An Initial Approach to Reuse Non-Functional Requirements Knowledge

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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.

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Related Work (1/2)


• 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.

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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 * 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).

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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

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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

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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

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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)

<i>NFR Usability ontology instance represented with OWL [10]</i>

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

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Ongoing work – NDR Ontology (3/3)

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

![Graphical Visualization of NDR Ontology Using Web-VOWL](image-url)
Future work – NDR Framework Conceptual Architecture (1/7)

- The NDR Framework Architecture overview:
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

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

• Applicability in a real world scenario with a given SIG representing the NFR of Transparency
Future work – NDR Framework Conceptual Architecture (4/7)

- NDR Framework internal behaviour based on the current example:

```
NDR Framework

Transparency SIG Catalog

UPLOAD

Knowledge Extraction

Knowledge conversion into a machine readable format

Knowledge Base update

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```
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:

```sql
```

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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:

<table>
<thead>
<tr>
<th>interlinkId</th>
<th>softgoalParent</th>
<th>softgoalSpring</th>
<th>contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>ndr:UH_correlation2</td>
<td>ndr:Informativiness</td>
<td>ndr:Anonymity</td>
<td>ndr:Hurt</td>
</tr>
<tr>
<td>ndr:UH_correlation7</td>
<td>ndr:Integrity</td>
<td>ndr:Data_Share_and_Use</td>
<td>ndr:Help</td>
</tr>
<tr>
<td>ndr:UH_correlation1</td>
<td>ndr:Usability</td>
<td>ndr:Anonymity</td>
<td>ndr:Hurt</td>
</tr>
<tr>
<td>ndr:UH_correlation6</td>
<td>ndr:Completeness</td>
<td>ndr:Data_Share_and_Use</td>
<td>ndr:Help</td>
</tr>
<tr>
<td>ndr:UH_correlation4</td>
<td>ndr:Operability</td>
<td>ndr:Data_Share_and_Use</td>
<td>ndr:Help</td>
</tr>
<tr>
<td>ndr:UH_correlation8</td>
<td>ndr:Decomposability</td>
<td>ndr:Data_Share_and_Use</td>
<td>ndr:Help</td>
</tr>
<tr>
<td>ndr:UH_correlation5</td>
<td>ndr:Adaptability</td>
<td>ndr:Data_Share_and_Use</td>
<td>ndr:Help</td>
</tr>
<tr>
<td>ndr:UH_correlation3</td>
<td>ndr:Availability</td>
<td>ndr:Data_Share_and_Use</td>
<td>ndr:Help</td>
</tr>
</tbody>
</table>

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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)
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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References

Thank you

Questions?

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