Requirements in SysML

Experience gathered working on the Consortia Model

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Why talk about requirements?

"The most difficult part of requirements gathering is not the act of recording what the user wants, it is the exploratory development activity of helping users figure out what they want."

Steve McConnell Software Project Survival Guide: (1997)

"The most important single aspect of software development is to be clear about what you are trying to build."

Attributed to Bjarne Stroustrup - C++ Coding Standards (2005)

Main Points

- Requirements are a core part of Model Based Systems Engineering
- Cameo offers tools for managing requirements from other sources
- Cameo offers the tools for working directly with requirements
- It is possible to trace the impact of change
- There are open questions and limitations,
- There are also possibilities for further investigation

Requirements - A core part of MBSE

System Engineering is a set of disciplines that when correctly applied will ensure the existence of valid, traceable, complete and endorsed **requirements.**

Model-based systems engineering (MBSE) is the formalized application of modeling to support **system requirements**, design, analysis, verification and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases (INCOSE-TP-2004-004-02, Version 2.03, September 2007).

Within an MBSE approach

- Requirements are not separate from the model but are are core entities
- They have relationship to other aspects of the model
- These relationships make it possible to trace all the other entities and artifacts back to the original specified need.

Working with externally managed requirements

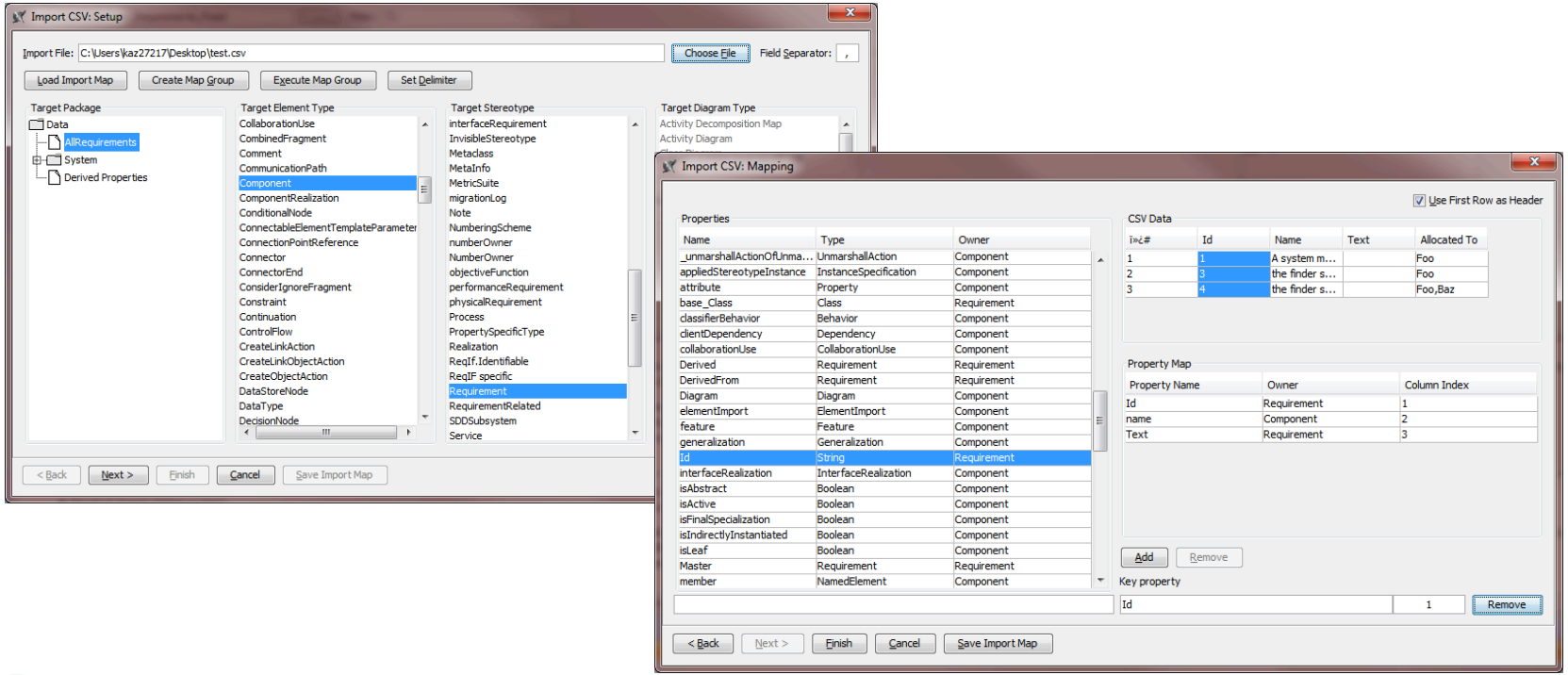
Cameo Systems Modeler offers 3 different tools for importing and exporting requirements:

