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“Improving Software Acquisition Processes: A Study of Real Project Costs”

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Outline

§ Real and Hidden Costs in Software Acquisition

• Software Acquisition Issues
• Research Background
• Research Results
• Impact of the Hidden Cost

§ Conclusions
Role of Organizations and Software Projects

Organization is sole developer (In-House Projects)

Organization contracts for software (Out-House Projects)

Organization is prime, with one or more external subcontractors

Domain of interest
“A major problem that has been recognized in acquisition of software intensive systems is management practices. The problem is characterized as continued failure of large software intensive acquisition and development efforts to meet cost, schedule, and/or performance goals. An immature acquisition organization can doom a software intensive project to failure as surely as an immature software development organization.”

From the SEI Web Site
Software Cost Estimation Issues

Rationale for Cost Estimation

- Cost estimation supports the planning and control functions of project management:
  
  Develop Project’s schedule
  
  Budget
  
  Allocate personnel and resources

- Cost Estimation is needed in economic analysis to support strategic decisions for software acquisition or development.
Software Cost Estimation Issues

Problems in Current Estimation Methods and Tools

- Focus primarily on the technical resources needed for developing the software product.
- Do not produce estimates for and do not take into consideration the cost of the contracting organization cost i.e. the “hidden cost”
Software Acquisition Issues

Examples of costs incurred by a Contracting Organization:

- user and management time and effort before and during acquisition
- hardware & software resources to manage the acquisition
- cost of domain experts
- milestone reviews
- testing activities
- quality assurance oversight
- travel
- user training

“hidden costs” → RISKS
Research Background: Acquisition and Estimation Process Improvement Goal

- Point out the need for improvements in software cost estimation processes for a contracting organization.
- Point out the need to improve the acquisition processes by planning the needed contracting organization resources and making them available when needed.
- Contribute to the refinement of the available software estimation models by examining the contracting organization user and management costs i.e. the hidden cost which is ordinarily not factored into such models.
- Encourage a quantitative approach in collecting acquisition costs within an organization so that databases of completed projects can be used to forecast costs for future projects.
Research Background: The Big Questions

• **Do contracting organisations have formal processes for the estimation of their resources involved in contracted software projects?**
• **Are there costs incurred by such organisations that are not accounted for in the project budget that can be considered hidden?**
• **What is the magnitude of such a cost? Can it be modelled?**
• **Is this cost included in any economic analysis or feasibility of the project?**
Research Background

Approach: Using the SA-CMM Processes

- SA-CMM, a product of Collaboration between Carnegie Mellon’s Software Engineering Institute and the Department of Defense
- SA-CMM is a capability maturity model for acquisition organizations that acquire or procure software-intensive systems.
- A framework that provides acquisition organizations with guidance on how to gain control of their software acquisition processes
- The framework describes the key elements of an effective software acquisition process … and … an evolutionary improvement path for acquisition organizations from an ad hoc, immature process to a mature disciplined one.
- The goal:
  - Improve the acquisition processes for software intensive systems
  - set senior management goals for improvement
  - enable prediction of potential acquisition process performance
## Research Background

**Approach: Using the SA-CMM Processes**

### The SA-CMM Framework

<table>
<thead>
<tr>
<th>Level</th>
<th>Focus</th>
<th>Key Process Areas</th>
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</thead>
<tbody>
<tr>
<td>1 Initial</td>
<td><em>Competent people and heroics</em></td>
<td>Transition to Support</td>
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<td>. Evaluation</td>
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<td>. Contract Tracking and Oversight</td>
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<td>. Project Management</td>
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<td>. Requirements Development and Mgt</td>
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<td>. Solicitation</td>
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<td></td>
<td></td>
<td>. Software Acquisition Planning</td>
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<td>2 Repeatable</td>
<td><em>Basic project management</em></td>
<td>. Training Program</td>
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<td>. Acquisition Risk Management</td>
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<td>. Contract Risk Management</td>
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<td>. Project Performance Management</td>
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<td>. User Requirements</td>
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<td></td>
<td>. Process Definition and Maintenance</td>
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<tr>
<td>3 Defined</td>
<td><em>Process standardization</em></td>
<td>. Quantitative Acquisition Management</td>
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<td>. Quantitative Process Management</td>
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<tr>
<td>4 Quantitative</td>
<td><em>Quantitative management</em></td>
<td>. Acquisition Innovation Management</td>
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<td></td>
<td>. Continuous Process Improvement</td>
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<tr>
<td>5 Optimizing</td>
<td><em>Continuous process improvement</em></td>
<td>. Acquisition Innovation Management</td>
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<tr>
<td></td>
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<td>. Continuous Process Improvement</td>
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</tbody>
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Research Background

