Boeing Supplier Engagement Framework, and OMG Collaborative Artifact Spec. Context and Data Exchange

Juan Carlos Mendo

- **MBSE Technical Lead, BR&T-Europe**

September 24th 2025, Phoenix AZ

Note 1: Presentation released under RROI726291

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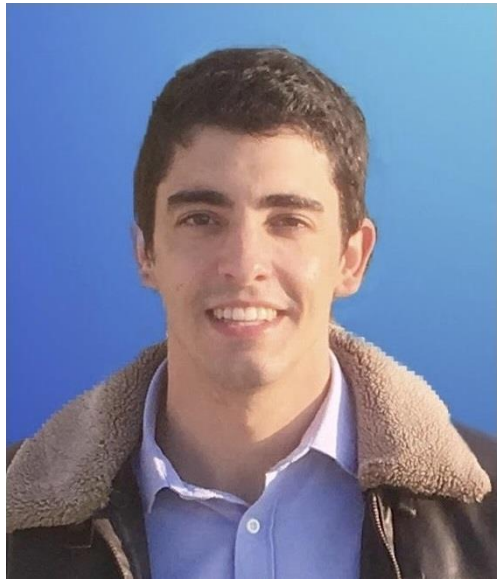
Juan Carlos Mendo



I am a Model-Based Systems Engineering (MBSE) technical lead at Boeing Research & Technology-Europe.

I have Aerospace and Mechanical Engineering background

I am a Product Owner leading several scrum teams focusing on *Digital Thread infrastructure* implementation, *Digital Collaboration with suppliers*, and the adoption of *Data Interoperability Standards*. My focus is the transition of these new digital methods and tools to Boeing commercial and defense Business Units.

I act as Systems Engineering team leader for PDES.INC. He leads the LOTAR EN/NAS9300 standard for MBSE. He is the subject matter expert for STEP AP243, “MoSSEC”.

I chair the Collaborative artifact spec OMG project. He currently supports INCOSE as TIMLM WG co-chair.

Learn more: https://www.linkedin.com/in/jcmendo/

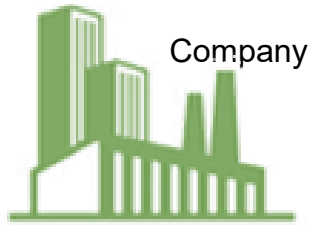
Agenda

1. Problem Statement & Strategy for Standardizing Digital Collaboration
2. Boeing's Supplier Engagement Framework
3. Standards-based Digital Thread: OMG Collaborative Artifact Spec. and the Digital Data Package
4. MBSE-iF
5. Call for action.

Problem statement: Cross-domain Digital Collaboration

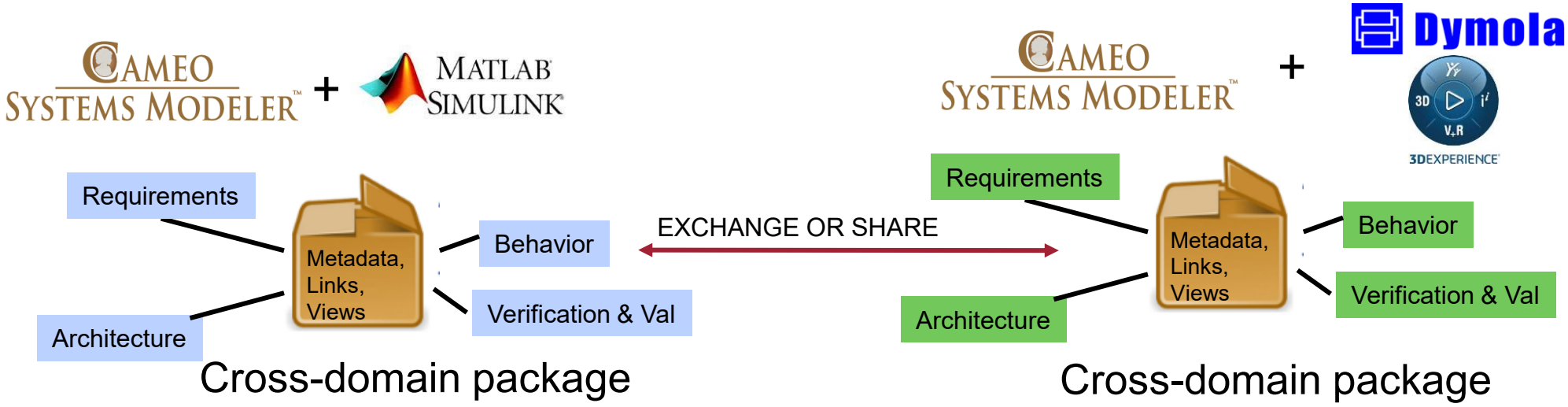
Company A: e.g. OEM, customer

COLLABORATE?



Company B: e.g. Supplier, contractor

The Supplier has delivered several control and multiphysics behavior models in .FMU format, used to verify and validate the supplied system, however, **metadata is missing** (co-simulation details, the design intent…) and **links to the architecture affected are unknown**. Rework and cost assertions occur as a result.



