

DRIVEN TO PRECISION

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Short Abstract

Why do projects almost always seem to take longer and cost more than planned? Or if they do deliver on time and within budget the scope and/or quality that is delivered is often less than anticipated. These facts, the author's believe, are underpinned by an unwillingness to accept that at the outset of any project it is impossible to predict precisely what the end date and final outturn cost will be, yet we are encouraged within organisations, and often compelled contractually to commit to precise and invariably optimistic estimates. This paper focuses on the hypothesis that in most organisations project managers are driven to precision by two main factors; inherent human bias, and organisational attitudes to project time and cost estimating. People know theoretically, although sometimes fail to acknowledge in practice, that project time and cost plans (schedules and budgets) are guesses, based on best estimates. People also know that in some environments there is lots of historical data and expert knowledge that can be used to make guesses as "educated" as possible although this data is sometimes not used to good effect. In other environments where a particular type of project is being done for the first time and therefore there is no historic data the chance of any guess being correct is even more remote. Unfortunately neither of these scenarios seems to have any effect on the prevailing culture of precise estimating and project managers are again driven to precision.

Key words: risk, estimate, schedule, budget, uncertainty, Monte Carlo

Paper

The Problem

There are numerous factors that affect the ability to estimate with any degree of accuracy including the availability of relevant data, the time available to prepare the estimate, the domain experience of those involved, a lack of knowledge of estimating techniques, inherent human bias and organisational attitudes to project time and cost estimating. Although all of these factors are relevant to the problem it is the final two; inherent human bias and organisational attitudes to time and cost estimating that are considered further below because they are the most difficult to rectify.

Inherent human bias

Over 30 years ago¹ the Society of Petroleum Engineers in the USA noticed that many projects were failing to meet their promised (estimated) time and cost objectives. In order to try to understand why this might be happening they conducted an experiment based on a simple questionnaire to determine how good (or bad) their members were at estimating numeric values in uncertain conditions. Those who took part in the experiment were asked to give a numerical answer in the form of a range (minimum and maximum value) to ten non-job

related questions, but questions where they could be expected to have some rudimentary knowledge, or ability to work out by comparison e.g.

- What is the area of Canada in square miles?
- How long is the Amazon River in miles?

In this experiment different groups were asked to provide ranges with different levels of confidence from 30% to 98% i.e. what two numbers (minimum and maximum) represent the probability (30% to 98%) and that the actual answer has, in the case of 30% and 98% confidence, a 70% or 2% chance of being incorrect. The results of the experiment produced the following conclusions:

- People who are uncertain about answers to a question have almost no idea of the degree of their uncertainty i.e. they did not know if the probability that they might be correct was 30% or 98% or any other value.
- The more people know about a subject the more likely they are to construct a large range regardless of what confidence range they have been asked to use i.e. a range that has a high chance of including the correct answer.
- The less people know the smaller the chance that the range will include the correct answer.
- People tend to be a lot prouder of their answers than they should be i.e. they exude confidence that their answer is right even though they have often have no underpinning knowledge.
- Even when people have been told that probability ranges tend to be too small they cannot bring themselves to set their ranges wide enough.

Although these findings are 30 years old, they still have profound implications for the practice of estimating today. To a large extent this is due to a lack of appreciation of the nature of risk, or uncertainty that should it occur would affect project objectives.

Our practical experience working with many different companies tells us that:

1. There is a propensity for individuals to guess as if they were confident of the accuracy of their estimate, i.e. people are unwilling to provide estimates that truly reflect that they don't know until more data is available. There is a school of thought that suggests that engineers and scientists are more likely to do this, as they live in a world of precision and find it difficult to accept uncertainty. This may or may not be true.
2. There is a propensity for individuals to please and this pushes estimates to the optimistic end of the possible range, with little attention paid to the things that may happen to make the "worst-case" scenario occur. This propensity to please is further fuelled by attitudes held by sponsors and business managers to want to hear good news, believing that a focus on risks (threats) is negative.

Organisational Attitudes to Project Time and Cost Management

Traditionally a project's time (schedule) and cost (budget) estimates have been put together using methods and tools that require a single point estimate rather than a range of values. Of course if a single point estimate is used to feed a traditional scheduling tool or an estimating spreadsheet then what is produced is a single point, deterministic answer. Because of this, tradition has always been that a project's end date is a single date and its estimate is a single monetary value.

Planning time and cost using single point estimates is dangerous as there is no indication in this estimate as to the extent to which risks have been considered. Is the estimate optimistic, pessimistic, somewhere between, or in worst case it is not known?

Organisations need not work in this way. Relatively simple software that uses Monte Carlo modelling now allows organisations to model three point estimates and a range of distributions between the three points. This is no longer the world only for specialist risk analysts, but for everyone involved in project planning.

Even with accessible tools to put together schedules and budgets that take into account the inherent uncertainty in estimates, there remains a further problem. In many organisations, the notion of projects is a precise one; particularly where work is being committed to with a business critical fixed end date or bid competitively on a fixed price basis. Telling a sponsor or client that the project might take between nine and 15 months to complete and cost between €1m and €1.5m may be the most realistic estimate that can be given, but is nevertheless avoided believing that communicating such uncertainty would be unacceptable. The reality is that communicating certainty when this is actually totally unrealistic should be less acceptable. Single point estimating inevitably leads to optimism and as a result the setting of false expectations. It also leads to apparent failure when deterministic objectives are missed.

