An Initial Approach to Reuse Non-Functional Requirements Knowledge

Rodrigo Veleda and Luiz Marcio Cysneiros

School of Information Technology
York University, Canada
rveleda@yorku.ca, cysneiro@yorku.ca

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Outline

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Motivation

- Non-functional Requirements (NFRs) are:
  - Fuzzy by its nature
  - Difficult to identify
  - Sometimes missed along the process

- A solution to implement a given NFR might affect another NFR

- The use of Softgoal Interdependency Graphs (SIGs) catalogues [1] contribute to avoid omissions and missed conflicts. However, according to empirical work [2], SIGs may not scale too well over complex contexts.

Related Work (1/2)

- *Doerr et al.* [3] and *Zhang et al.* [4] proposed experience-based elicitation and recommendation for the use of NFRs in software service.

- Other approaches [5, 6, 7] aim the use of ontologies to assist NFR elicitation.

- None of these proposed works address the challenges of potential trade-offs between NFRs. Also, nor they have a direct interaction with *i** Tools to promote the reuse of knowledge.

Related Work (2/2)

- Al Balushi et al. [6] introduced the ElicitO framework as an ontology-based tool that supports NFRs elicitation.
- Najera et al. [7] highlights an approach that uses OWL and RDF for representation of *i** variants.
- Sancho et al. [8] proposed an ontological database represented by the NFR Ontology and SIG Ontology.
- Guizzardi et al. [9] emphasize the understanding of NFRs as quality attributes based on the Unified Foundation Ontology (UFO).

Objectives and Scientific contribution (1/2)

- Long-term goal: NDR Framework
  - A framework that aids software engineers to elicit and model NFRs based on the knowledge that has previously been elicited and validated

- Current first goal: NDR Tool
  - A tool to store NFR information into a knowledge base and allow querying at different levels for retrieving this existent information

Objectives and Scientific contribution (2/2)

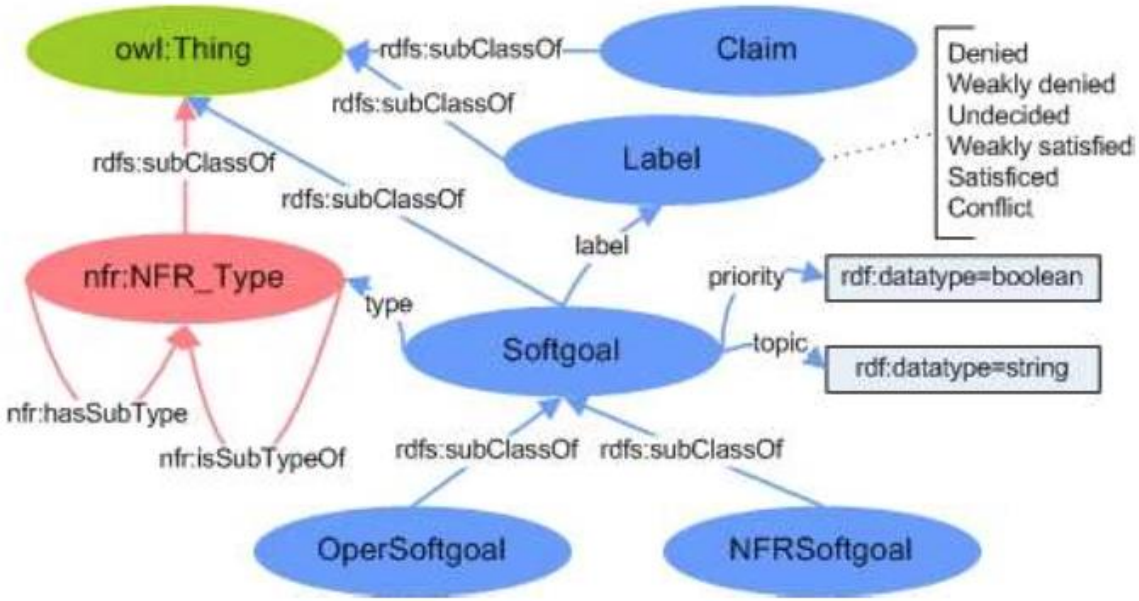
- At first, our environment will only accept queries from the academic community.
- In a near future, we envision to allow members from industry to query the knowledge base and submit comments
- At a later stage, we aim to accept contributions to add to the knowledge base from a broad audience