Bottom line: Need **connectivity of the shared models**, and good **metadata** documentation

Digital Collaboration Strategy

Breakdown the problem in "**Use Cases**" and define **Requirements**

Criteria/dimensions:

- User journeys
- Level of engagement OEM-Supplier
- Lifecycle / collaboration stage
- Product data domain

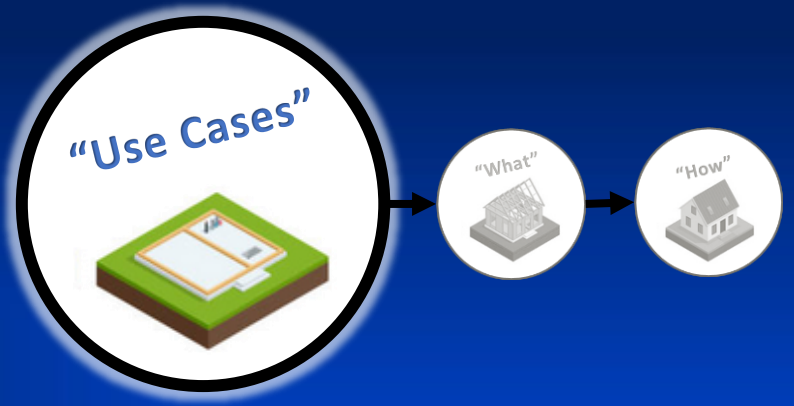
Define "**What**" data to exchange or collaborate on

Recognize authoritative sources and focus on semantic integration (e.g. graph technologies) of an existing, federated Standard set. Digital Data Package

Define "**How**" to exchange or collaborate

Including the packaging or sharing process, the model development plans and reference models.

Iterate



Boeing's MBE Supplier Engagement Framework

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https://www.boeingsuppliers.com/MBE_Supplier_Engagement_Framework.html

Boeing’s MBE Supplier Engagement Framework

Practical roadmap to Digital Collaboration Success

Collaboration Framework Setup. — Journey 1 Setup

Collaboratively manage product Requirements. — Journey 2 Requirements

Collaborative Architecture Design Co-Development. — Journey 3 Architecture

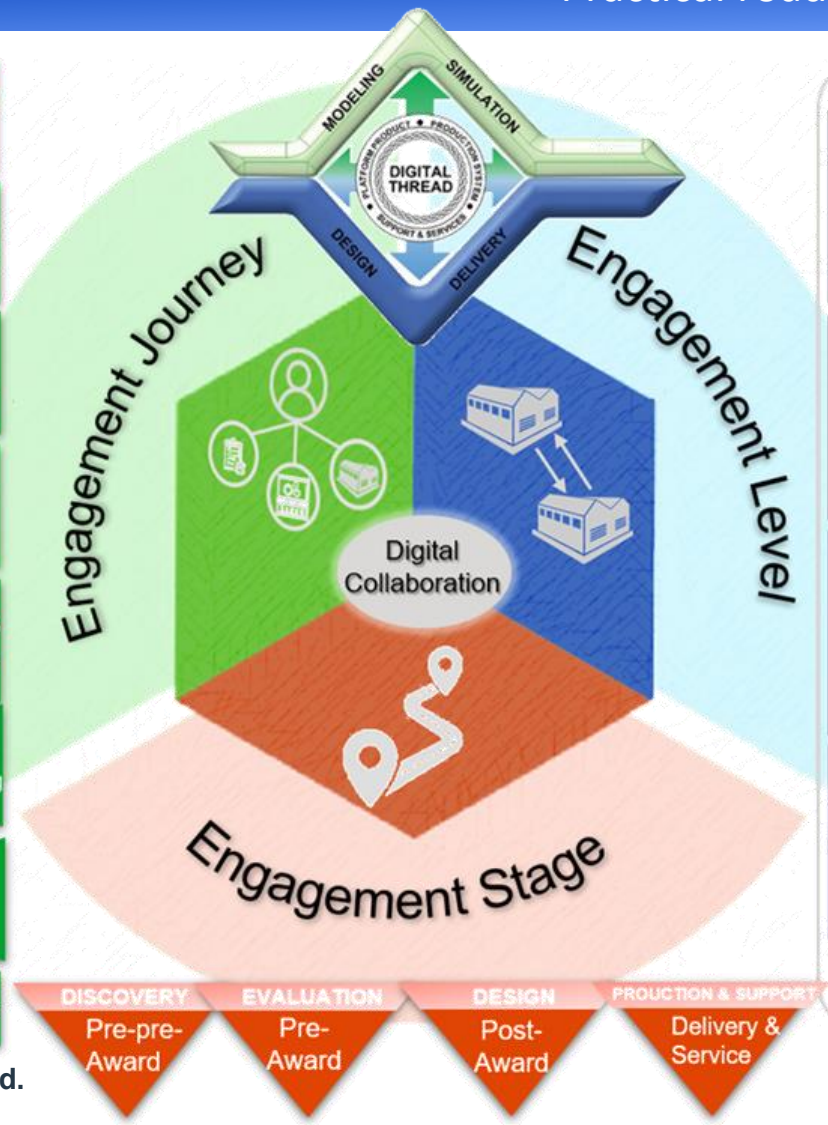
Collaborative Co-Simulation & early Requirements Validation. — Journey 4 Co-sim