What Can Be Done To Overcome the Problem

Based on our research and practical experience there are four things that can be done to rectify the affect of human bias and organisational attitudes; all of which will require a level of education:

- **Effective use of three point estimates and risk models as part of early planning, prior to the submission of bids, contract agreement or authorisation for full project go-ahead.** In the past this used to be difficult to achieve but today there are numerous, software applications that can analyse three-point estimates and produce a view of the probability of achieving an end date or outturn cost. The same analysis will give a prediction on the range of possible outcomes which in itself can be very enlightening. The graph in Figure 1 is the output of a Monte Carlo simulation based on a simple cost risk model.

Consider the example shown in the diagram and imagine that a contract is being bid for on a fixed price basis. The original estimate for the work, excluding profit margin, is €1.2m.

Inspection of the graph shows that there is only a 10% chance of achieving it. Is this a viable situation? Logic would say that what should be bid is €1.42m plus a margin for profit, say 15%. This means that there is a 50:50 chance of completing the project and making a 15% profit. If the organisation's Business Development Team believe that there is no way that work can be won at €1.63m then the business has a decision to make. Does the company bid less knowing the risk that it might make less profit or worse – or does it refuse to bid? The data allows a sensible decision to be made by the investors.

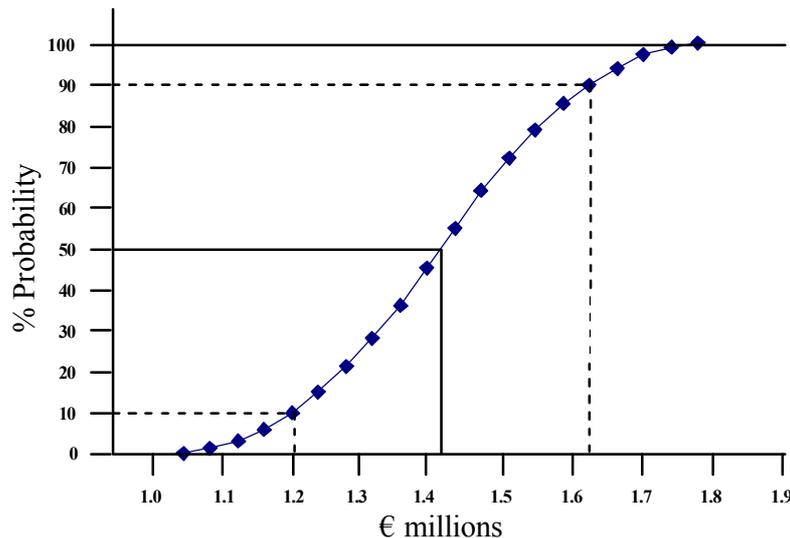


Figure 1 - output of a Monte Carlo simulation based on a simple cost risk model

- **Resist the temptation to provide single point forecasts.** In many circumstances there will be pressure from sponsors or clients to provide precise, single point estimates of project end dates and outturn costs. Project managers need to understand why the organisation is demanding such precision and if possible provide a range of values. If the demand continues to provide a single point then the project manager might say (see Figure 1) that there is about a 25% (or 1 in 4) chance of the outturn cost being €1.3m or less. If they are daring they might even say there is a 75% chance (or 3 in 4) of it being exceeded and see what the reaction is.
- **Honest awareness of what is being done when bidding or agreeing a project's objectives and understand the consequences of chosen actions.** If a bid or agreement is based on a schedule that uses optimistic times and costs such that a risk model predicts there is significantly less than 50% chance of achieving the estimate then the consequences of failing to manage everything perfectly are obvious. As a result every company's approach to setting contingency levels must be different and it should be a project by project decision based on the chance of being able to deliver and the consequences of not doing so. Contingency should not be regarded as a slush fund or unnecessary float. It should be seen as a means of addressing uncertainty and in managing stakeholder expectations.

- **Very focused, proactive risk management.** A living and committed-to risk process is essential, rather than a “tick in the box” attitude that ensures that uncertainties that would result in worst-case times and costs being achieved are identified and managed. Much has been published on how to do this. It is increasingly recognised that the human, psychological aspects of risk management are critical²; those things that make sure that people actually *commit to action*. There is a need to identify and manage the uncertainties that would, if they occurred, speed things up or reduce costs. Doing this will help to alleviate some of the effects of things going wrong i.e. there is a compelling need to manage the opportunities as well as the threats.
- **Understanding for all.** Perhaps the most difficult thing to action is the need for everyone involved in the estimating process to understand the effect of over-optimistic, precise, single point estimating. There is a huge amount of information available that illustrates the effect of what could be said to be poor estimating. Unfortunately someone else’s problem is never as relevant as your own. We challenge all organisations to look hard at their previous projects and critically analyse the reasons for schedule and cost overruns. Where these can be attributed to the estimating process then this must be highlighted and lessons learned. In such circumstances it would always be worthwhile to ask those involved in the ‘failed project’ if they could ever have imagined the project taking so long or costing so much; the answers might be quite surprising.

Summary

All the points outlined above are generally well understood by the profession of project management. However they are often only understood at a theoretical level, and not applied with “hearts and minds”. Few organisations address these issues from a business perspective and in a way that addresses the human dimension in order to gain true commitment from all the members of the project organisation. Knowledge is easy to attain, changes to attitudes and behaviours are more elusive but nevertheless achievable – this is the place to start.

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