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

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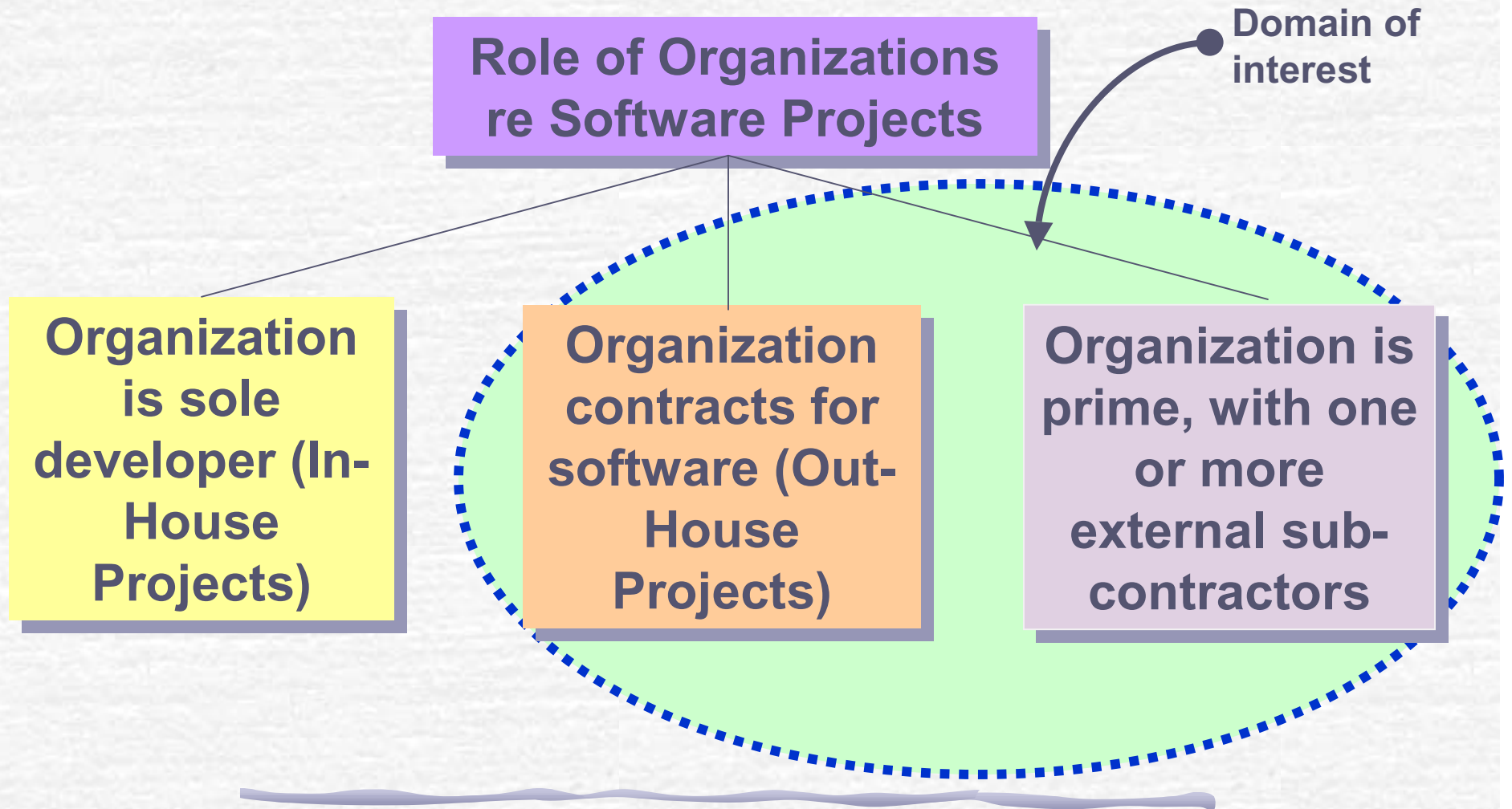
Outline

§ 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



Software Acquisition Issues

“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.
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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

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

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%)