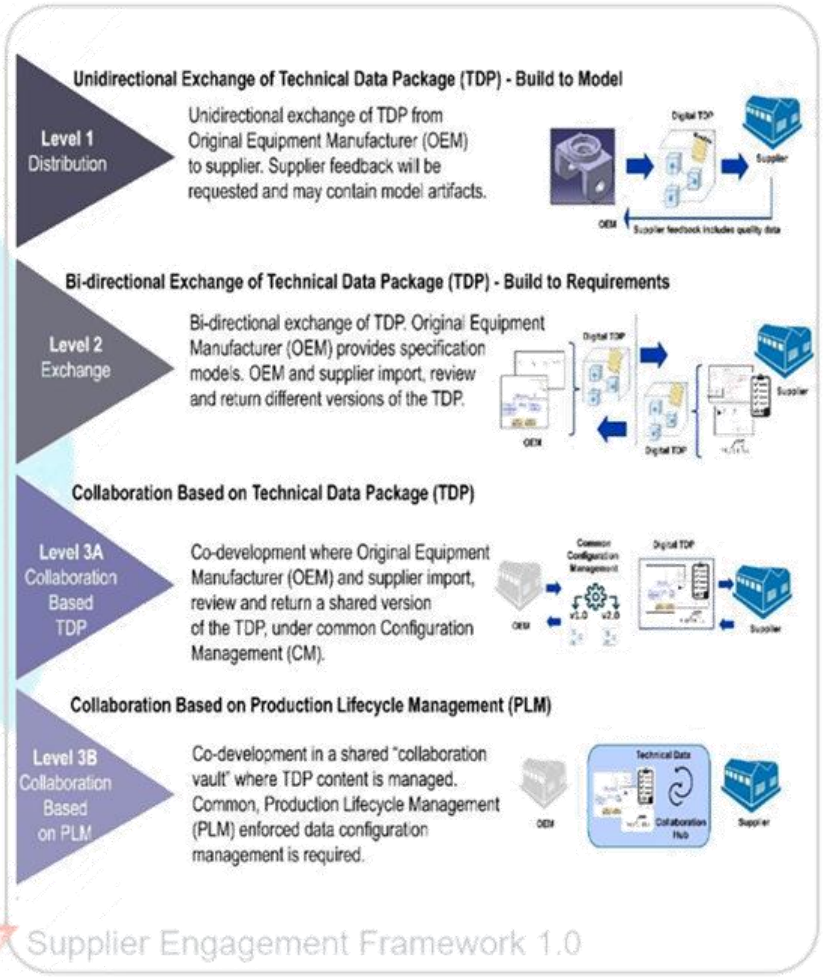
Collaborative 3DMBD Design Co-Development. — Journey 5 3D Design

Collaborative Manufacturing Engineering. — Journey 6 Manufacturing

Collaborative Digital APQP Deployment — Journey 7 D-APQP

Not comprehensive* — Others



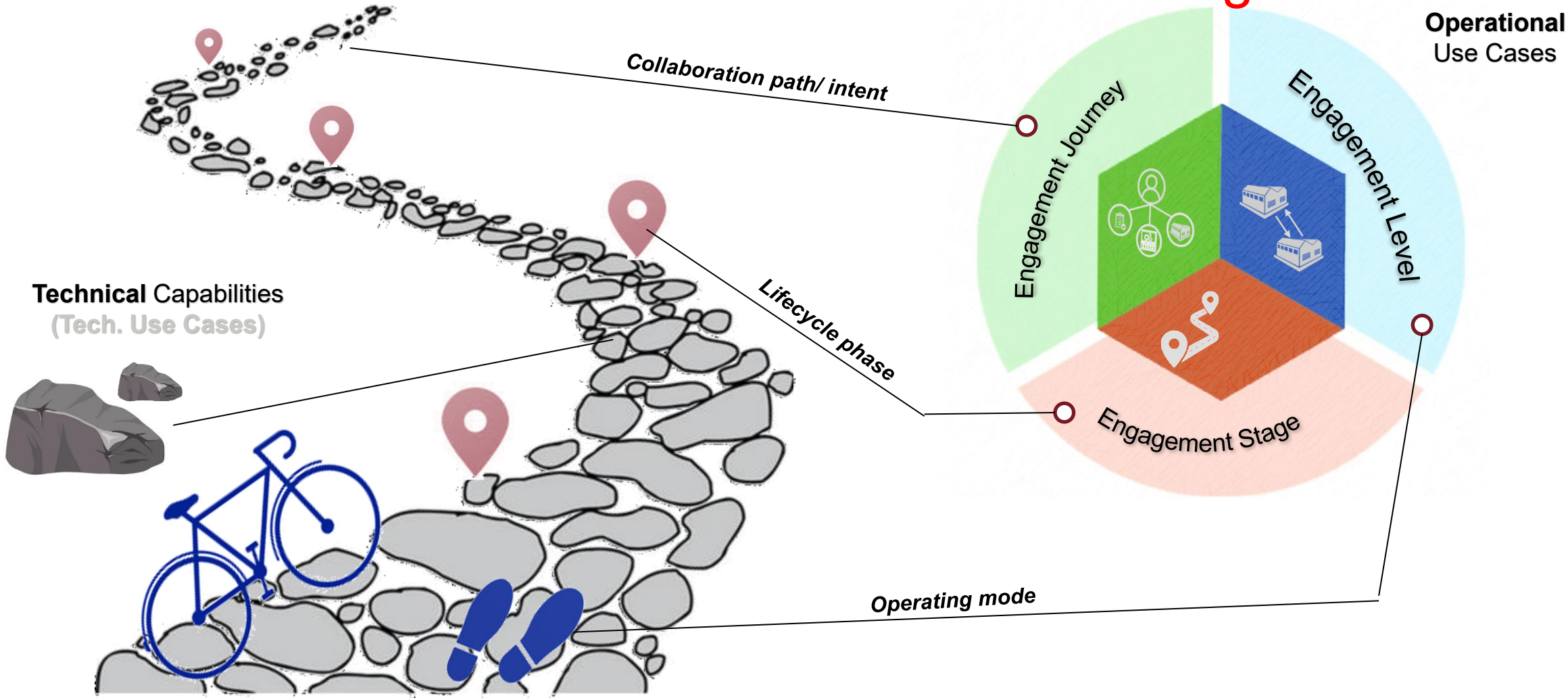


POC: juan.c.mendo@boeing.com

Slide released under **24-182624-ETT RROI**

Supplier Engagement Framework V2.0: Usage

Animate this slide to show better the Usage



OMG Collaborative Artifact

Spec. Standard

GfSE prostep IVIP VDA PDES, Inc. Connecting the Digital Enterprise OMG Object Management Group.

