INCOSE Guide to Writing Requirements

Meet our new digital assistant!

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THE REUSE COMPANY

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Your **digital assistant** for quality reviews

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The REUSE Company is a solutions provider specialized in the application of **semantic technologies** and artificial intelligence to improve the **digitalization of the Systems Engineering** processes.

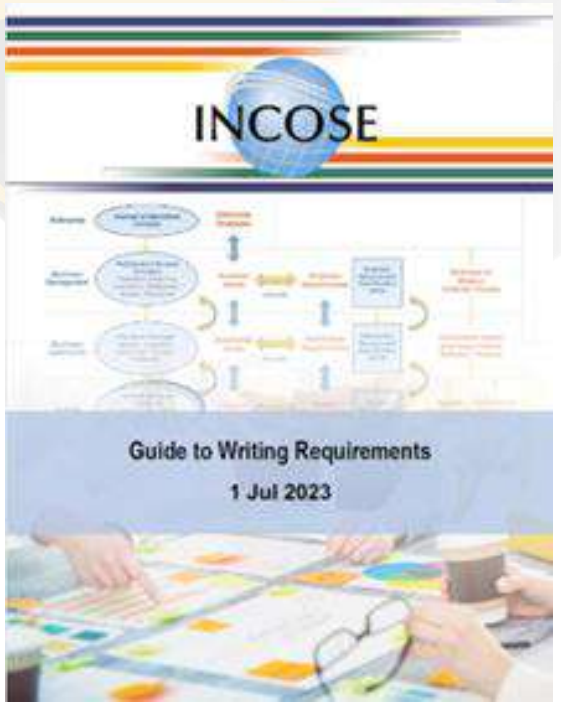
Introduction to the INCOSE GtWR

General approach

The INCOSE RWG (**Requirements Working Group**) in line with its goal

"Expand and promote the body of knowledge of requirements engineering and its benefits within the systems engineering community"

has developed the INCOSE GtWR (**Guide to Writing Requirements**)



The GtWR provides *guidance* on how to express

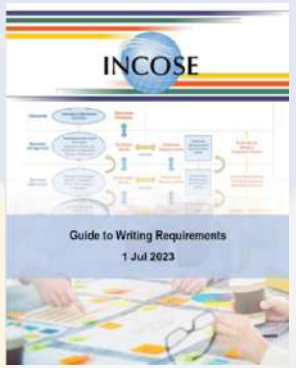
textual needs *AND* requirements expressions.

The GtWR: a single, comprehensive set of **characteristics, rules and attributes** for well-formed need and requirement expressions.

- **15 Characteristics** of individual and sets of needs and requirements.
- **42 Rules** to help formulate individual and sets of needs and requirements.
- **49 Attributes** are attached to need or requirement statements to form need or requirement expressions.

42 Rules / 15 Characteristics

Type	Rule Number	Rule name	C1 - NECESSARY	C2 - APPROPRIATE	C3 - UNAMBIGUOUS	C4 - COMPLETE	C5 - SINGULAR	C6 - FEASIBLE	C7 - VERIFIABLE	C8 - CORRECT	C9 - CONFORMING	C10 - COMPLETE	C11 - CONSISTENT	C12 - FEASIBLE	C13 - COMPREHENSIBLE	C14 - ABLE TO BE VALIDATED	C15 - CORRECT
Accuracy	R01	Sentence Structure			1	1			1	1	1						
	R02	Use Active Voice		1	1	1			1								
	R03	Subject Verb		1	1				1			1				1	
	R04	Use Defined Terms			1				1				1		1	1	1
	R05	Use Definite Articles			1				1								
	R06	Units			1	1			1	1							
	R07	Avoid Vague Terms			1	1			1								
	R08	No Escape Clauses			1	1			1								
	R09	No Open Ended			1	1	1		1								
Concision	R10	Superfluous Infinitives			1				1								
	R11	Separate Clauses			1	1			1	1							
Non Ambiguity	R12	Correct Grammar			1				1	1	1						
	R13	Correct Spelling			1				1								
	R14	Correct Punctuation			1					1							
	R15	Logical Condition			1				1								
	R16	Avoid Not			1				1	1							
	R17	Oblique			1				1								
Singularity	R18	Single Sentence			1		1		1		1				1		
	R19	Avoid Combinators			1		1										
	R20	Avoid Purpose	1				1										
	R21	Avoid Parentheses					1										
	R22	Enumeration			1		1										
	R23	Context			1	1	1										
Completeness	R24	Avoid Pronouns			1	1			1								
	R25	Use Of Headings				1											
Realism	R26	Avoid Absolutes						1	1	1				1			
Conditions	R27	Explicit				1			1	1							
	R28	Explicit Lists			1				1								
Uniqueness	R29	Classify										1	1				
	R30	Express Once	1								1		1				
Abstraction	R31	Solutionfree		1													
Quantifiers	R32	Universals			1				1	1							
Tolerance	R33	Value Range			1	1		1	1	1				1			
Quantification	R34	Measurable			1	1			1					1			
	R35	Temporal Indefinite			1	1			1								
Uniform Language	R36	Use Consistent Terms			1					1	1		1		1	1	1
	R37	Define Acronyms			1						1		1		1	1	1
	R38	Avoid Abbreviations									1		1		1	1	1
	R39	Style Guide				1	1				1		1		1	1	1
	R40	Decimal Format			1	1					1		1				
Modularity	R41	Related Requirements				1					1	1	1		1		1
	R42	Structured										1	1		1	1	1



49 Attributes

Att	Attribute	Attributes to Help Define the Requirement and its Intent	Associated with the System of Interest (SOI) Verification	Attributes to Help Maintain the Requirements	Attributes to Show Applicability and Allow Reuse
A01	Rationale*	1			
A02	SOI Primary Verification or Validation Method*	1			
A03	SOI Verification or Validation Approach	1			
A04	Trace to Parent*	1			
A05	Trace to Source*	1			
A06	Condition of Use	1			
A07	States and Modes	1			
A08	Allocation*	1			
A09	SOI Verification or Validation Level		1		
A10	SOI Verification or Validation Phase		1		
A11	SOI Verification or Validation Results		1		
A12	SOI Verification or Validation Status		1		
A13	Unique Identifier*			1	
A14	Unique Name			1	
A15	Originator/Author*			1	
A16	Date Requirement Entered			1	
A17	Owner*			1	
A18	Stakeholders			1	
A19	Change Board			1	
A20	Change Status			1	
A21	Version Number			1	
A22	Approval Date			1	
A23	Date of Last Change			1	
A24	Stability			1	
A25	Responsible Person			1	
A26	Need or Requirement Verification Status*			1	
A27	Need or Requirement Validation Status*			1	
A28	Status (of the Need or Requirement)			1	
A29	Status (of Implementation)			1	
A30	Trace to Interface Definition			1	
A31	Trace to Peer Requirements			1	
A32	Priority*			1	
A33	Criticality or Essentiality*			1	
A34	Risk (of Implementation)*			1	
A35	Risk (Mitigation)			1	
A36	Key Driving Need or Requirement (KDN/KDR)			1	
A37	Additional Comments			1	
A38	Type/Category			1	
A39	Applicability				1
A40	Region				1
A41	Country				1
A42	State/Province				1
A43	Application				1
A44	Market Segment				1
A45	Business Unit				1
A46	Business (Product) Line				1

i) Characteristics: New characteristic C15 – Correctness of sets of needs/requirements.

- Compiles the other characteristics to stress the importance of having them all :
  - *C10 - COMPLETE*
  - *C11 - CONSISTENT*
  - *C12 - FEASIBLE*
  - *C13 - COMPREHENSIBLE*
  - *C14 - ABLE TO BE VALIDATED*

ii) Rules:

- Updated Rules: R06 (Units), R33 (Tolerance)
- ****New Rule** :** R40 (DecimalFormat)

iii) Requirement Patterns (Appendix C)

iv) Rule Applicability Matrix (Appendix D) : Needs vs. Requirements and Data Dictionaries

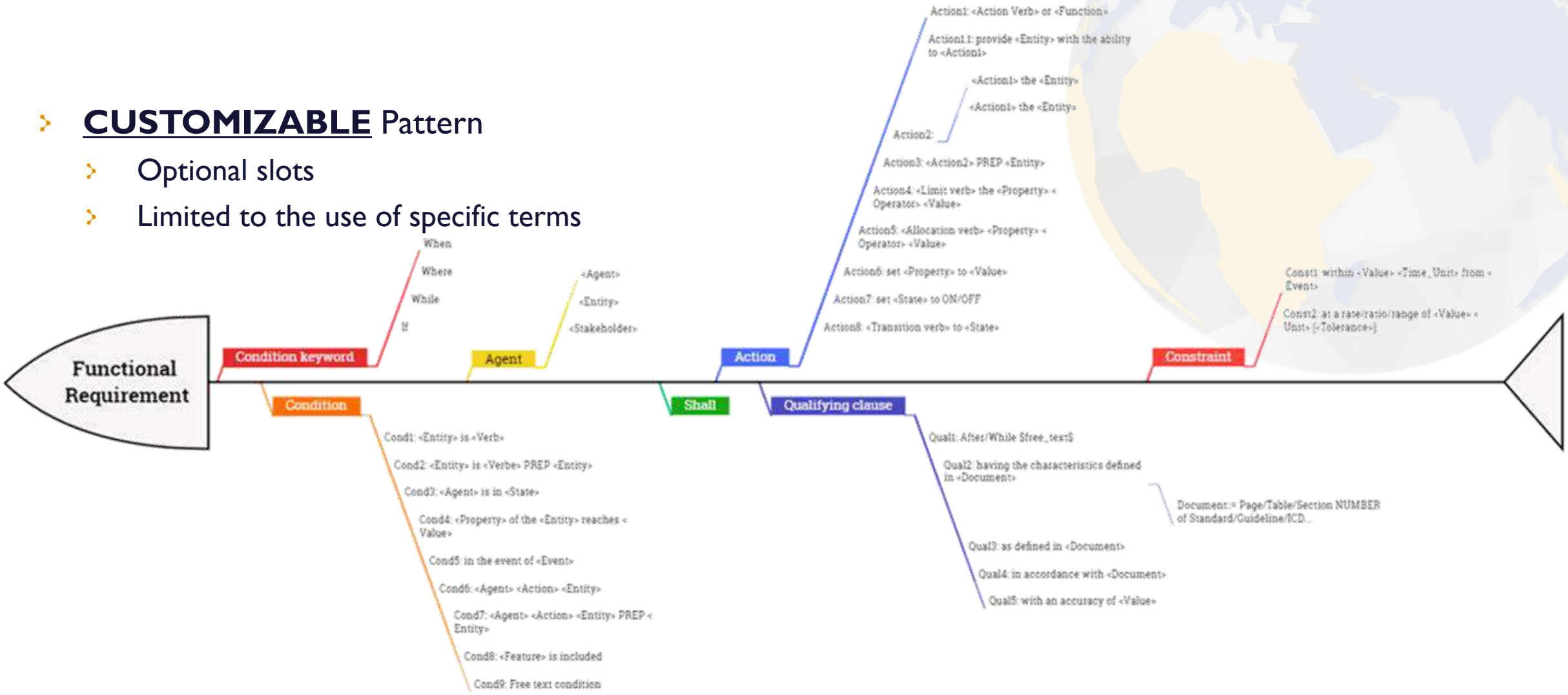
*****THE CHALLENGE*****

"address both need and requirement statements and understand the differences between the two"

