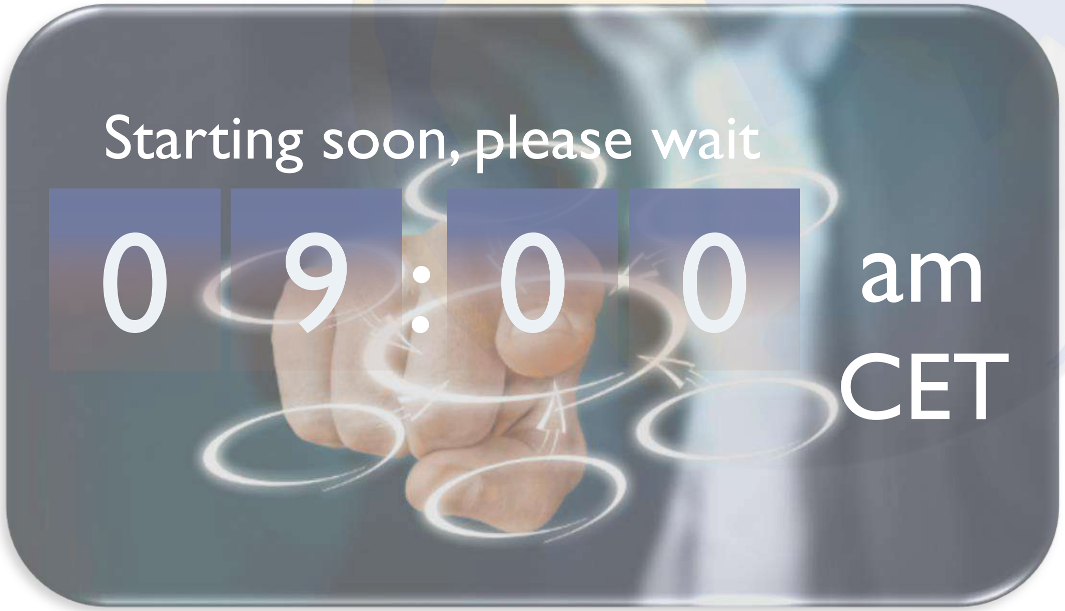
- Writing rules for numbers in textual requirements



- Webinar rules:
  - You'll be muted all along the Webinar
  - There's a chatting box to ask your questions or send your comments when you want
  - Please address these comments and questions to the user "The REUSE Company" and not to the presenter directly
  - If you have any technical issue please use this chatting box, or mail us at: support@reusecompany.com
  - The Webinar will be recorded. A link to the recording will be sent to you in a few days

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Writing rules for numbers in textual requirements:

When writing textual requirements, why is it more difficult to choose the correct numbers than to choose the correct words?

José M. Fuentes
The REUSE Company
Chief Operating Officer
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The presenters

José Fuentes

- **Current position:** Chief Sales Officer at The REUSE Company
- Product manager of the Systems Engineering Suite tools during the last 5 years
- INCOSE CSEP Certified
- Graduated in the INCOSE Institute for Technical Leadership
- Active contributor to the INCOSE Guide for Writing Requirements
- Member of the board of AEIS – The Spanish Chapter of INCOSE

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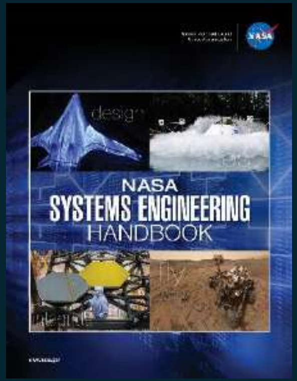

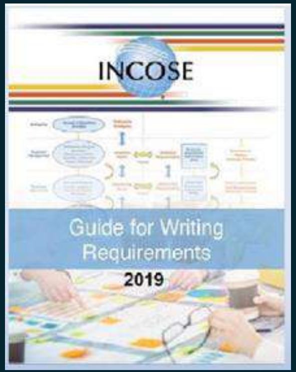

EUROPEAN COOPERATION
ECSS
FOR SPACE STANDARDIZATION

ISO
International Organization for Standardization

Requirements quality Rules

Verifiable
Consistency
Spelling
Combinators
Data dictionary
Completeness
Conciseness
Pattern
Passive voice
Negations
Ambiguity
Testability
Escape clauses
Phrase structure
Atomicity
Vague terms
Open-ended

