



2020
Annual **INCOSE**
international workshop
Torrance, CA, USA
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TIMLM - Tool Integration and Model Lifecycle Management

Integrate Behavior Models

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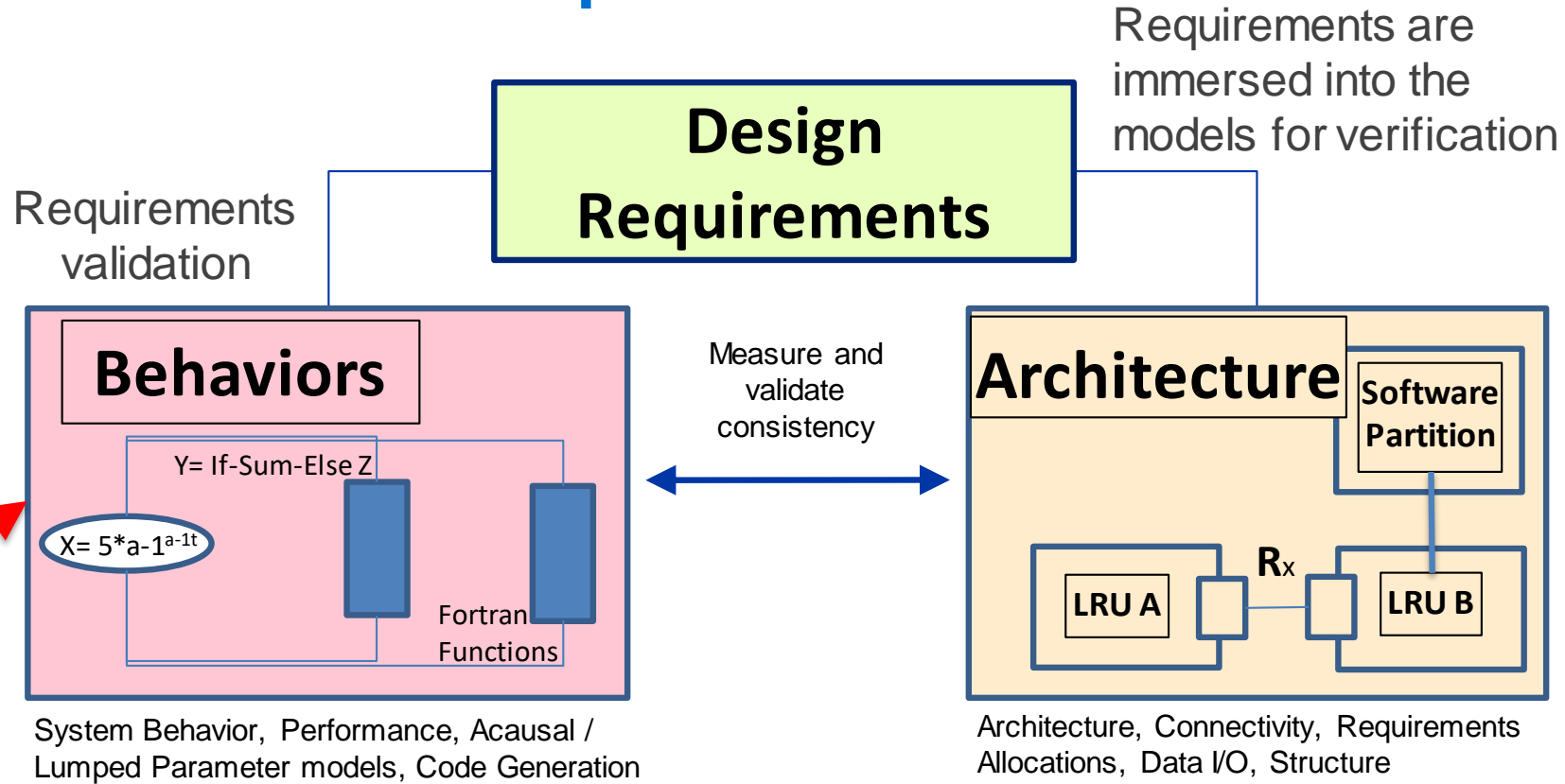
What is MBSE?

- 1) define **BIG M** (MBSE)
all of the digital thread, all domains, all models, the digital twin enabler
- 2) define little **m** (mBSE)
RFLB (Behaviors), not defined by CAD model, Concept Design to Physical Implementation (not spatial)



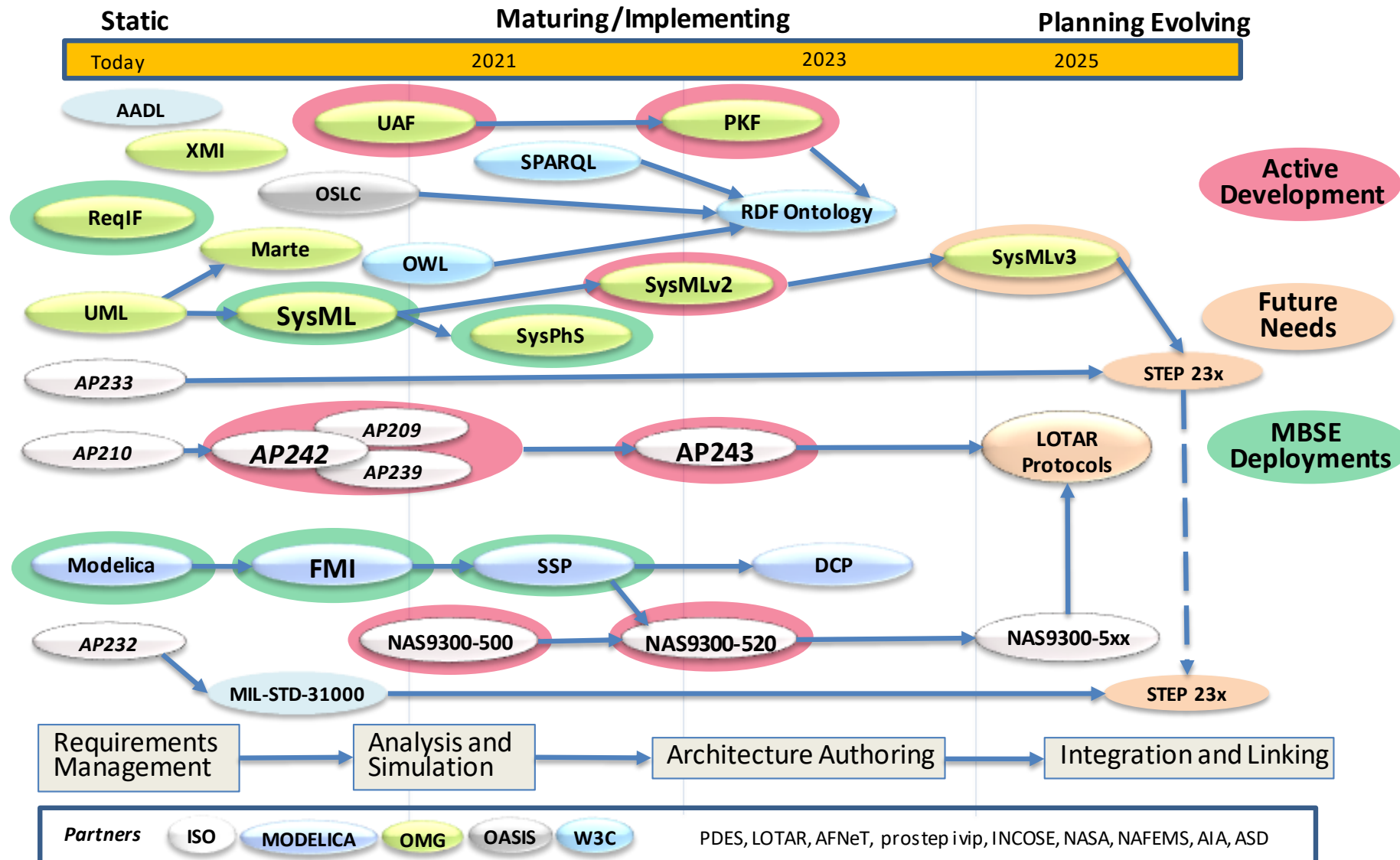
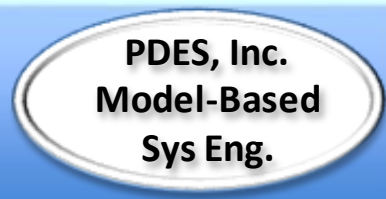
Keep mBSE Simple!


