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Resource estimation of information systems projects: A case study

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ABSTRACT

Estimating resource requirements on any project is challenging and this is certainly the case for Information Systems (IS) projects. The impact of resource estimation of I/S projects has far reaching consequences, for the individual, the team, and the organization as a whole. In spite of its critical importance, estimating project resource requirements is still somewhat arbitrary and ad hoc in many organizations. This paper presents a case study about a large insurance company and its efforts to develop and implement a successful estimation model for IS projects. The impact of this methodology on productivity and cost savings is also outlined. Planed improvements to the current methodology are discussed.

INTRODUCTION

It is common knowledge that cost overruns and missed timelines are typical in many IS projects. Popularly referred to as 'runaway projects' the economic impact of IS project failures is quite staggering. It is estimated that less than one in 10 large MIS projects succeed (Hume, 1997). According to project management analysts, 40 percent of all IS projects fail, costing U.S. businesses approximately $100 billion annually (Field, 1997). Clearly, resource estimation and allocation plays a crucial role in the success of a project.

However, estimating the cost and duration of a project is a difficult and challenging task (Chatzoglou & Macaulay, 1996). In many cases, schools and universities fail to pay adequate attention to resource estimation skills and many IS project managers rely on their individual experience, expertise, and intuition to be successful in this phase of project management. In the absence of formal education in estimation methods, managers attempt to build a formal or informal cohesive and comprehensive knowledge repository of lessons learned from their past experiences. They tap into this repository of knowledge when called upon to develop estimates for new projects. This is often referred to as 'estimation-by-analogy' and is one of the most popular

methods of generating project estimates (van Genuchten & Michiel, 1991). However, unless managers have a rigorous method to gauge the similarity between current projects and past projects, this method quickly becomes 'guessing-by-analogy' rather than 'estimating-by analogy' (Phan et al., 1995).

Furthermore, even managers who understand how to estimate the overall needs of a project often have a difficult time estimating the resources required for each task within the project. Unfortunately, without a clear and useful estimation model, it is difficult to transfer this knowledge to new members of a team. Further, in such cases estimation becomes a guess, a process that is difficult to repeat or justify. An estimation method, unlike a guess (educated though it may be), helps individuals to arrive at a repeatable result. An estimation method helps managers to not only identify all factors that influence project costs, but also understand the interplay between these factors. Hence, it is important to focus on developing estimation methods that all project members can utilize. While several estimation software packages were developed as early as the mid-1960s, companies are reluctant to use them (Kumar & Ganesh, 1998). In fact, one study found that fewer than a quarter of project managers use such tools (van Genuchten & Koolen, 1991). This is because the software may be too restrictive, unfriendly, or simply does not fit the development methodology that the company uses. Further, different software estimation models give different cost estimates for the same data.

Project estimation is not a one-time activity, but is instead a continuous process. Resource estimation is a critical activity as early as the feasibility analysis stage of a project. In fact, resource estimation is so critical that it may lead to successful project launches or project rejections. Over-inflated estimates cause suspicion and under-estimated projects lead top managers to believe that IS lacks the knowledge to successfully implement the project. Once the project is approved in concept, project managers develop an estimate of time, cost, materials and manpower required to complete the project and then submit it for approval to the finance department. Once the project is launched, project managers closely monitor variances between resource goals and resource consumption. Further, as needs, perceived or otherwise, change managers must reallocate limited resources in a fair, equitable, and practical way. Thus, project estimation is a continuous activity and any miscalculation along the way can lead to significant economic and morale losses.

