the REUSE company

Capturing content for your Knowledge base

with KM, RQA and RAT

Webinar
Monday, December 19, 2016

Content

- Introduction to TRC and RQS
- Requirements quality: knowledge needs
- Collecting knowledge
- Live demo
- Q&A

Introduction

Introduction

the REUSE company

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@ReuseCompany

The REUSE Company (TRC)

Knowledge Centric Systems Engineering

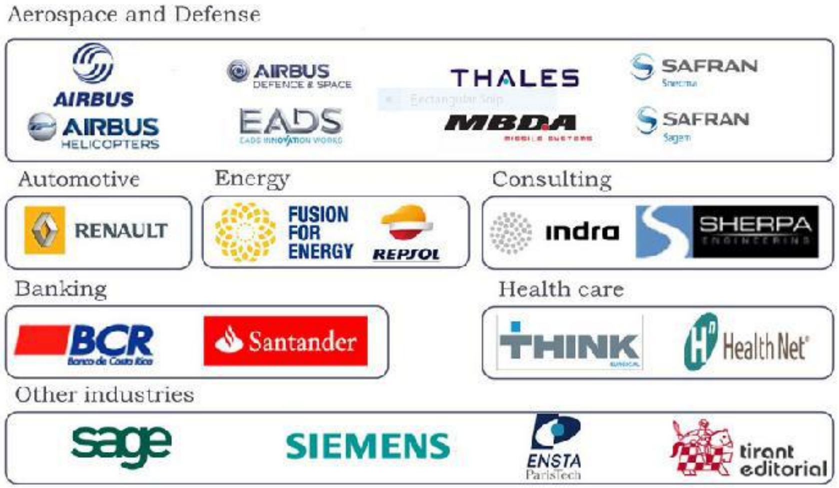
The REUSE Company is specialized in the application of **Semantic Analysis Technologies** to a wide range of industries (Aerospace, Defense, Automotive, Railway, Energy…)

Our main focus is on System/Software **Traceability, Reuse and Quality**. The integration of tools and technology from The REUSE Company facilitates the representation, analysis and exploitation of knowledge allowing for a knowledge-centric systems engineering approach.

Our mission is to promote system/software and knowledge reuse within any organization, by offering processes, methods, tools and services that make it possible. We offer technology that is fully integrated within the organization's production chain.