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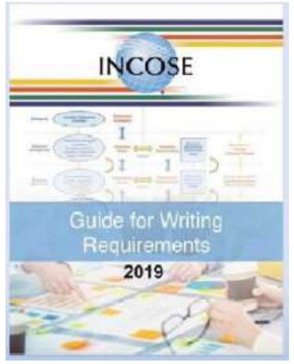
Requirements Quality Rules

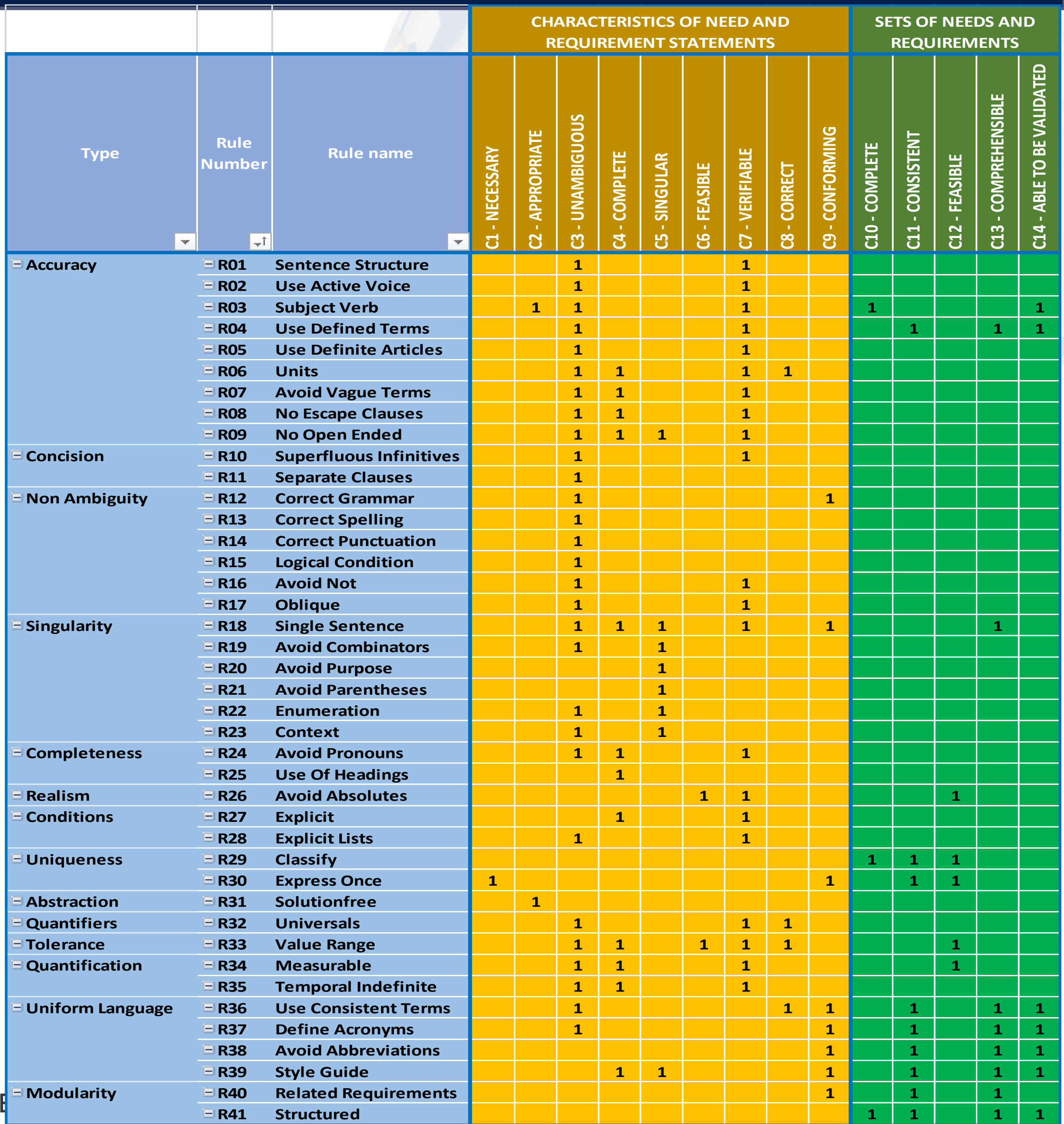


INCOSE GfWR

Rules based on numbers:

- R6 - Use appropriate units when stating quantities. All numbers should have units of measure explicitly stated.
- R7 - Avoid the use of vague terms such as "some", "any", "allowable", "several", "many", "a lot of", "a few", "almost always", "very nearly", "nearly", "about", "close to", "almost", and "approximate".
- R26 - Avoid using unachievable absolutes such as 100% reliability or 100% availability.
- R33 - Define quantities with a range of values appropriate to the level stated.

- A13 – Unique Identifier*



			CHARACTERISTICS OF NEED AND REQUIREMENT STATEMENTS									SETS OF NEEDS AND REQUIREMENTS				
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
Accuracy	R01	Sentence Structure			1				1							
	R02	Use Active Voice			1				1							
	R03	Subject Verb		1	1				1			1				1
	R04	Use Defined Terms			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											
Non Ambiguity	R12	Correct Grammar			1						1					
	R13	Correct Spelling			1											
	R14	Correct Punctuation			1											
	R15	Logical Condition			1											
	R16	Avoid Not			1				1							
	R17	Oblique			1				1							
Singularity	R18	Single Sentence			1	1	1		1		1				1	
	R19	Avoid Combinators			1		1									
	R20	Avoid Purpose					1									
	R21	Avoid Parentheses					1									
	R22	Enumeration			1		1									
	R23	Context			1		1									
Completeness	R24	Avoid Pronouns			1	1			1							
	R25	Use Of Headings				1										
Realism	R26	Avoid Absolutes						1	1					1		
Conditions	R27	Explicit				1			1							
	R28	Explicit Lists			1				1							
Uniqueness	R29	Classify										1	1	1		
	R30	Express Once	1								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
	R37	Define Acronyms			1						1		1		1	1
	R38	Avoid Abbreviations									1		1		1	1
	R39	Style Guide				1	1				1		1		1	1
Modularity	R40	Related Requirements									1		1		1	
	R41	Structured										1	1		1	1

Requirements Quality Rules

- #1 Keep your requirements short and precise
- #2 Be consistent with the use of shall, must, will, can
- #3 Only one main action (shall) per requirement
- #4 Avoid passive voice (mind the subject)
- #5 Avoid vague adjectives and adverbs
- #6 Use vocabulary consistently
- #7 Use acronyms SMARTly
- #8 No problem with repeating a concept over and over (avoid pronouns and synonyms)
- #9 Keep the level of detail in mind
- #10 Be aware of negative requirements
- #11 Solution-free requirements
- #12 Atomicity vs completeness/consistency
- #13 Mind ambiguous terms
- #14 Use numbers and measurement units wisely
- #15 Be consistent with the structure (use patterns)