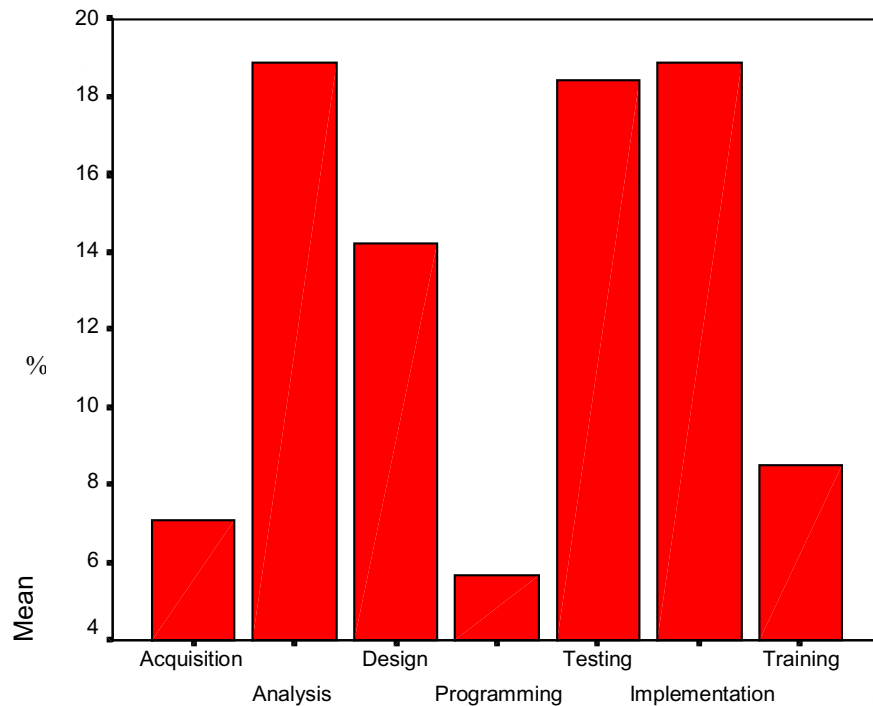
Research Results (continued)

- 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:
$$M = 2.2 * KLOC + 52 \text{ (person months)}$$
 - By phase, the greatest is user and manager involvement in the systems analysis phase