Innovative technologies applied to Systems Engineering

TRC main Customers



TRC - Our competences

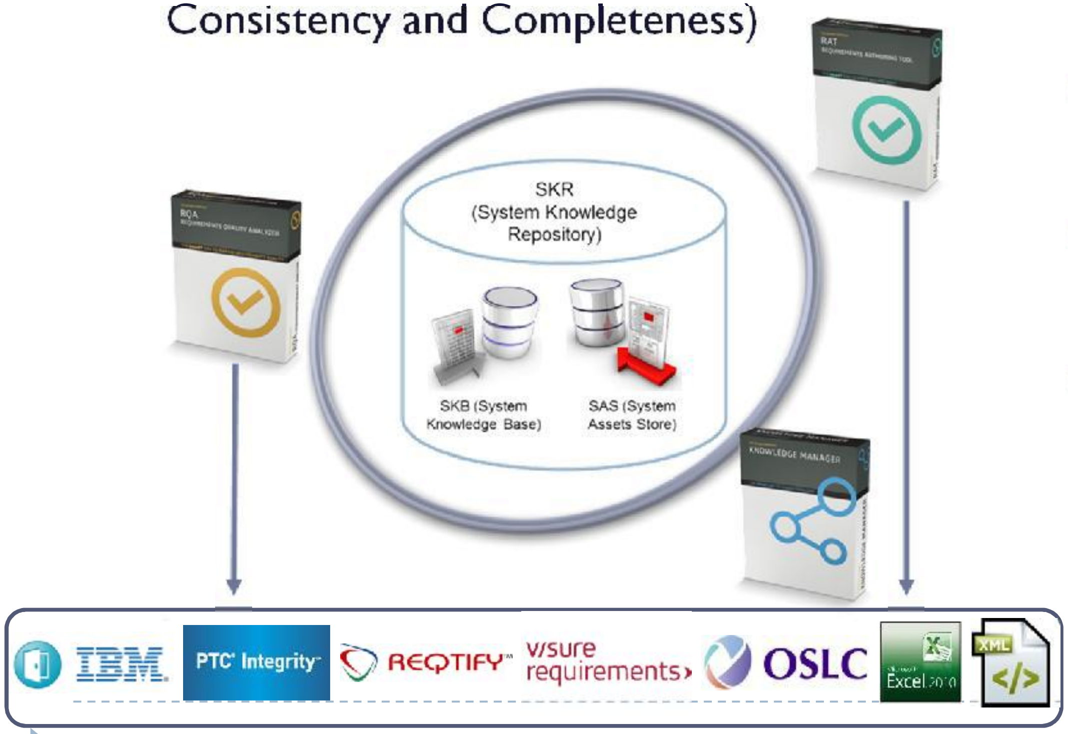
Trace + Retrieval + Quality

Towards systematic **Reuse**

By means of : **Repositories** containing **Ontologies and Assets**

RQS – Requirements Quality Suite

- The Requirements Quality Suite (RQS) intends to tackle requirements quality management by offering a set of tools and processes
- Automatic measurement of requirements quality metric
- Support to Requirements Authoring
- RQS models requirements quality metrics using the CCC approach (Correctness, Consistency and Completeness)

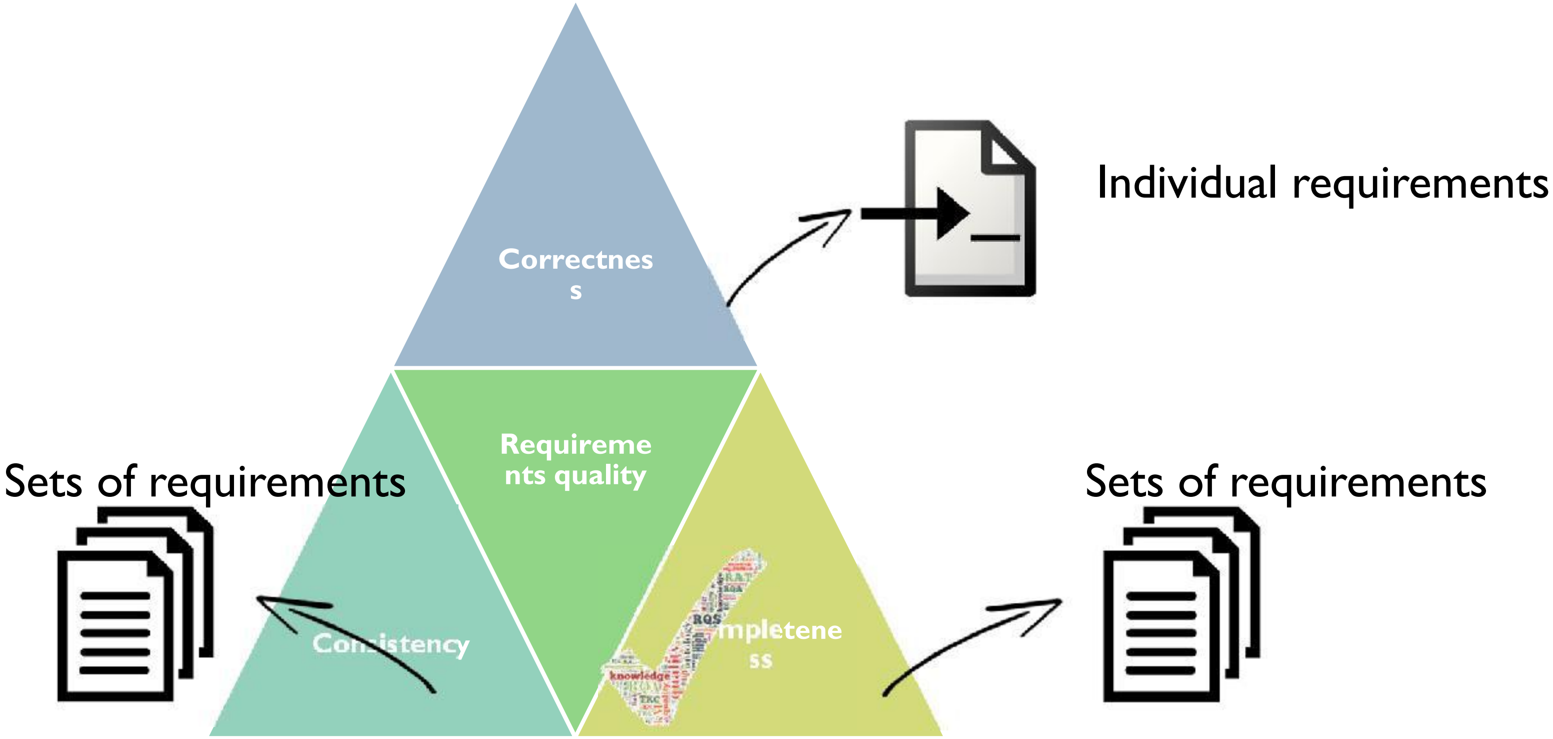


- **Requirements Quality Analyzer (RQA):** to setup, check and manage the quality of a requirements specification
- **Requirement Authoring Tool (RAT):** to assist authors while they are creating or editing requirements.
- **Knowledge Manager (KM):** to manage knowledge around a requirements specification: dictionaries, glossaries, concept maps, knowledge models, ontologies, patterns…

