

[MBSE 2021] ESA MBSE Evolution: From ESA SysML Toolbox to ESA MBSE Solution

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ESA/TEC-S MBSE Space Team

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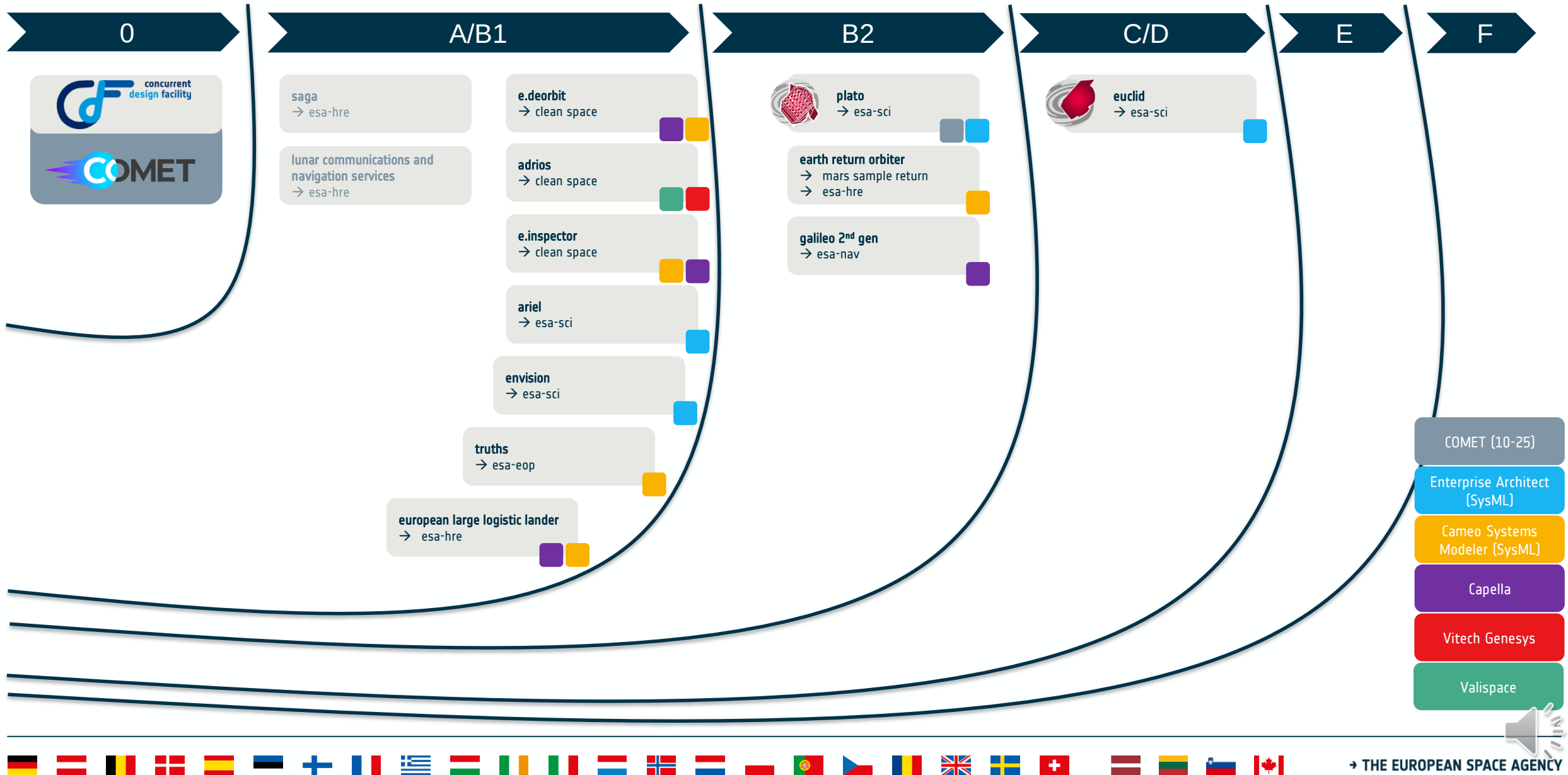
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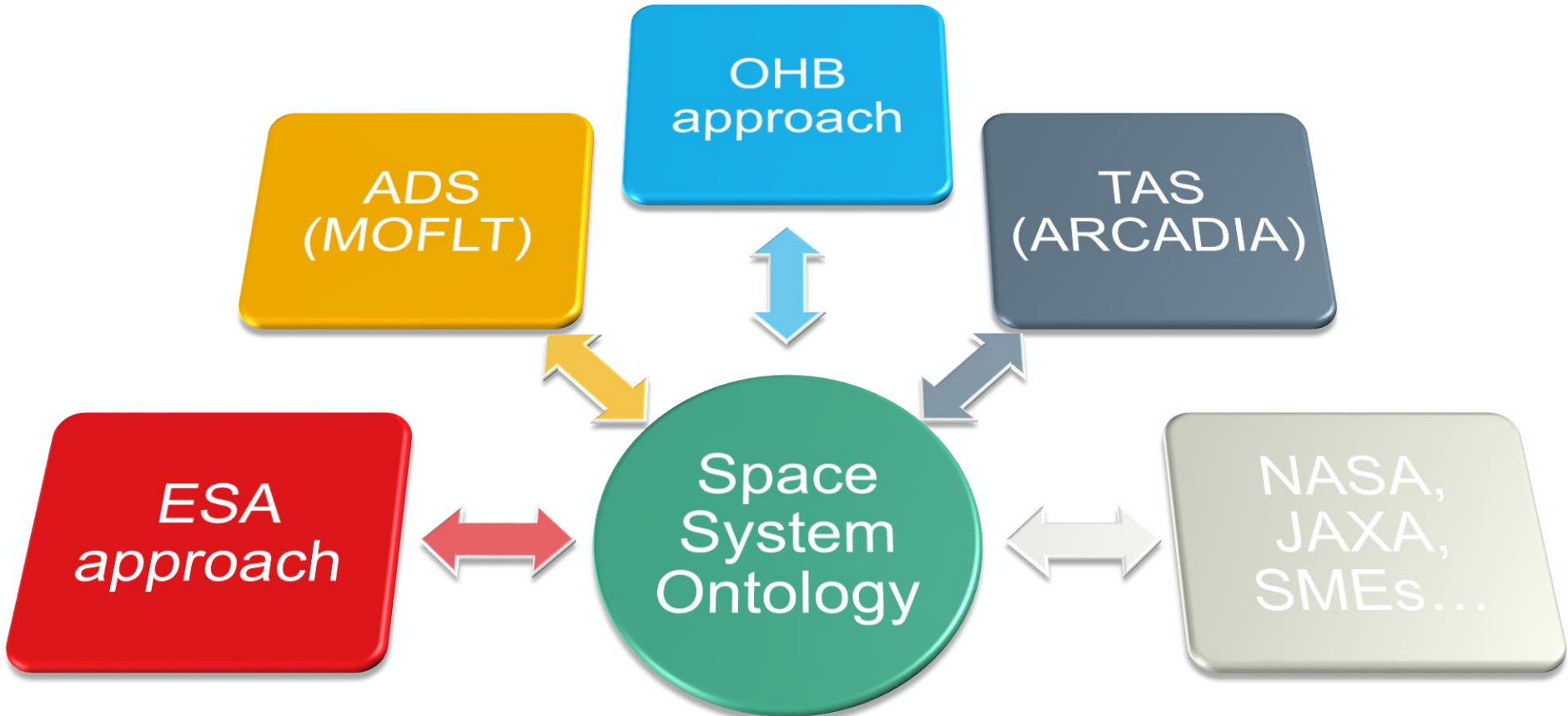
Mission Overview