Ongoing work – NDR Ontology (1/4)

- Currently, the NDR Ontology [10] is the baseline for our proposed knowledge base

- NDR Ontology characteristics:
  - Represents NFRs and design argumentative rationale knowledge in a machine-readable format
  - Follows the proposed standards of OWL [11]
  - Complies with RDF [12] to encode information into resources
  - Uses RDF Schema [13] to describe properties and classes over the RDF resources

Ongoing work – NDR Ontology (2/4)



Softgoal-related concepts and relationships [10]

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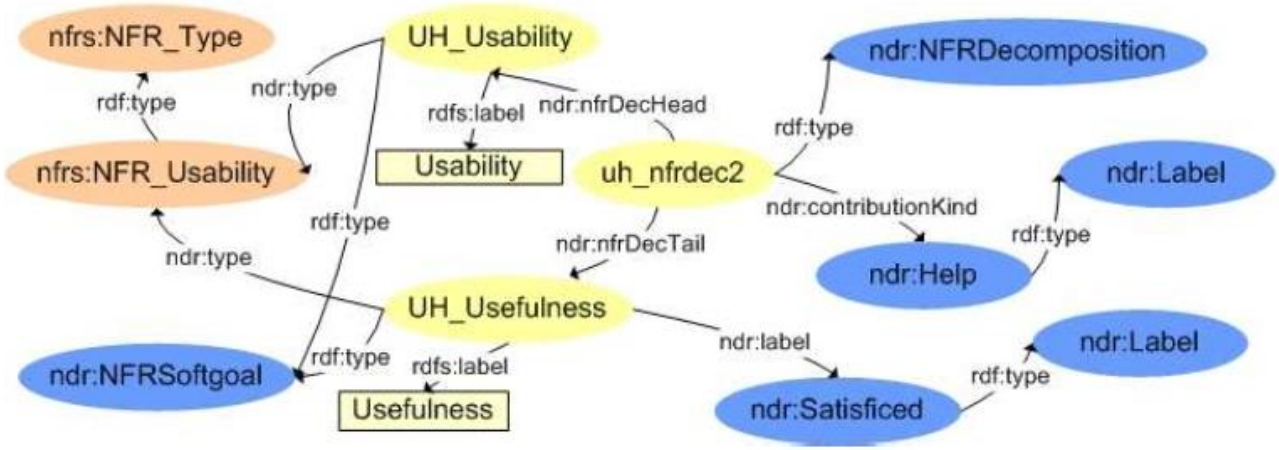
Ongoing work – NDR Ontology (3/4)



Ontology instances [10]

