33rd Annual INCOSE international symposium

hybrid event

Honolulu HI USA

Presenters: Kyle Hall – Airbus
Juan Carlos Mendo – Boeing

MoSSEC – The common meta language supporting digital transformation

Introductions

Kyle Hall is the Airbus lead for ISO 10303-243:2021 (MoSSEC). The focus of their career has been to realise methods to digitize and transform the ways in which knowledge can be made accessible to machines - in close cooperation with international partners across industries and academia. In their current role as an Airbus Data Driven System Engineer they are working closely with Airbus' digitalization transformation community to produce and procure solutions which answer the domain specific requirements of Airbus' Centres of Competence, while also providing effective interoperability amongst Airbus teams, their systems and Airbus' extended enterprise partners.

Introductions

Juan Carlos Mendo is a Systems Engineer lead in the Boeing Research & Technology organization. As part of the Model-Based Engineering (MBE) team in Boeing R&D, He is 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. Juan Carlos is 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).

01 What is MoSSEC?

02 Why MoSSEC?

03 How to apply MoSSEC

04 MoSSEC and Long Term Archive and Retrieval

01

What is MoSSEC?

MoSSEC and
Long Term Archive and
Retrieval

02

04

Why MoSSEC?

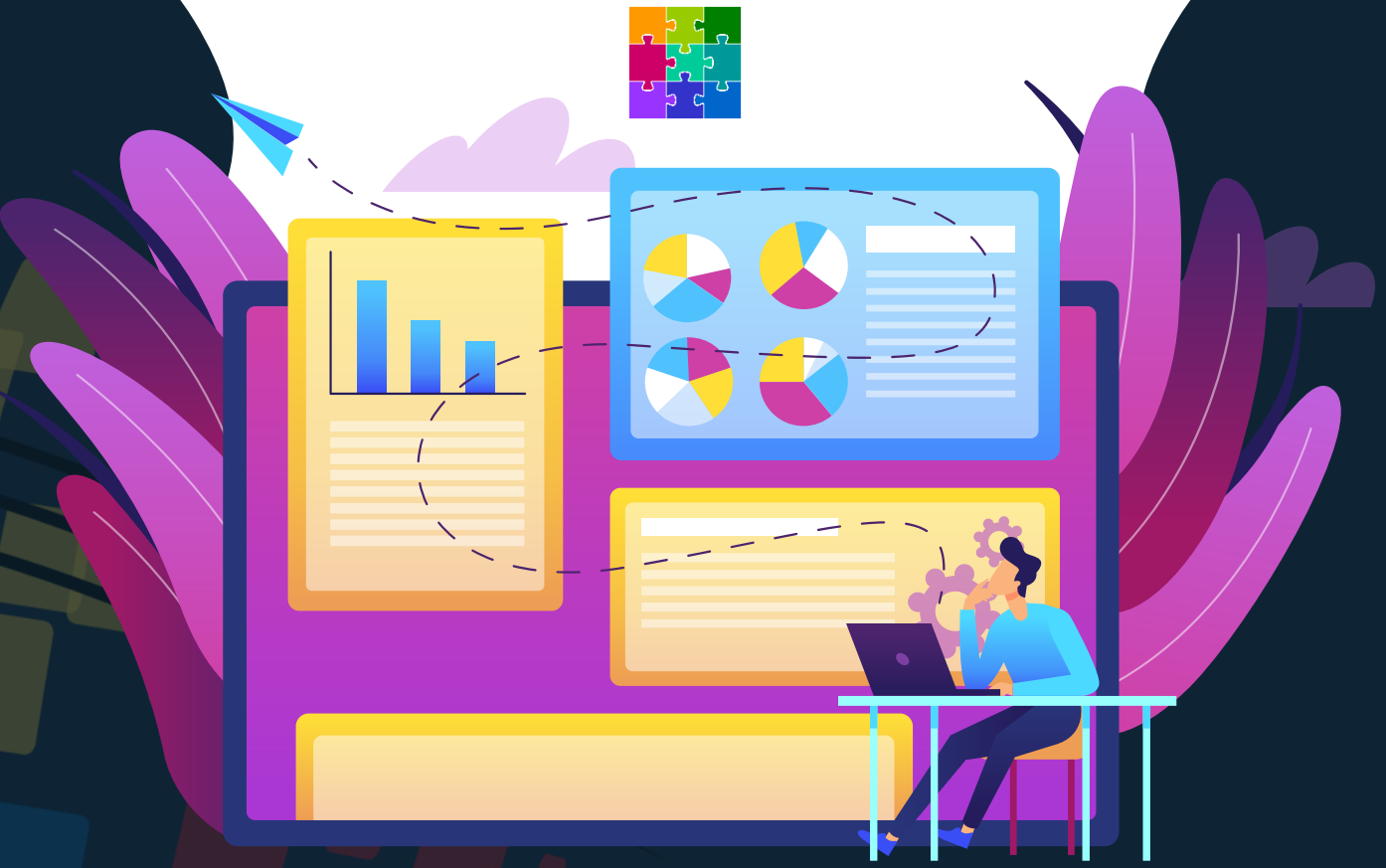
How to apply MoSSEC

03

MoSSEC

Modelling and
Simulation information in a
collaborative
Systems
Engineering
Context

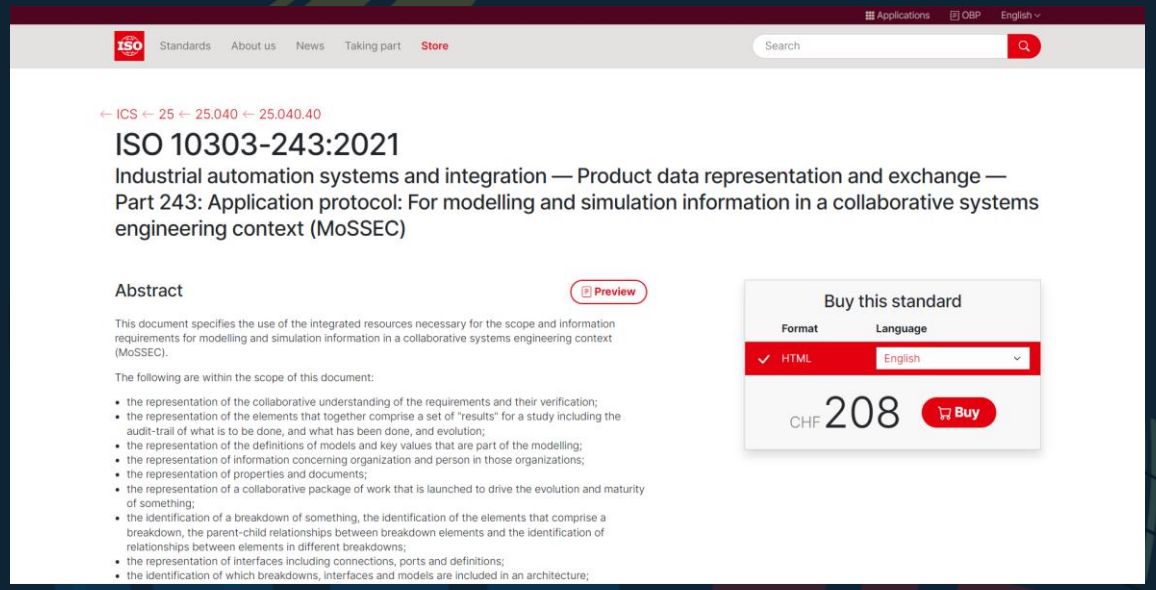
“**MoSSEC** enables Engineering Architects to connect Modelling and Simulation capabilities across the Extended Enterprise using a robust, stable and value proven ISO methodology.”



The MoSSEC Standards

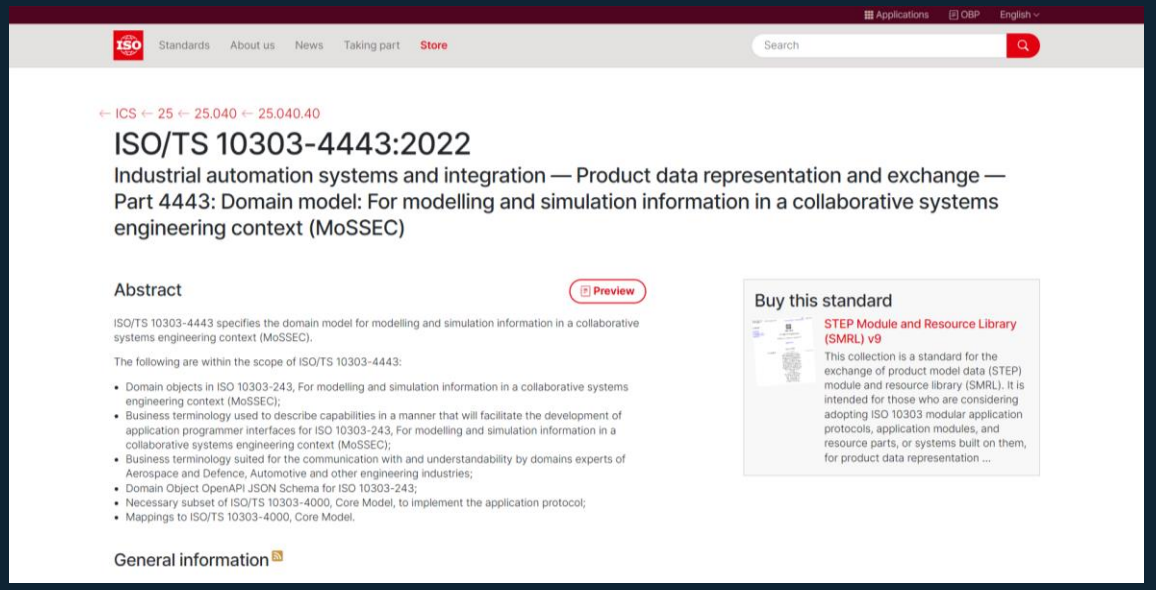
ISO 10303-243
The MoSSEC Application Protocol

A complete activity flow describing how to perform M&S activities in a collaborative systems engineering context

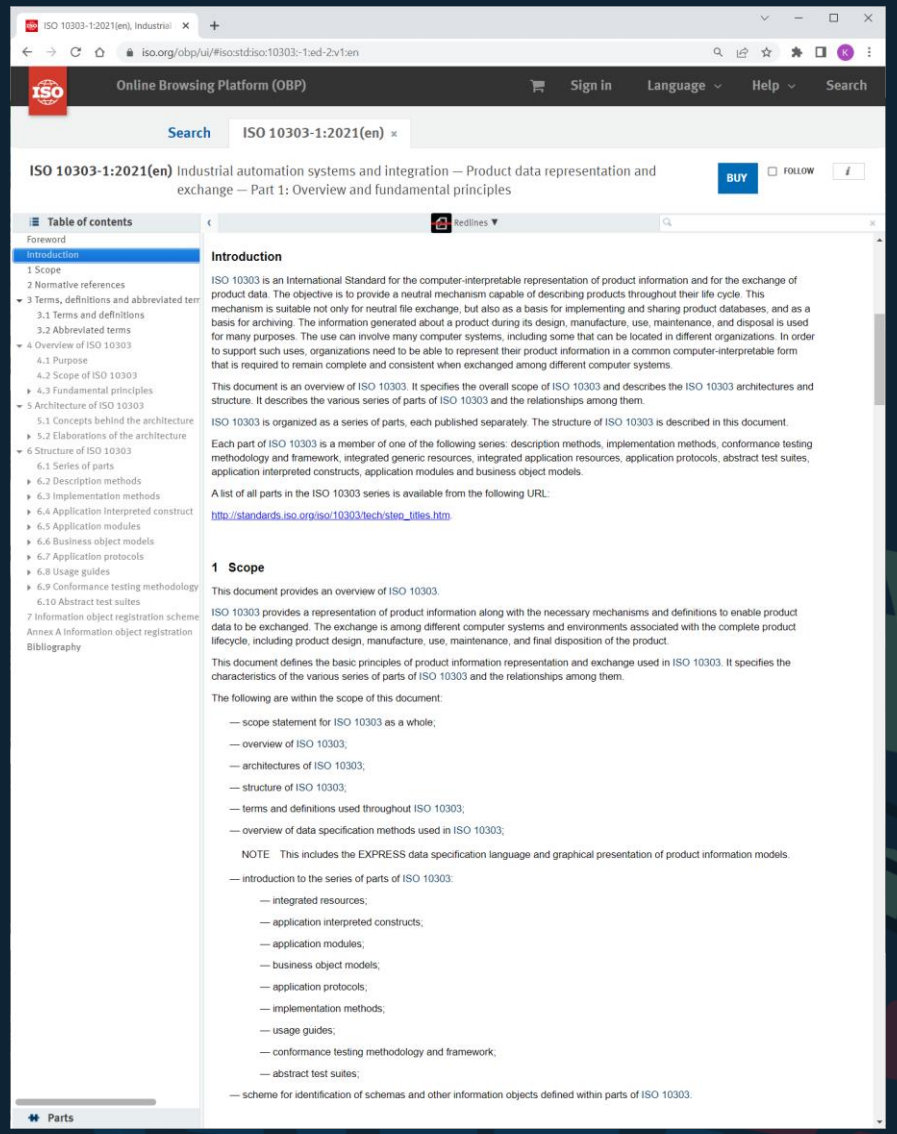


ISO 10303-4443
The MoSSEC Domain Model

The domain neutral object model used to share the context behind decisions made in collaborative M&S activities



The STEP Standards – ISO 10303



"ISO 10303 is an International Standard for the computer-interpretable representation of product information and for the exchange of product data.

The objective is to provide a neutral mechanism capable of describing products throughout their life cycle.

This mechanism is suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases, and as a basis for archiving.

The information generated about a product during its design, manufacture, use, maintenance, and disposal is used for many purposes.

The use can involve many computer systems, including some that can be located in different organizations.

In order to support such uses, organizations need to be able to represent their product information in a common computer-interpretable form that is required to remain complete and consistent when exchanged among different computer systems." **- ISO**

The MoSSEC Domain Model

The MoSSEC Domain Model

Security & Trust

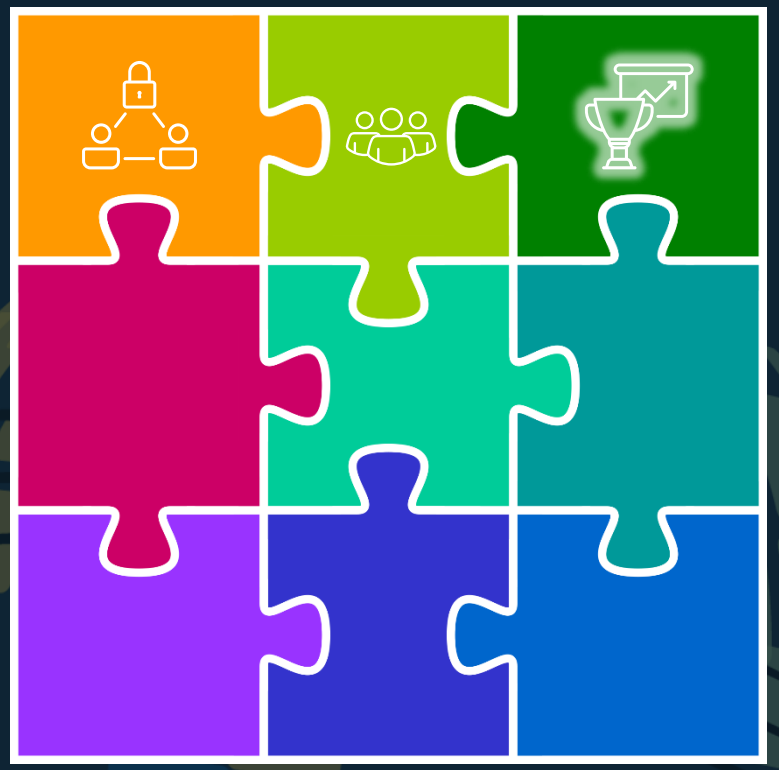
- Collaboration contracts
- Access rights
- Security classifications

