

MODEL-BASED REQUIREMENTS VERIFICATION LIFECYCLE – MARVL

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E-TM-10-25 AND THE ECSS GLOSSARY OF TERMS

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MODEL-BASED REQUIREMENTS VERIFICATION LIFECYCLE





OBJECTIVES AND SCOPE

- To develop a methodology and process for the exchange of modelbased information along the customer – supplier chain.
- To develop a software solution for the exchange of model-based information along the customer supplier chain.
- To develop a software solution for model-based review and early verification of requirements



MARVL CONSORTIUM













EUROPEAN SPACE AGENCY NEED

- Move from document centric to model centric information exchange
- A platform that facilitates model-based information exchange through the project life-cycles between:
 - / interdisciplinary / multifunctional information exchange
 - / multiple stakeholders (e.g. ESA, LSI, subcontractors)
- A platform that supports traceability through the project lifecycle
 - ✓ Support technical oversight and formal review process





DOCUMENT ORIENTED VS MODEL BASED

- Conversions of model data to documents and vice versa has the following down sides:
- Same information is repeated in different documents,
- Inconsistencies due to lack of configuration control,
- Difficult to navigate between documents,
- Tracking of evolution, changes, and overall status is difficult







KEY ENGINEERING CONCEPTS

Navigation, Inspection and Annotation (review) of Engineering Data coming from deliverables in a model-based fashion







SEVERAL DATA MODELS HAVE BEEN ANALYSED TO SELECT THE BEST FOR MARVL

FOR MARVL			EGS-CC	Range DB	ETM-10	0-25 VS	D	SVTLC - System	SVTLC - Simulation		
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MARVL – DATA MODEL

The MARVL Conceptual Data Model is based on multiple available models to provide coverage of identified engineering concepts:

- ECSS E-TM-10-25A
- VSEE (Virtual Spacecraft Engineering Environment)
- J EGS-CC (European Ground Systems Common Core)

















WEB APPLICATION

ISO2018 Regif Conversion Requirements Verification Product Tree Product Tree PRODUCT TREE CONFIGURATION ASSEMBLY TREE SHELF CONFIGURATION ASSEMBLY TREE SHELF CONFIGURATION ASSEMBLY TREE SHELF CONFIGURATION ASSEMBLY TREE SHELF Optical Architecture Optical Architecture Optical Architecture	
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WEB APPLICATION







WEB APPLICATION





RCP SUPPORTED PLATFORMS

- Java 8/64 Bit runtime
- ✓ Windows 7/10
- / Mac/OSX

/ Linux (tested on Ubuntu)

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ECSS-E-TM-10-25 AND THE ECSS GLOSSARY OF TERMS

SPACE MISSION SYSTEM VIEWS

- A Space Mission Design can be broken down along 3 main planes (views):
 - Problem statement "plane" (requirements)
 - Functional "plane"
 - Physical "plane"
- In-Plane & Out-Plane Relationships

Importance of defining **Standardized Semantics** for each "plane"







ECSS GLOSSARY OF TERMS

- Based on ECSS Glossary of Terms we assign for each of these System "planes" a Categorization and a Hierarchy Decomposition
- Inside each plane, based on **ECSS Glossary of Terms** we establish hierarchy + relationships.
- Outside the planes, based on **ECSS Glossary of Terms** we establish relationships





ECSS GLOSSARY OF TERMS





ECSS-E-TM-10-25A

Need for a model and tool that is capable of:

- Element Definitions
- Element Usages
- Decomposition Trees

Parameter Creation

Parameter Subscriptions 4

Requirement Specification

Parameter Creation & Application

Build

these 3-

views

elements

Build & Visualize Relationships between elements

Implements a

categorization

with these

elements

- Category CreationCategory Browser
- Super Category Definition

- Relationship Creation
- Rules Creation
- View: Relationship Matrix



DATA REPOSITORY

In a framework that **simultaneously** accounts for the work of all **Domains of Expertise active** in the current Model



CDP4 – SEMANTICS & ARCHITECTURE



A strength of **ECSS-E-TM-10-25A** and **CDP4/OCDT** is that they allow for a flexible Modelling Architecture or Methodology using **categorizations** and **rules**

- Main Category is applied to give significance of Hierarchy to each of the elements: Functions (FUNC), Subsystem (SS), Equipment (EQT)...
- A **Secondary, descriptive category** is applied so that it can be used transversally to refer to a specific Domain of Expertise: AOCS Descriptor, Power Descriptor... with Descriptor as Super Category
- Agreement between organizations can be formalized using reference data captured in Reference Data Libraries: QUDV, categories, rules





CDP4 IMPLEMENTATION



Use of relationships to model and perform requirements verification



	Deprecated	MIS-010	MIS-020	MIS-030	MIS-040	MIS-050	MIS-060	MIS-070	MIS-080	MIS-300	MIS-400
DeltaV Allocation											
Launch Vehicle										t	t
Nano Particles Handling			t								
Number of Collisions			t		t	t	t				
Orbit Design										t	t
Repeatability of the Experiments								t	t	t	

CDP4 IMPLEMENTATION



• Complex System Modelling allowing for flexible and DoE-Oriented visualization



Q&A

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