Insert NAFEMS here!

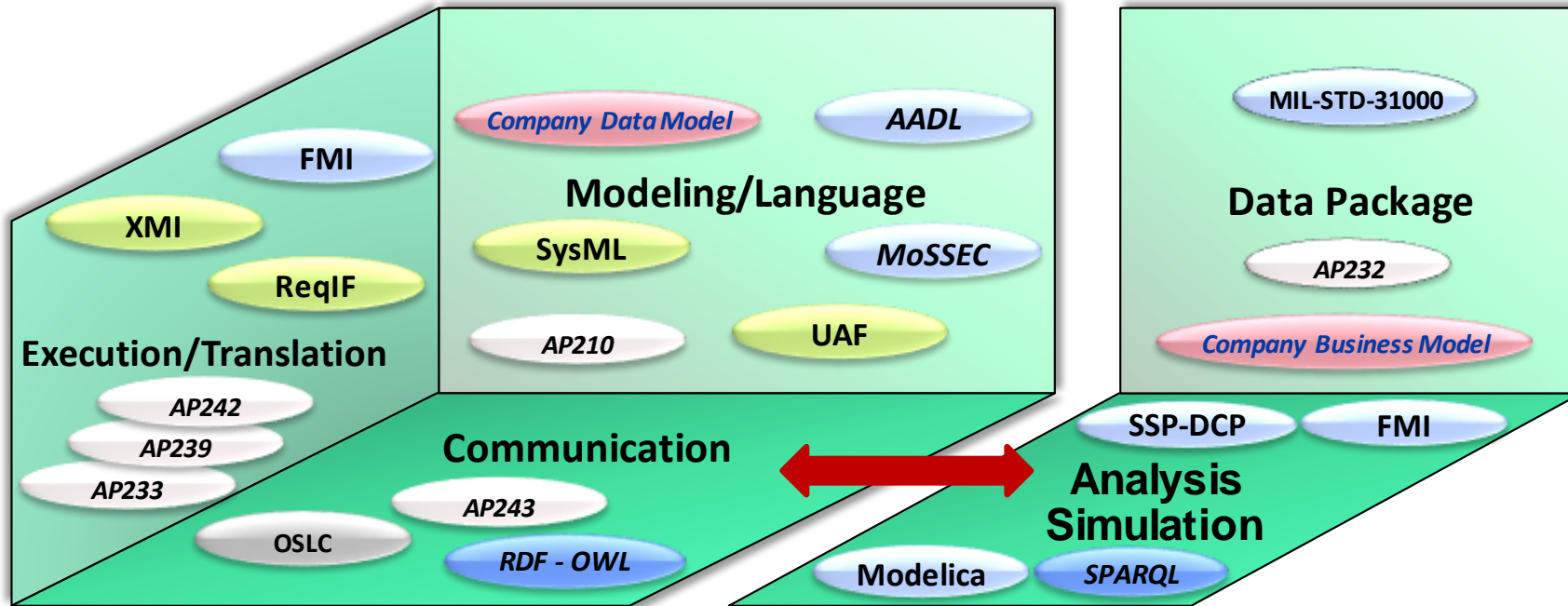


MBSE is achieved if the models are consistent, and are used downstream **without recoding or recreation**