The MoSSEC Domain Model

Actors & Organizations

- Organizations
- Persons
- Teams

The MoSSEC Domain Model



Value Generation

- Expectations
- Needs and Goals
- Value Creation Strategy

The MoSSEC Domain Model

Requirements and Quality

- Requirements
- Approvals
- Assumptions
- Justifications
- Quality Gates

The MoSSEC Domain Model

Study Management

- Studies
- Objectives
- Concepts

The MoSSEC Domain Model

Models Management

- Model Networks
- Model Instances and Types
- Key Values

The MoSSEC Domain Model

Methodologies

- Templates
- Methods
- Libraries

The MoSSEC Domain Model

Architecture & Interfaces

- Connections
- Components
- Breakdowns

The MoSSEC Domain Model

Optimisation

- Objectives
- Variables
- Uncertainties

01 What is MoSSEC?

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The DIKW pyramid

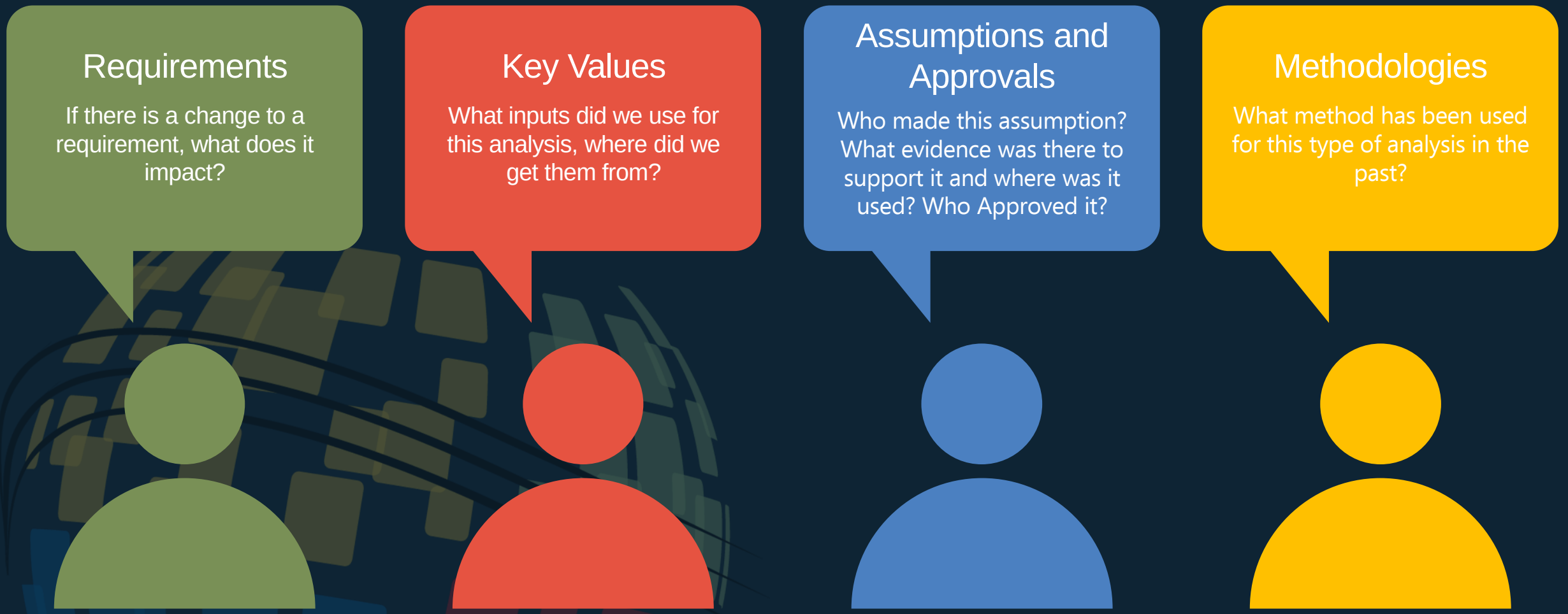
Wisdom
Application of Knowledge

Knowledge
Understanding of Information

Information
Contextualization of Data

Data
Raw facts and figures

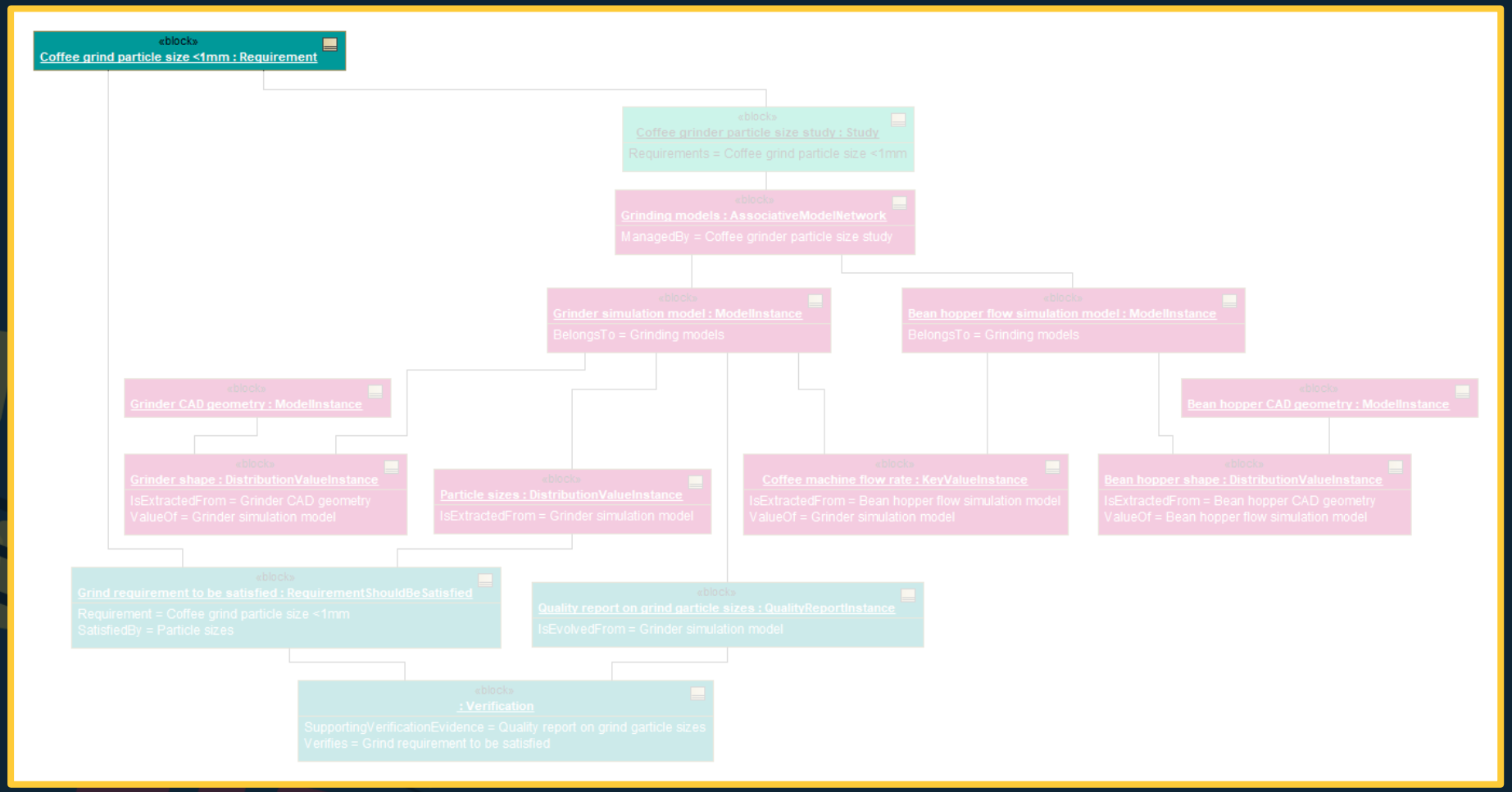
Typical painful queries



A MoSSEC resolution

Requirements

If there is a change to a requirement, what does it impact?



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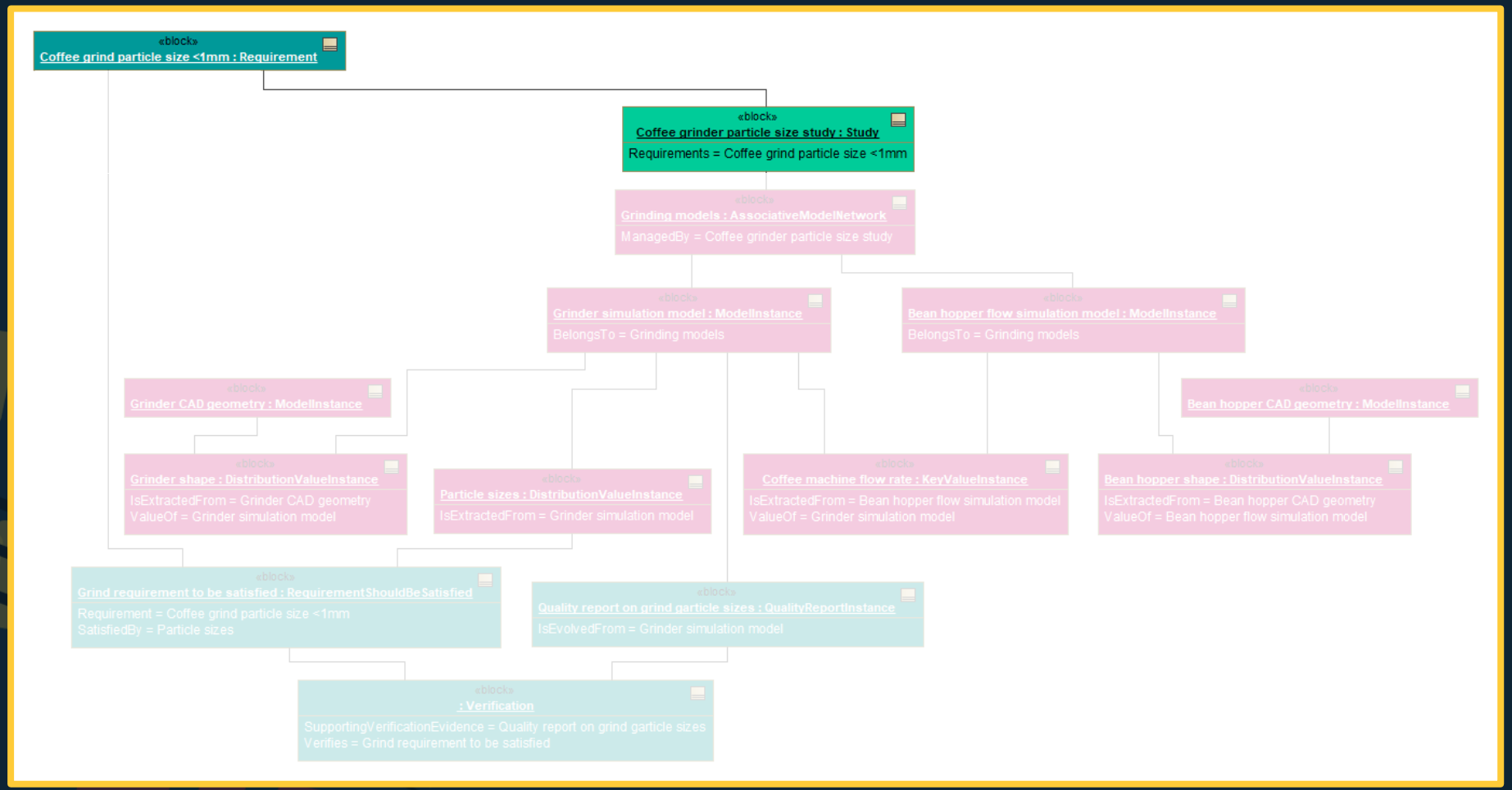

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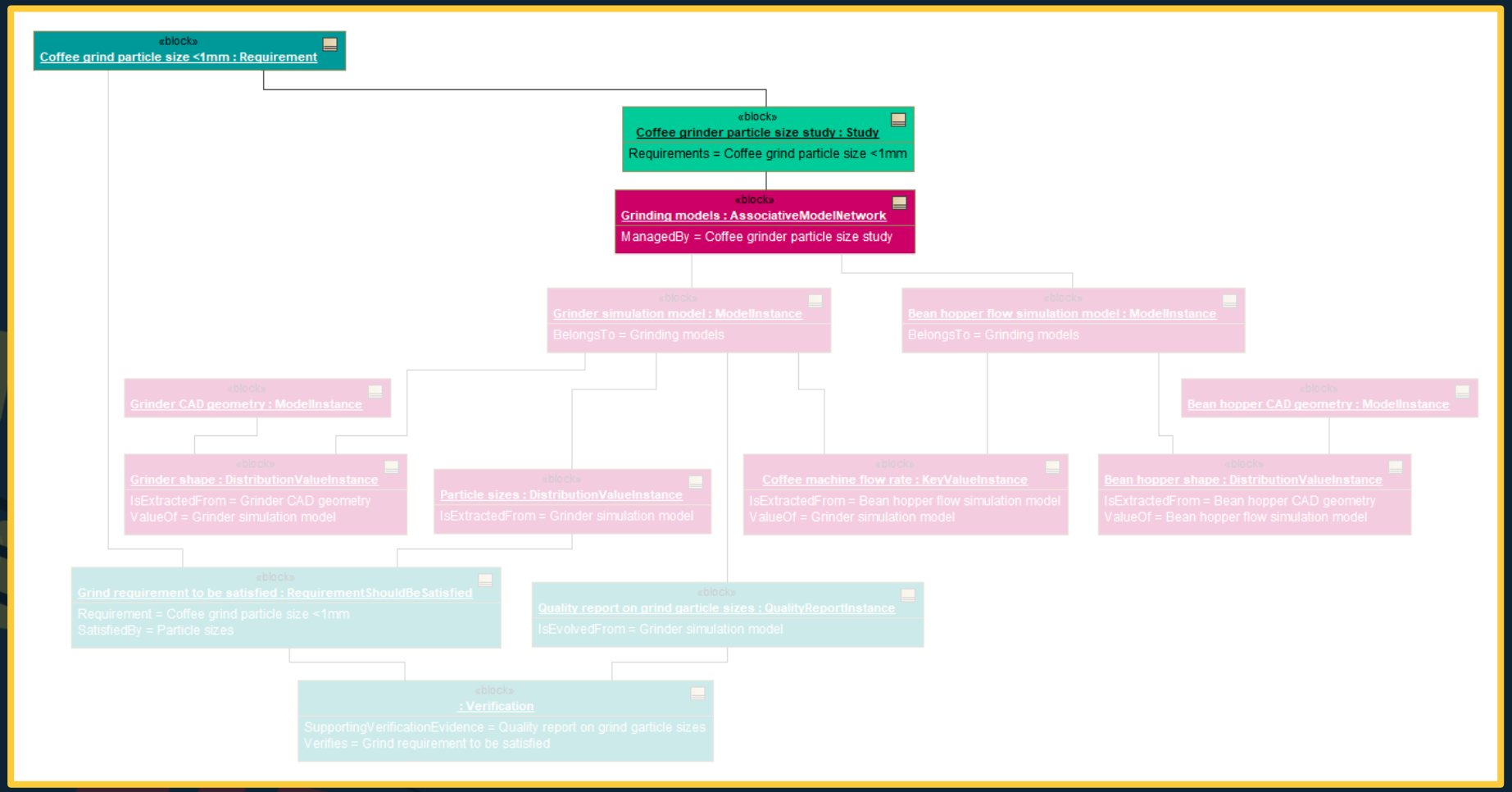

