Tool Vendor Challenge
Disaster relief… provide ice
A ontology based approach
Case study summary

Disaster relief challenge… provide ice:

- A natural disaster has devastated a huge area of land
- 15,000 people have lost their homes
- No electricity and impassible roads
- Shelter must be provided for them in less than 24 hours
- Power, water, food and ice must be provided !!!

Option1: making

Option2: procuring
Global architecture of the challenge

RMS
- RQs (Functional)

RM DB

SKB

REUSE Studio
- Asset management

UML Models
- SysML models (Use Cases, Components)
- Risks
- Requirements

OSLC Interoperability bus

RQS
- Domain Expert
- Quality Manager
- Analyst

KM
- Terms
- PBS
- RQs Patterns
- Compliance rules

RQA
- RQs quality Metrics

RAT
- RQs (Functional) with quality on the fly

swREUSER
- Requirements
- Risks
- UML/SysML
- Semantic I&R

SKB

RQS: Requirements Quality Suite
- RAT: Requirements Authoring Tool
- RQA: Requirements Quality Analyzer
- KM: Knowledge Manager

RMS: Requirements Management Tool

SKB: System Knowledge Base

Repository
Role
Tool
Data flow Or
Data Relation
Global architecture of the challenge

- Repository:
  - SKR: System Knowledge Repository
  - SKB: System Knowledge Base
  - Asset store: semantic representation of all the indexed assets
Global architecture of the challenge

- SKB – Systems Knowledge Base

- Terminology layer
- Thesaurus layer
- Patterns layer
- Formalization layer
- Inference layer
Global architecture of the challenge

- **SAS – Systems Assets Store**

  - All the artifacts generated during a project are represented (formalized) as semantic graphs and stored in this repository
  - This allows:
    - Further analysis of the assets (e.g. consistency analysis of requirements…)
    - Semantic retrieval and reuse of assets
    - All different types of assets represented using the same metamodel

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**Formalization example**

UR0258: The shelter shall provide enough power for 15000 people
Stakeholder identification and information management plan
Information management: a semantic approach

- Every asset will be managed into a centralized semantic repository
- Services of the repository:
  - Assets indexing
  - Assets retrieval and reuse
  - Semantic search engine for external sources
- E.g. this plan will be stored into the repository as an asset for further reuse
Information management: a semantic approach

- Look for a suitable ontology and merge
Knowledge reuse

- Procurement management:
  - Reusing experiences from previous bids is of vital importance
  - Importing a suitable vocabulary related to public contracts:
    - NICS-North American Industry Classification System (US)
    - CPV-Common Procurement Vocabulary 2008 (EU)
    - UNSPSC
    - NACE
    - ...
  - Extracting metadata from a catalog of previous bids allows to reuse experiences, requirements… A semantic tool can easily gather this metadata
Knowledge reuse

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Knowledge reuse

Procurement management:

Public contract:
- Title: xxxx
- Published by: yyy
- Publication date: xx.xx.xx
- Deadline: yy.yy.yy
- Notice type: ...
- Abstract: xxxxxxx

Metadata
Publisher: yyy
Date: xx.xx.xx
...

Requirements
Risk management and reuse
Risk management and reuse

- Mitigation actions from previous projects can be reused
Risk management and reuse

- Valuable information is used for tradeoff analysis
Requirement management along the “V” model
Reusing existing requirements: coarse-grained
Reusing existing elements: “Fine-grained” reuse
Reusing existing elements: “Fine-grained” reuse

- Semantic retrieval and reuse of requirements based on semantic graphs:

```
UR044: The Fridge shall make ice at a minimum rate of 10 units per second

UR852: Ice cubes shall be provided by the refrigerator device sensor at a frequency not lower than 10 units per second

Semantic equivalences:
Identifies
Find
Distinguish
Discover
...
```

Diagram:

- UR044
- UR852
- Fridge
- Ice
- <<Minimum Value>>
- 10
- Units per Second
- SKR
- System Knowledge Repository

Synonyms:
- Electromagnetic sensor
- Electromagnetic device
- System
- Lidar
...

Synonyms:
- Target
- Echo
...

<<Make>>

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Requirements Quality Checking

- CCC quality approach for the reused requirements:
  - Correctness, Consistency and Completeness
Requirements Quality Checking

- CCC quality approach for the reused requirements
  - Correctness analysis based on more than 50 metrics
  - Metrics aligned to the INCOSE Requirements Guide Rules

- Metrics for consistency:
  - Consistency among the different requirements into an specification
  - Among different levels of requirements in the same project
  - Between requirements and models
    - ...

- Metrics for completeness:
  - Is all the needed information provided for every requirement according to the agreed upon patterns and requirements types?
  - Are all the elements depicted in the models described in the requirements
    - ...

Authoring new requirements

- Authoring a new requirement with RAT: correctness checking
Authoring new requirements

Authoring a new requirement with RAT: writing assistant
Authoring new requirements

- Authoring a new requirement with RAT: writing assistant based on patterns

[Diagram showing the structure of a requirement, with components and actions represented by arrows and verbs.]
Check for inconsistencies within the specification
Pattern based completeness

[Diagram showing relationships between User Requirements, System Requirements, and Acceptance Tests]

Completeness report: boilerplates

- User Requirements
- System Requirements
- Acceptance Tests

Number of boilerplate groups: 31
Number of boilerplates: 44
Ontology based completeness

- Ontology represented as a taxonomy of concepts
- After a semantic index of the requirements: which branches of the ontology are really covered by the specification?
Reporting

- Complete quality reports
  - For individual requirements
  - For requirements documents

- Mailing system for instant reporting:
  - To the authors of the requirements: when quality is not enough
  - To the quality control team
UML diagramming: reuse from umlModels.com
UML Diagramming: elicitation of elements from requirements

1. Information coming from the requirements specification:

SthReq_Cust_00010: The health personnel must be able to maneuver the equipment within the hospital

NF/Std_0105: The freezing device shall support temperatures ranging between 70 and 100 degrees Fahrenheit.

2. Application of boilerplates:

The <STAKEHOLDER> shall be able to <ACTION> <OBJECT><COMPLEMENT>*

The <SUBSYSTEM> shall <SUPPORT_VERB> <ATTRIBUTE> <RANGE><UNIT>
UML diagramming: swREUSER
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Debriefing

- Once the problem is over, the project is closed.

Debriefing activities:
- Costs
- Risk related activities
- Generation of KPIs

- All assets must be stored back to the common repository for further reuse in other projects.
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Reminder: keep updated the ontology
Conclusions

- Knowledge, as a leading actor of the systems engineering processes
- Mainly three enhanced factors:
  - Traceability
  - Reusability
  - Quality
- Ontologies and semantics the core element: SKB