Supplier Engagement Framework - Version 2.0

&

Digital Data Package standardization - CASCaDE

Phoenix, AZ. September 24th, 2024

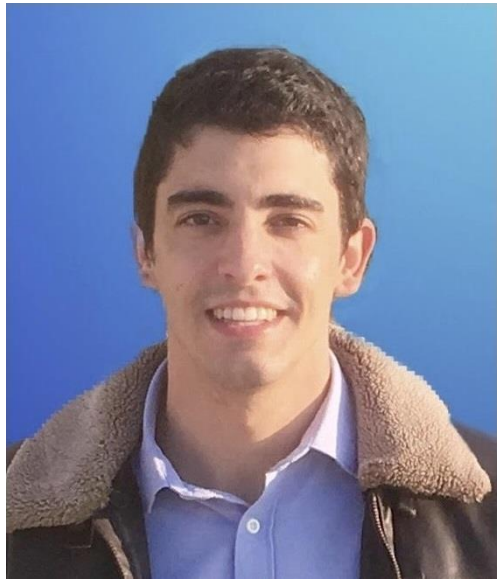
Juan Carlos Mendo, MBSE Tech Lead,

Marcus Richardson, Senior Interoperability Standards Engineer

GLOBAL PRODUCT DATA INTEROPERABILITY SUMMIT 2024

Presenters Bio

Juan Carlos Mendo



My role is 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 am the Systems Engineering tech. representative for Boeing for PDES, PROSTEP, LOTAR, several INCOSE WGs and the Modelica Association.

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

Agenda

1. What is MBSE Interoperability?
2. Boeing's Strategy for Standardizing Digital Collaboration
3. Boeing's Supplier Engagement Framework - *version V2.0*
4. Standardizing the new "Digital Data Package" – *OMG CASCaDE,*
5. MBSE OEM Reference Framework
6. Call for action!

Beyond SysML: the new MBSE “Technical Data Package”

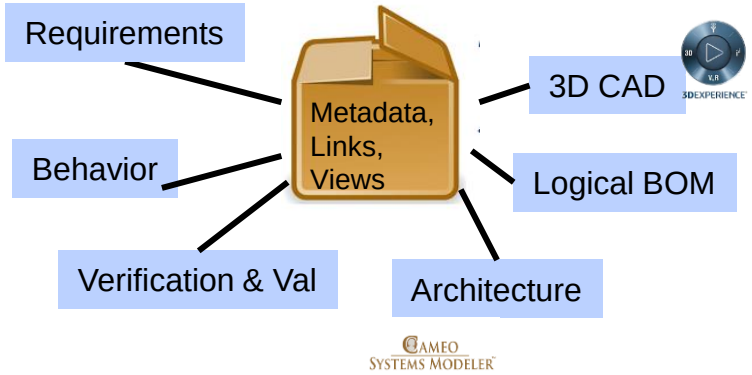
Company A: OEM

COLLABORATE

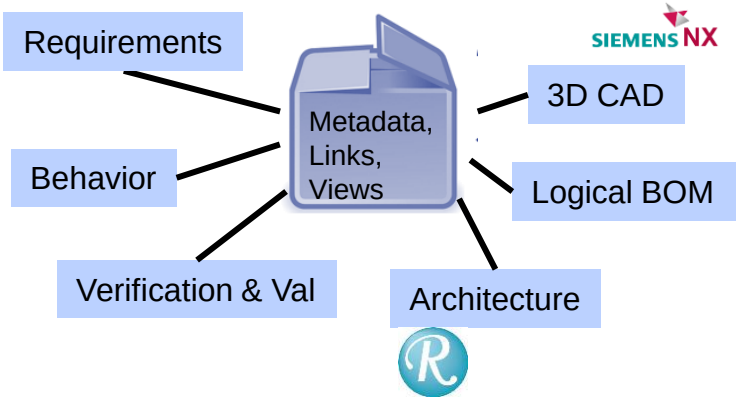
What are the challenges?

Company B: Supplier

Cross-domain package or partition A



Cross-domain package or partition B



- Cross-domain, heterogeneous

fmi Functional Mock-up Interface

STEP AP242

SysML v2

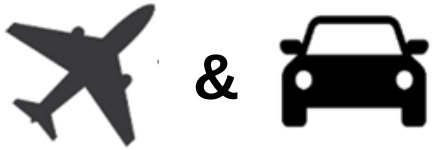
- Graph technologies for hardware still maturing

neo4j

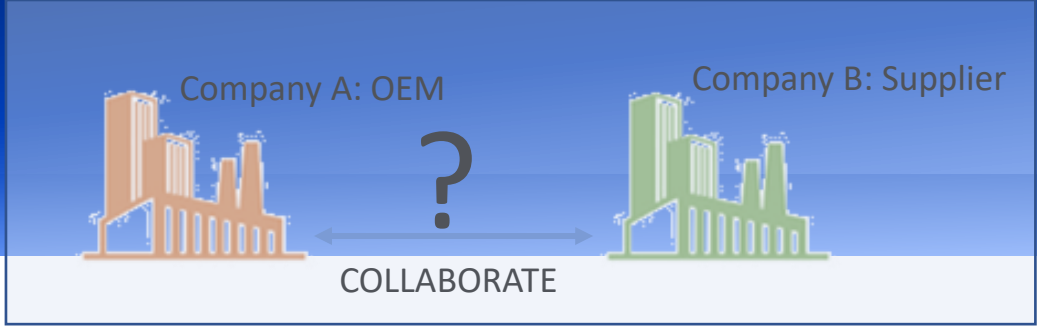
RDF

- Multiple context metadata standards
- No framework specific for OEM-Supplier collaboration

Applies to multiple Industries



Start with a simple Strategy…



1 "Use Cases"

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

Criteria/dimensions:

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

2 "What"

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

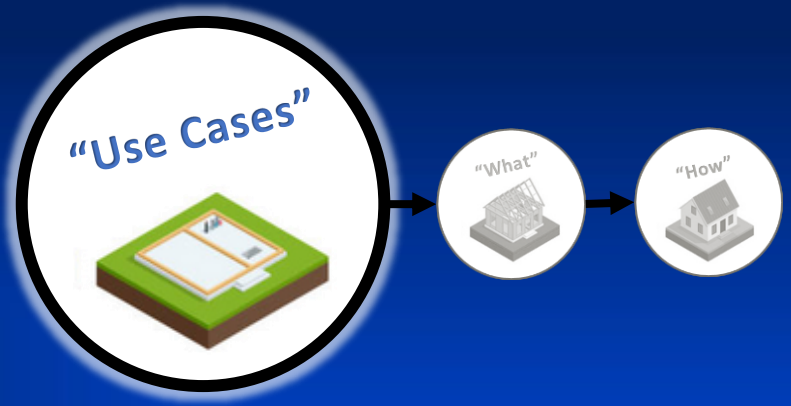
Recognize authoritative sources and focus on semantic integration (e.g. graph technologies) of an existing, federated Standard set. Digital Data Package