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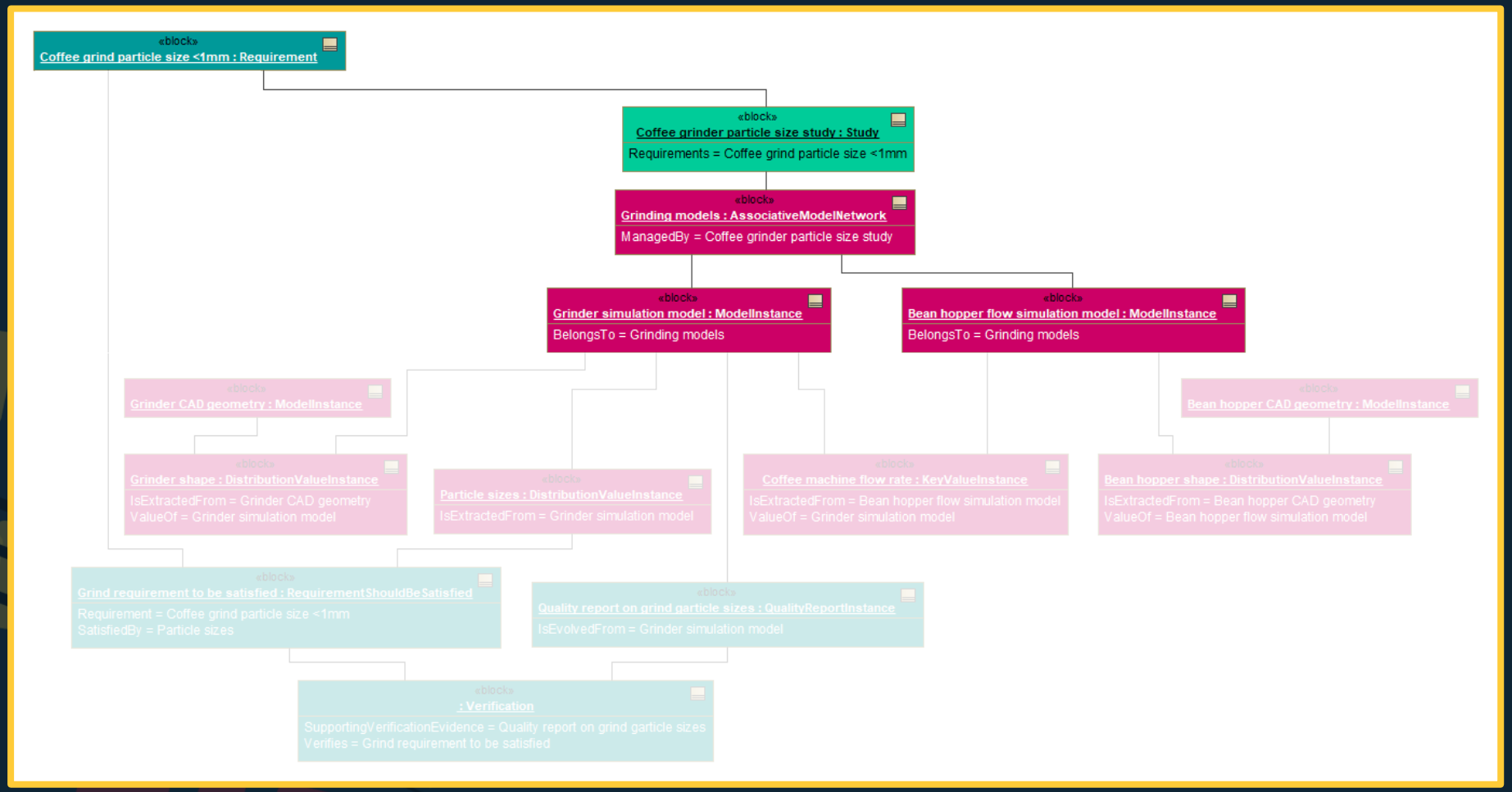

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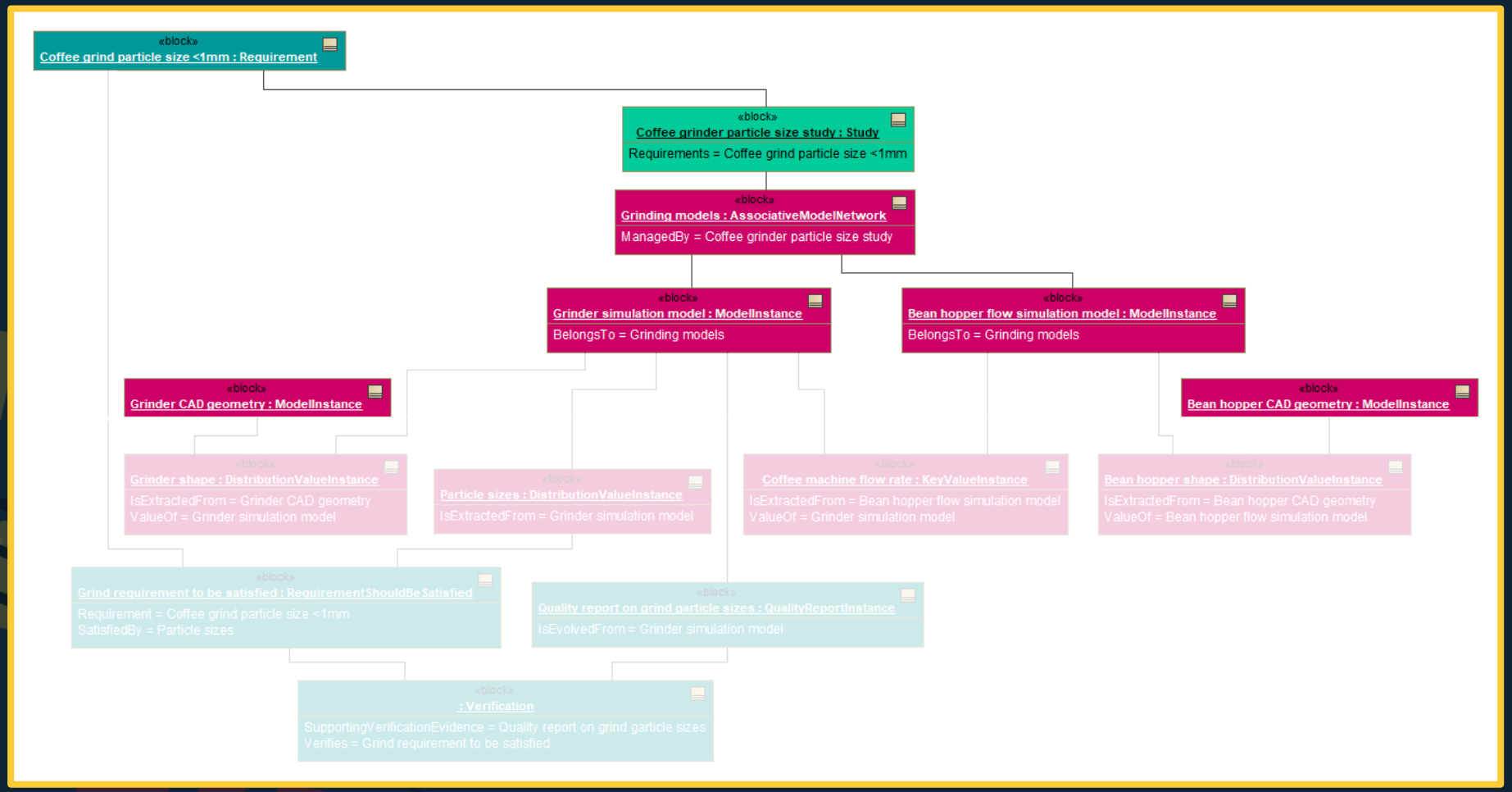

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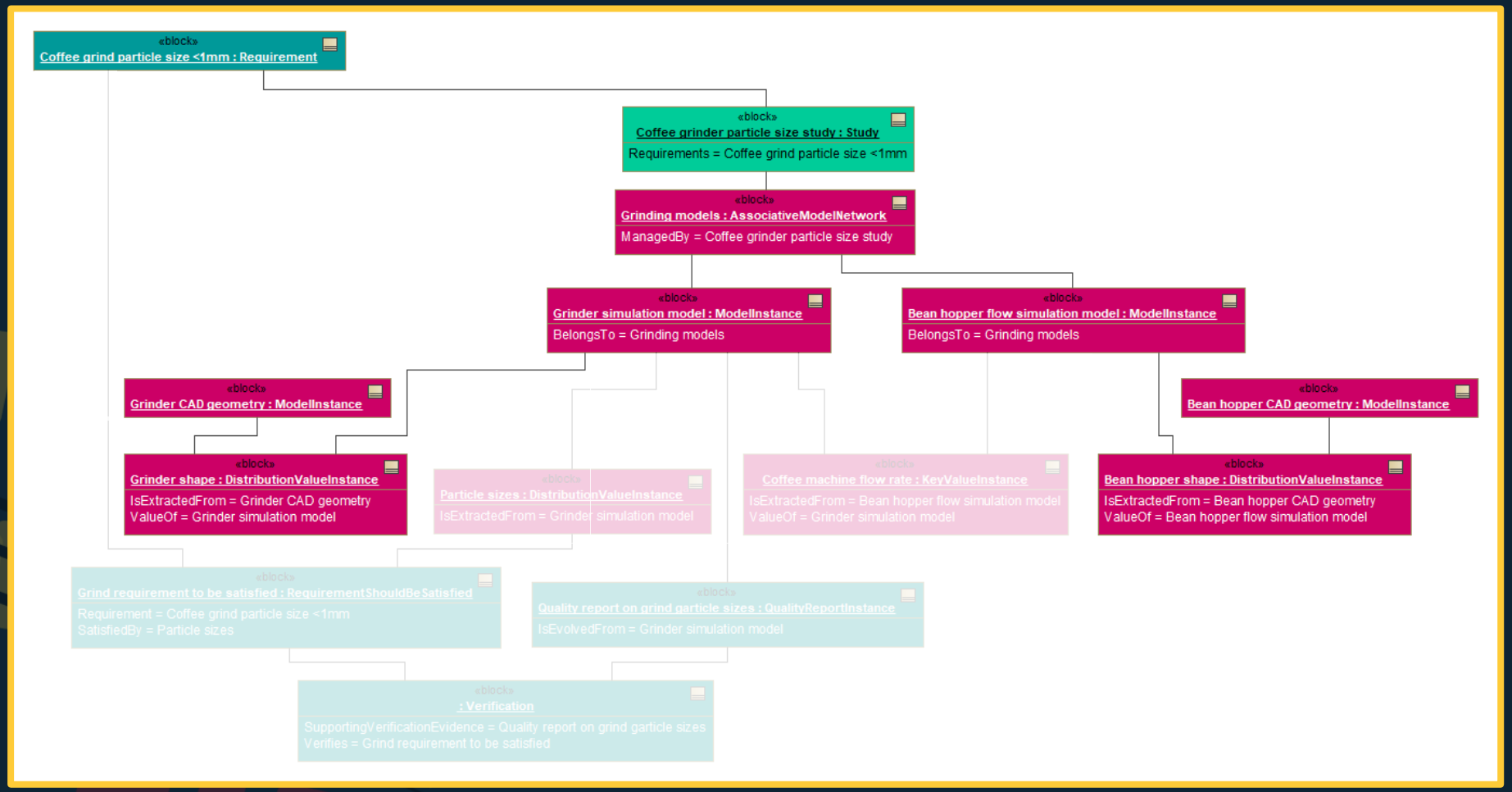

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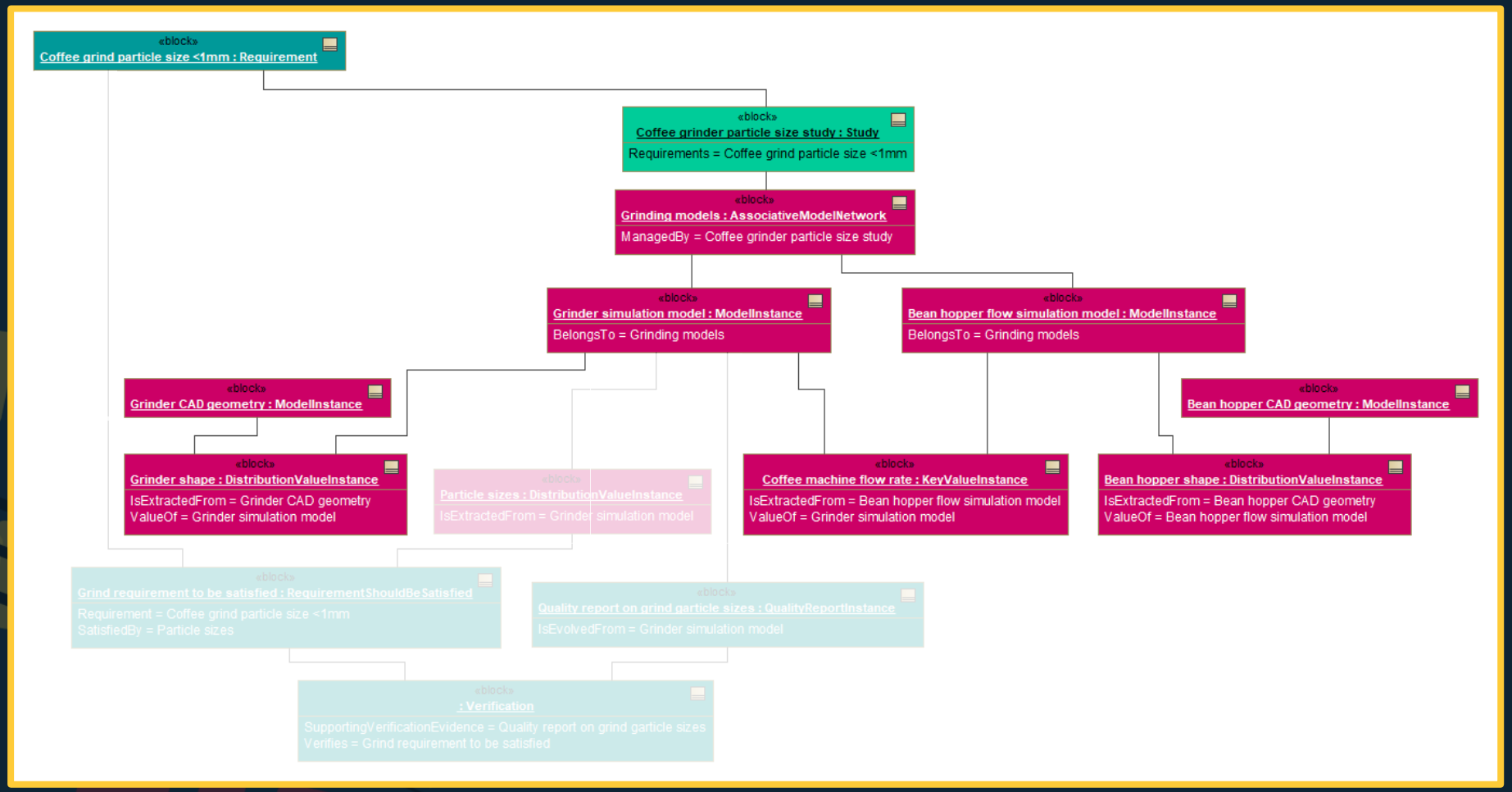

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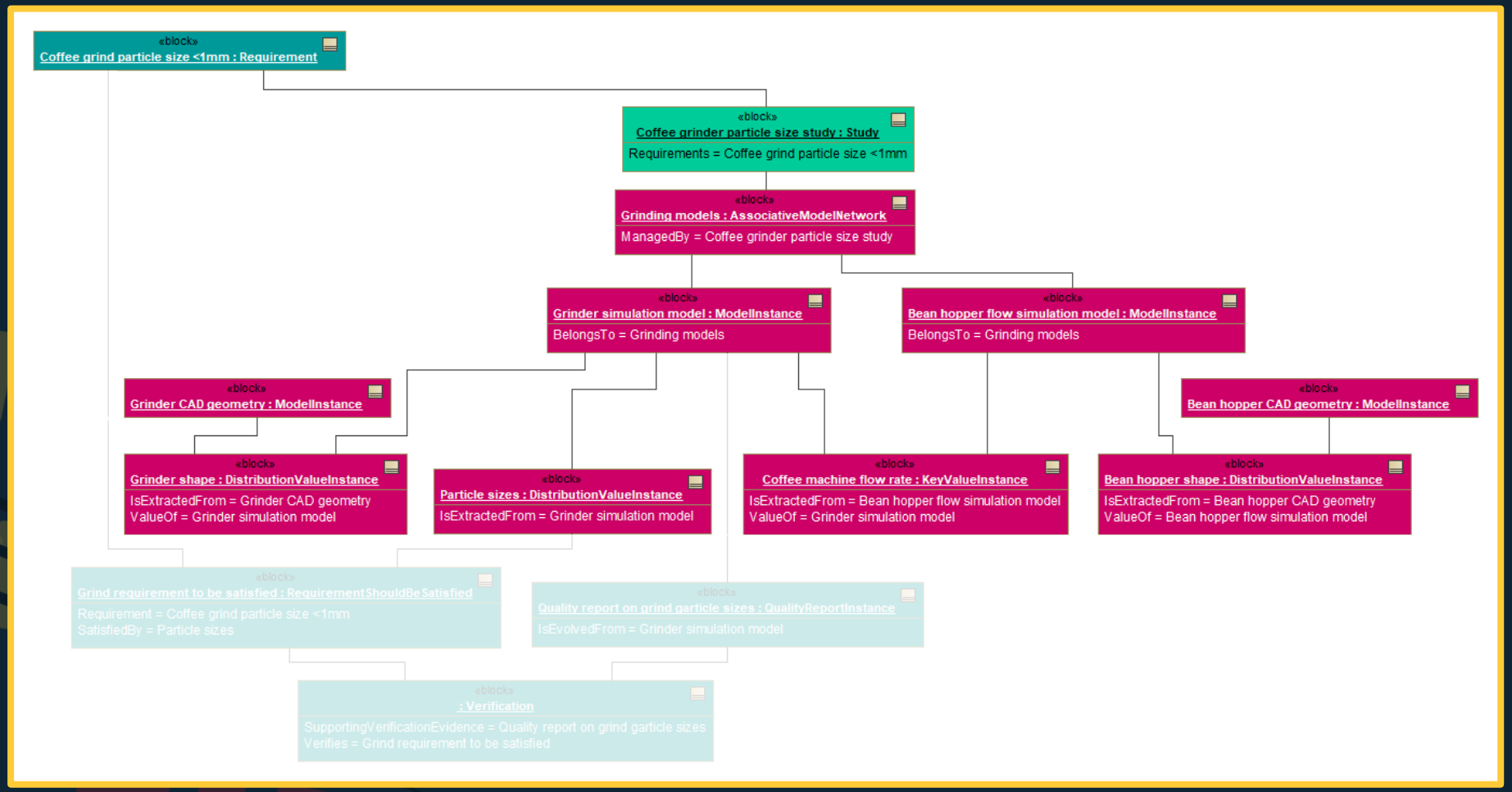