Standard Website

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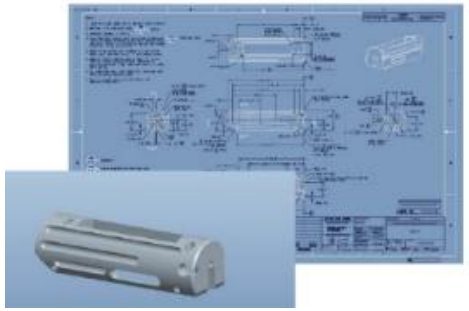
Digital Data Package as evolution of the "Technical Data Package"

	Technical Data Package (TDP)	**"Pathfinding TDP into Digital Engineering"**	**We are here** / **Digital Data Package (DDP) Collab Artifact Spec**	**Digital Data Partition & Full Development Assurance (Future)**
	Early 2000s	***2020 - 2024***	**2024-2027 (Collab Artifact Spec)**	***2030+***
▪ **DATA**	MIL31000 (Defense) AP232 (Commercial)	Includes requirements, architecture, V&V artifacts. No common schema/ontology	Industry standard schema Supports main Industry Data standards for MBSE, and PLM	Industry standard schema supporting V&V, Safety, Traceability, CM and other key capabilities for dev. assurance
▪ **PROCESS**	Limited to 2D and 3D models and schematics	Packaging independent models. Manual linkages Manual metadata and views	Build standard, machine readable "DDP" package (EL-3A) Model and entity linkages Model metadata and views	Build/define standard, integrated package or PLM partition
▪ **TOOL**		Do not interpret models Limited metadata Limited change control Limited views	Can interpret model content ISO AP243 metadata Improved change control Improved views	Synced PLM systems (EL-3B)



Collaborative artifact spec. Project Structure (2025)

Funding

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

Collaborative artifact spec 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

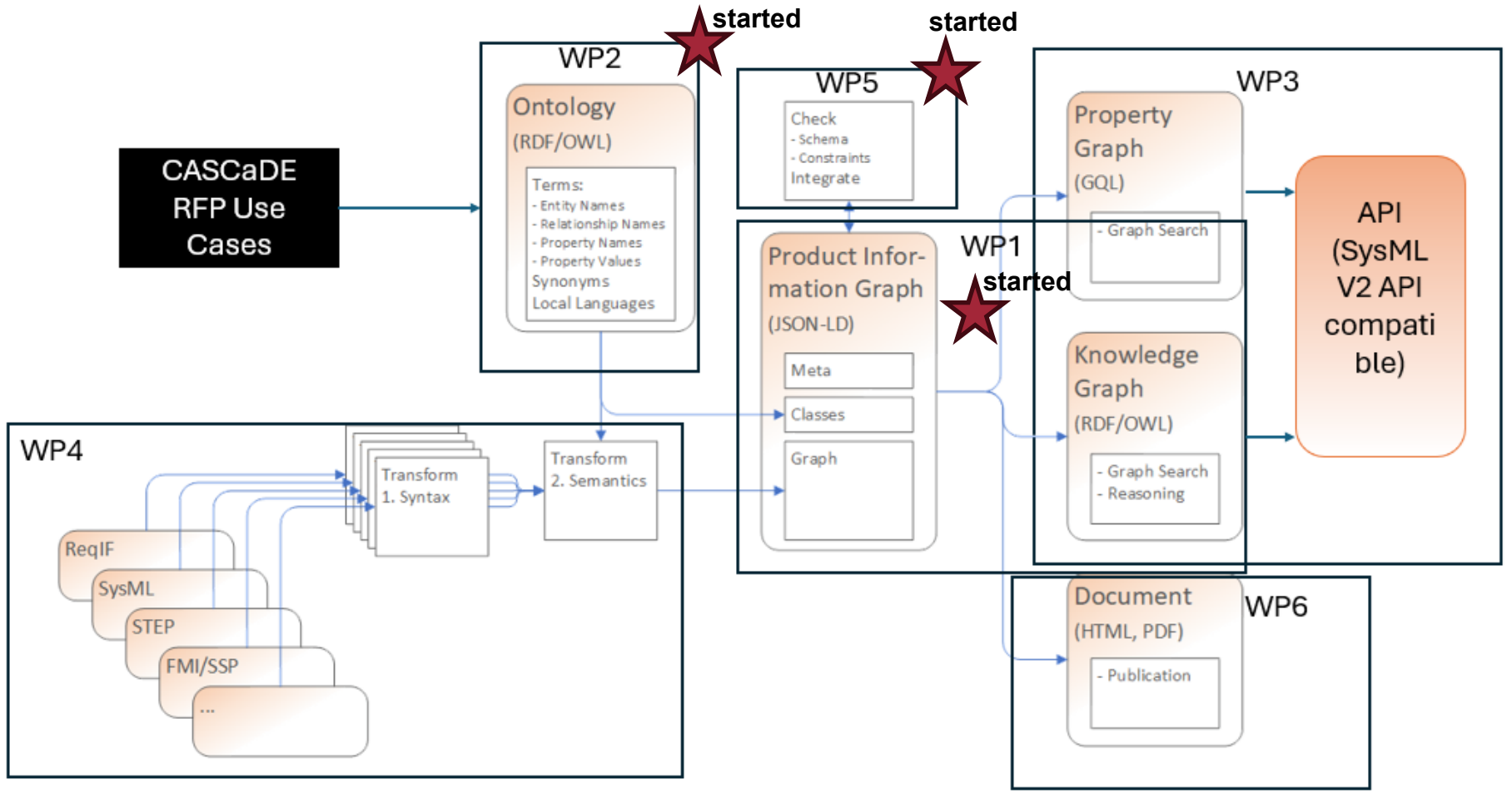
Software Vendors

PROSTEP · ANARK · ELYSIUM · CONWEAVER · [...]