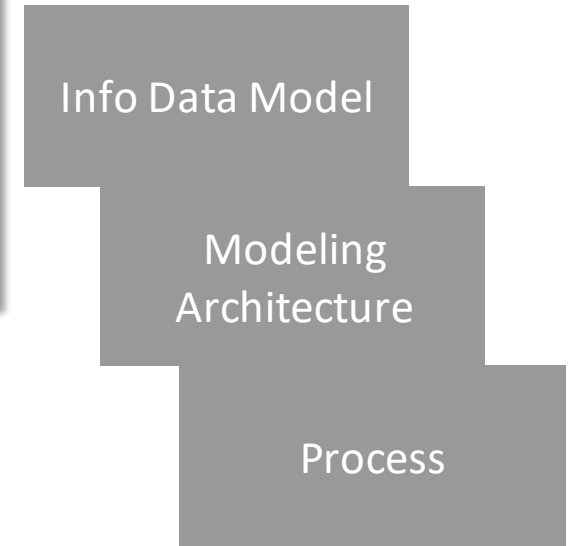
MBSE Standards Roadmap



MBSE Data Standards Domain



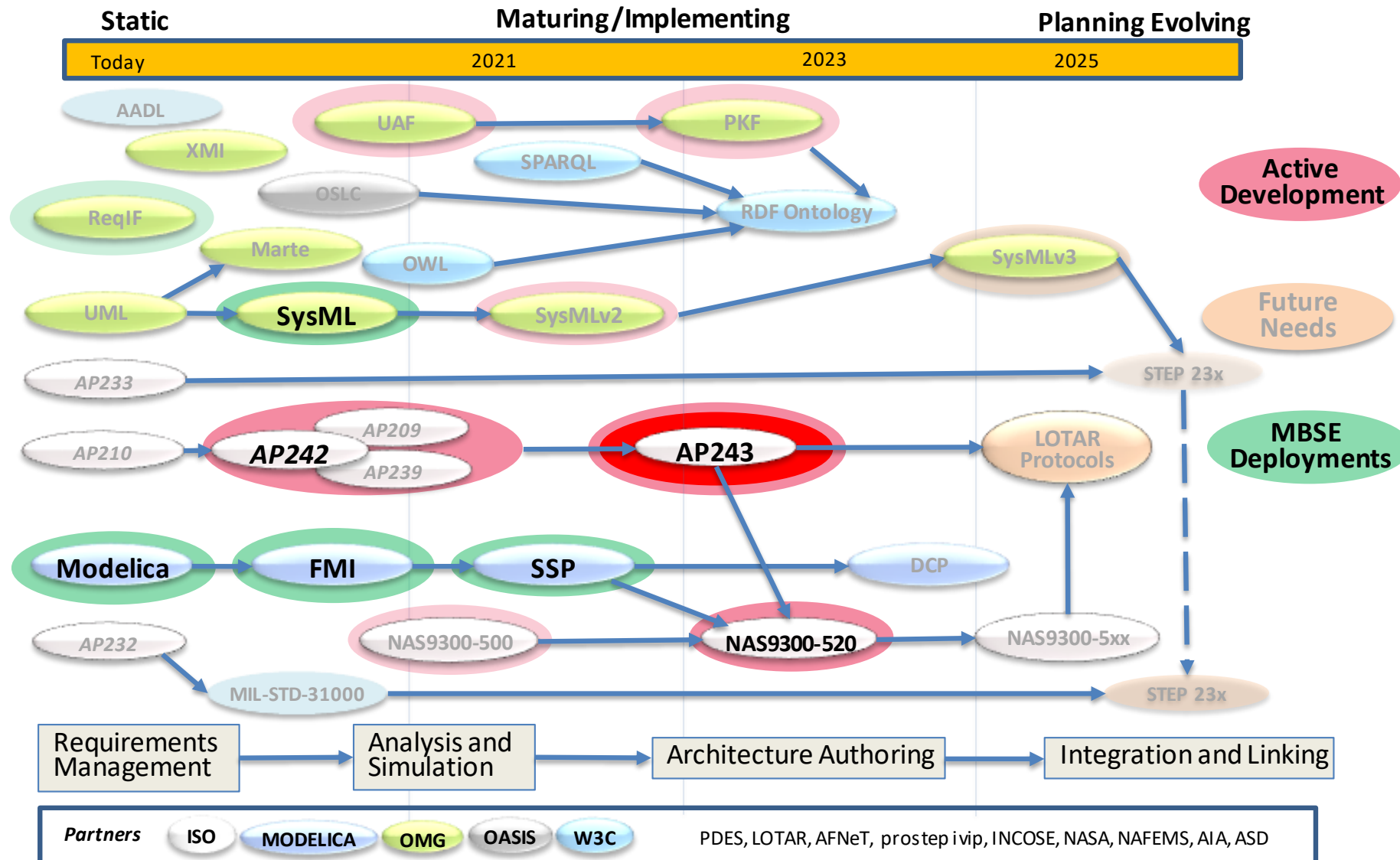
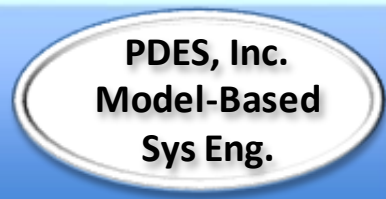
Critical Enablers !