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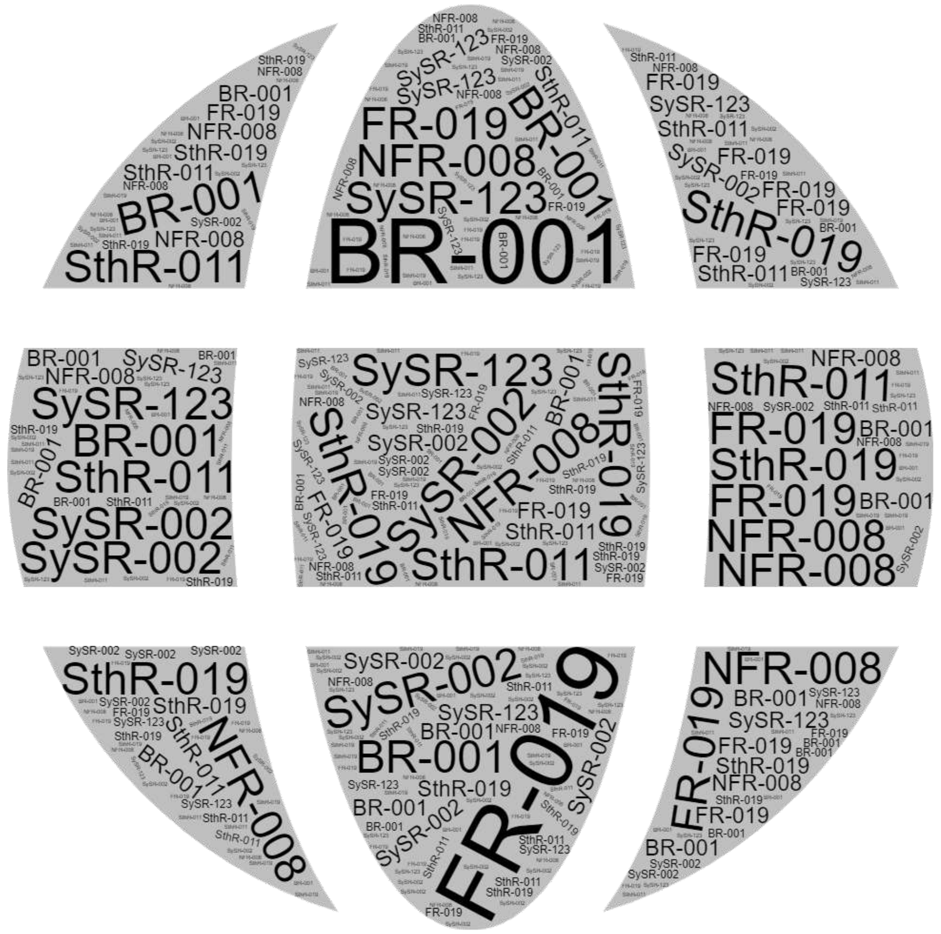
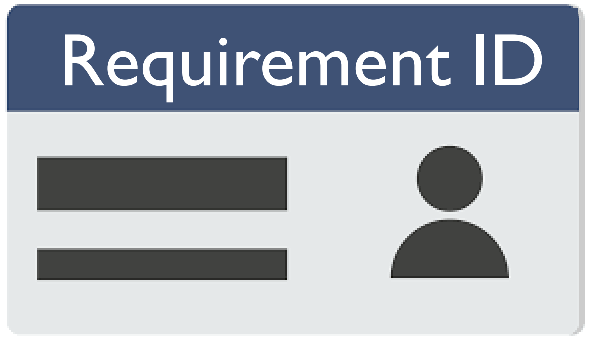
Rules based on Numbers

Rules based on numbers (1/5)





- They must be unique
- Always follow the same schema: e.g. SyR-xxx, SthR-yyy…
- Consistent across the document and documents
- Never modified once it's created
- Never reused: including after removals

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Rules based on numbers (2/5)

- Agree on the format for decimal numbers x.yyy,zz or x,yyy.zz : and keep this format along the documents
- Avoid numbers less than one as .99 or ,99. Use the 0 in front of the decimal sign instead 0.99 or 0,99
- Don’t forget the units:
  - ✗ “When the car speed reaches 120, the temperature of the oil shall be maintained over 90”
  - ✓ “When the speed reaches 120 mph…”, “…shall connect to at least 4 satellites in less than 10 seconds”
- Agree on a fixed form to express the units: e.g. “mph”, “miles per hour”
- Agree on a fixed system of measurement for the entire project: e.g. metric or imperial…
- In those cases where a magnitude is intentionally expressed in two different units, agree on the fixed format: e.g. “When the speed of the car is below 5 mph (8 km/h)…”
- Use the units consistently, the same magnitude for the same system element or parameter always using the same units: e.g. the amount of petrol always in *liters*, don’t use also *cm*^{3} randomly

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Rules based on numbers (3/5)

