ESA SysML Solution – Specification and Implementation

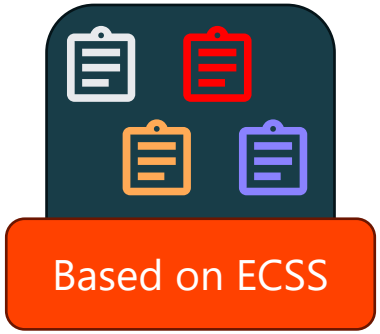
Final Presentation

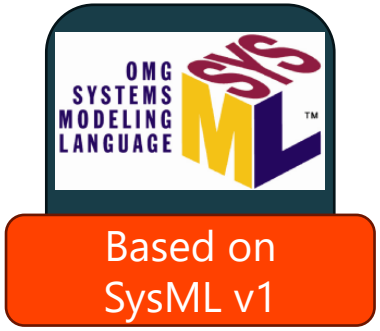
Anh Toan Bui Long | Final Presentation | 8th October 2024

Contents

- Introduction
- Partners
- Project Objective and scope
- Specification, Mapping & Implementation
- Enterprise Architect Plugin

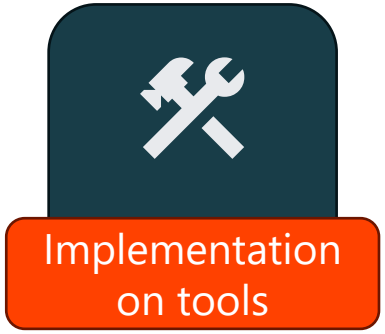
The ESA SysML Solution


Based on ECSS

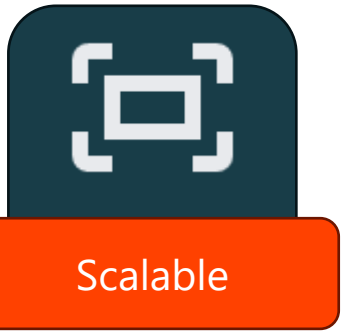


Based on SysML v1


A rigorous and iterative process


Implementation on tools


Modelling methodology


Scalable

Partnership and roles

Product owner

Prime, implementation and development (Enterprise Architect)

Analysis and validation

Implementation (Cameo) and consultancy

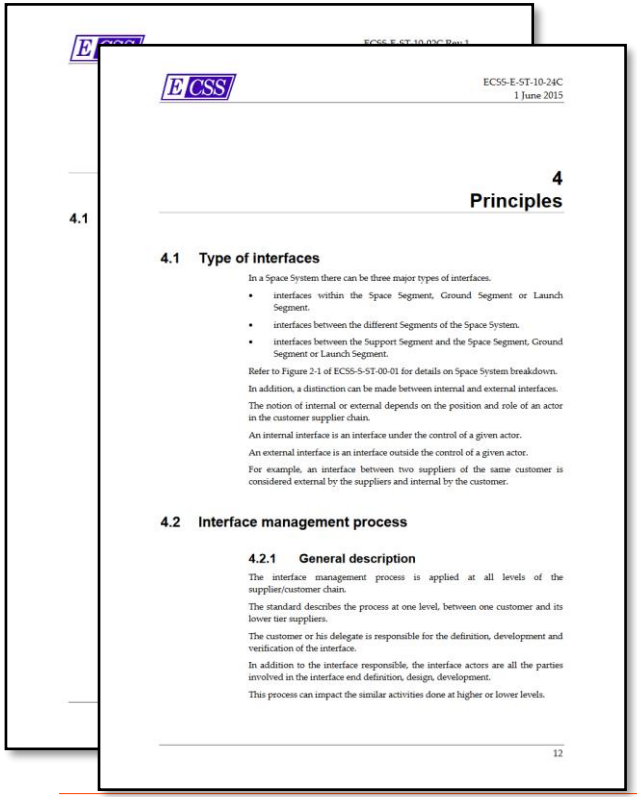
Consultancy

Objective

- Iterative process: building new concepts from the previous iteration.
  - Specification of the new elements
    - Interfaces specification
    - Validation specification
  - Implementation of the profile onto SysML v1
    - Cameo Systems Modeler
    - Enterprise Architect
  - Customisation of tool interface
- Cameo Systems Modeler & Enterprise Architect Plugin development

Specification, mapping & implementation

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.

