



# Webinar

Wednesday, August 2, 2017

**Host:** José Fuentes

## Content

- Introduction to TRC and RQS
- Public tenders: how customer needs are collected
- A semantic approach applied to a tendering process
- Semantic tools to help during the tender process
  - Vocabulary extraction
  - Extraction of needs and requirements from textual documents
  - Requirements quality analysis
  - Needs vs Requirements matching
  - Needs clustering
- Live demo
- Q&A



# Introduction



## TRC - Our competences



T<sub>(he)</sub> R<sub>(euse)</sub> Q<sub>(ompany)y</sub>

**Trace + Retrieval + Quality**

**Towards systematic Reuse**

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

# About ULMA

We offer specialized consulting, design, development & test services along the whole embedded product lifecycle

SYSTEMS ENGINEERING  
SOFTWARE  
HARDWARE  
PROGRAMMABLE LOGIC

Focused on *Safety Critical*  
applications

RAILWAY  
MEDICAL  
ENERGY  
AUTOMOTIVE  
INDUSTRIAL

Team

20 ENGINEERS



Located in Oñati  
- SPAIN

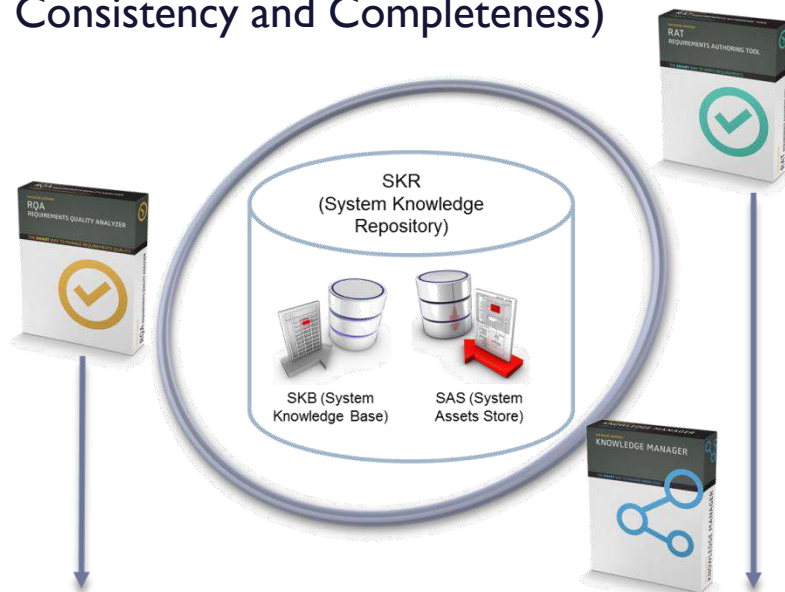
PART OF ULMA GROUP





## 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...

A close-up photograph of two business people in suits. One person's hand is shaking the other's, while a third hand holds a tablet computer nearby. The background is blurred, suggesting an office or meeting environment.

Improving public tender requirements analysis  
and asset matching



## Scenario setting



- **Objective:** provide a bid after analyzing the public tender
- Analysis includes performing an asset gap analysis to determine
  - What needs to be developed
    - In-house
    - Subcontracted
  - What can be reused
    - Equipment
    - Requirements
    - Tests
    - Code
    - Documentation
    - Blueprints
    - Schematics
    - Etc.

## Tasks to perform during analysis



- **T1 Parsing the public tender**
  - Break it down into a manageable requirements document
  - Make it ready to be analyzed and compared
- **T2 Cluster the requirements:** Allocate requirements to one or more teams or departments so they can further analyze them to:
  - Detect inconsistencies, errors and incoherencies
  - Estimate development effort: time and effort
- **T3 Match assets and perform gap analysis:**
  - Determine if we can reuse any of our existing assets in this new opportunity
    - Have we done similar systems before?
    - How compliant are we?
    - Do our existing systems need additional but minor functionality?
    - Are required functionalities available through configuration of our existing equipment?
  - Identify gaps, systems and artifacts we haven't done before
    - Can we scope them fast enough to determine if they are going to be developed in-house or subcontracted? If the latter, could we get estimates from subcontractors before we bid?