- Cameo CSV Importer
- Cameo Excel Importer
- Cameo Data Hub

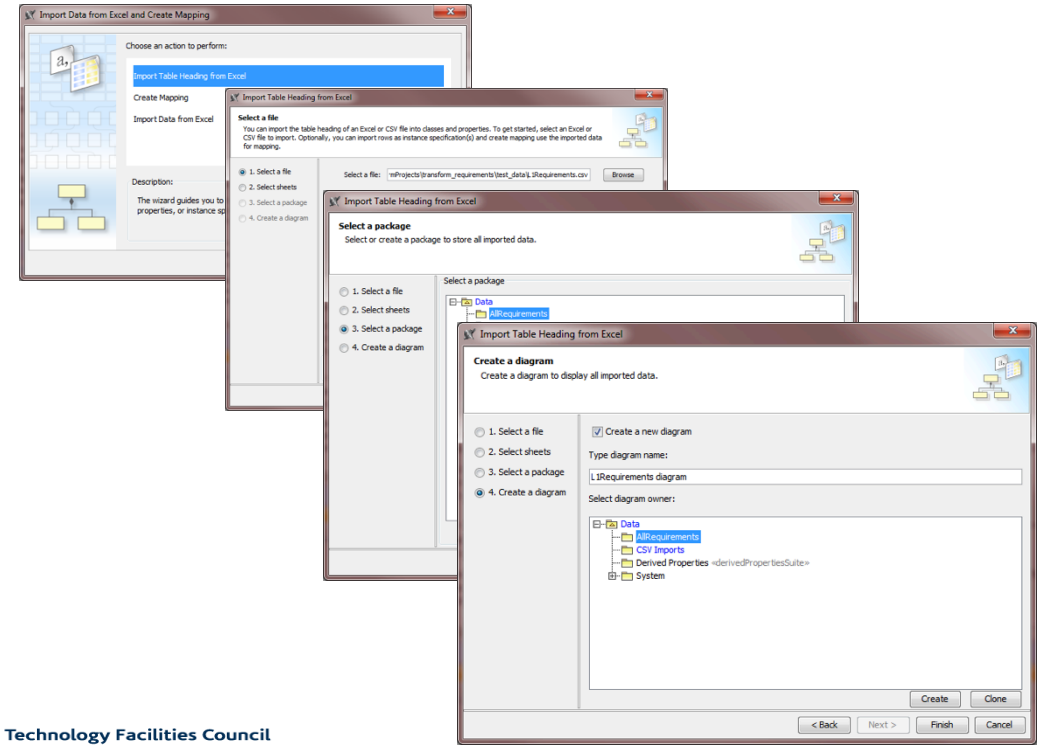
None are perfect - but all are workable with

For SKA have had to customise the basic Requirement types offered.