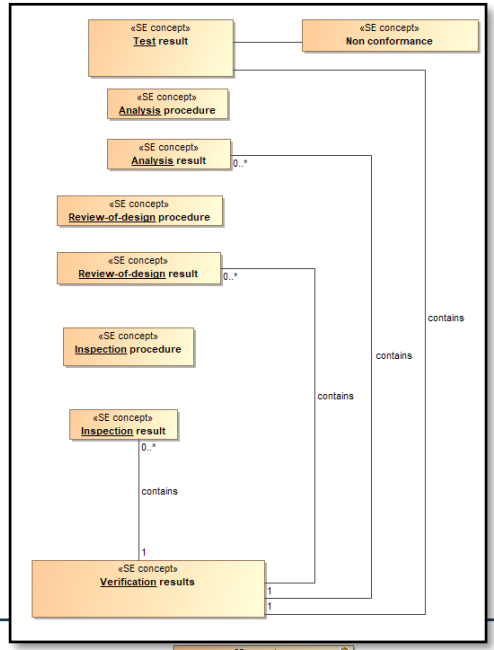
The customer or his delegate is responsible for the definition, development and verification of the interface.

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

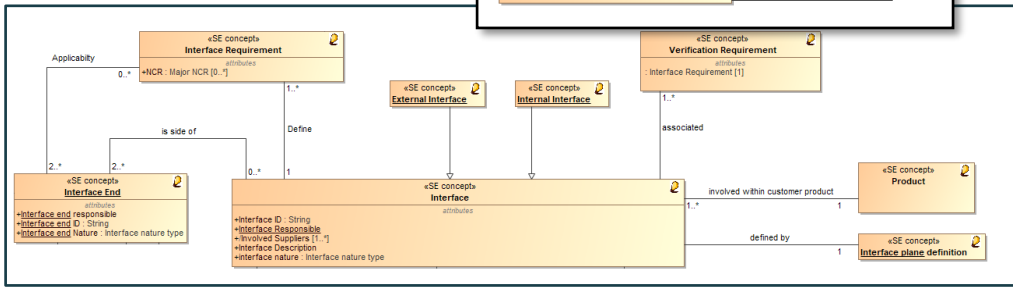
This process can impact the similar activities done at higher or lower levels.