3 "How"

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

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

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

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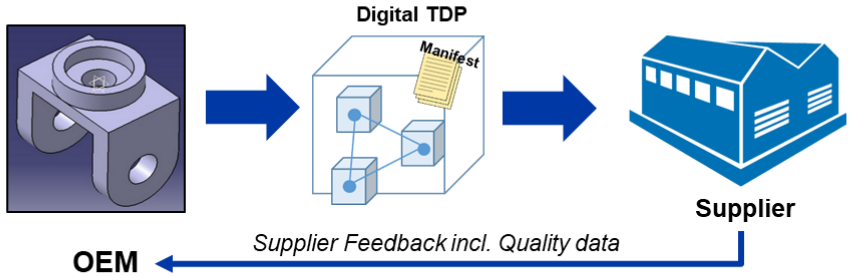
BOEING ELYSIUM NORTHROP GRUMMAN Parker PDES, Inc.® Connecting the Digital Enterprise

Supplier Engagement Framework, 2022

LEVEL 1
EXCHANGE

Unidirectional Exchange of TDP – *build to model*

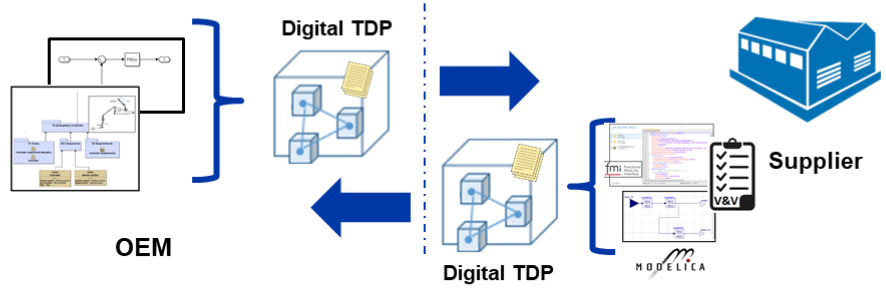
Unidirectional exchange of Technical Data Packages (TDP) from OEM to Supplier. Supplier feedback will be requested and may contain model artifacts.



LEVEL 2
INTEROPERABILITY

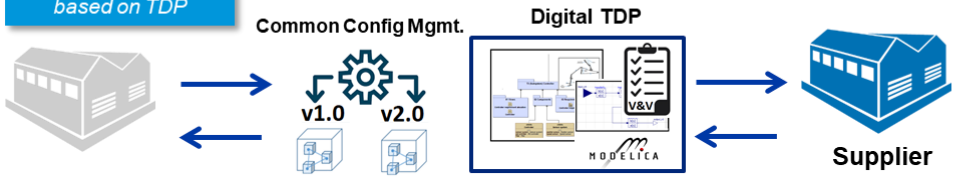
Bidirectional Exchange of TDP – *build to requirements*

Bi-directional exchange of TDP. OEM provides specification models. OEM and supplier import, review and return different versions of the TDP.



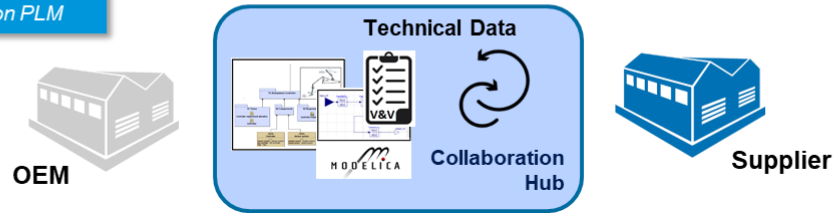
LEVEL 3A
COLLABORATION based on TDP

Co-development where OEM and supplier import, review and return a shared version of the TDP, under common Configuration Management (CM).



LEVEL 3B
COLLABORATION based on PLM

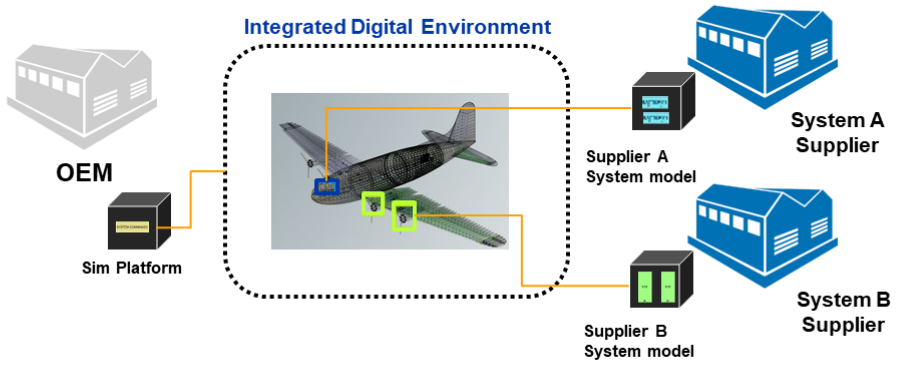
Co-development in a shared "collaboration vault" where TDP content is managed. Common, PLM-enforced data Configuration Management is required.



Add-on

…latform level co-simulation

…oint simulation of behavior (executable) models to perform system or platform level integration tests. Used in combination with other Engagement Levels. Multiple variants: real time, distributed, cloud based…



Engagement Journey and Engagement Stage

ENGAGEMENT JOURNEY

ENG. JOURNEY = business user story that describes collaboration intent and domain of applicability.
It represents "pockets of value" brought when collaborating with an external supplier or stakeholder.

Combines with…

ENGAGEMENT LEVEL

ENGAGEMENT LEVEL = Interaction frequency between stakeholders in a cross-company collaboration scenario

By itself does not describe Collaboration Intent and Needs

SEF 1.0 (2022)

ENGAGEMENT STAGE

ENGAGEMENT STAGE = Contracting phase associated with a product maturity level and lifecycle stage.