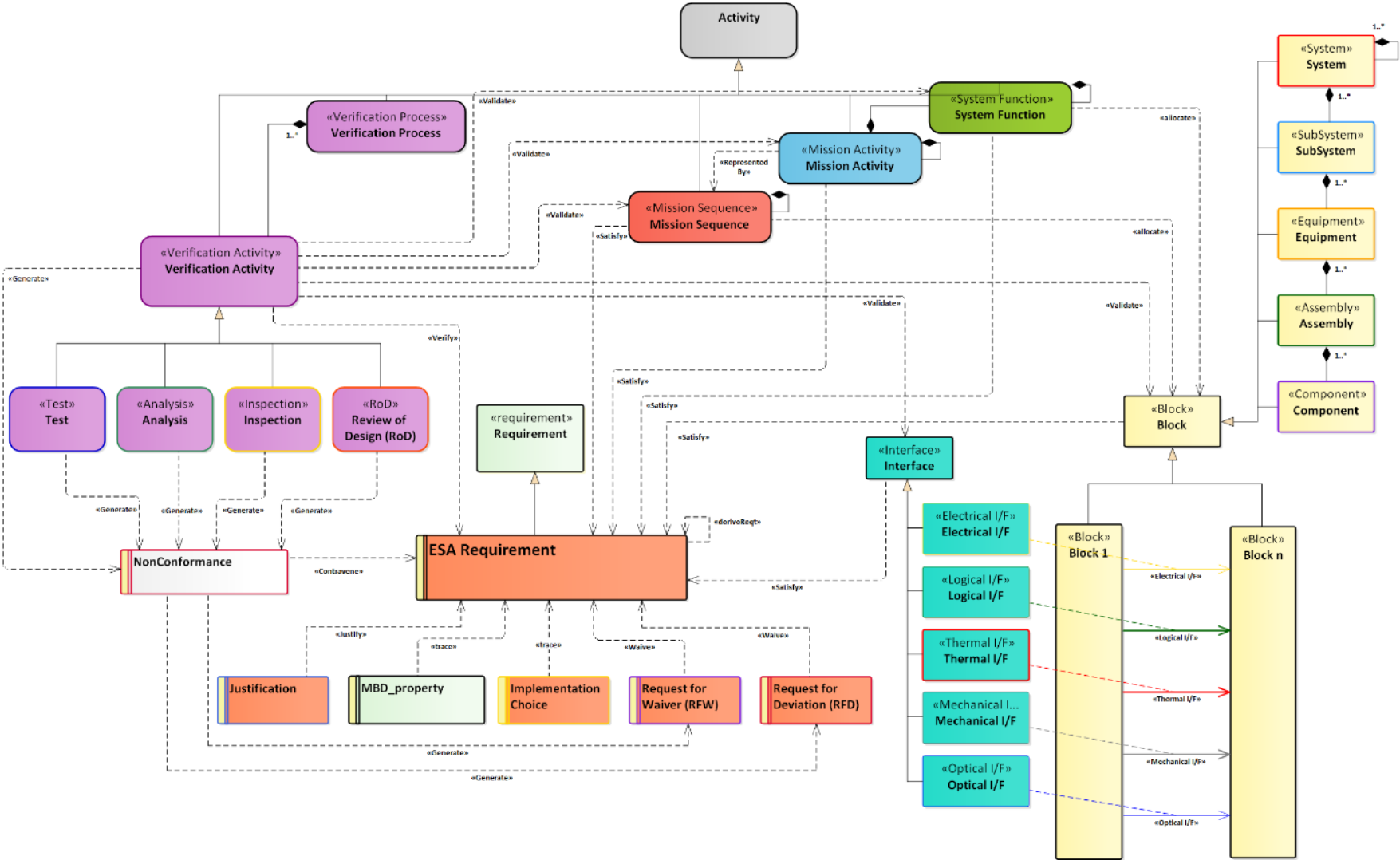




- | | | |
|--|---|-------------------------------------|
| ✗ Project-specific | ➡ | ✓ Re-use of data, competences... |
| ✗ Large effort at the start of the project | ➡ | ✓ Default option for MBSE |
| ✗ Opaqueness | ➡ | ✓ Based on standards |
| ✗ High development cost of custom tools | ➡ | ✓ Customization of commercial tools |
| ✗ Information silo | ➡ | ✓ Interoperability |