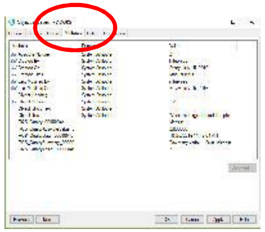
needs

Requirements quality metrics: knowledge needs

- CCC Requirements Quality Approach



Requirements quality metrics: knowledge needs for correctness



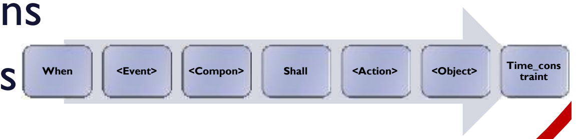
- Metrics based on information coming from the RMS:
  - Attributes, links, versions…
- Metrics based on lists of terms:
  - Forbidden: ambiguous…
  - Restricted: negations, pronouns…
  - Mandatory: 'shall'

- Metrics based on linguistic algorithms:
  - Text length, misspelling….
  - Detection of passive voice, imperative tense…

PRAGMATICS
SEMANTICS
SYNTAX
MORPHOLOGY
PHONOLOGY
PHONETICS
speech sounds
phonemes
words
phrases and sentences
literal meaning of phrases and sentences
meaning in context of discourse

- Metrics based on the conformance with models:
  - Concepts in your requirements coming from PBS, FBS…
- Metrics based on patterns:
  - Compliance with different types of requirements patterns
  - Detection of specific structures within the requirements

Domain specific knowledge



Requirements quality metrics: knowledge needs

- Consistency:
  - Are your requirements consistent with each other?
  - Are your requirements consistent with the models of your projects?
  - Do you have duplicated requirements in your specifications?
  - Are you using the proper measurement units in your requirements?
  - Are all the properties property allocated along the system decomposition?
  - …
  - **Consistency: requirements vs. knowledge base**
- Completeness:
  - Are all the expected requirements types involved in your specifications?
  - Are all the key concepts (from the ontology or from other models) properly covered?
  - Are your requirements properly linked? At the different levels?
  - Are all the properties stated for every system element?
  - …
  - **How requirements information covers the knowledge base**

Requirements quality metrics: knowledge needs

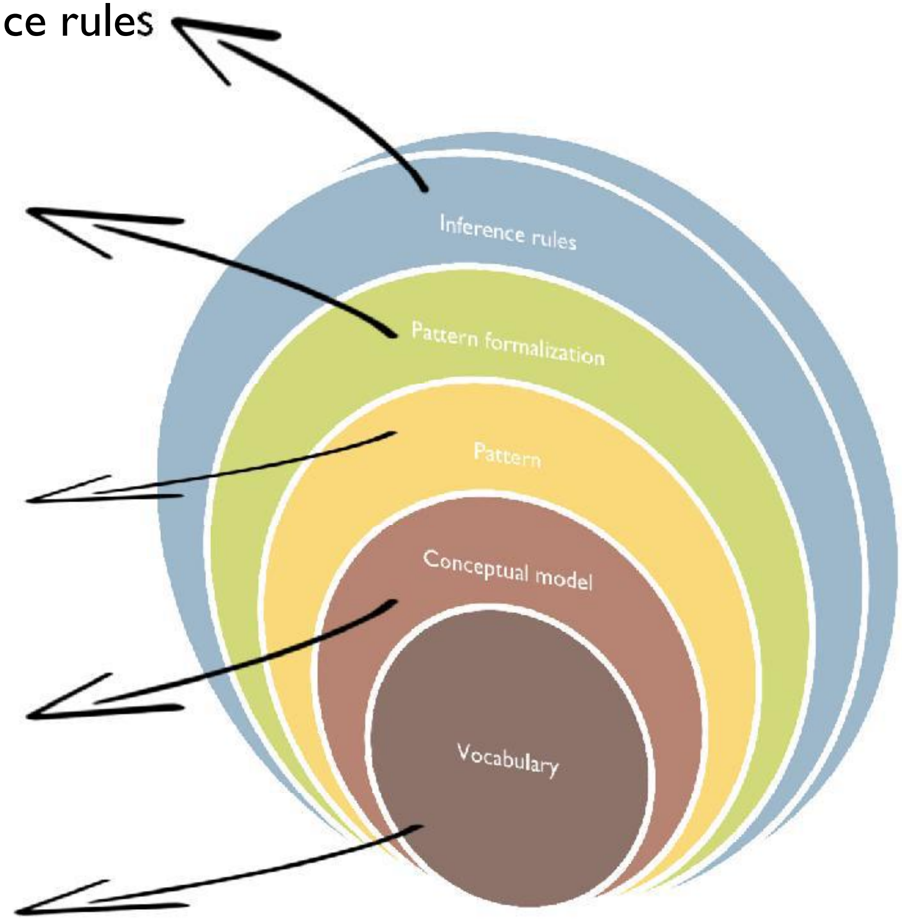
All RQS Metrics are mapped as Inference rules