Standard Body Legend

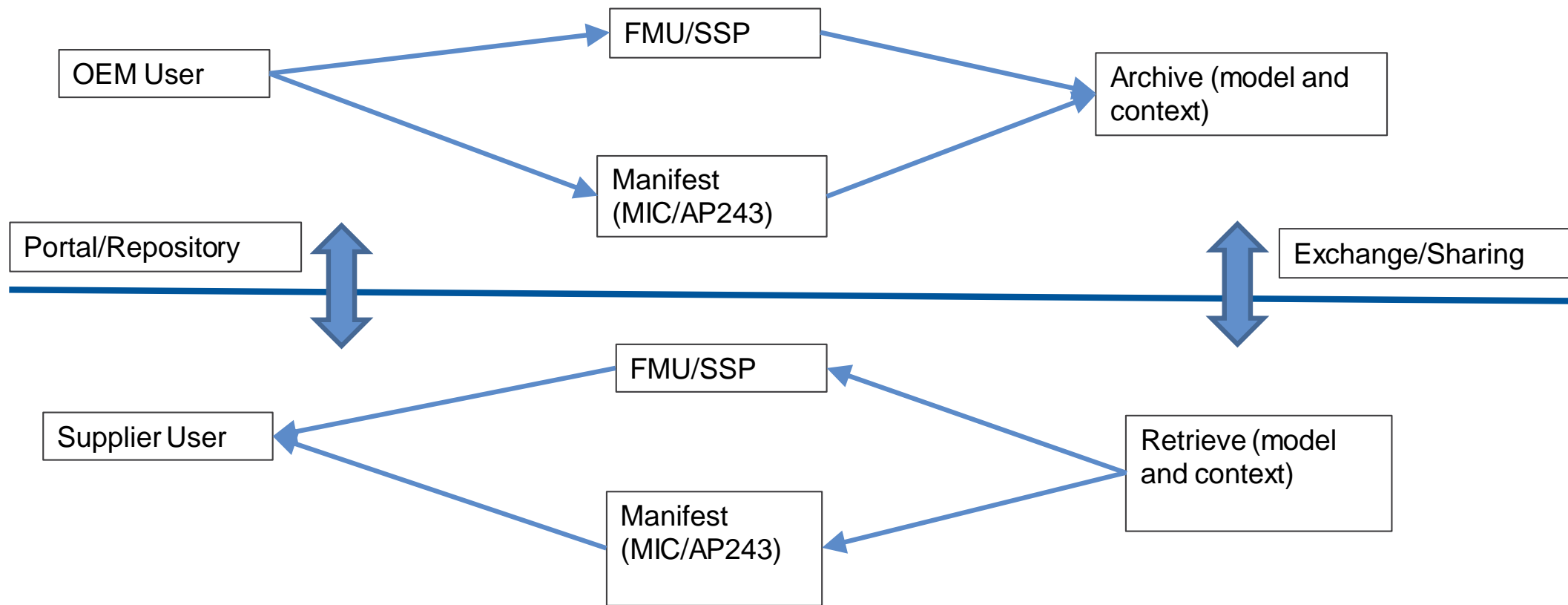


MBSE Standards Roadmap





Archiving or Exchanging is a similar package





Summary: NAFEMS sponsored IF

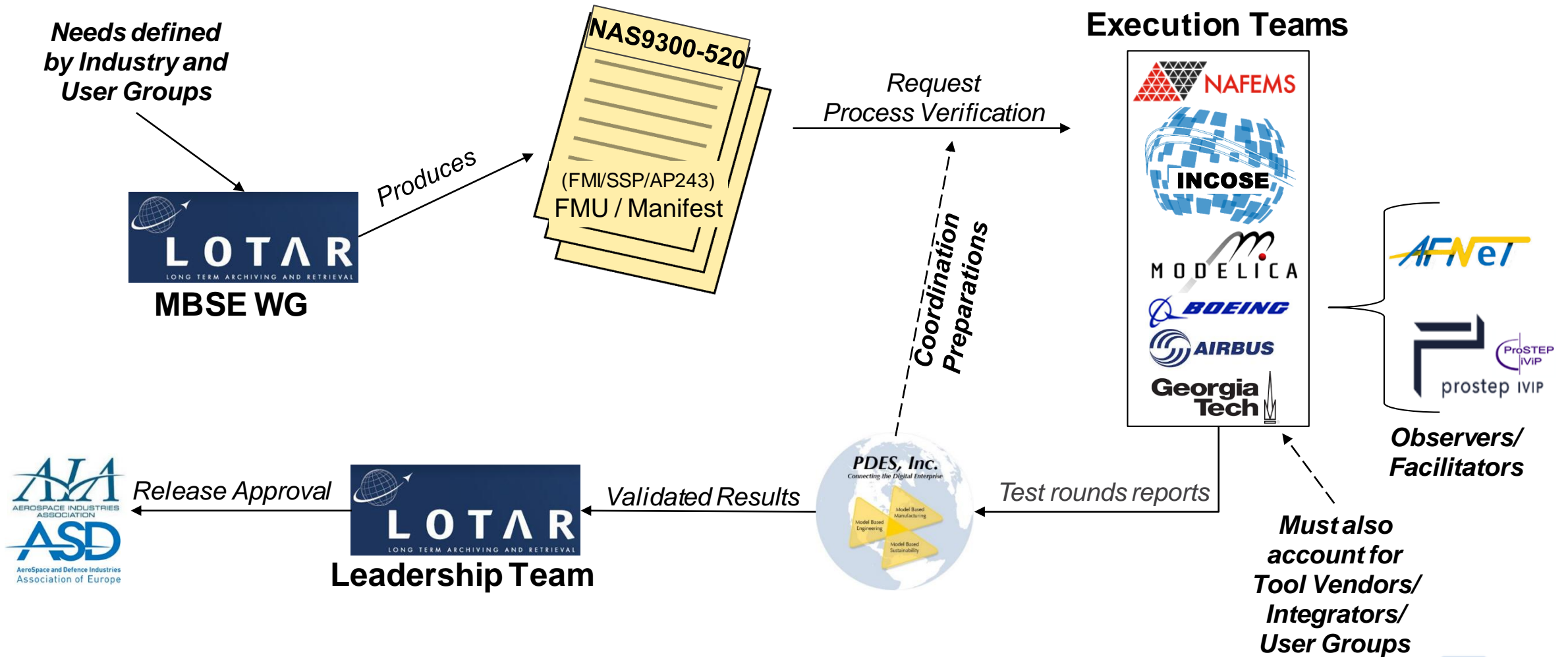
For Data Standards there is a recommended set of best practices for an IF.

- Authorized and moderated by PDES-LOTAR, prostep ivip, or AFNeT.
- Activities are to intended to validate a process, written or coded standard
- Results and participants are published and publically available
- Goal is document/code approval by AIA ([Aerospace Industries Association](#)) and/or ASD ([AeroSpace & Defense Strategic Standardization Group](#)). The IF is defined, sponsored and promoted by a User Group or Industry Consortium (e.g. INCOSE, **NAFEMS**, NDIA, AA, EAA, etc.)

Recommendation is NAS9300-520, (Archiving and Exchanging) Engineering Analysis and Simulation data for MBSE (combines the FMI, SSP, and AP243 data standards)



Validation Proposal for Behavior Models





NAFEMS – Define the Collaboration FMU

BASELINE Example:

Solver is packaged into a license free standalone FMU, or co-simulation FMU, not coupled to a brand of tool. Open library functions. NOT compiled binaries!

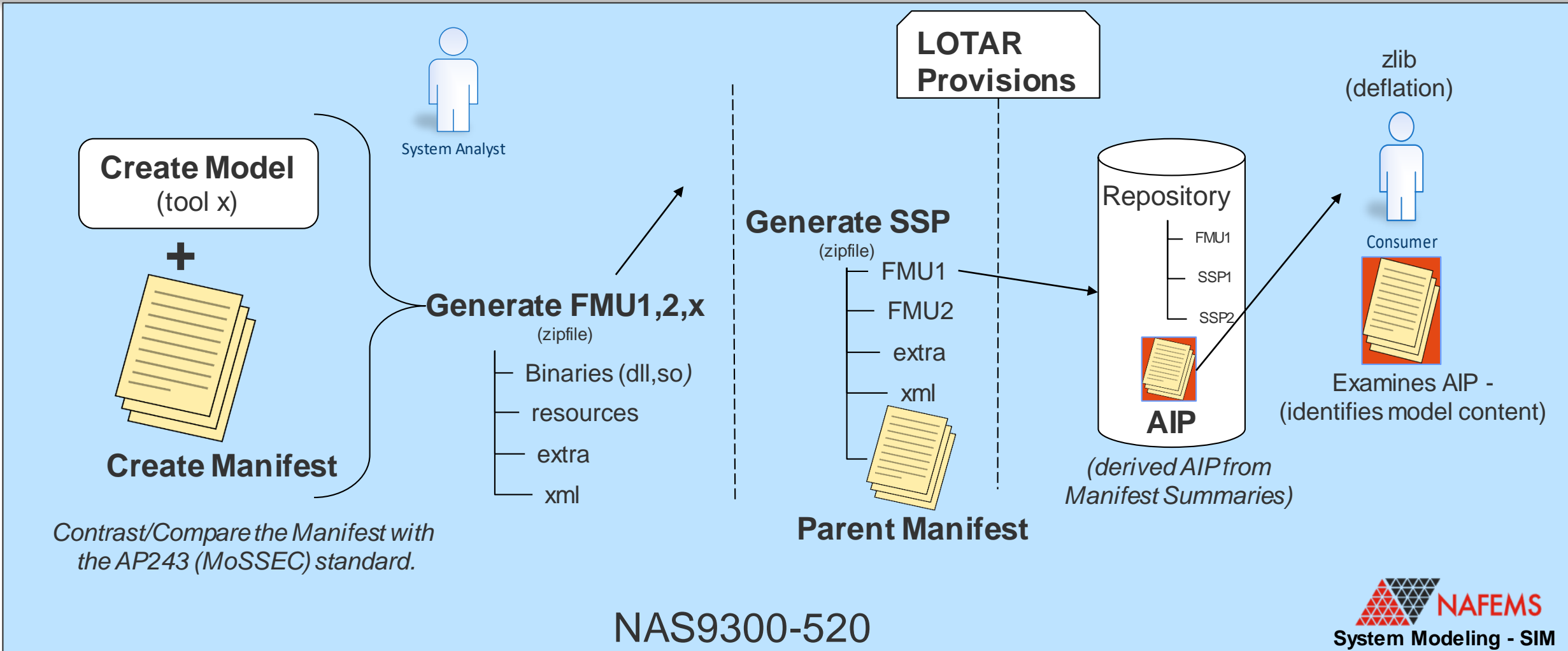


LOTAR MBSE Data Standards

**Target
Activity**

- 500: Fundamentals and Concepts
- 510: Requirements management “text, graphics, tables”, “parameter based”, and coded information
- 515: Validation and Verification requirements information
- 520: Lumped parameters models for behaviours and controls described by specification or executable code, containing differential, algebraic and discrete equations
- 530: Models defined using architecture description languages (ADLs), ISO 42010, e.g. industry standards: AADL, SysML, UML

