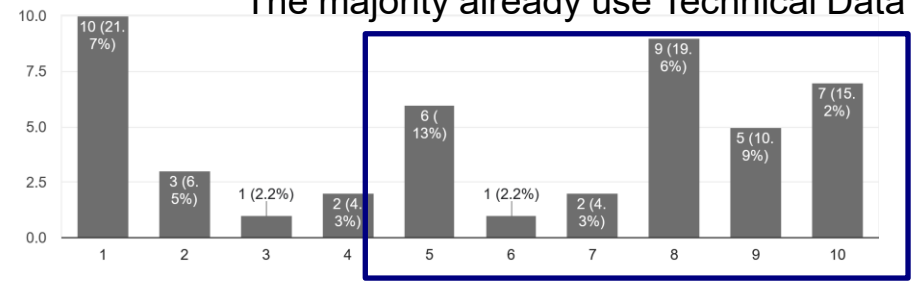


YES, this is a need!

What is the current implementation status and usage of Technical Data Package (TDP) at your current company

46 responses

The majority already use Technical Data Package

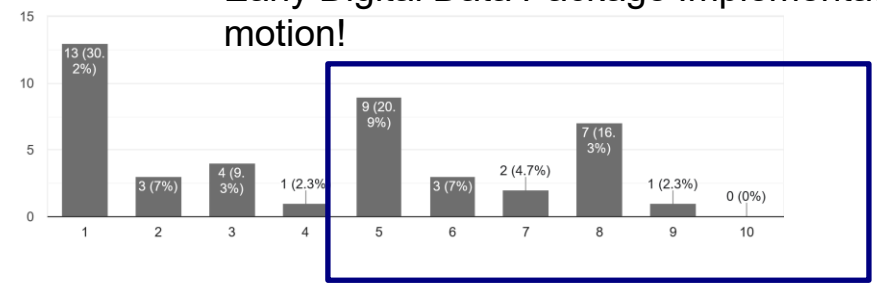


Connectivity with "P"= **OMG CASCaDE**

What is the current implementation status and usage of Digital Data Package (DDP) at your current company

43 responses

Early Digital Data Package Implementations in motion!



GPDIS Data Standards – Needs cont.

What other standards do you use and **what MBSE and Digital manufacturing standardization gaps** and needs do you identify?

1. SysML, UAF, DoDAF, UML
2. Large model and federation approaches
3. **STEP AP 242/239**
4. Maturity models for stages of the product lifecycle
5. **Data relationships**
6. SysML v1 & Step. Integration STDs between MBSE models of different context/perspectives. MBSE data exchange and **linkage to physical** definition.
7. MIL-STD-3100 specifically markings and data packaging
8. **ADF** and **CASCaDE**, also Model Based Acquisition
9. Ontology backed interoperability
10. STEP ap242, 209, 245, 210, 239
11. MBSE standards need to **interoperate with downstream environments** and there's a big gap between engineering and manufacturing but beyond that to servicing and operations of a product. There really is no linkage from the engineering definition to the operational definition of a product like an aircraft.
12. Archimate, too many gaps/needs to identify.
13. **ADF**, **SYSML V1/2 MBSE AND MANUFACT GAP**
14. Need common infrastructure for SCRM (Supply Chain Risk Management).
15. **Agents to negotiate model interoperability** on case-by-case basis. Patterns for negotiation of models. Patterns for maturing within each lifecycle stage
16. Gaps with Composite design & CNC programming stds
17. I use SysML for production system modeling
18. IDO
19. QIF

GPDIS Workshop topic Prioritization

			Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6	Topic 7	Topic 8	Topic 9	Topic 10
		TOTAL VOTES	273	352	287	316	301	247	309	238	306	356
			TOP 8	TOP 2	TOP7	TOP 3	TOP6	TOP 9	TOP 4	TOP 10	TOP 5	TOP1

TOP 1	**Topic 10**	**Governing the Digital Thread: Roles, Responsibilities, and Change Management** To focus on the crucial human and organizational aspects of implementing and sustaining a collaborative, model-based environment. This session will explore the new roles, skills, and change management strategies required for a successful transition.
TOP 2	**Topic 2**	**Architecting for Interoperability: Aligning the Digital Thread with Business Capabilities** To discuss how to apply Enterprise Architecture (EA) principles and Business Capability Mapping to create a strategic, standards-based roadmap for developing an interoperable digital thread that is directly aligned with business goals.
TOP 3	**Topic 4**	**Securing the Digital Thread: IP Protection and Trust in Multi-Party Collaboration** To address the critical non-technical barriers to inter-company collaboration by exploring strategies and technologies for protecting intellectual property (IP) while sharing detailed models with partners and suppliers.

TOPIC Recommendations:

1. Teaching the difference between language, framework, tool, process, and methods.
2. Investing in MBSE education for all engineers
3. Tool vendor implementation of standards
4. Model-based configuration and change mgmt to include key roles, model type identification and hierarchies
5. Leveraging AI for MBSE in digital thread of manufacturing
6. Adoption and getting buy in from users

Reach out and participate!

PDES, Inc.®
Connecting the Digital Enterprise

juan.c.mendo@boeing.com

kyle.hall@airbus.com

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