Cost and Quality Negotiation Aids:
QARCC (Quality Attribute and Risk Conflict Consultant)
and S-COST (Software Cost Option Strategy Tool)

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WinWin Scalability Challenges
- Tool Responses

- **Identifying potential conflicts**
  - Analyze quality interactions (QARCC)

- **Notifying appropriate stakeholders**
  - Quality Attribute/Stakeholder mapping (QARCC)

- **Generating solution options and supporting negotiation**
  - Cost conflict negotiation (S-COST)
Analysis of Quality Interactions

Some users want the system to be portable to Mac

Developer wants to build GUI using Motif because of experience

Win Condition Level

Quality Attribute Level

portability

performance

usability

architecture strategy level

Use platform-dependent user interface, efficiency features

* P : Positive Effect
N : Negative Effect

Portability layers

separation of data generation and presentation

P: Positive Effect
N: Negative Effect
Quality Attribute/Stakeholder mapping
Stakeholders enter Identify Attribute Win Condition with quality-attribute taxonomy element

Identify Attribute Strategies for Win Condition

For each attribute strategy identified, determine likely negative effects on other attributes

Send message to stakeholder indicating potential conflict with affected Win Condition.

Yes

For each affected attribute, do directly-concerned stakeholders have Win Conditions?

No

Send message to directly-concerned stakeholders indicating potential need for new Win Condition
Potential Conflict between Win Conditions on Development Affordability and Win Conditions on Assurance Due to:

- verification, specification, Firewalling
  (The techniques such as verification, specification, and firewalling can improve assurance, but increase development cost and schedule.)

- Input checking, Integrity functions
WinWin Scalability Challenges
- Tool Responses

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- Generating solution options and supporting negotiation
  - Cost conflict negotiation (S-COST)
Cost Option / Stakeholder Relationships

Stakeholder:
- General
- Public
- Interoperator
- User
- Developer
- Customer
- Maintainer

Cost-Reduction Option Strategies:
- Reduce/defer
- Relax functionality, schedule
- Improv personnel constraints
- Improve capabilities
- Improve tools, platform
- Reuse assets
- Increase budget
- Quality

Directly concerns
### Top-level Cost-Resolution Option Strategies

<table>
<thead>
<tr>
<th>Option Strategies</th>
<th>COCOMO Parameters</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce/defer functionality</td>
<td>KDSI, DATA</td>
<td>• Reduce cost, IOC, schedule</td>
<td>• Capabilities unavailable to stakeholders</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Smaller product to maintain</td>
<td>• Need to pay later if deferred</td>
</tr>
<tr>
<td>Reduce/defer quality</td>
<td>RELY, CPLX, TIME</td>
<td>• Reduce cost, schedule, complexity</td>
<td>• Stakeholders lose quality capabilities (see QARCC table)</td>
</tr>
<tr>
<td>Improve tools, techniques, platform</td>
<td>TIME, STOR, VIRT, TURN, TOOL, MODP</td>
<td>• Reduce s/w cost, schedule</td>
<td>• Increase tool, training, platform costs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Improve maintainability, other qualities</td>
<td>• Reducing tool, platform experience would increase s/w cost</td>
</tr>
<tr>
<td>Relax schedule constraint</td>
<td>SCED</td>
<td>• Reduce cost if schedule was tight</td>
<td>• Defer stakeholders use of product capabilities</td>
</tr>
<tr>
<td>Improve personnel capabilities</td>
<td>ACAP, PCAP, AEXP, VEXP, LEXP, $K/PM</td>
<td>• Reduce cost, schedule, quality</td>
<td>• Projects losing better people will suffer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Improve quality</td>
<td>• Potential staffing difficulties, delays</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Increased cost/person-month unless low-cost outsourcing</td>
</tr>
<tr>
<td>Reuse software assets</td>
<td>ADSI, DM, CM, IM</td>
<td>• Reduce cost, schedule, May gain quality</td>
<td>• Stakeholders may lose quality capabilities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Risk of overestimating reuse</td>
</tr>
<tr>
<td>Increase budget</td>
<td>Revised Win Condition</td>
<td>• May enable product to reach competitive critical mass, May increase ROI</td>
<td>• Added funds may not be available</td>
</tr>
</tbody>
</table>
### Implementation of S-COST

<table>
<thead>
<tr>
<th>Role</th>
<th>User</th>
<th>Priority</th>
<th>Target Cost</th>
<th>Estimated Cost</th>
<th>Cost Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Very High</td>
<td>$3000.00</td>
<td>$334.33</td>
<td>$354.33</td>
</tr>
</tbody>
</table>

**Target Schedule**: 35.00

**Estimated Schedule**: 26.05

**Schedule Difference**: 9.05

**Implementation of S-COST**

**Nsne**

- **Focus on Defer Strategy**
  - **Implementation**: Select Fill & Reduce/defer Functionality
  - **Pros**:
    - Reduce cost, IOC, sche
  - **Cons**:
    - Smaller produce to existing
    - Capabilities unabail

**Operation**: Select Fill

**Resolution Strategies**:

- **Reduce/defer Functionality**

### S-COST Generation Aid

- **Name**: Focus on Defer Strategy
- **DATA UPDATE**: High
- **TRAIL-COLL-CLASSIFY**: High
- **DATA INTEGRATION**: High
- **QUERY/DISPLAY CHEAT**: High

**Total**: 5854

**Target**: 5854

**Negotiation Aid**: 5854

**Pros & Cons**

- **Pros of this strategy**
  - Reduce cost, IOC, sche
- **Cons of this strategy**
  - Smaller produce to existing
  - Capabilities unabail
Conclusions

• QARCC and S-COST Strengths and Limitations
  - Strengths:
    * Provide a more thorough set of candidate issues and options with their pros and cons
    * Provide visualization and negotiation support for human users
  - Limitations:
    * Generally cannot generate situation-specific issues and options.

• We conclude that semi-automated approach is stronger than a heavily manual approach or a heavily automated approach.

Web Sites for the full papers:
1) QARCC: http://sunset.usc.edu/TechRpts/ieee-software96.ps
2) S-COST: http://sunset.usc.edu/TechRpts/compsac96.ps