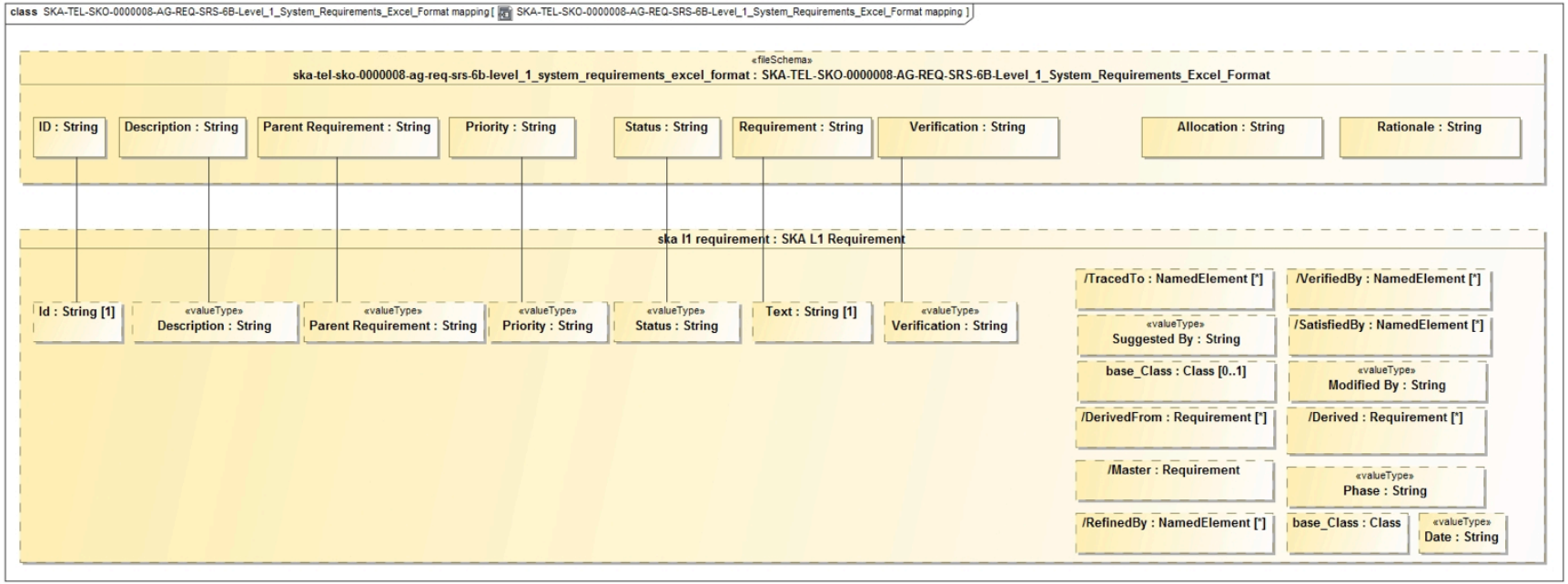
CSV Importer



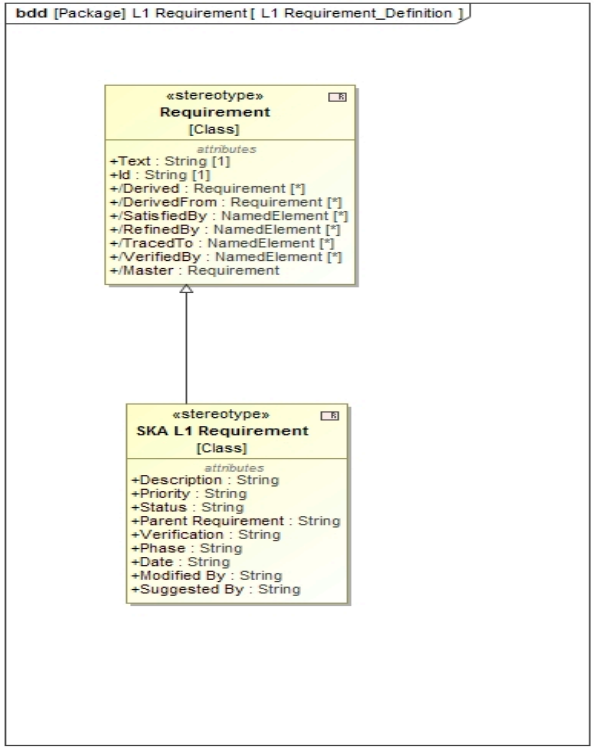
Excel/CSV Importer



Requirement Mapping



A quick note on stereotype extensions



Working with requirements within Cameo

- Requirements lists and tables
- Linking Requirements to other SysML artifacts
- Modeling relationships between different levels of requirements
- Reporting to stakeholders