Archive/Exchange a Behavior Model Package



NAS9300-520



Boeing's Model Identity Card

Integrate the MICs:

1. the System Template from prostep ivip's SmartSE project
2. the Model Identify Card from [SystemX](#)
3. the EDS (Electronic Data Sheet), XML Specification for Electronic Data Sheets Blue Book (876.0)

Boeing's Model Identify Card

BOE-MIC Benefits and History

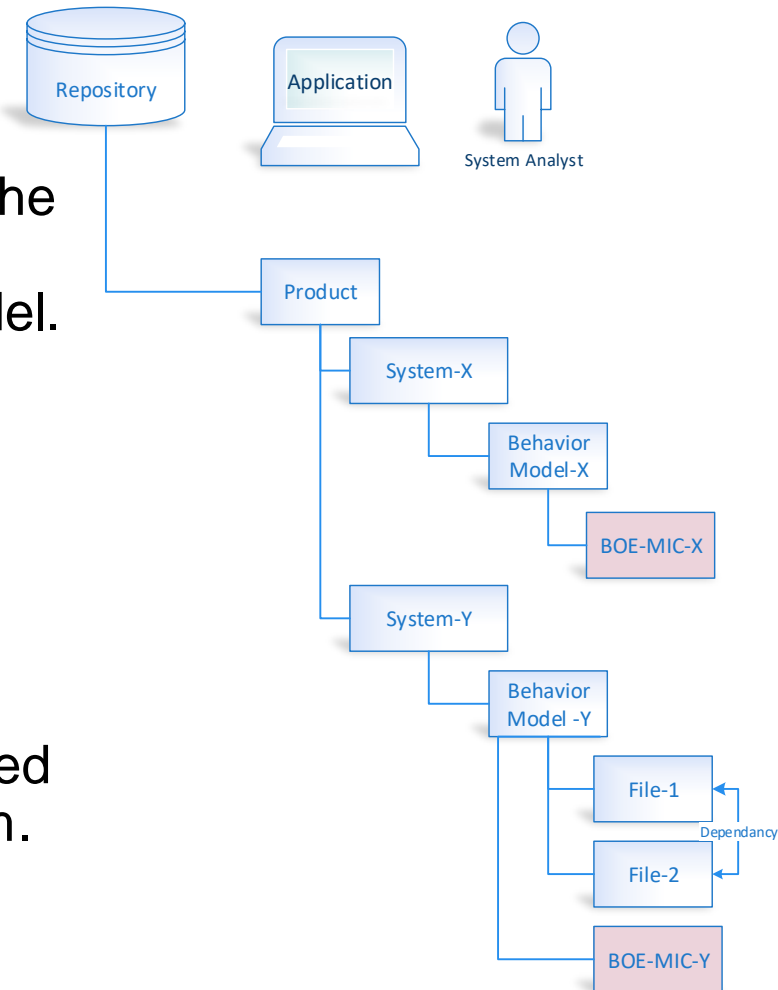
Purpose and Benefits:

- The BOE_MIC is Boeing's version of a model manifest that is designed to capture the PLM and meta-data associated with an analytical behavior model. It defines the model's Design Intent, and a means to identify the model's intended configuration or product application. The BOE_MIC captures a model's pedigree and provenance, and a path for requirements traceability. It enables model archiving and opportunities for reuse.
- The BOE-MIC integrates the best features of existing MICs

How to use the BOE-MIC?

The BOE-MIC defines a behavior, control, or validation model's purpose, context, and applicability. It contains the meta-data needed by other users to identify, categorize and reuse the model. The validation data may actually be comprised of multiple files or models that are represented by the MIC.

A significant portion of the meta-data captured within a BOE-MIC can be automatically populated by the parent application and subsequently consumed based on the ability of the PLM system.



Implementing Boeing's Model Identify Card

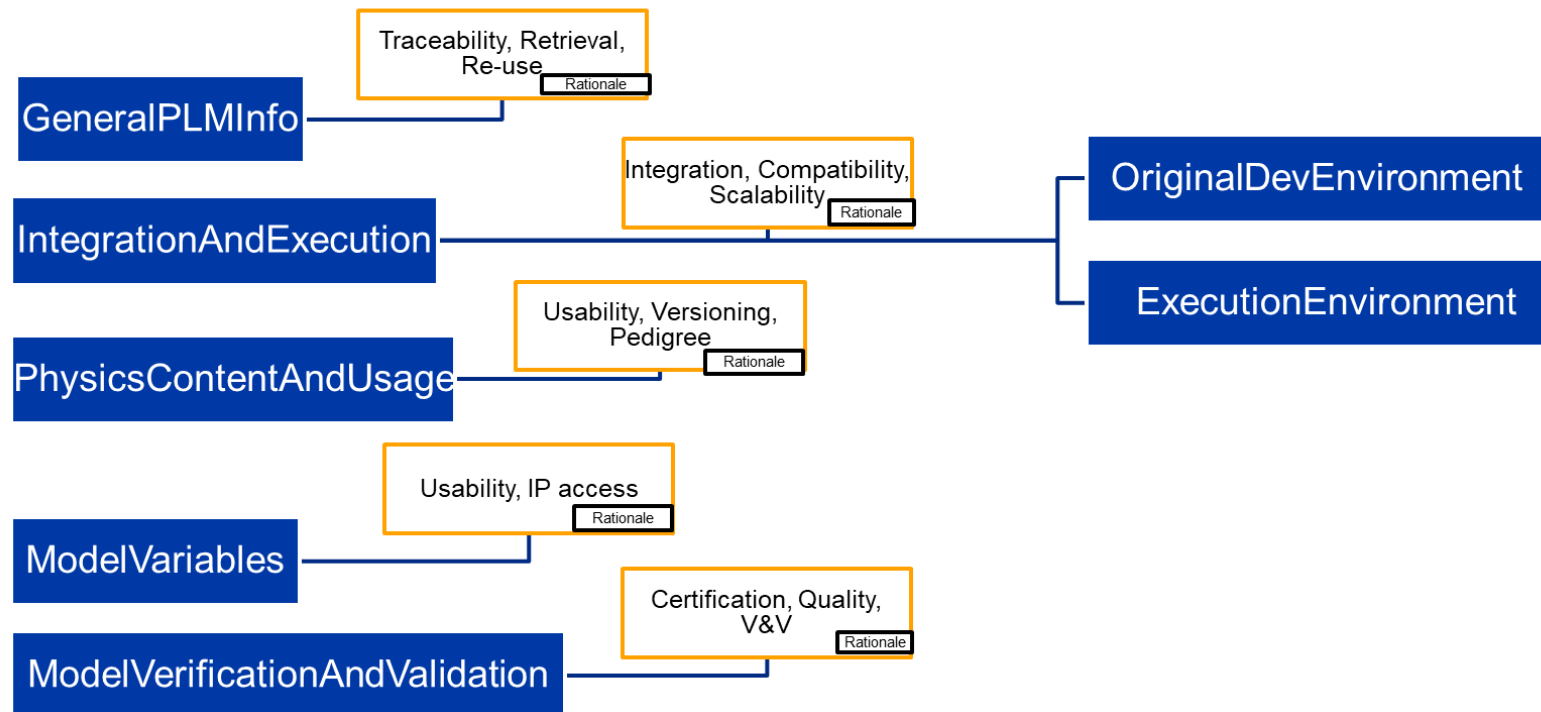
- The *Boeing MIC* will be mandatory for any math or multi-physics model that implements a final design decision, validates a product requirement, and/or substantiates the configuration of the product design.
- The *Boeing MIC* will be a delta increment (and not redundant) to what is already exposed in the FMU's ModelDescription.xml, Modelica's documentation class, and other standard meta-data exposition files.
- The *Boeing MIC* will be required for Boeing's Suppliers and Partners that collaborate in the design - build process.
- The *BOEING MIC* will be the path that prepares us for the implementation of ISO 10303-243 (MoSSEC) when implemented by the solution provider's applications.