12

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

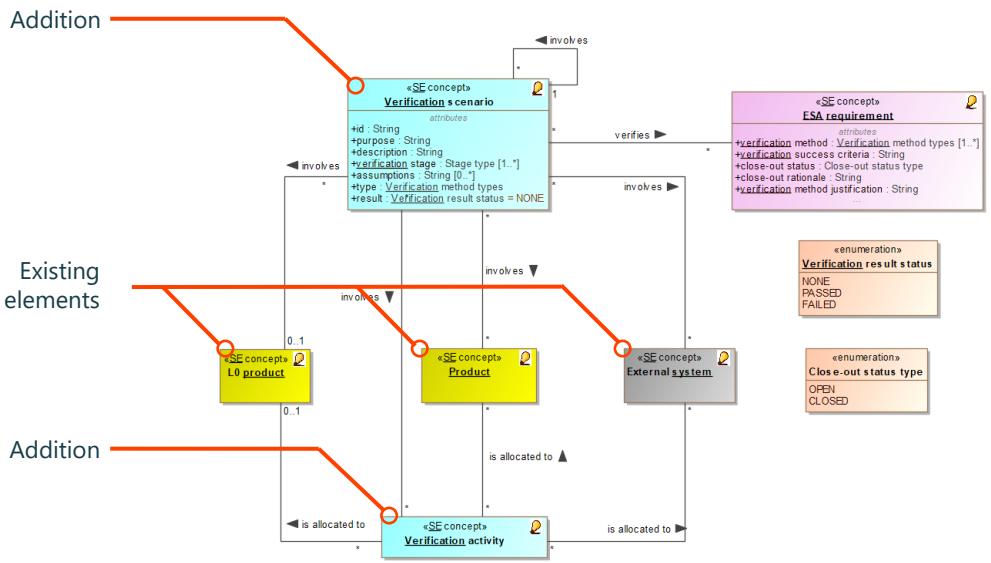


ECSS-E-ST-10-24C analysis extract



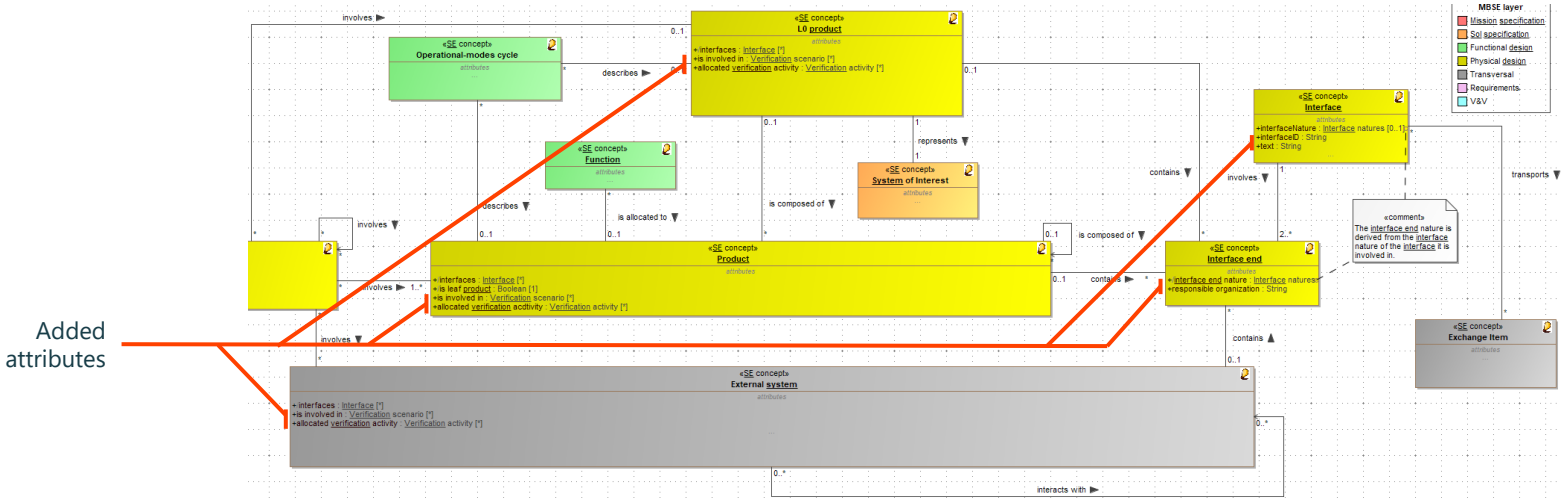
Architecture simplified for readability

Nexus - Representation of verification



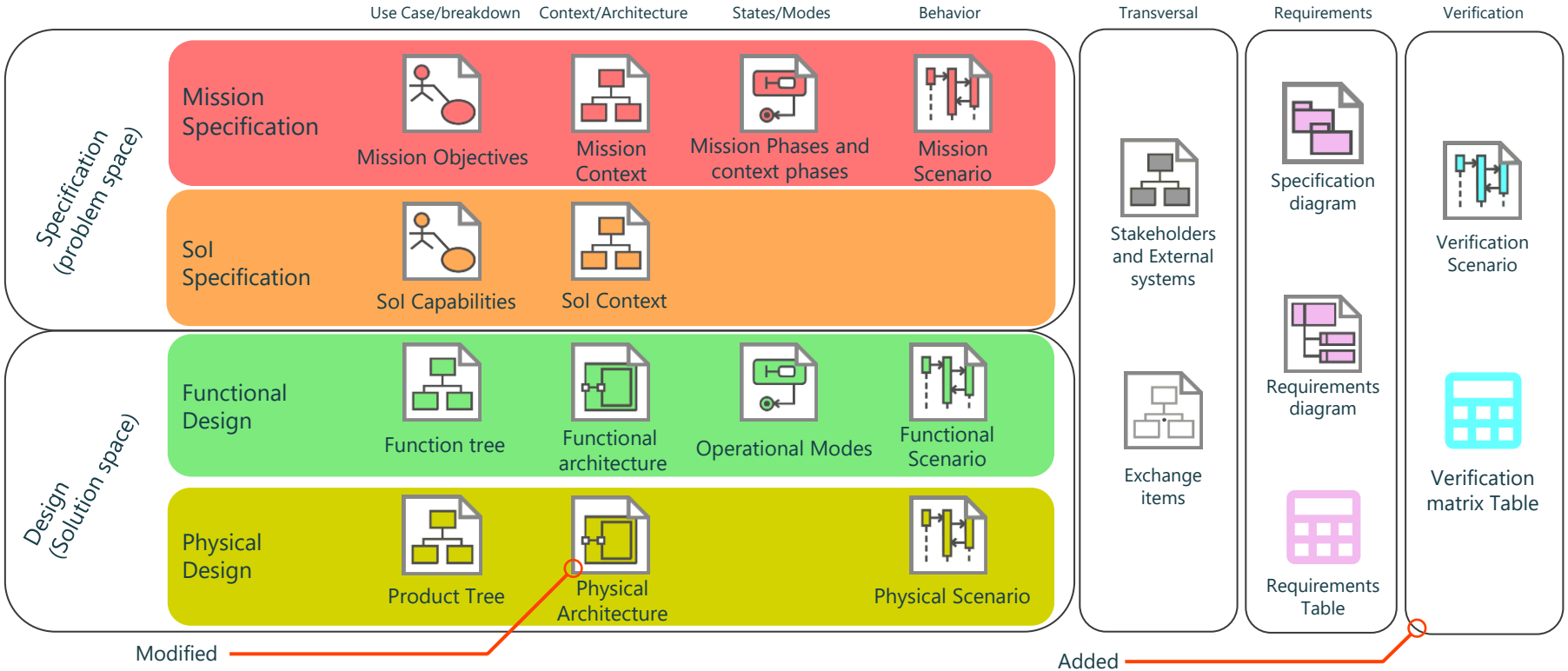
Architecture simplified for readability

Nexus - Representation of Interfaces



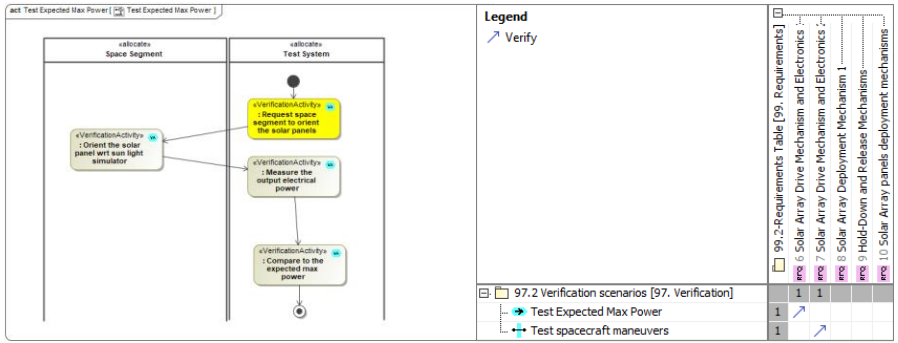
Architecture simplified for readability

Integration in the current methodology

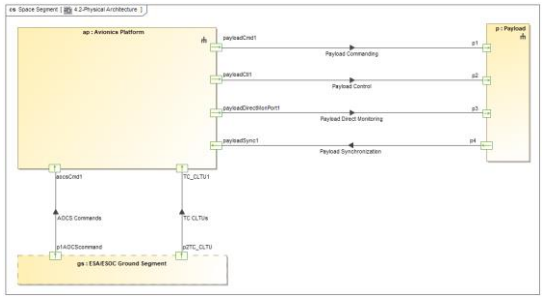


Implementation and demonstration

Cameo System Modeler

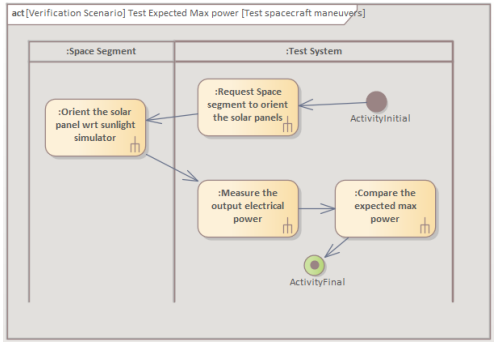


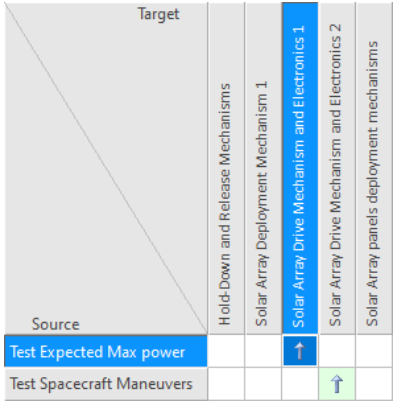
Verification layer



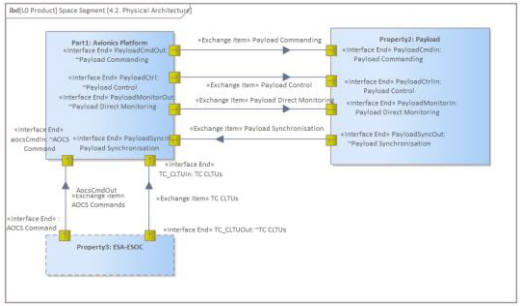
Physical Architecture

Enterprise Architect





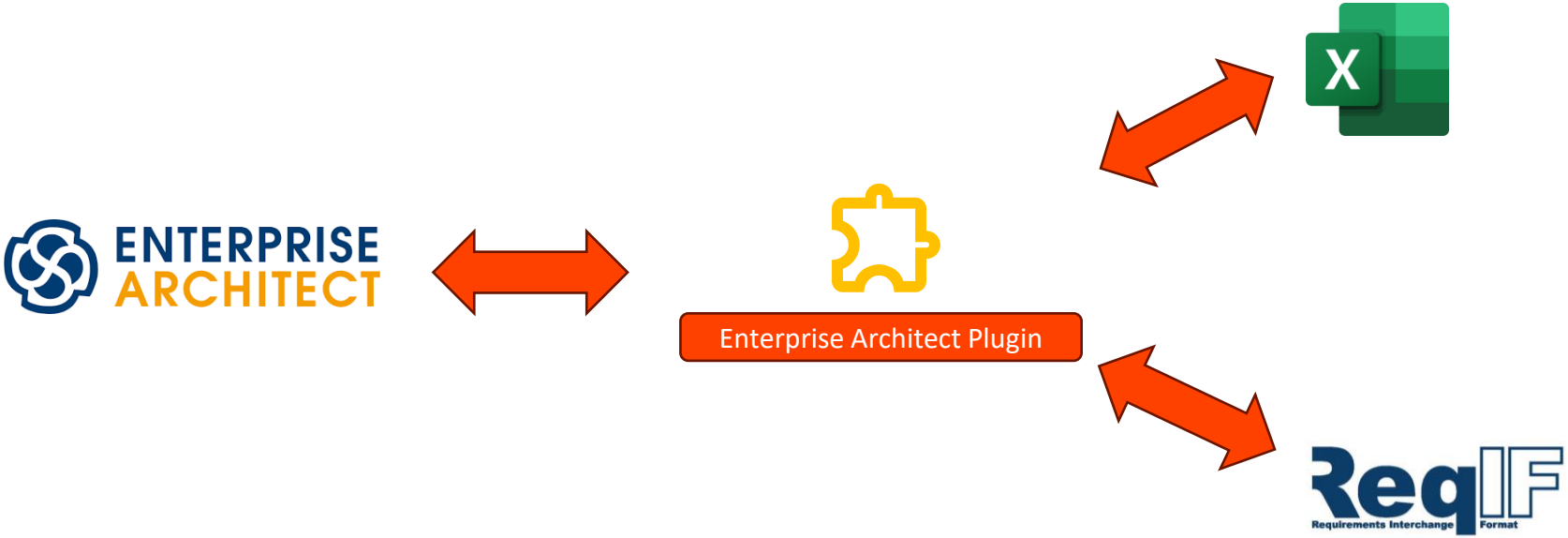
Verification layer



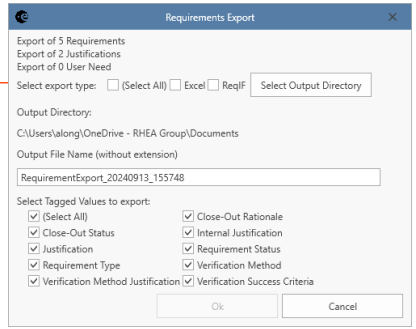
Physical Architecture

Enterprise Architect plugin

Enterprise Architect Plugin for ESA SysML solution