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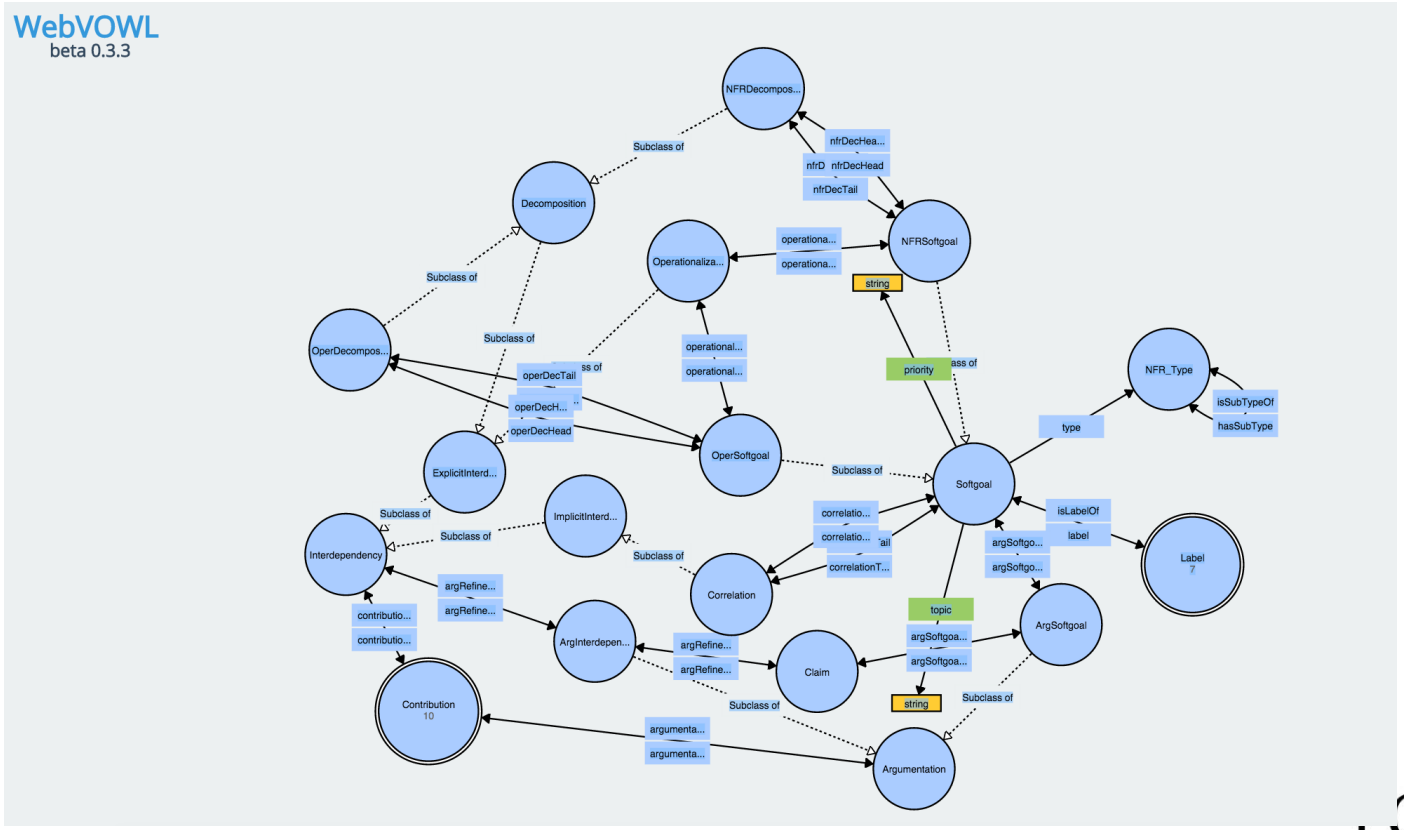
Ongoing work – NDR Ontology (4/4)

```
<nfrs:NFR_Type rdf:ID="NFR_Usability">
  <rdfs:label>Usability</rdfs:label>
</nfrs:NFR_Type>
<ndr:NFRSoftgoal rdf:ID="UH_Usability">
  <ndr:type rdf:resource="#NFR_Usabili
  ty"/>
  <rdfs:label>Usability</rdfs:label>
</ndr:NFRSoftgoal>
<ndr:NFRSoftgoal rdf:ID="UH_Usefulness">
  <rdfs:label>Usefulness</rdfs:label>
  <ndr:label rdf:resource="../ndr/
  ndr.owl#Satisficed"/>
  <ndr:type rdf:resource=
  "#NFR_Usability"/>
</ndr:NFRSoftgoal>
<ndr:NFRDecomposition rdf:ID=
"uh_nfrdec2">
  <ndr:nfrDecHead rdf:resource=
  "#UH_Usability"/>
  <ndr:nfrDecTail rdf:resource=
  "#UH_Usefulness"/>
  <ndr:contributionKind rdf:resource=
  "../ndr/ndr.owl#Help"/>
</ndr:NFRDecomposition>
```

NFR Usability ontology instance represented with OWL [10]

