



The ECSS Knowledge Library

Tuesday, 11 December 2018

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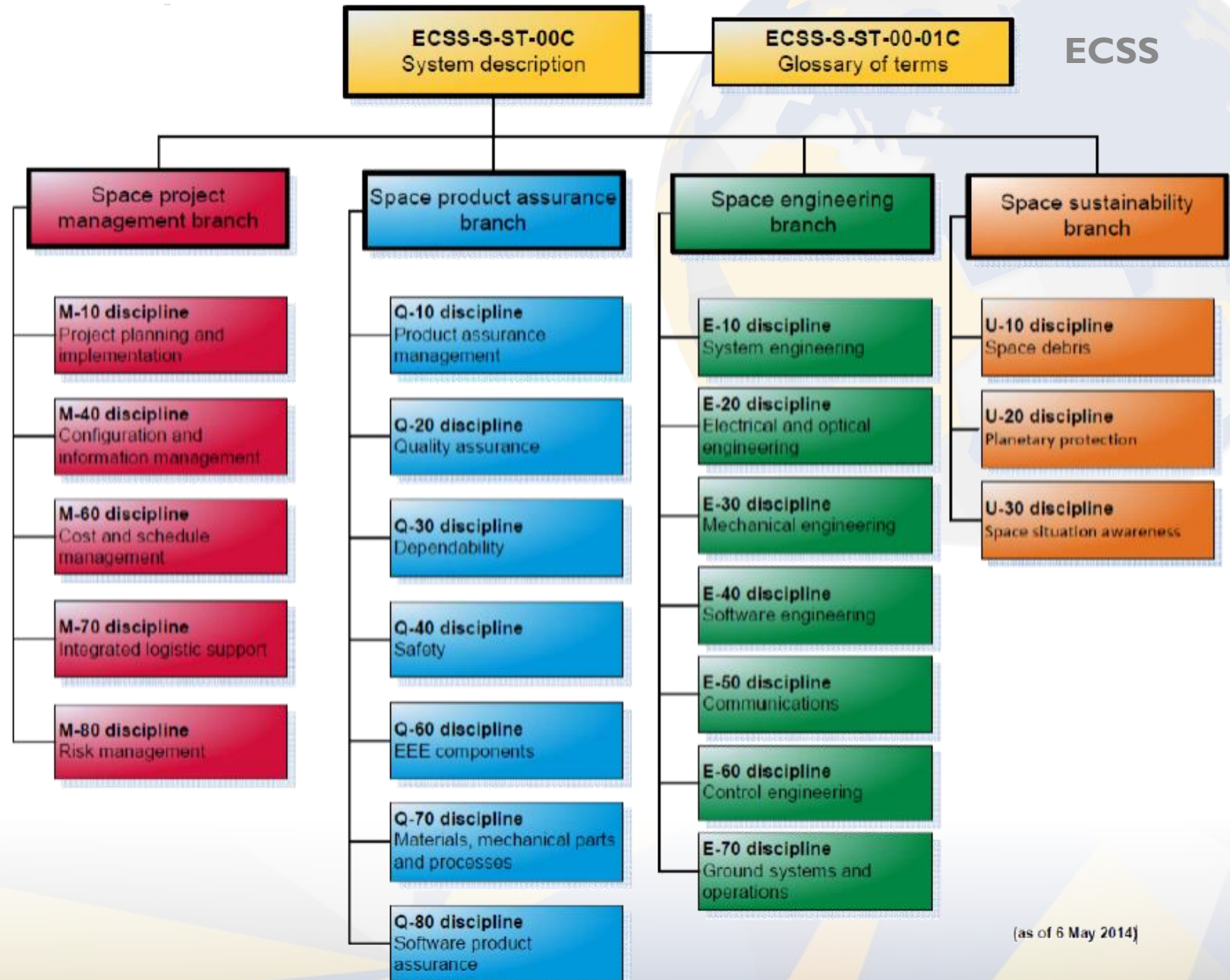
What is the ECSS

- *European Cooperation for Space Standardization (ECSS): ecss.nl*
- *founded in 1996 as an initiative established to develop a coherent, single set of user-friendly standards for use in all European space activities,*
- *thus providing the European space community with an integrated set of space-specific standards*



What is the ECSS

- Standards, Handbooks and Technical Memoranda
- Glossary of terms
- 4 technical disciplines



(as of 6 May 2014)