Consistency metrics (most)
Completeness metrics (some)
Correctness metrics (few)
Semantic retrieval capabilities

Writing assistance (RAT)
Completeness metrics (some)
Correctness metrics (few)
Semantic retrieval capabilities

Completeness metrics (some)
Correctness metrics (few)
Semantic retrieval capabilities
Writing assistance

CCC Metrics (most)



SKB – System Knowledge Base

Collecting knowledge?

Knowledge collection: document analysis (archeology)

- Existing glossaries can be imported with KM: bulk insert of terms
- KM can analyze existing textual documents/specs and look for:
  - Most common terms: based on statistics
- Acronyms are easily identified: metric in RQA
- KM+RQA can use patterns to classify some of these common terms:
  - System names
  - Actions
- Synonyms detection based on patterns:
  - "… shall orbit the Second LaGrange Point (L2) …" → "Second LaGrange Point" ≈ "L2"
  - "…shall be correlated to Coordinated Universal Time (UTC) to …"
  - → "Coordinated Universal Time" ≈ "UTC"

Knowledge collection: document analysis (archeology)

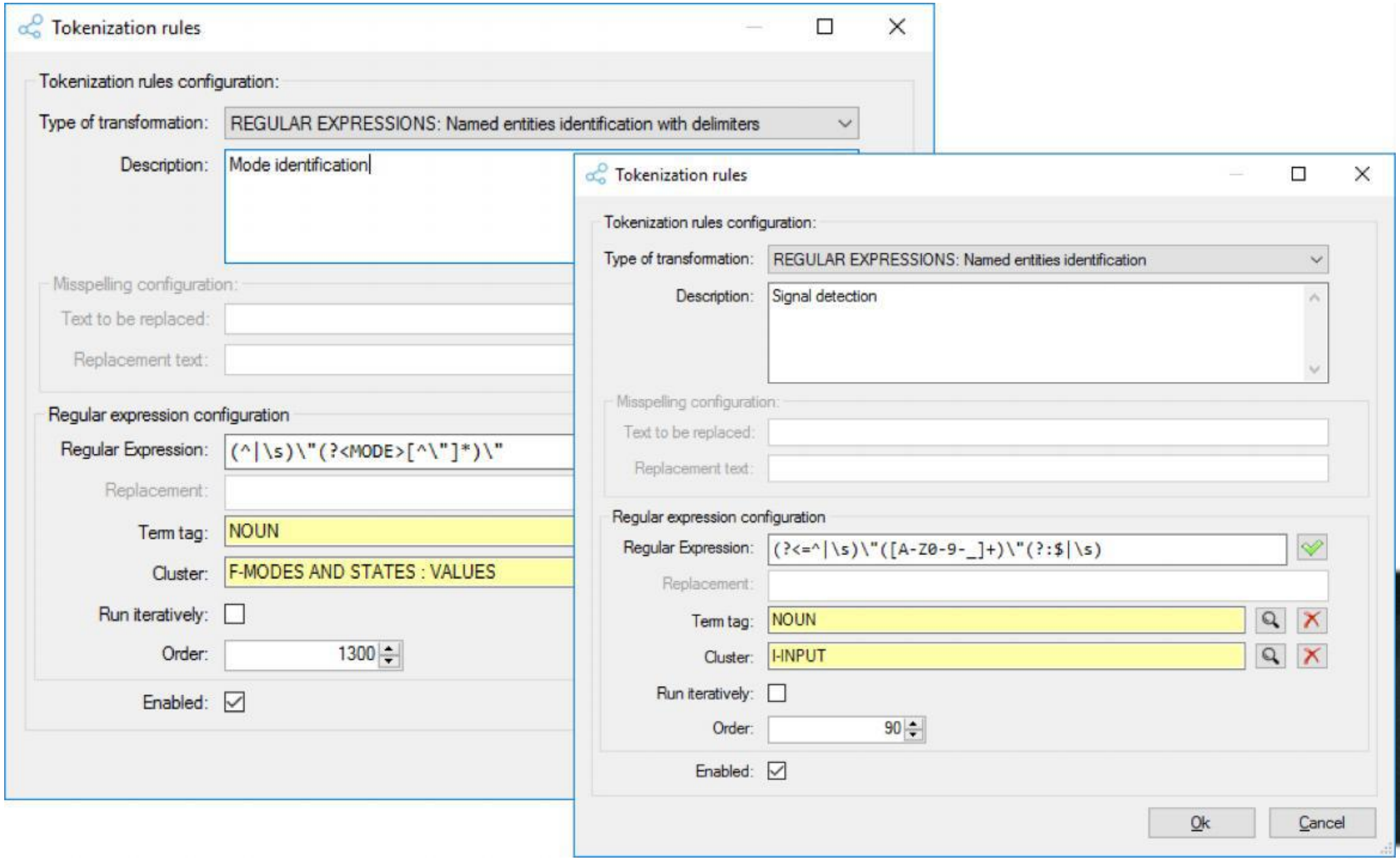
- Patterns can also be used to automatically generate knowledge graphs
- Knowledge graphs could be transformed into other short of models managed into External tools: e.g. SysML models
- E.g.:
  - "The ISIM shall contain a camera that provides …"
    - Composition relationship
  - "The Observatory shall utilize the Deep Space Network to communicate with the Ground Segment"
  - "The operational JWST system shall utilize the Deep Space Network (DSN)"
    - Interface relationship
- Extraction of physical and quality characteristics:
  - "The JWST Observatory wet mass shall not exceed 6,159 kilograms
  - "The ISIM mass allocation shall be 1,505 kilograms"
  - "The reliability of the ISIM shall be greater than or equal to .758."