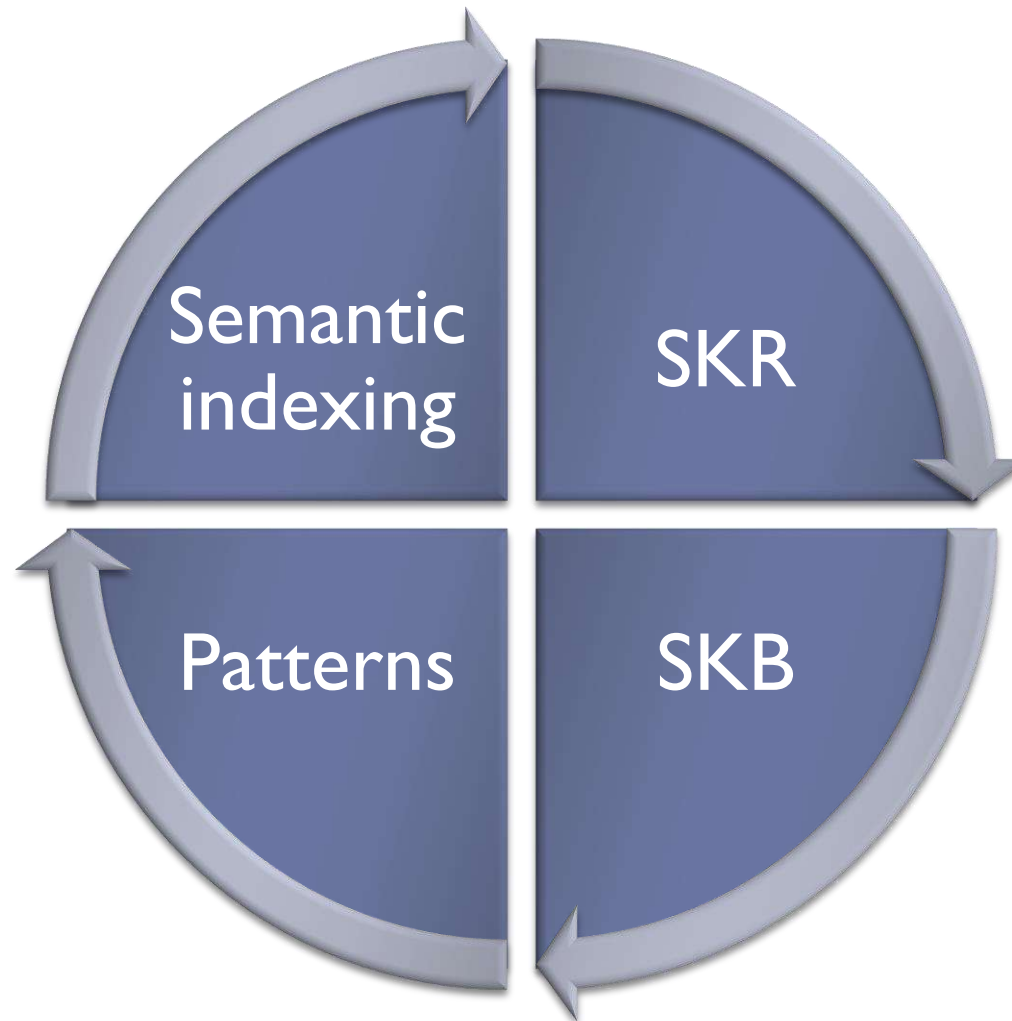
# Knowledge Centric Approach

*Semantic techniques*





## Knowledge Centric Approach: the key concepts



## Requirements quality metrics: knowledge needs

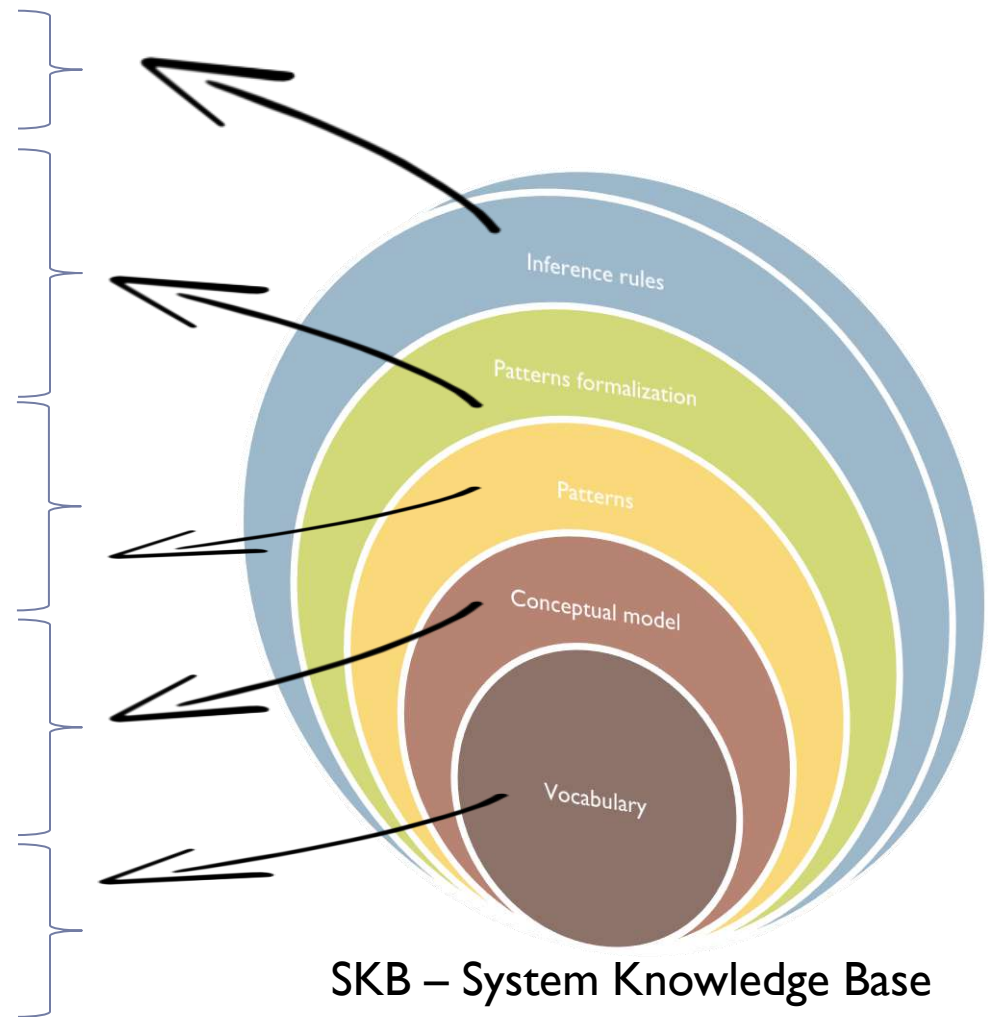
To provide advanced reasoning