- Commercial Implementation
- Extensions
- Industry PoCs

11

Collaborative artifact spec Work-Package integration



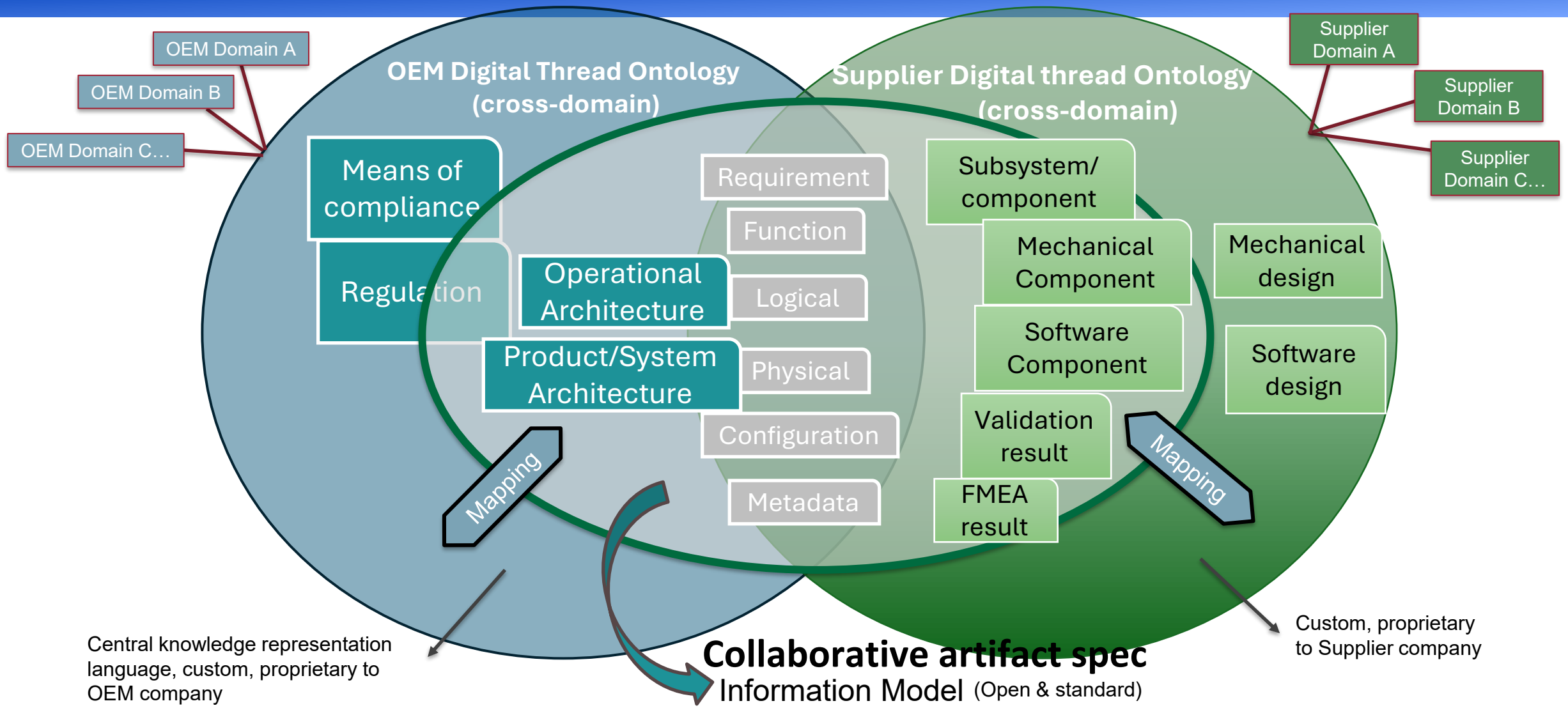
[WP1: Latest metamodel]

[WP2: Latest Ontology]

[WP5: Validation Process]