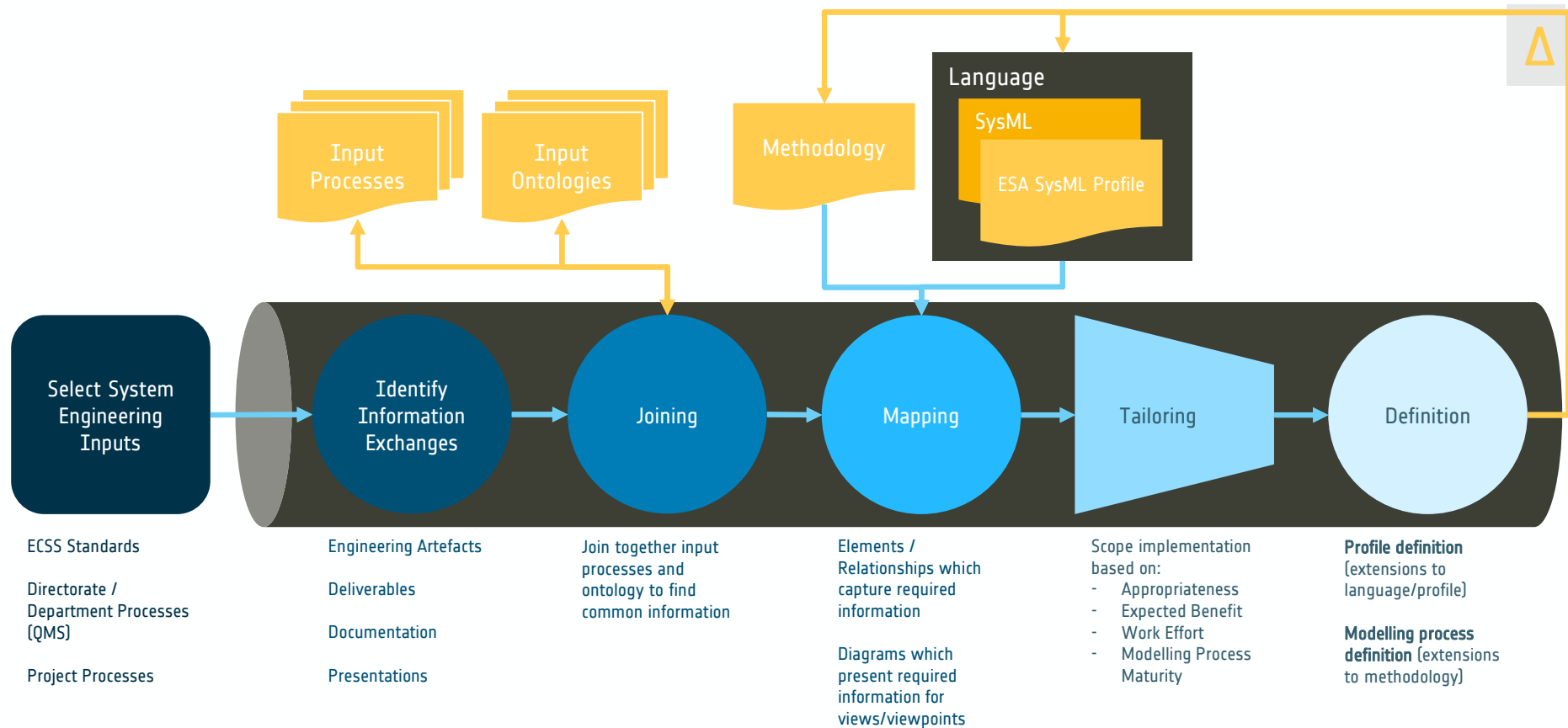
ESA MBSE approach (V4) - Improvements from V3



- Ensure compatibility with ECSS and QMS documents
- Justify all decisions
- Elaborate MBSE framework and modelling guides alongside the profile – *what* to model, and *how* to model it
- Allow remapping to different target languages (SysML v1/v2)
- Establish rigorous definition process which allows for future extensibility



Proposed Definition Methodology





Select Engineering Inputs



Select System Engineering Inputs

- ECSS Standards
 - ECSS-E-ST-10C Rev.1
 - ECSS-E-ST-10-06C
 - ECSS-E-TM-10-25A
 - ECSS-S-ST-00-01C
- QMS processes within Directorate / Department (e.g. SCI)
- Project-specific process (potentially not formalised)

ECSS-E-HB-10	
ECSS-E-ST-10-02	
ECSS-E-ST-10-03	
ECSS-E-ST-10-06	
ECSS-E-ST-10	
ECSS-E-TM-10-23	
ECSS-E-TM-10-25	
ECSS-M-ST-10	
ECSS-M-ST-40	
ECSS-S-ST-00-01	
ECSS-S-ST-10-24	

Scoped Documents

Documents considered for V4 definition pipeline.

Including a document for consideration

1. Create a folder on repo with document name, e.g. [input/ECSS-E-ST-10](#)

2. Add entry in the table below

3. Prioritise documents for consideration based on following criteria:

- 0 ...

