How you choose the right level of quality for your non-functional requirements – the QUPER model

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“The mp3 player shall start to play music in 2.5 seconds”
QUality PERformance (QUPER) model

**Benefit view**
- Excessive
- Competitive advantage
- Useful
- Useless

**Cost view**

**Roadmap view**
- Competitor A
- Target release $n_1$
- Competitor B
- Target release $n_2$
- Current
- Bad Target

Utility | Differentiation | Saturation
---|---|---
Useful | Differentiation breakpoint | Quality level
Useless | Saturation breakpoint | Quality level
Excessive | Excessive
Competitive advantage | Competitive advantage
Useful | Useful
Useless | Useless

Roadmap view (Feature X, Segment Y)
### Practical Guidelines

#### Identify candidate QR

#### Define scale and unit

<table>
<thead>
<tr>
<th><strong>FEATURE</strong></th>
<th>Mobile TV Time Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ID</strong></td>
<td>MTV_12</td>
</tr>
</tbody>
</table>

**QUALITY REQUIREMENT:** Time shift buffer size

**DEFINITION:** The number of minutes of HDTV buffered

**REFERENCE LEVELS**

- **PRODUCT:** Competitor X  **LEVEL:** 20 min
- **PRODUCT:** Own product Y  **LEVEL:** 40 min
- **PRODUCT:** Competitor Z  **LEVEL:** 160 min

**QUALITY BREAKPOINTS**

- **UTILITY:** 15 min  **RATIONALE:** all products are able
- **SATURATION:** 200 min  **RATIONALE:** films are shorter
- **DIFFERENTIATION:** 50 min  **RATIONALE:** high price point

**BARRIER**

- **Qref:** 40 min
- **Q1:** 90 min  **RATIONALE:** new SW architecture needed
  - **C1:** 4 weeks
- **Q2:** 180 min  **RATIONALE:** new HW component needed
  - **C2:** 24 weeks

**TARGET**

- **GOOD:** 80 min  **RATIONALE:** will beat most
- **STRETCH:** 90 min  **RATIONALE:** if SW architecture is feasible

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**Decision**

[Not use QUPER]  
[Use QUPER]

**Identify reference levels**

**Elicit quality breakpoints**

[Not needed]  
[Need to]

**Set candidate requirements**

**Estimate cost barriers**

[Not needed]  
[Need to]

**Identify cost dependencies**

[OK]  
[Not OK]
QUPER in Industry

Part of development 'BV' + 'RV'
2008

Introduced 'BV', 'CV', 'RV'
2009

Presentation 'BV' + 'RV'
2009
Quality indicator: Time to play music
Definition: Measured from player invoke button pressed until music is played using 2 GB memory with 100 tracks with average duration of 3 min

Current reference products
Competitor product X: 4 seconds
Competitor product Y: 2 seconds
Own product z (Qref): 3 seconds

Current market expectations
Utility breakpoint: 5 seconds
Differentiation breakpoint: 1.5 seconds
Saturation breakpoint: 0.2 seconds

Candidate target
Min target: 2 seconds – This target is possible without new architecture, but needs some software optimization
Max target: 1 second – If we create a new architecture, this target (which is better than differentiation) will be easy to reach. Users might require this level of quality within 2 years.
The subjects identified three main challenges: lack of feedback, difficulty in gathering information about competitors, and who should decide when to stop improving quality. Two reasons were discovered, first, lack of reliable and historical data to support estimates for the benefit view. Moreover, another subject questioned who should decide at which level the quality was seen as excessive. When do you know that you are 'over the top' asked one subject?

Breakpoints Download success rate (per interface)

<table>
<thead>
<tr>
<th>Breakpoints</th>
<th>Utility</th>
<th>Differentiation</th>
<th>Saturation</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>60</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>Q</td>
<td>60</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>R</td>
<td>60</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>S</td>
<td>40</td>
<td>75</td>
<td>80</td>
</tr>
<tr>
<td>T</td>
<td>50</td>
<td>90</td>
<td>95</td>
</tr>
</tbody>
</table>

Table 1

<table>
<thead>
<tr>
<th>Feature</th>
<th>Quality indicator</th>
<th>Measurement</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upgradability</td>
<td>Time</td>
<td>Time measured in minutes</td>
<td>P Q R S T</td>
</tr>
<tr>
<td></td>
<td>Download success</td>
<td>Success rate</td>
<td>P Q R S T</td>
</tr>
<tr>
<td>Transaction Processing</td>
<td>Speed A</td>
<td>Time measured in seconds</td>
<td>P Q R S T</td>
</tr>
<tr>
<td></td>
<td>Speed B</td>
<td>Time measured in seconds</td>
<td>P Q R S T</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Interface</th>
<th>Qref</th>
<th>Q1</th>
<th>Q2</th>
<th>CB</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>85</td>
<td>90</td>
<td>95</td>
<td>10% of the total software optimization budget</td>
</tr>
<tr>
<td>Q</td>
<td>95</td>
<td>90</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>89</td>
<td>90</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>40</td>
<td>90</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>50</td>
<td>90</td>
<td>95</td>
<td></td>
</tr>
</tbody>
</table>
In general, the subjects appreciated the use of intervals to understand where our product stands in relation to the competitors, and "we have an idea where the differentiation is", one subject explained. However, intervals should not be used for all quality level improvements in an early phase, i.e., before the competitors have to deliver. Another subject compared with the previous process of handling quality requirements, before the competitors have to deliver. Five main lessons learnt were identified during the evaluation of QUPER at the case company, without any direct support. Moreover, another subject stated that the "roadmap view is very helpful to surpass the competitors. According to the subject, the introduction of QUPER helps the case company in making decisions for both functional requirements and quality requirements.

One subject stated that he/she already uses the mindset of QUPER for functional requirements. The subject explained, "This is the most important for me. Thinking in..."

One of QUPER's goals is that the model should be easy to use in practice. The practitioners at the case company that were involved in the evaluation of QUPER mentioned that "it is possible to understand where you stand and your competitors are" with QUPER. For the case company, the visualization of all competitors is very important, as illustrated by Figure 7. The subject explained, "when you show two competitors that are in front of [the case company], it triggers for improvement."

The roadmap view was viewed as the most essential and influential part of QUPER by the subjects. The visualization of all competitors and how much of the budget should be reserved to achieve a certain quality level improves the constant thinking of where to aim. The subject explained, "The judgment of the roadmap view and the support for early decision-making, the constant thinking of where to aim, triggers for improvement."

Moreover, another subject stated that the "roadmap view is very helpful..." One subject explained, "when you show..." The subject created a presentation for the board to explain where the competitors are. According to the subject, this feature is a functionality that some of their competitors have, but the case company is missing. To stress the importance of implementing this feature, the subject created another feature that some of their competitors have. The practitioners at the case company that were involved in the evaluation of QUPER agreed that the cost view is very useful in their situation. The mapping of cost to potential improvements in an early phase is very important. One subject explained, "This is the most important for me. Thinking..." 

The practitioners at the case company that were involved in the evaluation of QUPER mentioned that "QUPER is easy to use in practice." The practitioners explained, "QUPER is easy to use..." One subject explained, "This feature is a functionality that some of their competitors have,..." The practitioners explained, "This feature is a functionality that some of their competitors have,..."

### Table 6

<table>
<thead>
<tr>
<th>Interface</th>
<th>Qref</th>
<th>Good target</th>
<th>Stretch target</th>
<th>Direct cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>85</td>
<td>90</td>
<td>100</td>
<td>€273,360</td>
</tr>
<tr>
<td>Q</td>
<td>95</td>
<td>90</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>89</td>
<td>90</td>
<td>100</td>
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<td>S</td>
<td>40</td>
<td>80</td>
<td>95</td>
<td></td>
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<tr>
<td>T</td>
<td>50</td>
<td>80</td>
<td>95</td>
<td></td>
</tr>
</tbody>
</table>

(\text{Number of months needed})
\times (\text{(number of needed employees)})
\times (\text{working hours per month})
= \text{numbers of needed man} - \text{hours}

(\text{Number of needed man} - \text{hours}) \times (\text{cost per hour})
= \text{direct cost}.
Each, that is, in performing QUPER related activities. However, these hours do not only include performing QUPER’s six steps, but it also includes introduction of QUPER, presentations, and general meetings, brainstorming and planning meetings, results and evaluation meetings, and the tailoring of QUPER.

6.5.2 Tailoring of QUPER

A third goal with QUPER is for the model to be domain-relevant, i.e., it should be possible to combine the concepts of QUPER with existing practices by tailoring the model. It was possible, with a few additions and one modification, to adopt and tailor QUPER’s generic concepts and guidelines (Sect. 2.1) to the case company. The main addition to QUPER’s steps was competitor analysis. In order to identify competitive advantage and identify the differentiation breakpoint, competitors’ level of quality is essential. If an organization does not have a process or an approach for gathering information about its competitors, one approach could be to call its competitors in a discrete manner through anonymous inquiries to, e.g., the competitors sales and support services, which was a strategy applied by the case company. Furthermore, a direct cost was added to the candidate target step. Instead of quantifying QR by using QUPER and then, in a later phase of the development process, estimate the cost, the case company identified a possibility to estimate the cost of achieving the specified target directly in QUPER’s steps. One main benefit of adding the direct cost was the ability to discuss the targets in release planning and know its cost, which may have an influence on the specified targets for coming releases.

6.5.3 Applicability of QUPER in more than one domain

In previous evaluation of QUPER [11,16], the model has only been evaluated in the mobile handset domain. In this evaluation, the QUPER model was evaluated in a different domain, namely the electronic payment-processing domain. The results from the two domains are similar. The view of an improved release planning process by using QUPER and importance of a rich understanding of the market as input for release planning and early decision-making is inline with the results in Berntsson Svensson et al. [11]. In addition, similar to the experiences in the mobile handset domain [11], the main benefit of the breakpoints was the saturation breakpoint, where the quality level changes from competitive to excessive quality. Moreover, the challenges of the identification of the values for the differentiation and saturation breakpoints are the same as [11]. However, the reasons differ, while the case company in this study had problems with gathering competitor information to be able to calibrate the differentiation breakpoint, in [11], the mobile handset company’s problems was related to when to stop calibrating those breakpoints.

Similar to the practical guidelines of QUPER’s cost view in [16], the subjects believe that the first cost barrier is related to software optimization, while the second cost barrier may be related to new investments in larger architectural evolution steps. Furthermore, the first cost barrier is viewed as easier to estimate than the second cost barrier. The reason is that the first cost barrier is closer to the current quality level than the second one, which is inline with the results in [16].

“the QUPER way of thinking is essential because it forces you to know where you stand on the market, what you want to achieve, and how much it would cost you to get there” - A product manager
Pros and Cons

Strengths
• Same ‘language’
• Understanding the market situation

Weaknesses
• Mainly Performance
• Dependencies
QUPER Prototype tool
Do you want to try QUPER?

Contact: rbsv@cs.lth.se
Visit: http://quper.org