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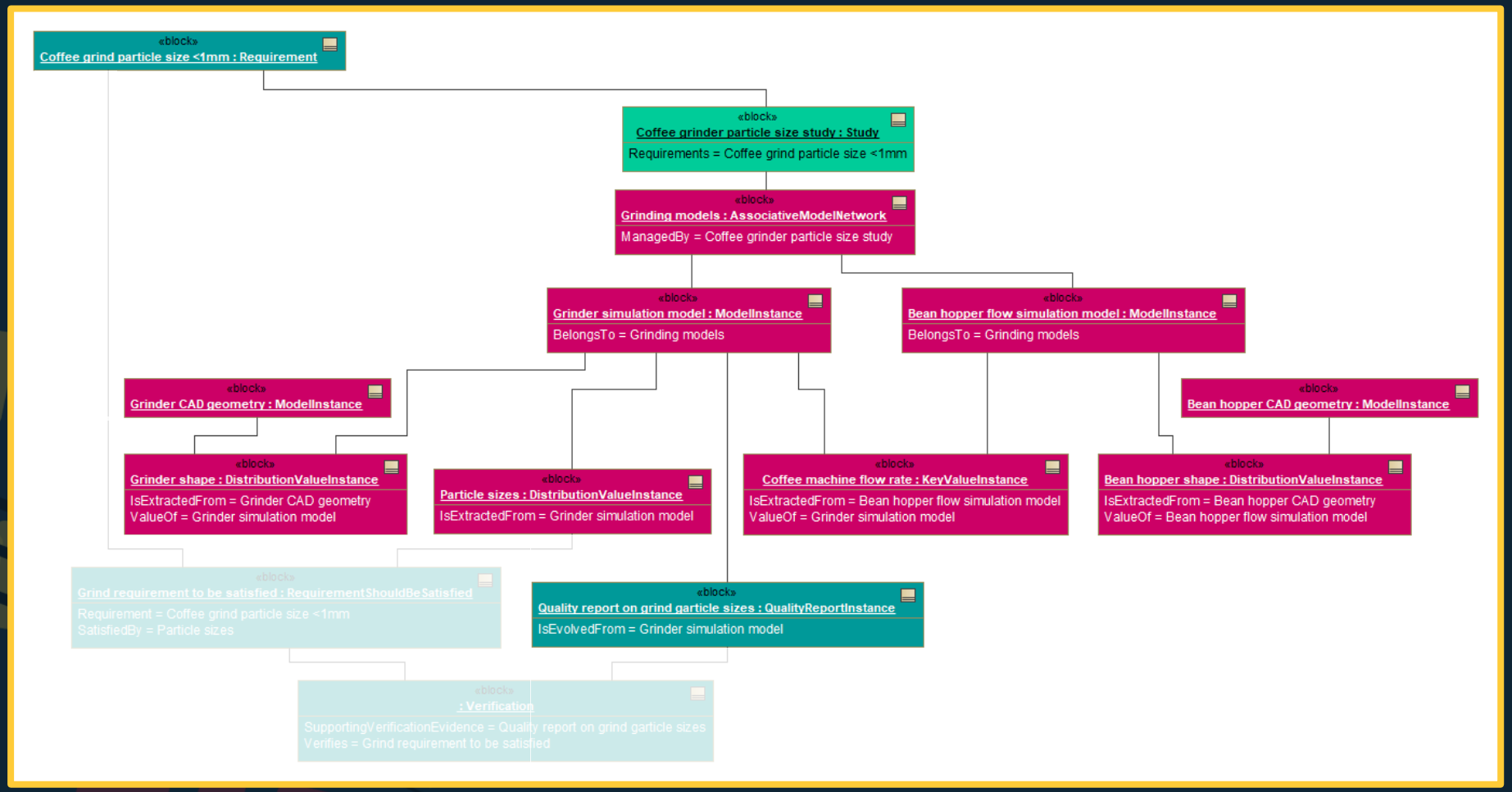

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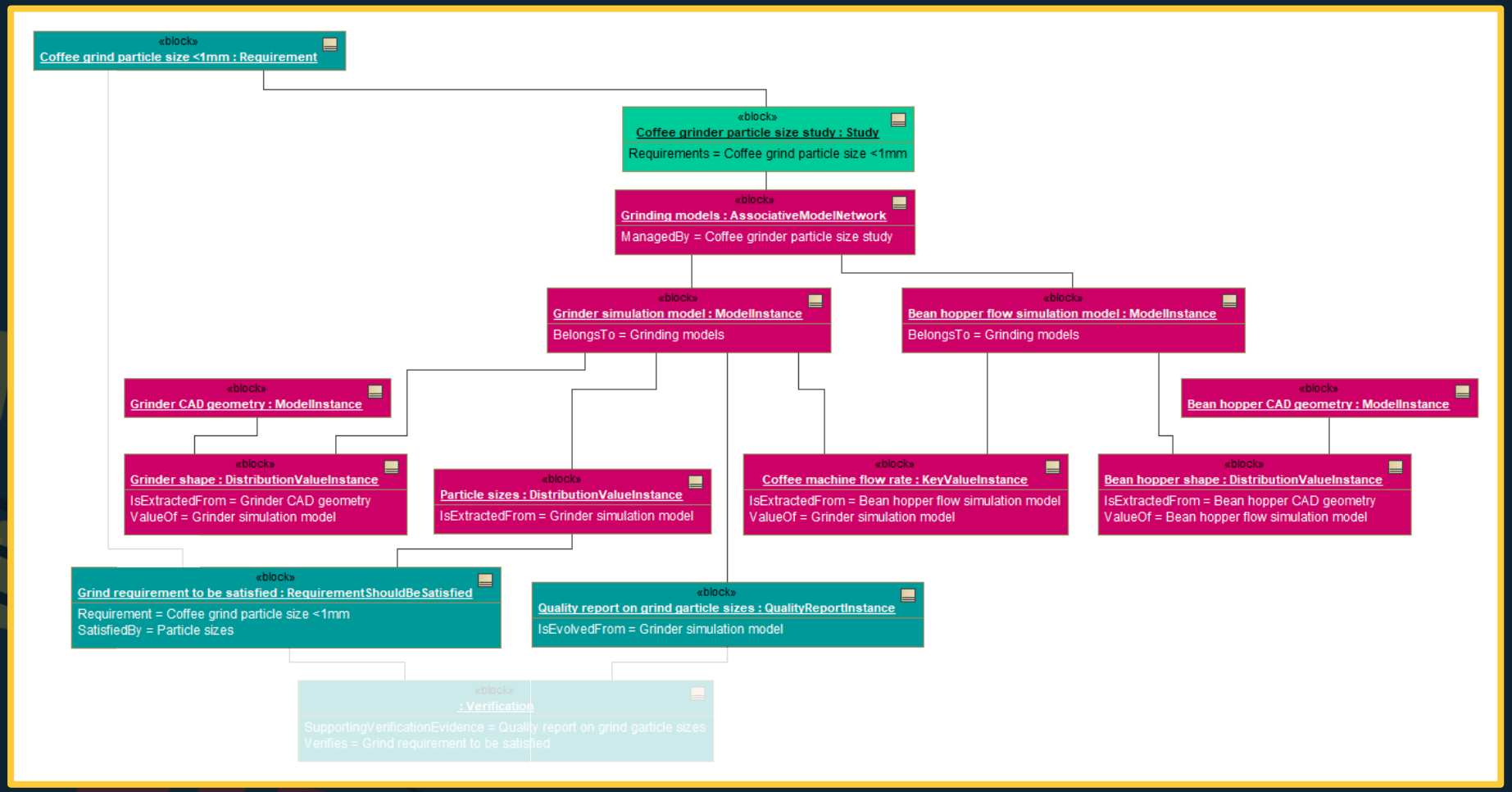

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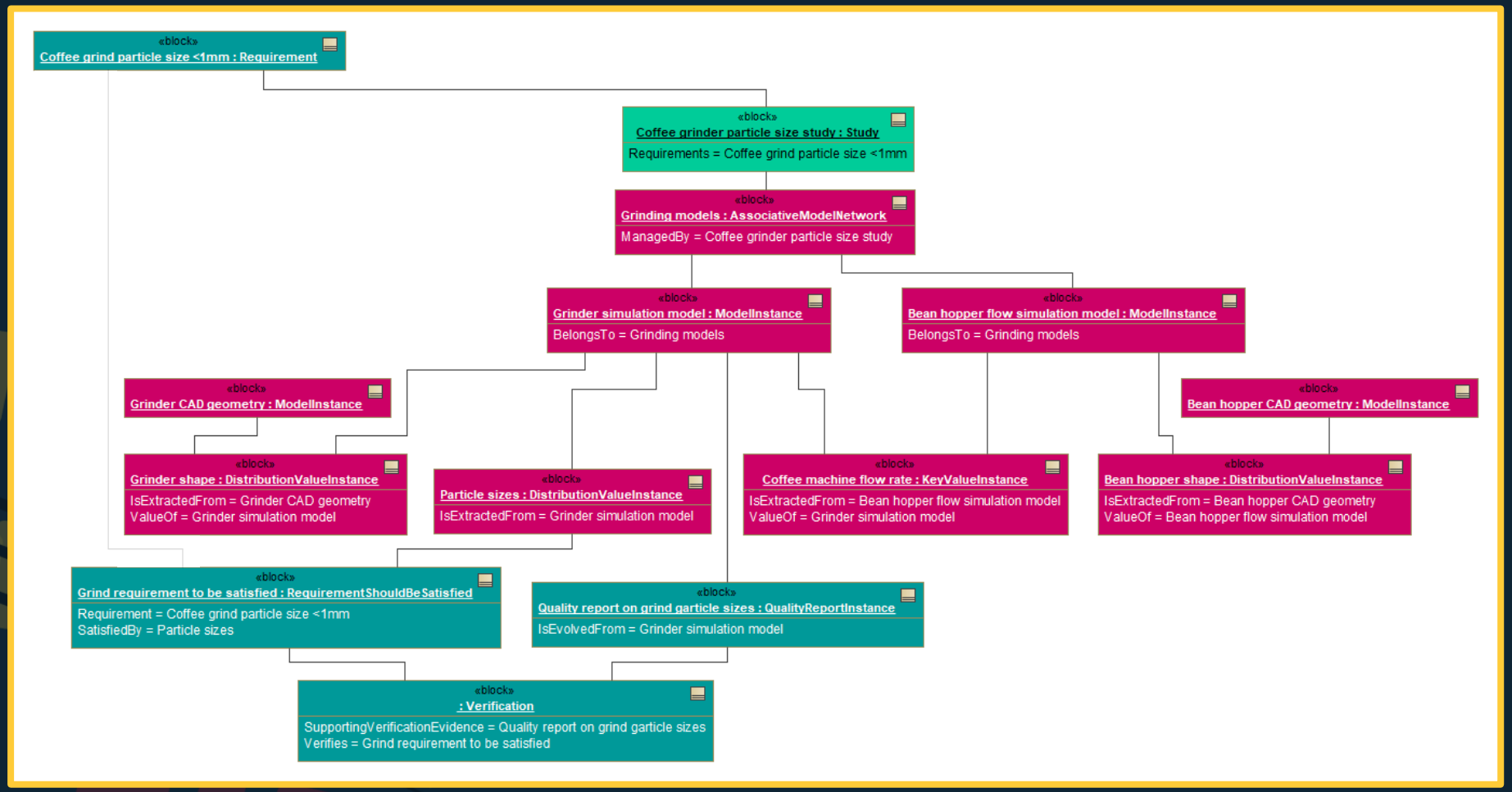

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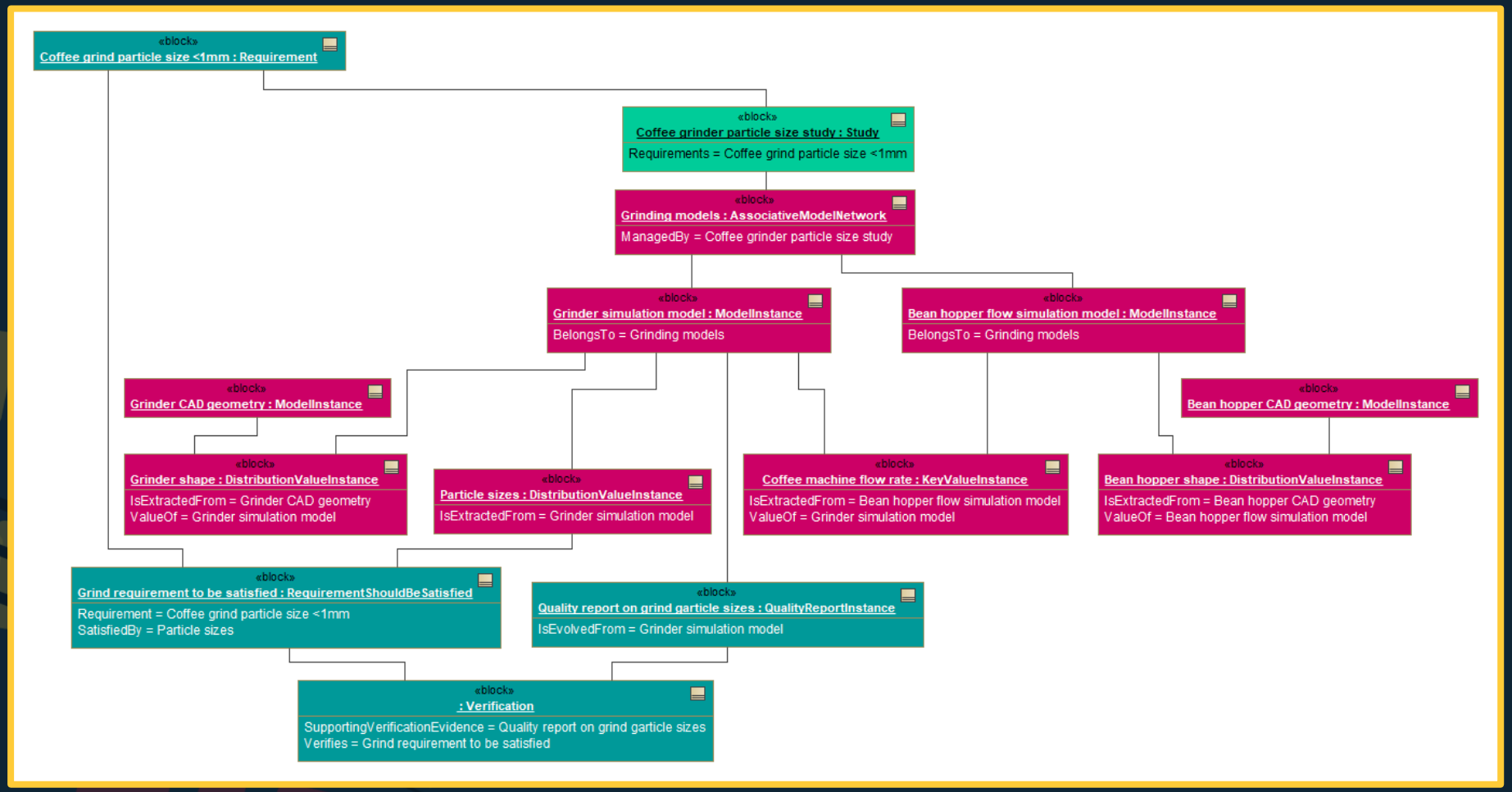
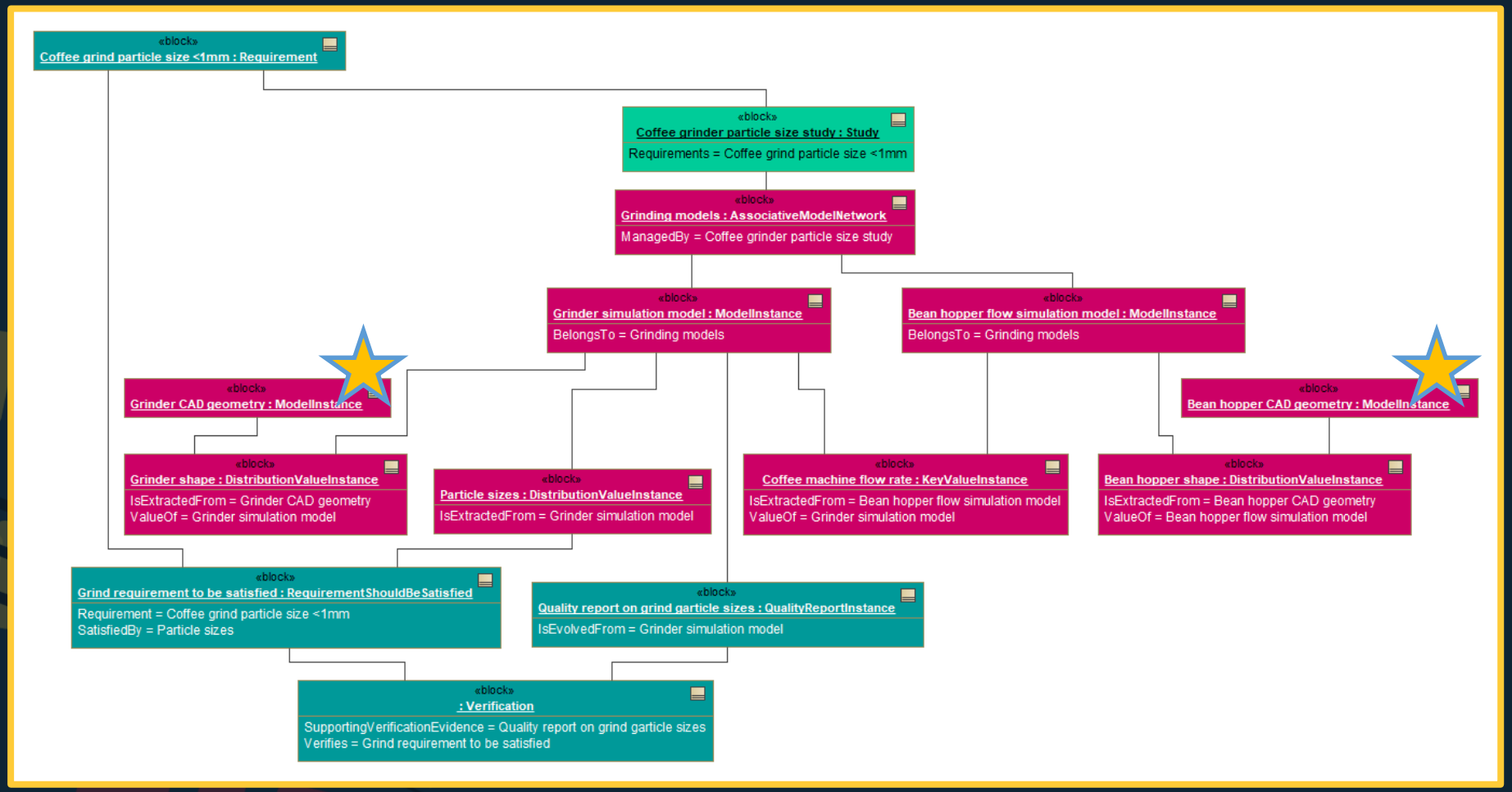