To define…

COLLABORATION SCENARIO

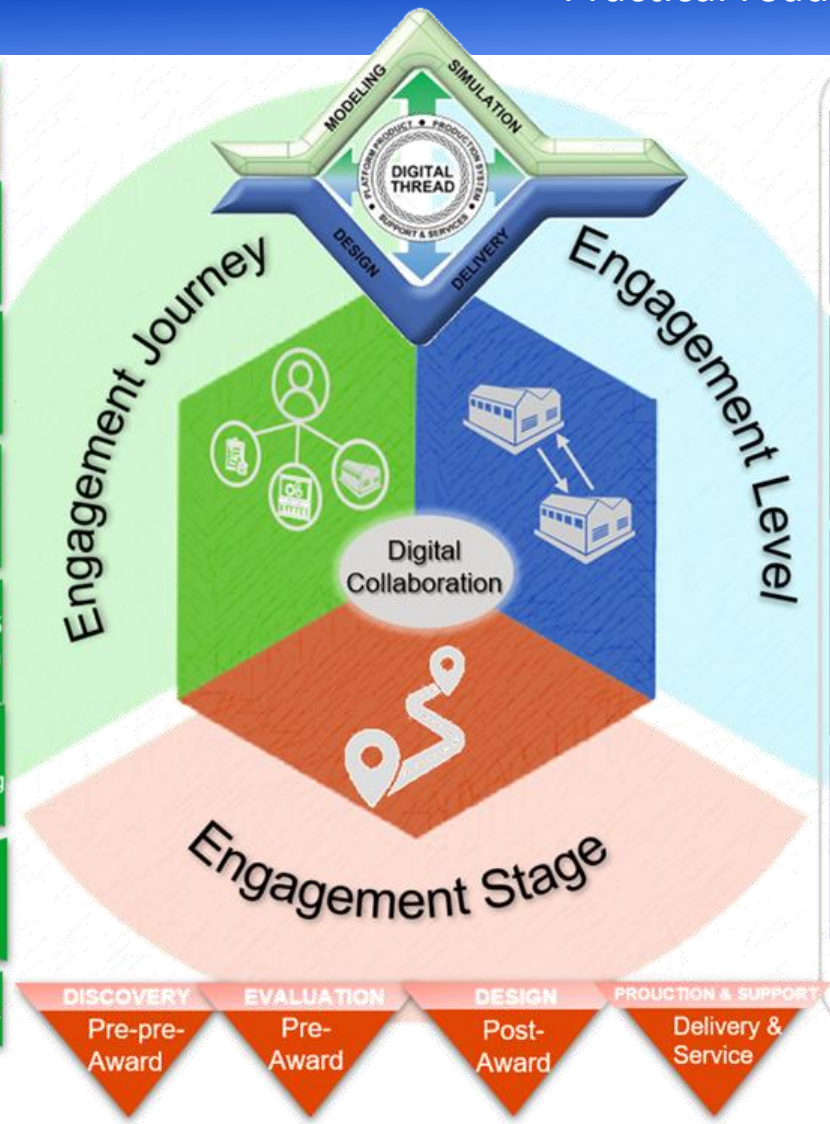
SCENARIO= Cross. Company collaboration solution enabled by a set of information products: i.e. collaboration data, process, and tool assets, that solve for a specific Journey(s), Level(s) and Stage(s)

SEF 2.0 (pending)

Supplier Engagement Framework V2.0 (pending)

Practical roadmap to Digital Collaboration Success

- **Journey 1 Setup** — Collaboration Framework Setup.
- **Journey 2 Requirements** — Collaboratively manage product Requirements.
- **Journey 3 Architecture** — Collaborative Architecture Design Co-Development.
- **Journey 4 Co-sim** — Collaborative Co-Simulation & early Requirements Validation.
- **Journey 5 3D Design** — Collaborative 3DMBD Design Co-Development.
- **Journey 6 Manufacturing** — Collaborative Manufacturing Engineering.
- **Journey 7 D-APQP** — Collaborative Digital APQP Deployment
- **Others** — Not comprehensive*



Unidirectional Exchange of Technical Data Package (TDP) - Build to Model

Level 1 Distribution — Unidirectional exchange of TDP from Original Equipment Manufacturer (OEM) to supplier. Supplier feedback will be requested and may contain model artifacts.

Bi-directional Exchange of Technical Data Package (TDP) - Build to Requirements

Level 2 Exchange — Bi-directional exchange of TDP. Original Equipment Manufacturer (OEM) provides specification models. OEM and supplier import, review and return different versions of the TDP.

Collaboration Based on Technical Data Package (TDP)

Level 3A Collaboration Based TDP — Co-development where Original Equipment Manufacturer (OEM) and supplier import, review and return a shared version of the TDP, under common Configuration Management (CM).

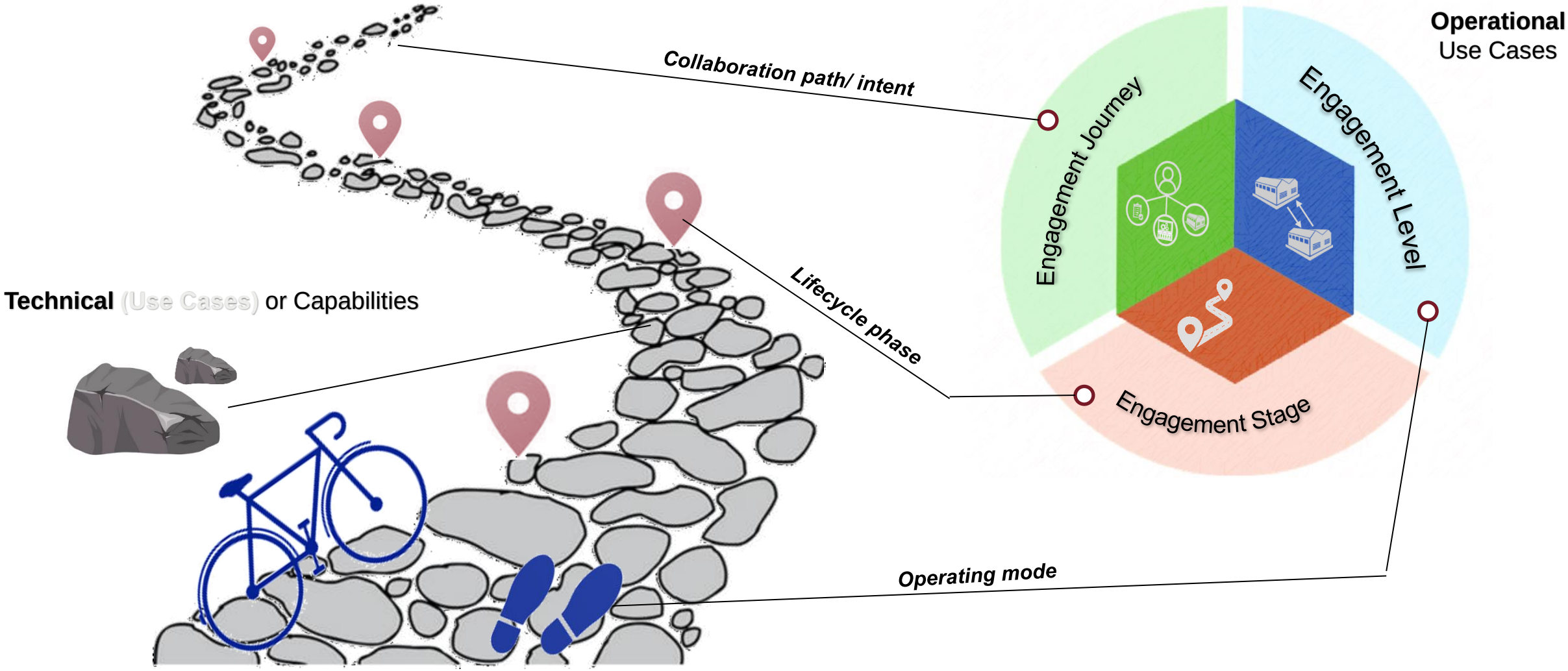
Collaboration Based on Production Lifecycle Management (PLM)