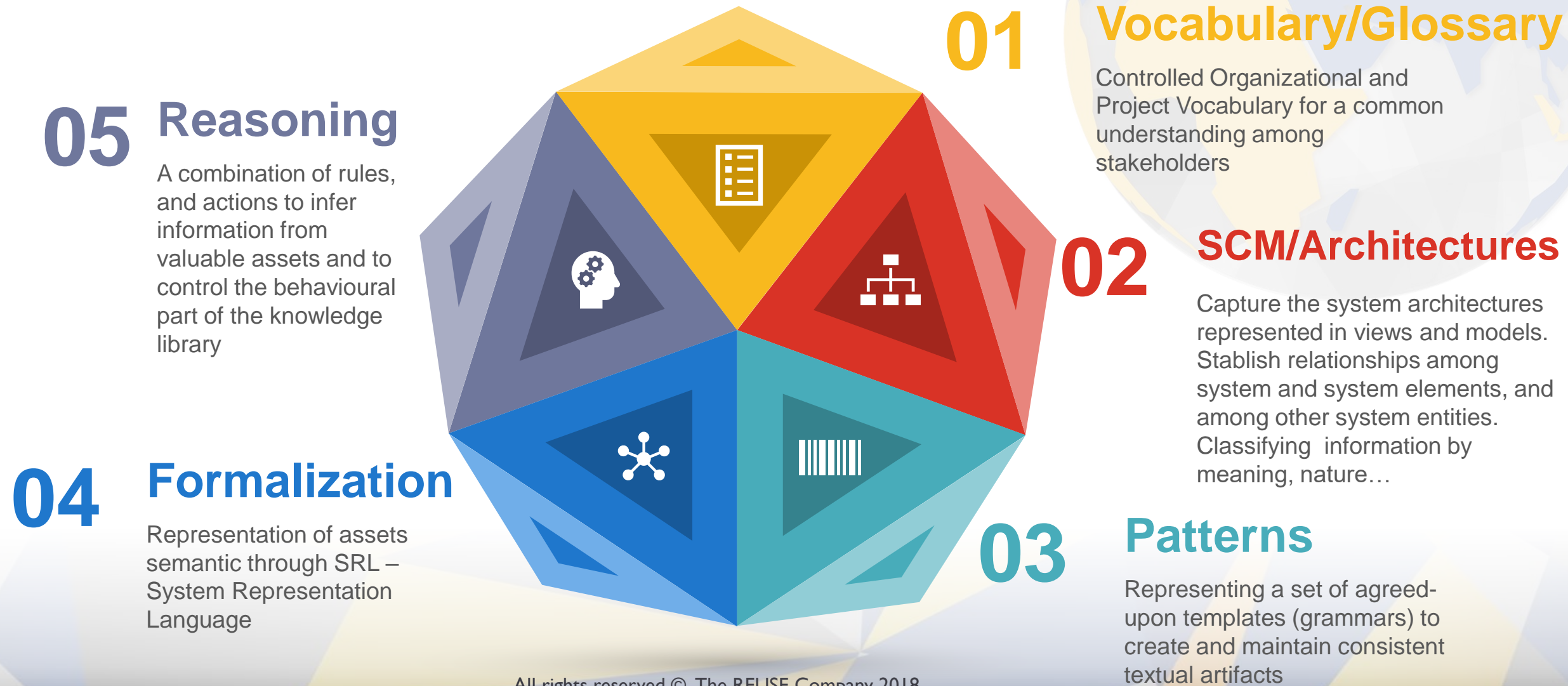
What is a Knowledge Library

- A combination of Knowledge items,
 - of different nature,
 - at different levels of abstraction
- Representing a specific business domain or **area of knowledge**
- With the aim of improving the way projects are managed, including:
 - the promotion of the principle: **quality** *right the first time*,
 - enabling semantic search portals to archive and retrieve assets,
 - thus providing tools to **reuse** assets at different level,
 - and reducing **time** to market,
 - improving the way engineers generate (**author**) new assets,
 - enhancing the way items are inspected and **verified**,
 - Enabling real **interoperability** mechanisms and services,
 - reducing **time** to elaborate documents, systems and projects

Knowledge Libraries



What is a Knowledge Library



Example of Knowledge Library

Vocabulary

Aircraft

Ground
segment

System

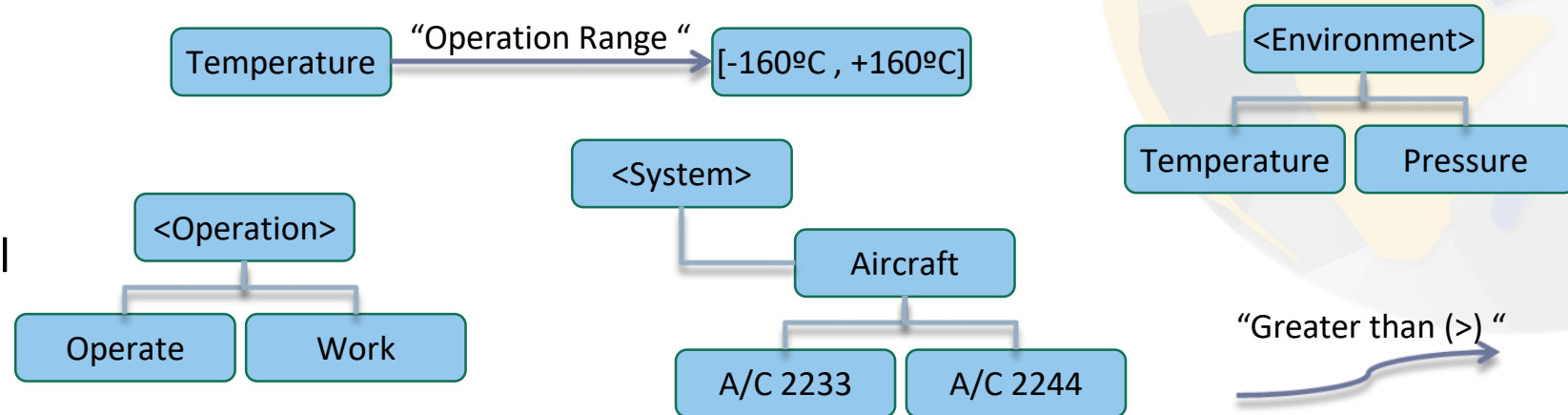
Operate

Temperature

Environment

Pressure

Architectures - Conceptual model



Patterns

<System>

Shall

<Operation>

At

Minimum

<Environment>

Of

NUMBER

MEASUREMENT
UNIT

Formalization

The aircraft shall be able to operate at a minimum temperature of -170° C

Temperature

"Greater than (>)"