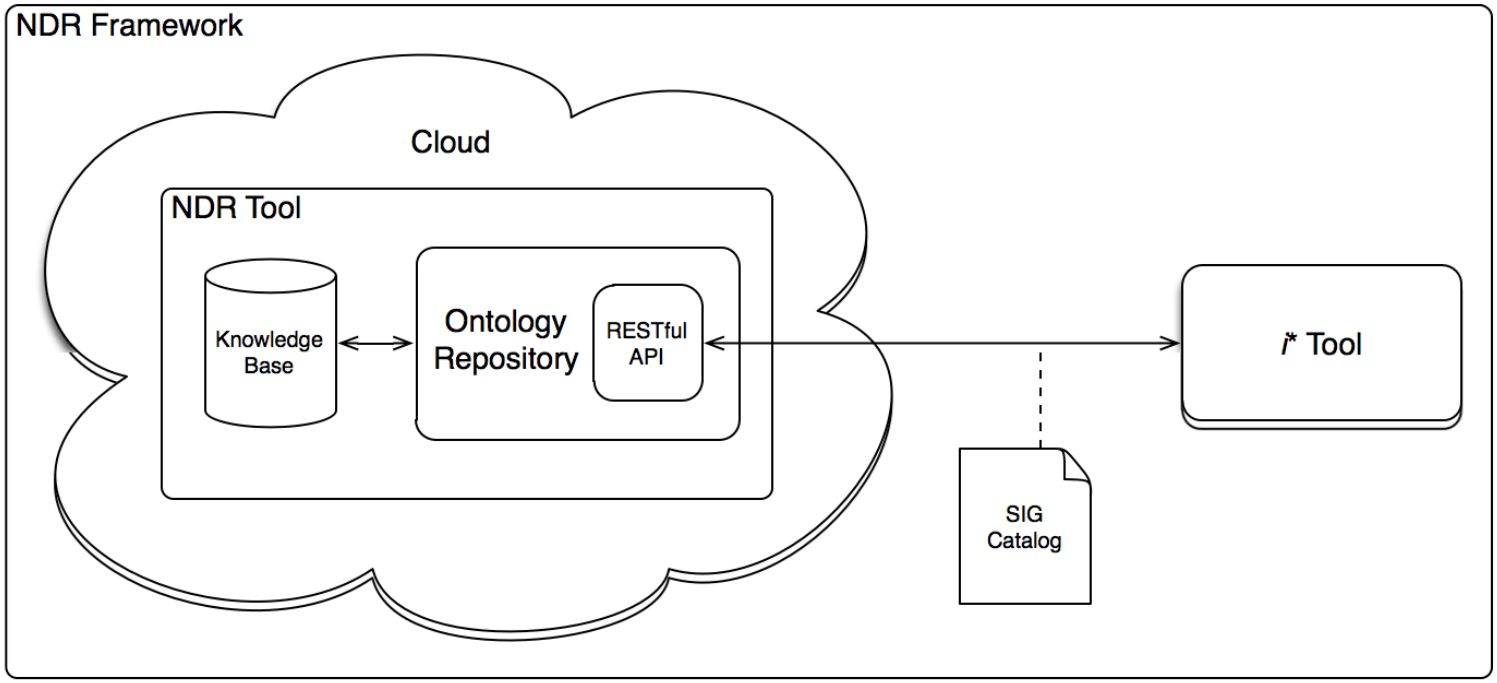
Ongoing work – NDR Ontology (3/3)

- A graphical visualization of the NDR Ontology in our platform using Web-VOWL [14]:



Future work – NDR Framework Conceptual Architecture (1/7)

- The NDR Framework Architecture overview:



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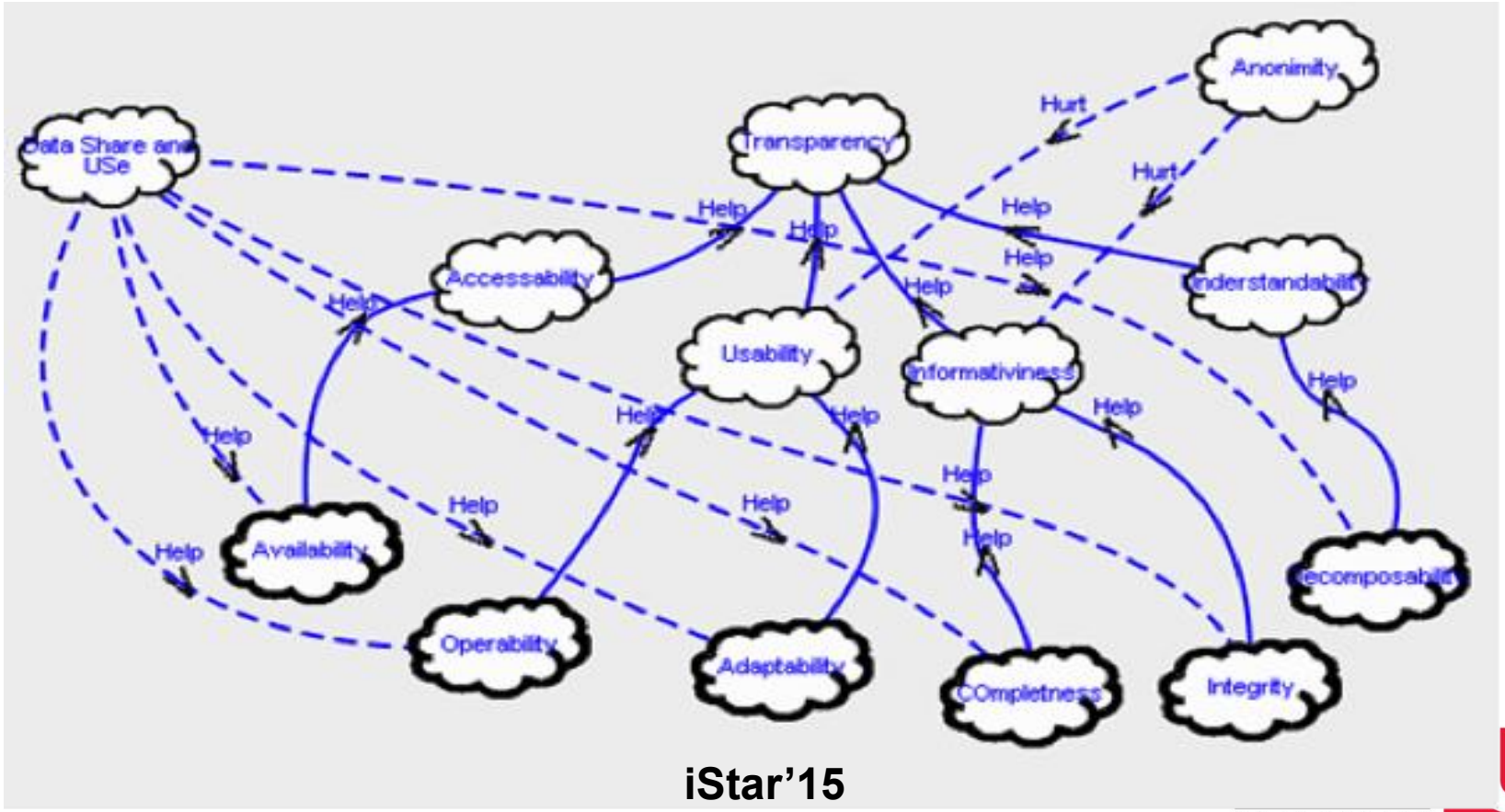
Future work – NDR Framework Conceptual Architecture (2/7)

- Main characteristics:
  - NDR Tool in a cloud environment
  - Generic ontology repository
  - Relevant knowledge detection based on definitions manually specified by administrators
  - Knowledge retrieval through web services
  - Possibility of integration with multiple *i** Tools

Future work – NDR Framework Conceptual Architecture (3/7)

- Applicability in a real world scenario with a given SIG representing the NFR of Transparency