To make information understandable by computers: quality, retrieval...

To identify structures in requirements and textual documents

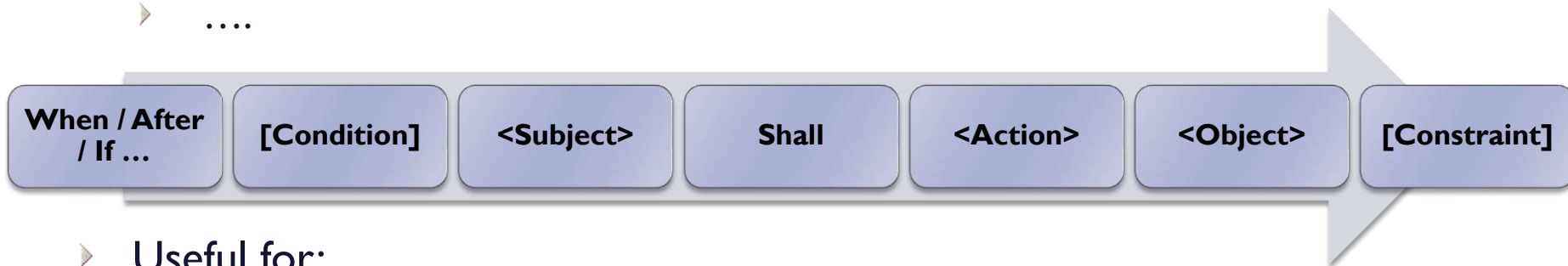
Terms are linked together and clustered according to business relationships

Common terms, forbidden terms, domain specific terms...



## Requirement templates: for individual requirements

- Different names for ‘almost’ the same “thing”:
  - Requirement templates
  - Statement level template
  - Boilerplates
  - Requirement patterns
  - ....



- Useful for:
  - Requirements identification
  - Vocabulary gathering
  - Requirements matching
  - Requirements quality checking



## Controlled Vocabulary

A380

A350

System

Operate

Temperature

Environment

Pressure

Shall

At a minimum

Of

## Thesaurus

Temperature

“ Operation Range “

[-60°C , +60°C]

Environment

Temperature

Pressure

&lt;&lt;Minimum&gt;&gt;

At a minimum

&lt;&lt;Operation&gt;&gt;

Operate

Work

&lt;&lt;Aircraft&gt;&gt;

A380

A350

“ Greater than (&gt;) “

“ Lower than (&lt;) “

## Patterns

&lt;&lt;Aircraft&gt;&gt;

Shall

&lt;Operation&gt;

At

&lt;&lt;Minimum&gt;&gt;

Environment

Of

NUMBER

[MEASUREMENT UNIT]

## Formalizations

The aircraft shall be able to operate at a minimum temperature of -70° C

temperature

“ Greater than (&gt;) “

-70

°C

## Inference Rules

If

NUMBER

“ Lower than (&lt;) “

-60°

°C

||

NUMBER

“ Greater than (&gt;) “

+60°

°C

→



## Semantic indexing process



- Tokenization