Requirements Table

nistration* [Read-Only] | 10. User & Community Sup... [Read-Only] | 3. Reviewers [Read-Only] | L2 requirement allocatio... [Read-Only] | L2 requirements listing ... [Read-Only] | **Functional Requirements [Read-Only]** | temp

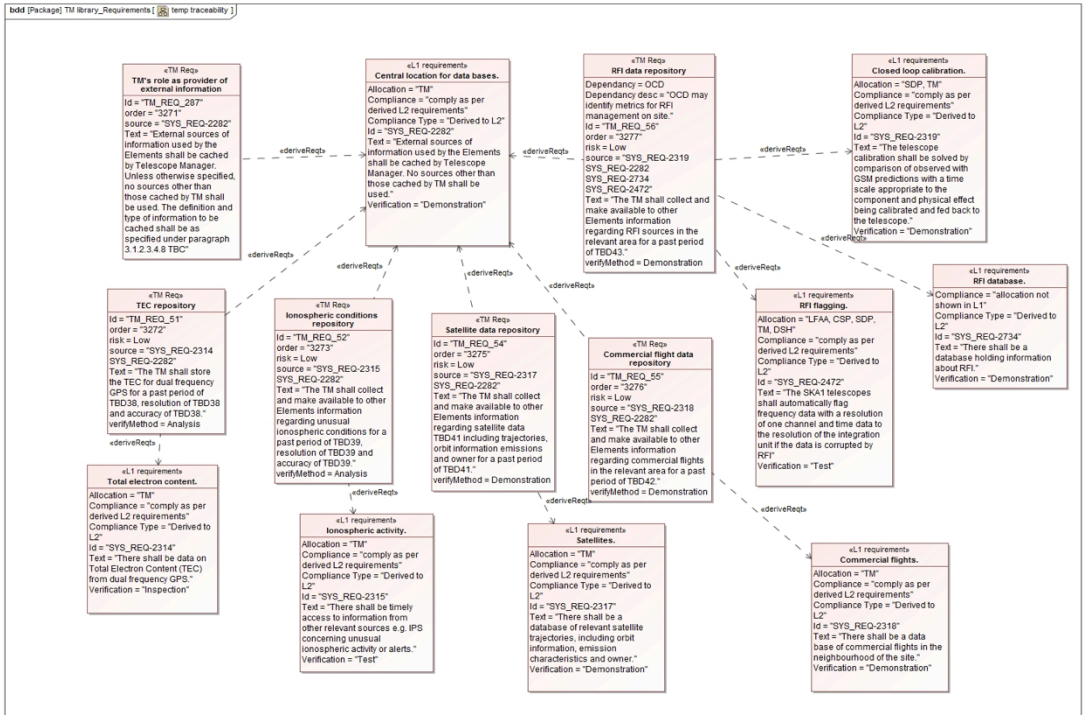
Add New | Add Existing | Delete | Remove From Table | Show Columns | Export

Criteria

Element Type: Requirement Heading, TM Req ... Scope (optional): ification,Packaging,Outstanding Actions ... Filter:

#	Name	Id	Text	Source	Verify Method
7	Limited Operation functionality	TM_REQ_194	The TM shall allow a user to limit certain functionalities and operate the TM in a limited functionality mode to assist in isolation of failures.	[RD30] par. 6.2	Demonstration
8	Shutdown	TM_REQ_195	The TM shall perform any required closure of functionality and configuration to ensure no failures can be introduced and that the system can initialise properly during Start-up. The TM shall not be allowed to perform any operations and interactions with its external environment when it is in the Shutdown state. Note: The TM is not required to perform any functions in the Shutdown state.	[RD30] par. 7.2	Demonstration
9	Failure mode	TM_REQ_196	The system shall perform normal operations but with the additional condition that some functionality has been detected not to perform as specified. During the Failure Mode state an operator shall have the ability to perform isolation and recovery procedures.	[RD30] par. 6.2	Demonstration
10	Shutdown time	TM_REQ_197	The TM shall complete the shutdown process (i.e. enter and exit the Shutdown state) in an average time of 10 minutes. TBC35. Rationale: This time is determined by how long INFRA can maintain power to equipment after a power failure, and by the ratio of temperature rise in case of INFRA cooling system failure. Note that power down of equipment on cooling system failure results in less heat generated. INFRA-SA: Can provide power in order of during power failure. For critical failure of cooling system, 10 minutes can be used, will be confirmed later. INFRA-AUS: Can provide power for a few hours during power failure (depending on fuel storage). For critical failure of cooling system, 10 minutes can be assumed.	[RD30] par. 7.2	Test