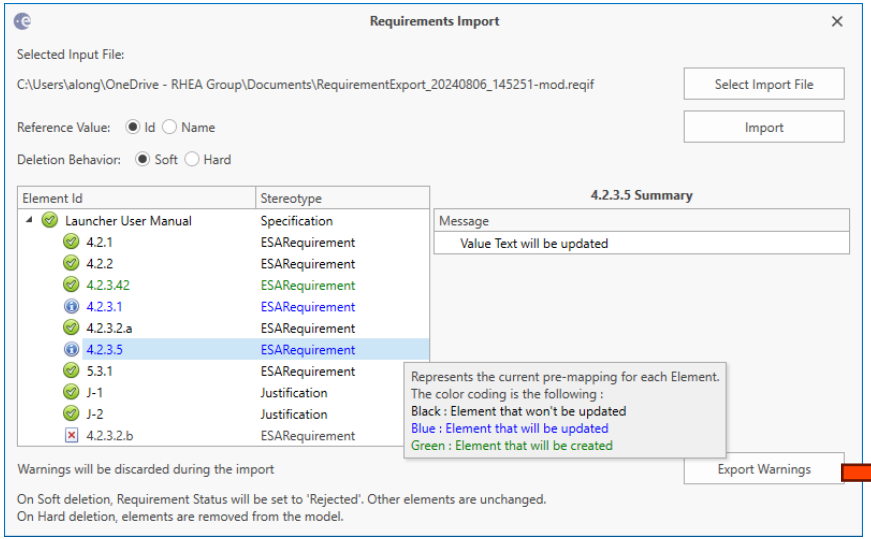


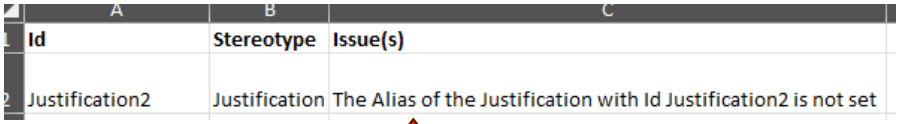
Exporting requirements (Excel + ReqIF)



Id	Title	Text	Specification	Specification chapter	Justified by	Derives to	Derives from	Responds to user need	Satisfied by	Is verified by	Close-Out Rationale	Close-Out Status	Internal Justification	Justification	Requirement Status	Requirement Type	Verification Method
ESASYSML-EA-EXT-GEN-R-030		The ESA SysML plugin for Enterprise Architect shall mention the version of the profile used.	Package1		ESASYSML-EA-EXT-GEN-J-030										Proposed		
ESASYSML-EA-EXT-GEN-R-040		The ESA SysML plugin for Enterprise Architect shall be compatible with ESA SysML Solution 1.2 only.	General Specification						ESA SysML plugin Enterprise Architect						Proposed		
ESASYSML-EA-EXT-GEN-R-050		The ESA SysML plugin for Enterprise Architect shall be clear for the user	General Specification		ESASYSML-EA-EXT-GEN-J-020										Proposed		
ESASYSML-EA-EXT-GEN-R-070		The ESA SysML plugin shall import requirements from XLSX documents.	General Specification			ESASYSML-EA-EXT-IMP-R-010									Proposed		