- Normalization



- Disambiguation



- Pattern matching

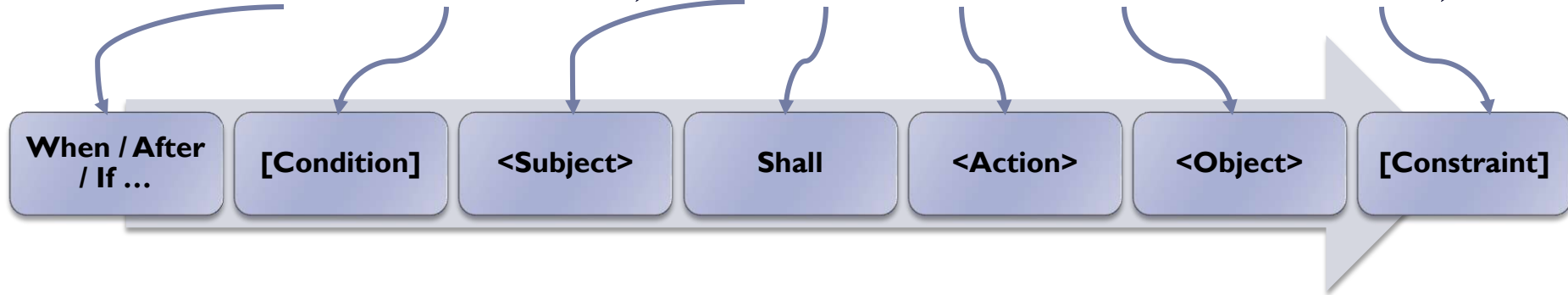


- Formalization

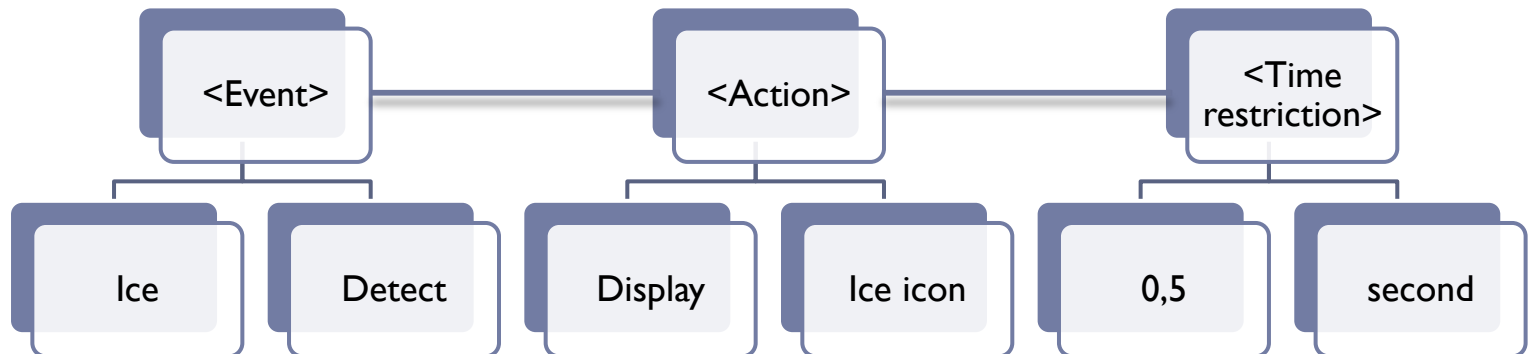
## Semantic indexing process

### ► Inputs and outputs:

SR0254: “When ice is detected, the car shall show an ice icon in less than 0,5 s”



### Semantic formalization (output):



A close-up photograph of two business professionals in a meeting. One person, wearing a dark suit, is shaking the hand of another person who is wearing a light blue shirt. In the background, a hand is holding a tablet computer. The scene is set in a professional office environment with a blurred background.

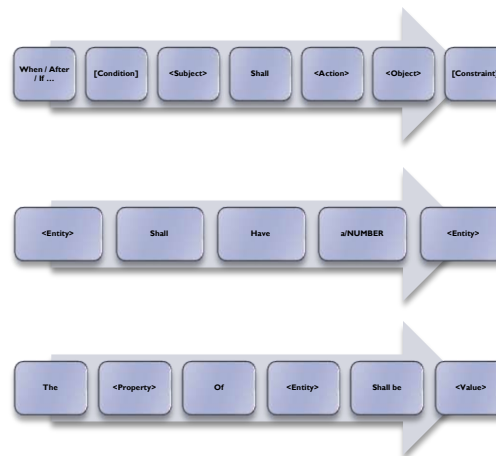
**Applying a semantic approach  
to a tendering process**

## Applying a semantic approach: vocabulary extraction

- Sharing a key vocabulary among all parties is key:
  - Using glossaries from the tender document
  - Based on semantic indexing and frequencies
  - Based on patterns: to provide additional meaning (semantic) and accuracy to the extraction

## Applying a semantic approach: extraction of needs

- Based on semantic patterns:



integrity™



**ReqIF**  
Requirements Interchange Format

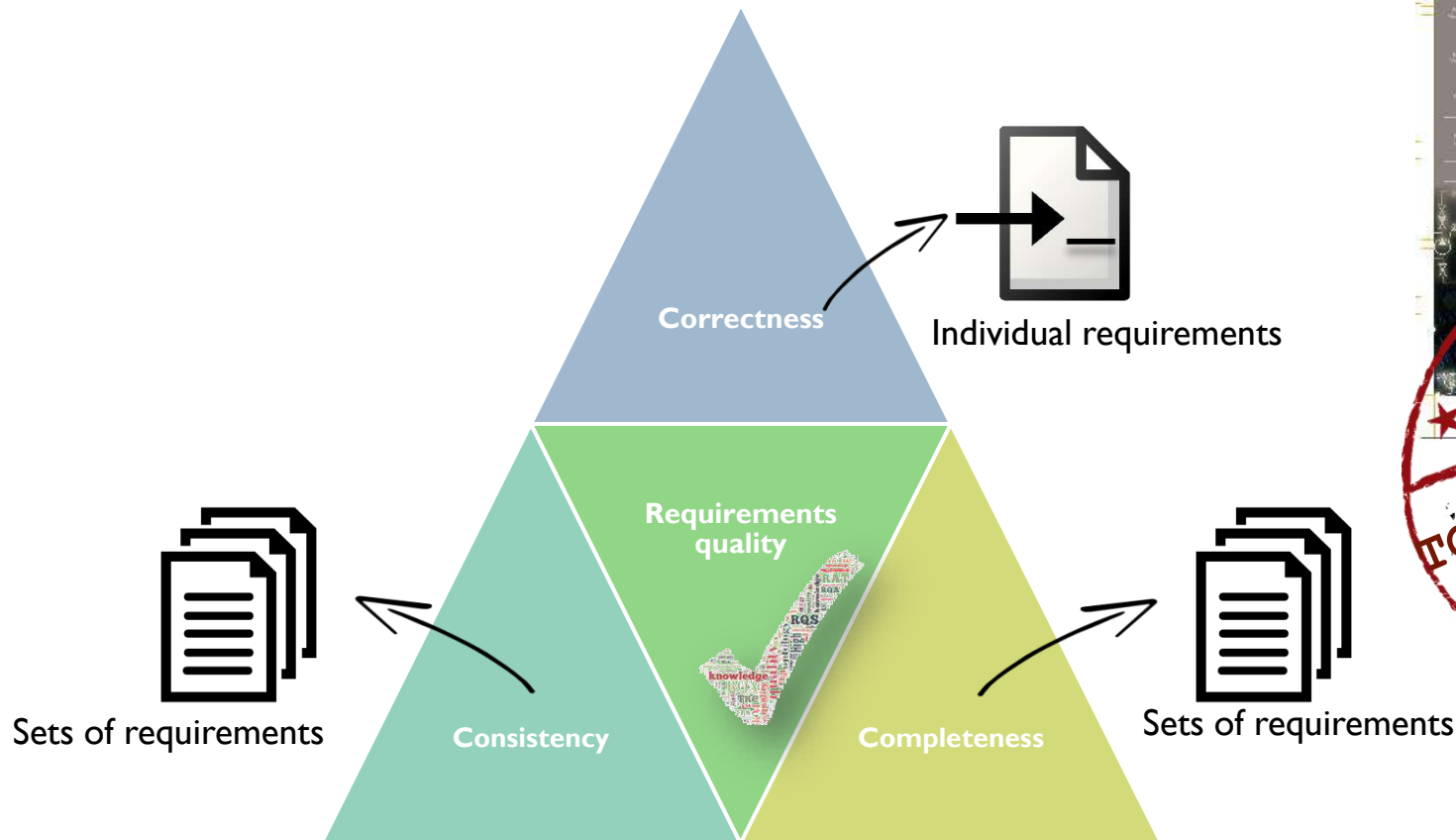


... and more



## Applying a semantic approach: requirements quality analysis

- CCC – Correctness, Consistency and Completeness

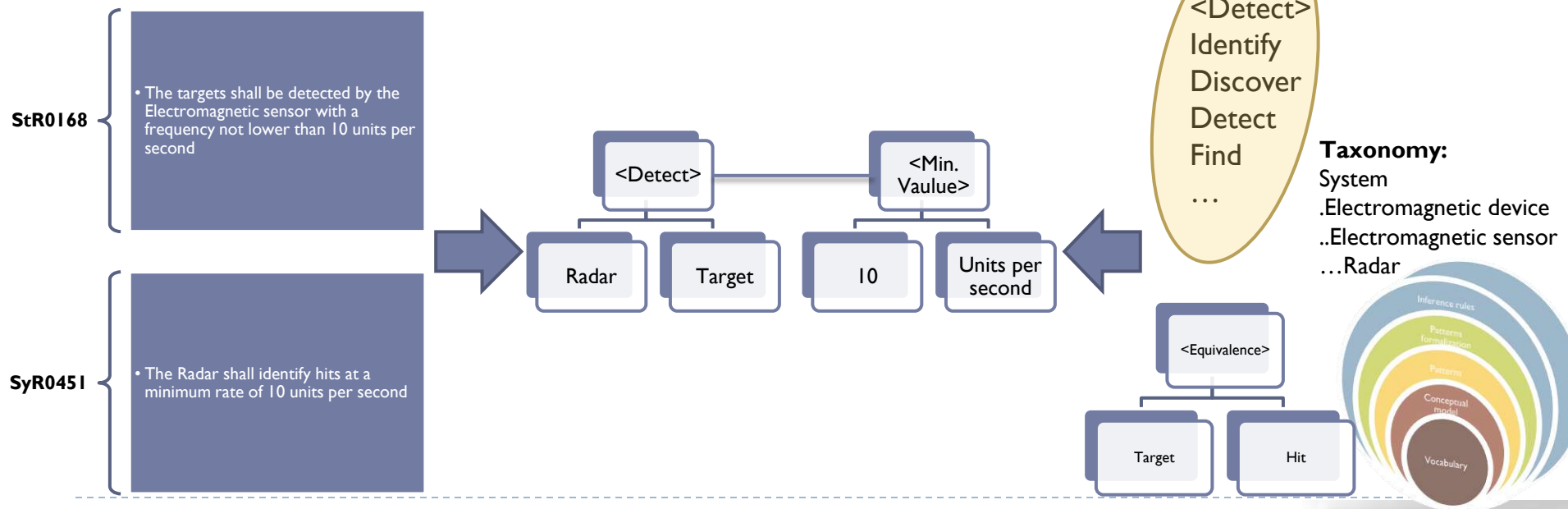


## Applying a semantic approach: Needs vs Requirements matching

- Based on patterns, formalization and knowledge bases:

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

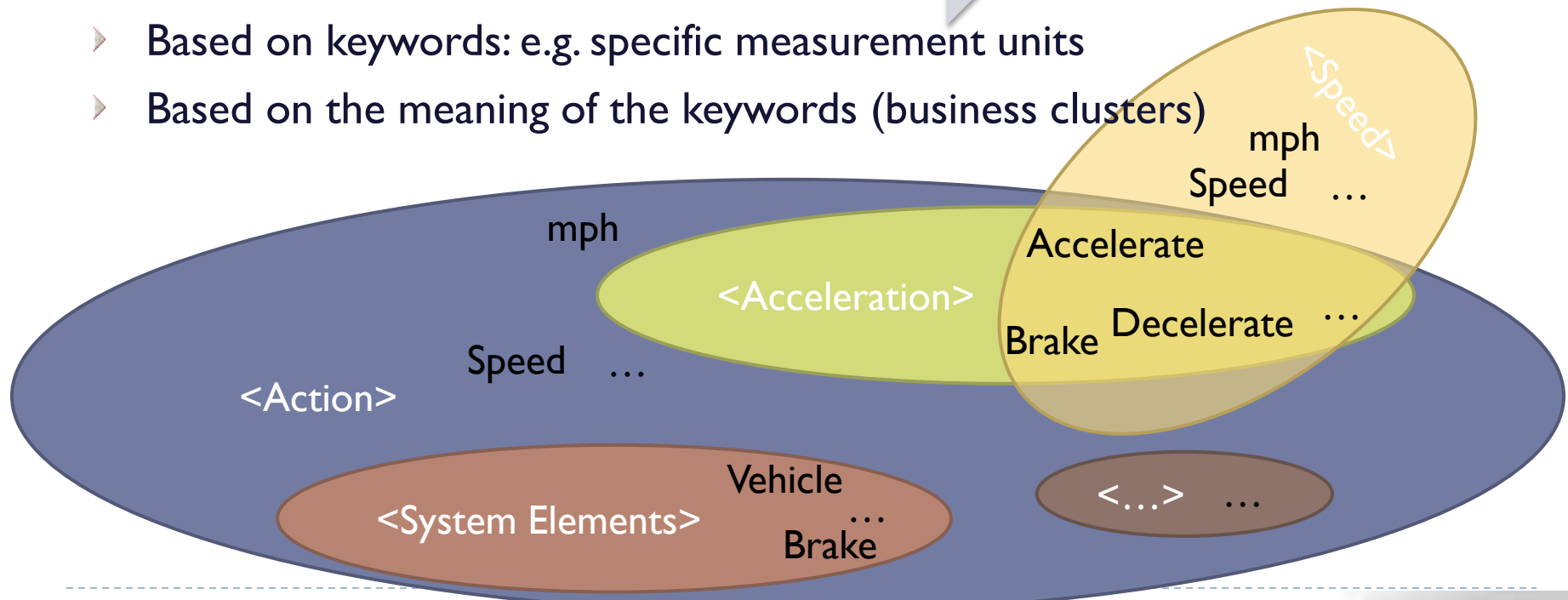


## Applying a semantic approach: clustering

- Based on the structure of the requirement (pattern): e.g. structural



- Based on keywords: e.g. specific measurement units
- Based on the meaning of the keywords (business clusters)