A MoSSEC resolution

Key Values

What inputs did we use for this analysis, where did we get them from?



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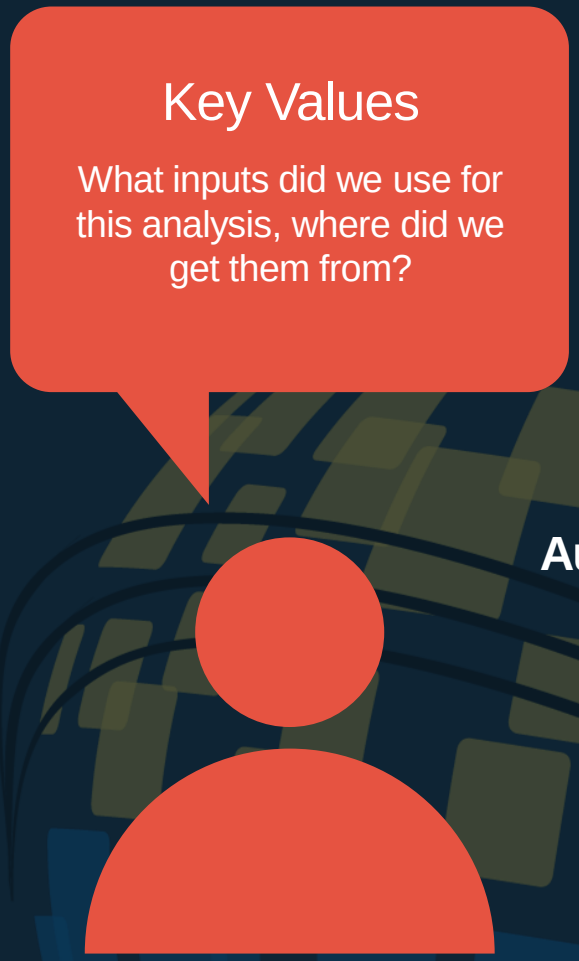


«block»
Grinder CAD geometry : ModelInstance

«block»
Bean hopper CAD geometry : ModelInstance

ModelInstance properties:

ExecutorOf – Who executed this model instance?

IsAnInstanceOf – What type of model is this?

IsEvolvedFrom – Are there other models that this model evolved from?

Approvals – Who approved this final model? Why? What was the evidence?

Authorizations – Who authorized this model to be created? Why? What was the evidence?

CreatedBy – Who was the original author?

BelongsTo – Which Associative Model Network (AMN) does this connect to?

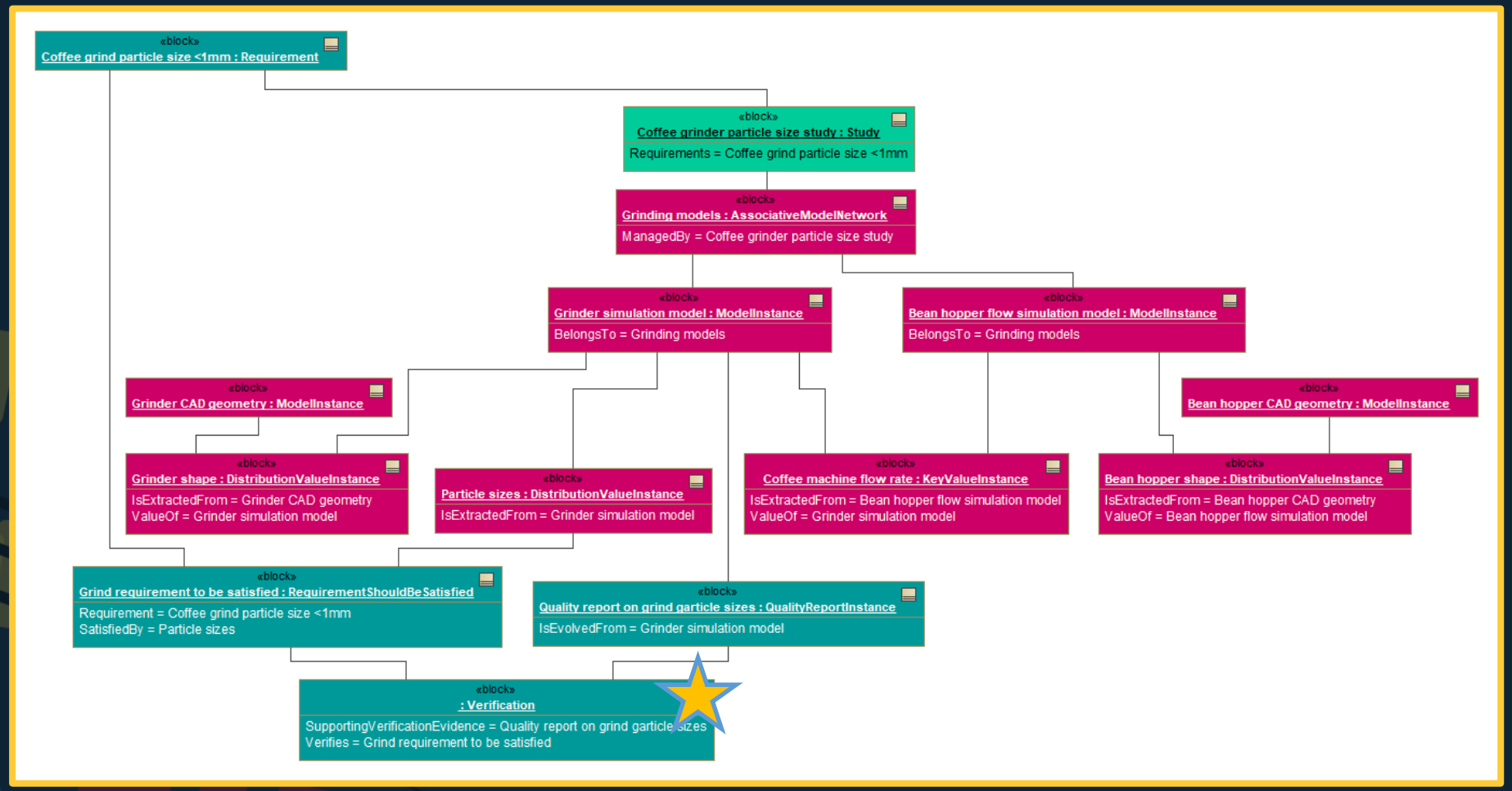
SynchronizerOf – Who is responsible for ensuring the AMN is synchronized?

**this list is not exhaustive - more properties may be related to resolving this problem are discussed*

A MoSSEC resolution

Assumptions and Approvals

Who made this assumption? What evidence was there to support it and where was it used? Who Approved it?

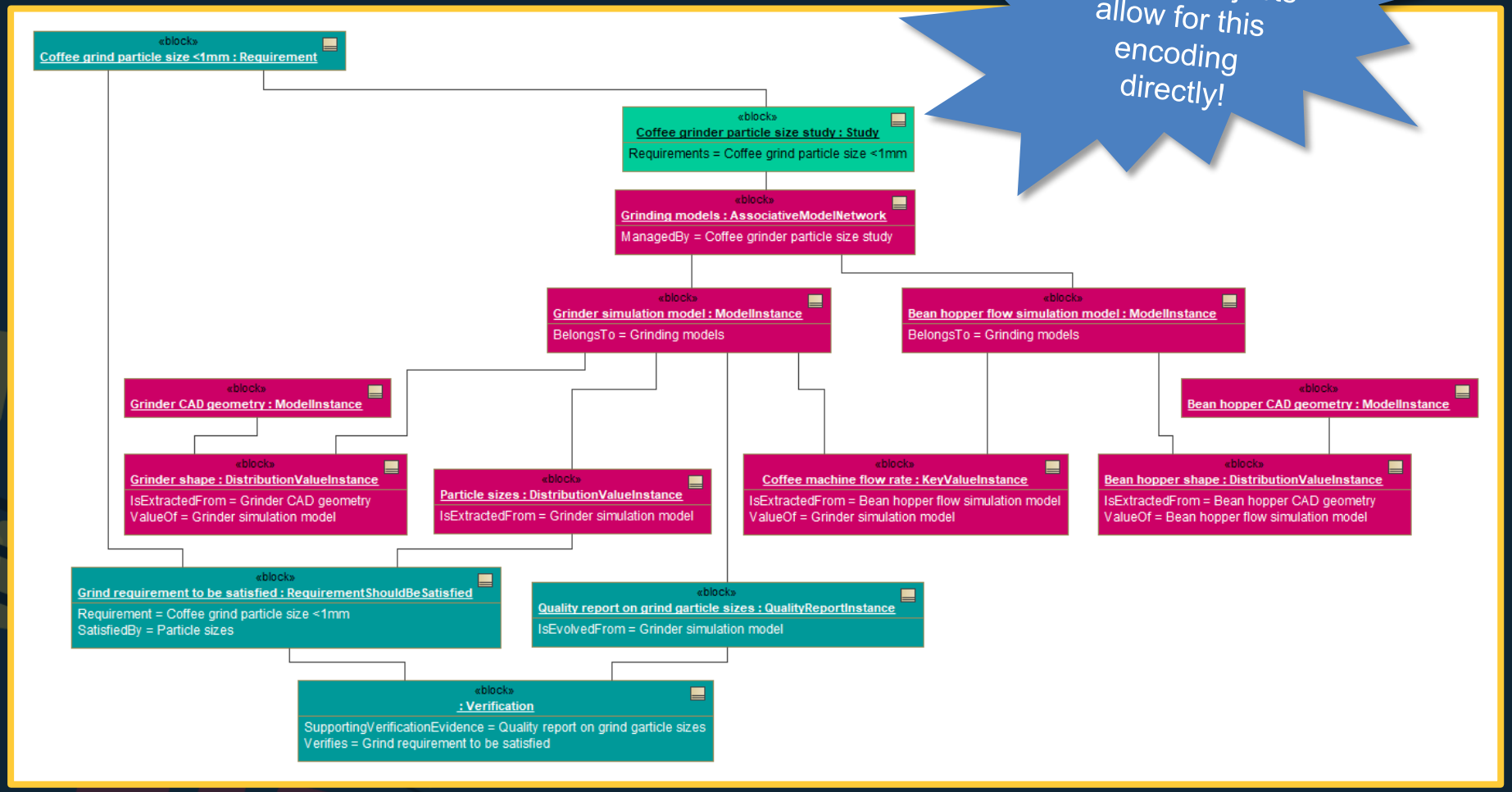


A MoSSEC resolution

Methodologies

What method has been used for this type of analysis in the past?

MoSSEC "Method" objects allow for this encoding directly!



But what about semantic web ontologies?

MoSSEC and Semantic Web Ontologies

1. MoSSEC provides contextual logic metadata - The context behind decisions.

   Semantic Web Ontologies are being actively deployed to perform this activity too.

2. These Semantic Web Ontologies in fact expand MoSSEC capabilities.

   MoSSEC allows for the use of OWL in the definition of certain object types to tailor tool operations according to an Enterprise's Semantic Web architecture.

MoSSEC and Semantic Web Ontologies

3. Where there is indeed crossover in functionality, the Ontology can and should be mapped to MoSSEC. Why?

   MoSSEC is a domain neutral format – designed specifically for robust and stable context exchange between platforms

4. If you have an Ontology map to MoSSEC, you have effectively created:

Interoperability of your ontology to other ontologies

+

The ability to map ontological data directly from MoSSEC compliant tools

MoSSEC and Semantic Web Ontologies

The key benefits for the use of MoSSEC as a part of an Enterprise Semantic Web implementation:

MoSSEC is Value Proven

Better products,
Faster,
Easier
and Cheaper

MoSSEC is Robust

Having been certified for completeness and accuracy by ISO.

MoSSEC is Accessible

MoSSEC is built upon the ISO STEP core model and is shared using OpenAPI REST web services

MoSSEC is Stable

The MoSSEC editions will always be referenceable and available through ISO.

