Requirements Negotiation for Multilayer System Components

Juan Pablo Carvallo
Universidad Del Pacífico
Cuenca, Ecuador

Xavier Franch
Universitat Politècnica de Catalunya
Barcelona, Spain

RE’11, Trento (Italy) – August, 2011
Requirements Negotiation for Multilayer System Components

Juan Pablo Carvallo
Universidad Del Pacífico
Cuenca, Ecuador

Xavier Franch
Universitat Politècnica de Catalunya
Barcelona, Spain

RE’11, Trento (Italy) – August, 2011

Greetings from Ecuador!
OUTLINE

• Introduction
• The Industrial Case
• The Method Used
• Evaluation of the Approach
• Conclusions
Introduction

Hybrid systems:

• Integration of software components of different nature and origins

• Opportunistic development oriented to integration instead of development

• Multilayer architecture
Hybrid Systems: life cycle

- Selection
- Adaptation
- Integration
- Maintenance
Still challenges to overcome

- Documentation and matching of requirements and components
- Unstructured processes
- Non-technical-driven selection
- Most work on selection focuses on individual components
Our approach so far

- **From the theory**
  - Use of quality models (QMs) to drive component selection (RE’02 onwards)
Our approach so far

- **From the theory**
  - Use of quality models (QMs) to drive component selection (RE’02 onwards)

- **From the practice**
  - Architecting hybrid systems (PoEM’09)
  - Importance of non-technical attributes reported (RE’06)
  - Adoption of ISO/IEC 9126 quality model (IEEE Sw’03&07)
Our approach so far

• From the theory
  • Use of quality models (QMs) to drive component selection (RE’02 onwards)

• From the practice
  • Architecting hybrid systems (PoEM’09)
  • Importance of non-technical attributes reported (RE’06)
  • Adoption of ISO/IEC 9126 quality model (IEEE Sw’03&07)

See our catalogues at
http://www.essi.upc.edu/~gessi/tools.html
OUTLINE

• Introduction
• **The Industrial Case**
• The Method Used
• Evaluation of the Approach
• Conclusions
The Mutualista Azuay case (1/3)

• Medium size banking organization

• The adoption of a new *banking system* (BS) was identified as a core strategic issue
The Mutualista Azuay case (2/3)

- BS selection process conducted last year (2010)
  - One product was chosen after the selection process
The Mutualista Azuay case (2/3)

• BS selection process conducted last year (2010)
  • One product was chosen after the selection process

• Technical requirements were not rigorously elicited
  • Ambiguities
  • Some mandatory reqts. were not marked as critical
    • E.g., the need for the selected product to run over the OS400/DB2 IBM platform already in use
The Mutualista Azuay case (2/3)

- **BS selection process conducted last year (2010)**
  - One product was chosen after the selection process

- **Technical requirements were not rigorously elicited**
  - Ambiguities
  - Some mandatory reqts. were not marked as critical
    - E.g., the need for the selected product to run over the OS400/DB2 IBM platform already in use

- **Final selection based on:**
  - Demonstrations to non-technical staff, and
  - Acquisition costs
    - disregarding other technical concerns
The Mutualista Azuay case (3/3)

- Implementation frozen due to lack of agreement of parties on operational platform
The Mutualista Azuay case (3/3)

• Implementation frozen due to lack of agreement of parties on operational platform
  • BS supplier reluctant to support OS400/DB2 platform
    • not much in use
    • to be discontinued
The Mutualista Azuay case (3/3)

• Implementation frozen due to lack of agreement of parties on operational platform
  • BS supplier reluctant to support OS400/DB2 platform
    • not much in use
    • to be discontinued
  • IT department reluctant to move from OS400/DB2
    • expertise, training, …
    • some running software specific for OS400/DB2
The Mutualista Azuay case (3/3)

- Implementation frozen due to lack of agreement of parties on operational platform
  - BS supplier reluctant to support OS400/DB2 platform
    - not much in use
    - to be discontinued
  - IT department reluctant to move from OS400/DB2
    - expertise, training, …
    - some running software specific for OS400/DB2
  - HW supplier in the middle
    - happy to support any alternative
    - did not want to be involved in the fight
OUTLINE

• Introduction
• The Industrial Case
• **The Method Used**
• Evaluation of the Approach
• Conclusions
Our proposal: a four-phase process