12

Collaborative artifact spec as interface between Digital Threads

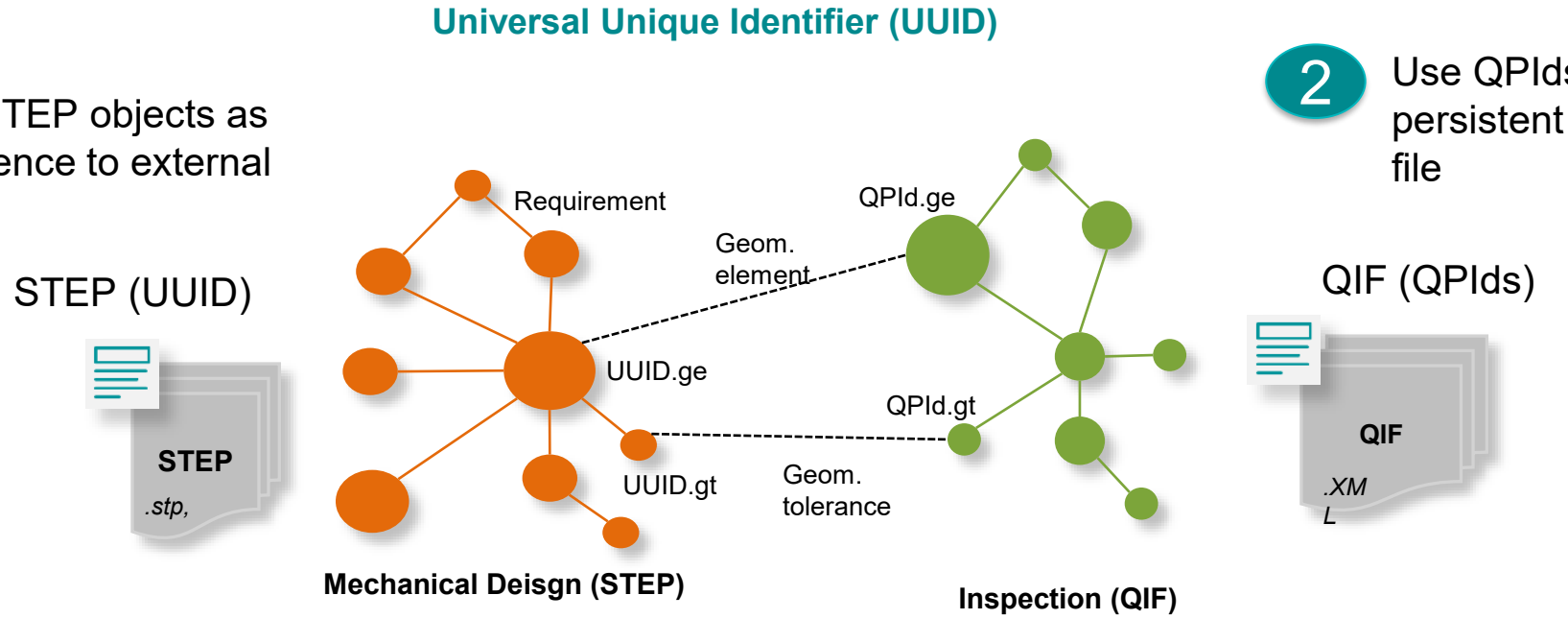


Standards-based Digital Thread

UUID approach (AP242 & QIF) vs Common Knowledge graph (DDP/Collaborative artifact spec)

1

Assign UUID to STEP objects as a persistent reference to external file



2

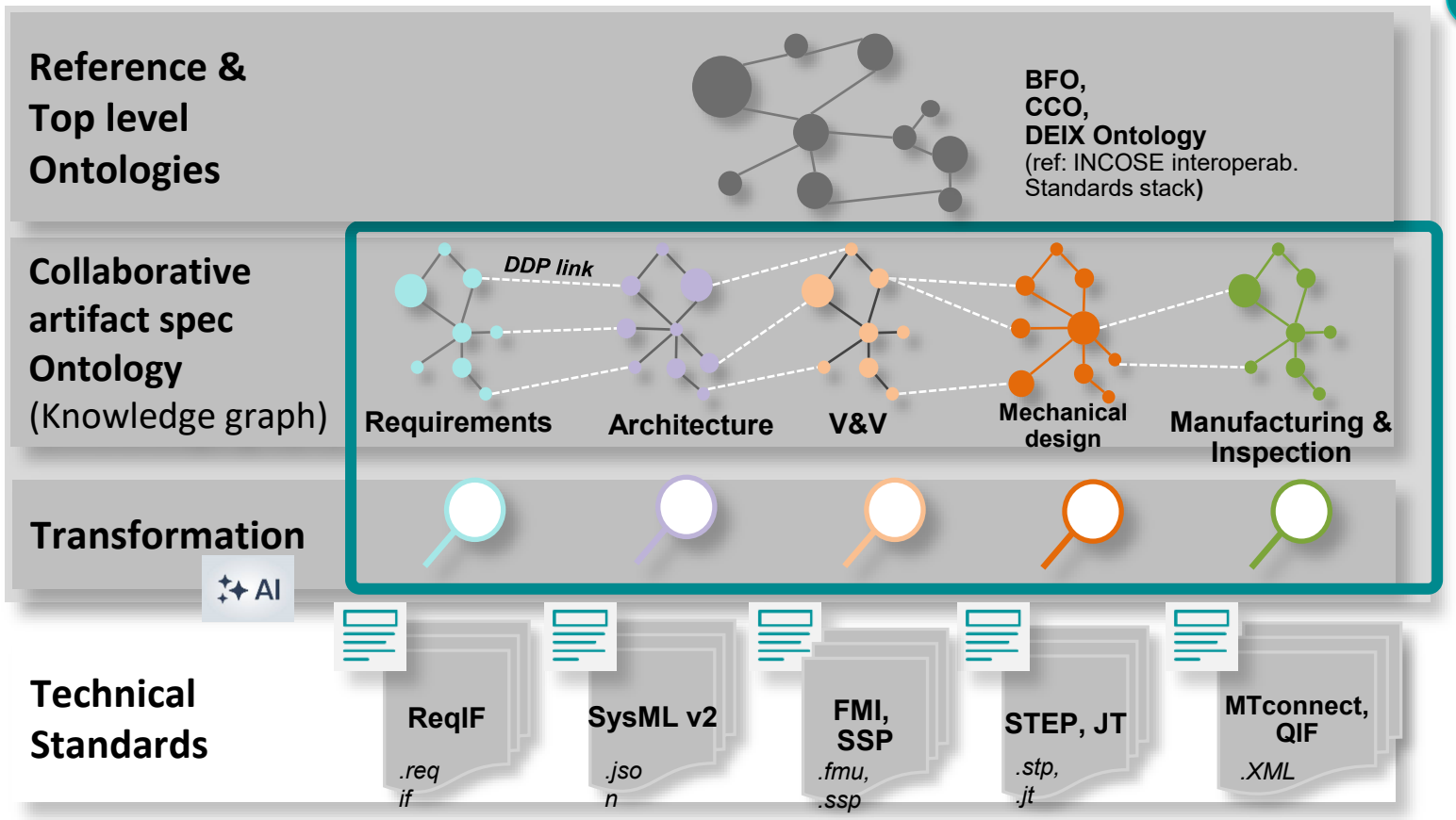
Use QPIds to QIF Objects as a persistent reference to external file

3

All external sources of product data must consistently implement UUIDs in the same way, to identify and manage links correctly

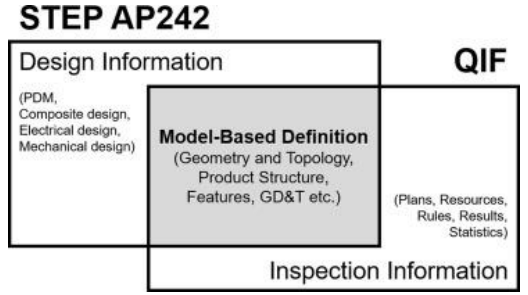
Standards-based Digital Thread

UUID approach (AP242 & QIF) vs Common Knowledge graph (DDP/Collaborative artifact spec)



