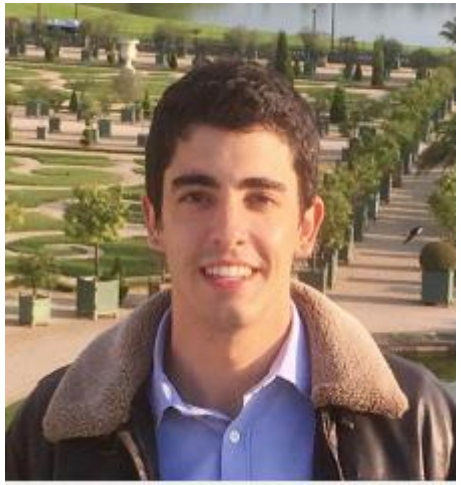
Boeing's Supplier Engagement Framework (SEF) and Technical Data Package (TDP)

The Need for Industry Alignment

Juan Carlos Mendo and Mark Williams

Presenters Bio

Juan Carlos Mendo



I am a Systems Engineer in the Boeing Research & Technology organization. As part of the Model-Based Engineering (MBE) team in Boeing R&D, I am the Product Owner of several projects focusing on Data Interoperability, the Digital Thread, digital collaboration with suppliers, the Technical Data Packages (TDP), and the implementation of Data Interoperability Standards. I am leading multiple initiatives for commercial and defense product customers with the end goals of supporting Boeing's transition to Model Based Systems Engineering (MBSE) and Model Based Development (MBD).

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

Agenda

1. **Traditional “TDP” exchange**
2. **The Supplier Engagement Framework (SEF)**
3. **The Boeing TDP and the importance of Model Manifests**

   Example package based on MBE Reference Model (Stratoliner)
4. **Differences with the ProSTEP TDP (Automotive)**
5. **For Design Collaboration, Industry needs an enhanced TDP**

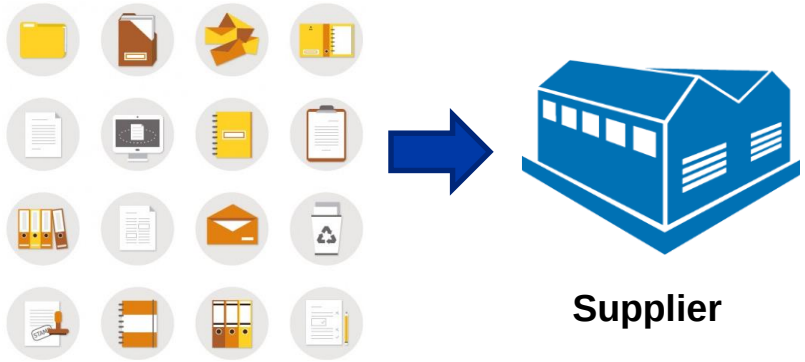
Traditional TDP exchange

"Build to Print"

Build to print

LEVEL 0

One way distribution of textual requirements and drawings

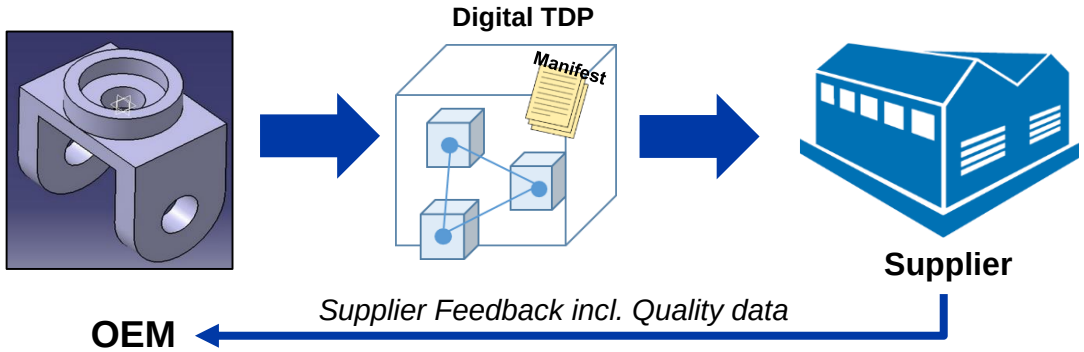


Build to model

LEVEL 1
EXCHANGE

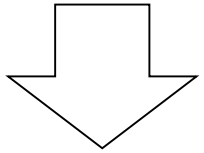
Unidirectional Exchange of TDP – *build to model*

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



Issues with traditional TDP and the need for a new Framework

- **Limited to written requirements and/or Geometry models**
- **Relationship is mostly OEM to Supplier, unplanned iterations/re-work**
- **No process to exchange Behavior and MBSE models, or model links, etc**
- **MBSE collaboration examples are limited to office tools and graphics**



Need to promote and classify OEM-Supplier MBE engagements!

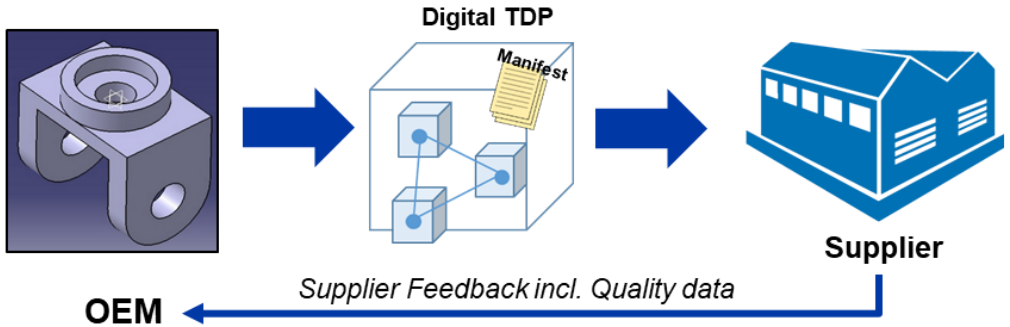
- Provide a reference framework, guidelines and examples
- Leverage the digital capabilities of our suppliers and vendors
- Utilize standards, change control, and document model objectives

Supplier Engagement Framework

LEVEL 1 *EXCHANGE*

Unidirectional Exchange of TDP – *build to model*

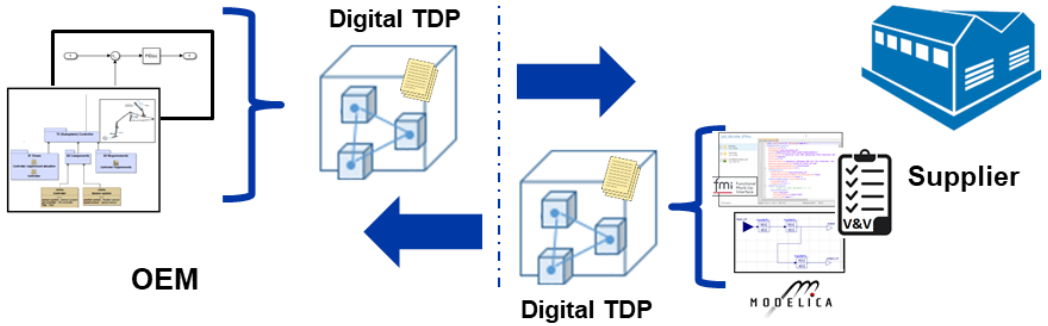
Unidirectional exchange of Technical Data Packages (TDP) from OEM to Supplier. Supplier feedback will be requested and may contain model artifacts.