1. Identification of underlying platform
   - Sitio Principal
   - Sistema Comercial
   - Base de Datos
   - Sistema Operativo
   - Hw y Sw de Comunicaciones

2. Construction of QMs
   - Technical
   - Functional
   - Non-Functional
   - Non-Tech

3. Evaluation of alternatives
   - Technical
     - Functional
     - Non-Functional
   - Non-Tech

4. Issue of recommendations
   - Details not shown in the image
P1-Act. 1: Definition of the baseline architectural diagram

1. Identification of underlying platform
   - High level definition by leading consultant to understand the system
   - Sources of information include
     - Technical information provided by supplier of business solution
     - Local regulators and their security, availability and continuity requirements

2. Construction of QMs

3. Evaluation of alternatives

4. Issue of recommendations
P1-Activity 2: Validation of the architectural diagram

1. Identification of underlying platform
   - Workshop format was selected
     - more interaction, brainstorming, discussion, negotiation

2. Construction of QMs

3. Evaluation of alternatives

4. Issue of recommendations
P1-Activity 2: Validation of the architectural diagram

1 Identification of underlying platform
   - Workshop format was selected
     - more interaction, brainstorming, discussion, negotiation
     - some decisions confirmed
   - Layers of components to be selected
     - IBM Blade servers
     - H type chassis

2 Construction of QMs

3 Evaluation of alternatives
   - Selected BS firm

4 Issue of recommendations
P1-Activity 3: Identification of initial candidate solutions

1. Identification of underlying platform
   - Alternatives of components for each layer and their possible combination are selected

<table>
<thead>
<tr>
<th>Database Alternatives</th>
<th>DB2</th>
<th>AIX</th>
<th>Linux</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORACLE</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>ITERA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Binary</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAC</td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Replication Alternatives</th>
<th>DB2</th>
<th>AIX</th>
<th>Linux</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITERA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Binary</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAC</td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

2. Construction of QMs

3. Evaluation of alternatives
   - Oracle
   - DB2
   - i
   - AIX
   - Linux

4. Issue of recommendations
   - ITERA
   - Binary
   - RAC
P2-Activity 1: Construction of a base QM

1. **Identification of underlying platform**
   - Reuse of quality factors from previous experiences
     - ISO/IEC extended catalogues
     - Focused on technical non-functional and non-technical aspects
   - Three main sections in the model
     - hundreds of quality factors (QFs)

2. **Construction of QMs**

3. **Evaluation of alternatives**
   - Reuse of quality factors from previous experiences
   - ISO/IEC extended catalogues
   - Focused on technical non-functional and non-technical aspects
   - Three main sections in the model
     - hundreds of quality factors (QFs)

4. **Issue of recommendations**
P2-Activity 2: Conversion of the QM into a multi-layer QM

1. Identification of underlying platform
   - 1
   - 2
   - 3

2. Construction of QMs
   - 1
   - 2
   - 3
   - 4
   - 5

3. Evaluation of alternatives
   - 1
   - 2
   - 3
   - 4
   - 5

4. Issue of recommendations
   - 1
   - 2
   - 3

• Replication

Multi Layer QM

DB Layer
- Technical
  - Non-Functional
- Contractual
  - Adoption and operation costs
  - Non-Technical

OS Layer
- Technical
  - Non-Functional
- Contractual
  - Adoption and operation costs
  - Non-Technical

Servers Layer
- Technical
  - Non-Functional
- Contractual
  - Adoption and operation costs
  - Non-Technical
P2-Activity 3: Tailoring of the multi-layer QM

- To include the exact level of detail required for the process
- To evaluate more precisely some aspects or the particular process
P2-Activity 4: Statement of requirements

1. Identification of underlying platform
2. Construction of QMs
3. Evaluation of alternatives
4. Issue of recommendations

- **Constraints using the measures defined in the QM**
  - Requirements are measurable
  - Identification of mismatches improved

  e.g.: Training = Tuple(Included, Hours, Participants)
  Requirement: (Yes, 80, 10)
P2-Activity 5: Validation workshops.

