2014 SEI Research Review: Aligning Software Architecture and Acquisition Strategy

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2014 SEI Research Review: Aligning Software Architecture and Acquisition Strategy

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Purpose of Our Research

Can we improve the probability of a program’s success through a method, to be used by PMOs, that produces mutually constrained and aligned program acquisition strategy and software architecture?

Why this is important

- Software is increasingly important to the success of government programs.
- There continues to be little consideration of the software architecture in the development of either the system architecture or the program’s acquisition strategy.
- Software architecture is often over constrained by decisions made early in the acquisition lifecycle when key program choices are being made – negatively affecting program success.

Alignment among the software and system architecture and acquisition strategy does not occur naturally
Interplay of Acquisition and Architecture

monolithic legacy architecture

new modular architecture with new and legacy capabilities

Program Manager

Should I have 1 contractor, or 2 or 3 or 6?

If 1 contractor, how do I enforce a modular architecture?

If multiple contractors, how do I ensure the parts fit together?

Can I migrate legacy to give me a quick delivery?
Phase 1 Research: Characterize Failure Patterns

Reoccurring patterns of failure
- Undocumented Business Goals
- Poor Consideration of Software
- Unresolved Conflicting Goals
- Failure to Adapt
- Turbulent Acquisition Environment
- Overlooking Quality Attributes
- Inappropriate Acquisition Strategies

Phase 1 results published in SEI TN CMU/SEI-2013-TN-014: “Isolating Patterns of Failure in Department of Defense Acquisition”
Phase 2 Research: Explore Acquisition Quality Attributes

Focus research to start filling the gaps

- Captured 75 scenarios across 23 programs
  - Identify candidate acquisition quality attributes (AQA)
  - Determine how to express program-specific AQAs
  - Construct AQA scenarios
  - Analyze the scenarios
  - Build a prototype workshop to elicit AQA scenarios

Phase 2 results to be published in SEI TN CMU/SEI-2013-TN-026: "Results in Relating Quality Attributes to Acquisition Strategies"
## Candidate Acquisition Quality Attributes (AQAs)

### Original candidates

<table>
<thead>
<tr>
<th>Acceptability</th>
<th>Competitiveness</th>
<th>Modiﬁability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accountability</td>
<td>Contract manageability</td>
<td>Promptness in reporting problems</td>
</tr>
<tr>
<td>Affordability</td>
<td>Credibility</td>
<td>Responsiveness</td>
</tr>
<tr>
<td>Appropriateness of contract</td>
<td>Effectiveness</td>
<td>Responsiveness</td>
</tr>
<tr>
<td>Appropriateness of technology</td>
<td>Evolvability</td>
<td>Sensibility</td>
</tr>
<tr>
<td>Achievability</td>
<td>Fairness</td>
<td>Staffability</td>
</tr>
<tr>
<td>Accreditability</td>
<td>Flexibility</td>
<td>Suitability</td>
</tr>
<tr>
<td>Balance</td>
<td>Implementability</td>
<td>Sustainability</td>
</tr>
<tr>
<td>Commitability</td>
<td>Legality</td>
<td>Timeliness</td>
</tr>
<tr>
<td>Communicability</td>
<td>Manageability of risk</td>
<td>Traceability with requirements</td>
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<tr>
<td></td>
<td>Management visibility</td>
<td></td>
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</tbody>
</table>

### What our data showed

<table>
<thead>
<tr>
<th>Acquisition Quality Attribute</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility</td>
<td>23</td>
</tr>
<tr>
<td>Performability</td>
<td>15</td>
</tr>
<tr>
<td>Realism</td>
<td>14</td>
</tr>
<tr>
<td>Affordability</td>
<td>10</td>
</tr>
<tr>
<td>Survivability</td>
<td>6</td>
</tr>
<tr>
<td>Executability</td>
<td>5</td>
</tr>
<tr>
<td>Responsiveness</td>
<td>4</td>
</tr>
<tr>
<td>Programmatic Transparency</td>
<td>2</td>
</tr>
<tr>
<td>Innovativeness</td>
<td>1</td>
</tr>
<tr>
<td>Schedulability</td>
<td>1</td>
</tr>
</tbody>
</table>