- Exact values are difficult to match/verify, use a way to deal with ranges and tolerances and use it consistently: e.g.
  - ✗ "When the car is stopped for more than 3 seconds, the temperature of the oil must be kept at 80°C"
  - ✓ "When the car is stopped for more than 3 seconds, the temperature of the oil must be at 80°C ±5%"
- Ranges should not be excessive: "80°C ±40°C", "80°C ±60%"…
  - ✗ … nor too tight: "80°C ± 0.1°C"
  - ✗ … range adapted to the level of detail of the document

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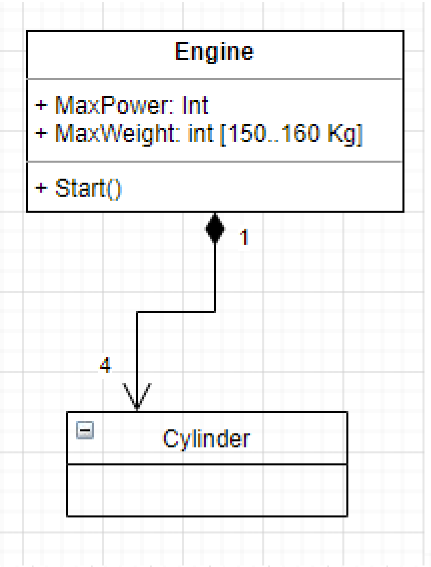
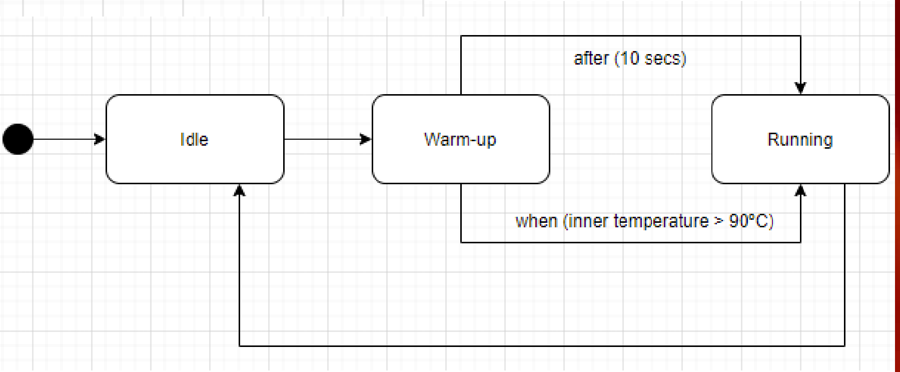
Rules based on numbers (4/5)

- Avoid expressions such as: "100% reliable", "100% available", "100% flexible", "maximize", "minimize" if you cannot guarantee it or verify it ✗
- Some verbal structures require to be quantified: e.g. "increase" or "reduce" in
  - ✓ "When the temperature exceeds 30°C the flow of air must be increased in 10%"
- Make sure boundary values are clearly defined: use "inclusive", "exclusive", "greater than or equal"…
- A number is always better than other quantifiers: some, most, few…
- And better than adverbs:
  - ✓ "… less than 2 seconds" better than
  - ✗ "…rapidly"

Rules based on numbers (5/5)

- Consistency between the values in your requirements, and the values in your models…
- … but this will be a topic for another webinar