Level 3B Collaboration Based on PLM — Co-development in a shared "collaboration vault" where TDP content is managed. Common, Production Lifecycle Management (PLM) enforced data configuration management is required.

Supplier Engagement Framework 1.0

POC: juan.c.mendo@boeing.com

Operational (SEF V2.0) vs Technical Use Cases



CASCaDE

Collaborative Artifact, Specification, Context and Data Exchange

Spinning the digital thread across enterprises

OMG Object Management Group.

INCOSE

GfSE Gesellschaft für Systems Engineering e.V.

VDA Verband der Automobilindustrie

prostep ivip

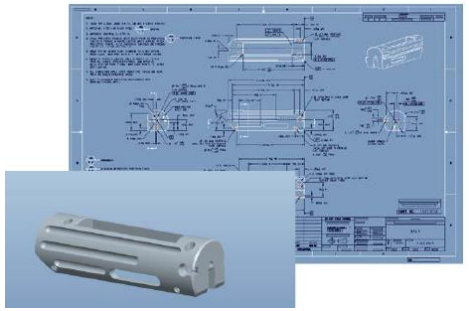
Sponsors

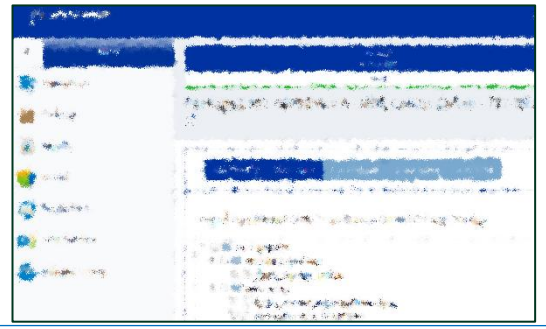
Industry evolution of a “Technical Data Package”

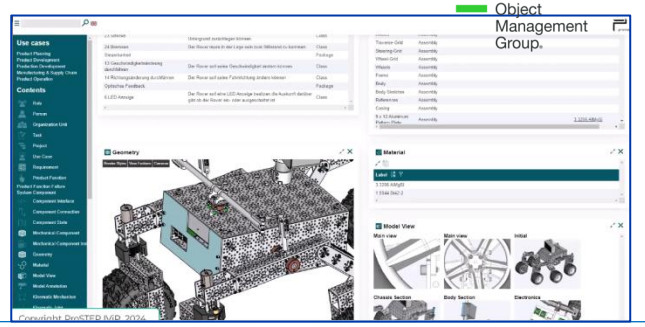
	Technical Data Package (TDP)	“Pathfinding TDP into Digital Engineering”	Digital Data Package *(DDP) compliant with CASCaDE*	Digital Data Partition & Full Development Assurance (Future)
	Early 2000s	*2020 - 2024*	*2024-2026 (CASCaDE)*	*2030+*
▪ **DATA**	MIL31000 (Defense) AP232 (Commercial)	Includes requirements, 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)