## Conclusions: leveraged activities and techniques

- Knowledge management: common understanding with shared vocabularies
- Requirements tagging and extraction
- Quality checking of individual requirements: CCC approach
- Identification of gaps: to ask for clarifications...
- Requirements vs. Needs matching: leveraging reuse activities
- Requirements clustering: to streamline the tender review process

## Conclusions: benefits for buyer and bidder

### ➤ For the buyer:

- **REDUCE RISKS**
- Common understanding
- High quality projects
  - Cross-checking of inconsistencies among different tenders (SoS)
- Reduce overall costs

### ➤ For the bidder:

- **REDUCE RISKS**
- Common understanding
- High quality specifications
- Reduce project cost
  - More reuse
  - Less re-work



## Live demo

Requirements Quality Analyzer

File Quality Control Project configuration Quality Assurance

Module selector: STRS

Requirements: Simple view Quality view Full view

Correctness Users Charts Metrics Metrics Suggestions Knowledge base

Requirements:

ID	Text	Correctness	Score	Mand...	Correctness qualit...	Consistency	Issues
StR1	The altitude resolution is equal to or less than	★ ★ ★	2.85	0	21/03/2017 12:51:...	★ ★ ★	N/A
StR2	The pressure altitude from an approved s... controller	★ ★ ★	2.85	0	21/03/2017 12:51:...	★ ★ ★	N/A
StR3	The system shall warn the air traffic con...	★ ★ ★	2.85	0	21/03/2017 12:51:...	★ ★ ★	N/A
StR4	The pilot shall be able to light the inter...	★ ★ ★	3.57	0	21/03/2017 12:51:...	★ ★ ★	N/A
StR5	The engine shall provide enough powe...	★ ★ ★	2.85	0	21/03/2017 12:51:...	★ ★ ★	N/A
StR6	The air traffic controller shall be warn...	★ ★ ★	3.57	0	21/03/2017 12:51:...	★ ★ ★	N/A
StR7	The dashboard shall warn the pilot abo...	★ ★ ★	3.57	0	21/03/2017 12:51:...	★ ★ ★	N/A
StR10	There shall be a button in the dashboa...	★ ★ ★	4.28	0	21/03/2017 12:51:...	★ ★ ★	N/A
StR11	The aircraft should quickly allow the rem...	★ ★ ★	2.85	0	21/03/2017 12:51:...	★ ★ ★	N/A
StR43	The maximum speed of the aircraft shall be 90...	★ ★ ★	3.33	0	21/03/2017 12:51:...	★ ★ ★	N/A
StR13	The maximum speed of the aircraft shall be 900 mph (1448 km/h)	★ ★ ★	2.66	0	21/03/2017 12:51:...	★ ★ ★	N/A
StR14	The maximum speed of the aircraft shall be 900 mph (1600 km/h)	★ ★ ★	2.00	0	21/03/2017 12:51:...	★ ★ ★	N/A
StR31	TBD	★ ★ ★	20.00	1	21/03/2017 12:51:...	★ ★ ★	N/A
StR32	When the speed of the car is above 5 mph (8 Km/h) the passengers shall not be allowed to o...	★ ★ ★	2.00	0	21/03/2017 12:51:...	★ ★ ★	N/A
StR34	The fire alarm shall be activated when the temperature is over 100 degrees	★ ★ ★	2.85	0	21/03/2017 12:51:...	★ ★ ★	N/A
StR33	The aircraft shall be white	★ ★ ★	2.85	0	21/03/2017 12:51:...	★ ★ ★	N/A
StR35	The aircraft shall have flaps	★ ★ ★	4.28	0	21/03/2017 12:51:...	★ ★ ★	N/A
StR36	The aircraft shall have 2 wings	★ ★ ★	4.66	0	21/03/2017 12:51:...	★ ★ ★	N/A

Total requirements: 22

Reports Assess CCC for the whole specification View quality details

RMS Repository: 36677@localhost; Project: Webinar examples RMS User: jmfuentes Connected to 'C:\Program Files (x86)\The REUSE Company\Requirements Quality Suite Server\RQS v15.1 (English).mdb'