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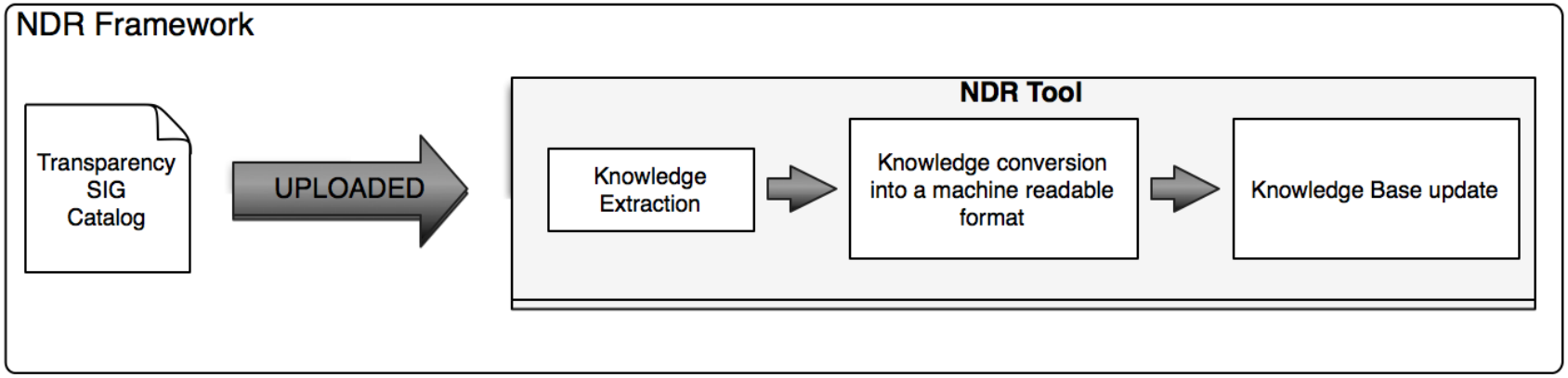
Future work – NDR Framework Conceptual Architecture (4/7)

- NDR Framework internal behaviour based on the current example:



Future work – NDR Framework Conceptual Architecture (5/7)

- The reuse of knowledge will be possible by the use of SPARQL [15] queries
- In the current example, a user wants to know all the correlations that are directly related to the *satisficing* of Transparency. Internally, the NFR Tool will produce a SPARQL query similar to the following:

```
SELECT DISTINCT ?interlinkId ?softgoalParent ?softgoalSpring
?contributionKind WHERE {?interlinkId rdf:type ndr:Correlation.
?interlinkId ndr:correlationHead ?softgoalParent. ?interlinkId
ndr:correlationTail ?softgoalSpring. ?interlinkId ndr:contributionKind
?contributionKind.}
```

Future work – NDR Framework Conceptual Architecture (6/7)

- The machine-readable format result of the previous SPARQL query will be similar to the following table:

interlinkId	softgoalParent	softgoalSpring	contribution
ndr:UH_correlation2	ndr:Informativiness	ndr:Anonymity	ndr:Hurt
ndr:UH_correlation7	ndr:Integrity	ndr:Data_Share_and_Use	ndr:Help
ndr:UH_correlation1	ndr:Usability	ndr:Anonymity	ndr:Hurt
ndr:UH_correlation6	ndr:Completeness	ndr:Data_Share_and_Use	ndr:Help
ndr:UH_correlation4	ndr:Operability	ndr:Data_Share_and_Use	ndr:Help
ndr:UH_correlation8	ndr:Decomposability	ndr:Data_Share_and_Use	ndr:Help
ndr:UH_correlation5	ndr:Adaptability	ndr:Data_Share_and_Use	ndr:Help
ndr:UH_correlation3	ndr:Availability	ndr:Data_Share_and_Use	ndr:Help

Future work – NDR Framework Conceptual Architecture (7/7)

- Key points noteworthy to mention:

  - Open-source concepts will be used as approaches for internal knowledge extraction and conversion.
  - The knowledge retrieval will be query-free to the end-user. In other words, the framework will be responsible by the abstraction between the user request and the actual needed information.
  - The possibility of having results in a graphical way will depend on the level of integration with a given *i** Tool.