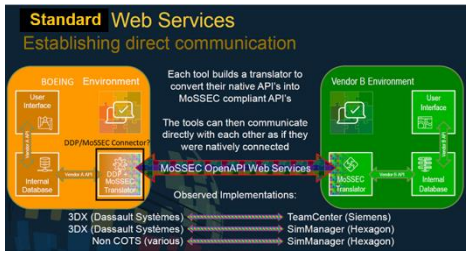
We are here

Next target









CASCaDE: Collaborative Artifact Specification, Context and Data Exchange

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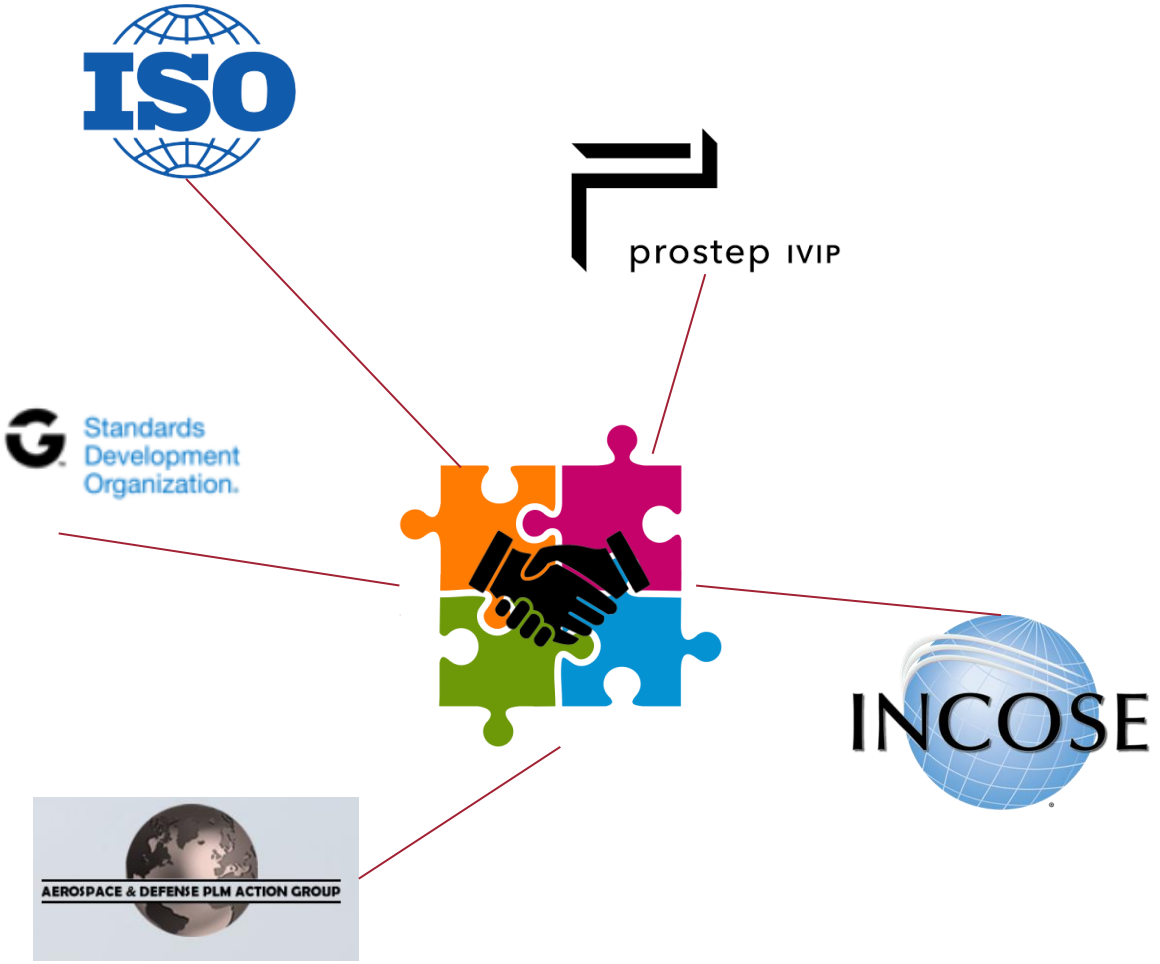
From GPDIS 2023: Need of alignment in Digital Collaboration!

1. MoSSEC Implementers Forum (AP243) < MBSE IF
2. ProSTEP IVIP: Digital Data Package, Collaborative Digital Twins
3. OMG: SysMLV2, Model Based Acquisition Metamodel
4. INCOSE Digital Engineering Information Exchange: Digital view point Model, DE Guide
5. A&D PLM Action Group: Global Collaboration Checklist



CASCaDE harmonizes the Industry for Digital Collaboration

CASCaDE

Converging to deliver a *Digital Engineering Collaboration* solution.

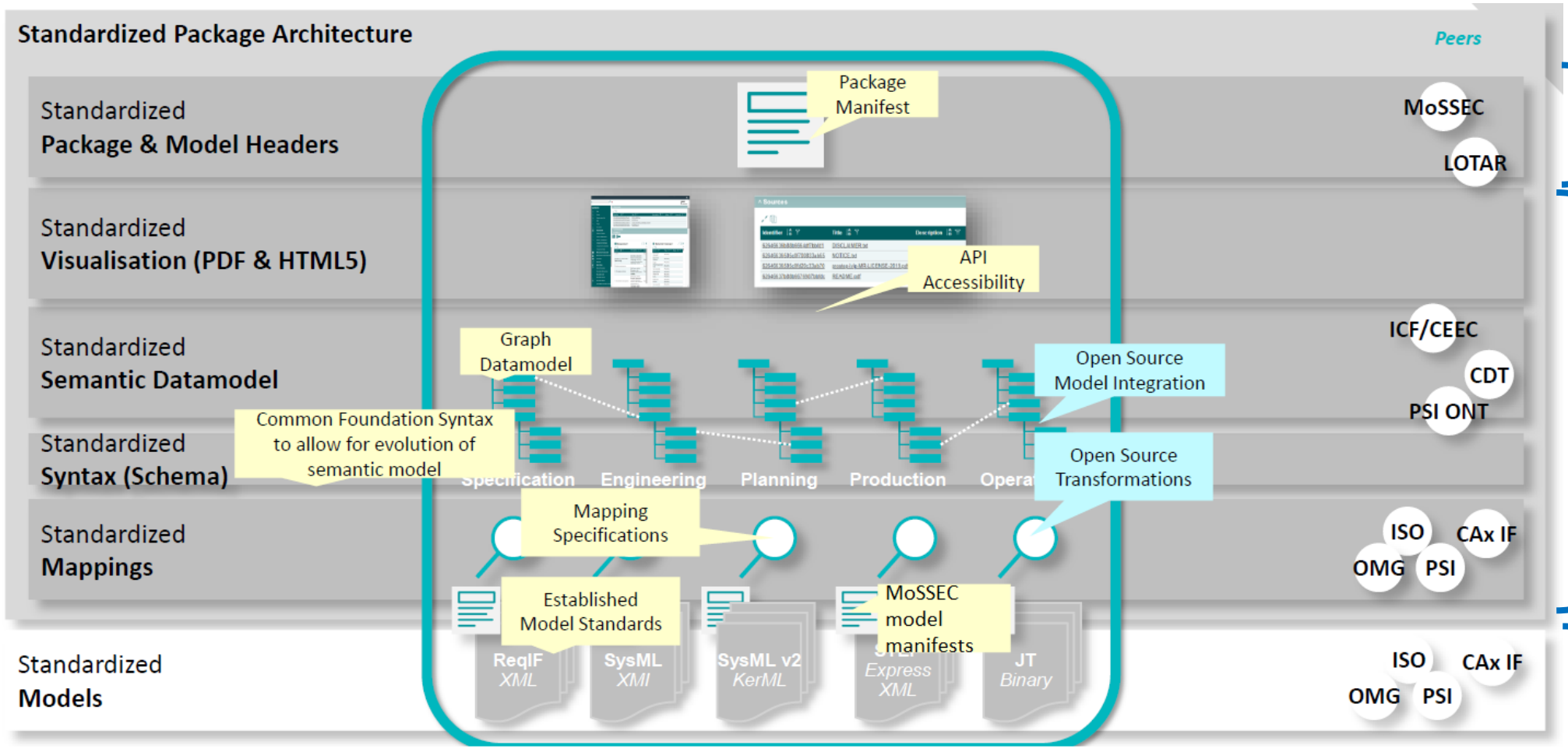
- **SME** System Modeling Environment
- GfSE **SpecIF** Initiative (PLM4MBSE)
- **SysML** WF, WP6 → **DDP** Digital Data Package
- **MoSSEC** STEP AP243
- INCOSE **Digital Engineering Information Exchange (DEIX)**
- A&D PLM Action Group: MBSE and Global Collaboration Projects
- **ONT** Ontologies
- **CDT** Collaborative Digital Twins