FMU – is a functional mock-up unit generated by the [FMI](#) data standard

[Modelica](#) is a non-proprietary modeling language that supports multi-physics representations

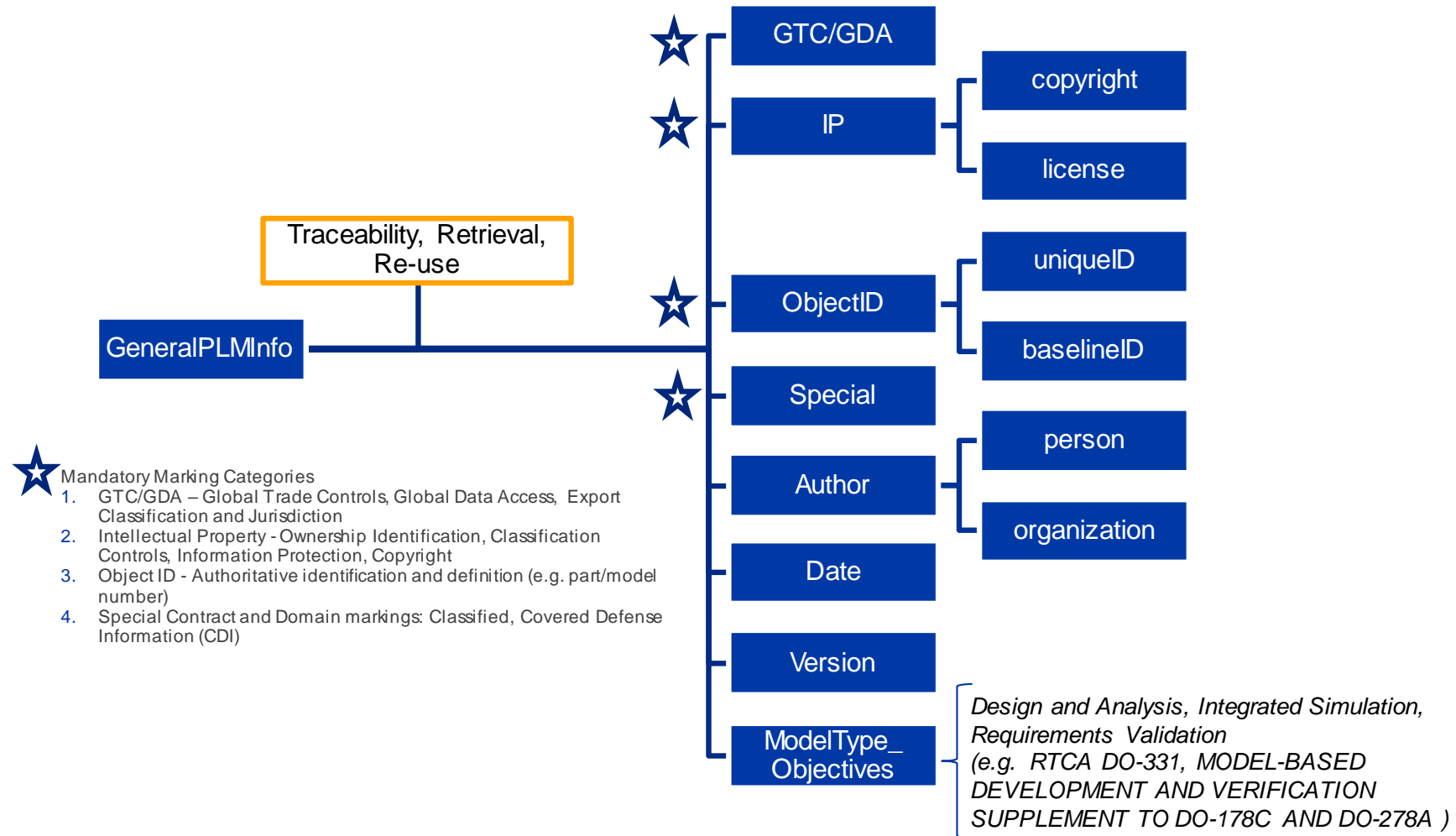
ISO 10303-243 is the application protocol for Modelling and Simulation information in a Systems Engineering Context