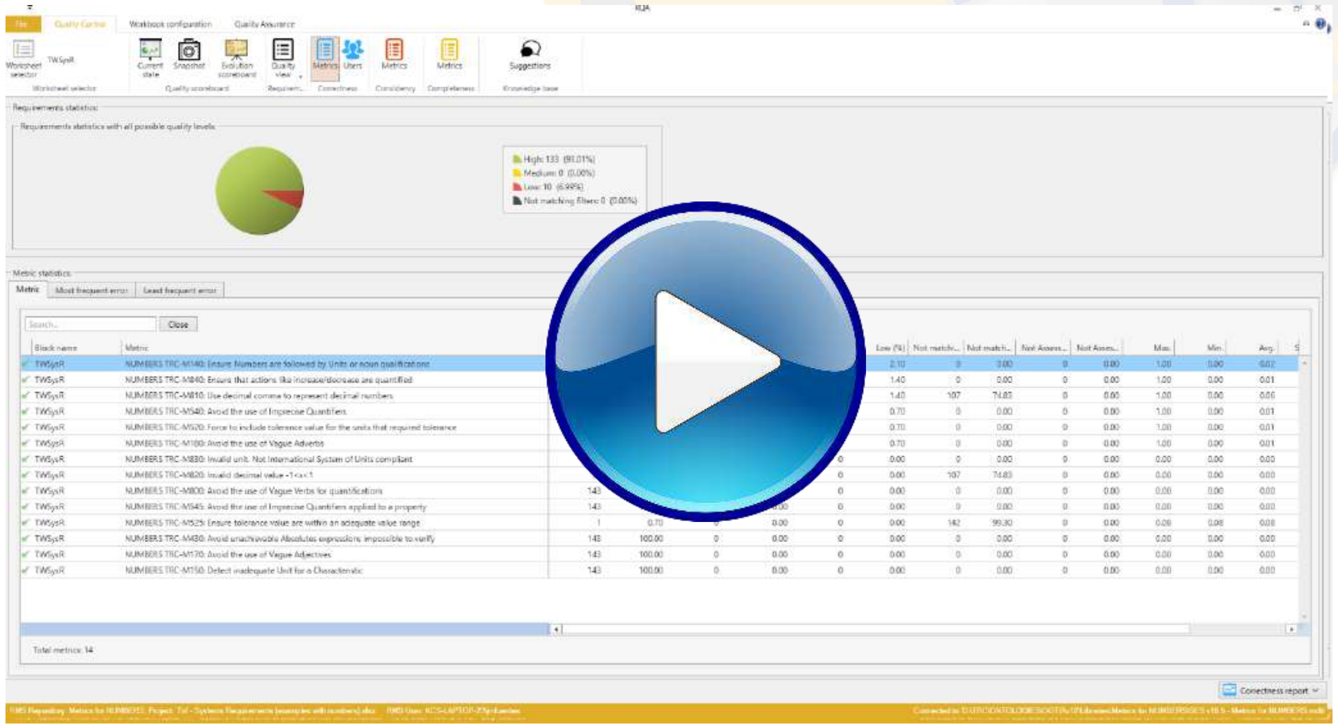
Checking quality of numbers

Demo

Metrics based on numbers : Use case #1

- **Use case #1:** Verbs that require quantification and other metrics
- **Steps:**

1. The **RQA – QUALITY Studio** is already connected to a formal module in DOORS
2. Analyze the level of correctness of a document
3. Detect wrong ways to write decimal numbers
4. Detect vague quantifiers
5. Detect those verbs that might require quantification and eventually don't include such quantification



Requirements statistics:

Requirements statistics with all possible quality levels

High: 133 (93.01%)
Medium: 0 (0.00%)
Low: 10 (6.99%)
Not matching filters: 0 (0.00%)