Requirements for
Object Management Group:

CASCaDE RfP
promoted through
ManTIS
Manufacturing & Industrial Systems
Domain Task Force

- Requirements consolidated
- Requirements to be consolidated
- Close technical collaboration

Technical Architecture: Digital Data Package and MoSSEC



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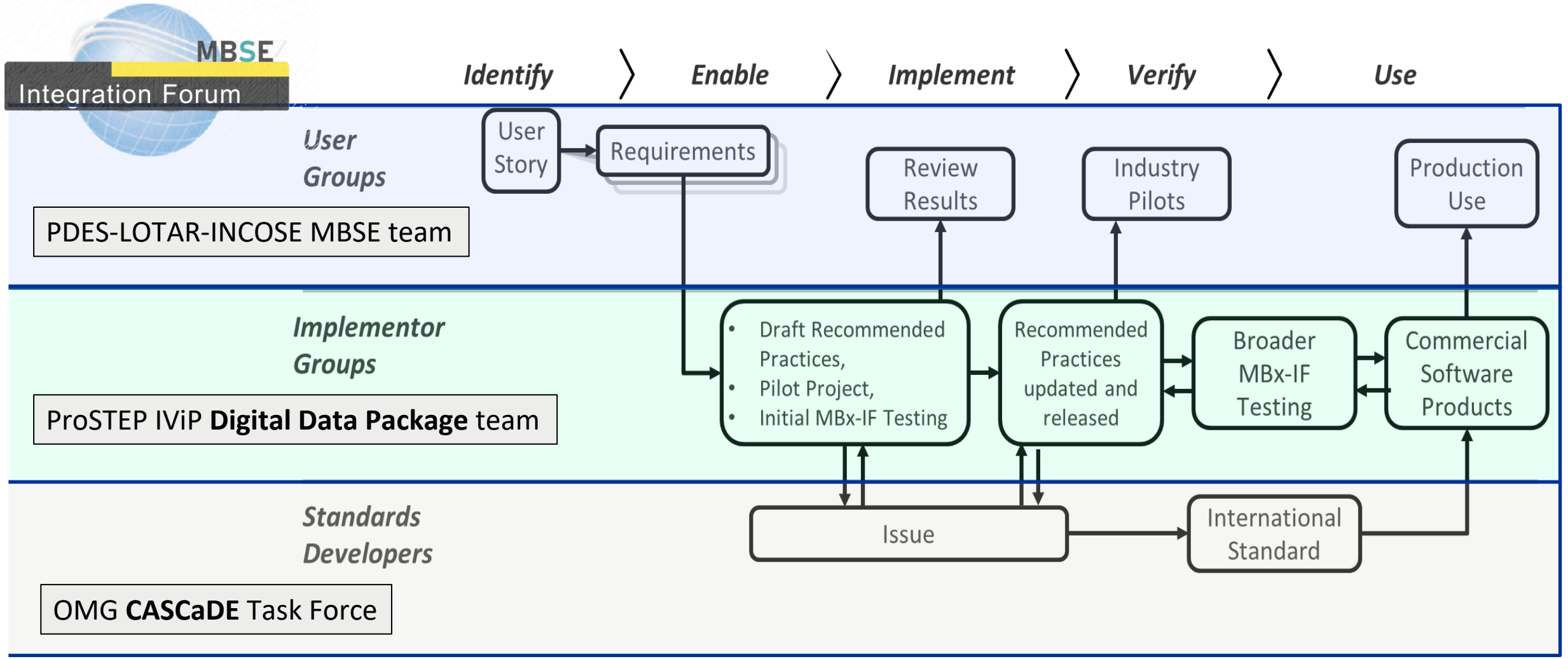
MBSE Integration Forum (MBSE-iF).



MBSE Integration Forum (MBSE-iF) cont.

MBSE Integration Forum

User Groups

PDES-LOTAR-INCOSE MBSE team

- Boeing
- Airbus
- RTX
- Honeywell
- Northrop Grumman
- Saic Inc.
- Modelon

Implementor Groups

ProSTEP IViP **Digital Data Package** team

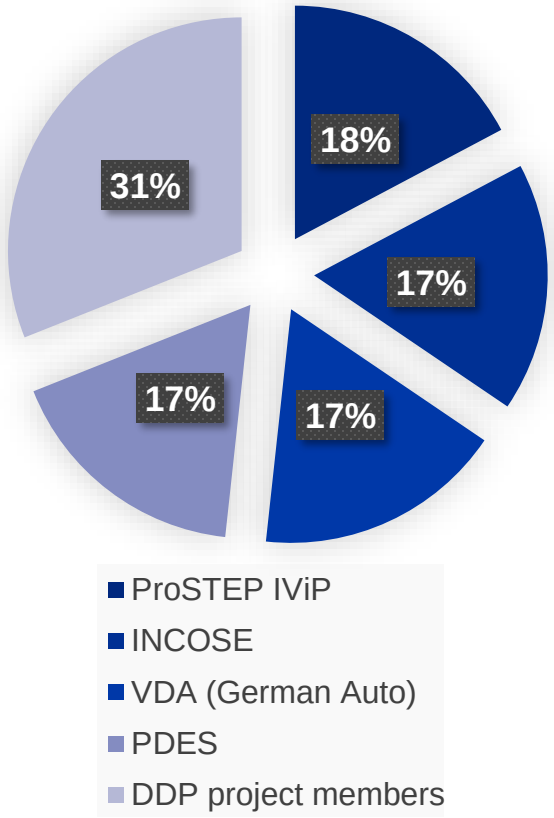
- Anark AG
- em AG
- ProSTEP AG
- UC3M
- Dassault (TBD)
- Volkswagen AG
- Schaeffler AG
- Porsche AG
- Robert Bosch