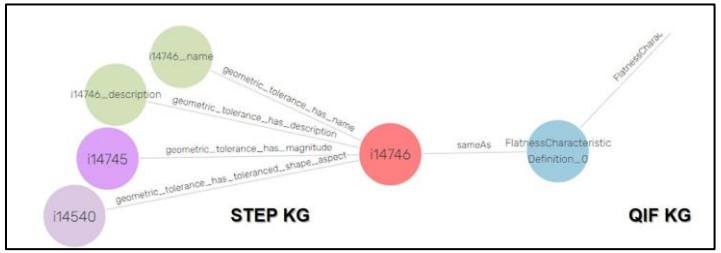
Common Knowledge Base

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



2 Define syntactic and semantic rules to constraint allowed relationships

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



e.g.: geometric tolerance linkage AP242 and QIF (Ref. here)

Standards-based Digital Thread: Conclusion & Recommendations

Conclusions:

1. Current federated data landscape with data standards developed for different domains by different SDOs (ISO, OMG, Modelica, SAE…)

2. The use of UUID is mature and recommended in certain use cases such as “Design to manufacturing release, and “Shared design collaboration” (reference: NIST AMS 300-12)

3. UUID approach however is not scalable since a unique a common way of identifying objects would be needed across all the data standards, and SDOs involved in the PLM cycle.
   - Ongoing effort aligning AP242 and QIF implementation for UUID, what about the other domains??

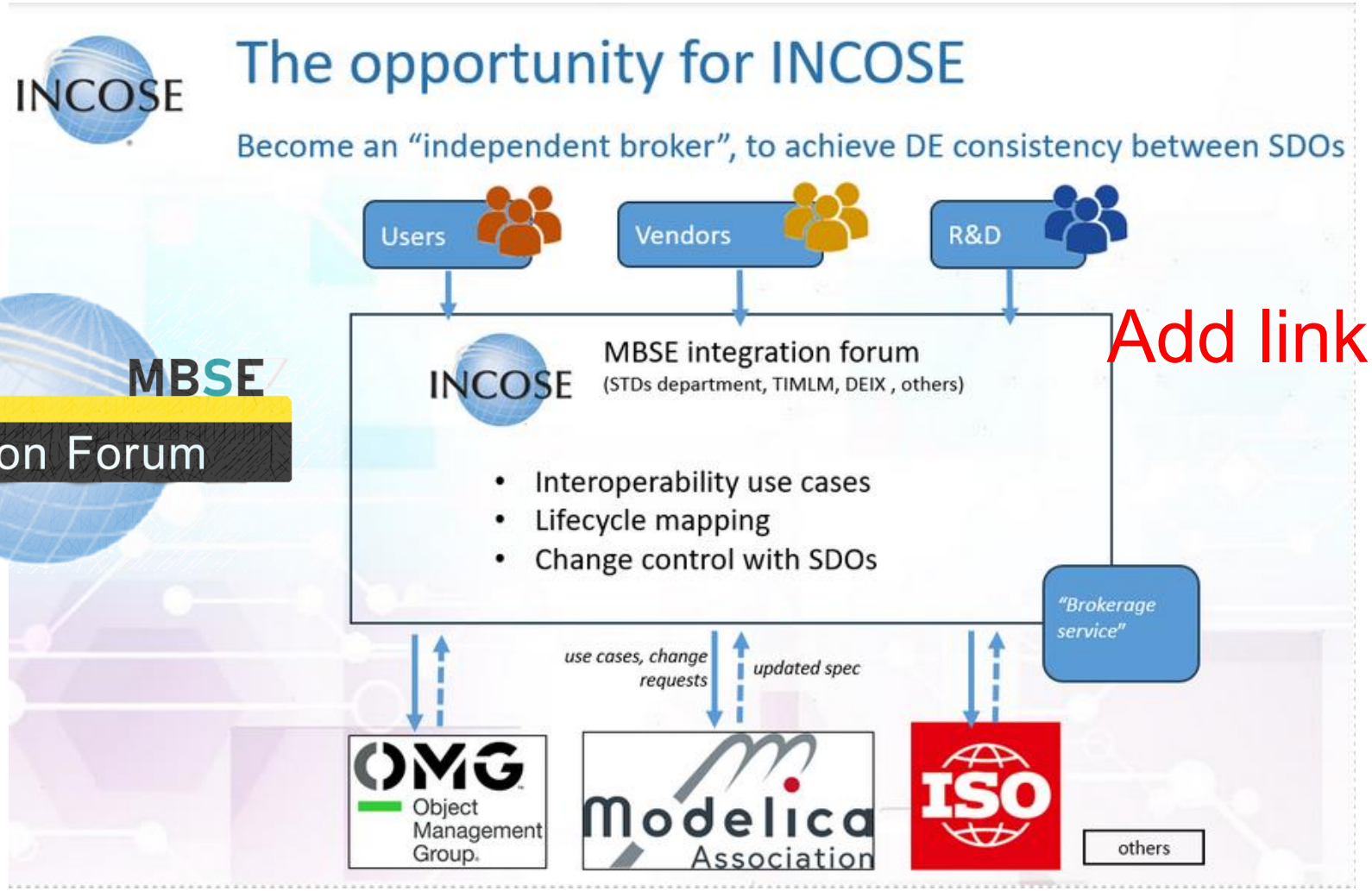
4. The approach for using a *common*, and *layered* knowledge base is:
   - Scalable across domains and SODs, as a single, common knowledge base is needed.
   - Easy for the end-user: Links can be identified, queried and managed in a central, DDP-based collaboration environment
   - Ready for AI and automation, that can speed up the development of new transformations to the central knowledge based

Recommendations:

1. For the Collaborative artifact spec, AP242 and QIF teams to further investigate what domain-specific use cases can continue to benefit from the UUID approach vs which cross-domain use cases should use the common knowledge base approach.