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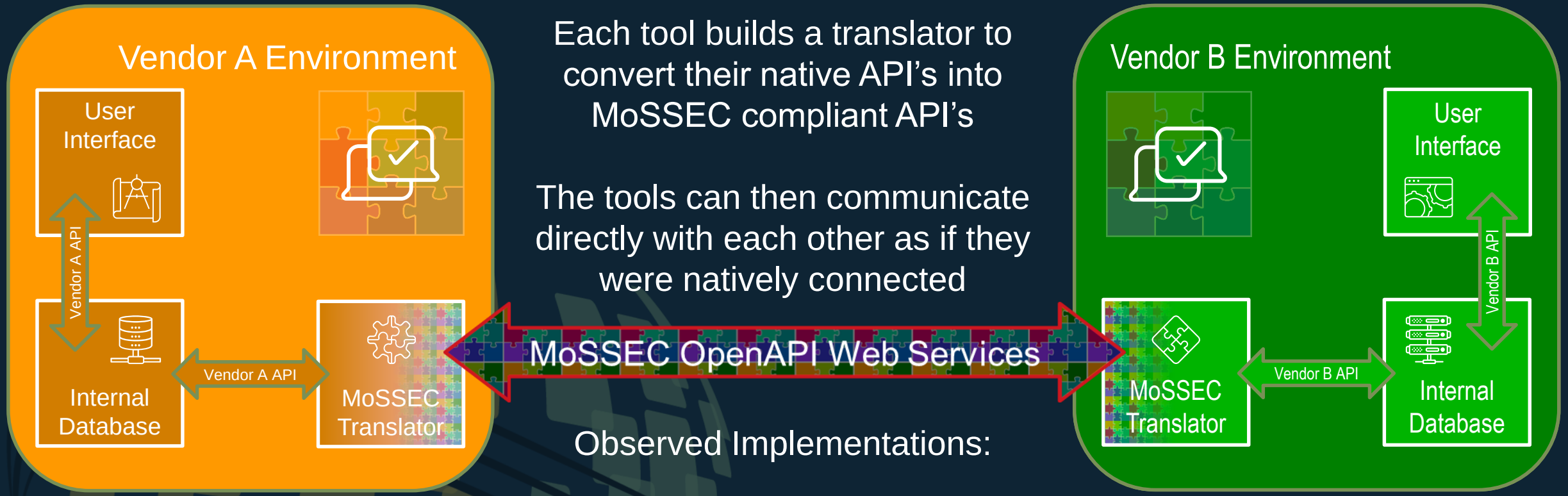
MoSSEC Web Services
Establishing direct communication

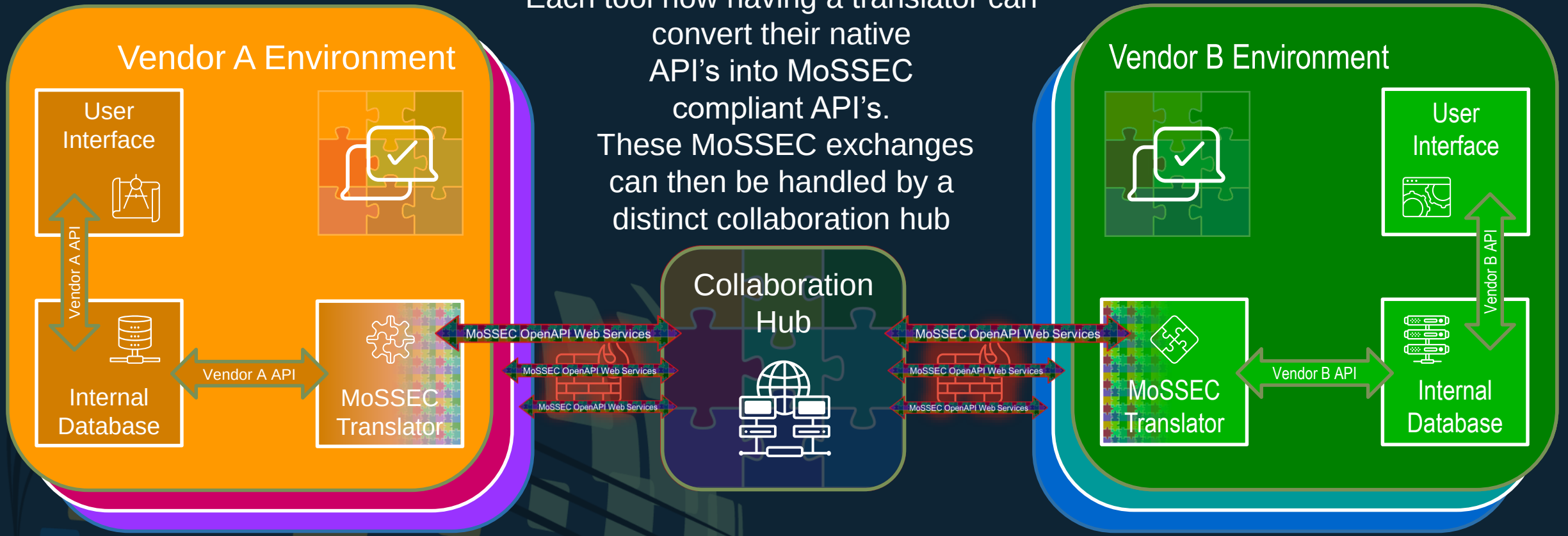


Observed Implementations:

3DX (Dassault Systèmes) ⟷ TeamCenter (Siemens)
3DX (Dassault Systèmes) ⟷ SimManager (Hexagon)
Non COTS (various) ⟷ SimManager (Hexagon)

MoSSEC Web Services
Establishing direct communication

Each tool now having a translator can convert their native API's into MoSSEC compliant API's. These MoSSEC exchanges can then be handled by a distinct collaboration hub



Observed Implementations:

ShareAspace (Eurostep)

MoSSEC Web Services
Using a separate MoSSEC translator

Observed Implementations:

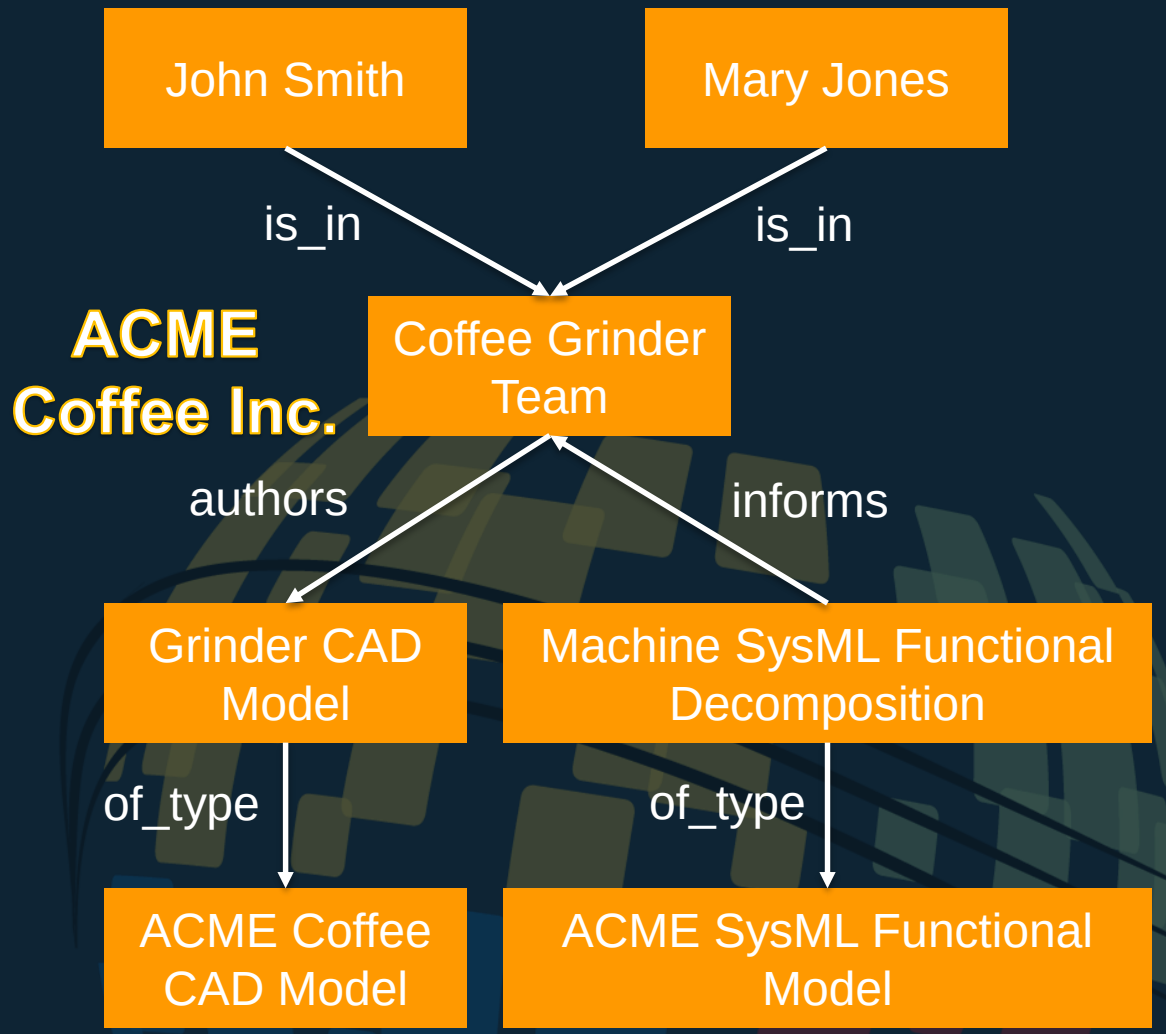
SES Engineering Studio (The Reuse Company)

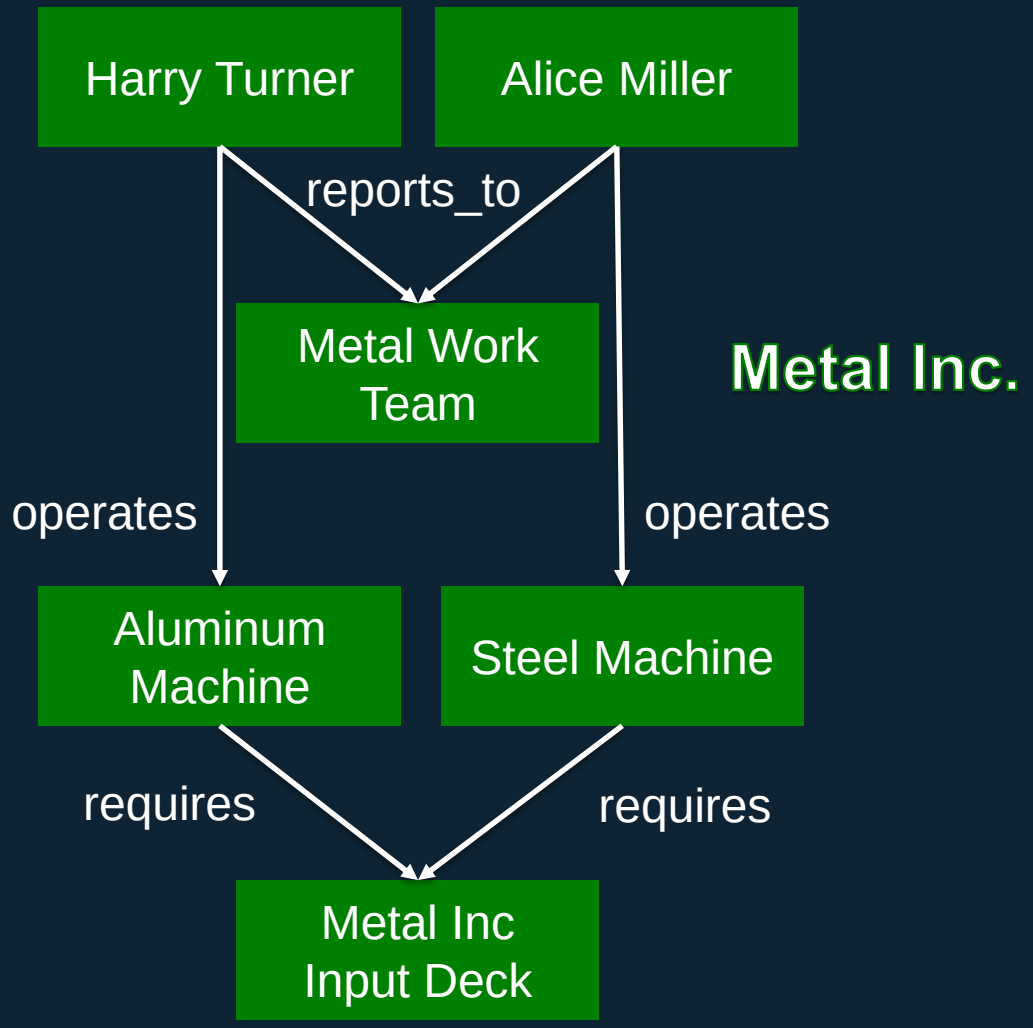
MoSSEC Web Services
Using a separate MoSSEC translator

This approach can also be considered for Ontologies and proprietary concept sharing.
If the concept or Ontology can be mapped to MoSSEC then the context of the transfer is understood

Example

Simple Business Ontology exchange using MoSSEC





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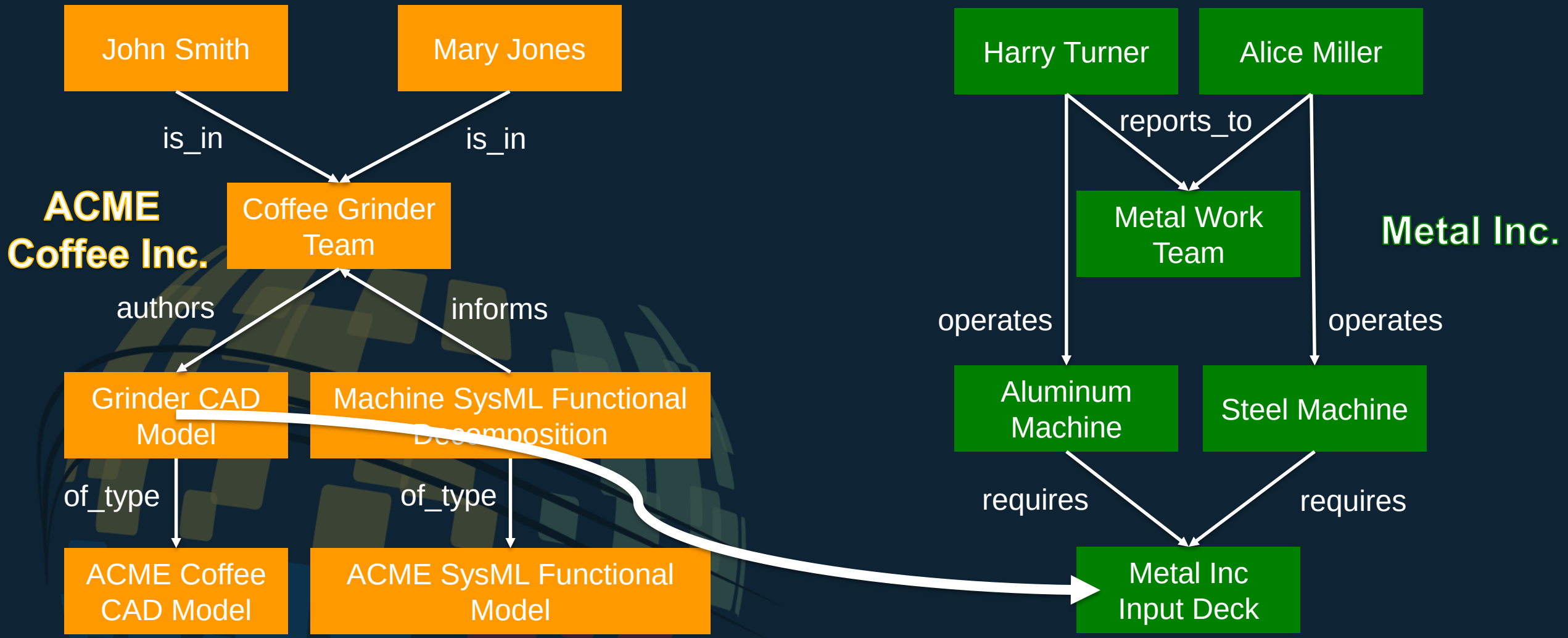

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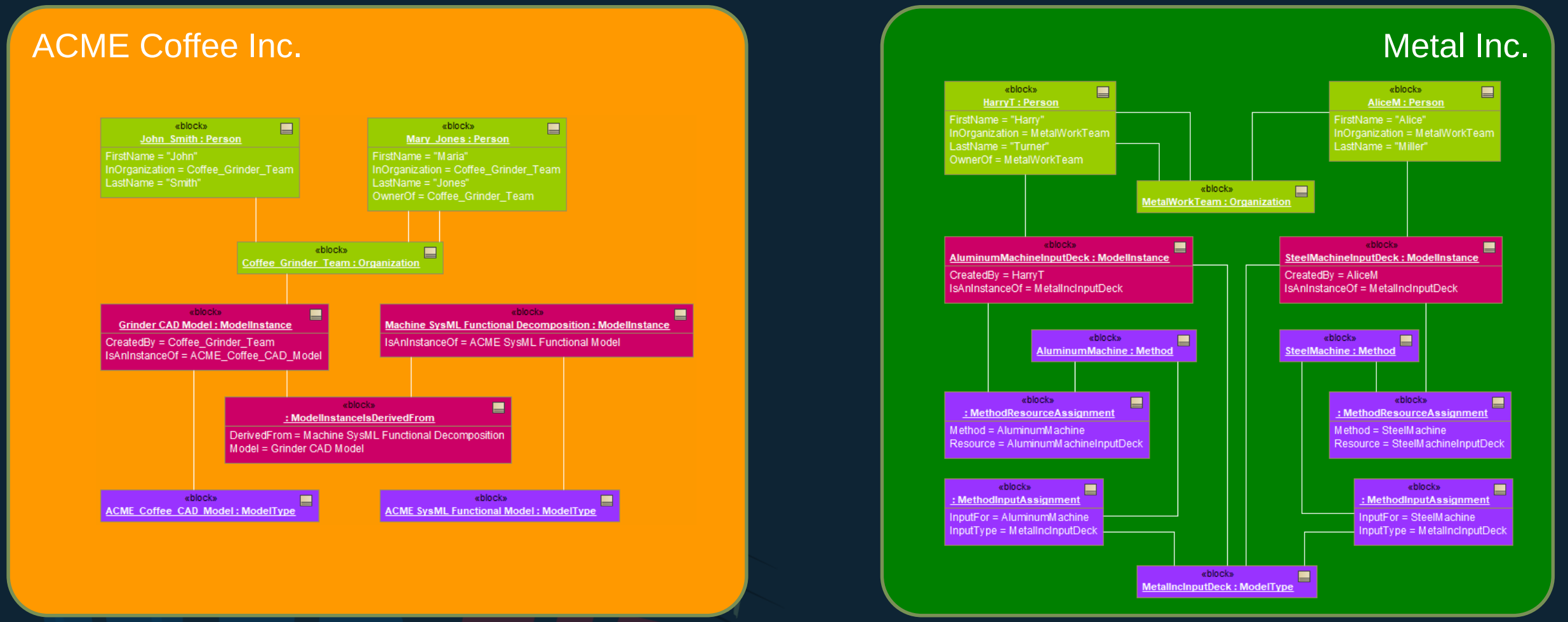