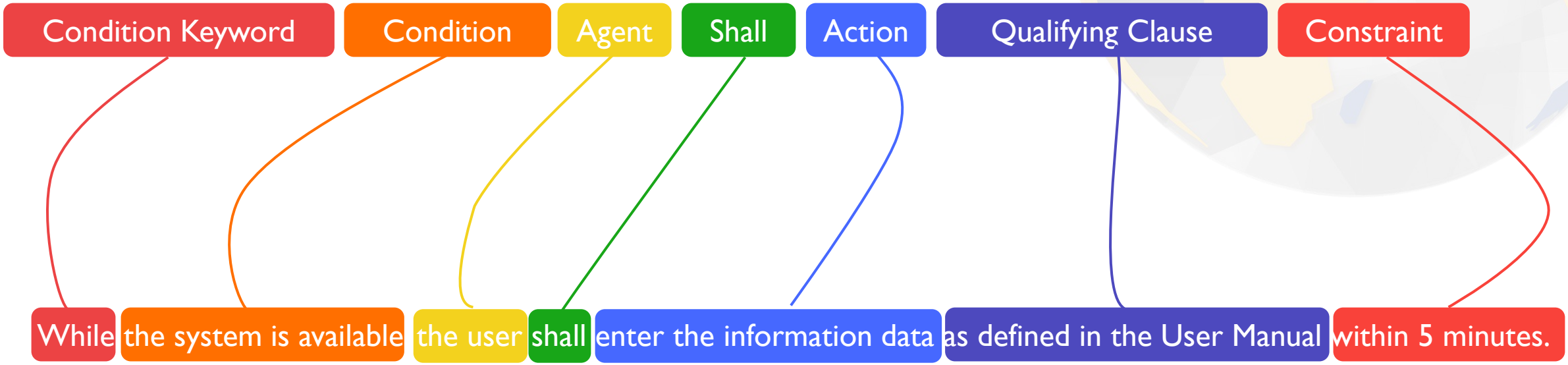
INCOSE GtWR sect. 1.8

Appendix C of the INCOSE GtWR v4.0 : Generic pattern

- **CUSTOMIZABLE** Pattern
  - Optional slots
  - Limited to the use of specific terms

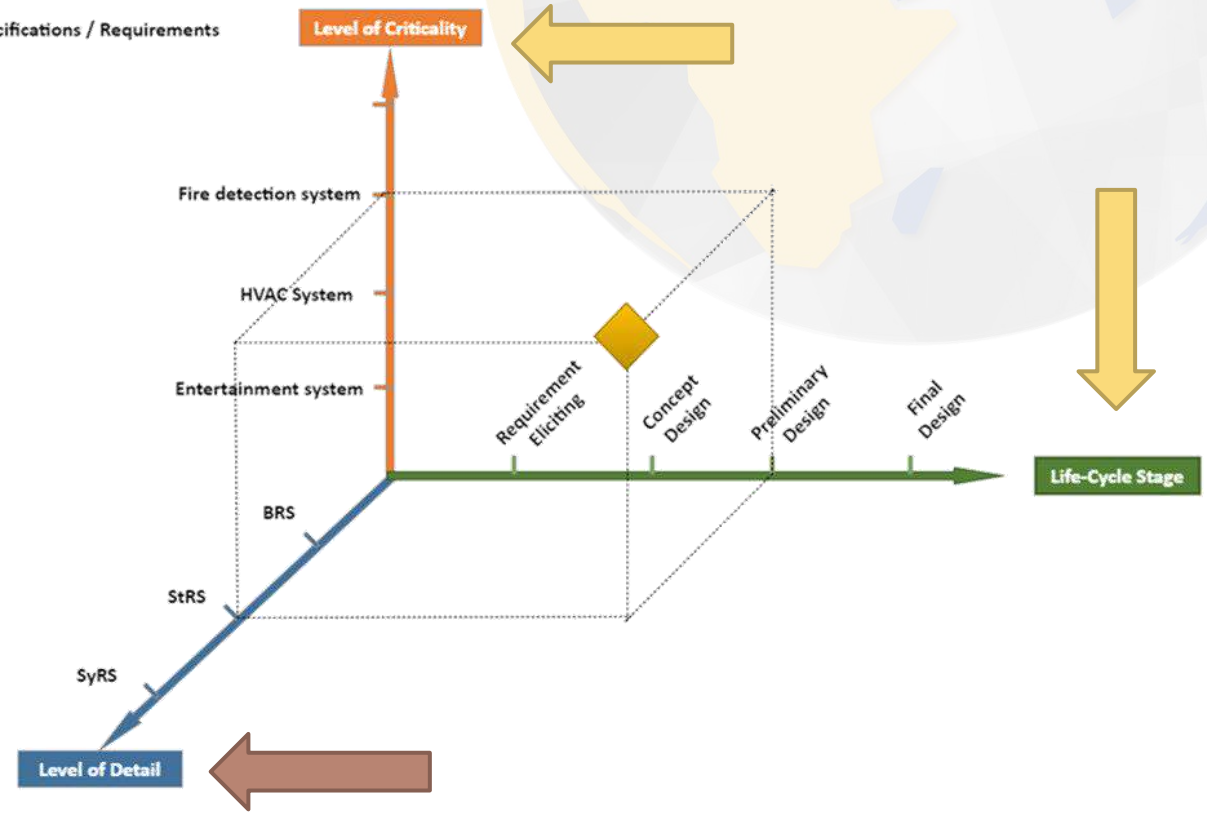


- **CUSTOMIZABLE** Pattern



Appendix D of the INCOSE GtWR v4.0 : Applicability Matrix

- Guidelines/**Recommendations** to apply a tailored set of rules to either Needs or Requirements
  - *Optional / Recommended* rule for Needs
  - *Compulsory* rules for Requirements



- **Tailoring** to either Needs or Reqs
- Is a **Project Data Dictionary** needed?
  - 1. check cross-domain aspects
  - 2. check domain-specific aspects

Tailoring Guide
(Link to download the book) :

Appendix D of the INCOSE GtWR v4.0 : Applicability Matrix

RULE #	RULE NAME	RULE SHORT DESCRIPTION	RULE APPLICABILITY	APPLICABILITY COMMENTS	RULE SCOPE Requires Project Data Dictionary, Glossary, Models or Ontology? (Y/N)	SCOPE COMMENTS
R01	Sentence Structure	Use the form of a complete sentence: subject, verb, object.	CNCR		N	
R02	Use Active Voice	Use the active voice in the main sentence structure with the responsible entity clearly identified as the subject.	RNCR	**Needs:** The use of active voice can have a higher tolerance when considering needs, although it is recommended to avoid it in both cases.	N	

RULE APPLICABILITY

CNCR = Compulsory for Needs AND Requirements

RNCR = Recommended for Needs; Compulsory for Requirements [+Comments]

CR = Compulsory for Requirements (Optional for Needs)

RULE SCOPE : Requires Project Data Dictionary, Glossary, Models or Ontology?

Y: Yes /N: No

INCOSE GtWR v4.0 release: more info to this topic

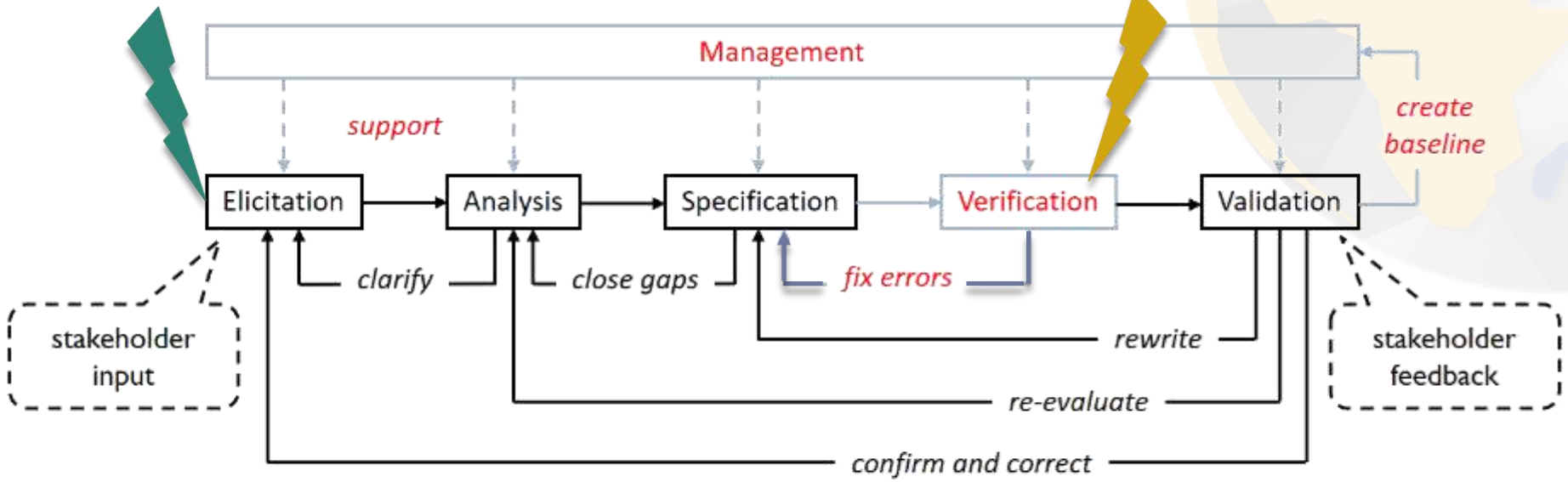
Meet our digital assistant(s)

TBD

Rules applied at authoring phase (StRD)

TBD

Rules applied at verification phase (SyRD)