Highlights of Respondents/Projects:

- Broad range of companies and government agencies
- 26 different projects studied
- Contracts ranged from $30K to $50M
- Respondents understood all aspects of the contracted project
Research Results

- Faulty Estimation Processes -- majority of contracting orgs.:
  - Do not estimate resources for oversight of contracts (88%)
  - Do not have formal planning processes for scheduling resources (65%)
  - Do not collect metrics on project resources (81%)
  - Do not include cost of contract oversight in total project cost (88%)
  - Do not include costs of resources in economic analysis or feasibility studies (75%)
Research Results (continued)

- **Distribution of Hidden Costs**
  - May exceed total project costs (in man months)
  - The mean value of the hidden cost for the surveyed projects was measured at 190% of the development cost.
  - There is a linear relationship between hidden costs and project size:
    \[ M = 2.2 \times \text{KLOC} + 52 \]  (person months)
  - By phase, the greatest is user and manager involvement in the systems analysis phase
Distribution of the Hidden Cost by Phase and Labor Category

Hidden Cost
Percentage Distribution by Phase

Hidden Cost
Percentage Distribution by Labor Category
Distribution of Hidden Cost (continued)

![Distribution of User Resources](image)

![Distribution of Management Resources](image)
### Respondents’ Opinion on Impact of Hidden Cost

<table>
<thead>
<tr>
<th>Factor</th>
<th>Observation</th>
<th>Observed %</th>
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<tbody>
<tr>
<td>Impact on Cost</td>
<td>Negative</td>
<td>91</td>
</tr>
<tr>
<td>Impact on schedule</td>
<td>Negative</td>
<td>88</td>
</tr>
<tr>
<td>Impact on deliverable quality</td>
<td>Negative</td>
<td>82</td>
</tr>
<tr>
<td>Impact on final product quality</td>
<td>Negative</td>
<td>91</td>
</tr>
<tr>
<td>Impact on the Quality of Project Management</td>
<td>Negative</td>
<td>91</td>
</tr>
<tr>
<td>Impact on contractor/customer relations</td>
<td>Negative</td>
<td>93</td>
</tr>
<tr>
<td>Impact on user/customer personnel performance and morale</td>
<td>Negative</td>
<td>79</td>
</tr>
<tr>
<td>Impact on personnel working conditions</td>
<td>Negative</td>
<td>85</td>
</tr>
<tr>
<td>Impact on stress level</td>
<td>Negative</td>
<td>82</td>
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Research Results (continued)

- Estimation of hidden costs is rarely done
- Collection of hidden cost metrics is rare
- Hidden costs are incurred and are considerable
- Because they are hidden, they are not managed
- Hidden costs imply project risks
Risk Categories

Primary Areas of Risks

• Customer Internal Risk Sources:
  • Inaccurate estimates of effort (time, scope, $)
  • User availability and involvement
  • Specification of customer requirements

• Risk Sources in the Customer/Contractor Interface
  • Mutually accepted ambiguous contract
  • Ill-defined interfaces
  • Antagonistic interfaces
  • Loosely defined checkpoints
  • Contractor Internal Risk Sources

• Contractor Internal Risk Sources
Success Factors for a Contracted Project

- A formal, institutionalized, software acquisition project management process model will require that the organization plan all aspects of the acquisition
  - Manage software requirements,
  - Plan resources and availability
  - Track project team and contractor team performance,
  - Manage the project’s cost and schedule baselines,
  - Evaluate the products and services
  - Transition the software to its support organization.

- Risk management must be integrated into all aspects of the project; how to identify and manage risks.
  The cost and risk impacts of not improving software acquisition processes are substantial.

Future Research: Use of Knowledge Management
Some comments from Participants

“Failure to include the oversight cost in original estimates can result in having to forego oversight activity to the detriment of the project. It can also result in embarrassment when the true cost of the project becomes apparent.”

“Unbudgeted work by end users, managers and executives that get taken away from the main business become very large on enterprise scale projects.”

“I may be a little cynical, but it seems to me that the software estimation methodology most important to use in complex integrated software/hardware systems is whatever the software project manager's management will believe.”

“This work is very important. I would like to have a copy of the results when they are available to encourage more organizations to plan for all that is necessary to make a project successful and optimize business resources who have the critical knowledge the business needs to get into their systems.”
"Improving Software Acquisition Processes: A Study of Real Project Costs"

Questions?