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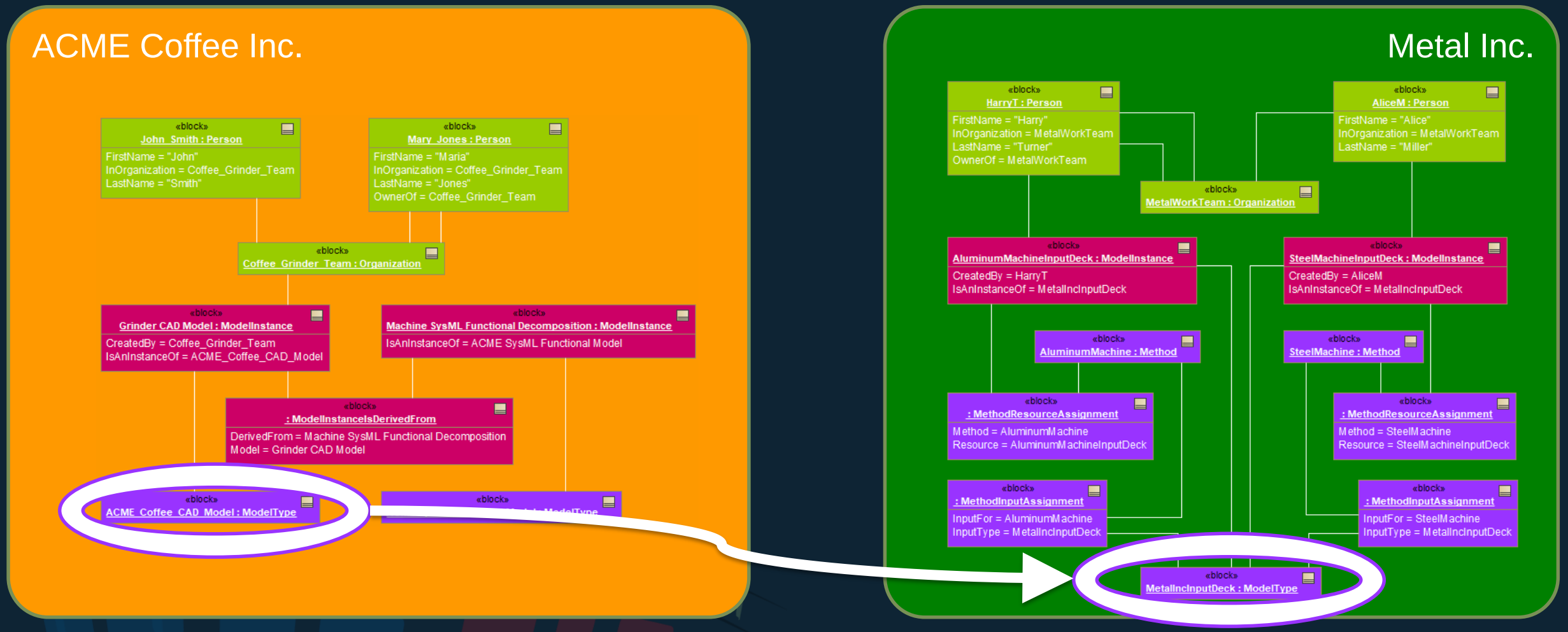

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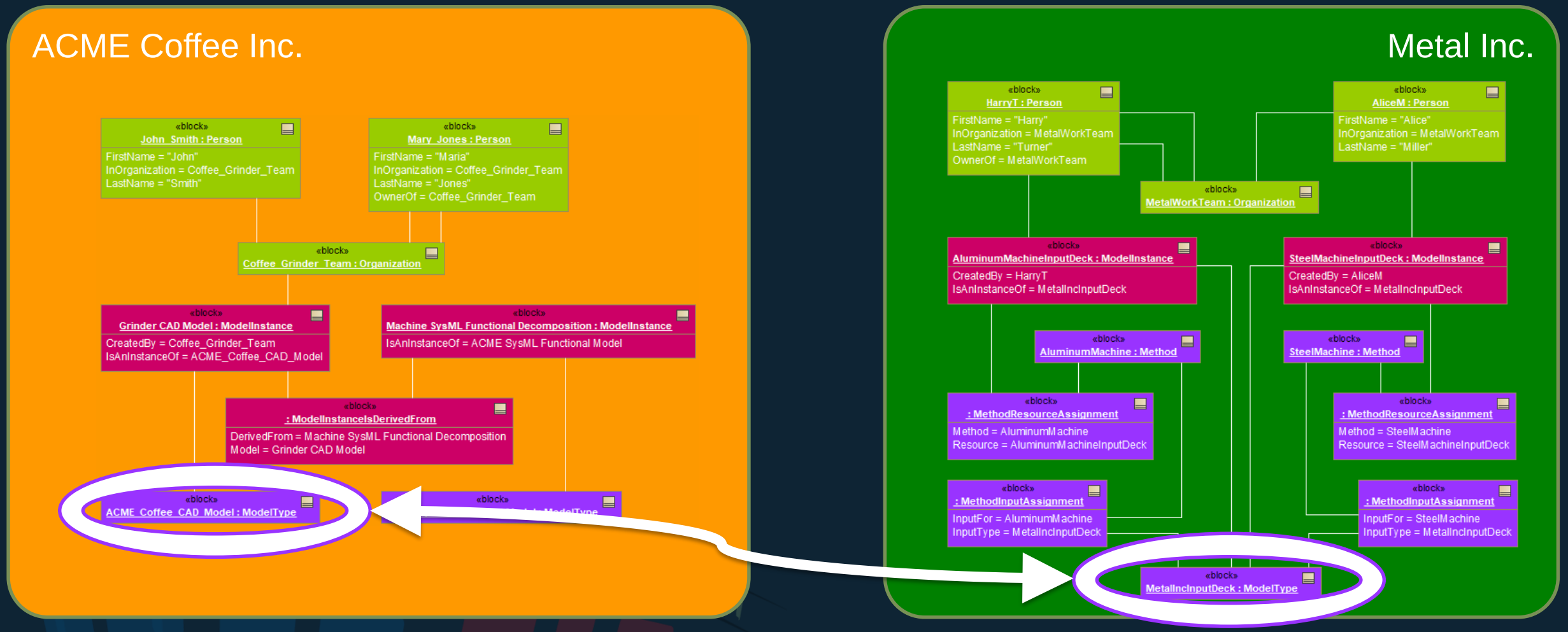

Example

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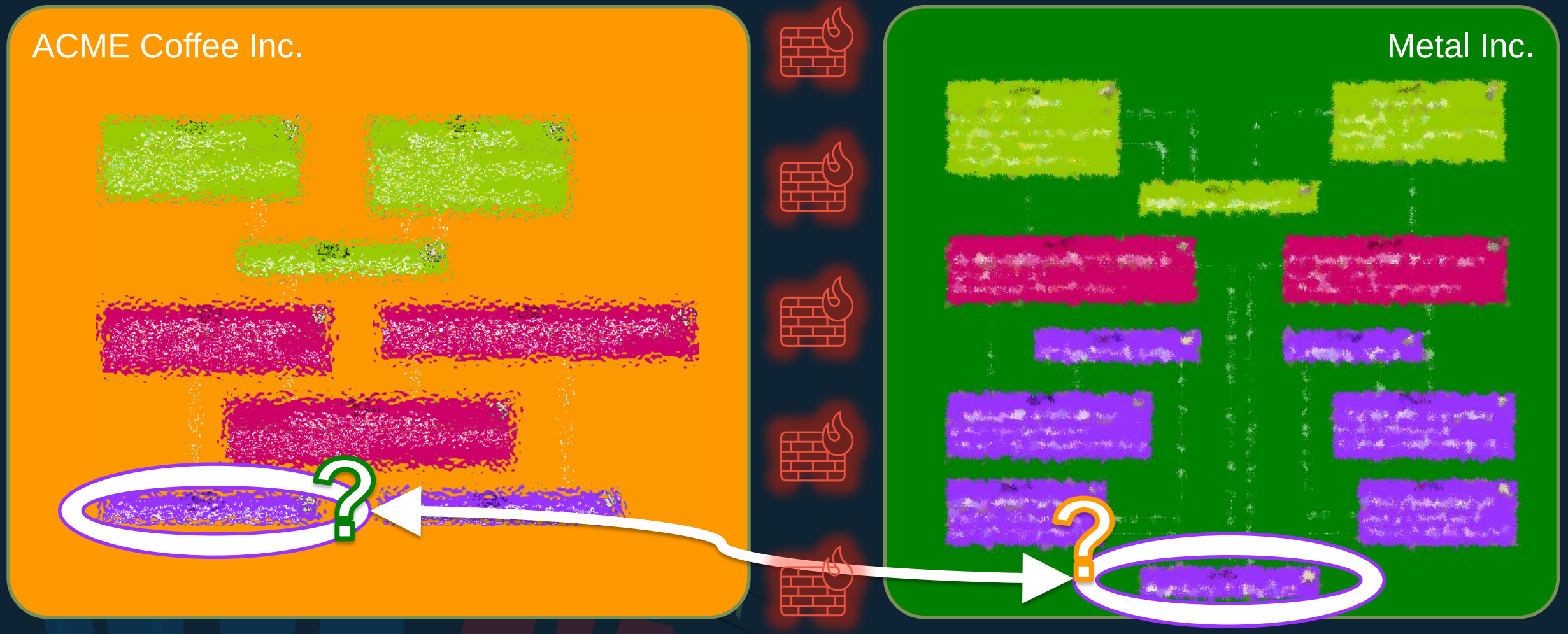


Example
Simple Business Ontology exchange using MoSSEC

Airframe & Engine collaboration project

APROCONE research project funded by industry and the UK government between 2016 and 2019.

Process standardisation and full data traceability between Airbus and Rolls-Royce.

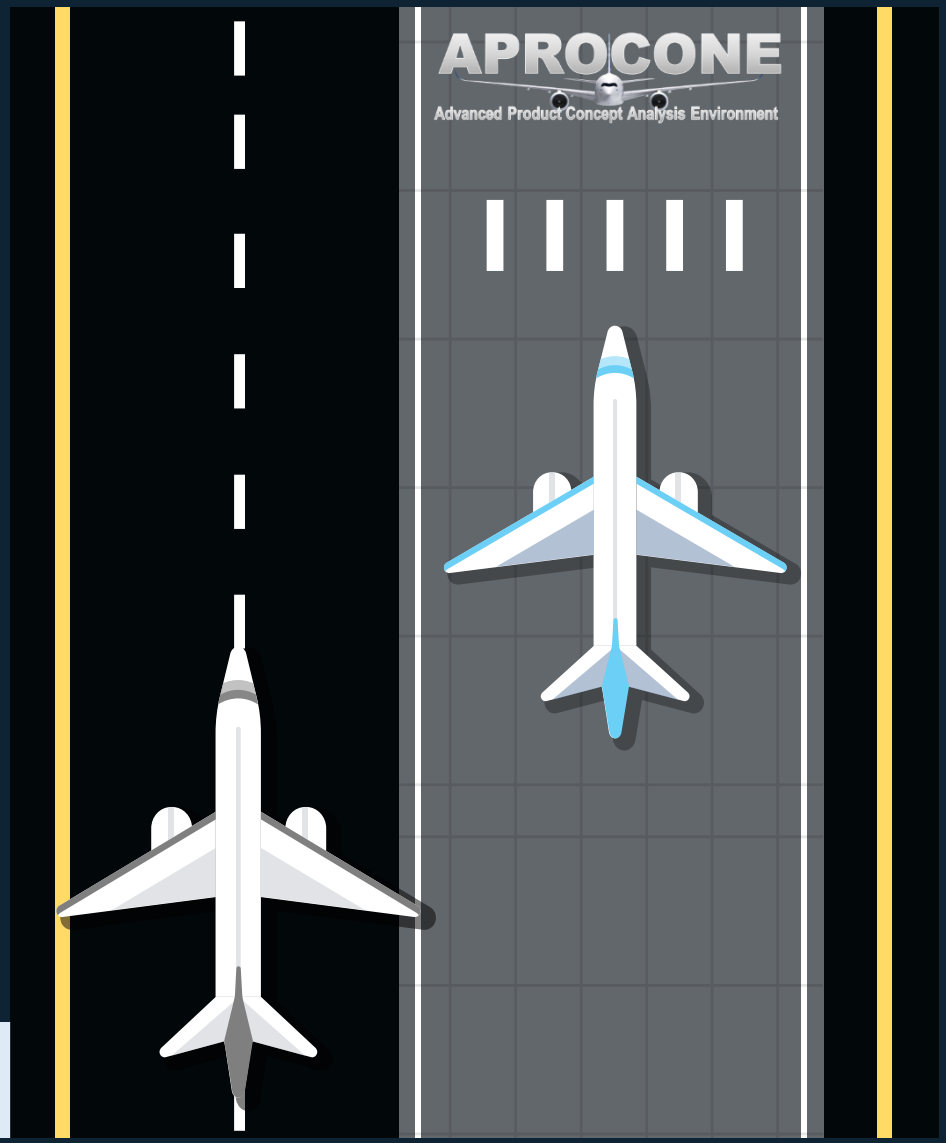
Conventional v. MoSSEC concept assessment Realistic but NOT Real:

Lighter engines

Lower Max Take Off Weight

Less fuel burn

Significant reduction in development time



AIRBUS · UNIVERSITY OF CAMBRIDGE Engineering Design Centre · cfms · Cranfield Aerospace · GKN AEROSPACE · MSC Software Simulating Reality, Delivering Certainty · Rolls-Royce

MoSSEC and the Long Term Archive and Retrieval

01 What is MoSSEC?

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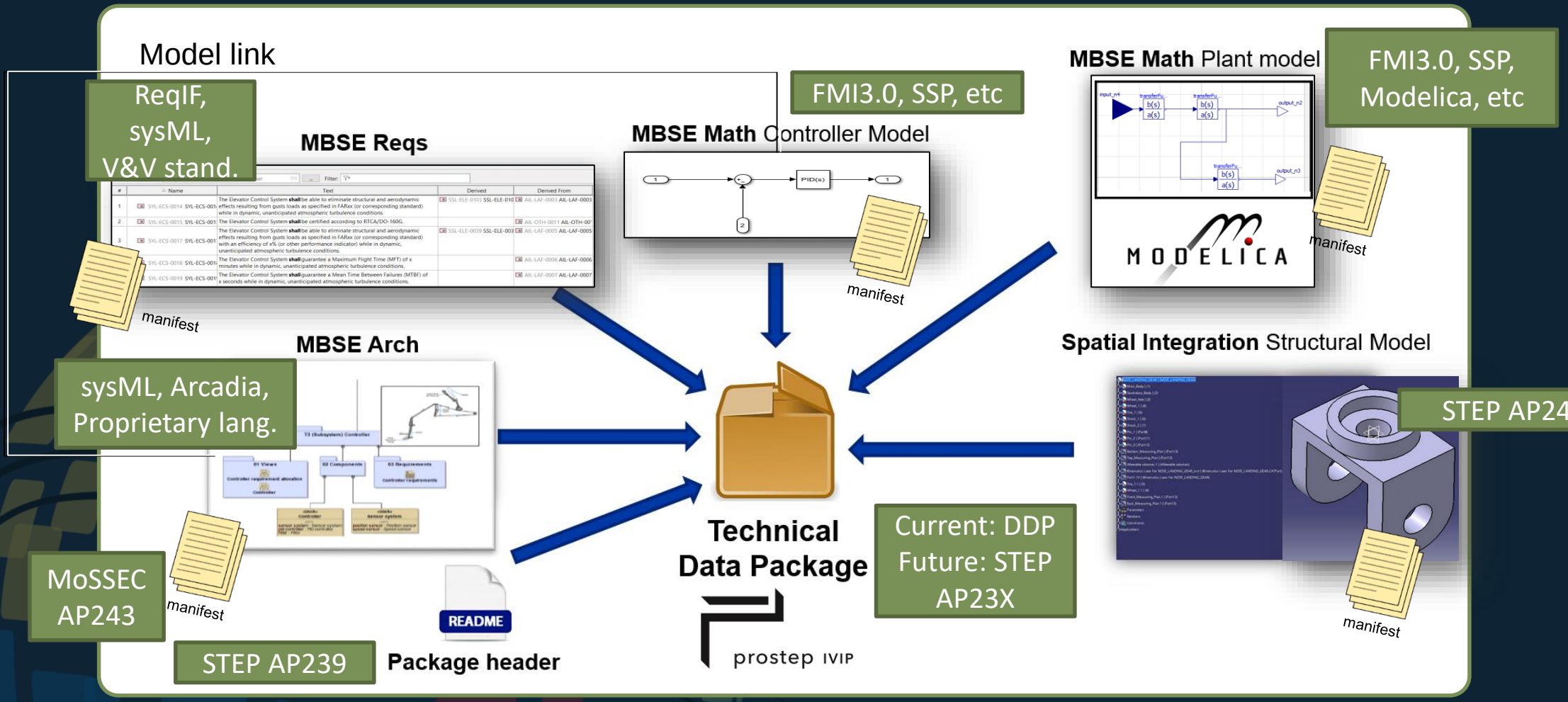
MBSE standards in a Technical Data Package