Knowledge collection: regular expressions

- Easy mechanism to pick special elements from any textual source
  - Signal names: e.g. (?<=^|\s)\"([A-Z0-9-_]+)\"(?:$|\s)
  - Quoted items:
    - "([a-zA-Z0-9_-])+“
    - (^|\s)\"(?<QUOTED>[^\"]*)\“
  - Some other special (important) keywords: e.g. references to other applicable documents and standards:
    - JWST-PROC-000654, RQMT-002558, JWST-OPS-002018 …
    - GEVS-STD-7000, IEC 60027-2

Knowledge collection: regular expressions

- Easy mechanism to pick special elements from any textual source



Tokenization rules

Tokenization rules configuration:

Type of transformation: REGULAR EXPRESSIONS: Named entities identification with delimiters

Description: Mode identification

Misspelling configuration:

Text to be replaced:

Replacement text:

Regular expression configuration

Regular Expression: `(^|\s)\"(?<MODE>[^\"]*)\"`

Replacement:

Term tag: NOUN

Cluster: F-MODES AND STATES : VALUES

Run iteratively: □

Order: 1300

Enabled: ☑

Tokenization rules

Tokenization rules configuration:

Type of transformation: REGULAR EXPRESSIONS: Named entities identification

Description: Signal detection

Misspelling configuration:

Text to be replaced:

Replacement text:

Regular expression configuration

Regular Expression: `(?<=^|\s)\"([A-Z0-9-_]+)\"(?:$|\s)` ✓

Replacement:

Term tag: NOUN

Cluster: I-INPUT

Run iteratively: □

Order: 90

Enabled: ☑

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Knowledge collection: suggestions from authors and quality teams

- When RAT and RQA users are reported low quality for a requirements…
- … they might think that the problem is <u>not</u> the requirement, but the dictionaries
- Suggestions can be send from RAT/RQA:
  - Terms
  - Relationships
  - Patterns
- And evaluated by knowledge architects in KM:
  - To accept vs decline
  - To influence thus the quality of the requirements

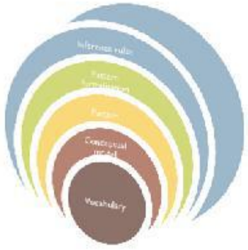
Knowledge collection: unknown vocabulary items

- Terms still unknown to the system can be gathered:
  - By means of the *misspelling* metric
  - By checking our <UNCLASSIFIED_NOUN> term tag

- RQA allows the creation of metrics for both types of methods
- … and the suggestions to add the relevant ones into the ontology

Knowledge collection: fully manual

- Subject matter experts
- Knowledge at all levels of the SKB:



- Last resort: time consuming
- Knowledge Manager allows to address all these levels:

- But also RQA and RQS Server can deal with some types of info:
  - Special sentences for correctness
  - Plain dictionaries of nouns and verbs
  - Default magnitudes

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