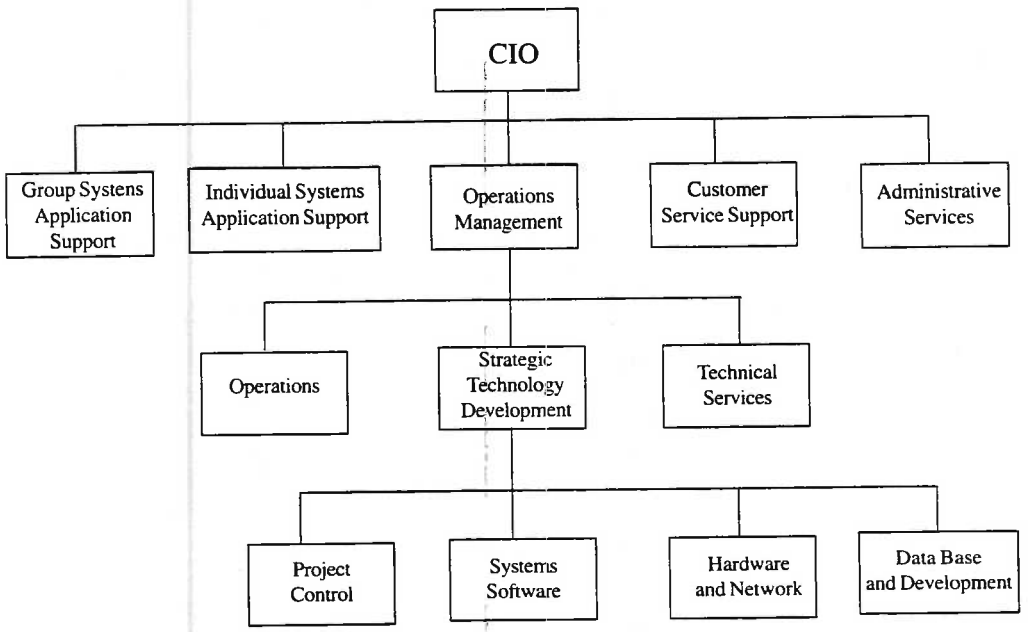
Project estimation has a serious and direct impact on the success of a project. Delayed projects can quickly become a competitive disadvantage in a fast-paced business environment. Losses in terms of productivity, profits, market responsiveness, and customer satisfaction can sometimes be traced to projects that failed. Also, the careers of project managers and senior team members sometimes rest on their ability to meet resource and time deadlines. Further, it also influences the moral team members and shapes the expectations and trust that other departments in the organization have in the IS department. Thus project estimation is a vital and critical activity for the project manager, the IS department, and the organization as a whole.

In the next section, we describe a case study that shows how a company custom built a meaningful estimation process and used it to monitor and implement successful projects.

A CASE STUDY

Mutual of Omaha is an insurance company with its headquarters in Omaha, Nebraska. It sells and services a broad range of insurance products (health, life, disability, and other insurance products) to customers around the world. The company's information systems are centralized in Omaha. The IS Operation, which operates mainly out of Omaha, consists of the following divisions: Operations Management, IS Customer Service Support, Administrative Services, Group/ Corporate Applications Support, and Individual Systems Application Support. Within the Operations Management division, the Strategic Technology Area was created to support development and implementation of strategic technologies for the Companies. See Figure 1.

Figure 1. Organizational Chart for Strategic Technology Development



Organizational Structure

A few years ago, like many other IS shops, the IS operation at Mutual of Omaha was made up of teams designed to support specific technologies such as mainframe, midrange, LAN, and so on. However, this led to a very parochial and narrow view of technology and its application to the overall success of the business. The teams were consumed in day-to-day operations and putting out fires, rather than assuming a long-term posture that would help the company embrace new and innovative technologies to leverage growth and profits. Clearly, this was not the fault of the team. Instead, the organizational structure was inhibiting the ability to take a long-term view of what needed to be accomplished. Since the business drivers were forcing substantial change to the infrastructure, in June 1997, the company created a new area to focus exclusively on infrastructure projects that were of strategic importance to the company. The new area was called *Strategic Technology Development* (STD) and was housed under the Operations Management Division. Please see Figure 1, organizational chart of the IS department at Mutual of Omaha.

The Strategic Technology Development area consists of four teams: Systems Software, Network and Hardware, Database and Development Tools; and Project Control. The first three groups consist of a manager and a number of technical staff. The Project Control group, on the other hand, is made up of one manager and several project managers of different projects. The area is run as a matrix organization. All projects are managed by the Project Control group, which in turn draws resources from the remaining three groups, and if necessary from teams and vendors outside the area. The projects range in size from $4.5 million and 4,700 workdays to projects that are 100 days and around $60,000.