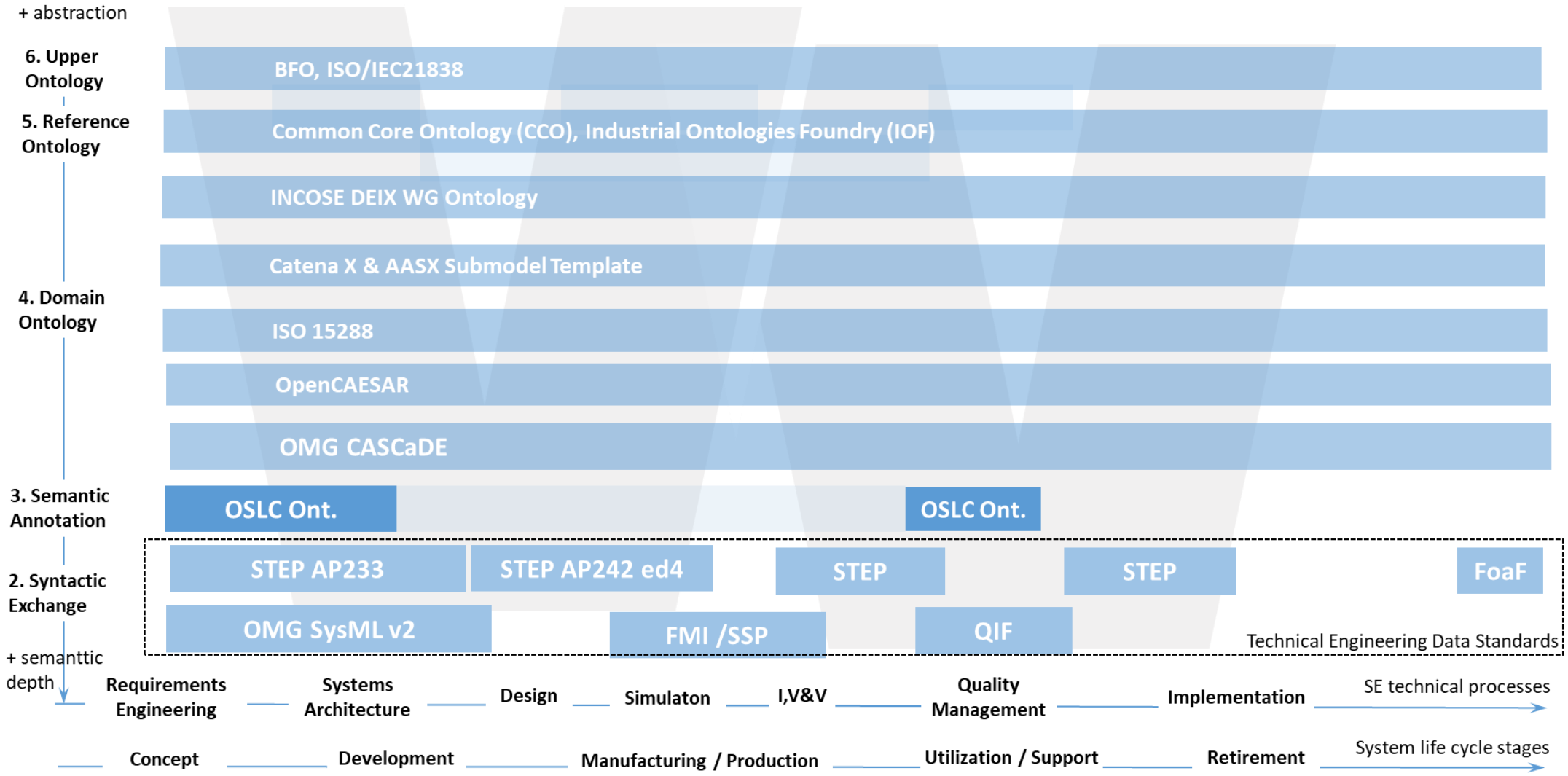
2. For the MBSE-integration forum (MBSE-iF) team in INCOSE, to establish a governance process for managing changes from the SODs that may affect the common knowledge base.

MBSE integration Forum (MBSE-if) – Proposed to INCOSE



Add link to insight article

INCOSE‘s Layared Interoperability Standards Stack



Call for action

1. **Collaborative artifact spec** gaining momentum and acceptance within the OMG
2. New companies in Aerospace + Automotive joining DDP and Collaborative artifact spec: **50+ members, 4 sponsoring associations.**
3. Connects to **35 industry standards**, including ReqIF, SysML v1/v2, STEP, JT, KBL/VEC, QIF, I++, AutomationML. Full product lifecycle semantics, to **enable collaboration from requirements to retirement.**
4. DDP (data instance) and Collaborative artifact spec (specification) tested in **5+ industry PoCs and 4 sucessful vendor implementations.**
5. The **MBSE-iF** focuses on defining MBSE User use cases and owning governance between SDOs

Join OMG Collaborative artifact spec (no fee)

- Uwe Kaufmann (uwe.kaufmann@modelalchemy.com)
- Juan Carlos Mendo (juan.c.mendo@boeing.com)

Join Digital Data Package

(Prostep ivip fee)

- Torsten Schmied (Torsten.Schmied@PROSTEP.com)
- Oliver Klaar (oliver.klaar@zf.com)

Join MBSE-iF (INCOSE members)

- John Nallon (John.Nallon@incose.net)
- Joe Marvin (Joe.Marvin@incose.net)

Thank you!

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