LEVEL 2 *INTEROPERABILITY*

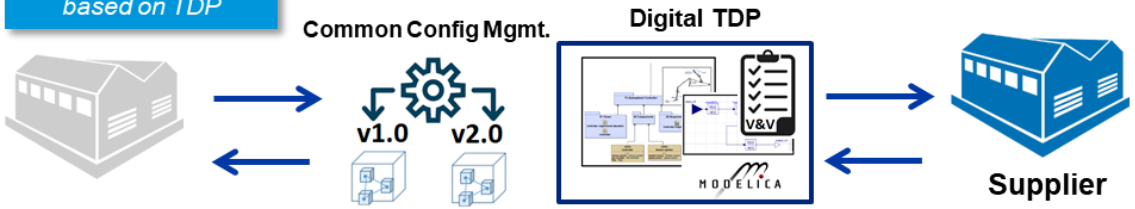
Bidirectional Exchange of TDP – *build to requirements*

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



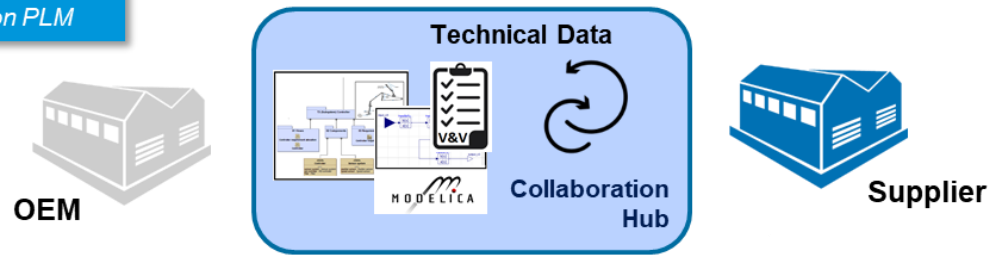
LEVEL 3A *COLLABORATION based on TDP*

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*

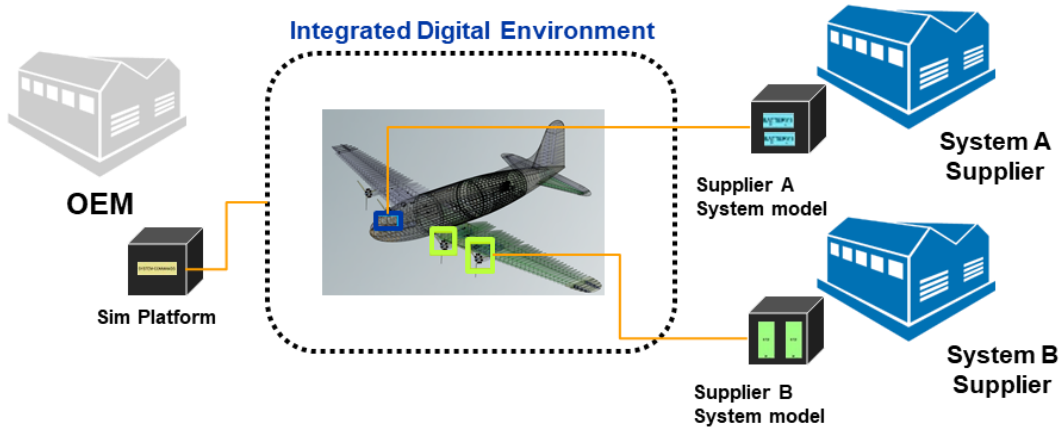
Co-development in a shared "collaboration vault" where TDP content is managed. Common, PLM-enforced data Configuration Management is required.