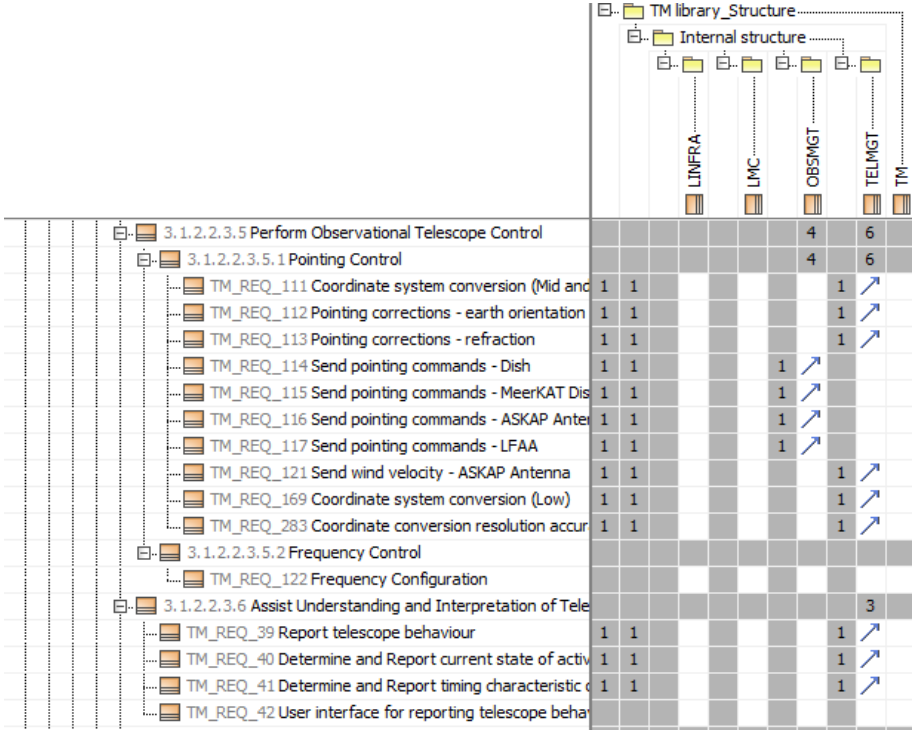
Traceability (derived requirements)

