The development of the ESA SysML Methodology

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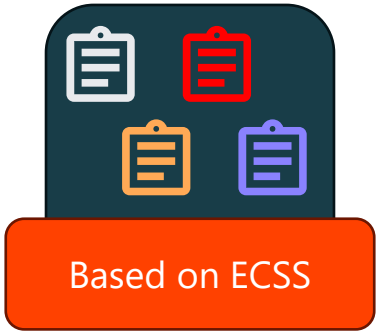
Why ESA has a MBSE Methodology ?

- Language uniformized among system modelers
- But no methodology to create a model
- Too many tools available

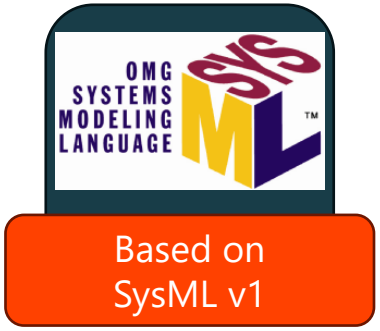
→ Risk of having divergent models

- Need of having a standardized method for space systems
- Entry point for organizations in space domain to dive into MBSE domain

The ESA SysML Solution

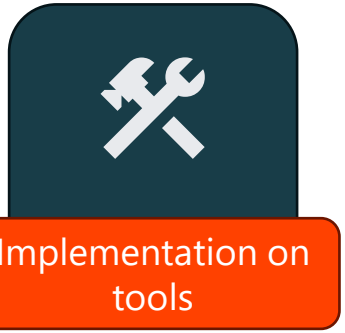


Based on ECSS

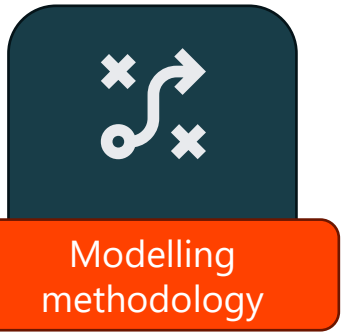


Based on SysML v1

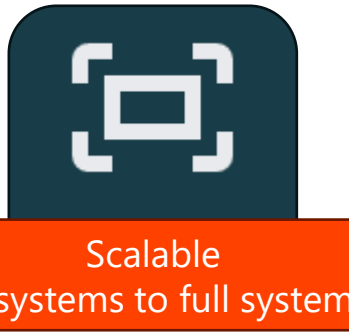
A rigorous and iterative process



Implementation on tools



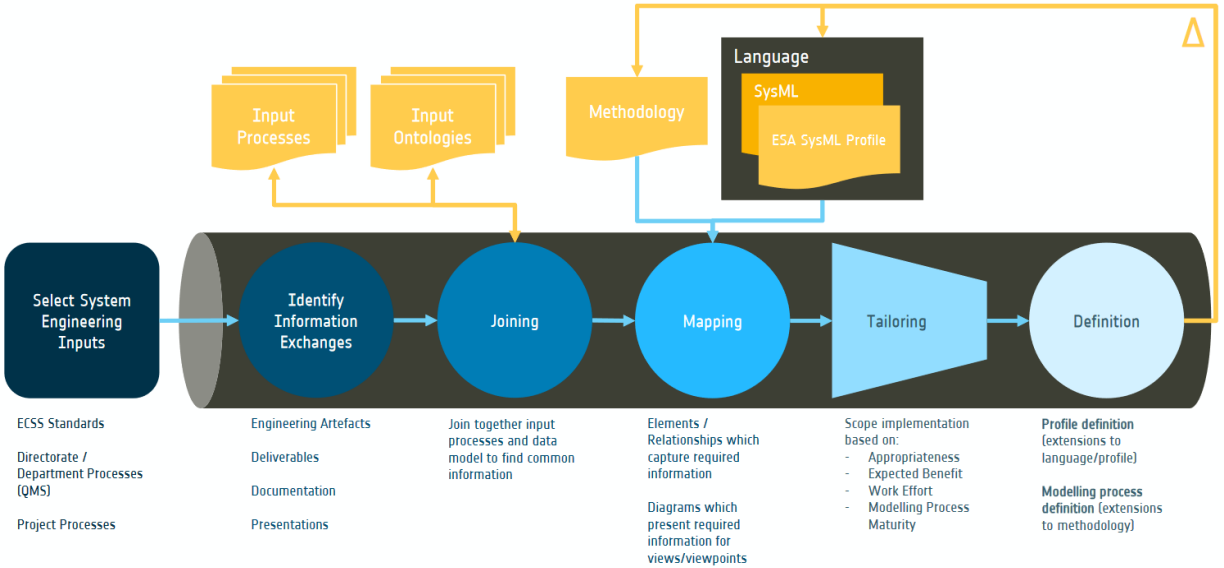
Modelling methodology



Scalable (subsystems to full systems)

The ESA SysML Solution - Creation

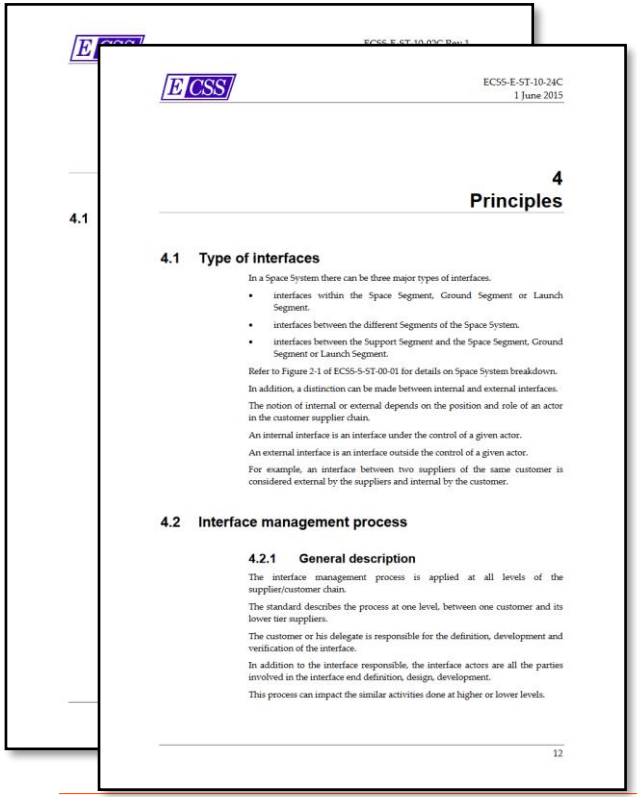
ECSS-E-TM-10-25
CDF Model
ECSS-E-ST-10-06
Requirements
ECSS-E-ST-00-01
Glossary
ECSS-E-ST-10
Requirements
ECSS-M-ST-10
Project Planning
ECSS-E-ST-10-02C
Verification & Validation
ECSS-E-ST-10-24C
Interfaces



CAMEO SYSTEMS MODELER™

ENTERPRISE ARCHITECT

Data model inputs



ECSS-E-ST-10-24C
1 June 2015

4
Principles

4.1 Type of interfaces

In a Space System there can be three major types of interfaces.

- interfaces within the Space Segment, Ground Segment or Launch Segment.
- interfaces between the different Segments of the Space System.
- interfaces between the Support Segment and the Space Segment, Ground Segment or Launch Segment.

Refer to Figure 2-1 of ECSS-S-ST-00-01 for details on Space System breakdown.

In addition, a distinction can be made between internal and external interfaces.

The notion of internal or external depends on the position and role of an actor in the customer supplier chain.

An internal interface is an interface under the control of a given actor.

An external interface is an interface outside the control of a given actor.

For example, an interface between two suppliers of the same customer is considered external by the suppliers and internal by the customer.

4.2 Interface management process

4.2.1 General description

The interface management process is applied at all levels of the supplier/customer chain.

The standard describes the process at one level, between one customer and its lower tier suppliers.