LEVEL 4 *DIGITAL INTEGRATION*

Platform level co-simulation

Joint 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…



Level 3 Collaboration - Key challenges

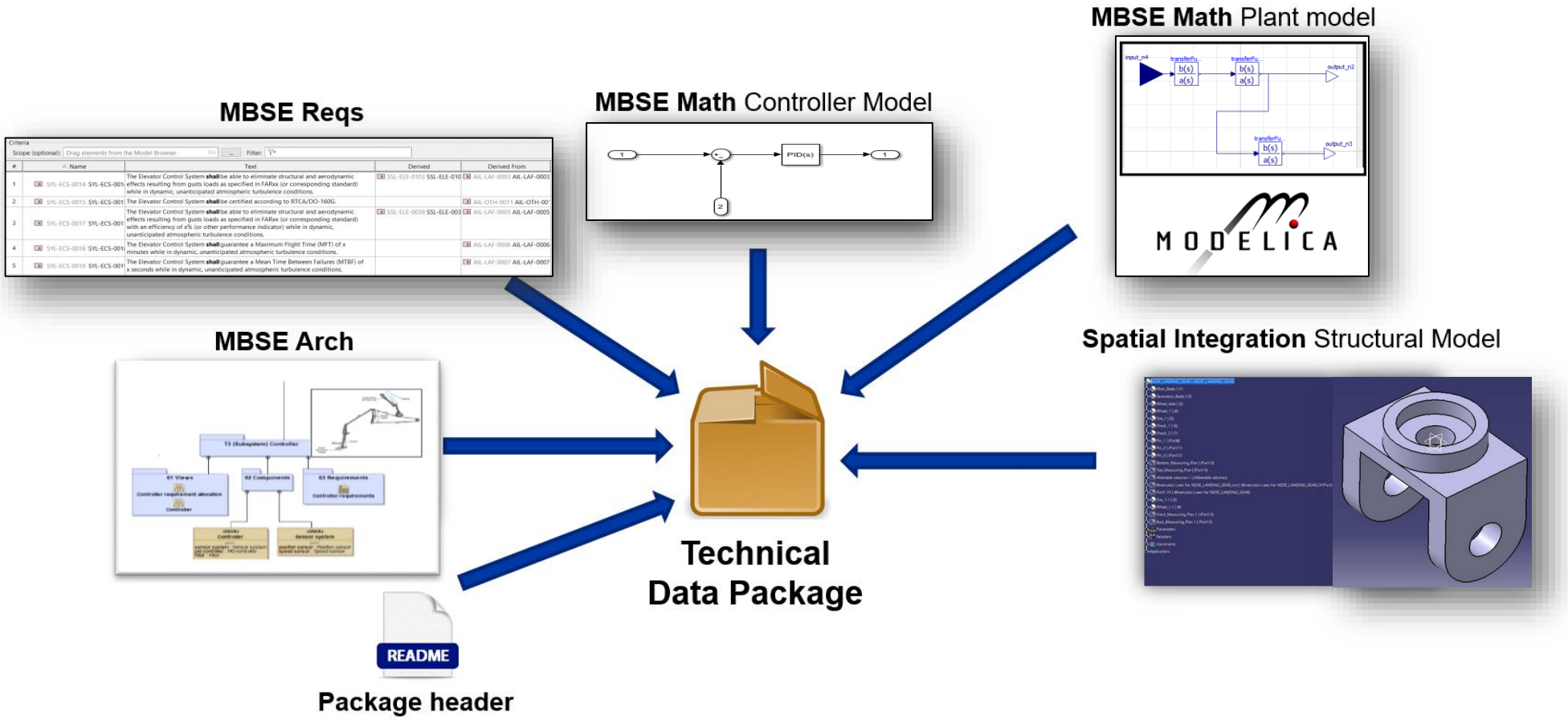
- **Capturing model and package level metadata**
- **Cross-domain digital data relationships**
- **Model translation (to common standard) and validation**
- **Maintaining change and configuration management**
- **IP protection and obfuscation**
- **Generation of Model/package views and sharing model links**

(Engagement Levels)

TDP based collaboration (3-a)

PLM based collaboration (3-b)

Technical Data Package based on MBE Reference Model



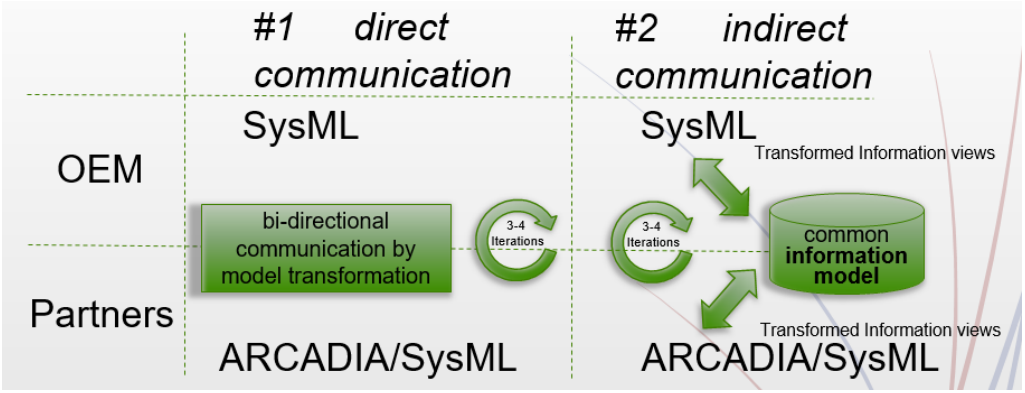
Example: Collaboration & Exchange of Architecture Models

A&D MBSE Team Recommendation

DIRECT Communication:

1. Limit SysML authoring products to one specific brand

2. **Limit SysML authoring products to popular brands and use a third party translation tool**



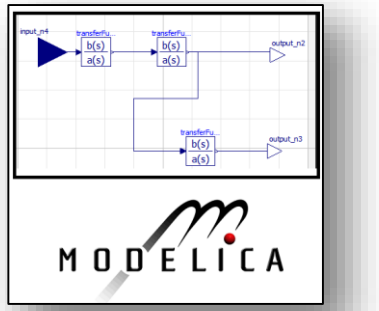
AEROSPACE & DEFENSE PLM ACTION GROUP

INDIRECT Communication:

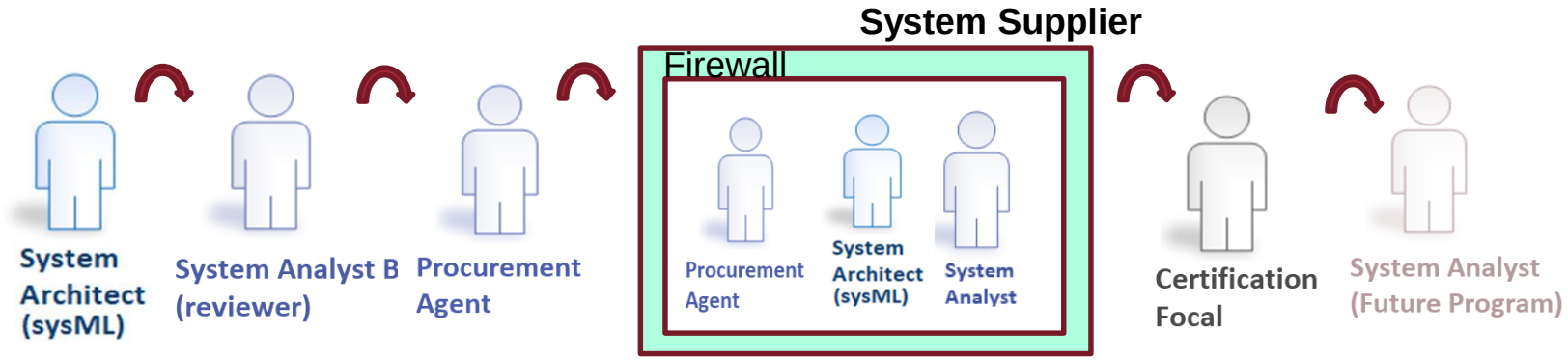
3. Use an in-direct transformation product to integrate multiple model types (requires integration of additional data management environment)

Why do we need Model Manifests?