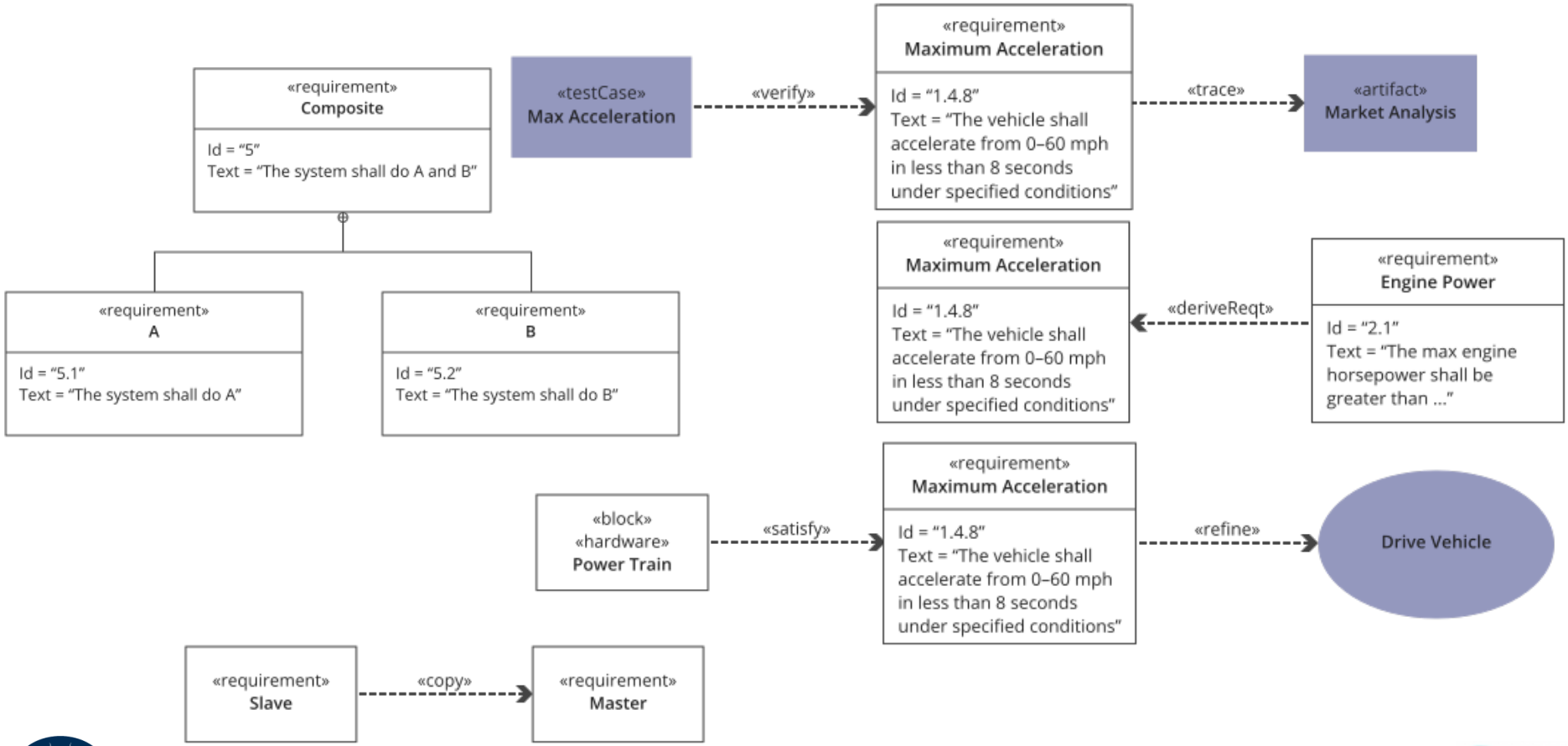


Matrix relationships

An easy way to see at a glance

- Trace
- Derived
- Refines
- Copy
- Verify (test)
- Satisfy (implementation)




«requirement»
Composite
Id = "5"
Text = "The system shall do A and B"
«requirement»
A
Id = "5.1"
Text = "The system shall do A"
«requirement»
B
Id = "5.2"
Text = "The system shall do B"
«testCase»
Max Acceleration
«verify»
«requirement»
Maximum Acceleration
Id = "1.4.8"
Text = "The vehicle shall accelerate from 0–60 mph in less than 8 seconds under specified conditions"
«trace»
«artifact»
Market Analysis
«requirement»
Maximum Acceleration
Id = "1.4.8"
Text = "The vehicle shall accelerate from 0–60 mph in less than 8 seconds under specified conditions"
«deriveReqt»
«requirement»
Engine Power
Id = "2.1"
Text = "The max engine horsepower shall be greater than ..."
«block»
«hardware»
Power Train
«satisfy»
«requirement»
Maximum Acceleration
Id = "1.4.8"
Text = "The vehicle shall accelerate from 0–60 mph in less than 8 seconds under specified conditions"
«refine»
Drive Vehicle
«requirement»
Slave
«copy»
«requirement»
Master

Managing changing requirements

No intrinsic concept of version control within Cameo for requirements.

Could be modelled either as a field on each requirement, or by having each iteration copied to a new location.

Either way can use smart folders to manage the impact on relationships to the rest of the model

Puzzles and limitations

- Tracing requirements between models
- Working with large number of model elements
- Problems with smart folders - search
- No easy way to manage requirement versions
- Manual effort required for round-trip, though could be automated with effort

Possibilities

- Generation of test matrices from requirements
- Measuring and reporting of AIV activities
- Measuring the impact of change

Conclusions

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Thank You