SOFTWARE COST NEGOTIATION AIDS:
S-COST (SOFTWARE COST OPTION STRATEGY TOOL)

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Notes:
- S-COST is a tool for supporting to generate cost options and negotiate them.
What does S-COST do?

- It suggests options for resolving cost issues
- It provides visualization and negotiation aids for cost issue/option resolution

Notes:
- Let’s see briefly what S-COST does.
  - It suggests options for resolving cost issues
  - It notifies affected stakeholders of their availability and implications
  - It provides visualization and negotiation aids for cost issue/option resolution
- I will explain them in detail next.
### Contents

- The Problem
- Solution Approaches
- S-COST
- Conclusion

### Notes:
The Problem

- Current Agreement: a $5M, 16-month upgrade to add Satellite Surveillance data services to a Mission Data Integration Facility.
- New Rqmts: Add weather data services to the MDIF upgrade.
- COCOMO Estimate:

| $6.6M; 17.6 months |

- Problem: How to resolve this cost issue collaboratively and effectively?

Notes:

- The user, customer, and developer of a system called Strikeware have negotiated a $5 million, 16-month upgrade to add Satellite Surveillance data services to a Mission Data Integration Facility (MDIF).
- The Strikeware user has determined that it will be important to add weather data services to the MDIF upgrade.
- A COCOMO estimate for the resulting added software indicates a $6.66 M cost and 17.6 month schedule, but the customer is strongly constrained to keep to the original $5M cost and 16 month schedule.
- The problem is "How to resolve this cost conflict issue collaboratively and effectively?" How to reduce the complexity of the resolution process and how to reach a win-win situation quickly?
- How can they generate resolution options? May defer or reduce a function, but what function? and how much? Or adjust cost drivers, but what drivers? RELY, PCAP? There are many options. And each stakeholder has different options. How do they reach an agreement?
What makes it difficult to solve the problem?

- Difficulties in coordinating multiple stakeholders' interests and priorities
- Complicated dependencies and tradeoff analyses between quality attributes
- Exponentially increasing resolution option space

Notes:

- **Difficulties in coordinating multiple stakeholders' interests and priorities:** Users feel that full functionality, dependability, and ease of use are the most important attributes. Most concerns of Customers are cost and schedule. Developers are usually mostly concerned with low project risk and reusing assets. Maintainers are strongly concerned with good diagnostics and easy maintenance. Finding the middle ground among these requirements commitments is difficult.

- **Complicated dependencies and tradeoff analyses between quality attributes:** Every decision to improve some quality attributes may impact others, particularly the cost and schedule. Some requirement decisions may be not compatible with others.

- **Exponentially increasing resolution option space:** In order to resolve a conflict involving a cost overrun, several items should be considered. For example, which modules should be reduced and by how much to get the project back on track? Which modules can be degraded in terms of their quality attributes? How much of which qualities should be degraded?
A general capability to surface and negotiate conflicts and risks among requirements: *WinWin*

Capabilities to support the resolution of cost conflicts with functional and quality requirements based on early information:
- Aids for identifying cost conflicts with functional requirements: *CCCOMO*
- Aids for identifying cost conflicts with quality requirements based on early information: *QARCC*

Capabilities to generate, visualize, and negotiate potential resolution options for cost conflicts: *S-COST*

*: info. is available at USC/CSE Homepage (http://sunst.usc.edu/)

Notes:
S-COST

- S-COST Concept of Operation
- S-COST Internal: how does S-COST work?
  * Support Option Generation
  * Support Option Negotiation
- Conclusions
Notes:

- Using WinWin system, stakeholders enter their new win conditions. These may involve functions, quality goals or constraints. Using Priority and Taxonomy Elements of Win Condition schema, QARCC examines its architectural and process strategies to search for potential conflicts.
- To sharpen QARCC’s identification of cost-conflict, COCOMO estimates the project cost. If the resulting estimated cost exceeds the target cost, a new cost-overrun issue is drafted in WinWin.
- S-COST operates on the Issue and COCOMO estimate information such as target and estimated cost, size, priorities, cocomo cost drivers, functional requirements, and quality requirements.
- Using S-COST, the stakeholders suggest potential options, negotiate them, and converge on a mutually satisfactory (win-win) combination of options. They draft a WinWin agreement schema and follow WinWin’s procedures for voting on and adopting the Agreement.
How Does S-COST Work?