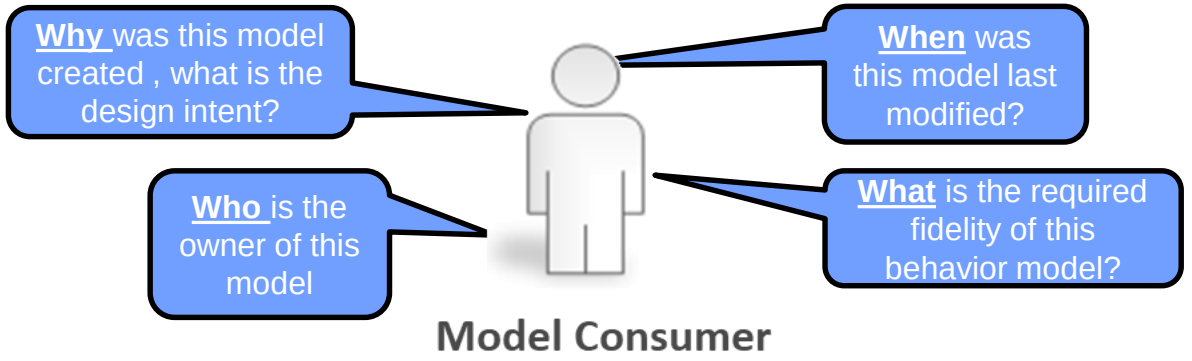
Scenario: The life of a Simulation - Math Tool user (sysMBD):



This model will be consumed by external users in the system lifecycle:



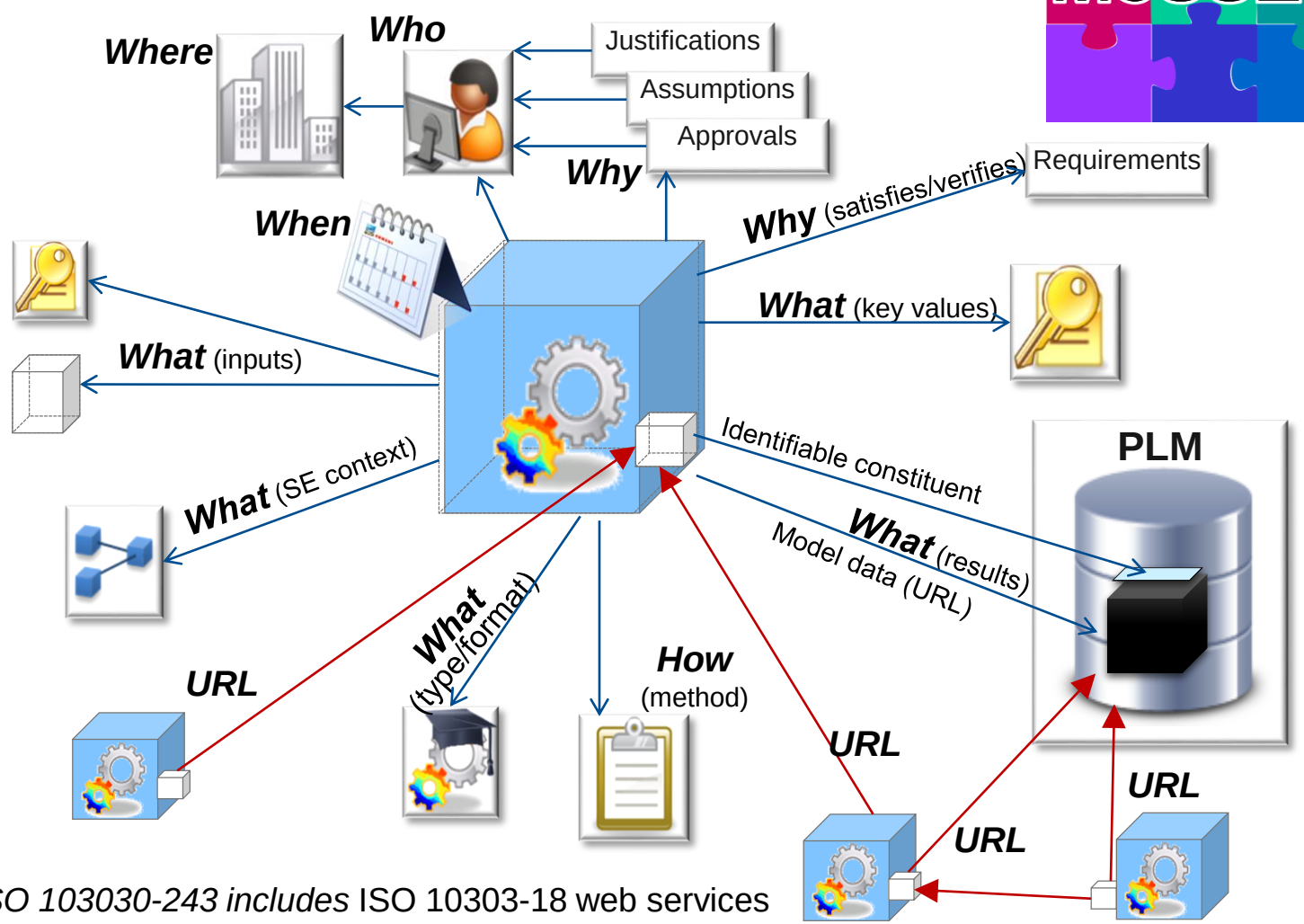
But wait… none of these stakeholders know the model's origination, purpose, fidelity etc…



State of the art:
Coordination memos?
Email exchanges?

MoSSEC = Data that describes the model

- Comprehensive Views
- Exclusive for Models
- Model Connectivity
- Data Identification
- Supports Data Exchange
- Supports Data Preservation
- Designed for Authoring Applications



✓ Interim Solutions: **Model Manifests** e.g. LOTAR P520 manifest, BOE-MIC (Model Identity card)