4. When selected for consideration:

1. Create an issue ticket with document name, e.g. [ECSS-E-ST-10](#)
2. Associate with a [cycle milestone](#)

Input Documents

Document Name	Document Version	Description	Document Link	Issue Ticket
ECSS-E-ST-10	C Rev. 1	Specification for system engineering implementation requirements for space systems and space products development	Link	Link
ESA Proposal for ECSS-E-HB-10	A Draft version 1	Provides support when using ECSS-E-ST-10C "System Engineering General Requirements" and ECSS-E-ST-10-06C "Technical Specification Requirements". It also provides functional analysis methods in support of system engineering activities.	Link	-----
ECSS-E-TM-10-23	A	Establishes a formal specification of the semantics of the engineering data in order to enable the creation of engineering data repositories with standardised data exchange interfaces – a so-called space system data repository – thereby allowing interoperability between data repositories managed by different stakeholders.	Link	-----

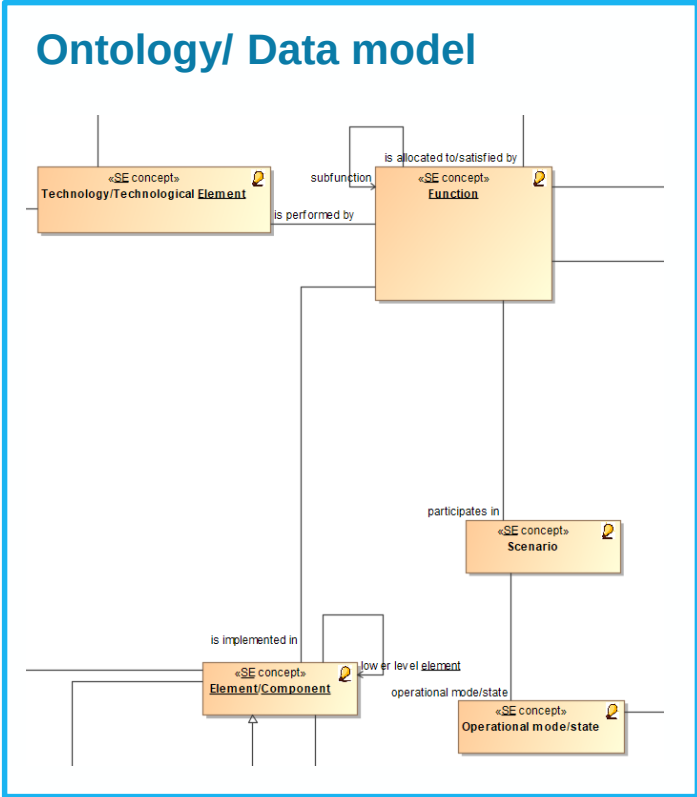
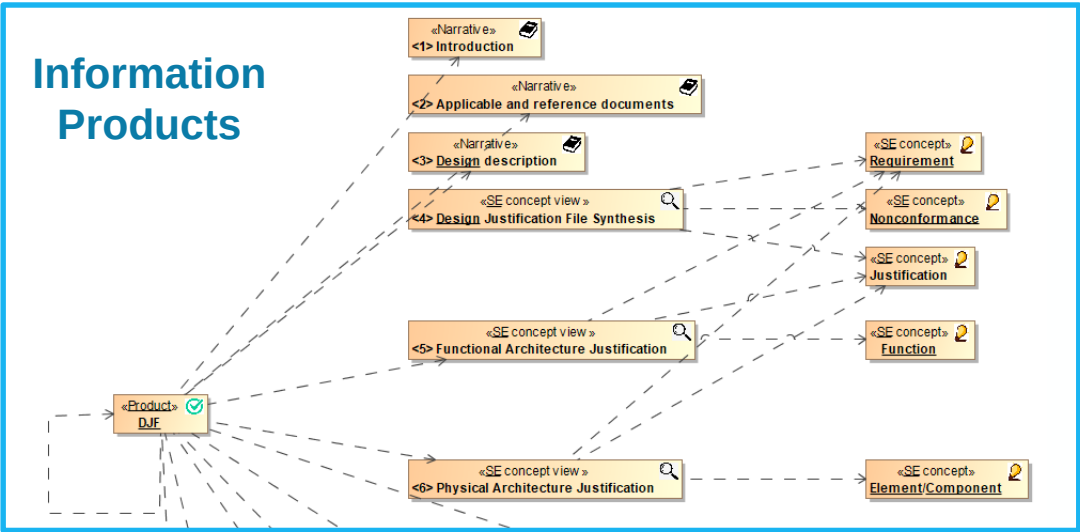
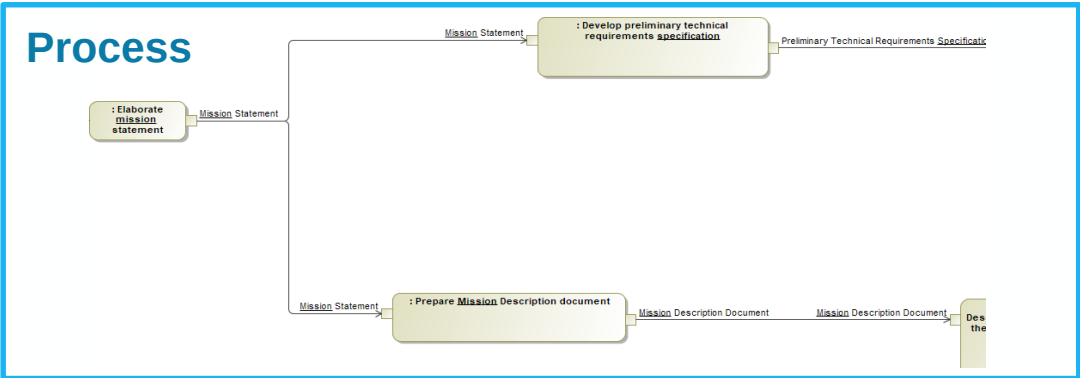