Standards Developers

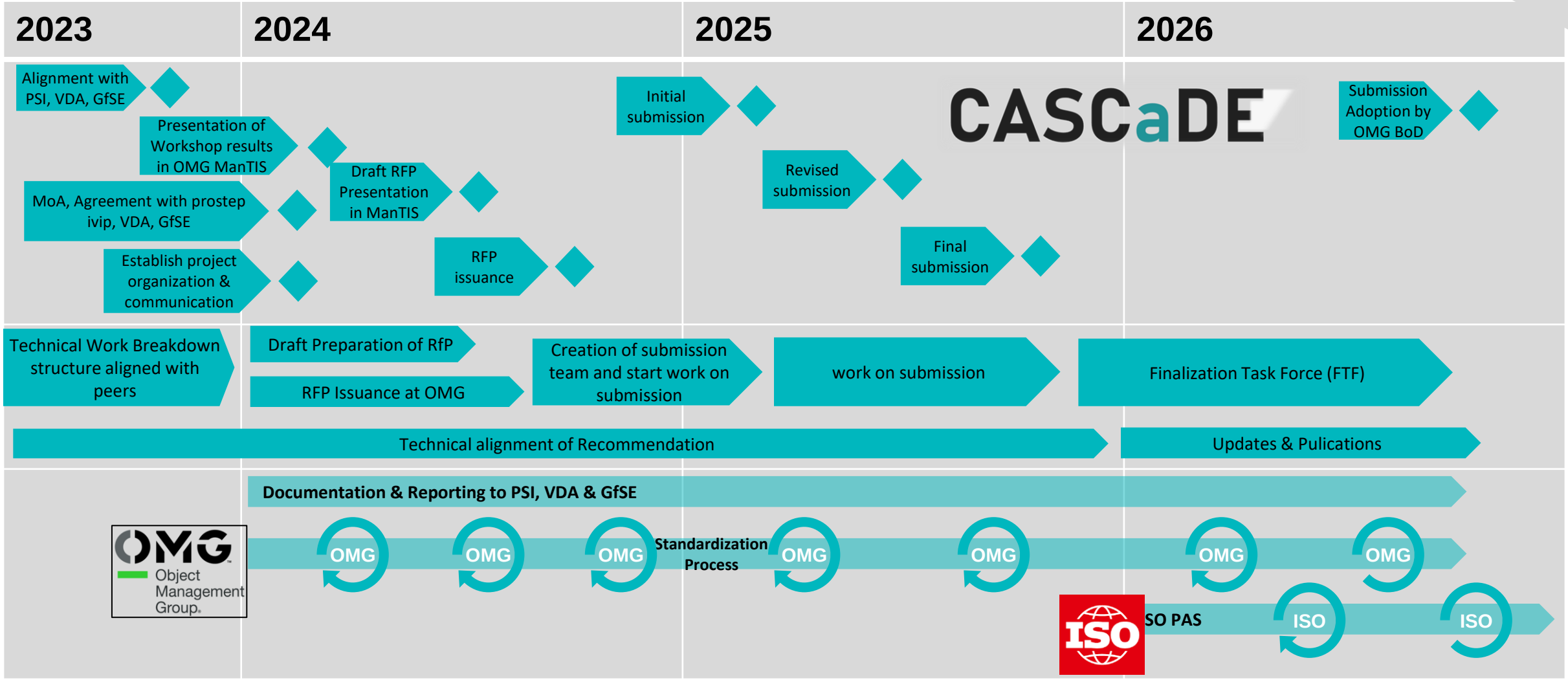
OMG **CASCaDE** Task Force

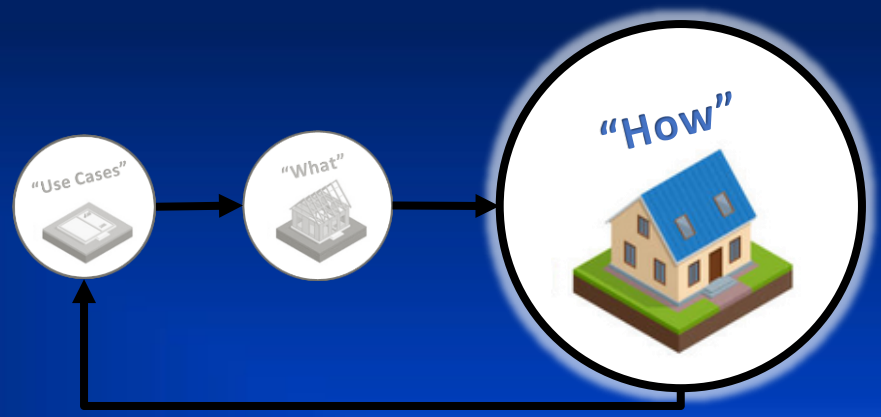
- OMG ManTIS Task Force
- ISO Committee (TBD)

MBSE-iF
2025 Funding Sources



OMG roadmap: CASCaDE





OEM MBSE Reference Architecture

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

MBSE-Framework for OEM-Supplier Collaboration

Reference Architecture for Defense Acquisition

Defense customer DE Collaboration Reference Architecture

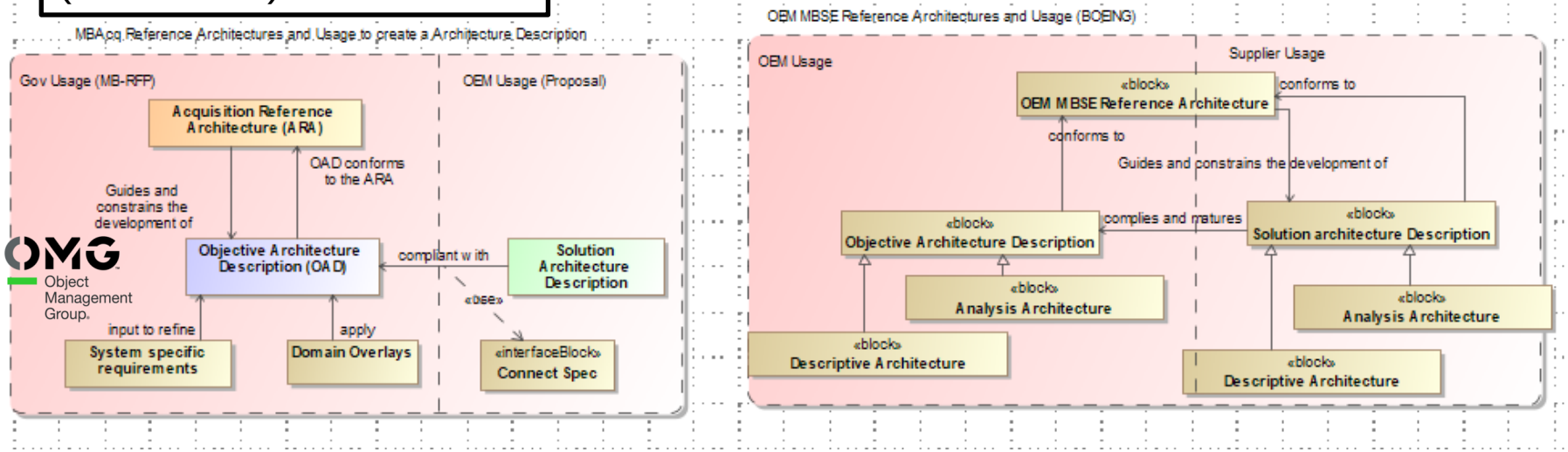
Reference Architecture for OEM-Supplier Collaboration