ISO 103030-243 includes ISO 10303-18 web services

AP243 Model Manifest and AP239 Package Manifest

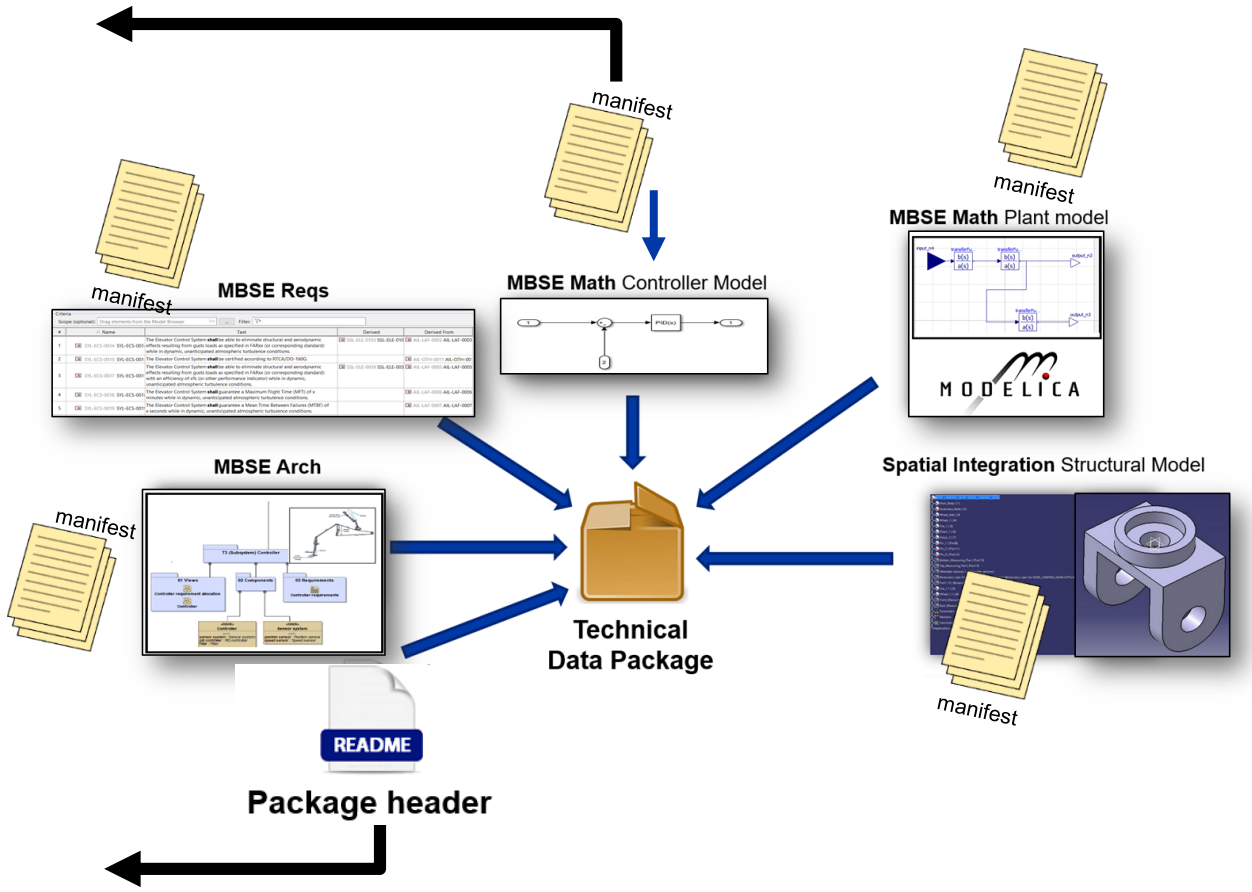
AP243 Model Manifest

1. What were the objectives of the model, and were the objectives met?
2. What is the source of the specifications used to define the model elements? (defines level of abstraction)
3. What were the assumptions, requirements, risks, and constraints affecting the model and the process?
4. How will the model results be used or reported?
5. What was the process used to define an appropriate, suitable and credible model? (Quality check)
6. What decisions will potentially be made based on the model?

8. *Other Administrative: pedigree, provenance, identification of the model, the system, persons, org, the tool, the modeling environment, and data protection*

AP239+AP243 Package Header

1. TDP Header represents the context metadata of the exchange
2. Message ID, sender info, receiver info
3. Package purpose, Dictionary, contents list
4. Link information
5. TDP Header is at a higher level than the individual model manifests
6. The TDP Header should comply with the appropriate parts of STEP AP239 and AP243
7. Traceability between Package and Package Header must be persistent

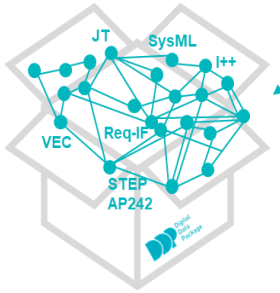


http://tdp.asd-ssg.org

Digital Data Package (Automotive) vs. Boeing's TDP

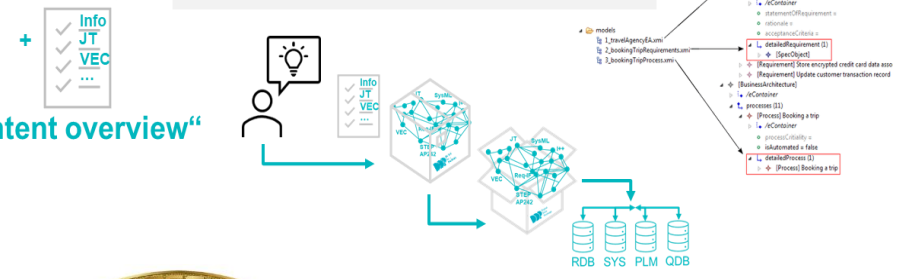
Automotive's Digital Data Package

Human Readable, Interactive, Visualization

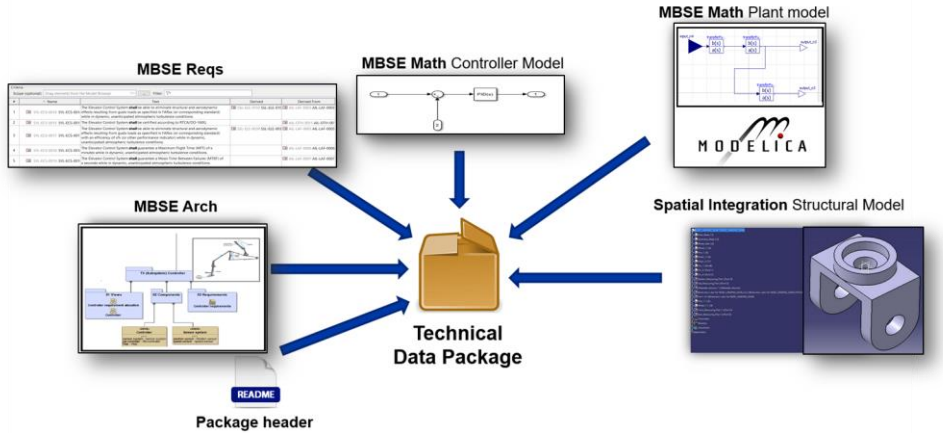


Linked data which will be integrated in the systems on receiver side, provide full cross-domain/cross-model traceability

Human readable, View the table of content of a DDP / Navigate through the content of a DDP / Identify and browse documents contained in the DDP