ESASYSML-EA-EXT-GEN-R-080		The ESA SysML plugin for Enterprise Architect must give feedback to the user about the process status	General Specification												Proposed		
ESASYSML-EA-EXT-GEN-R-100		The ESA SysML plugin for Enterprise Architect shall mention the version of the profile used.	General Specification												Proposed		
ESASYSML-EA-EXT-GEN-R-110		The ESA SysML plugin for Enterprise Architect shall be clear for the user	General Specification												Proposed		
ESASYSML-EA-EXT-EXP-R-010		The ESA SysML plugin for Enterprise Architect shall support: Word Export Excel Export ReqIF Export	Exporting Requirements			ESASYSML-EA-EXT-EXP-R-020 ESASYSML-EA-EXT-EXP-R-030	ESASYSML-EA-EXT-GEN-R-060			Verification Scenario1					Proposed		
ESASYSML-EA-EXT-EXP-R-020		The ESA SysML plugin for Enterprise Architect shall provide a template for the export.	Exporting Requirements		Justification1		ESASYSML-EA-EXT-EXP-R-010								Proposed		
ESASYSML-EA-EXT-EXP-R-030		The export shall comprises as minimum: Requirement Alias Requirement Name Requirement Text Derived From (requirements IDs) Derives To (requirements IDs) Justification text Any other attributes	Exporting Requirements		Justification1	ESASYSML-EA-EXT-EXP-R-040	ESASYSML-EA-EXT-EXP-R-010								Proposed		
ESASYSML-EA-EXT-IMP-R-030		During the import of the excel file, the plugin shall create all relationships between requirement and justifications in the requirement file.	Specification1				ESASYSML-EA-EXT-IMP-R-020										
ESASYSML-EA-EXT-IMP-R-010		The import from XLSX shall be defined from a template.	Specification1			ESASYSML-EA-EXT-IMP-R-040	ESASYSML-EA-EXT-GEN-R-070								Proposed		
ESASYSML-EA-EXT-IMP-R-020		During the import of the excel file, the plugin shall create all relationships between requirements in the requirement file.	Specification1			ESASYSML-EA-EXT-IMP-R-030											
		Requirements in the imported excel file shall be identified either by															