Identify Information Exchanges

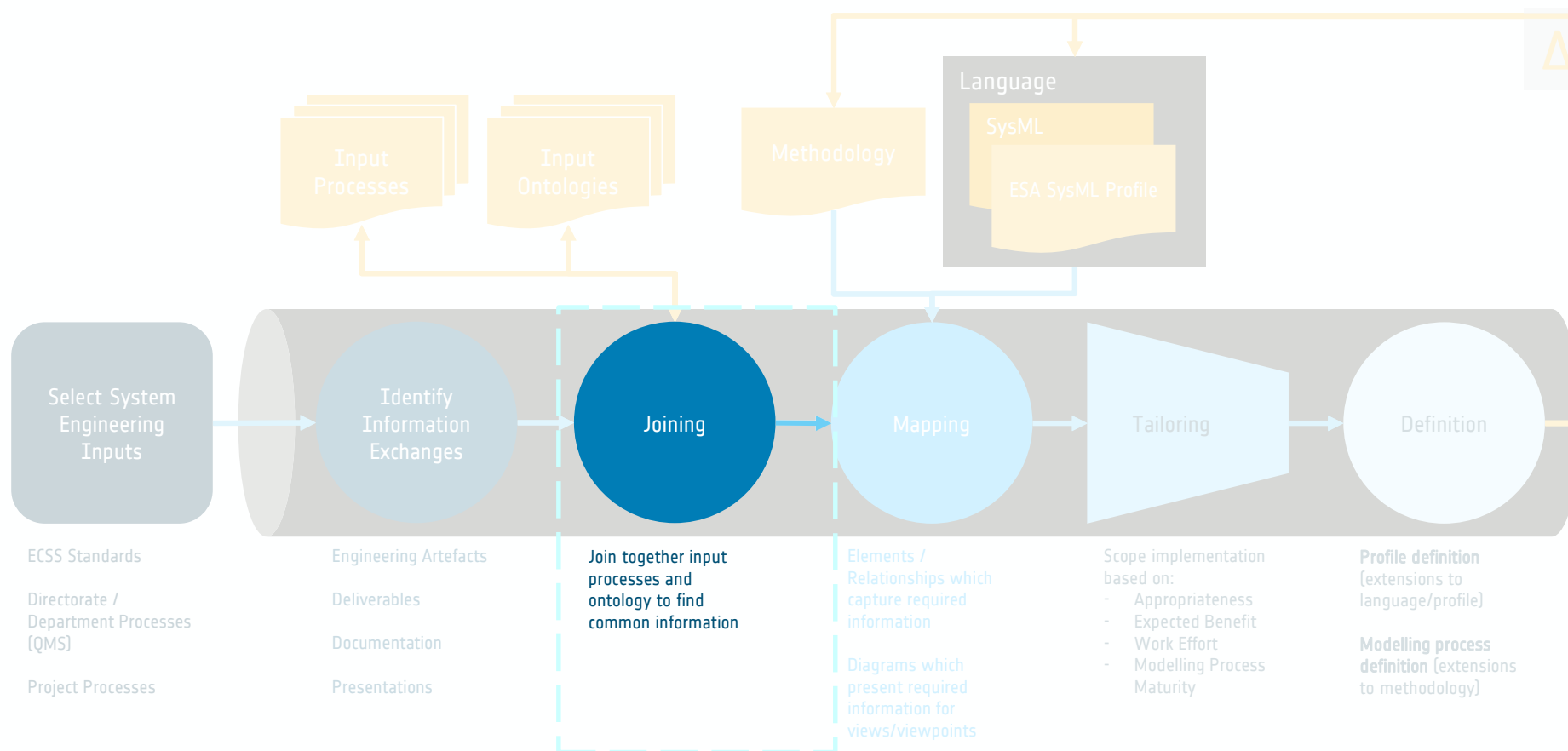


- Process Modelling
- Product Identification
- Product Definition
- Concept Extraction