Since this was a major effort in the organization using matrix management, the area decided to develop several new supporting processes. One such process was to develop a database of all PWW (Project Workbench for Windows) work plans. The area then generated all project reports based on the work plans. For example, one of the key reporting processes in the company is a report that reviews staff needs based on upcoming work plan requirements. Human resource managers use this report to determine the kind of technical skills and the number of technical staff (UNIX System programmers, DBAs, etc.) the area will need in the short term to successfully complete projects. Another new process that was spawned from the matrix organizational setup was using the repository of work plans to develop activity plans for the following year based on proposed projects. Proper staffing became a pressing issue because the company was implementing more than 12 major projects involving up to 60 full time staff members and more than 20 part-time resources to supplement staffing needs.

PROJECT PROCESS

The project approval process at Mutual of Omaha is structured and streamlined. A project board consisting of a project sponsor, a technical representative, and one or more business representatives, approves all major aspects of a project. Project managers are responsible for answering the following questions in detail:

- What will the project accomplish?
- When will the project be completed?
- How much will the project cost in workday effort and other expenses?

The above process is called the stage commitment and the answers to the above questions are answered in detail in a commitment document.

At the end of the project, a *stage end assessment document* shows the actual consumption of resources. The *sponsor and other members of the project board then review the stage end document.* This group carefully analyzes the resources consumed by the project and evaluates if resource consumption exceeded, met, or fell below the estimates outlined in the commitment document. The ability of project managers to meet the commitments outlined in the commitment document is factored into their annual incentive. Due to the confidential nature of the incentive plan, the authors are not at liberty to discuss the incentive plan.

The Estimation Challenge

As senior management and project managers began to track the success of the company in meeting resource commitments outlined in the *commitment document* it became clear that there was plenty of opportunity for improvement. Further analysis revealed that IS teams had an excellent track record for completing the "what" features of a project. In other words, Project teams were highly successful in meeting the technical specifications of a project. However, when it came to estimating the time, cost, and manpower requirements for a given project, the teams fell short. As management began to look for the root cause of this problem, managers narrowed in on the estimating skills of the teams. It was clear that many project managers were skilled at managing the smooth flow and implementation of large projects, where someone else had developed the estimates. Under the new environment, when these managers were called upon to develop project time, cost, and manpower estimates, they found themselves in uncharted territory. To complicate matters further, many project staff members were new contractors or employees who were not familiar with estimating the resources necessary to complete a task in this new environment. Management realized the importance of estimation skills for project managers and took the innovative step to train staff on basic estimating techniques. Managers also developed some simple metrics to assess the value and impact of this training on IS staff and project managers.

Training in Project Estimation

Many technical personnel understand the importance of project estimates to the success of a project. However, as indicated earlier, few IS professionals receive formal training in estimation methodologies as it applies to projects in a company. To add to the problem, few companies hold their managers fully accountable for their estimates. There is a sense of *deja vu* when it comes to estimates and their validity. Mutual of Omaha hold training classes on the company's IS application development and project management methodology, which provides for the capability to apportion a high-level project forecast across a work breakdown structure, using a top

down approach, in predefined templates. In addition, the training covers the various methods, which can be used to develop, project or task level estimates. Senior management felt that incorporating estimation skills as a component within the training classes on system methodology would be a good starting point. In the case of task estimating, the principle of 'short interval' tasks was adopted as a basic precept. The shorter the task duration, the easier it is to 'size' i.e., estimate the time or effort associated with the completion of the task. It follows that the greater the degree of task refinement, the higher the probability of arriving at a relatively accurate time estimate. It is much easier to visualize the effort to be expended over a shorter interval of time. A sound and detailed work breakdown structure (WBS) is the key to this process. Once the proper tasks are defined at a sufficient level of detail, different techniques may be applied in arriving at the task completion estimate (e.g., past experience with tasks of a similar nature, modeling, or prototyping).

In addition to the overall training on estimating, one manager assumed the charge for developing additional training materials and measurement processes, for task level estimating, to be used within the Strategic Technology Development area.

Establishing the Culture

Estimating the work effort at either the project level or task level is a critical component in the management of a project. Various techniques have been attempted in the past; however, none have proven very reliable or successful. It is an extremely complex process that is complicated even further by the myriad of factors that may have an impact on the estimate. The first step taken by the Strategic Development Technology Area was to emphasize the importance and value the company placed in the estimation skills of IS staff and project members. In order to nurture a learning culture, trainers emphasized several important themes:

- Develop a knowledge repository that taps into the estimation skills and experiences of other project managers.
- Encourage participants to learn from their own past failures and those of others.
- Early discussions revealed that new employees who could greatly benefit from the experiences of senior staff never consulted them for fear of coming across as inexperienced. The idea that estimates are not built in isolation, but instead rely heavily on teamwork and participation was therefore heavily emphasized.
- Encouraged participants to view estimates as part of a commitment.
- Explain the relationship between estimates and project incentives.