Sources: DoD acquisition strategy guidance and instruction documents
Acquisition Quality Attribute Scenarios

Expressing AQA scenarios similarly to software QA scenarios is a viable path

Scenario from software domain:

Stimulus: An internal component fails

Environment: During normal operation

Response: The system is able to recognize a failure of an internal component and has strategies to compensate for the fault

Scenario from acquisition domain:

Stimulus: An unexpected budget cut

Environment: For a multi-segment system

Response: The program is able to move work between major segments to speed up or slow down separate segments within the available funding
What can AQA scenarios tell us?

Fundamentally, AQA scenarios can be used to

- Express business and mission goals in a way that directly influences the acquisition strategy
- Determine the appropriateness of the acquisition strategy with respect to any given scenario

Specifically, 3- and 6- part AQA scenarios can be used to identify possible incompatibilities between

- AQA scenarios
- Software QA scenarios and AQA scenarios
# Incompatibilities between Scenarios

**Stakeholder A:** advocates use of open source software as a means of increasing responsiveness to users

| Stimulus | Users request significant new functionality to be delivered rapidly |
| Environment | during the program's development phase |
| Response | create the functionality rapidly by reusing open source and software from other projects to provide much of the capability. |

**Stakeholder B:** is responsible for ensuring that the deliverables meet rigorous safety standards

| Stimulus | A new requirement to adhere to a rigorous safety standard is applied to the system |
| Environment | during the program's development phase |
| Response | The developers remove all unreachable code to insure that the system will pass stringent new certification standards. |
Prototype Elicitation Workshop

Adapted the QAW for eliciting software quality attributes

- Greater emphasis on the business goals and objectives presentation
- Replaced the architecture presentation with an acquisition strategy and plans presentation

Conducted the prototype on a real program using SEI staff that were supporting the program

- Generated 20 acquisition QA scenarios

<table>
<thead>
<tr>
<th>Acquisition Quality Attribute</th>
<th>Scenario</th>
<th>Potential Acquisition Tactic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility</td>
<td>The user’s system requirements change radically 30 days before the RFP is released when the “go live” date is fixed; the RFP is released regardless.</td>
<td>Establish fallback strategies that protect the “go live” date.</td>
</tr>
<tr>
<td>Affordability</td>
<td>We discover that the cost of operating the system will be higher than the ceiling mandates during development but before initial fielding; the system (including its architecture) is shifted to a less costly alternative.</td>
<td>Emphasize the need for architecture adaptability and flexibility.</td>
</tr>
</tbody>
</table>
Phase 3: Develop and Pilot an Alignment Method

Research questions that are focusing our work this year

• Can business goals that represent the full range of program stakeholders be explicitly defined and prioritized?

• Will having a more complete, explicit set of business goals generate a more complete set of AQA scenarios?

• Will reconciling Acquisition QA scenarios and Software QA scenarios lead to mutually constraining acquisition strategy and software architecture?

• Will a method that aligns Acquisition QAs and Software QAs be useful to a program?
Phase 3 Research: Work to Date in FY14

Business Goal Determination

Focus on capturing business goals

- Identify stakeholders
- Elicit business goals
- Represent goals in standard form*

Analyze goal subjects and objects to identify additional stakeholders

Expect the PM to carry this out

Probably applies to Mission Goal elicitation

*Business Goal Scenarios found in SEI TN CMU/SEI-2010-TN-018: “Relating Business Goals to Architecturally Significant Requirements for Software Systems”
Phase 3 Research: Work to Date in FY14

Focus on consistency of scenarios

- Just beginning this work

Hypotheses

- Needs reasonably complete scenarios
- Will require feedback to stakeholders if goals have to be modified
- Performed by PM and evaluation team
Conclusion

We’re making progress

There is more work that could be added to this year’s effort

• An assessment instrument
• Metrics
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