Quality Requirements Elicitation Based on Inquiry of Quality-Impact Relationships

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Please cite as follows:

Quality Requirements

ISO/IEC FDIS 25010
Goal Modeling

[Chung et al, 2000]
How can we determine the appropriate quality levels for requirements that are specified with a scale, rather than with operationalized goals?

Quality attributes such as
- Performance such as response time
- Reliability such as mean-time-to-failure
- etc.

Impact of the problem:
- Too little quality disappoints users
- Too much quality is costly and inefficient
Agenda

- Quality-Impact Relationships
- Requirements Elicitation Method
- Real-World Example of Method Application
- Discussion and Future Work
- Summary
A *quality-impact relationship* is a function between software quality levels and their impacts for a given pair of quality attribute and impact.

- **Example (positive)**
  - Software quality level: 0.1 seconds response time
  - Impact: user thinks the software is excellent

- **Example (negative)**
  - Software quality level: 10 seconds response time
  - Impact: user thinks the software is bad
In prior empirical work, we have explored one kind of quality-impact relationship: Quality of Service (QoS) and Quality of Experience (QoE) for telecommunication services [10].

The quality-impact relationship can be expressed as:

\[ q_{imp} = \alpha \cdot e^{-\beta q_{msr}} + \gamma \]
Key Ideas

- Quality-impact relationships make the pragmatic meaning of quality levels explicit.
  - instead of just saying we need 0.1 sec response time…
  - …we know that the user will be happy with it

- Quality-impact inquiry method design:
  - Framework of inquiry-based requirements analysis
  - Supporting methods:
    - **Prototype:** enable the quality experience and measurement ($q_{msr}$)
    - **Questionnaire:** collect user experience data ($q_{imp}$)
    - **Workshop:** efficient, controlled setting
Quality-Impact Inquiry
Diabetes Self-Management App

Self-monitoring of glucose, stress, etc.

Data sharing with consulting doctor
The Requirement Problem

- Type of quality impact, $q_{imp}$: user acceptance
- Type of quality, $q_{msr}$: response time (waiting time)

What waiting time shall be acceptable for the user (patient) until data sharing is completed?
1. Preparation

- Prototype

- Questionnaire

<table>
<thead>
<tr>
<th>Overall, how satisfied are you with the feature you just have experienced?</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Excellent (5)   □ Good (4)    □ Fair (3)    □ Poor (2) □ Bad (1)</td>
</tr>
</tbody>
</table>

Please tell us why you feel that way:

\[ q_{\text{msr}}: \text{response time} \]

\[ q_{\text{imp}}: \text{user’s acceptance} \]

- Call for Workshop
2. Measurement

<table>
<thead>
<tr>
<th>Measurement</th>
<th>$q_{msr}$: response time</th>
<th>$q_{imp}$: user’s acceptance</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement 1</td>
<td>1.26 seconds</td>
<td>4</td>
<td>...because of...</td>
</tr>
<tr>
<td>Measurement 2</td>
<td>0.22 seconds</td>
<td>5</td>
<td>...because of...</td>
</tr>
<tr>
<td>Etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Analysis

- Option A, use existing generic relationship

- Option B, develop new model

User's acceptance ($q_{imp}$) vs. Response time ($q_{msr}$)

Rationales:
- I did not feel disturbed, and everything was working.
- I thought that the software was wrong.
4. Decision-Making

- 1- Use industry standard, competitive analysis [5], or collected rationales to set the appropriate quality impact.
- 2- Then look up the desired quality.

<table>
<thead>
<tr>
<th>Quality impact ( (q_{imp}) ) MOS</th>
<th>Estimated quality value ( (\hat{q}_{msr}) ) for Response time</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5</td>
<td>0.48 s</td>
</tr>
<tr>
<td>4</td>
<td>1.27 s</td>
</tr>
<tr>
<td>3.5</td>
<td>2.15 s</td>
</tr>
<tr>
<td>3</td>
<td>3.18 s</td>
</tr>
</tbody>
</table>

SRS
Example of Workshop
Example Scenario

i) selection of patient data

ii) patient authentication

iii) data submission

iv) questionnaire
Example Measurement

- **Log-file**

  ```
  ...  
  2014-01-27 15:11:25.029000 fistar.observation_sharing.select_activity.click_button_start_send
  2014-01-27 15:11:25.253000 fistar.observation_sharing.send_activity.start_activity
  2014-01-27 15:11:25.611000 fistar.observation_sharing.select_activity.stop_activity
  2014-01-27 15:11:33.694000 fistar.observation_sharing.send_activity.click_button_start_authorize
  2014-01-27 15:11:33.921000 fistar.observation_sharing.send_activity.stop_activity
  2014-01-27 15:12:39.997000 fistar.observation_sharing.send_activity.show_sending_dialog
  2014-01-27 15:12:41.787000 fistar.observation_sharing.send_activity.show_send_complete_dialog
  2014-01-27 15:12:43.182000 fistar.observation_sharing.select_activity.start_activity
  2014-01-27 15:12:43.301000 fistar.observation_sharing.send_activity.stop_activity
  ...
  ```

<table>
<thead>
<tr>
<th>Measurement</th>
<th>(q_{msr}: \text{response time})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement 1</td>
<td>1.08 seconds</td>
</tr>
</tbody>
</table>
Example Analysis

- Blue dots: collected data

- Compensation of lack of extensive data by using existing generic model [10]
Example Decision

What waiting time shall be acceptable for the user (patient) until data sharing is completed?

- Targeted quality impact, $q_{imp}$: user acceptance
  - MOS 4 “good” (based on stakeholder consensus)
- Type of quality, $q_{msr}$: response time (waiting time)
  - 1.26 s (based on specific quality-impact relationship)
Discussion

- Variations
- Feasibility in Practice
- Future Research
Variations (1)

- Different generic relationships to describe the impact function
  - Linear
  - Exponential
  - ...

- Simulated quality levels (through prototype)
Variations (2)

- **Software Features**
  - Data transfer
  - Chatting

- **Stakeholder Sampling**
  - Many patients
  - Many doctors
Variations (3)

Quality Attributes

Impact Attributes

ISO/IEC FDIS 25010
Feasibility in Practice

- Experienced requirements engineers vs. junior requirements engineers
- Construction of Service Level Agreements
- Extension of the requirements engineering toolset
- Complementing competitive analysis of product quality
Future Research

- Validating and evaluating the method in large-scale requirement engineering situations
- Expanding the understanding of the generic relationships between combinations of software quality attributes and their impacts as well quality attributes relationship.
- **Scaling**: how to get a sufficient number of data points
Summary

- **Problem**: How to determine the appropriate level of quality?
- **Approach**: Quality-Impact inquiry method
- **Example**
- **Key insights**
Thank you

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