Adapted from: Karl Wiegers

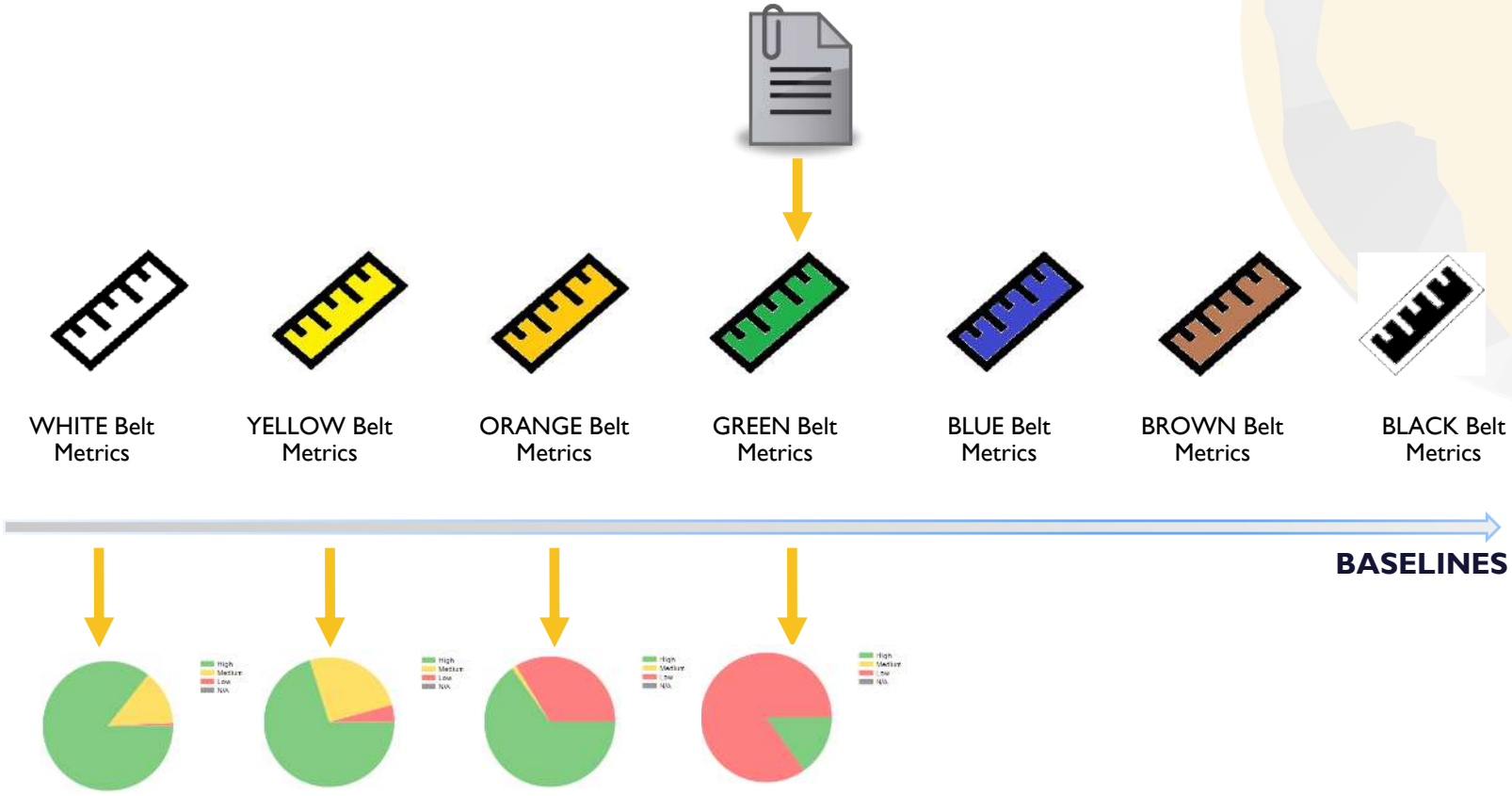
- **RAT – AUTHORING Tool**

- **Main Target :** requirement authors
- Key features:
  - **Real-time quality** check (Correctness)
  - **Autocompletion** powered by the semantic ontology's patterns.
  - Available in **plug-in** version (IBM DOORS, Capella, ...) and **web extension** (Chrome, Edge, Firefox).

- **RQA – QUALITY Studio**

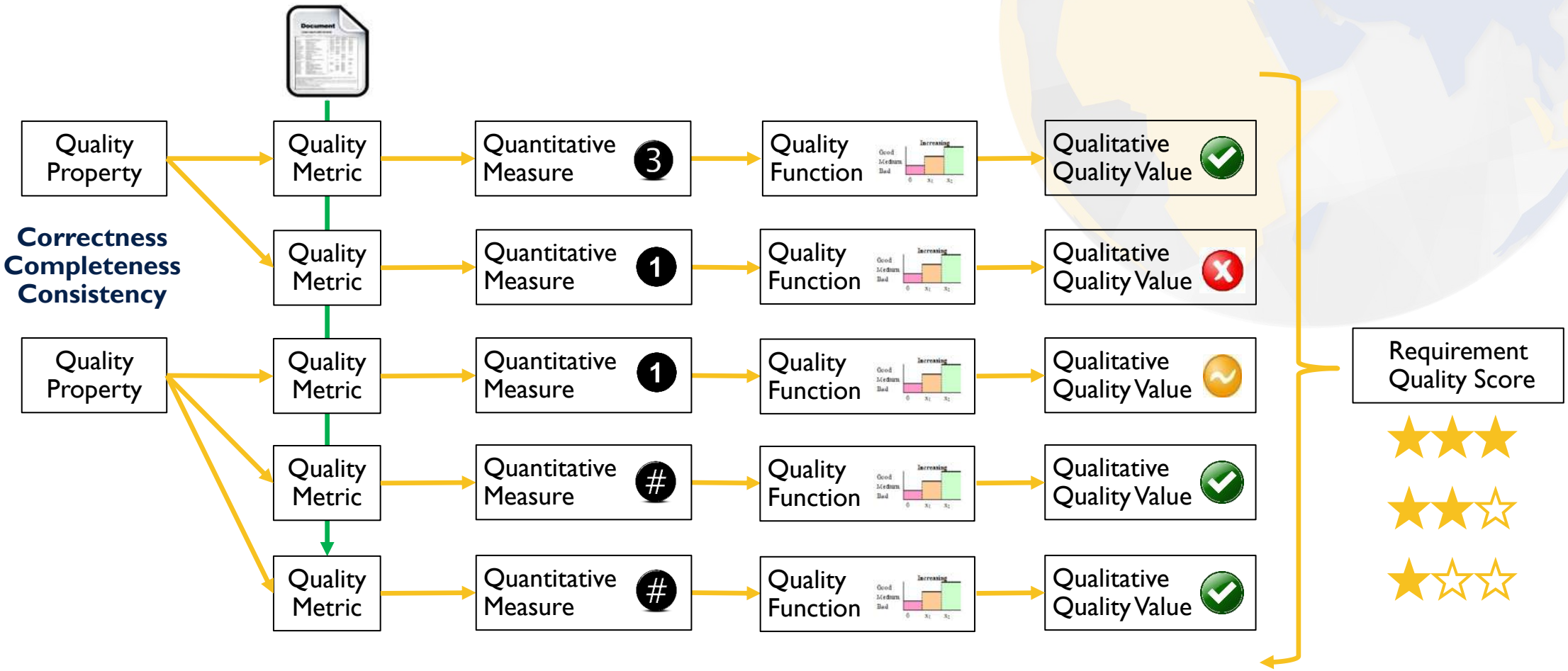
- **Main Target :** requirement reviewers
- Key features:
  - **CCC*** quality check of engineering items from 50+ tools (Requirements Management, ALM, MBSE...)
  - Settings to **configure and customize** quality rules (metrics)
  - Quality reports generation
  - Automated assessment tasks (batch process).