Commercial Supplier DE Collaboration Reference Architecture

NEW formalization!

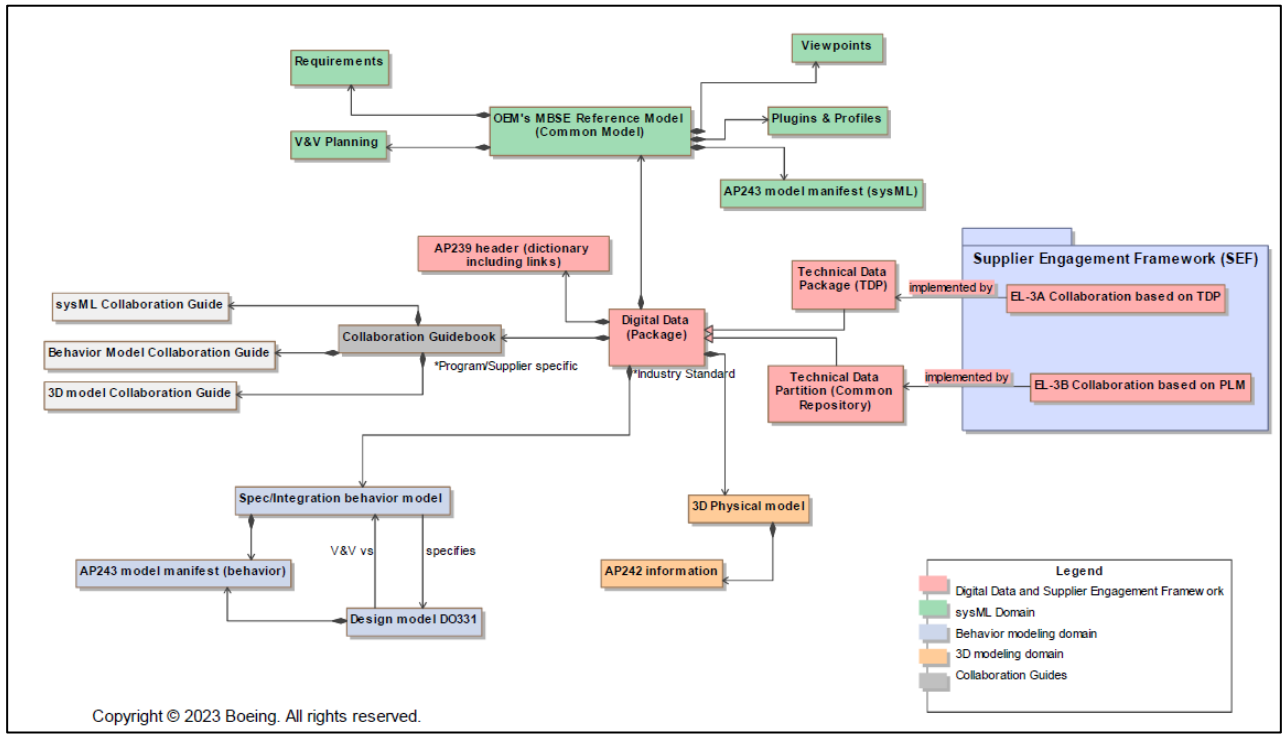
Model Based Acquisition (OMG/DoD)

Model Based Supplier Collaboration (BOEING)



MBSE Collaboration Framework (ISO 42010, ISO42042)

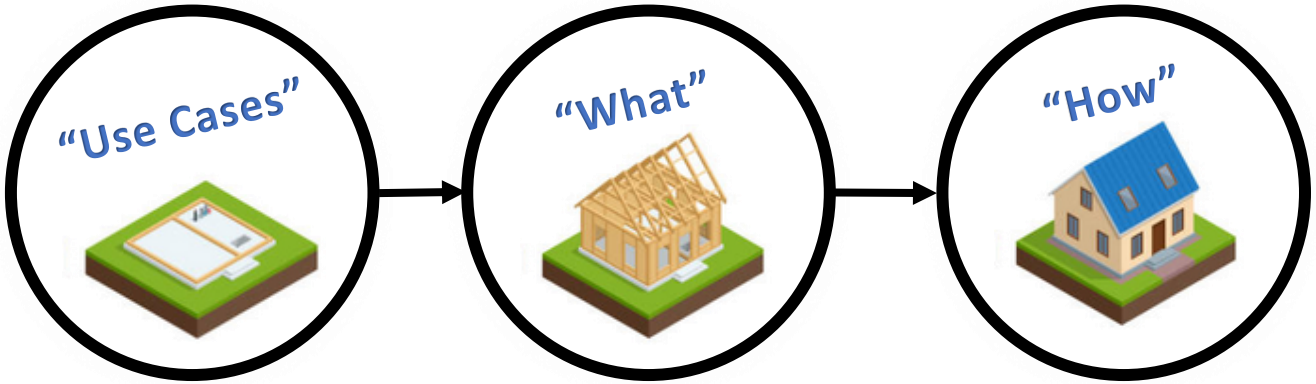
OEM Reference Architecture = MBSE Collaboration Framework



The **Reference Architecture** (ISO 42042) guides and constraints the development of the Objective Architecture Description (ISO 42010)

- ✓ Starter model templates and patterns
- ✓ Modeling guidelines and model development plans
- ✓ Collaboration process workflows
- ✓ Compliance Criteria (OMG “Domain Overlays”)
- ✓ Recommended IT infrastructure

Harmonizing Digital Collaboration – join now!



Digital Data Package

CASCaDE

MBSE Integration Forum

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Thank you!

Questions?