Modelling of the ECSS-E-ST-10C document



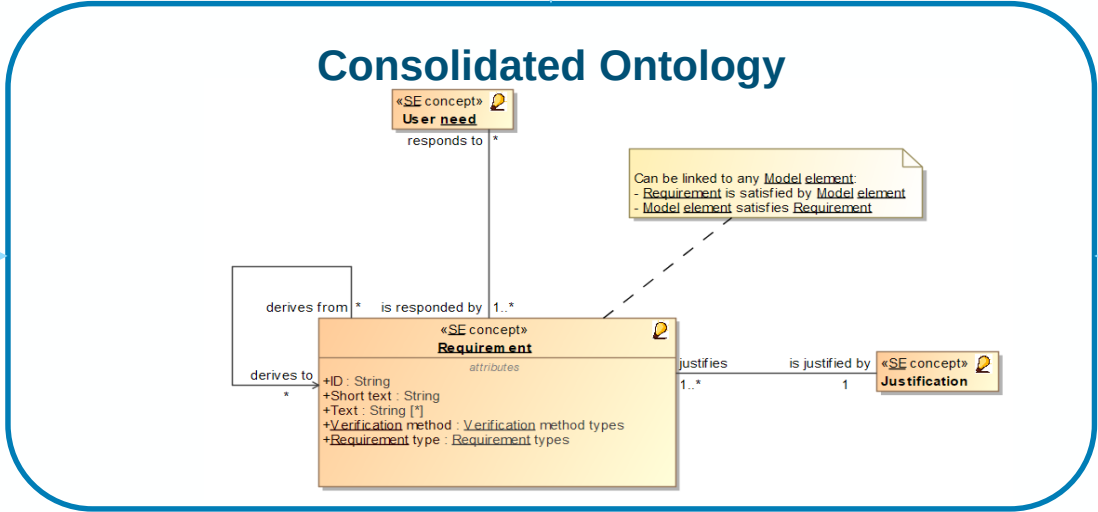
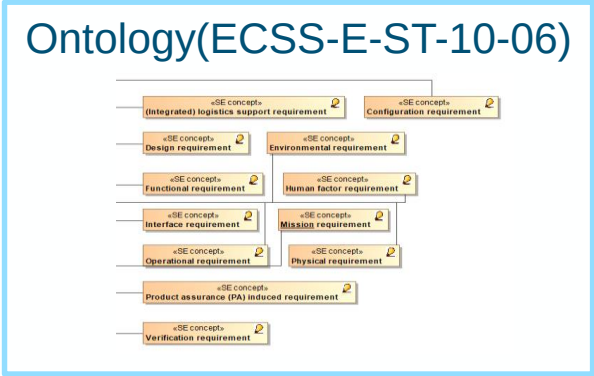
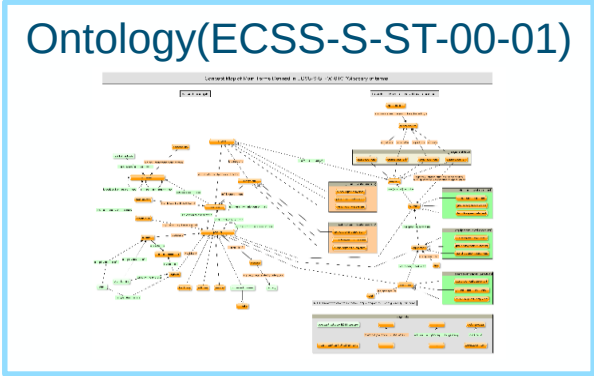
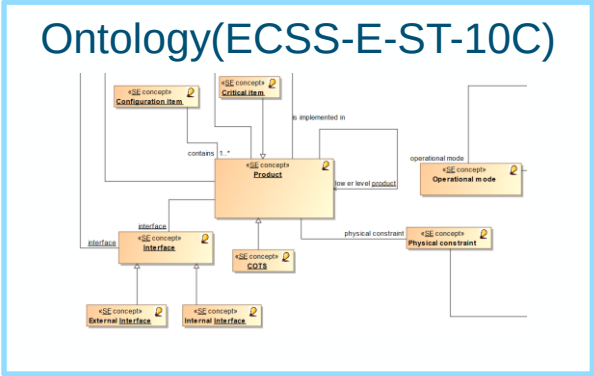
Joining