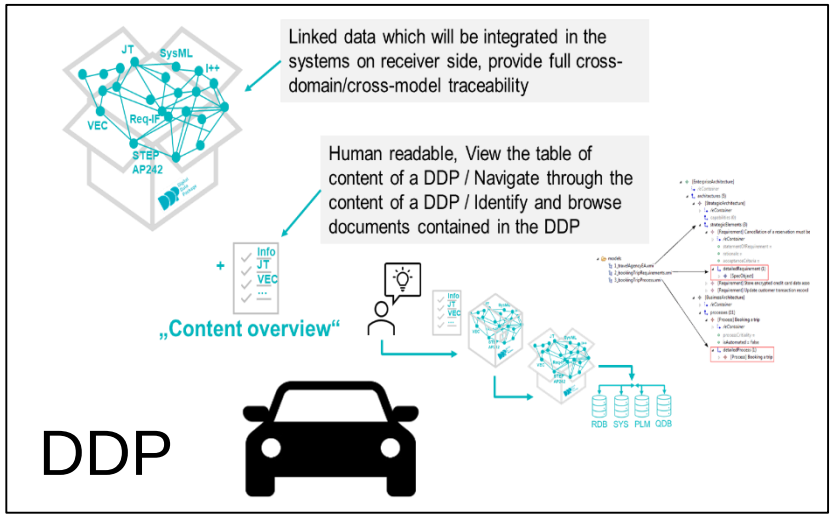


Boeing's Technical Data Package

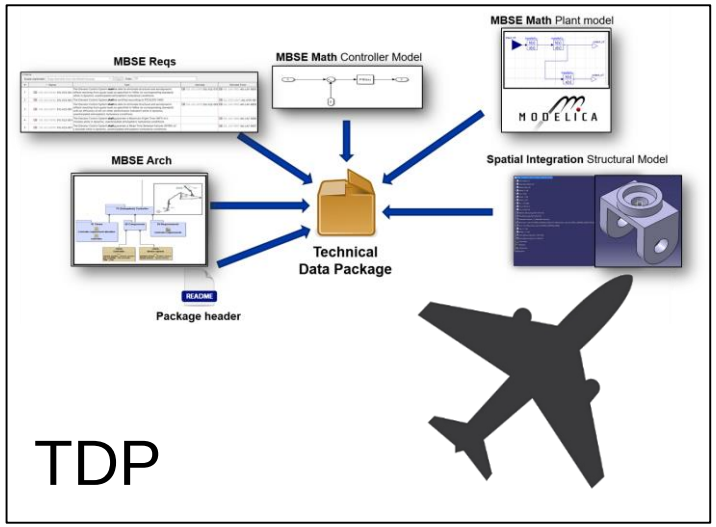


Digital Data Package (Automotive) vs. Boeing's TDP – cont.

- DDP prioritizes the use of **standard** formats.
- DDP has a special emphasis on **links** between elements documented in a **package dictionary**
- DDP provides a human-readable **interactive visualization** of all the content and links.
- DDP features a custom schema not based on ISO



- TDP includes both **standard and native** formats.
- TDP approach provides guidelines to model **Translation and Validation**
- TDP promotes collaboration documenting metadata using **model manifests**.
- Uses ISO compliant **package header**



TDP - Areas that require Alignment

[Data] "*What*"

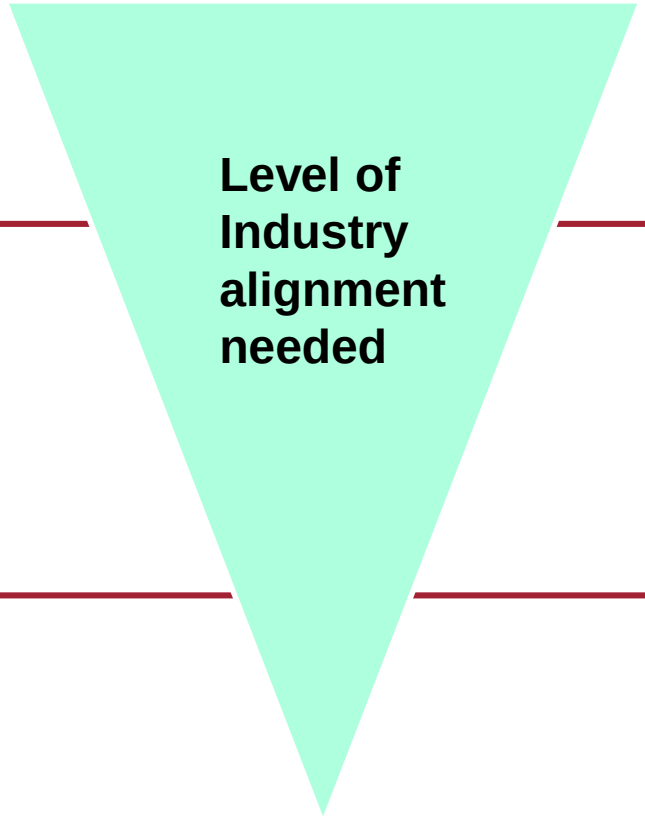
- Information Model
- Data Interoperability Standards
- AP243 Model and package manifests

[Process] "*How*"

- Reference process
- RAA
- Supplier Engagement Framework
- Protection of Intellectual Property