Metric statistics

Metric | Most frequent error | Least frequent error

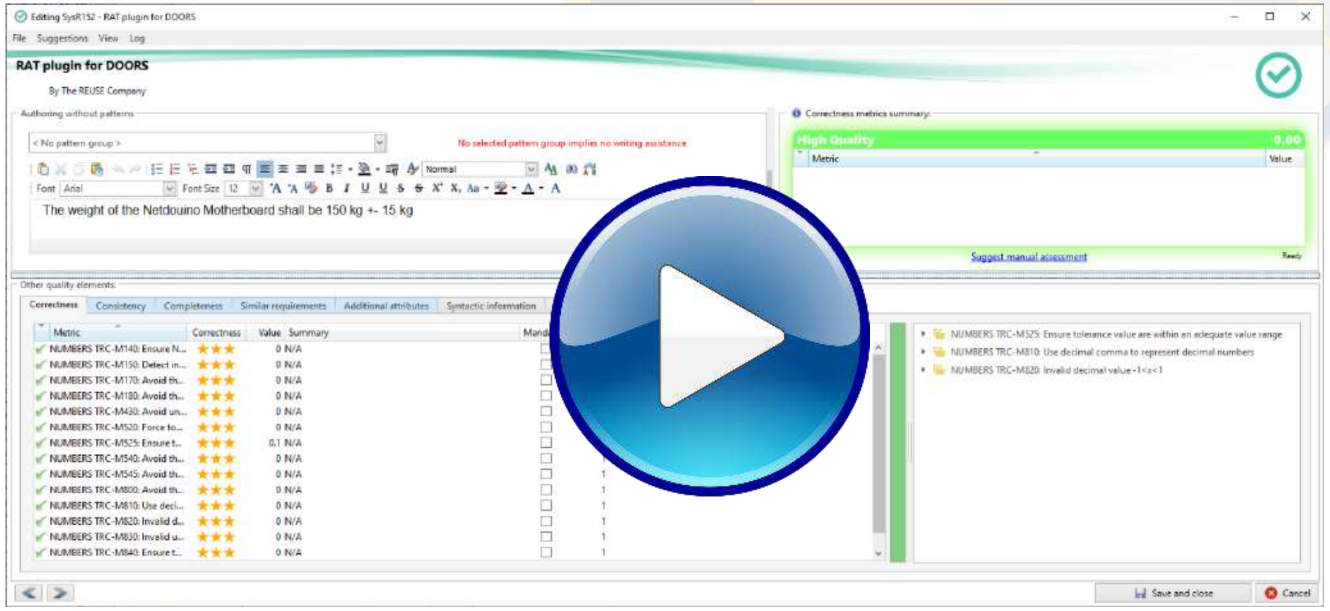
Block name	Metric						Low (%)	Not matchi...	Not match...	Not Assess...	Not Asses...	Max.	Min.	Avg.
TWSysR	NUMBERS TRC-M140: Ensure Numbers are followed by Units or noun qualifications	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.10	0	0.00	0	0.00	1.00	0.00	0.02
TWSysR	NUMBERS TRC-M840: Ensure that actions like increase/decrease are quantified	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.40	0	0.00	0	0.00	1.00	0.00	0.01
TWSysR	NUMBERS TRC-M810: Use decimal comma to represent decimal numbers	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.40	107	74.83	0	0.00	1.00	0.00	0.06
TWSysR	NUMBERS TRC-M540: Avoid the use of Imprecise Quantifiers	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.70	0	0.00	0	0.00	1.00	0.00	0.01
TWSysR	NUMBERS TRC-M520: Force to include tolerance value for the units that required tolerance	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.70	0	0.00	0	0.00	1.00	0.00	0.01
TWSysR	NUMBERS TRC-M180: Avoid the use of Vague Adverbs	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.70	0	0.00	0	0.00	1.00	0.00	0.01
TWSysR	NUMBERS TRC-M830: Invalid unit. Not International System of Units compliant	[illegible]	[illegible]	[illegible]	[illegible]	0	0.00	0	0.00	0	0.00	0.00	0.00	0.00
TWSysR	NUMBERS TRC-M820: Invalid decimal value -1<x<1	[illegible]	[illegible]	[illegible]	[illegible]	0	0.00	107	74.83	0	0.00	0.00	0.00	0.00
TWSysR	NUMBERS TRC-M800: Avoid the use of Vague Verbs for quantifications	143	[illegible]	[illegible]	[illegible]	0	0.00	0	0.00	0	0.00	0.00	0.00	0.00
TWSysR	NUMBERS TRC-M545: Avoid the use of Imprecise Quantifiers applied to a property	143	[illegible]	[illegible]	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00	0.00
TWSysR	NUMBERS TRC-M525: Ensure tolerance value are within an adequate value range	1	0.70	0	0.00	0	0.00	142	99.30	0	0.00	0.08	0.08	0.08
TWSysR	NUMBERS TRC-M830: Avoid unachievable Absolutes expressions; impossible to verify	143	100.00	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00	0.00
TWSysR	NUMBERS TRC-M170: Avoid the use of Vague Adjectives	143	100.00	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00	0.00
TWSysR	NUMBERS TRC-M150: Detect inadequate Unit for a Characteristic	143	100.00	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00	0.00