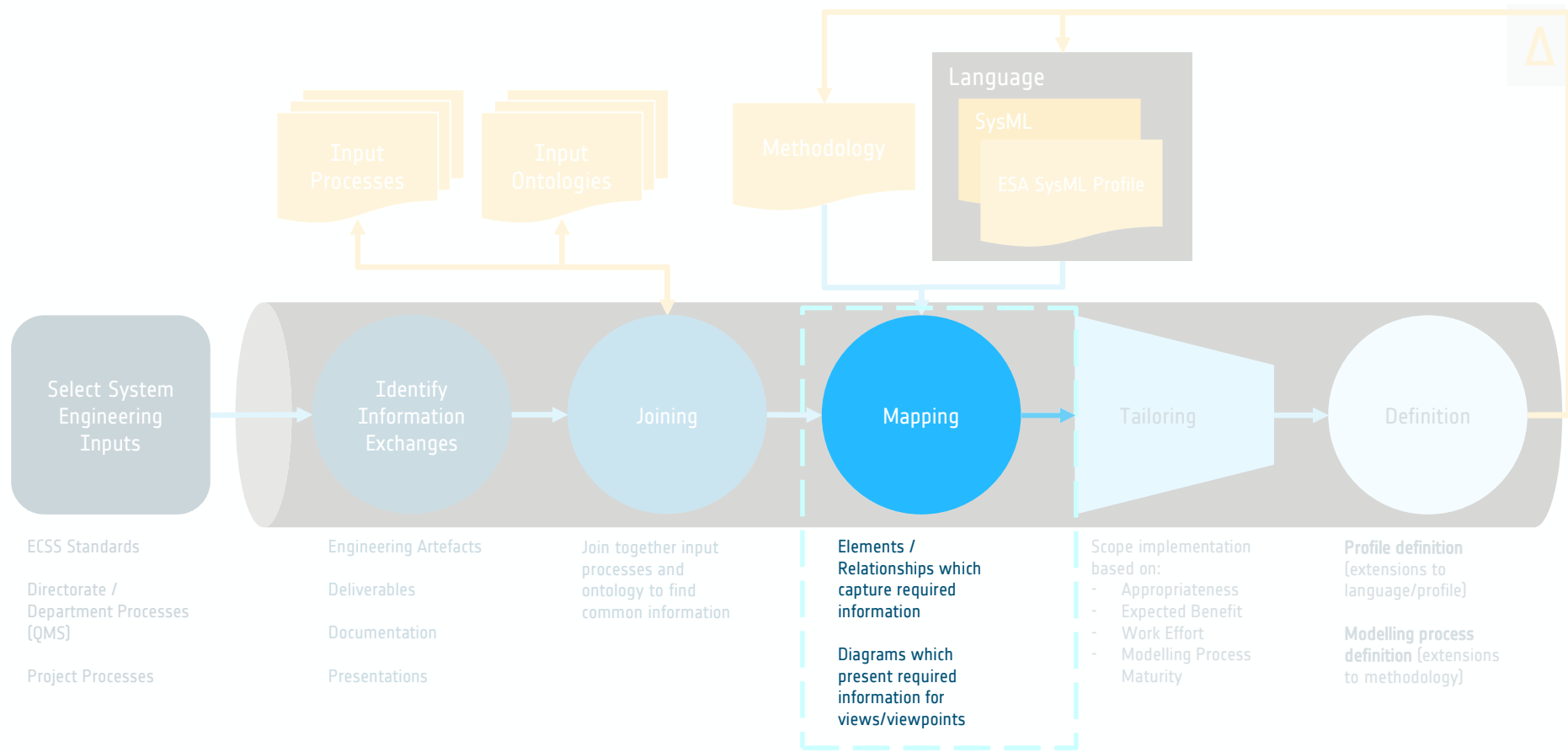


Joining

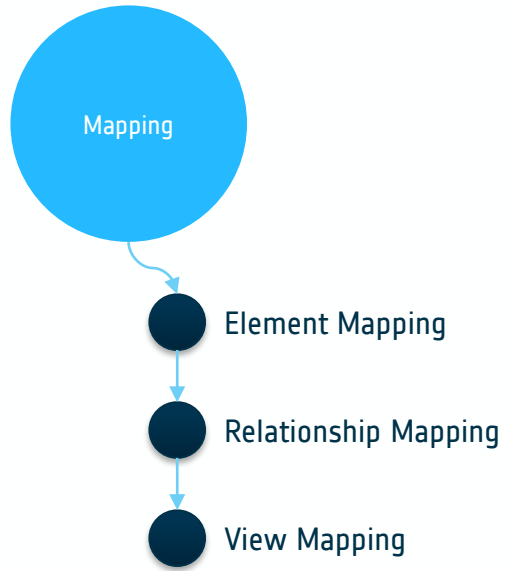


- Input Ontology
- Enrichment
- Filtering
- Joining (Process + Ontology)

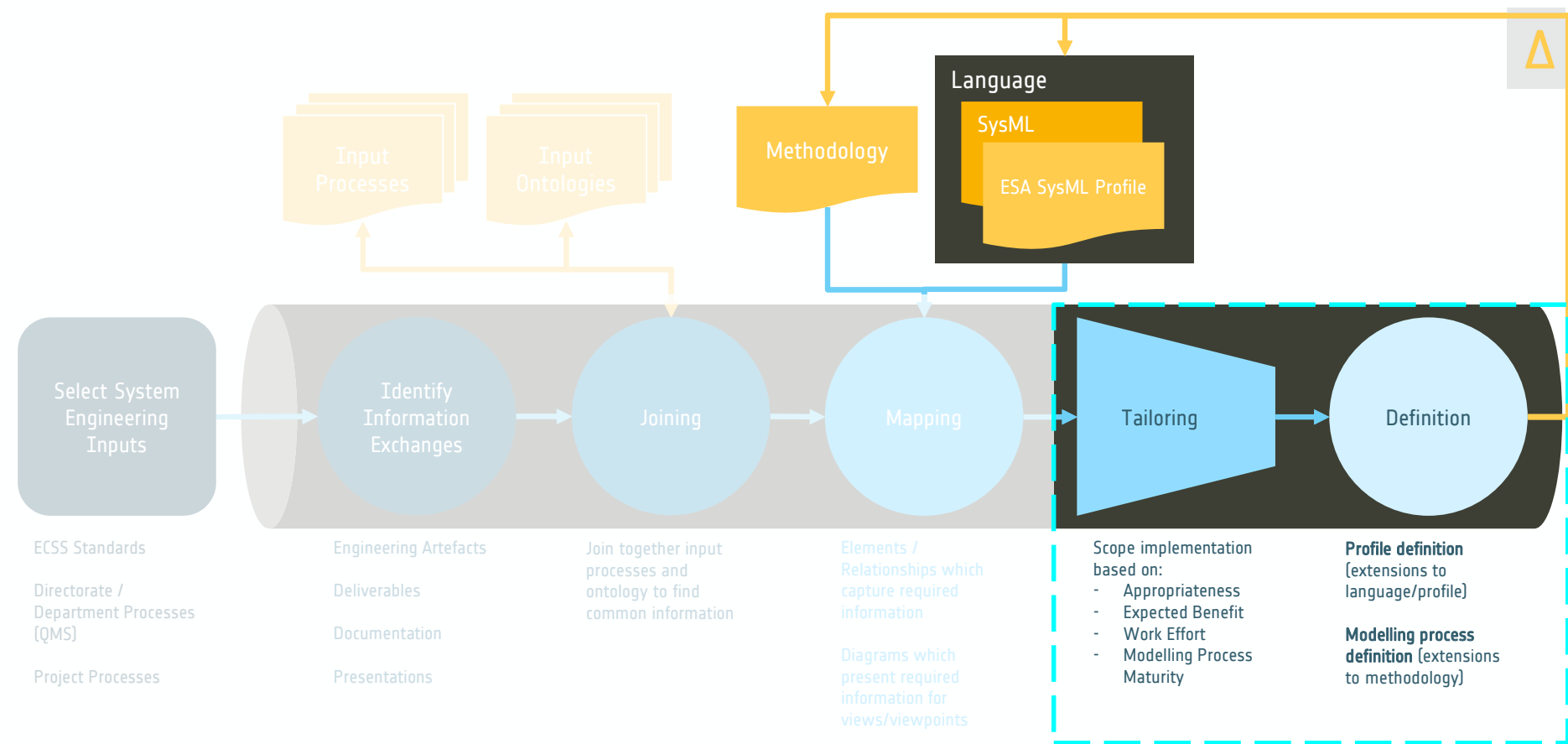




Mapping

[illegible]