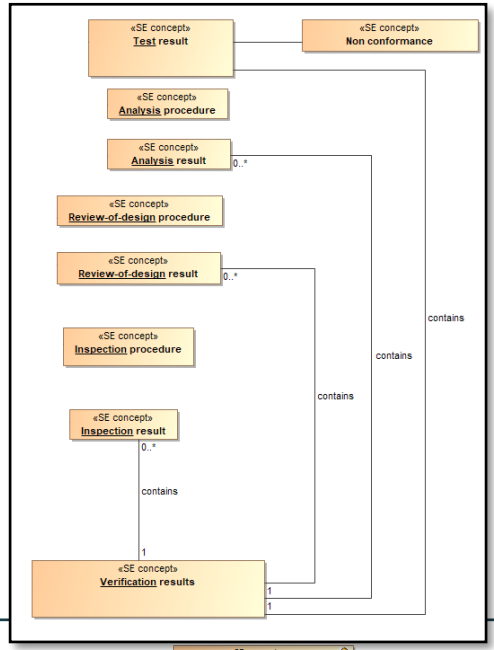
The customer or his delegate is responsible for the definition, development and verification of the interface.

In addition to the interface responsible, the interface actors are all the parties involved in the interface end definition, design, development.

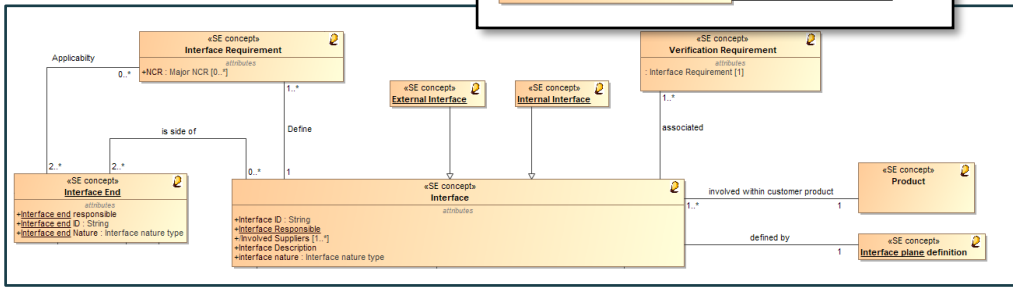
This process can impact the similar activities done at higher or lower levels.

