

Achieving Estimation Accuracy on IT Projects

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Overview

This whitepaper continues on from the paper presented by Martin Vaughan at PMOZ Conference Canberra 2009 – Improving Estimating and Cost Management on IT Projects. It draws on some of the key academic studies from around the globe and considers what factors contribute to improving estimation accuracy and the relationship to estimation techniques. It explores:

- What techniques lead to greater accuracy?
- What makes a difference to estimation accuracy?

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Introduction

Since the first Chaos Report (Standish Group, 1992), the Information Technology industry has been aware of the high average cost overrun Software Projects have suffered. While the average cost overrun has fluctuated over time, the general trend reported via bi-annual Chaos Reports (Standish Group, 2009) indicates cost overruns are not reducing.

Some analysis of the International Software Benchmarking Standards Group (ISBSG) database found that "Of the 439 projects in the ISBSG database, 200 projects have provided sufficient information around effort estimates to enable analysis. Of the 200 projects;

- 19% overestimated by at least 10%
- 23.5% estimated effort to within 10% of the actual value
- 57.5% under-estimated effort by at least 10%" (Hill, 2005)

Why has the average of cost overrun not improved over the years and why do Software Projects continue to suffer a reputation of performing poorly against cost expectations?

While there are likely to be many contributing factors to poor cost performance, we believe one of the main causes lies in inadequate estimation processes and budget establishment.

For many years industries such as construction and engineering have used historical cost information to assist the development of future estimates. The use of Quantity Surveyors and their application of historical cost information have been commonplace in construction, civil and other engineering projects for quite some time.

Both our observation and a review of key research confirms that "Expert Judgement" is used in IT estimation far more often than formal parametric or analogical approaches. In fact some studies indicate up to 80% of IT estimation is conducted using "Expert Judgement". Studies also indicate that this process rarely involves referencing of historical cost information to support current and future estimation efforts. If this is the case, it suggests IT project estimation is being conducted at relatively low levels of maturity on typical maturity model scales.

This approach differs greatly from construction and engineering projects where estimation engineer and quantity surveyors are commonplace and where historical cost information is used extensively to support greater accuracy in future estimates.

One of the impacts of having specialised roles for estimating is the awareness and desire it drives for collecting, analysing and storing past cost information to inform future cost estimates. IT projects only rarely provide for such specialist roles.

Our observation across a range of organisations with head offices in Melbourne indicates historical cost data is rarely captured and even more rarely applied to support future project estimates.

We have also observed cultures where estimation is considered to be a project by project exercise and not necessarily part of organisational maturity. As a result, few mechanisms exist for taking estimation and cost based learning's across the organisation within a continuous improvement framework.

Estimation Techniques

There are a range of estimation methods available for IT Project estimation teams. The most common methods are summarised below:

Parametric – Is based on a structured mathematical based model and allows for cost drivers and other aspects to be calibrated within the model. Models are sometimes calibrated to meet local conditions. Typically draws on historical information to support estimate. (eg. COCOMO, Functional Point Analysis).

Analogical – Seeks to compare and model the proposed project with similar historical projects. Identifies differences and applies adjustments for these.

Expert Judgement – Performed by an Estimation or Subject Matter Expert and based on past personal history and knowledge. This method does not necessarily draw on documented historical cost information but may draw on the experts' memory of cost.

Informal – Informal was specifically identified by Lederer and was defined as analogical without recourse to formal historical records. (Lederer 2000)

The table below summarises the identified estimation techniques and identifies those using formal models as the basis of the estimate and those that draw on historical cost information

Method	Empirical	Model Based	Uses Historical Data
Parametric	Yes	Yes	Mostly
Analogical	Yes	Yes	Yes
Expert Judgement	No	No	Rarely
Informal	No	No	No

Which Technique produces the most accurate estimate?

It would be great to be able to identify one estimation technique that consistently produces more accurate estimates than others. However, based on the research identified to date, this is not the case. Of the formal studies reviewed, authors provided evidence that parametric, analogical, and expert judgement all consistently resulted in greater estimation accuracy than each other. So it depends who you want to listen to.

The Project Manager’s skill in determining the best technique for the particular project’s circumstances was crucial to accurate estimation.

This is highlighted in Jorgensen’s review of studies on expert estimation where he identified 15 empirical studies that were mostly conducted during the 90’s, comparing expert estimates with estimates based on formal estimation models. (Jorgensen, 2004A) The review categorised 5 studies to be in favour of expert estimation, 5 to be in favour of parametric estimation and five to find no difference. A similar level of inconsistency is highlighted in Keung’s review of analogical estimating methods (Keung 2009).

However, a key finding of Keung’s review was the importance of knowing when to apply what estimating method in order to achieve the best outcome for that instance.

This view of suitability being based on project and organisation and capability was echoed in a review by Menzies. (Menzies et al, 2006) In a review of selecting best practices for effort estimation Menzies explored the impact of organisation

conditions and environment on selecting the best practice and concluded there was no single best practice. Rather it was concluded that the Project Manager’s skill in determining the best technique for the particular project’s circumstances was crucial to accurate estimation.

It appears evident from the studies that different techniques may produce different levels of accuracy in different environments.

The exception to the rule is the “informal” technique which was found to consistently produce poorer accuracy than other techniques.