Distribution of the Hidden Cost by Phase and Labor Category

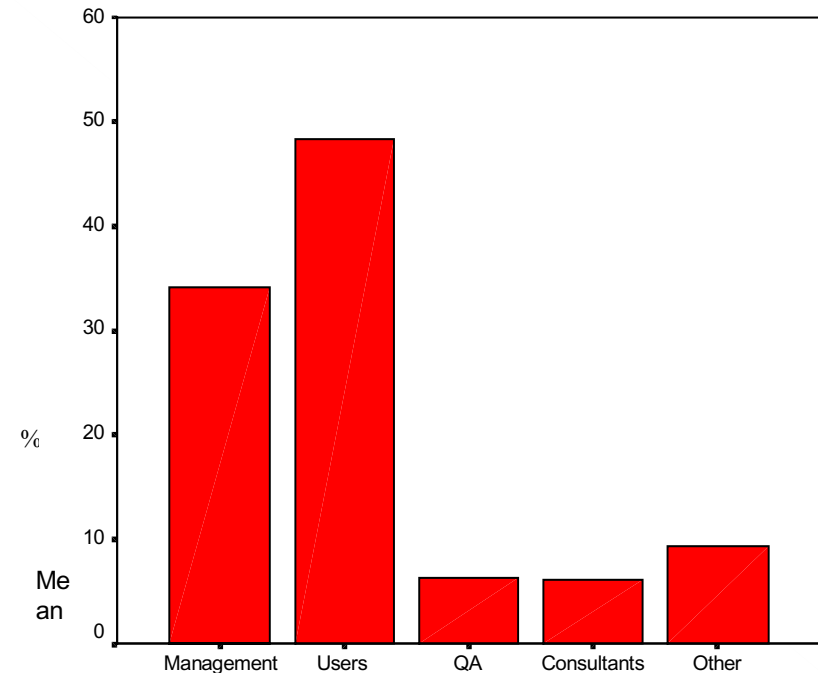
Hidden Cost

Percentage Distribution by Phase



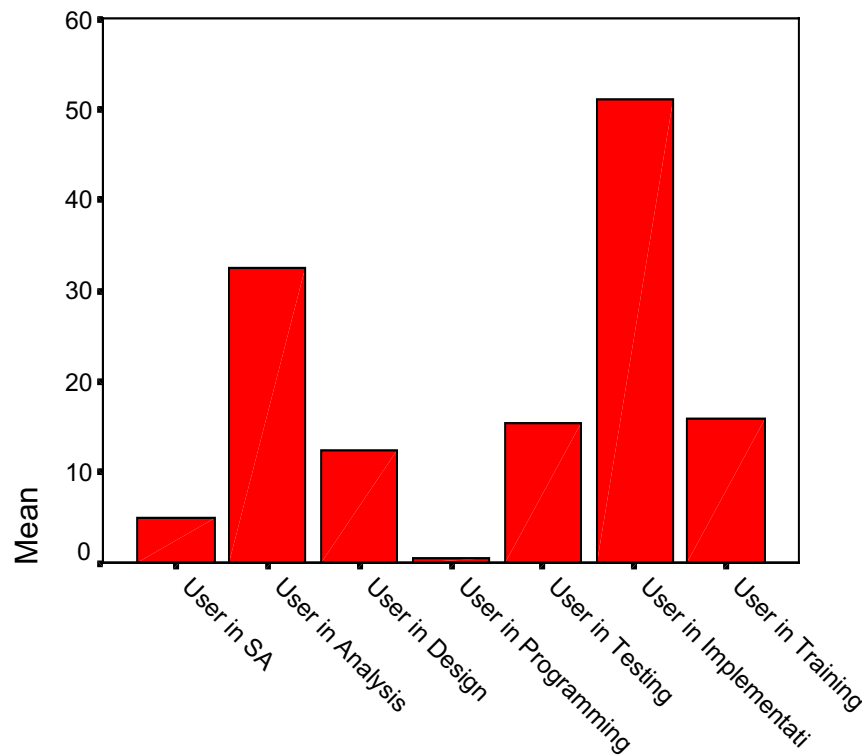
Hidden Cost

Percentage Distribution by Labor Category

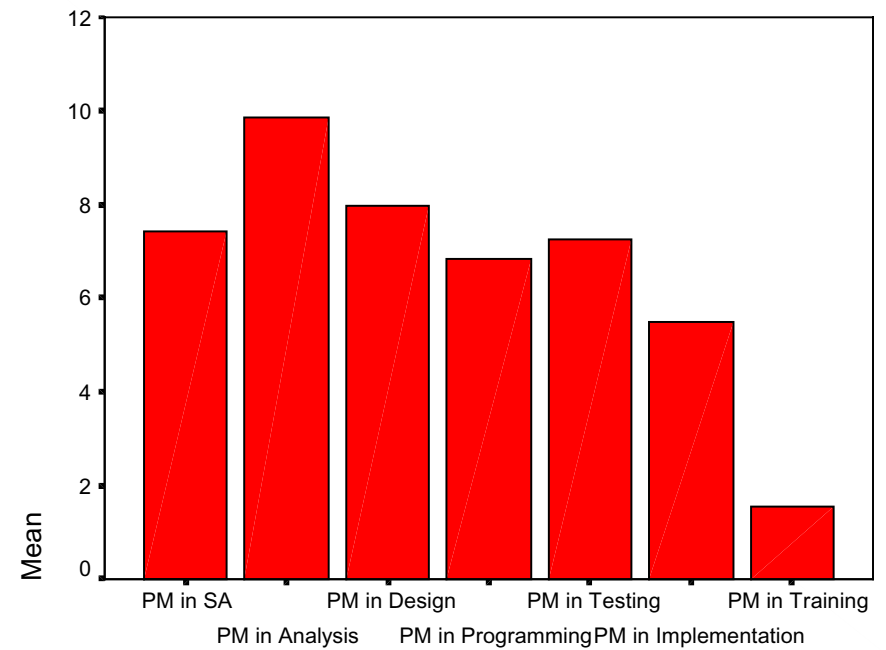


Distribution of Hidden Cost (continued)

Distribution of User Resources



Distribution of Management Resources



Respondents' Opinion on Impact of Hidden Cost

Factor	Observation	Observed %
Impact on Cost	Negative	91
Impact on schedule	Negative	88
Impact on deliverable quality	Negative	82
Impact on final product quality	Negative	91
Impact on the Quality of Project Management	Negative	91
Impact on contractor/customer relations	Negative	93
Impact on user/customer personnel performance and morale	Negative	79
Impact on personnel working conditions	Negative	85
Impact on stress level	Negative	82

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
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Conclusions

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.”

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A Study of Real Project Costs”**

Questions ?