The BOE-MIC – Main fields and rationale

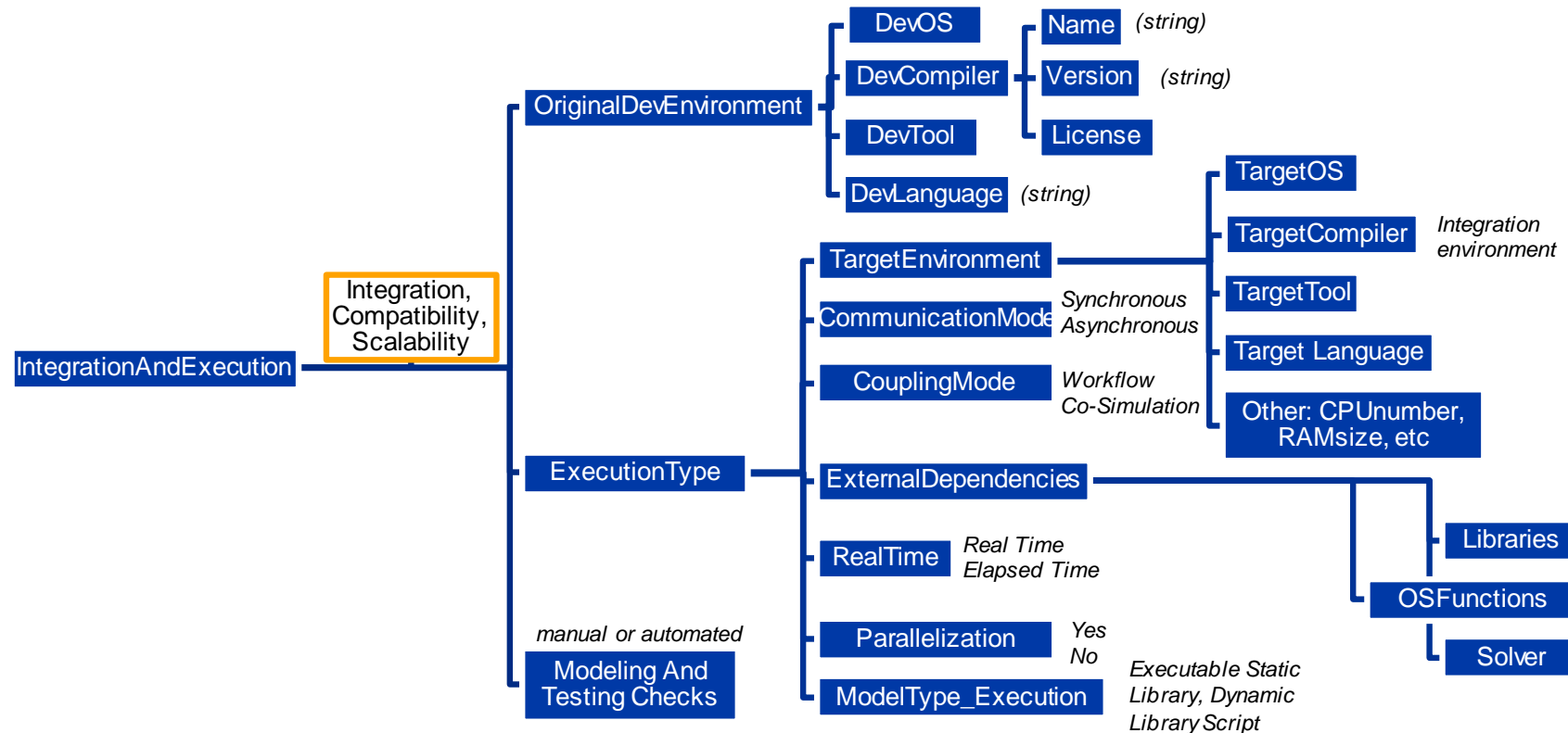


The Boeing MIC will be a OEM-Supplier shared responsibility and maintained at different stages in the model lifecycle