*Correctness, Consistency, Completeness

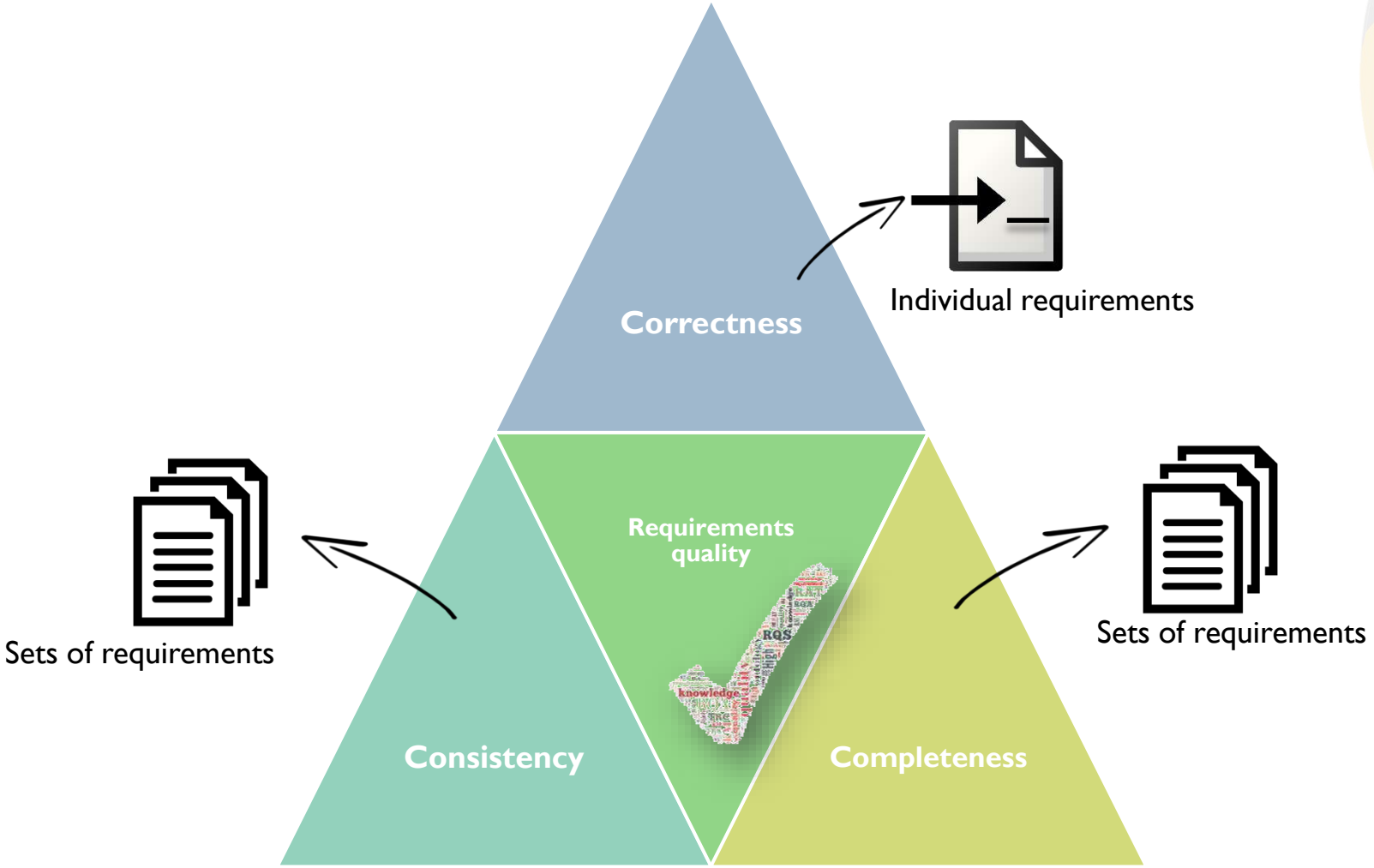


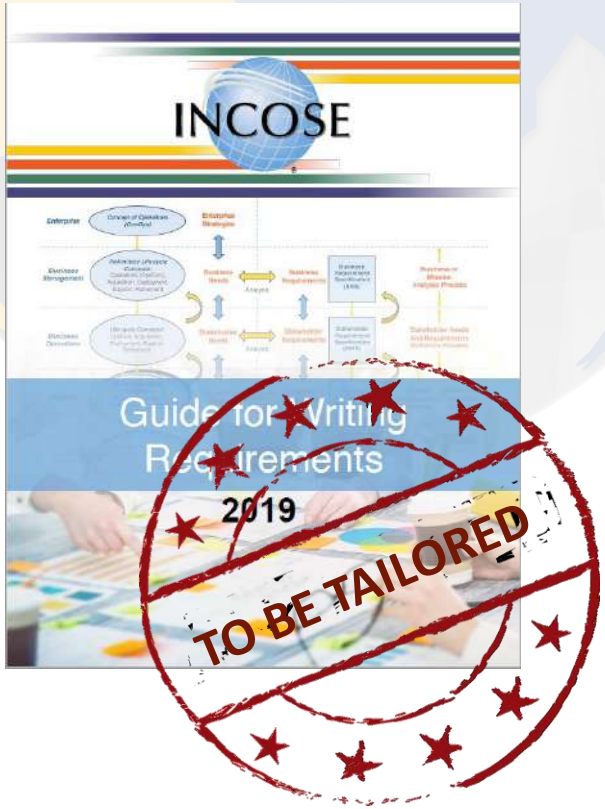
Tool-assisted Requirements Quality Verification

Implementation of a customized quality configuration



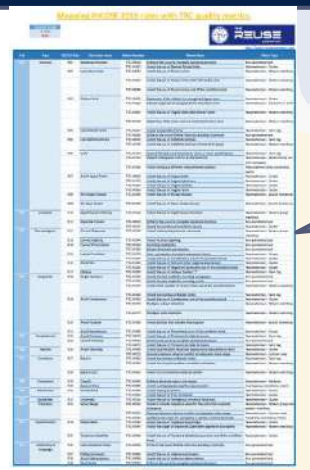
Requirements Quality Metrics: CCC Approach

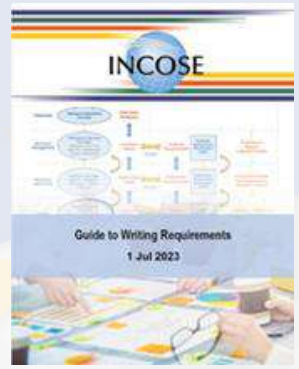


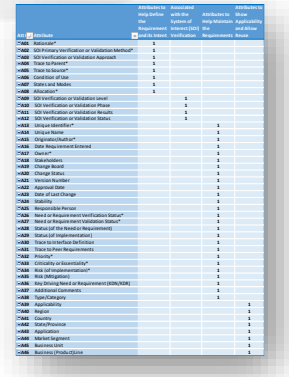


INCOSE GtWR with tailoring

- Characteristics
- Rules
- Attributes
- **58 Metrics:** A quality metric is a property which aims to quantify a qualitative indicator. It enables answering the question *'How should we measure?'*
- **Quality Function:** After defining the metric, the quality function is the conversion of the obtained result (quantitative value) to a quality level. Different profiles can be set (binary, concave, convex…)







INCOSE GtWR Mapping Table: zoom in

- **58 Metrics**

Mapping INCOSE GtWR v4.0 (2023) rules with TRC quality metrics

TACKLED SCORE
38 YES
4 NO

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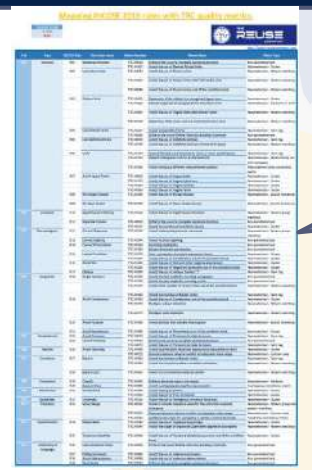
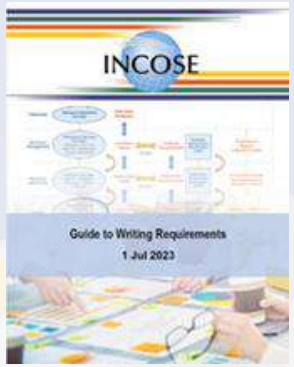
T id	Type	INCOSE Rule	Rule short name	Metric Number	Metric Name	Metric Type	Scope
T01	Accuracy	R01	Sentence Structure	TRC-M010	Enforce the use of a complete sentence structure	Non-parameterized	2-Domain-specific
				TRC-M365	Avoid the use of Banned Modal Verbs	Parameterized - Cluster	1-Cross-domain
		R02	Use Active Voice	TRC-M030	Avoid the use of Passive Voice	Parameterized - Pattern matching	1-Cross-domain
				TRC-M035	Avoid the use of Passive Voice after the modal verb	Parameterized - Pattern matching	1-Cross-domain
				TRC-M040	Avoid the use of Passive Voice out of the condition block	Parameterized - Pattern matching	1-Cross-domain
		R03	Subject Verb	TRC-M050	Determine if the subject is a recognized Agent term	Parameterized - Cluster	2-Domain-specific
				TRC-M055	Detect inappropriate subject at the document level	Parameterized - Sub terms in SCM	2-Domain-specific
				TRC-M065	Avoid the use of Vague Verbs after Modal Verbs	Parameterized - Pattern matching	1-Cross-domain
				TRC-M120	Determine if the main verb is a Controlled Action Verb	Parameterized - Pattern matching	2-Domain-specific
				TRC-M845	Avoid unspecified subject	Parameterized - Pattern group matching	1-Cross-domain
		R04	Use Defined Terms	TRC-M225	Avoid Unclassified Terms	Parameterized - Term tag	2-Domain-specific
				TRC-M630	Enforce the use of Define Terms by avoiding Synonyms	Non-parameterized	2-Domain-specific
		R05	Use Definite Articles	TRC-M020	Avoid the use of Indefinite Articles	Parameterized - Term tag	1-Cross-domain
				TRC-M130	Avoid the use of Indefinite Articles in front of an Agent	Parameterized - Pattern matching	1-Cross-domain
		R06	Units	TRC-M140	Ensure Numbers are followed by Units or noun qualifications	Parameterized - Term tag	1-Cross-domain
				TRC-M150	Detect inadequate Unit for a Characteristic	Parameterized - Relationships not SCM compliant	1-Cross-domain
				TRC-M160	Avoid mixing up different measurement systems	Measurement units consistency metric	1-Cross-domain

Link to download the mapping table

Applicability Matrix : Implementation





Applicability Matrix : Implementation

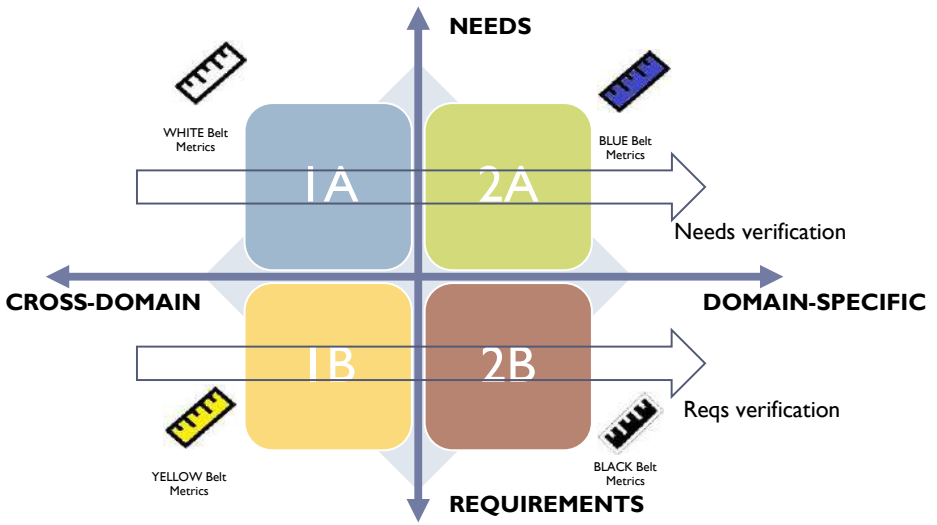
Quality Assurance - Metrics set templates

Metrics set templates:

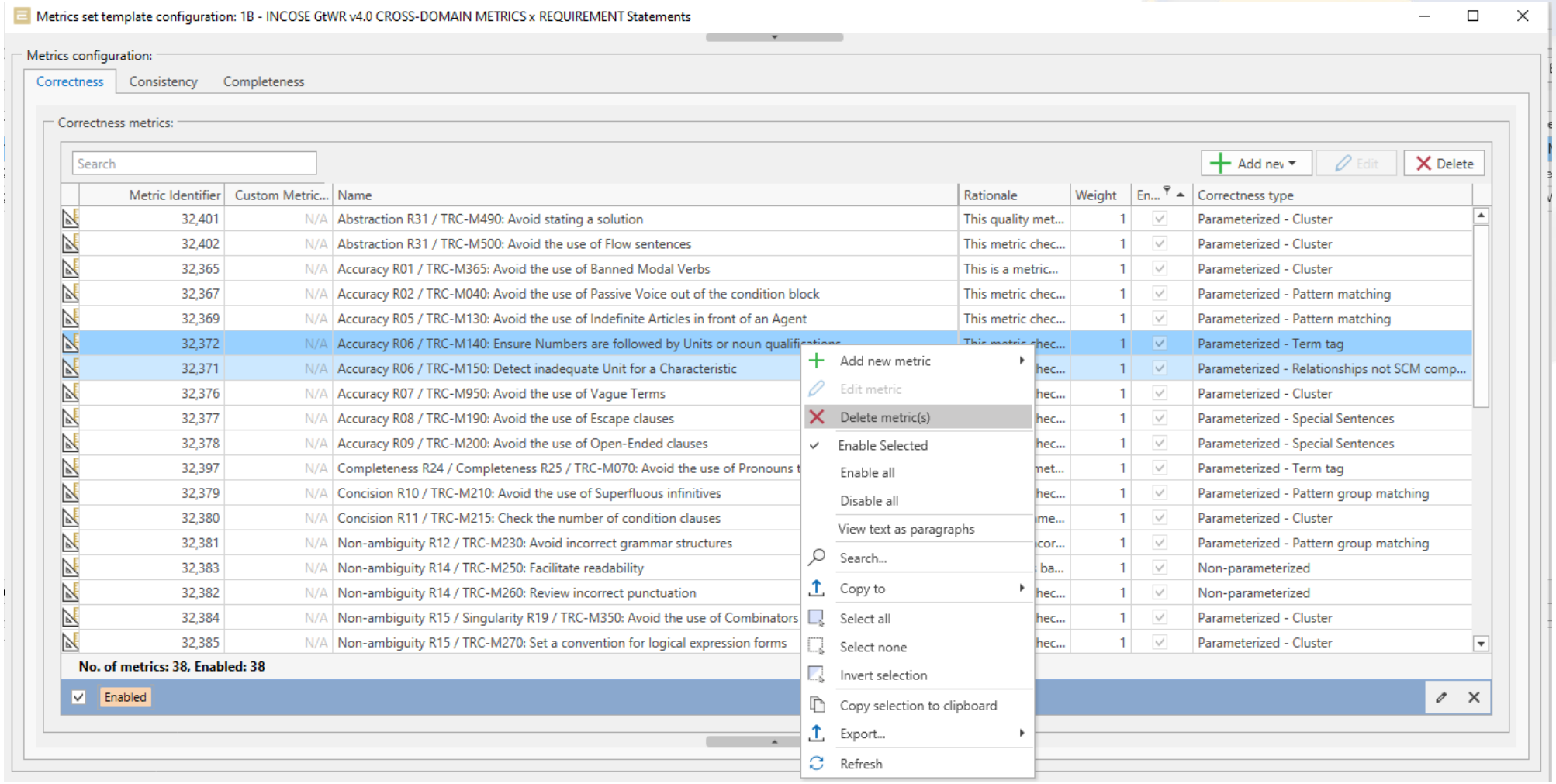
Search...

Add metric set

Identifier	Name	Description
187	1A - INCOSE GtWR v4.0 CROSS-DOMAIN METRICS x NEED Statements	1A. This subset includes cross-domain rules, which do not require domain-specific data dictionaries, and applies to NEED sta
188	1B - INCOSE GtWR v4.0 CROSS-DOMAIN METRICS x REQUIREMENT Statements	1B. This subset includes cross-domain rules, which do not require domain-specific data dictionaries, and applies to REQUIRE
189	2A - INCOSE GtWR v4.0 CROSS-DOMAIN & DOMAIN-SPECIFIC METRICS x NEED Statements	2A. This subset includes cross-domain & domain-specific rules, which require a project data dictionary, and applies to NEED
190	2B - INCOSE GtWR v4.0 CROSS-DOMAIN & DOMAIN-SPECIFIC METRICS x REQUIREMENT Statements	2B. This subset includes cross-domain & domain-specific rules, which require a project data dictionary, and applies to REQU



Applicability Matrix : Implementation

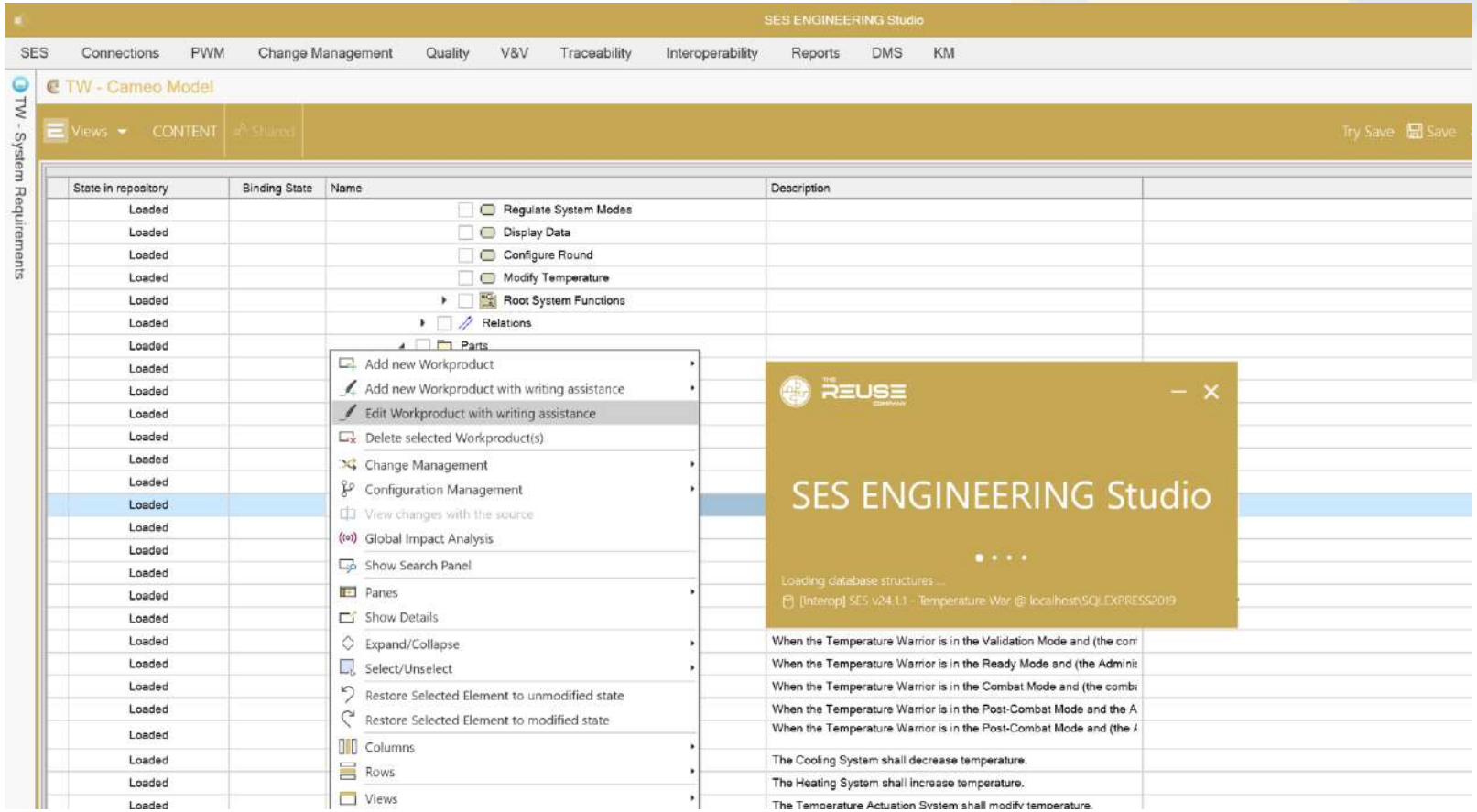


Demo #1 : Requirements Quality Review

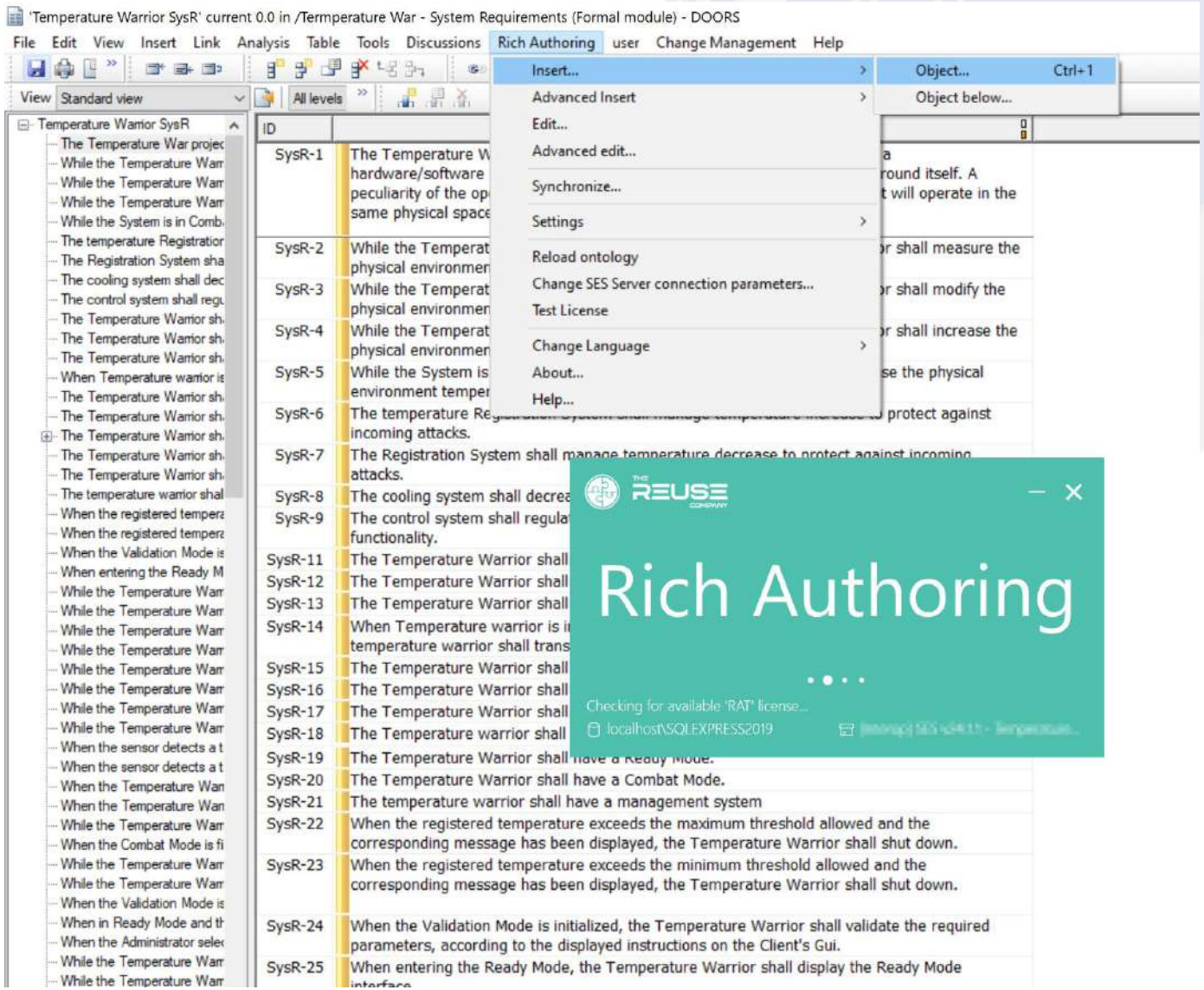
- ❑ Connect to a requirements repository (ALM)
- ❑ Select and customize a quality configuration
- ❑ Run a quality assessment
- ❑ View, store and export results