12

ECSS-E-ST-10-02C analysis extract

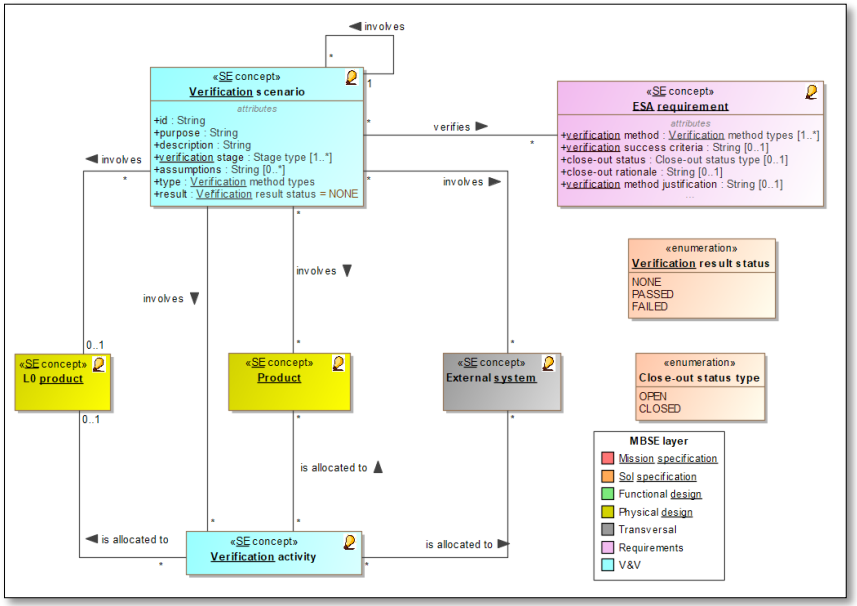


ECSS-E-ST-10-24C analysis extract



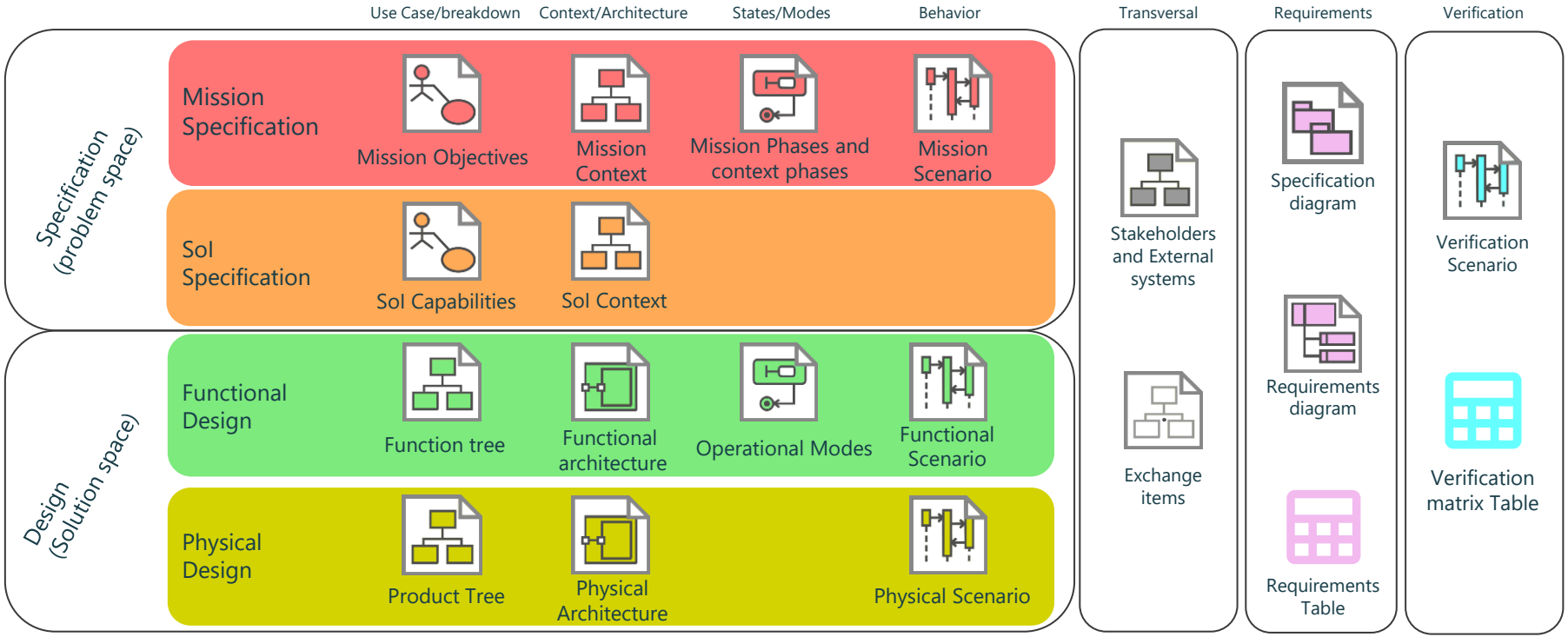
Joining, Mapping & Tailoring

- Joining: Assemble all Concepts in a single data-model
- Mapping: Affecting each concept to a layer
- Tailoring: Eventual pruning/extension of the data-model to conform to MBSE practices



Extract of the profile - Verification part

The ESA SysML Methodology



Mapping to SysML v1

Elements, relationships and views defined in the data-model are mapped onto SysML v1 and implemented onto Cameo and Enterprise Architect

System engineering mapping

Name	Missing Attributes	Mapped Attributes	Source SE Concept	Target SE Concept
ESA Requirement-Requirement	requirement type	ID	ESA requirement	Requirement [Class]
	requirement status	Short text		
	verification success criteria	title		
	close-out status			
	close-out rationale			
	verification method			
	verification method justification			