Importing requirements (Excel + ReqIF)





	A	B	C
1	**Id**	**Stereotype**	**Issue(s)**
2	Justification2	Justification	The Alias of the Justification with Id Justification2 is not set

Traceability of Requirements

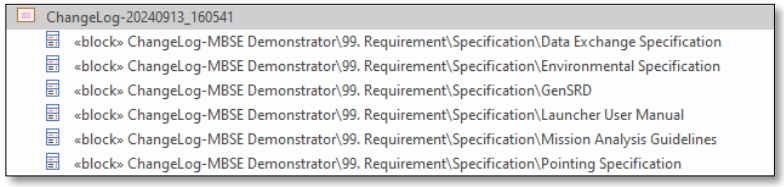
From one package, for each justification, what requirements are justified.

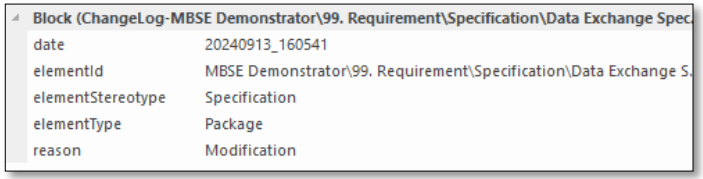
Launcher User Manual	"Justifies" Launcher User Manual	"Justifies" Pointing Specification
J-1	4.2.3.5	
J-2		9

For each requirement, which requirements it derives to in the different packages.

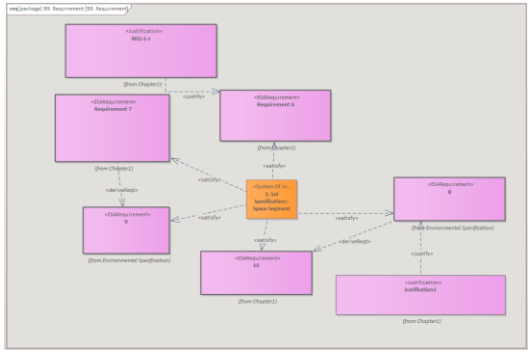
Launcher User Manual	"Derives to" Pointing Specification	"Derives to" Data Exchange Specification
4.2.1		
4.2.2		
4.2.3.1	9	
4.2.3.2.a		
4.2.3.2.b		
4.2.3.5		6 10
5.3.1	9	10