Total metrics: 14

Metrics based on numbers : Use case #2

- **Use case #2:** Numbers followed by units or entities
- **Steps:**

1. Open **RAT – AUTHORING Tools** as an add-on in DOORS
2. Edit a requirement that misses the units
3. Provide units (both valid, invalid)
4. Without and with tolerance
5. With an excessive value for the tolerance
6. With a correct value for the tolerance



No selected pattern group implies no writing assistance

The weight of the Netdouino Motherboard shall be 150 kg +- 15 kg

Metric	Correctness	Value	Summary	Mand	
✓ NUMBERS TRC-M140: Ensure N...	★★★	0	N/A	☐	
✓ NUMBERS TRC-M150: Detect in...	★★★	0	N/A	☐	
✓ NUMBERS TRC-M170: Avoid th...	★★★	0	N/A	☐	
✓ NUMBERS TRC-M180: Avoid th...	★★★	0	N/A	☐	
✓ NUMBERS TRC-M430: Avoid un...	★★★	0	N/A	☐	
✓ NUMBERS TRC-M520: Force to...	★★★	0	N/A	☐	
✓ NUMBERS TRC-M525: Ensure t...	★★★	0.1	N/A	☐	
✓ NUMBERS TRC-M540: Avoid th...	★★★	0	N/A	☐	
✓ NUMBERS TRC-M545: Avoid th...	★★★	0	N/A	☐	1
✓ NUMBERS TRC-M800: Avoid th...	★★★	0	N/A	☐	1
✓ NUMBERS TRC-M810: Use deci...	★★★	0	N/A	☐	1
✓ NUMBERS TRC-M820: Invalid d...	★★★	0	N/A	☐	1
✓ NUMBERS TRC-M830: Invalid u...	★★★	0	N/A	☐	1
✓ NUMBERS TRC-M840: Ensure t...	★★★	0	N/A	☐	1

Metric	Value

- NUMBERS TRC-M525: Ensure tolerance value are within an adequate value range
- NUMBERS TRC-M810: Use decimal comma to represent decimal numbers
- NUMBERS TRC-M820: Invalid decimal value -1<x<1

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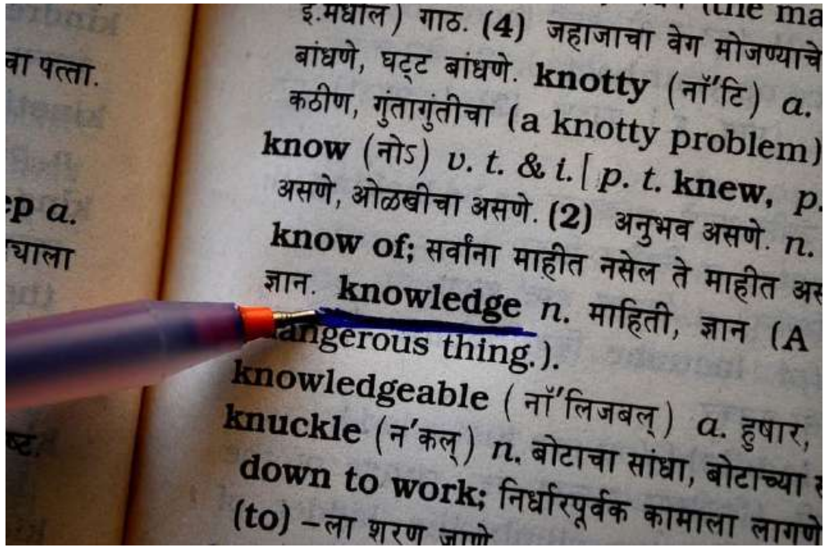
Next webinar



- **Knowledge Discovery Process: Automatic extraction of controlled vocabulary and relationships from legacy documentation (in 10 minutes)**
  - Getting into the most advanced quality rules (e.g. completeness, consistency and some advanced INCOSE Correctness metrics) requires some domain specific knowledge
  - Such knowledge might come from models, but also from legacy documentation
  - Learn how to populate domain dictionaries automatically from your legacy documentation
  - And all this in just 10 minutes, with the help of our *Knowledge Extraction* library
  - **Dates:** November the 30th and December the 2nd, 2021

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Q&A

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