The training for estimating work processes was broadly divided into four components:

1. Introduction to estimation
2. Statement of work
3. Measurement
4. Questions and Answers

Figure 2. Form Used for Estimating Project Resources

TEAM WORKPLAN REVIEW

The following project team members have reviewed the attached workplan and have provided the estimates for the tasks they have been assigned. They have also reviewed the estimated compleiton dates. Based on this, we recommend that this stage should be committed for the following work days and estimated completion date.

Project ID	
Stage ID/Name	
Estimated Stage Workdays	
Estimated Stage Completion Date	

Team Member	**Signature**
Project Manager:	
Tech Lead:	

Facilitating ISM: _____

The training covered several important themes including estimation components, reasons why projects fail, types of estimates, characteristics of estimating projects, and detailed discussion on the following estimation techniques:

- Aggregation
- Apportionment
- Consensus
- Comparable case and history
- Extrapolation
- WAVE

Details of each of the above estimating techniques are beyond the scope of this paper.

Area participants were also trained in the Statement of Work (SOW) processes. This training included an overview of SOW processes, activities, timing, and the participants involved. Finally, participants were told that all estimates would be subject to measurement against a pre-established benchmark. The plan was to develop a baseline for all estimates and then use statistical measures to develop comparisons between estimate and actuals. A report of variances would then be submitted to the manager for further analysis. A report of variances would then be submitted to the manager for further analysis. Analysis and discussions regarding this report was not handled in a punitive manner, but instead was performed to emphasize that estimation is a team activity that requires learning and relearning. This approach emphasized several key issues that were instrumental in enhancing the estimation skills of employees:

- It encouraged employees to use appropriate techniques when estimating.
- It encouraged employees to validate their estimates with more experienced personnel.
- It encouraged employees to learn from their successes and failures and thus continuously hone their estimation skills.
- It forced them to become active participants in evaluating and monitoring their own performance.

The training conveyed the message that estimation was no longer a guessing game. Instead, project estimates were viewed as vital components to the success of a project. It also led to employees playing a more active and involved role in the estimation process.

EVALUATING PROJECT ESTIMATES

Concurrent with developing and delivering the estimating training, the area also developed a coaching report based on a Microsoft Access database used to identify, monitor, analyze, and evaluate project estimates. The following data relating to estimates was collected from project reports and entered into the database:

- Project ID
- Stage ID

- Task Name
- Baseline Start Date
- Actual Start Date
- Baseline End Date
- Baseline Hours
- Actual Hours

Based on this information, two reports were generated for area personnel and project managers. See Figure 3 (Completed Tasks Coaching Report) and Figure 4 (Completed Tasks Coaching Report - With Detail).

Figure 3. Completed Tasks Coaching Report

Date:

Resource: (Name of Individual)

Work Hours Consumer	**Year to Date**	**Month to Date**
Total Baseline Hours:	774	71
Total Actual Hours:	743	56
Total Variance (Absolute Value):	144	24
Total Tasks	111	16
Met Baseline:	103	14
Percent Baseline Met:	93%	88%
Exceeded Baseline:	8	2

Deliverables/Tasks Completed On Time	**Year to Date**	**Month to Date**
Deliverable Date Met:	95	13
Percent Deliverable Met:	86%	81%
Deliverable Date Missed:	16	3

Figure 4. Detailed Completed Stage Coaching Report

Completed Stage Coaching Report - with Detail
For September 8/31/98 thru 9/25/98

Resource	Project		Task Name	Baseline Start Date	Actual Start Date	Baseline End Date	A E D
Analyst Name	IRC0P20	B9	Gather Unique Business Requirements	8/29/98	8/29/98	9/22/98	
	IRC0P20	B9	Gather Hardware & Software Inventory Information	8/21/98	8/21/98	9/22/98	
	IRC0P20	B9	Plan/Deliver Kickoff Meeting	8/24/98	8/24/98	9/2/98	
	IRC0P20	B9	Perform Component Testing for Business Unit	8/21/98	8/21/98	9/1/98	
	IRC0P20	B9	Review Software Requirements & Make Recommendations	8/25/98	8/25/98	9/22/98	
	IRC0P20	B9	Perform CAT Testing for Business Unit	8/21/98	8/21/98	9/1/98	
	IRC0P20	C1	Design Desktop for Business Unit	8/11/98	8/11/98	9/18/98	
	IRC0P20	C1	Review Software Requirements & Make Recommendations	7/20/98	7/20/98	9/1/98	
	IRC0P20	C1	Plan/Deliver Kickoff Meeting	9/15/98	9/15/98	9/15/98	
	IRC0P20	C1	Gather Unique Business Requirements	7/15/98	7/15/98	9/18/98	
	IRC0P20	C1	Reveiw Software Requirements & Make Recommendations	8/3/98	8/3/98	9/18/98	
	IRC0P20	C1	Review Hardware Requirements & Make Recommendations	8/11/98	8/11/98	9/1/98	
	IRC0P20	C1	Perform Component Testing for Business Unit	8/27/98	8/27/98	9/22/98	
	IRC0P20	C1	Gather Hardware & Software Inventory Information	7/29/98	7/29/98	9/15/98	
	IRC0P20	C1	Review Software Requirements & Make Recommendations	8/10.98	8/10/98	9/15/98	
	IRC0P20	C1	PReliminary Software Inventory Information	8/11/98	8/11/98	9/11/98	

The primary purpose of the Coaching Reports was to provide managers with a measure of the estimating abilities of their staff. Managers receive Coaching Reports on a monthly basis. It is up to the manager to be proactive in how the reports are used to enhance the estimating abilities of his or her staff. The first time the reports were provided was in a team meeting. Area management explained and reemphasized that the goal was not to punish people who strayed from the estimates, but instead to develop a culture that values good estimation skills.

CHALLENGES AND RESOLUTIONS

As the area began to implement its efforts to enhance the quality of estimation by IS staff and managers, the staff had some concerns that needed to be addressed in an effective and responsive manner. One concern was that the estimate for some activities requires input from several individuals, although one person could eventually be held accountable for that estimate. Area management felt that the best way to address this issue was through teamwork. It reiterated the importance of tapping into the expertise of experienced IS staff.

Another problem was the way in which data was compiled and analyzed. Since data was posted on a weekly basis, there were some problems with the end date for each task. Since the estimate to complete amount still showed time available on many tasks, even if it was a small

amount, the actual end date moved to the date the time was posted (on a weekly basis). When compared to the baseline date for the task, this meant that individuals appeared to be 'missing dates' when they had actually met the date. The area corrected this problem by zeroing the estimate to complete the task before the time is committed and the task is closed.

Finally, there were some communications gaps between project managers and IS staff. Just before a committing a project stage, managers would sometimes revise resource estimates without communicating the changes to IS staff. The area responded to this concern by requiring project managers to review the final work plan with their team before committing the project. All members of the project sign the form before it become a final document. Please see Figure 2.

ENCOURAGING RESULTS

The results of this effort to educate and train people in project estimation skills have been encouraging. The baseline year for comparing the results of this effort was chosen as 1997. This was the year when the STD had just formed and there was no training on project estimation skills. From June of 1997 to the end of the year, the percent deliverable date met for individual tasks was 36%. The training occurred in January of 1998. Since that time, the percent deliverable date met on tasks has increased to 66% for tasks completed through December of 1998. Likewise, in the last half of 1997, the baseline hours met for *all* tasks was 77%. Since that time, the percent of baseline hours met for all tasks has increased to 86% from January 1998 to December 1998. Besides the benefit of increasing staff skills in estimation, this process has also encouraged more communication between team members and project managers. This has contributed to fewer missed stage and project commitments over the past year for this area.

LESSONS LEARNED AND FUTURE WORK

The primary lesson learned was to provide better training in estimating and then to follow up and follow up with a measurement of its success. There is not a 'silver bullet' that can lead to accurate estimates, especially in the early stages of a project. For this reason the company has begun to constantly monitor the training curriculum in project management, including the estimating courses which have been implemented. As our project management and estimating techniques continue to improve, our ability to successfully complete IS projects within schedule, budget, and quality constraints should improve as well.

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