1. Identification of underlying platform
2. Construction of QMs
3. Evaluation of alternatives
4. Issue of recommendations

**Workshops are recommended to:**
- present the model to the administration
- obtain their approval before practical use
P3-Activity 1: Training Workshop

- **Training workshop conducted**
  - to present QM to Hw and BS suppliers

- QM areas reviewed in detail:
  - measures
  - requirements stated by the organization

- Suppliers’ doubts and concerns were clarified
**P3-Activity 2: Obtain component and supplier descriptions**

1. **Identification of underlying platform**
   - QM handled to HW and BS suppliers
     - to be used in the description of their offers
     - filled in selectively
   - **Very valuable activity**
     - description of alternatives easier and faster
     - HW and BS suppliers real scope identified

See paper Table IV for example
**P3-Activity 3: Clarification Workshops**

1. **Identification of underlying platform**
   - Individual workshops conducted with HW and BS suppliers
     - Clarify requirements and descriptions that were not correctly stated
       - Missing evaluations of some QFs
       - Evaluations not making appropriate use of the measures in the model

2. **Construction of QMs**

3. **Evaluation of alternatives**
   - Very valuable activity
     - It helped to clarify some of the characteristics of the proposals
     - but also to identify important architectural changes and emerging requirements
       - Application server required

4. **Issue of recommendations**
P3-Activity 4: Consolidation of QMs

- **QM results from the workshops were consolidated into a single QM**
  - Including all the descriptions provided by the HW and BS suppliers.
  - Answers from different suppliers were marked with different colors for traceability.

---

**Technical**

- Non-Functional
- Contractual
- Adoption and operation costs

**Non-Technical**

- Comparison matrices:
  - Cmp.1: \( \frac{1}{2} \)
  - Cmp.2: \( \frac{1}{2} \)
  - Cmp.3: \( f \)
P4-Activity 1: Identification of mismatches

1. **Attribute-by-attribute basis**
   - Mismatches were highlighted to make them more visible in the next activity.
P4-Activity 2: Issue of observations and recommendations

1. Identification of underlying platform

2. Construction of QMs

3. Evaluation of alternatives

4. Issue of recommendations

- Mismatches were reviewed and recommendations issued
  - in relation to potential risks, alternatives to reduce cost and ambiguous technical requirements
  - To issue tradeoff recommendations all mismatches had to be simultaneously considered
    - e.g., cost
  - Aggregations of basic attribute measures into higher level ones were discouraged
    - accuracy, subjectivity
P4-Activity 3: Consolidation of the final report

- Included sections for each of the three main areas of the model
  - aggregations discouraged when making trade-off decisions and issuing recommendations...
    - ...but useful for executive summaries
  - Mismatches in relation to every subcharacteristic were counted and represented in a four-level scale (0.25, 0.5, 0.75 and 1)
    - help in the construction of radar diagrams

[Diagram showing a radar chart with various indicators such as Replaceability, Stability, Analyzability, Resource Utilization, Time Behavior, Administrative Tools Provided, Maturity, Fault Tolerance, Recoverability, and Specific Environment.]
OUTLINE

• Introduction
• The Industrial Case
• The Method Used
• Evaluation of the Approach
• Conclusions
Strengths of the approach (1/2)

1. Fosters involvement of parties in the decision-making process
   • Importance of workshops

2. Lightweight approach to requirements elicitation
   • Cost-effective
   • Requirements are unambiguous and measurable

3. Structured framework for requirements negotiation at all layers
   • Simultaneous consideration of mismatches

4. Makes evident hidden information and potential risk
   • Hidden requirements, components, costs, …
   • Unsubstantiated assumptions, …
5. Helps to establish real cost of property
   • QMs include costs that often are miss-considered

6. Makes clear the scope of suppliers’ services & legal concerns
   • Dedicated sections of the QM’s Contractual Issues area

7. Easies the issue of recommendations
   • From QM-based mismatches
Drawbacks of the approach

1. The process need some time to work
   • e.g., one supplier didn’t engaged until workshops started
   • some IT personnel were reluctant due to the possibility of changes

2. Lightweight in terms of complexity, but a bit heavy in terms of artefacts
   • hundreds of QFs
OUTLINE

• Introduction
• The Industrial Case
• The Method Used
• Evaluation of the Approach
• Conclusions
Conclusions

• Approach to support requirements negotiation based on QMs

• Points to remark
  • When
    • after main component selection instead of before
  • Why
    • support negotiation
  • What
    • non-functional technical reqts. & non-technical reqts.
  • How
    • involvement of all parties through workshops
  • What for
    • finally the platform selected was AIX/Oracle
Questions ?