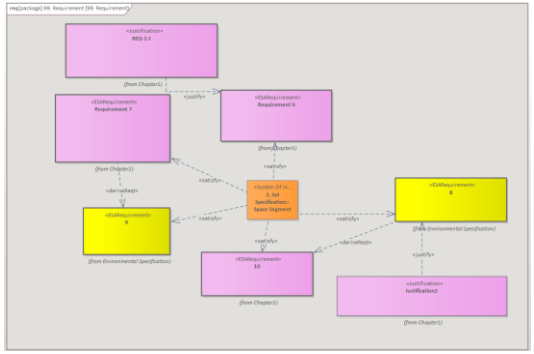
Change Log - Color change



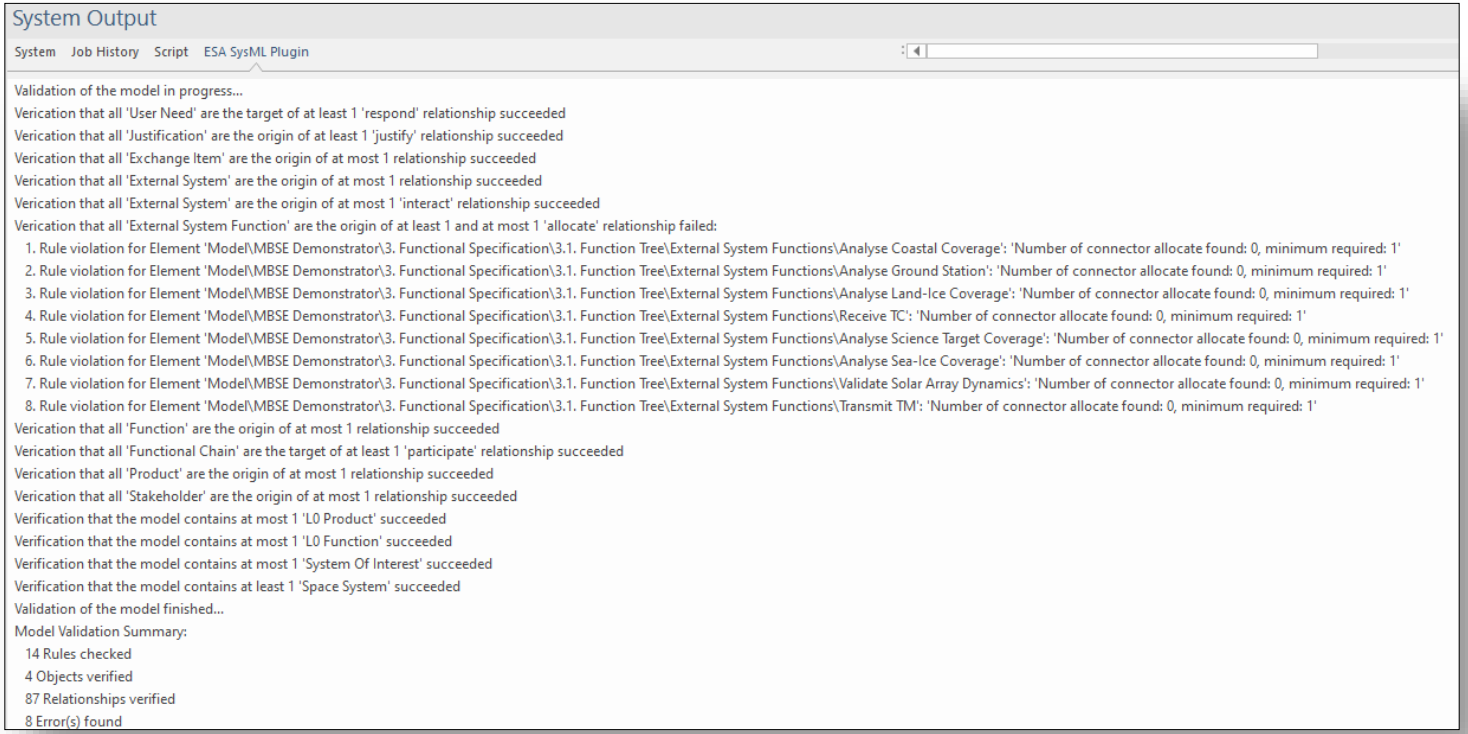


Element Id	Stereotype	Type	Date	Reason
MBSE Demonstrator\99. Requirement\Specification\Data Exchange Specification	Specification	Package	20240913_160541	Modification
MBSE Demonstrator\99. Requirement\Specification\Environmental Specification	Specification		20240913_160541	Deletion
MBSE Demonstrator\99. Requirement\Specification\GenSRD	Specification		20240913_160541	Deletion
MBSE Demonstrator\99. Requirement\Specification\Launcher User Manual	Specification		20240913_160541	Deletion
MBSE Demonstrator\99. Requirement\Specification\Mission Analysis Guidelines	Specification		20240913_160541	Deletion
MBSE Demonstrator\99. Requirement\Specification\Pointing Specification	Specification		20240913_160541	Deletion





Model Validation



Conclusion

Dissemination

- MBSE 2024 Conference (Paper + Presentation)
  - Scope: Interfaces and validation domains

- IAC 2024 Conference (Article + Presentation)
  - Scope: The building of the ESA SysML solution.

Conclusion

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

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