Tool-assisted Requirements Authoring

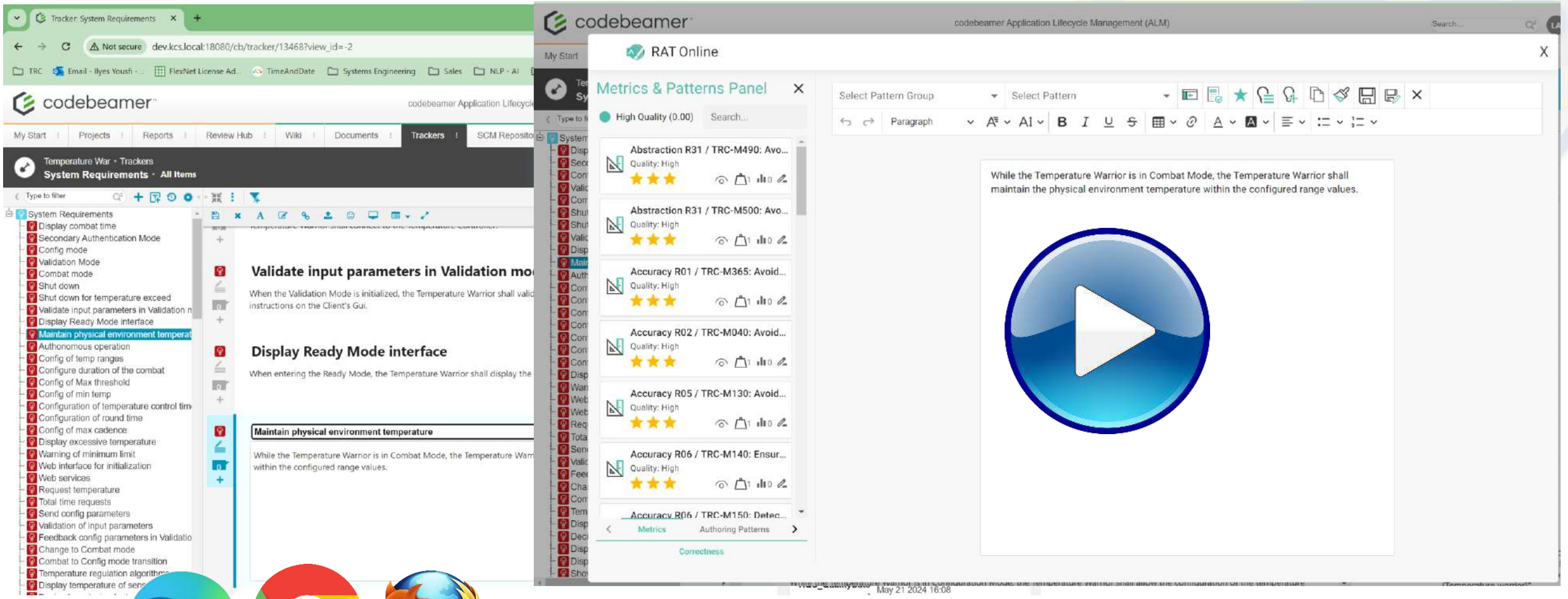
1. RAT – AUTHORING Tool Desktop version (SES ENGINEERING Studio)