Tailoring and Definition



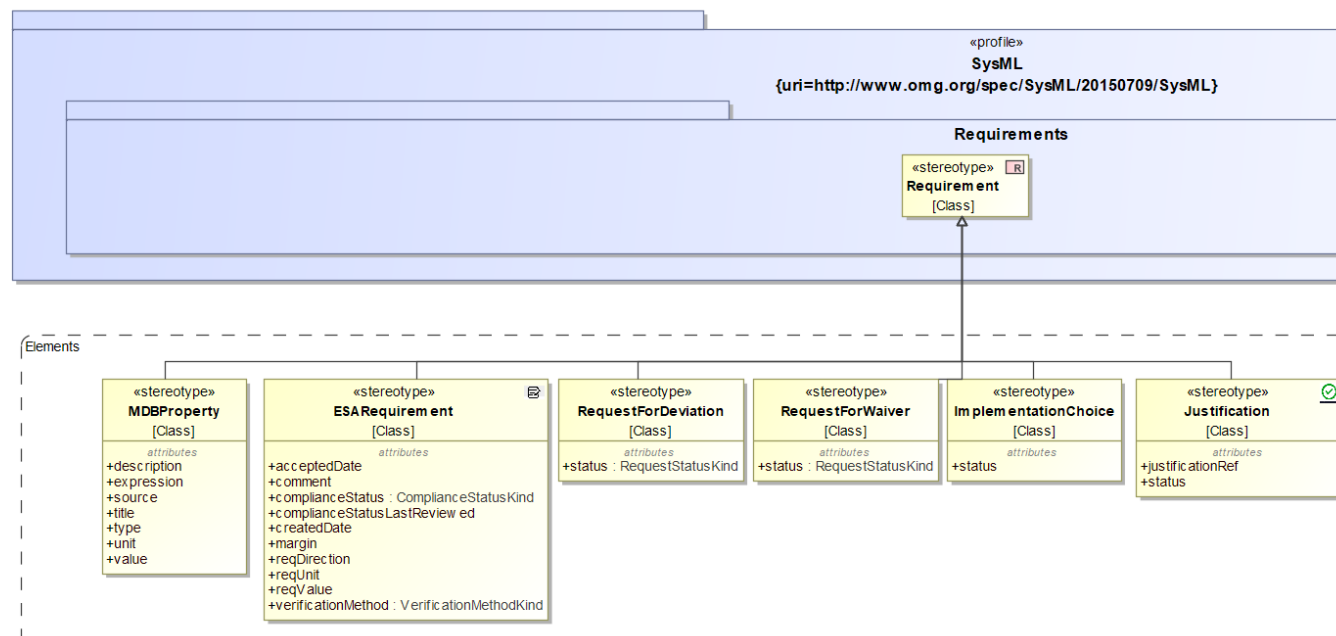
Tailoring and Definition

Tailoring

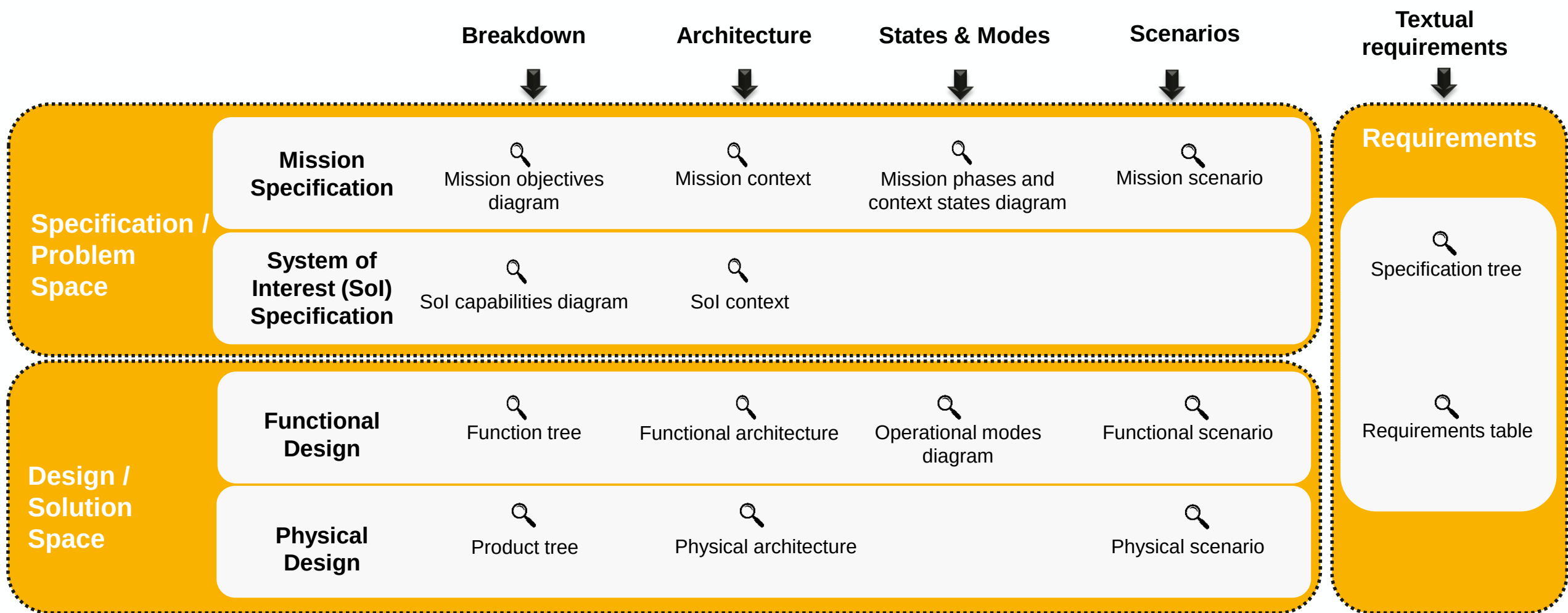
- Phase/Process-based (Top-down)
- Product-based (Bottom-up)
- Other criteria (Maturity / Work Effort / Expected Benefit)

Definition

- Profile Definition
- Modelling Process Definition



Output: MBSE Framework



First complete iteration being completed based on the following inputs:

- ## The next steps are:

- Application of the ESA MBSE approach in projects: already being used for the EL3 mission (European Large Logistic Lander)
- Delivery to the ADS MSR-ERO for a tool to tool mapping (Q4 2021)
- A second iteration of the definition process to incorporate other systems engineering areas such as interfaces management and verification and validation



Thank you for your attention