Relationships mapping

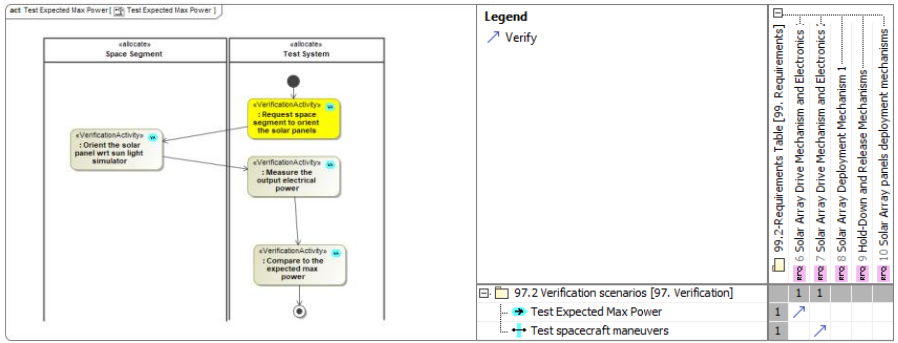
Name	Mapping to target language
Allocation	Allocate [Abstraction]
Association	Association
Composition	DirectedComposition
Containment	DirectContainment
Define	Typing
DeriveReqt	DeriveReqt [Abstraction]
Describe	Dependency

Views mapping

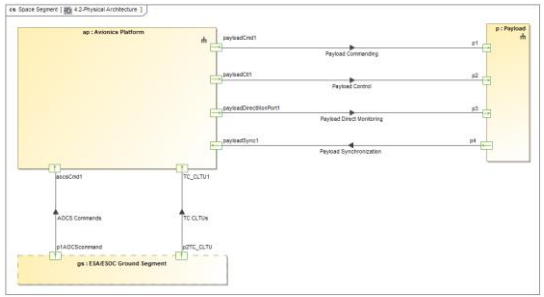
Name	Mapping to target language
Exchange item s diagram	bdd
Function tree	bdd
Functional architecture	ibd
Functional scenario	seq act
Mission context	bdd

Implementation and demonstration

Cameo System Modeler

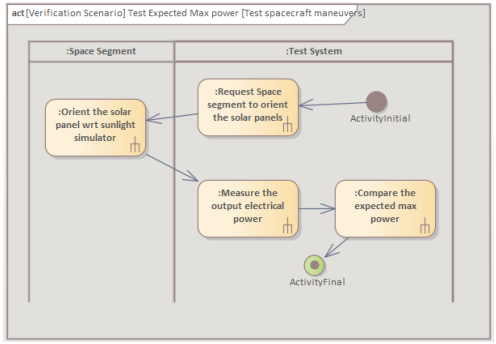


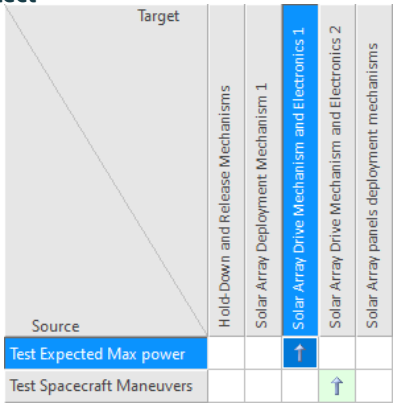
Verification layer



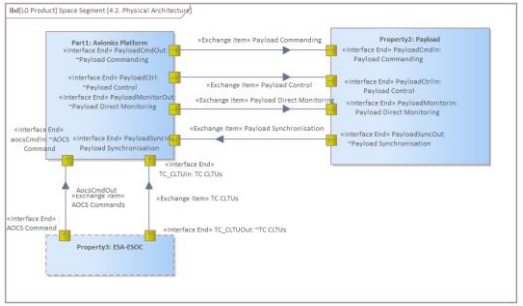
Physical Architecture

Enterprise Architect





Verification layer



Physical Architecture

Conclusion

- Profiles implementation
- Examples in Cameo and EA
- Maintenance manual
- Methodology pages
- Data Model
- Enterprise Architect Plugin for requirement management

ESA SysML Solution availability

The ESA SysML Solution can be found on the European Space Software Repository, to companies of ESA Member States :

https://essr.esa.int/project/esa-sysml-solution