WinCBAM: From Requirements Negotiation to Software Architecture Decisions

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From Software Requirements to Architectures (STRAW 2001)
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Outline

- Why Are We Here?
- Where Have We Been?
  - WinWin, ATAM, CBAM
  - An Integrated Process
  - Examples
- Where Are We Going?
Why Are We Here?

Issues Discussed

- Concurrent process between requirements negotiation and architectural design is inevitable
- But the link between all of these is currently vague.

Where Have We Been?

- A framework for successful requirements negotiation
  
  WinWin and negotiation support agents

- A method for analyzing architectural decisions
  
  ATAM

- A method for looking at the economic consequences of architectural decisions
  
  CBAM
WinWin

WinWin assists stakeholders in negotiating their requirements.

- They identify their *win conditions*.
- They negotiate the conflicts among their win conditions via a rigorous process.
The ATAM

- Presenting:
  - ATAM Steps/Business Case/Architecture
- Analysis:
  - Architectural Approaches
- Testing:
  - Scenario Brainstorming
- Reporting

- The ATAM looks at the consequences of architectural decisions in the light of the system’s stated business goals.
- It elicits and documents risks, sensitivity points, and tradeoffs among the key architectural decisions.
The CBAM

- takes over where the ATAM left off.
- It quantifies the costs and benefits of the architectural strategies that the system’s stakeholders are considering and produces a *Desirability* metric.
- It also quantifies the uncertainty surrounding these decisions.
An Integrated Process

- We propose WinCBAM:
  - an integrated process
  - allows requirements to be negotiated in terms of the Desirability (Benefit/Cost) of their realizations as architectural decisions.

- This is more comprehensive than either process on its own.
  - Requirements negotiation with risk reduction (alleviating uncertainty through architectural decision)
  - Mutual satisfied (win-win) architecture selection
  - Faster renegotiation and architecture V&V (by tracesability)
Steps of the Integrated Process

Step 1: Elicit Win Conditions
Step 2: Identify Conflict Issues
Step 3: Explore Options/Architecture Strategies (ASs)
Step 4: Assess QA Benefits
Step 5: Quantify the ASs’ Benefits
Step 6: Quantifying the ASs’ Cost and Schedule Implications
Step 7: Calculate Desirability

WinWin Spiral Model

CBAM Steps
Traceability: WinWin

Win Conditions

Requirements
Traceability: CBAM

- Business Goals
- Scenarios
  - Architectural Strategies
    - System Responses
      - Schedule
      - Cost
      - Benefits
Traceability: WinCBAM

Win Conditions

Business Goals

Requirements/Scenarios

Architectural Strategies

System Responses

Schedule

Cost

Benefits
Example 1 – Conflict Resolved

- USC/CSE Repository System
- Stakeholders developed requirements and easyWinWin was applied, e.g.

<table>
<thead>
<tr>
<th>User:</th>
<th>U2 System must be easily accessible from any location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manager</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M2 Project to be complete within two months</td>
</tr>
<tr>
<td></td>
<td>M7 Impossible for unauthorized people to access</td>
</tr>
</tbody>
</table>
Conflict Identified in Requirement Level

- Requirements U2, M7 conflict identified
- M2 also identified as a potential conflict

<table>
<thead>
<tr>
<th>Win Conditions</th>
<th>Conflicts with Win Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Direct Conflict</td>
</tr>
<tr>
<td>U1</td>
<td>S2</td>
</tr>
<tr>
<td>U2</td>
<td>M7</td>
</tr>
</tbody>
</table>
AS Implications

AS₈: Replace sockets with SSL
   Usability 0.7
   Security 0.6
   Availability 0.5
   .......

\[ \text{Benefit} = 73 \]
\[ \text{Cost} = 2 \text{ p.w.} \]

High benefit; low cost/schedule impact => conflict resolved!
Example 2 – Conflict Identified

- Requirements P5 and P8 were not identified as a conflict via easyWinWin

<table>
<thead>
<tr>
<th>Project Manager:</th>
<th>P5 Sufficient resources allocated to maintain system.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P8 Cross-communication capability of the system.</td>
</tr>
</tbody>
</table>
AS Implications

Maintainability++

P5 ← X → P8

Interoperability++

AS₉: Common message broker
Maintainbility -0.8
Interoperability 0.9
Availability -0.3

\[ \begin{align*}
\text{Benefit} &= 13 \\
\text{Cost} &= 6 \text{ p.m.}
\end{align*} \]

Low benefit; high cost/schedule impact => conflict/tradeoff found!
The Pudding

- The WinCBAM links Win conditions through to architectural decisions.
- We not only know what decision was made, but why:
  - this “why” is one that meets the stakeholders win conditions and is economically feasible and with an acceptable level of risk/uncertainty.
- This is the point of the combined method.
Where Are We Going?

- Using Desirability results to influence the choice of Win conditions and feed this back into the negotiation.
- Using Portfolio theory to choose sets of architectural strategies, rather than individual ones.
- Do a case study! (Volunteers?)