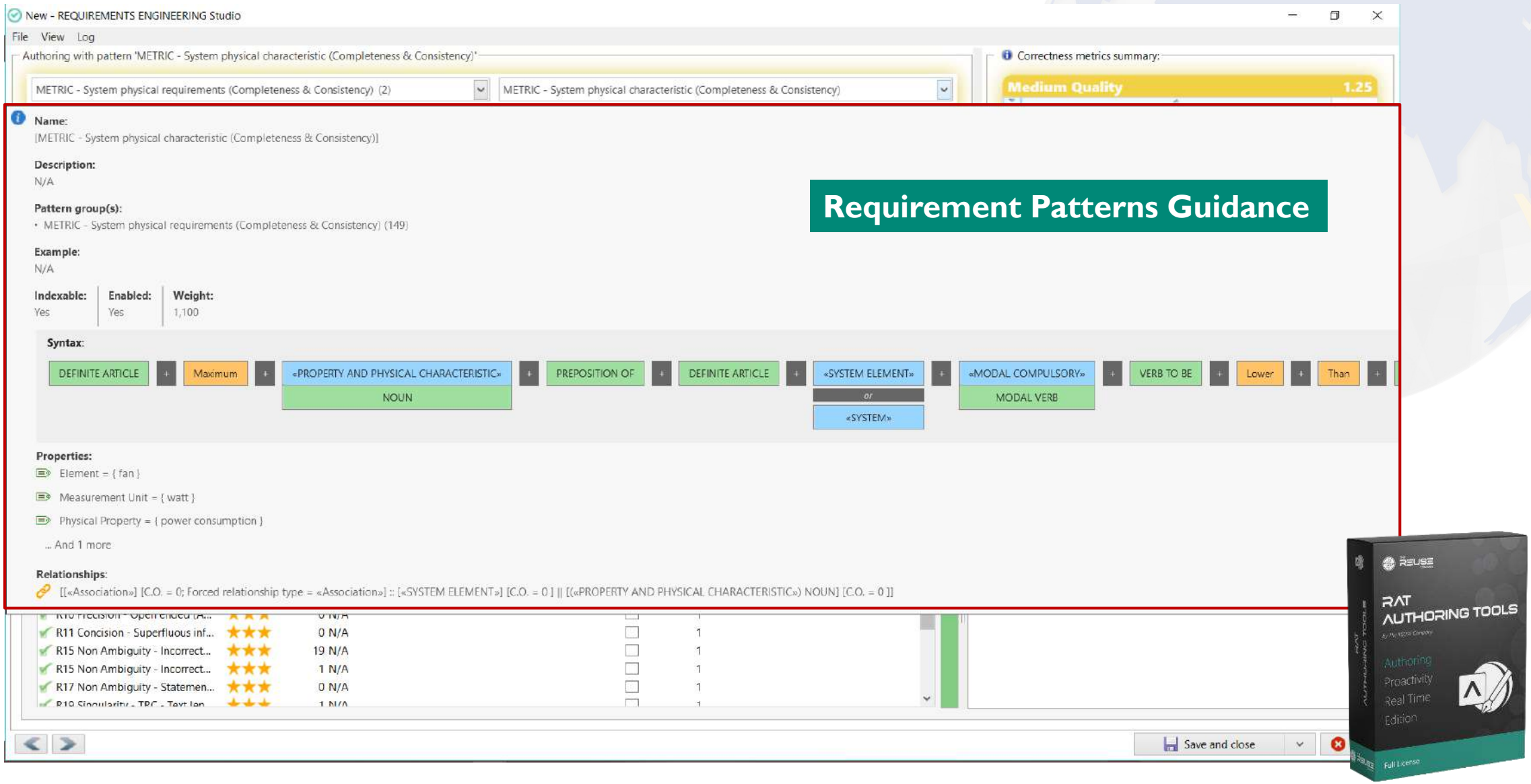
2. RAT plug-in



3. RAT – AUTHORING Web Extension

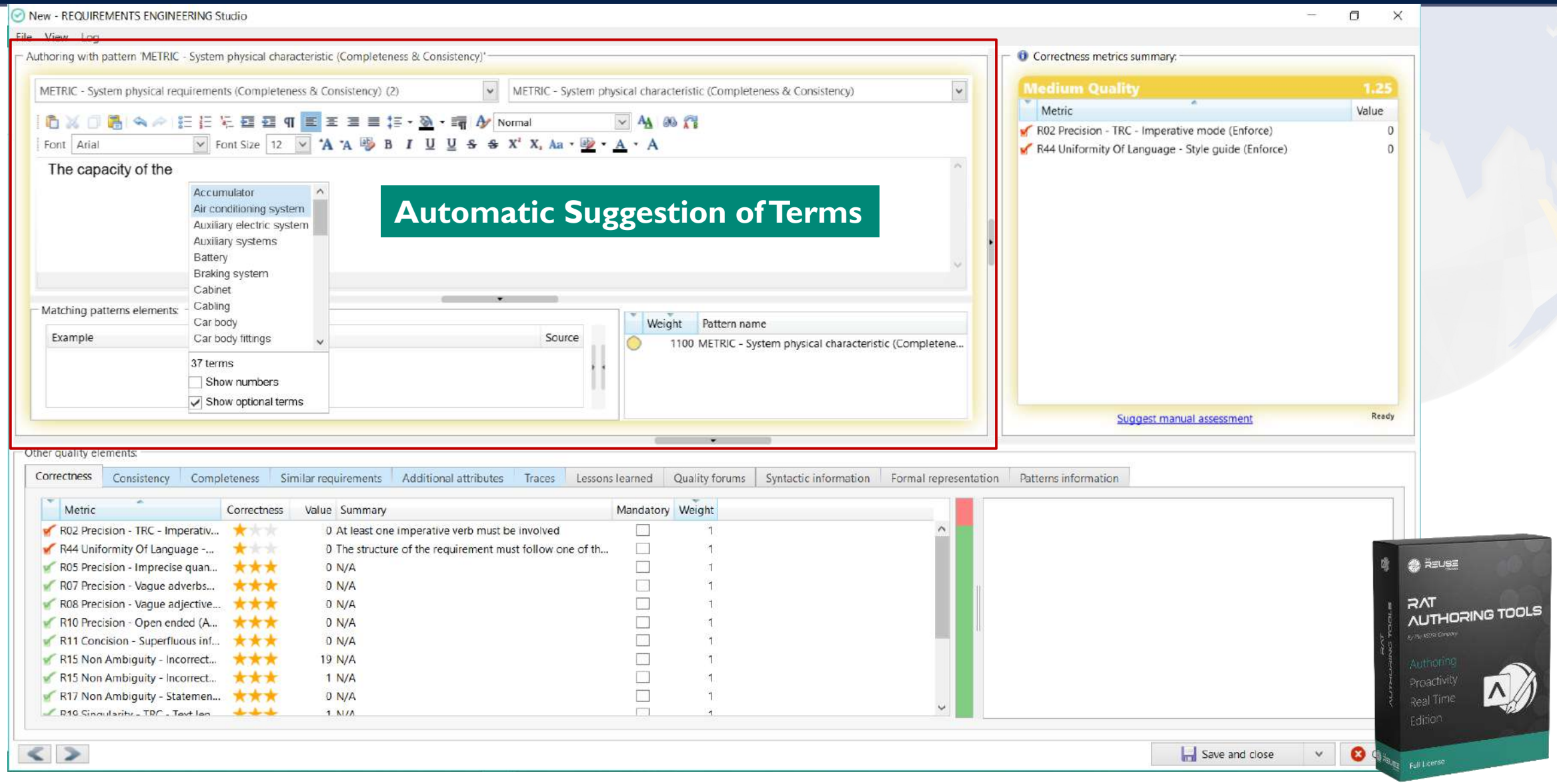


RAT – AUTHORING Tools : Main features

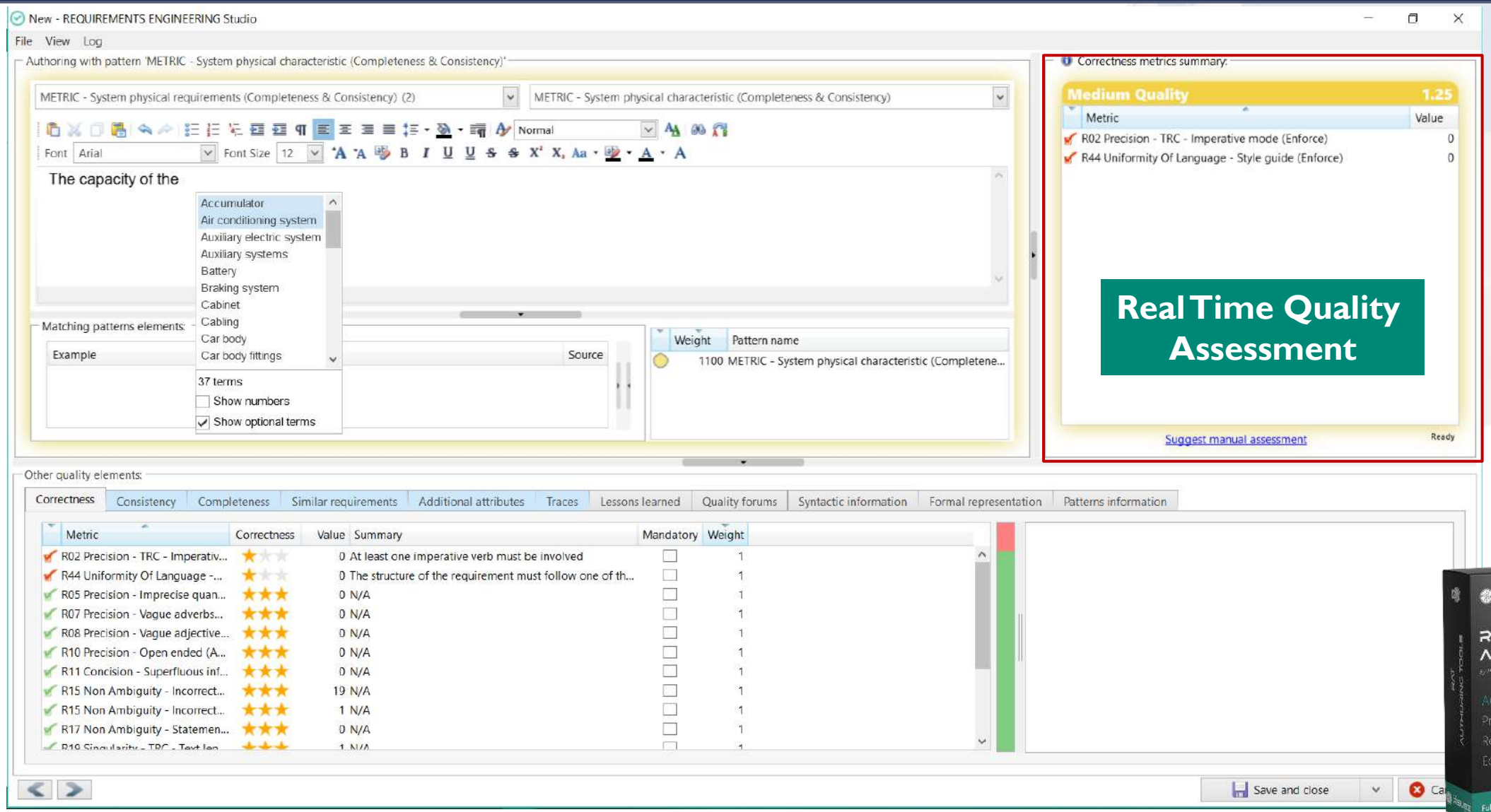


Requirement Patterns Guidance

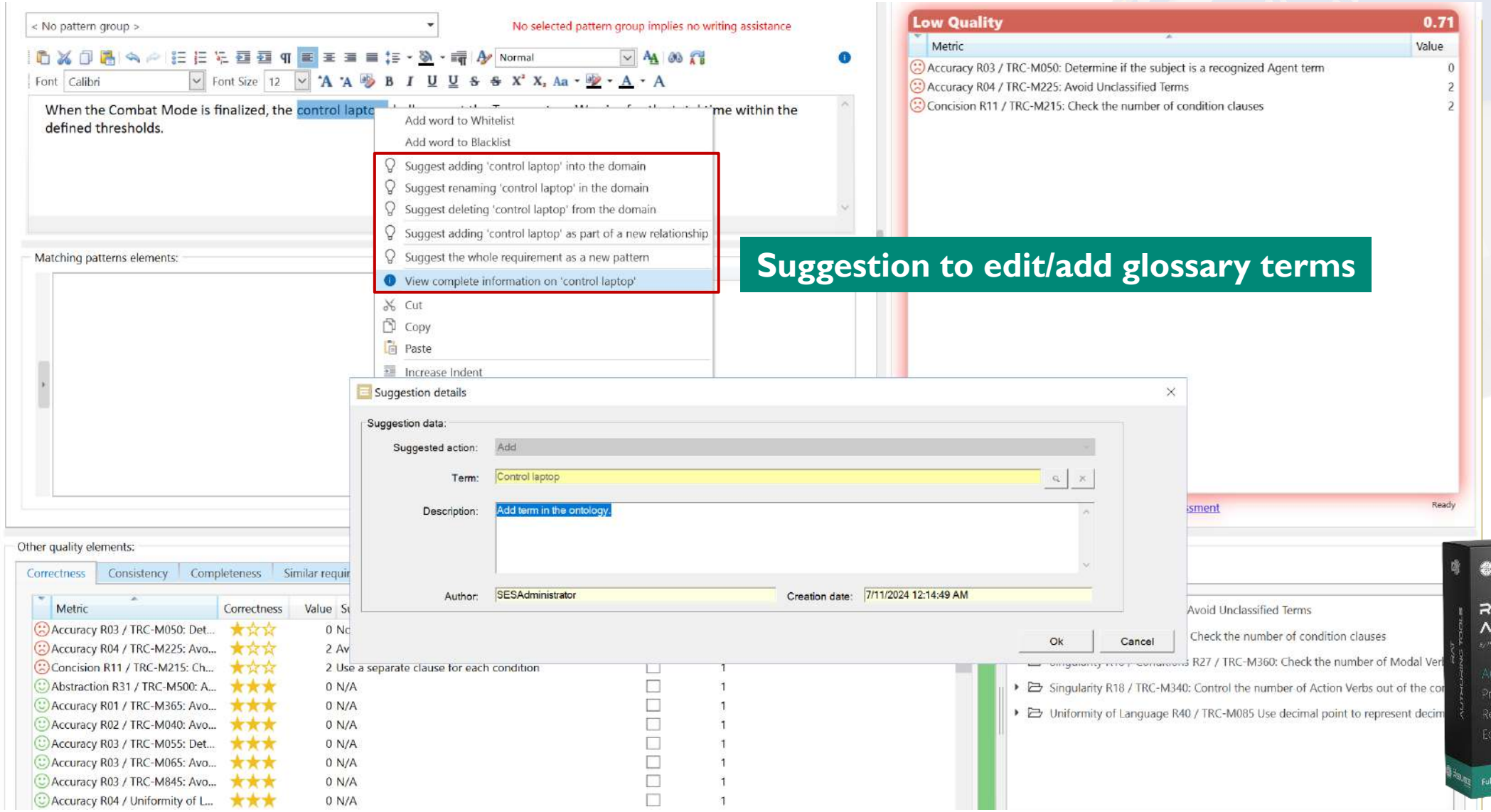
RAT – AUTHORING Tools : Main features



RAT – AUTHORING Tools : Main features



RAT – AUTHORING Tools : Main features



Suggestion to edit/add glossary terms

Demo #2 : Requirements Authoring Assistance

- ❑ Edit a requirement
- ❑ Check the metrics rating in real time and Use pattern assistance
- ❑ Update your requirement


Q&A

- Systems Engineering is an **iterative and recursive** endeavor to develop **requirements** and **architecture** gradually (recursively).
- This implies the use of **different tools** (RM tools and MBSE tools), to either **transfer requirements** between one tool and the other, or to **trace requirements and model elements** between these 2 different tools (or both things at the same time).
- Learn more about this Systems Engineering pattern, and discover how to seamlessly **interoperate different RM and MBSE tools** to accomplish it.