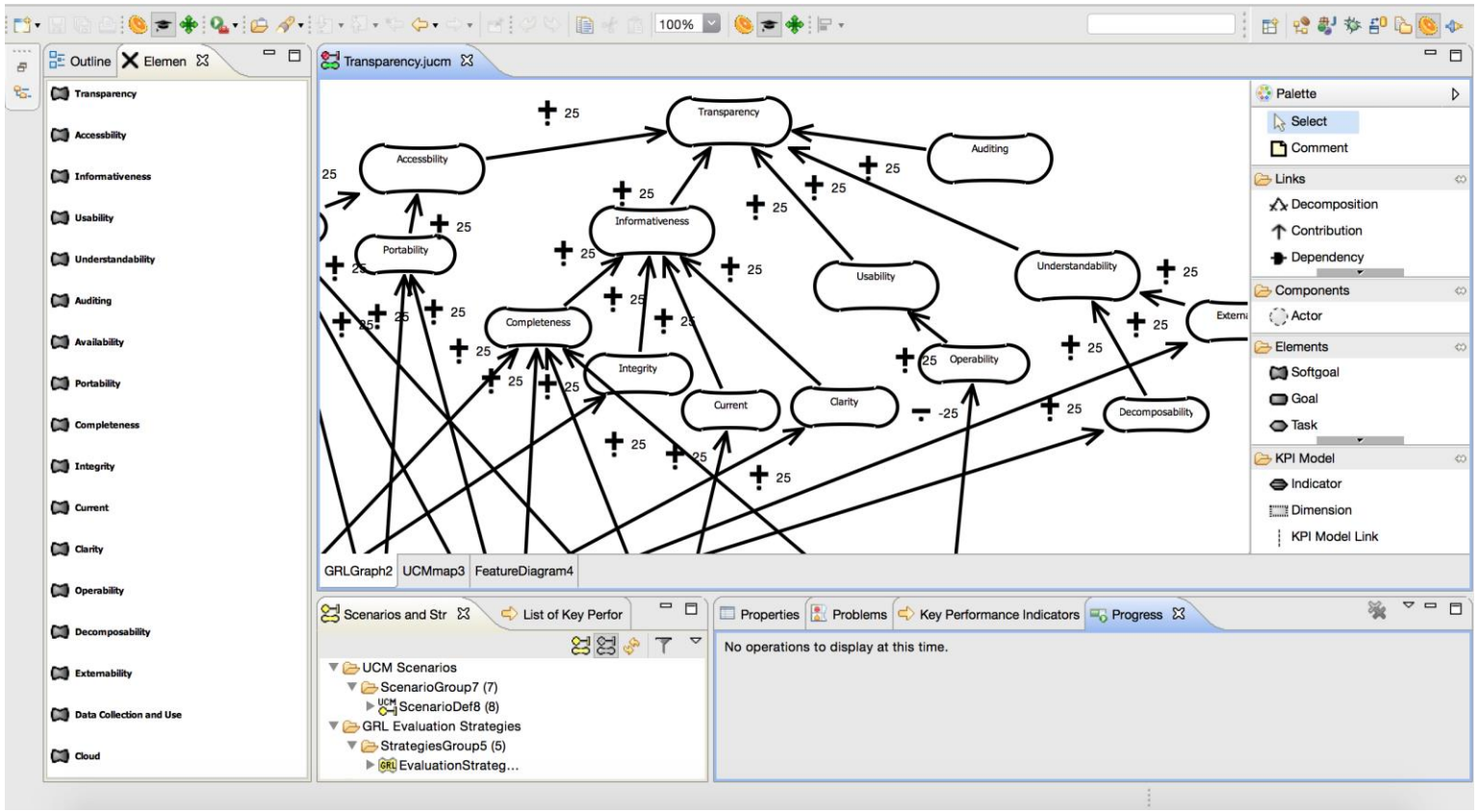
Future work – jUCMNav Integration (1/3)

- As a proof of concept, we aim to integrate our framework with jUCMNav [16].

- jUCMNav main characteristics:
  - Open-source
  - Cross-platform
  - Extensible

- After a careful analysis, we concluded that jUCMNav can provide us the possibility of presenting results in a graphical way due to its extensibility.

Future work – jUCMNav Integration (2/3)



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Future work – jUCMNav Integration (3/3)

- Noteworthy to mention:
  - All our efforts will take into account the development of an interactive approach that can work with as many *i** Tools as possible.
  - Minimum requirements such as the level of extensibility and supported platforms will be taken into account for each candidate *i** Tool.

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Thank you

Questions?

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