The BOE-MIC – General PLM Info

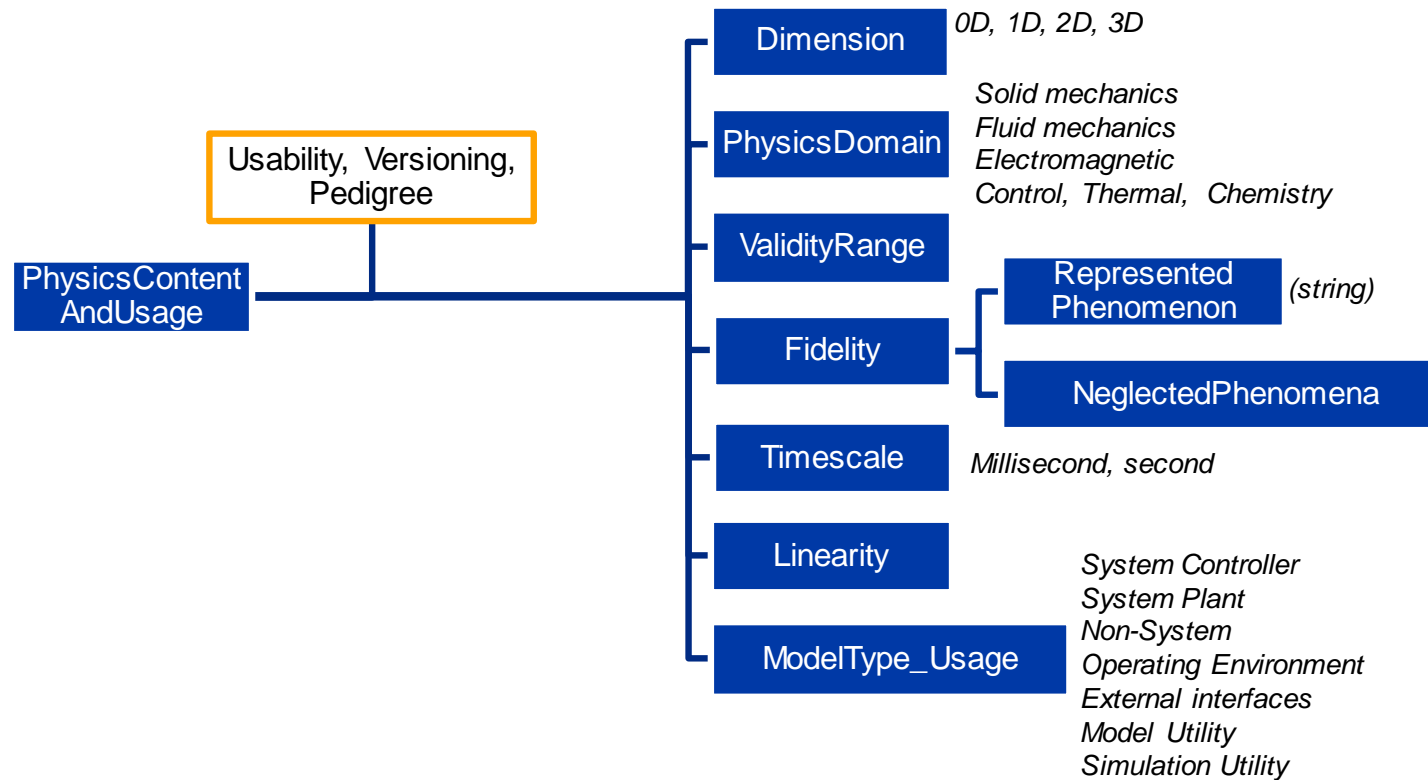


The BOE-MIC – Integration and Execution

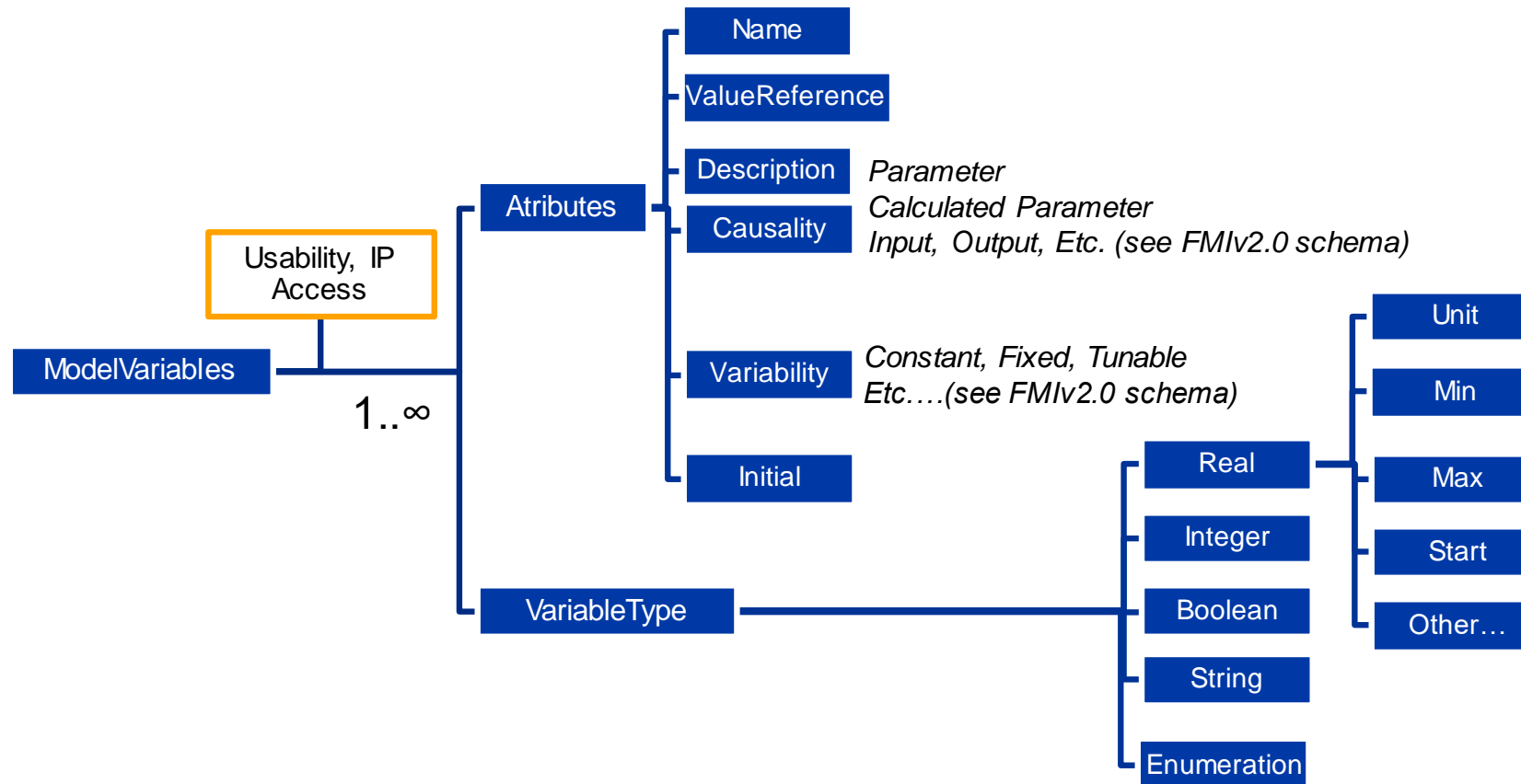


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The BOE-MIC – Physics, Content and Usage



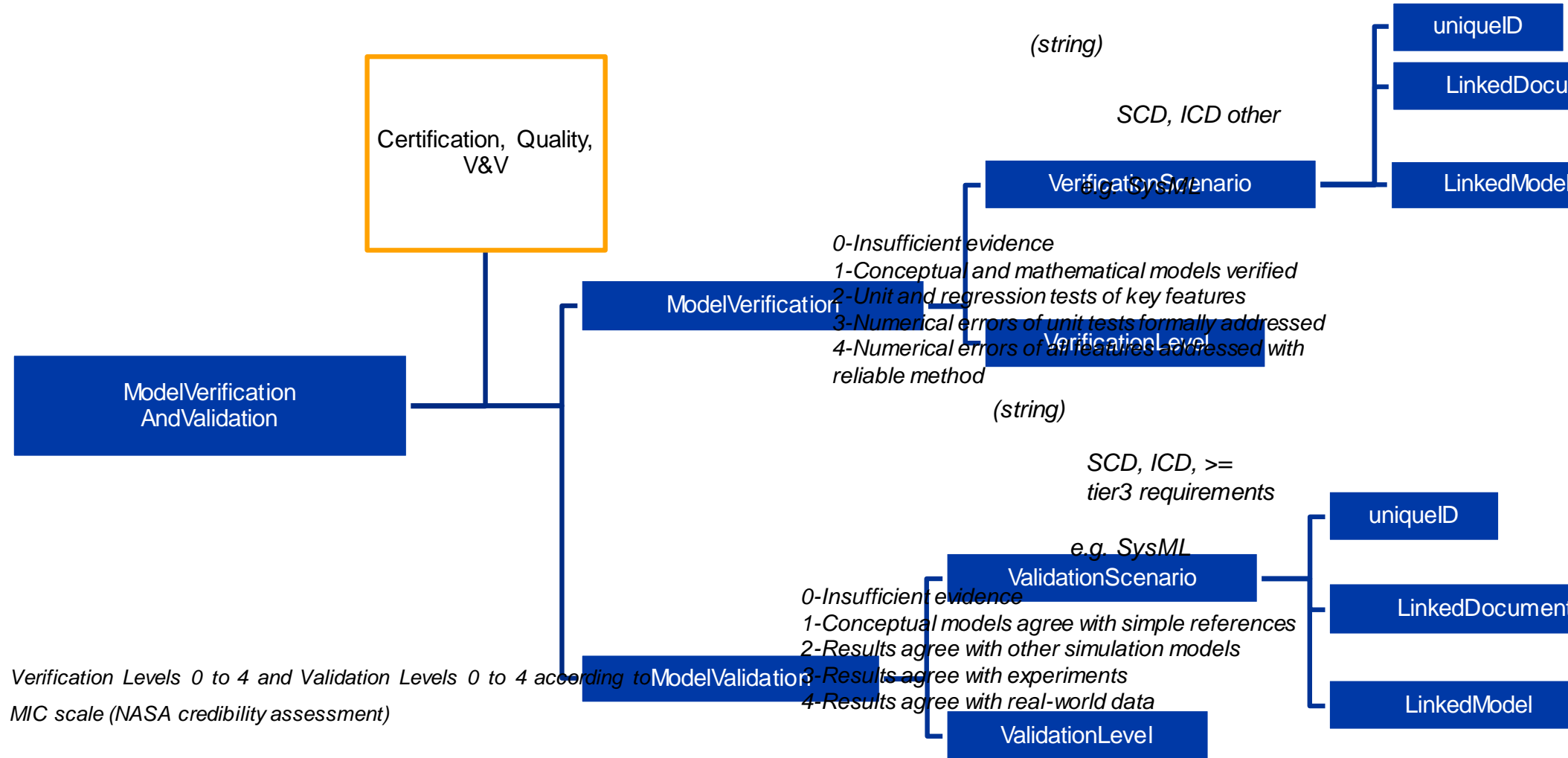
The BOE-MIC – Model Variables



Model Variables fields should be fully compliant with FMI ModelDescription.xml schema

[Link to FMIV2.0 Model Description.xml schema](#)

The BOE-MIC – Verification and Validation





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