In a study separate from the one referenced earlier, Jorgensen (Jorgensen, 2005) found that Expert Judgement produced results that were as accurate and sometimes more accurate than parametric. However, he also found that when variances occurred, those associated with Expert Judgement tended to be larger than those derived from parametric techniques.

What makes a difference?

If no one estimation technique consistently provides a significant advantage over others, what has been found to produce a positive effect on estimation accuracy? The following are a range of elements that various global research papers reported as having a significant impact on estimation accuracy.

1. Use more than one technique:

It has been found that applying more than one estimation technique to a particular estimate significantly increases accuracy. For example, if one uses Expert Judgment to produce one estimate and an Analogical technique to produce a second estimate, the resolution of the two estimates is highly likely to produce a greater level of accuracy than any single estimate.

Whilst this may in fact be the case, resources and time may not always be available. This may best be applied in highly critical estimates or high risk WBS elements.

2. It matters how you ask.....

Consider how you ask others for their estimate. A significant component of estimation is uncertainty. An expert can provide an estimate to complete a

certain activity, but unless the level of uncertainty associated with that estimate is known, contingency is difficult to apply. For further discussion on managing uncertainty through contingency refer to (Vaughan, 2009).

In a review of the impact of framing of questions on software projects Jorgensen found empirical evidence that the framing of the question does matter and that the traditional approach of minimum and maximum should be replaced. The research found that uncertainty was better understood by asking “How likely is it that the task requires twice as much effort as estimated?” as opposed to what is the maximum likely effort and the minimum likely effort. (Jorgensen et al 2004)

3. Link to Key Performance Indicators

Lederer and Prasad completed a study of practices that impact estimation accuracy. In doing so they considered a range of estimation techniques and wider business practices. The review concluded that the practice that had the most significant impact on estimation accuracy was a direct relationship with “Accountability”. They found that estimation accuracy improved most significantly where those responsible for estimation had estimation performance (accuracy) tied directly to their performance reviews. (Lederer A, Prasad J 2000)

4. Work Breakdown - Detail

Not surprisingly, estimation accuracy increases when the work breakdown is defined to an appropriate level of detail. In a review from 2000, Hill concluded that there is a “strong relationship between task time and number of subtasks involved in the task.” (Hill et al, 2000) Hill concluded that estimation accuracy increases when the work is broken down to an appropriate level of detail.

5. Adherence to Plan

Mizuno identified a direct relationship between cost performance and conformance to a plan. He found that construction of appropriate plan and its adherent execution is an effective approach to reduce projects with large differences between actual cost and an estimated cost. (Mizuno et al, 2000)

This is not surprising, but does illustrate the importance of a match between the estimate and the plan to complete the works. The Plan (PMP) is often produced on IT projects as a separate activity

to determining and setting budget (Business case). Greater correlation between the development of the plan and the estimation leading to the Business case will typically result in greater estimation accuracy.

6. Use of historical information

In an opinion piece offered by Rule he states, “project managers make estimates by referring to their past project histories. But few can produce any historical data when challenged, and typically there is very little rigor in the approach.” (Rule G, 2000)

How do we improve if we don't learn from our mistakes? The use of historical information to inform future estimates is crucial if we are to achieve better estimation and greater accuracy over time. This does not suppose all IT Projects are the same, but does expect that companies undertake IT Projects containing similar elements or Work Breakdown Structures.

The challenge is in how we collect and store historical data in a manner that is useful in the future and efficient to use.

7. Behaviour and Culture – The games people play.

We recognize the games played in developing an estimate and establishing budgets. Although humorous in nature the “Estimation Games” (Thomsett, 2009) article is a fairly sobering reflection of the games played on IT Projects and within the IT Industry in the process of establishing project estimates and budgets. This was similarly acknowledged within the summary of ISBSG Database information when it was noted by Hill that;

“we know sometimes delivery timeframes are preset or agreed with management. ISBSG found “Management directive” pre-determines the delivery date in 17% of the projects” (in their database). [Hill, 2005]

Any environment where transparency is favoured and estimates can be independently verified (from politics), will likely result in greater levels of estimation accuracy. Not surprisingly, organizations that draw on historical data to support estimation appear to suffer from less games and management imposed budget limitations.

8. Behaviour and Culture – Lying on IT Projects

In a paper from 2008, Glass et al report some staggering figures relating to lying on projects (Glass et al, 2008). They found that the most predominant form of lying on software projects related to estimating. Interestingly respondents to the survey indicated that lies were applicable to both overestimates and underestimates.

They found that of those who replied to the survey, 86% had experienced lying on projects on which they had worked on and that most did so to “tell management what they wanted to hear”.

When asked who lied and who knew, 53% indicated Management knew and 60% indicated the project Lead know about the lie.

Whilst the study did not attempt to quantify the size or impact of the “lie”, the apparent volume of misinformation is certain to cause problems for any organization attempting to improve estimation accuracy.

Conclusion

This paper has identified several practices that have been shown to improve the accuracy of estimation on IT Projects. Surprisingly not many of these relate to estimation techniques, while most relate to behaviour, culture and communication. Maybe this suggests we should focus future estimation improvement efforts on human factors as much as models, mathematics, statistics and techniques.

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