For **LO**ng **T**erm **A**rchive and **R**etrieval (LOTAR)



Publically Available on PDES Gitlab: https://git.pdes-ch.org/MBE-Demonstrator-RM/MBD-Demonstrator-RM

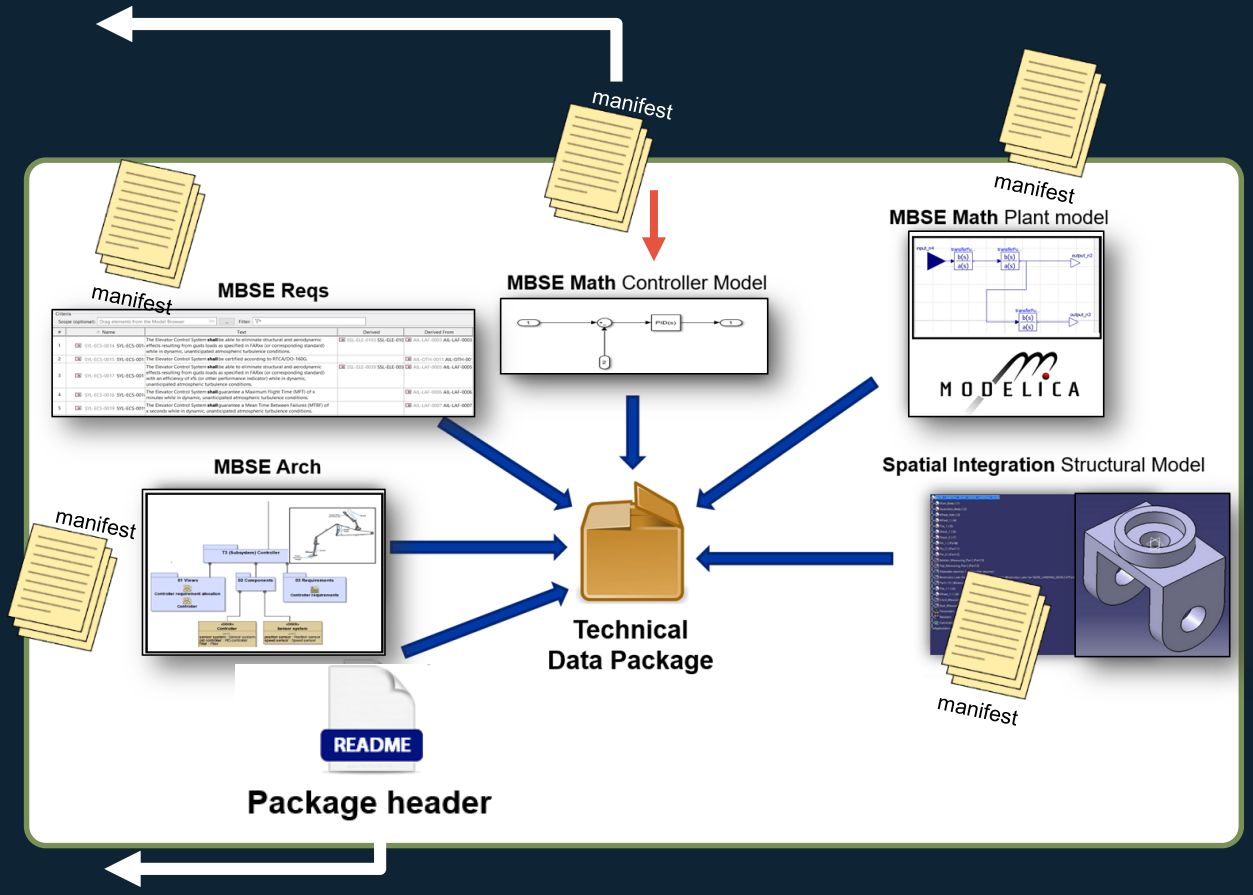
ISO STEP in a Technical Data Package
For **LO**ng **T**erm **A**rchive and **R**etrieval (LOTAR)

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)

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. Traceability between Package and Package Header must be persistent



http://tdp.asd-ssg.org

LOTAR MBSE Standards for Archive and Reuse

EN/NAS 9300-

Part 500: Fundamentals and Concepts for long term archiving and retrieval of Model-Based Systems Engineering information

Part 510: **Requirement** management “text, graphics, tables”, models, and “parameter based” information

Part 515: **Validation and Verification** “text based” and “parameter based” information (expanding Part 510)

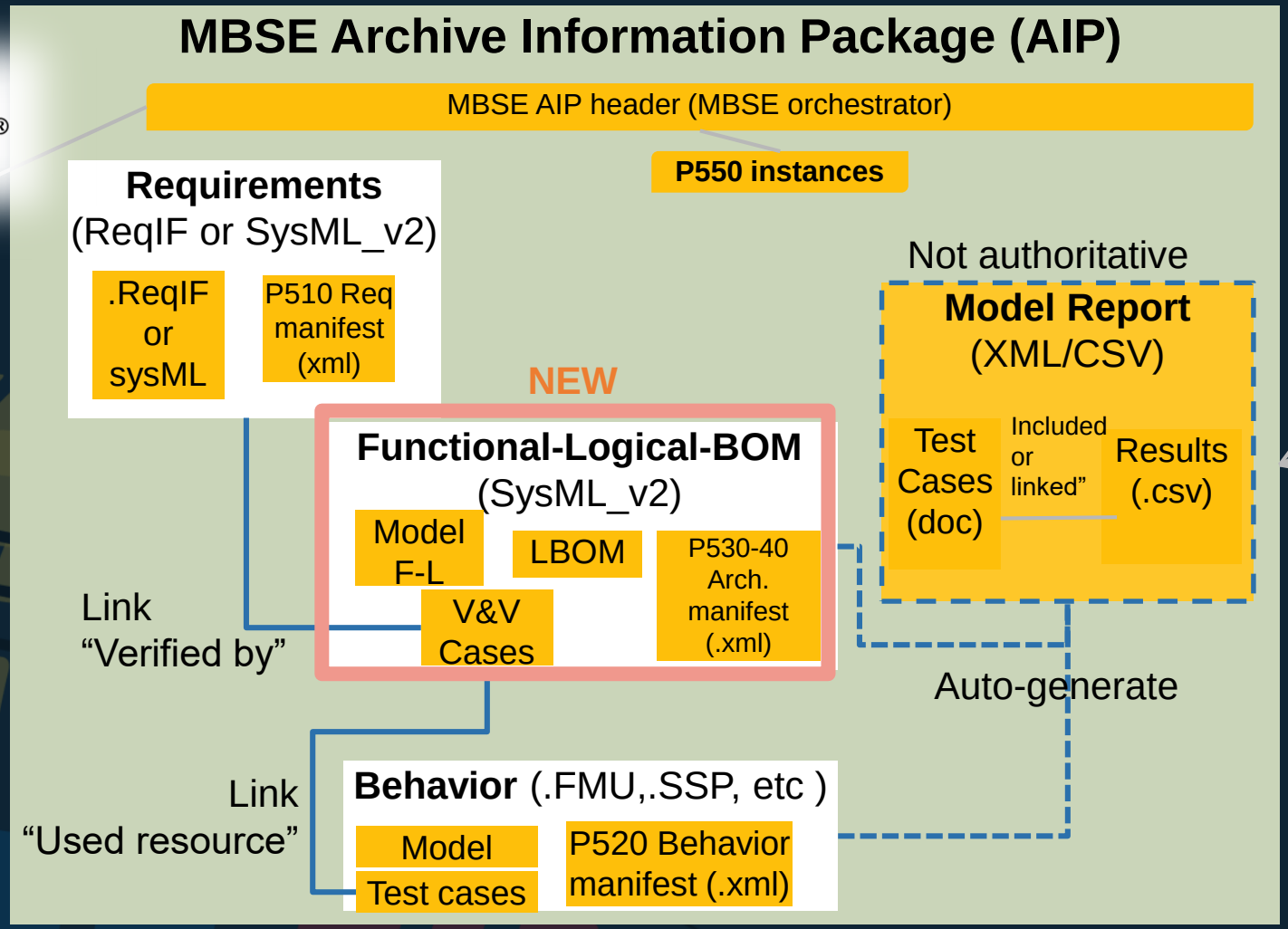
Part 520: Analytical **behaviour models** described by specification or executable code, containing differential, algebraic and discrete equations

Part 530: **Architecture** descriptions and architecture description languages (ADLs)

Part 540: The **Logical Bill of Materials** (LBOM)

Part 550: Digital or **relational links** specifying interrelated elements across numerous tools.

Standards in an MBSE Archive Information Package (AIP)

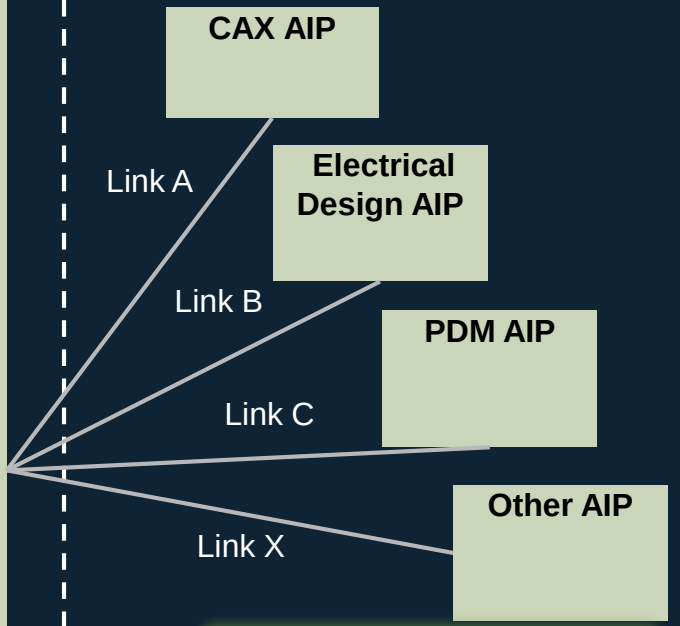


PDES, Inc.®
Connecting the Digital Enterprise

AIP header

- LOTAR *P002* AIP metadata
- Content/Model index (model or model entity level).

MBSE relationships (.rdf/.xml)
Verified by
Used



P500 – MBSE Package
P510 – Requirement Models
P515 – V&V Cases/Models
P520 – Behavior Model
P530 – Architecture model
P540 – Logical BOM
P550 – Links

MBSE team scope | **Out of scope**

The need for a community

The need for a community:

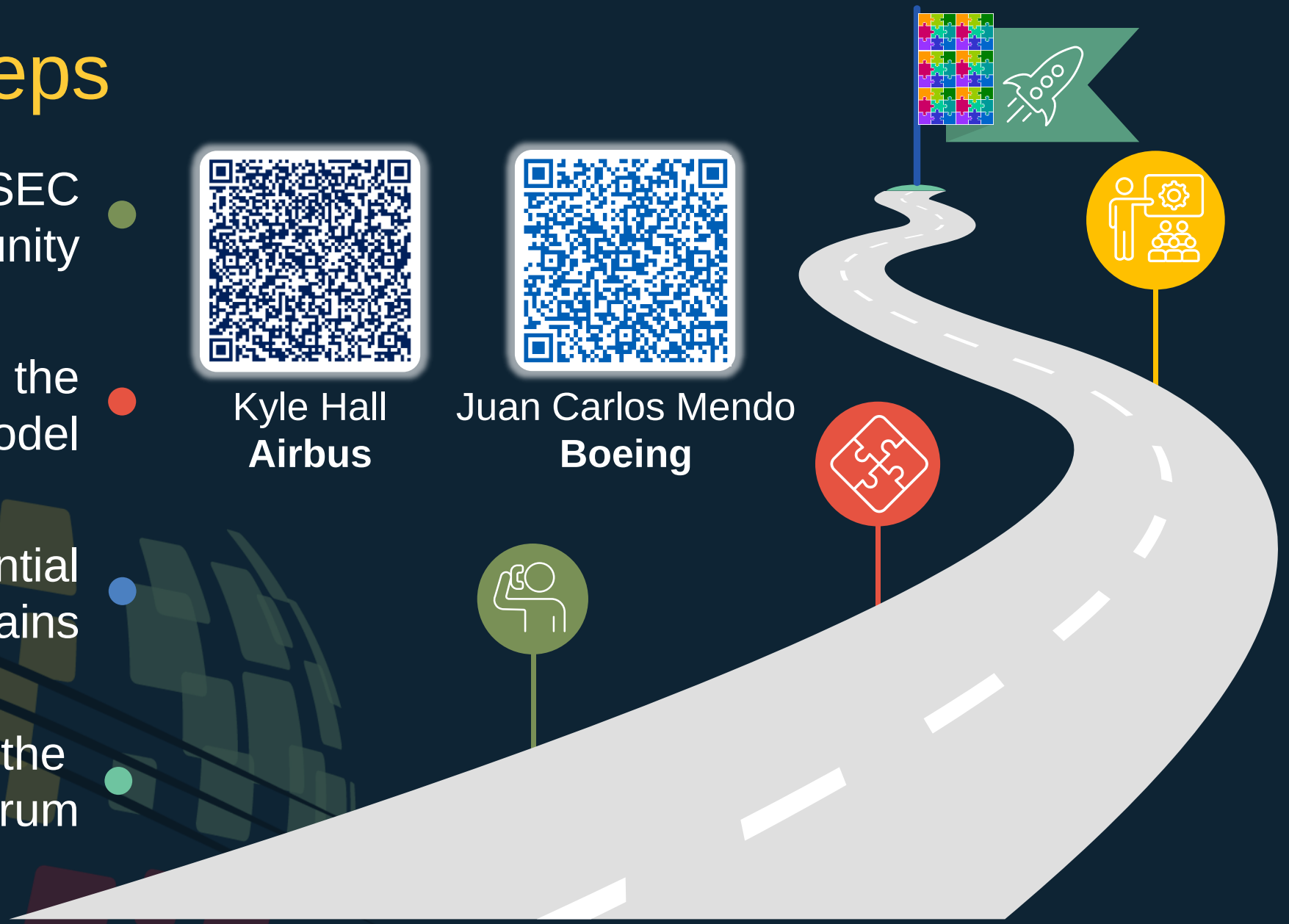
- Proprietary methods are being developed during Digital Transformation activities
- The standards discussed today provide interoperability for proprietary methods across an extended enterprise
- The community is reinforcing this need for digital data sharing/ packaging standardisation for an effective digital thread

Your next steps

- Reach out to the MoSSEC community
- Experiment with the MoSSEC object model
- Demonstrate the potential to your domains
- Get involved with the Implementation Forum

Kyle Hall
Airbus

Juan Carlos Mendo
Boeing



33rd Annual INCOSE international symposium

hybrid event

Honolulu HI USA

Presenters: Kyle Hall – Airbus
Juan Carlos Mendo – Boeing

MoSSEC – The common meta language supporting digital transformation

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