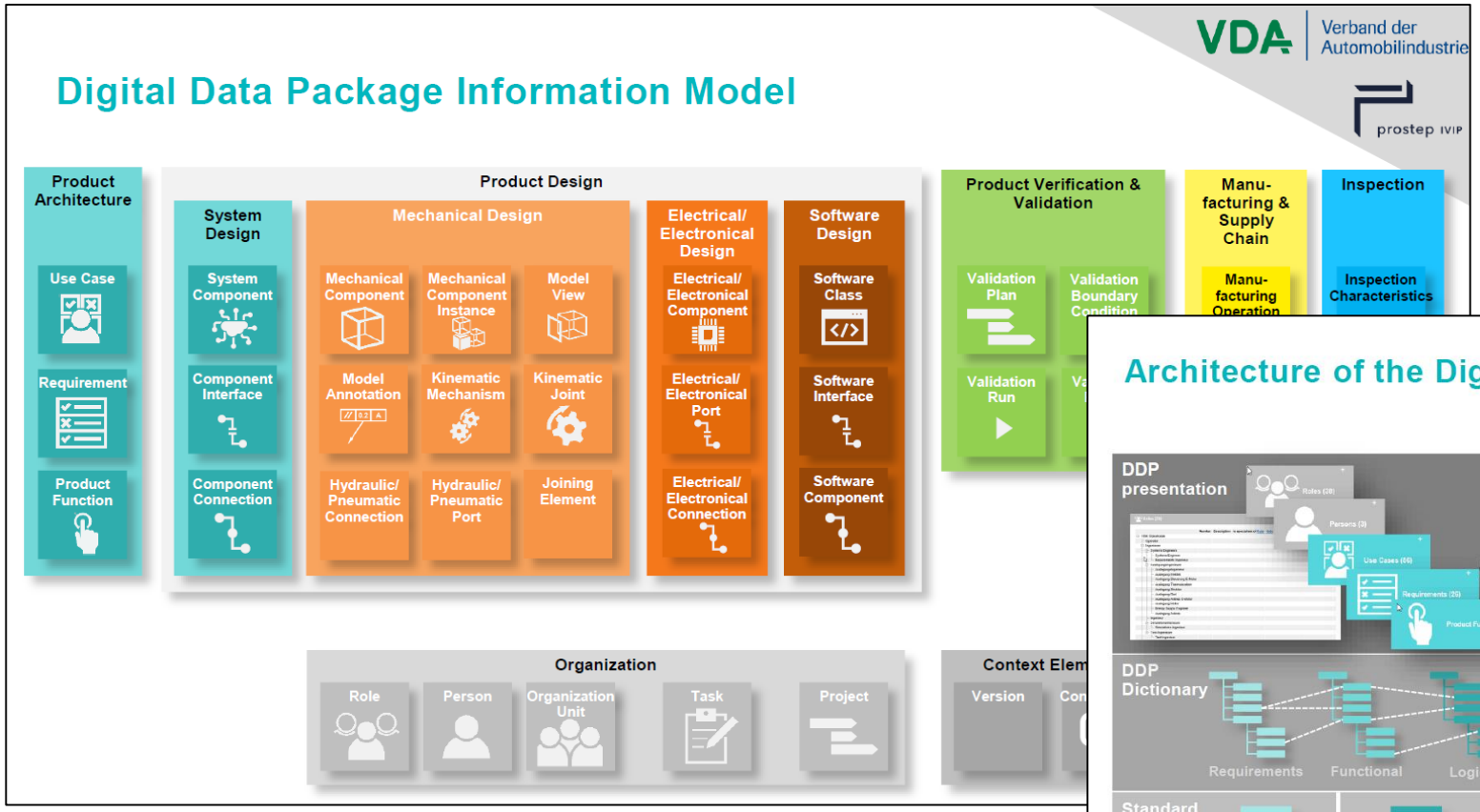
[Tools] "*Implementation*"

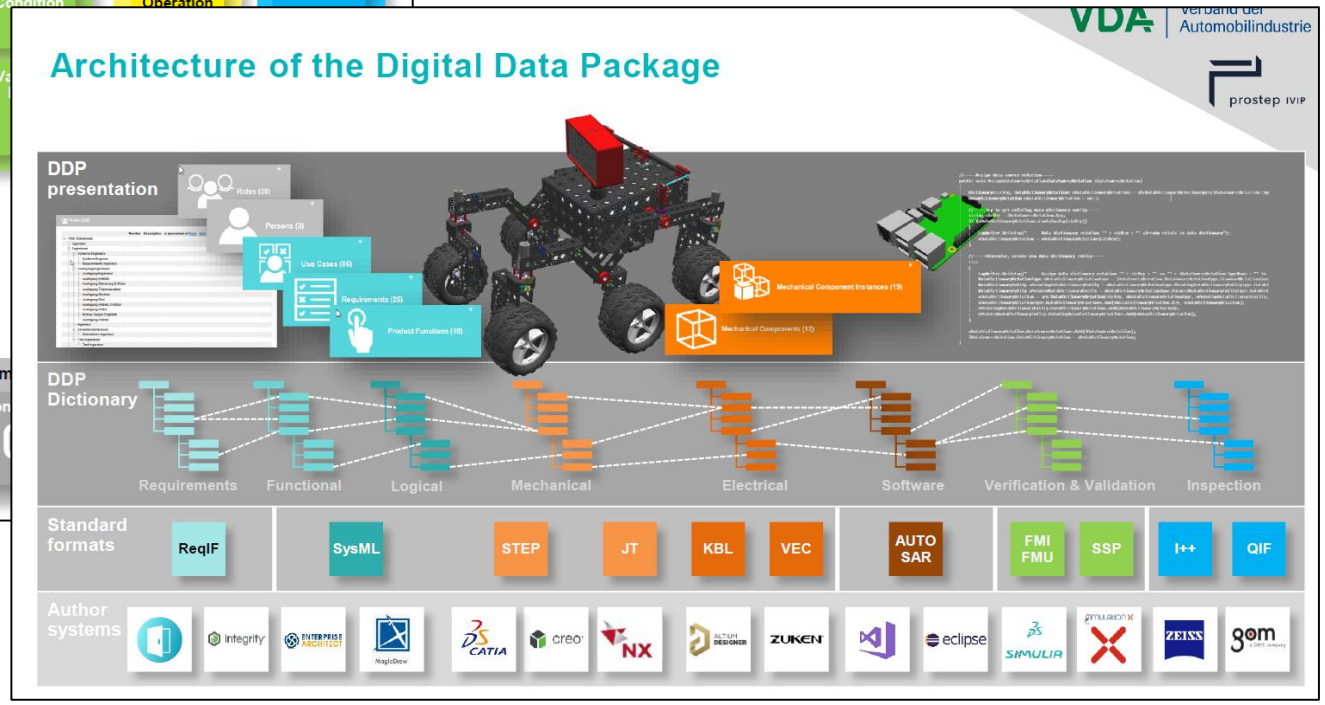
- Interfaces & Integration
- Predefined data Authority
- Capability Evaluation



DDP Information Model and Process (ProSTEP IViP)