-170

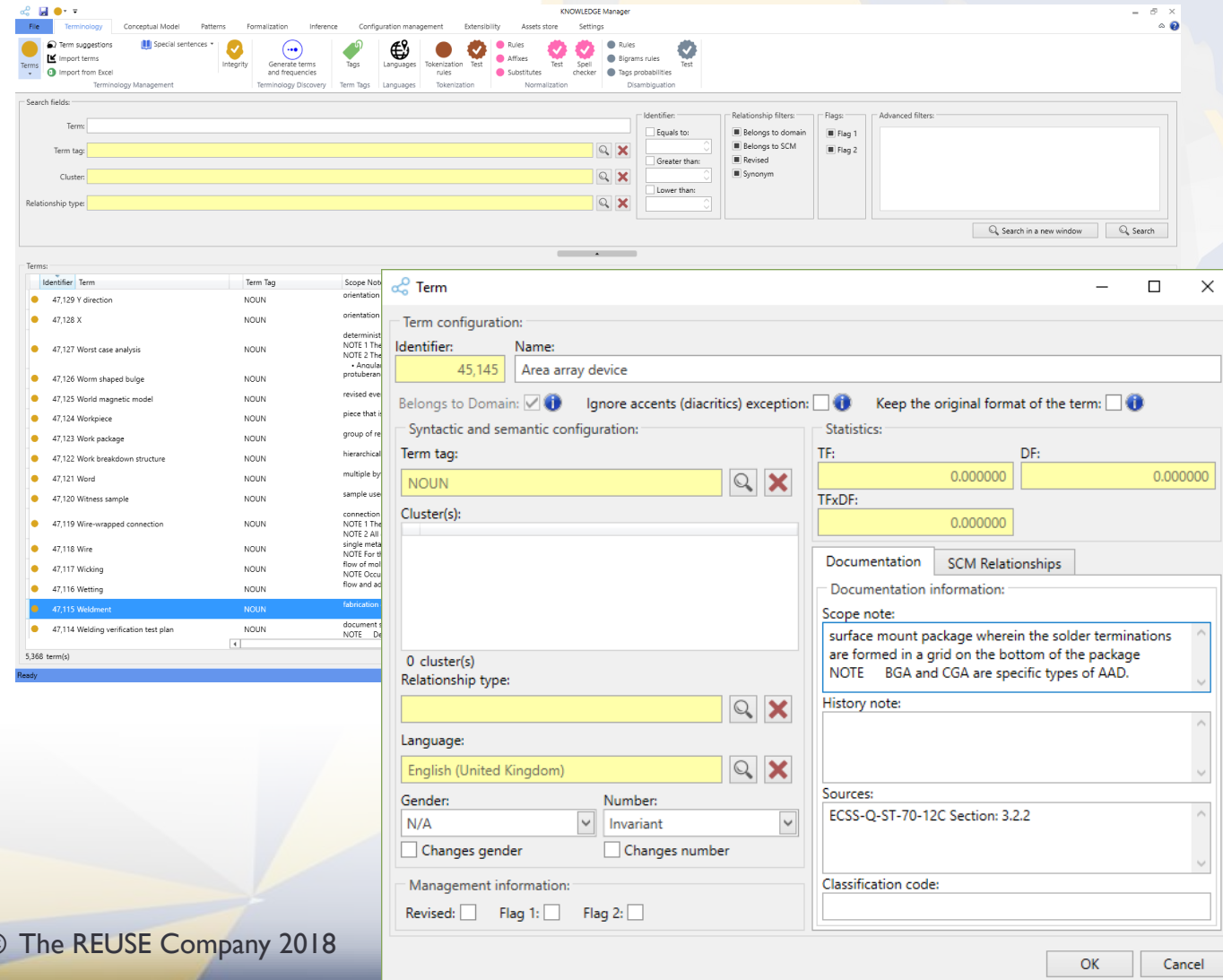
°C

Reasoning

If **NUMBER** Lower than (<) **-160°** **°C** Or **NUMBER** Greater than (>) **+160°** **°C** → **✗**

ECSS Glossary

- **ECSS-S-ST-00-01C – Glossary of terms (1 October 2012)**
- This document controls the definition of all common terms used in the European Cooperation for Space Standardization (ECSS) Standards System. Terms specific to a particular ECSS Standard are defined in that standard.
- **Provides a consistent way to name and understand all the concepts across the industry**
- **The system can highlight and link references to these entries in the body of the documents**



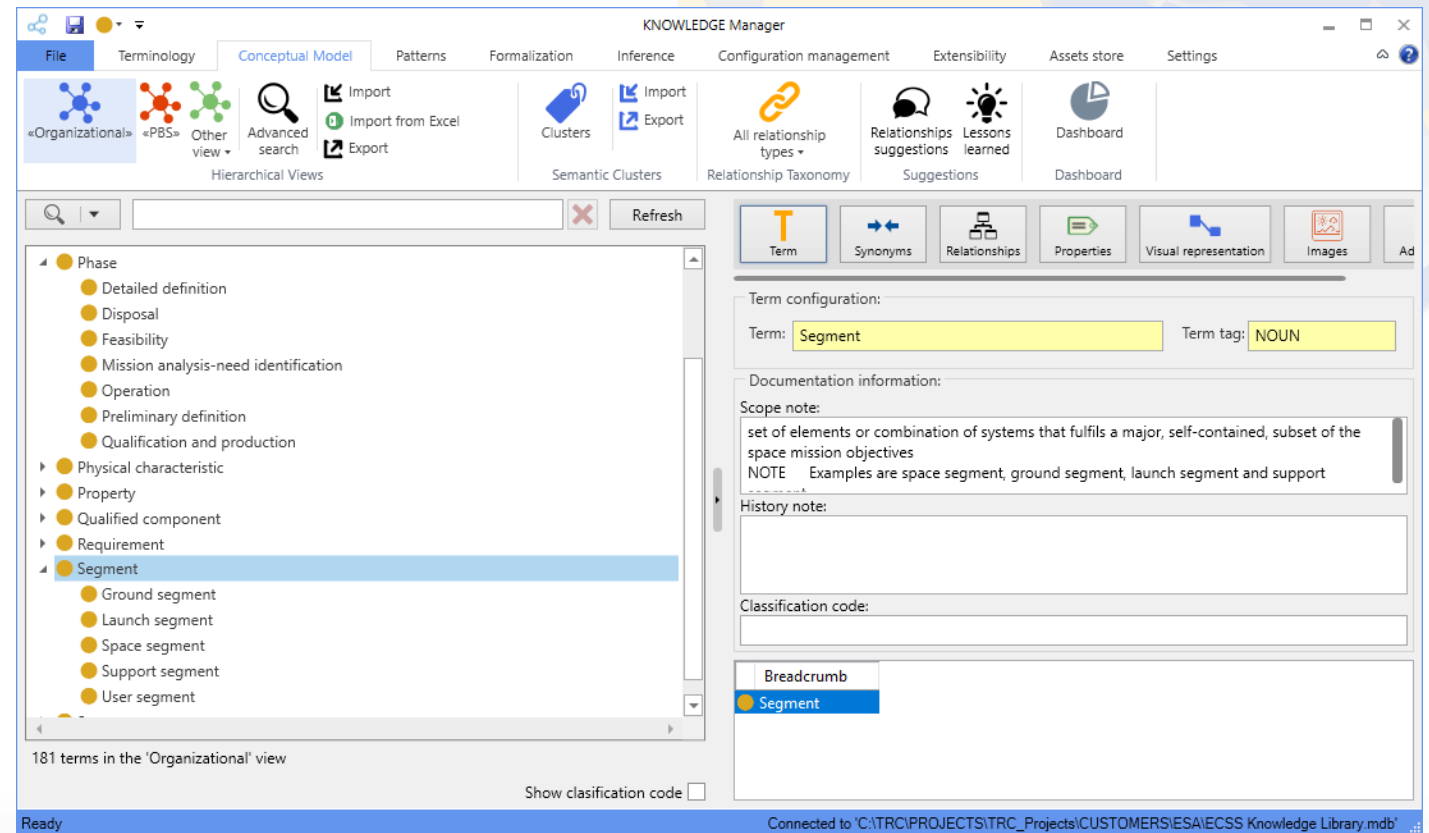
The screenshot displays the ECSS Knowledge Library software interface. The main window shows a list of terms with columns for Identifier, Term, Term Tag, and Scope Note. The term '47,115 Weldment' is selected. A 'Term configuration' dialog box is open, showing details for the selected term.

Term configuration details:

- Identifier:** 45,145
- Name:** Area array device
- Belongs to Domain:** ☒ Ignore accents (diacritics) exception: ☐ Keep the original format of the term: ☐
- Syntactic and semantic configuration:**
 - Term tag:** NOUN
 - Cluster(s):** 0 cluster(s)
 - Relationship type:**
 - Language:** English (United Kingdom)
 - Gender:** N/A **Number:** Invariant
 - ☐ Changes gender ☐ Changes number
- Management information:**
 - Revised: ☐ Flag 1: ☐ Flag 2: ☐
- Statistics:**
 - TF: 0.000000 DF: 0.000000
 - TFxDF: 0.000000
- Documentation:**
 - Documentation information:**
 - Scope note:** surface mount package wherein the solder terminations are formed in a grid on the bottom of the package
 - NOTE:** BGA and CGA are specific types of AAD.
 - History note:**
 - Sources:** ECSS-Q-ST-70-12C Section: 3.2.2
 - Classification code:**

Taxonomy of terms and other relationships

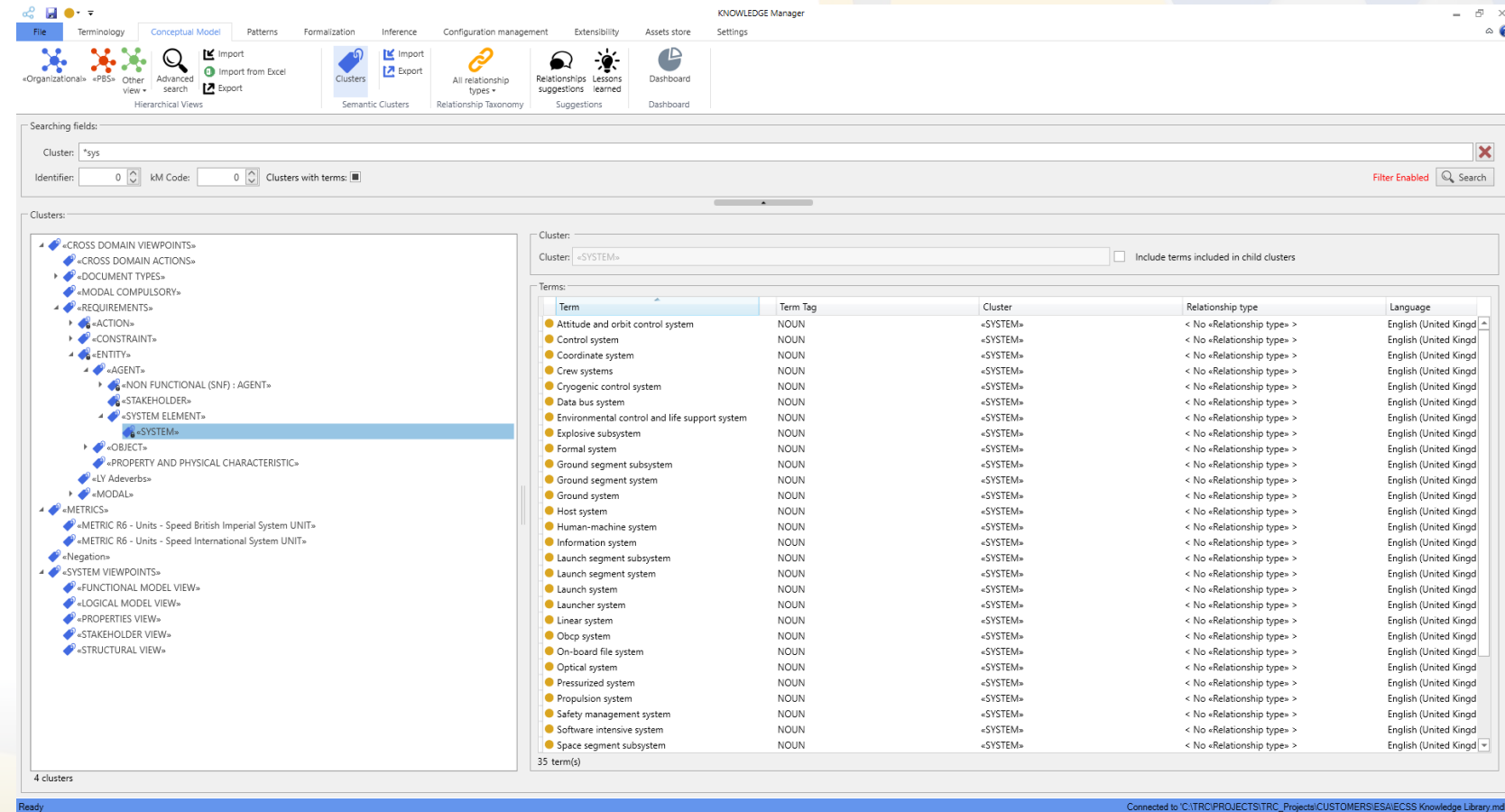
- Based on the glossary standard, and some other standards
- Represented as relationships in the Knowledge Library
- **Provides means to propagate queries in further reuse stages or just for information retrieval**



Clustering the terms of the glossary

➤ **Clustering:** according to the semantic of the terms in the library

➤ Provides means to fit the textual patterns and help authors while the write requirements or other types of textual assets



The screenshot displays the KNOWLEDGE Manager application. The top menu bar includes File, Terminology, Conceptual Model, Patterns, Formalization, Inference, Configuration management, Extensibility, Assets store, and Settings. The main workspace is divided into two panes. The left pane, titled 'Clusters', shows a hierarchical tree of clusters. The right pane, titled 'Terms', displays a table of terms belonging to the selected cluster.

Clusters:

- «CROSS DOMAIN VIEWPOINTS»
 - «CROSS DOMAIN ACTIONS»
 - «DOCUMENT TYPES»
 - «MODAL COMPULSORY»
 - «REQUIREMENTS»
 - «ACTION»
 - «CONSTRAINT»
 - «ENTITY»
 - «AGENT»
 - «NON FUNCTIONAL (SNF) : AGENT»
 - «STAKEHOLDER»
 - «SYSTEM ELEMENT»
 - «SYSTEM»
 - «OBJECT»
 - «PROPERTY AND PHYSICAL CHARACTERISTIC»
 - «LY Adeverbs»
 - «MODAL»
- «METRICS»
 - «METRIC R6 - Units - Speed British Imperial System UNIT»
 - «METRIC R6 - Units - Speed International System UNIT»
 - «Negation»
- «SYSTEM VIEWPOINTS»
 - «FUNCTIONAL MODEL VIEW»
 - «LOGICAL MODEL VIEW»
 - «PROPERTIES VIEW»
 - «STAKEHOLDER VIEW»
 - «STRUCTURAL VIEW»

Terms:

Term	Term Tag	Cluster	Relationship type	Language
Attitude and orbit control system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Control system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Coordinate system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Crew systems	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Cryogenic control system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Data bus system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Environmental control and life support system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Explosive subsystem	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Formal system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Ground segment subsystem	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Ground segment system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Ground system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Host system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Human-machine system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Information system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Launch segment subsystem	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Launch segment system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Launch system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Launcher system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Linear system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Obcp system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
On-board file system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Optical system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Pressurized system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Propulsion system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Safety management system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Software intensive system	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd
Space segment subsystem	NOUN	«SYSTEM»	< No «Relationship type» >	English (United Kingd

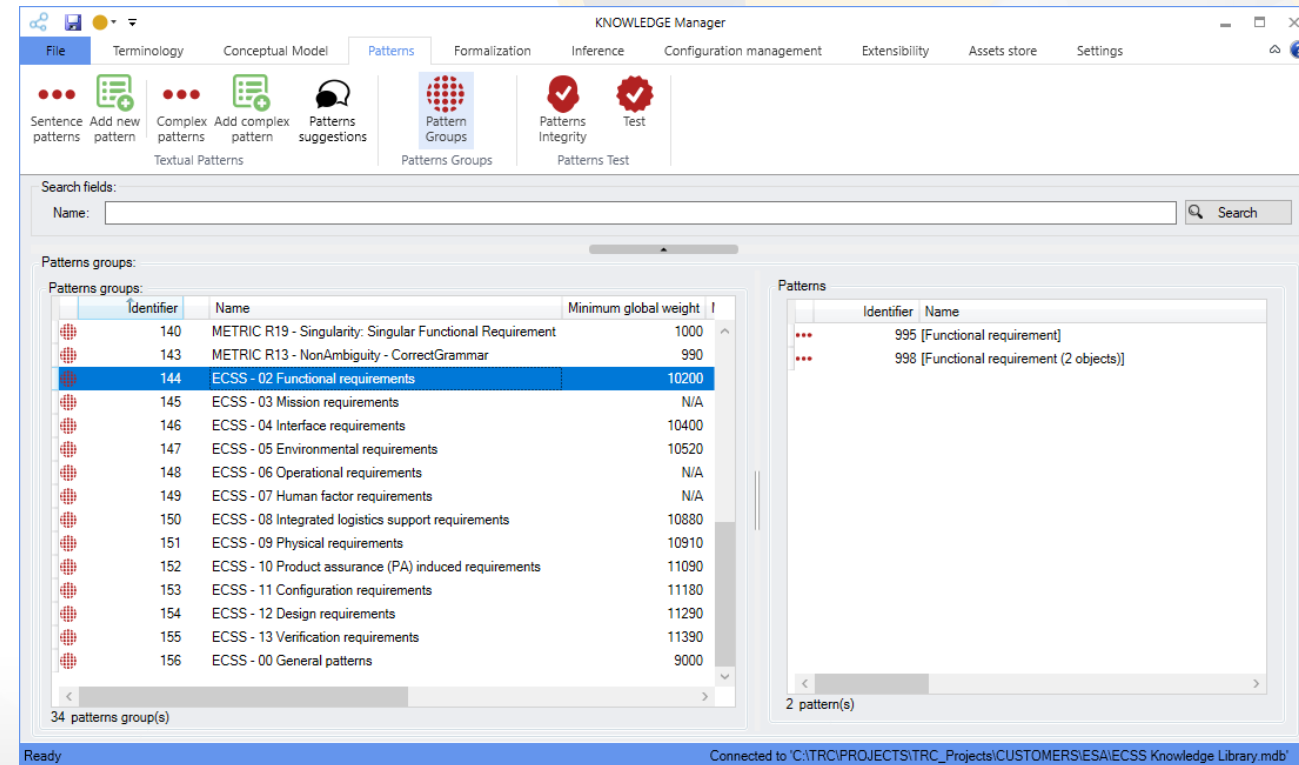
35 term(s)

Ready

Connected to 'C:\TRC\PROJECTS\TRC_Projects\CUSTOMERS\ESA\ECSS Knowledge Library.mdb'

Taxonomy of types of requirements

- **ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009)**
 - This Standard provides an overview of the purposes and positions of the technical requirements specification, defines the different types of requirements, and defines requirements on the TS and on its requirements.
 - This Standard is applicable to all types of space systems, all product elements, and projects.
- **Provides a reference during the requirements authoring phase**



Requirements patterns

- **ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009)**
 - This Standard provides an overview of the purposes and positions of the technical requirements specification, defines the different types of requirements, and defines requirements on the TS and on its requirements.
 - This Standard is applicable to all types of space systems, all product elements, and projects.
- **Provide a reference during the requirements authoring phase**
- **Allows an automatic parsing of textual and unstructured documents**
- **Some specific patterns allow:**
 - **Automatic extraction of properties: consistency checking**
 - **Automatic generation of models: SysML, ORM (Object Role Modeling)...**

Requirements patterns

- **ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009):**
 - **Example of requirement pattern: Interface requirement**
 - <Entity> <Modal> <Communication/VERB> <Entity> <Operation_VERB> <Entity>
 - Requirements related to the interconnection or relationship characteristics between the product and other items.
 - NOTE I This includes different types of interfaces (e.g. physical, thermal, electrical, and protocol).
 - Example: “The product shall dialogue with the ground segment using telemetry”

Requirements patterns

- **ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009):**
- **Example of requirement pattern: Interface requirement**

Pattern - Syntax

Pattern fields:

Identifier: 992 Name: Interface requirement

Original example: the product shall dialogue with the product use the product

Current example: the product shall dialogue with the product use the product

Syntax:

[Entity]	[Modal block]	«Communication» VERB	PREPOSITION	[Entity]	«Operation» VERB	[Entity]
+	+	+	+	+	+	+
+	+	+	+	+	+	+
the The DEFINITE ARTICLE GENDER: N/A NUMBER: INVARIANT	product Product «PRODUCT» NOUN GENDER: N/A NUMBER: INVARIANT	shall Shall MODAL VERB PERSON: GERUND VERBAL FORM: INVARIANT	dialogue Dialogue VERB PERSON: GERUND VERBAL FORM: INVARIANT	with With PREPOSITION GENDER: N/A NUMBER: INVARIANT	the The DEFINITE ARTICLE GENDER: N/A NUMBER: INVARIANT	product Product «PRODUCT» NOUN GENDER: N/A NUMBER: INVARIANT
use Use VERB PERSON: GERUND VERBAL FORM: INVARIANT	the The DEFINITE ARTICLE GENDER: N/A NUMBER: INVARIANT	product Product «PRODUCT» NOUN GENDER: N/A NUMBER: INVARIANT				
Show advanced options	Show advanced options	Show advanced options	Show advanced options	Show advanced options	Show advanced options	Show advanced options

Finish Cancel

Requirements patterns

➤ ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009):

➤ Example of requirement pattern: Interface requirement

Editing 34 - Requirements Authoring Tool Plugin for DOORS

File Suggestions View Log

Requirements Authoring Tool Plugin for DOORS

By The REUSE Company

Authoring with pattern 'Interface requirement'

ECSS - 04 Interface requirements (1)

Interface requirement

Correctness metrics summary: **Medium Quality** 0.34

Description: Requirements related to the interconnection or relationship characteristics between the product and other items.
NOTE 1 This includes different types of interfaces (e.g. physical, thermal, electrical, and protocol).

Font: Arial Font Size: 12

The product shall dialogue with the gr

- Ground segment
- Ground segment customer
- Ground segment element
- Ground segment equipment
- Ground segment operations
- Ground segment subsystem
- Ground segment supplier
- Ground segment system
- Ground system

9 terms

☐ Show numbers

☒ Show optional terms

Matching patterns elements:

Example	Source
The product shall dialogue with the	Ontology

DEFINITE ARTICLE | NOUN «Communication»

Name: [Interface requirement]

Description: Requirements related to the interconnection or relationship characteristics between the product and other items.
NOTE 1 This includes different types of interfaces (e.g. physical, thermal, electrical, and protocol).

Pattern group(s):

- ECSS - 04 Interface requirements (146)

Example:

- The product shall dialogue with the attitude and orbit control system use attitude and orbit control system

Indexable: Yes **Enabled:** Yes **Weight:** 10,400

Syntax:

[Entity] + [Modal block] + «Communication» + PREPOSITION + [Entity] + «Operation» + [Entity]

VERB VERB

Properties: N/A

Relationships: N/A

Save and close Cancel

Requirements Quality rules

➤ **ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009)**

8.2.1 Performance

8.2.2 Justification

8.2.3 Configuration management and traceability

8.2.4 Ambiguity

8.2.5 Uniqueness

8.2.6 Identifiability

8.2.7 Singularity

8.2.8 Completeness

8.2.9 Verification

8.2.10 Tolerance



8.3.1 Format



8.3.2 Verbal
form



8.3.3
Restrictions

Recommendations for wording

Requirements Quality rules

- **ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009)**

- **Issues:**

- The definition of the Quality rules in this standard is very abstract

8.2.4 Ambiguity

- a. The technical requirements shall be unambiguous.

8.2.5 Uniqueness

- a. Each technical requirement shall be unique.

- **Solution:**

- Mixed with the rules in the INCOSE Guide and other standards for Writing Requirements

- **Provides a reference about the rules to be met for each requirement.**

- **Assists the author of the requirements, and provides means and evidences for the inspection of the requirements**

Requirements Quality rules

- **ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009)**
- **8.2.1 Performance:**
 - a. Each technical requirement shall be described in quantifiable terms.
 - b. If necessary to remove possible ambiguities of a given performance requirement the method used to determine the required performance shall be indicated in the requirement itself.
- **Rules:**
 - Avoid unprecise quantifiers
 - Force a performance attribute

Requirements Quality rules

- **ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009)**
- **8.2.2 Justification:**
 - a. Each technical requirement should be justified.
 - b. The entity responsible of the technical requirement shall be identified.
 - c. The entity responsible of the specification shall define what part of the justification shall be included in the specification as informative material.
- **Rules:**
 - Justification attribute
 - Detection of the entity responsible for the technical requirement

Requirements Quality rules

- **ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009)**
- **8.2.3 Configuration management and traceability:**
 - a. Each technical requirement shall be under configuration management.
 - b. All technical requirements shall be backwards-traceable.
 - c. All technical requirements shall be forward-traceable.
- **Rules:**
 - Detection of back and forward traces

Requirements Quality rules

› **ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009)**

› **8.2.4 Ambiguity:**

- › a. The technical requirements shall be unambiguous.

› **Rules:**

- › Detection of ambiguous words and expressions
- › Detection of passive voice or conditional voice vs. active voice
- › Force a verb as the main action of the requirement
- › Detection of inconsistent measurement units
- › Each number must be followed by a measurement unit
- › Readability and incorrect punctuation
- › Detection of incorrect spelling
- › Detection of pronouns
- › Use of indefinite terms or acronyms

Requirements Quality rules

- **ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009)**
- **8.2.5 Uniqueness:**
 - a. Each technical requirement shall be unique.
- **Rules:**
 - Detection of overlapped requirements

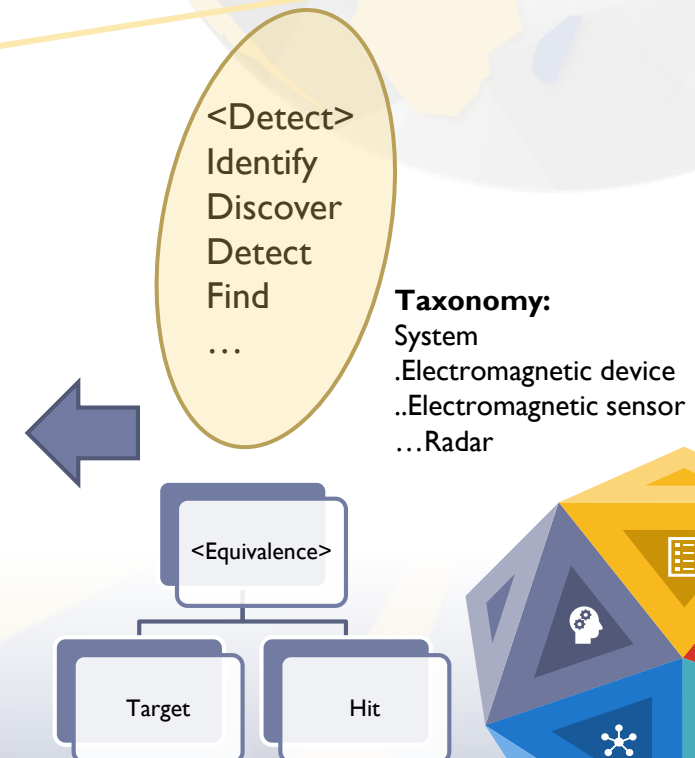
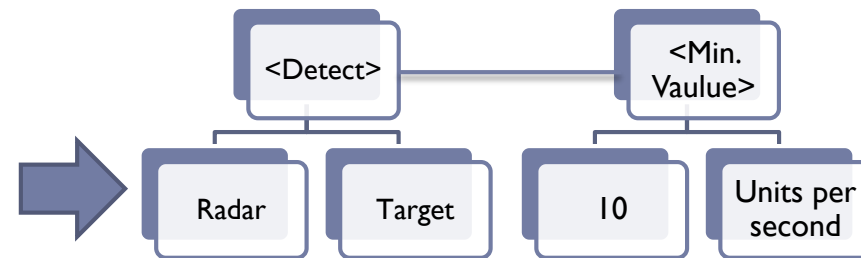
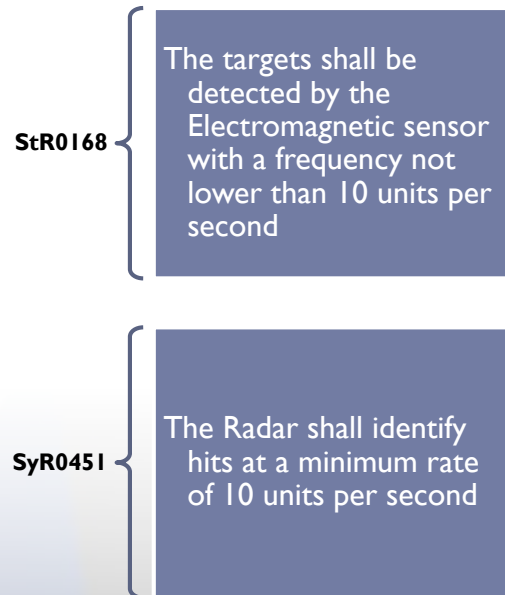
Requirements Quality rules

➤ ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009)

➤ 8.2.5 Uniqueness:

StR0168 - The targets shall be detected by the Electromagnetic sensor with a frequency not lower than 10 units per second

SyR0451 - The Radar shall identify hits at a minimum rate of 10 units per second



Requirements Quality rules

- **ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009)**
- **8.2.6 Identifiability:**
 - a. A technical requirement shall be identified in relation to the relevant function, product or system.
 - b. A unique identifier shall be assigned to each technical requirement.
 - c. The unique identifier should reflect the type of the technical requirement.
 - d. The unique identifier should reflect the life profile situation.
 - **NOTE** In general a technical requirement is identified by, for example, a character or a string of characters, a number, or a name tag or hypertext.
- **Rules:**
 - The subject of the requirement expression must be a: function, product or system
 - Force the unique identifier attribute
 - Check the content of the ID attribute: by means of a regular expression

Requirements Quality rules

- **ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009)**
- **8.2.7 Singularity:**
 - a. Each technical requirement shall be separately stated.
 - NOTE Technical requirements are single or separately stated when they are not the combination of two or more technical requirements.
- **Rules:**
 - Forcing a single expression: based on patterns
 - Ensuring the proper length (in words and in paragraphs)
 - Avoiding combinators: *and/or, as well as, but also, on the other hand, then, meanwhile, and, or...*
 - Avoid open-ended expressions: *etc, and so on...*
 - Avoiding enumerations
 - Avoiding too much detail in the requirement expression (avoid parenthesis)
 - Avoid the rationale in the requirement expression: *in order to, justify, so that, thus, thus allowing...*

Requirements Quality rules

- **ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009)**
- **8.2.8 Completeness:**
 - a. A technical requirement shall be self-contained.
 - NOTE A technical requirement is self-contained when it is complete and does not require additional data or explanation to express the need.
- **Rules:**
 - Conformance with the suggested patterns

Requirements Quality rules

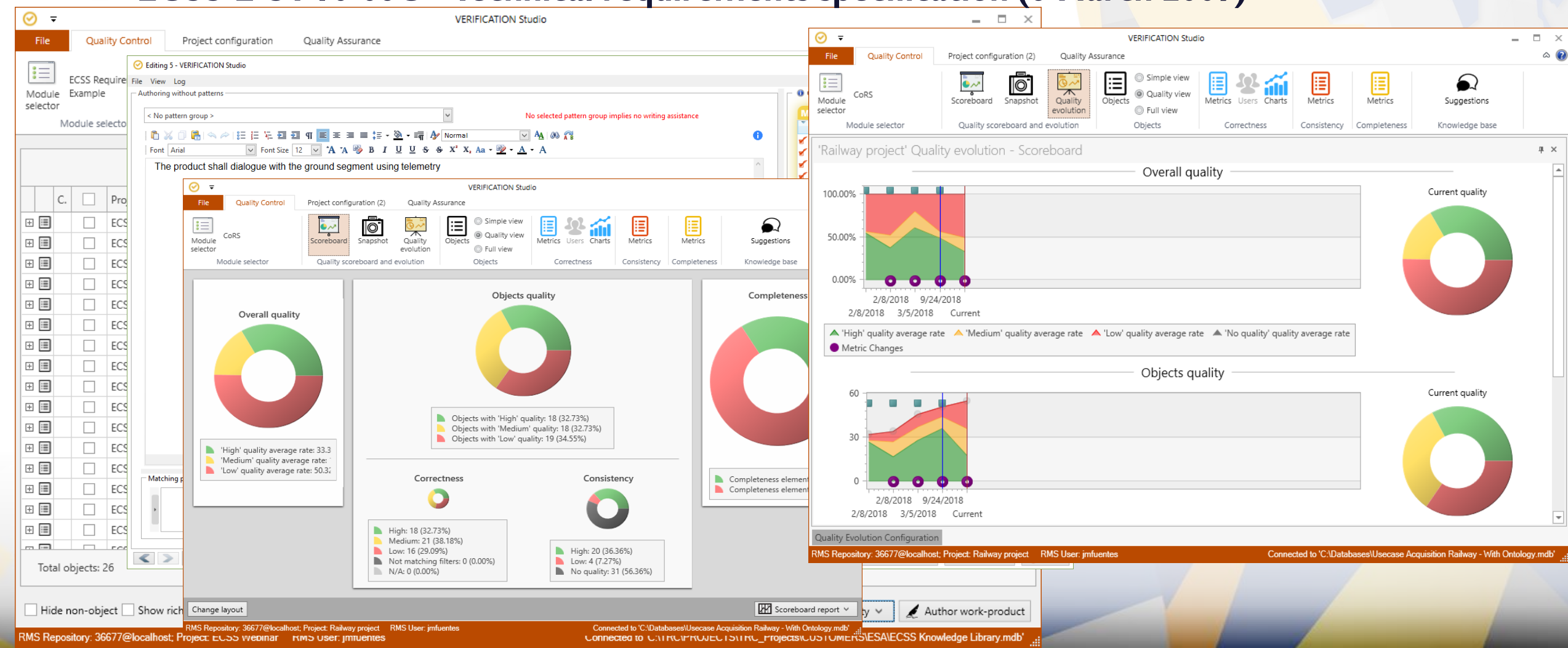
- **ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009)**
- **8.2.9 Verification:**
 - a. A technical requirement shall be verifiable using one or more approved verification methods.
 - NOTE A technical requirement is verifiable when the means to evaluate if the proposed solution meets the requirement are known.
 - b. Verification of technical requirements shall be performed in conformance with ECSS-E-ST-10-02.
- **Rules:**
 - Detection of non-empty value in the verification attribute