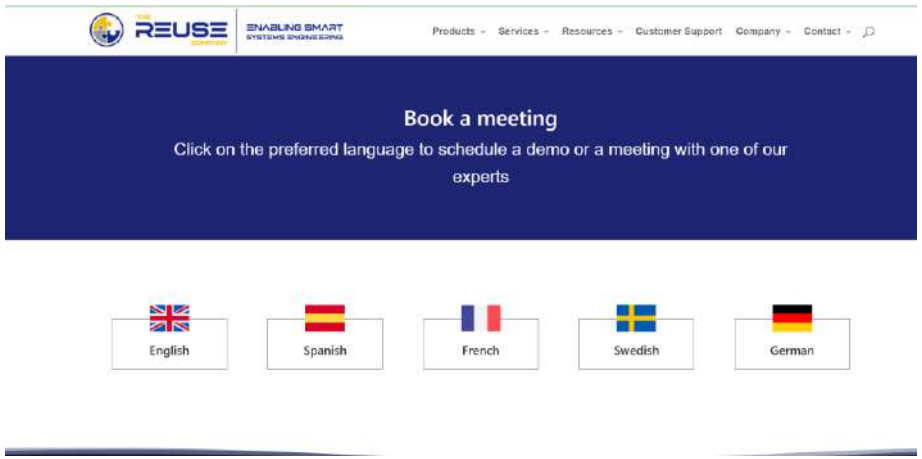
Dates: *September 11th & 12th , 2024*

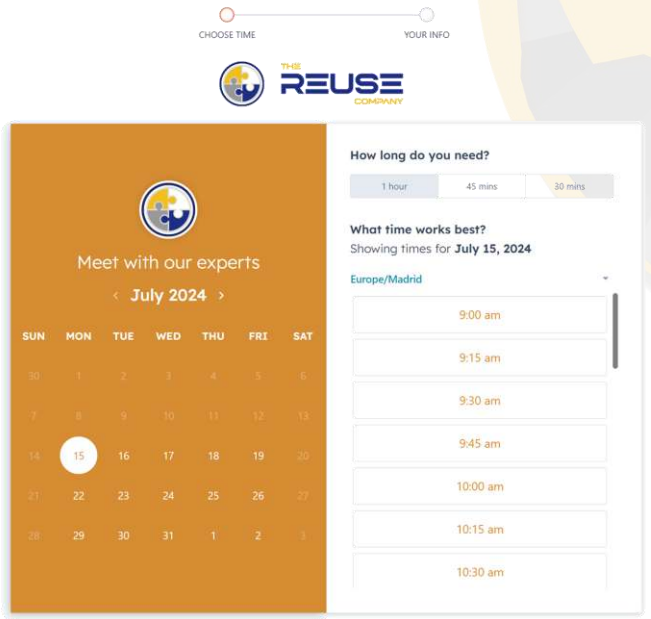
Link to the Registration:
https://www.reusecompany.com/webinars/mbse-zig-zag-pattern-a-theoretical-and-practical-approach


Q&A

Willing to go further? You have different options!

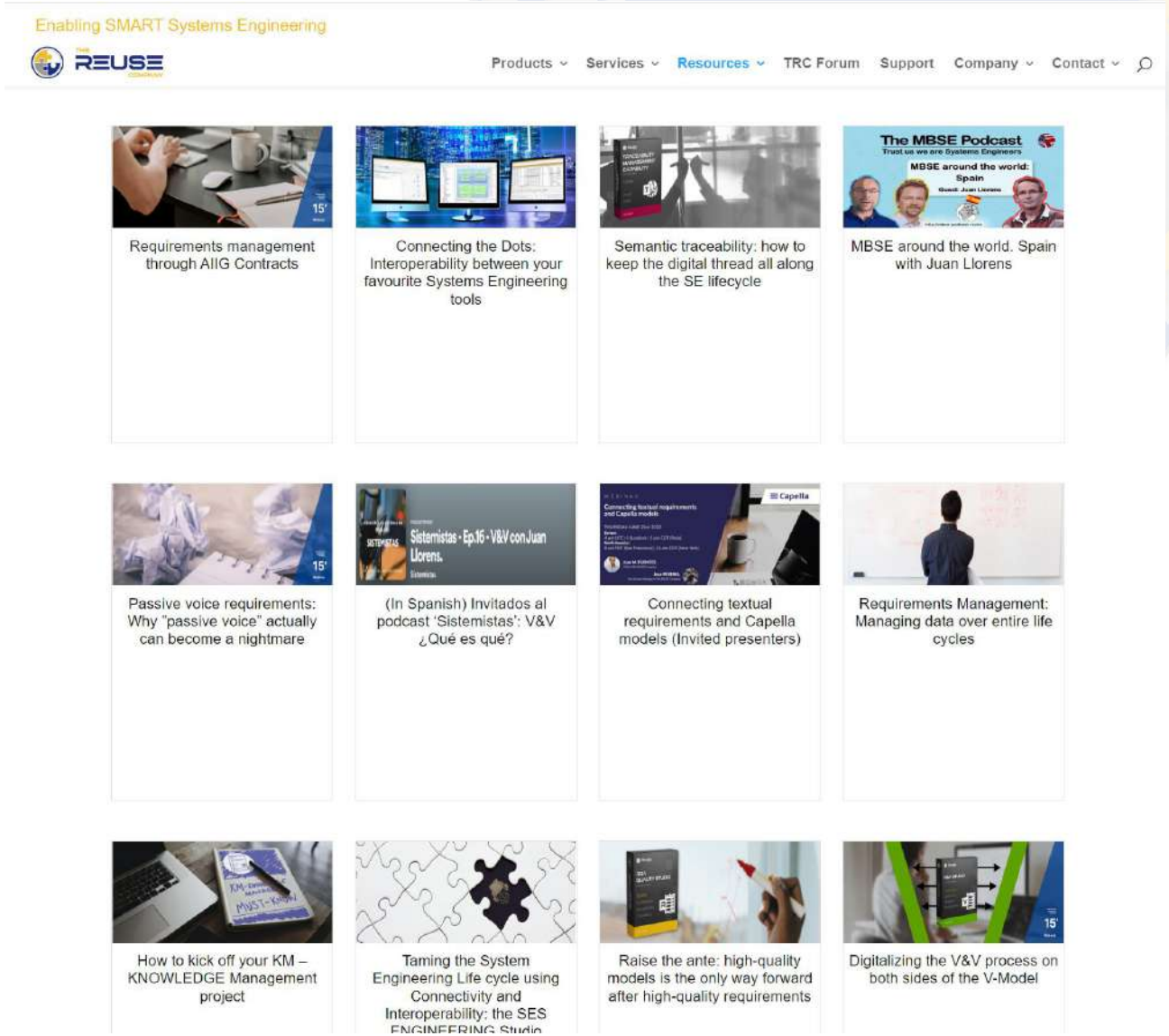
- Book a meeting with a consultant





- Requirements Analysis Service : https://www.reusecompany.com/personalized-requirements-analysis
- Request a trial license : contact@reusecompany.com
- Get further information...

- www.reusecompany.com
  - Information about the Systems Engineering Suite
  - Resources (Webinars, handbooks)
  - Request for demo
  - Support Forum



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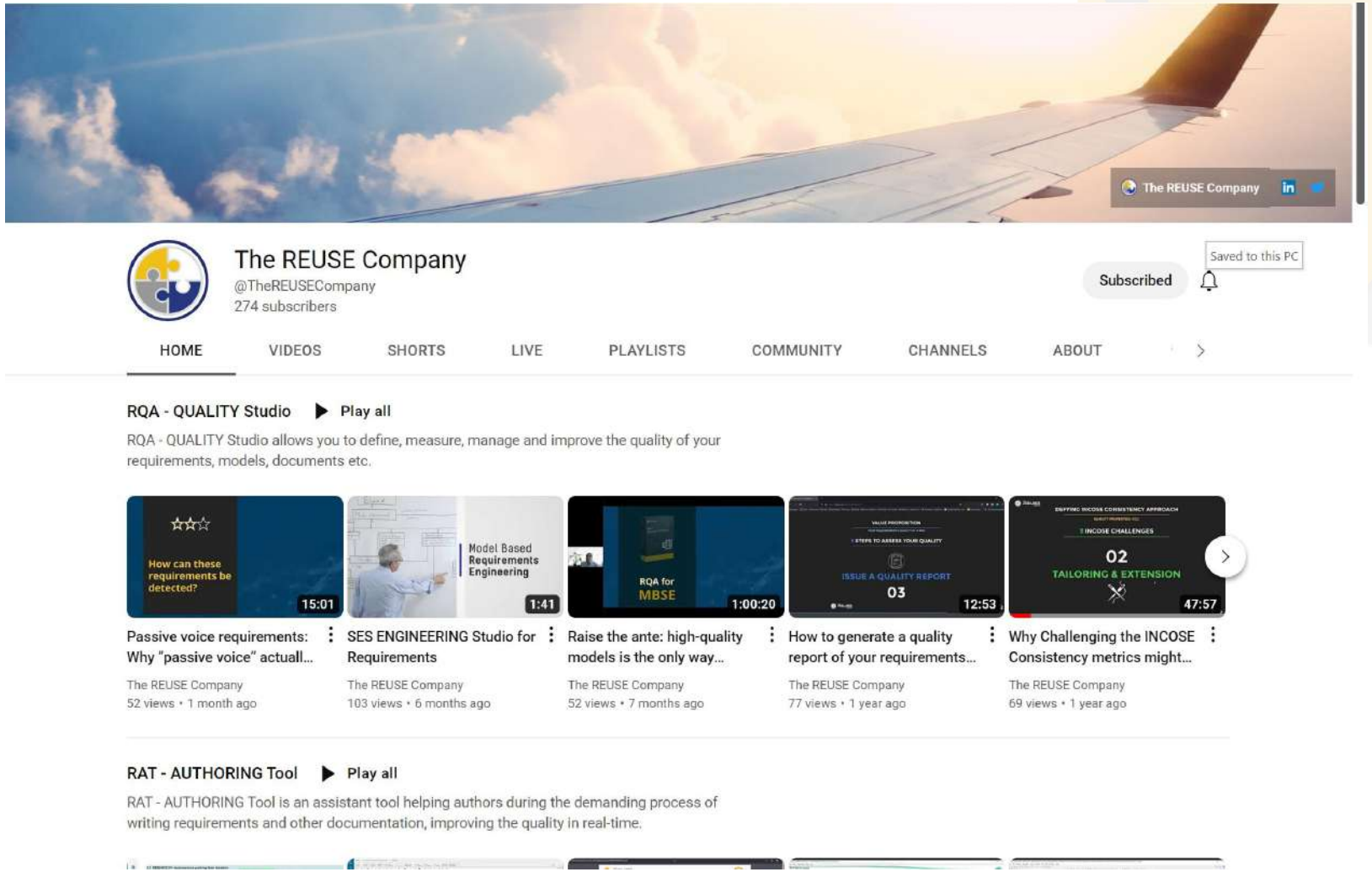

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