Global Product Data Interoperability Summit | **2022**



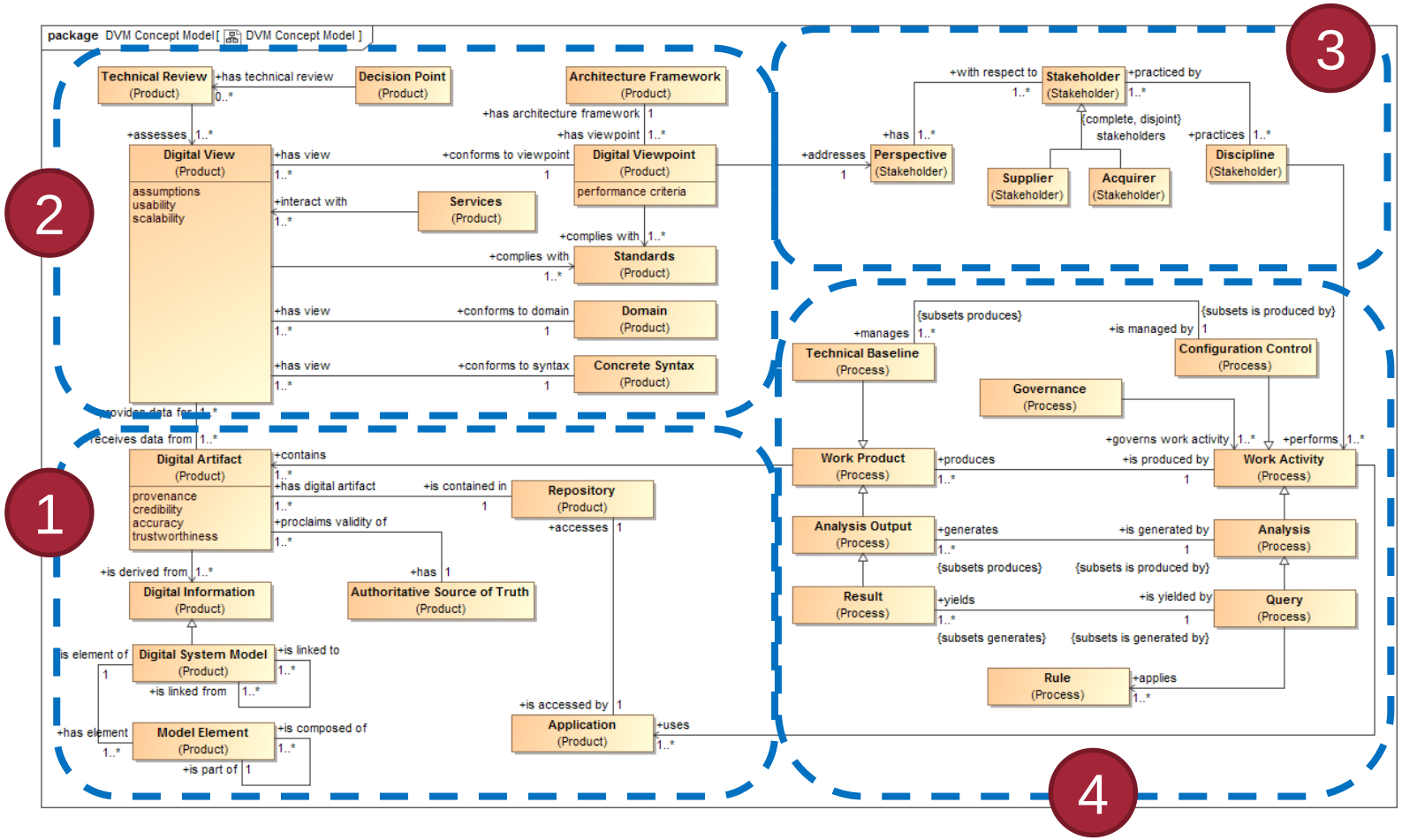


INCOSE - Digital Engineering Information Exchange (DEIX)

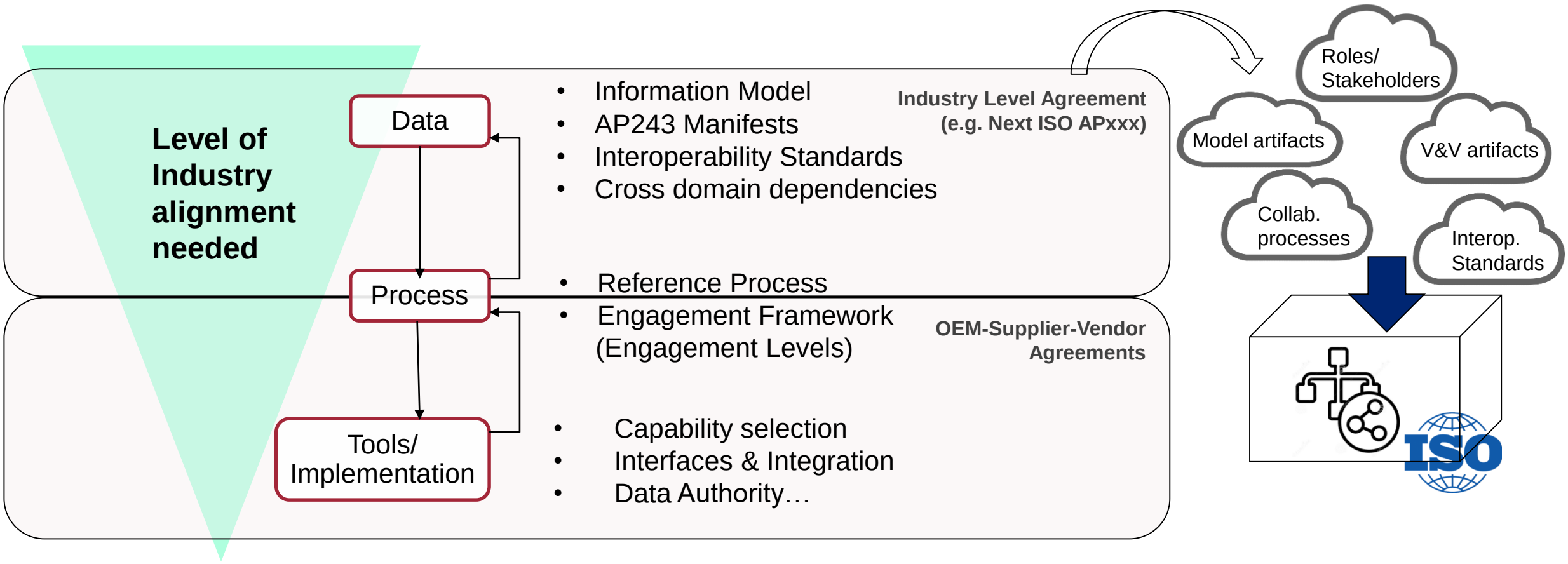
(Alternative to TDP and DDP)

Digital Viewpoint Model. Divided into four different ontologies:

1. Digital Artifact
2. Digital View
3. Stakeholder
4. Process



Industry Alignment needed on TDP



Q&A placeholder