Requirements Quality rules

- **ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009)**
- **8.2.10 Tolerance:**
 - a. The tolerance shall be specified for each parameter/variable.
 - **NOTE** The technical requirement tolerance is a range of values within which the conformity to the requirement is accepted.
- **Rules:**
 - Pattern to detect a parameter value without tolerance. For instance:
 - (30 +/- 2) Kg
 - (30 +/- 5%) Kg

Requirements Quality rules

➤ ECSS-E-ST-10-06C – Technical requirements specification (6 March 2009)



Next steps

- **ECSS-S-ST-00-01C** (ECSS Glossary):
 - Integration of new terms
 - Implementation of relationships among terms and semantic clustering
- **ECSS-E-ST-10-02** and **ECSS-E-HB-10-02A** (Verification Standard and Guidelines Handbook):
 - Definition of the main entities proposed in these documents: verification approach, method, level, stage...
 - Support to the verification process in our tool VERIFICATION Studio: planning, execution, reporting, control and close-out
 - Implementation of all the reports suggested in these standards
- Other capabilities:
 - Semantic search of requirements based on: the information managed in the ontology, the patterns already generated
 - Advanced traceability
 - Generation of models

Live demo

VERIFICATION Studio

File Quality Control Project configuration Quality Assurance

Module selector ECSS Requirements Example Module selector

Scoreboard Snapshot Quality evolution Objects

Simple view Quality view Full view Objects

Metrics Users Charts Metrics Metrics Suggestions

Correctness Consistency Completeness Knowledge base

Drag a column header here to group by that column

	C.	Project	Module	ID	Text	Correctness	Score	Ma...	Correctness...	Consistency	Issu...
	<input type="checkbox"/>	ECSS Web...	ECSS Req...	5	The product shall dialogue with the ground segment using telemetry	★★★★	0.00	0	26/11/2018...	★★★★	0
	<input type="checkbox"/>	ECSS Web...	ECSS Req...	6	The product shall analyse the power module	★★★★	0.00	0	26/11/2018...	★★★☆☆	1
	<input type="checkbox"/>	ECSS Web...	ECSS Req...	7	The product shall analyse the stand-alone space segment element so that...	★★★☆☆	0.89	0	26/11/2018...	★★★★	0
	<input type="checkbox"/>	ECSS Web...	ECSS Req...	8	The product shall analyse the data to be transmitted the data so tha...	★★★☆☆	1.60	0	26/11/2018...	★★★★	0
	<input type="checkbox"/>	ECSS Web...	ECSS Req...	9	The product shall be designed to maintain operation after a transfe...	★★★☆☆	0.35	0	26/11/2018...	★★★★	0
	<input type="checkbox"/>	ECSS Web...	ECSS Req...	10	The product shall operate in the temperature range from 30 °C to 50...	★★★★	0.00	0	26/11/2018...	★★★★	0
	<input type="checkbox"/>	ECSS Web...	ECSS Req...	11	The product shall operate in the temperature range from 30 °C to 50 °C	★★★★	0.00	0	26/11/2018...	★★★★	0
	<input type="checkbox"/>	ECSS Web...	ECSS Req...	12	The system shall work in the temperature range from 30 °C to 50 °C	★★★☆☆	0.34	0	26/11/2018...	★★★★	0
	<input type="checkbox"/>	ECSS Web...	ECSS Req...	17	The product shall display information on two windows...	★★★★	0.00	0	26/11/2018...	★★★★	0
	<input type="checkbox"/>	ECSS Web...	ECSS Req...	13	The product shall work in the temperature range from 30 °C to 44 °C	★★★★	0.00	0	26/11/2018...	★★★★	0
	<input type="checkbox"/>	ECSS Web...	ECSS Req...	14	The product shall be designed to maintain the function from the...	★★★★	0.00	0	26/11/2018...	★★★★	0
	<input type="checkbox"/>	ECSS Web...	ECSS Req...	16	The product shall be designed to maintain control of the viewing function fr...	★★★★	0.00	0	26/11/2018...	★★★★	0
	<input type="checkbox"/>	ECSS Web...	ECSS Req...	18	The product shall be designed to be installed at the customer site within t...	★★★★	0.00	0	26/11/2018...	★★★★	0
	<input type="checkbox"/>	ECSS Web...	ECSS Req...	19	The product shall have a mass of (30 ± 0,1) kg	★★★☆☆	0.35	0	26/11/2018...	★★★☆☆	1
	<input type="checkbox"/>	ECSS Web...	ECSS Req...	20	The MTBF of the product shall be 300 hour	★★★★	0.00	0	26/11/2018...	★★★★	0
	<input type="checkbox"/>	ECSS Web...	ECSS Req...	21	The mean time between failures of the attitude and orbit control system s...	★★★★	0.00	0	26/11/2018...	★★★★	0

Total objects: 26

☐ Hide non-object ☐ Show rich text format

Custom report Short module quality report Full module quality report Assess quality Author work-product

RMS Repository: 36677@localhost; Project: ECSS Webinar RMS User: jmfuentes Connected to 'C:\TRC\PROJECTS\TRC_Projects\CUSTOMERS\ESA\ECSS Knowledge Library.mdb'



the
REUSE
company