- It suggests options for resolving cost issues
  - Using Cost:Resolution Option Strategies
- It provides visualization and negotiation aids for cost issue/option resolution
  - By Visualization Windows for Option Generation
  - By Visualization Windows for Option Negotiation

Notes:
- I will explain what happens inside of S-COST.
- /* read a slide */
## Top-level Cost-Resolution Option Strategies

<table>
<thead>
<tr>
<th>Option Strategy</th>
<th>COCOMO Parameter</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce cost</td>
<td>RED, DATA</td>
<td>Reduce costs, IDC, and schedule</td>
<td>Cost savings are marginal in most cases, need to pay for hard work</td>
</tr>
<tr>
<td>Architecture and risk resolution</td>
<td>RELY, ORA, TIME</td>
<td>Reduce costs, time, and schedule</td>
<td>Risk assessment and control, architecture thoroughness, including verification of architectural specifications (RESL)</td>
</tr>
<tr>
<td>Reuse software assets</td>
<td>PCAP, ADAP</td>
<td>Reduce costs, time, and schedule</td>
<td>Risk assessment and control, architecture thoroughness, including verification of architectural specifications (RESL)</td>
</tr>
<tr>
<td>Improve process maturity level</td>
<td>PMAT</td>
<td>Reduce costs, time, and schedule</td>
<td>Risk assessment and control, architecture thoroughness, including verification of architectural specifications (RESL)</td>
</tr>
<tr>
<td>Improve development flexibility</td>
<td>FLEX</td>
<td>Reduce costs, time, and schedule</td>
<td>Risk assessment and control, architecture thoroughness, including verification of architectural specifications (RESL)</td>
</tr>
</tbody>
</table>

**Notes:**

- This table shows the top-level option strategies for resolving cost issues.
- Architecture and risk resolution, which reduces cost by reducing the program's risk and database (DATA) size, at least for the Initial Operational Capability (IOC).
- Reduce cost by reusing software (RESL) on performance (TIME) constraints, by leveraging the complexities (PCAP) of providing such capabilities as graceful degradation in information security, or by reducing documentation (DATA).
- Improve tools, techniques or platform, via a platform that is more powerful (PMAT, CMM, ORA) or via better software tools (PCAP).
- Relax the delivery schedule constraint (FLEX).
- Improve process maturity level (PMAT).
- Improve development flexibility (FLEX).
- Increase budget. This can be justified if the current win condition budget is insufficient to generate a critical mass competitive product, or if the return on investment (ROI) is sufficiently increased. Of course, this option strategy cannot be used if added funds are not available (Table 3 shows the option strategy's Pros and Cons shown in columns 3 and 4 of table 3).
Cost-Resolution Option Strategies (Cont'd)

- Reduce/defer functionality
  - COCOMO cost drivers: KDSI, DATA
  - Pros: Reduce IOC cost, schedule; Smaller product to maintain
  - Cons: Capabilities unavailable to stakeholders; Need to pay later if deferred

- Improve tools, techniques or platform
  - COCOMO cost drivers: TIME, STOR, PVOL, TOOL, SITE.
  - Pros: Reduce s/w cost, schedule; Improve maintainability, other qualities
  - Cons: Increase tool, training, platform costs; Reducing tool, platform experience would increase s/w cost

Notes:
Notes:

• Reducing reliability or performance may be acceptable options for some stakeholders but not for others.

• S-COST uses the cost option/stakeholder relationships in the figure to notify the appropriate stakeholders of options which may have first-order consequences for them.

• For each of the options in Table 1, the figure shows the stakeholders who would generally be directly concerned with the exercise of the option.

• Thus, for example, "Increase budget" can potentially affect any of the stakeholders by providing them more capability, but the directly-concerned stakeholder is the Customer, who must find a way to justify and obtain the budget increase.
Notes:

- S-COST has several capabilities to help stakeholders determine cost resolution options, visualize their impact on the problem situation, and negotiate a new win-win solution.

- The target icon represents the target cost. This boxes represent functions. The displayed functions is based on the priorities of the stakeholders' functional win conditions and the corresponding COCOMO estimates of the module's cost contribution.

- Using this display, the stakeholders could simply drop or defer the lowest-priority modules until the cost target is reached. And they can draft a resolution option.

- To draft better options, they can split a module into higher and lower priority modules, or adjusting other cost drivers such as personnel capability and experience, improved tools, or software reuse by applying the cost option strategies, or raising the target line if customer can be justified and feasible.

- The Cost-Reduction strategies button brings up a menu containing the cost resolution strategies described in Table 1, which will be discussed later. Each strategy has parameters which can be defined or adjusted once the strategy has been selected. This is done in the Option Generation area.
Visualization for Option Generation (Cont'd)

Notes:
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- Another mode, which is obtained via the MODE button in the pulldown menu bar, provides the option negotiation area.

- This area summarizes the status of negotiating a combination of Options suggested by the various stakeholders. The Options are displayed by originating stakeholder and by the option's stakeholder-assigned priority.

- Stakeholders can propose and agree to select or un-select Options, move their priorities up or down, or go back to Option generation mode to draft new options. As changes are made, the strategy agreements and their cost effects are summarized in this area.

- The stakeholders continue to interact with S-COST and each other until they converge on a win-win cost reduction strategy with no win-lose side effects. At that point, the stakeholders can return to the WinWin system.
Conclusions

• S-COST Strengths:
  - Provides a more thorough set of candidate cost-resolution options and analysis of their pros and cons
  - Provides visualization and negotiation support for human users

• S-COST Limitations:
  - Generally cannot generate situation-specific options.

• Conclusion: semi-automated approach is stronger than a heavily manual approach or a heavily automated approach.
  - Exploits strengths, avoids limitations of automated aids

Notes: