FinanceWeek

Cost Risk Analysis for managing large projects

Every large project, from building a new plant to replacing a legacy system, will experience unexpected complications and interruptions. But that doesn't mean it has to run over budget and fall behind schedule. Most projects to do because project managers treat initial cost estimates as firm predictions, forgetting that they're just a central case, with scope for positive or negative variation around them. Understanding the risks around cost estimates, and planning for possible departures from them, can significantly reduce the risk of cost overruns. In the first of a three-part series, George Sifri of ESI International looks at the use of probability to analyse cost risk.

There is no "right" cost estimate. The preceding statement has become a truism of cost estimation. Each cost estimate is associated with inherent probability that the final actual cost will be higher or lower than the estimate. A cost estimate is a forecast in which inherent uncertainties (lack of information or improper knowledge) arise from changes in requirements, technology, economic environment and a number of other factors.

Cost Risk Analysis is about evaluating and quantifying the uncertainty in a cost estimate. This article will explore the uncertainty in a cost estimate as a probability distribution over a range of possible costs, giving the decision maker the ability to assess the quality of an estimate used as one of the critical factors in making decisions.

Why estimate?

Estimating is a forecasting process used to guess costs, durations and the resources needed to complete a project. The output of the estimating process is typically used to establish the project baselines such as the budget and the duration. It is also used for other purposes such as the following:

- Evaluating the economic feasibility of this project
- Evaluating between different projects and different projects' options to select the most optimum one that will maximize the delivery of business objectives
- Providing the basis for project cost and schedule control

If the project is over estimated, it may be killed, because at this level of costs, it is not economically attractive. In this case, a genuine business opportunity to create value is lost. If it is approved, it is going to tie resources that it does not need and deny other projects from these resources. At the end, in most cases, the extra resources left are spent on gold plating.

If the project is under estimated and it gets approved, it may not be an attractive project and thus result in cost overruns and schedule delays, leading frequently to project failures. Thus the accuracy of the estimate is essential for both project selection and project control. Nevertheless, there are a number of challenges that impact the accuracy of an estimate such as risk and uncertainty.

Understanding risk and uncertainty

The terms "risk" and "uncertainty" are often confused and mistakenly used interchangeably. It is critical to clarify their differences at the onset. "Risk" is defined as an event or a set of circumstances that if it occurs will have an impact on project objectives. The impact may be positive or negative. If the impact is negative, it is referred to as a threat. If the impact is positive, it is an opportunity. Uncertainty is driven by improper knowledge or lack of information. It is described as the indefiniteness in outcome. It refers to the state of being unsure about something or the degree of variability in observations. An uncertainty has a probability of 100 percent, while a risk has a probability of less than 100 percent.

An uncertainty represents a factor that we know will occur, we just are not sure what the value will be. For example, prices are often represented by uncertainties. We know that a price will occur, so the probability is 100 percent. However, we don't know exactly what the price will be, so it will be represented by a distribution of potential outcomes.

In mathematical terms, it can be a statistically defined variance or discrepancy between a measured quantity and the true value of that quantity that cannot be corrected by calculation or calibration. It is an assessment of the confidence with which the data should be used, or a measure of how poorly we understand or can predict something such as a parameter or a future behavior.

Uncertainty is sometimes expressed as a probability distribution of potential outcomes. The wider the distribution, the higher is the level of the uncertainty associated with the outcome. Figure 1 depicts examples of different data sources with different levels of uncertainties.

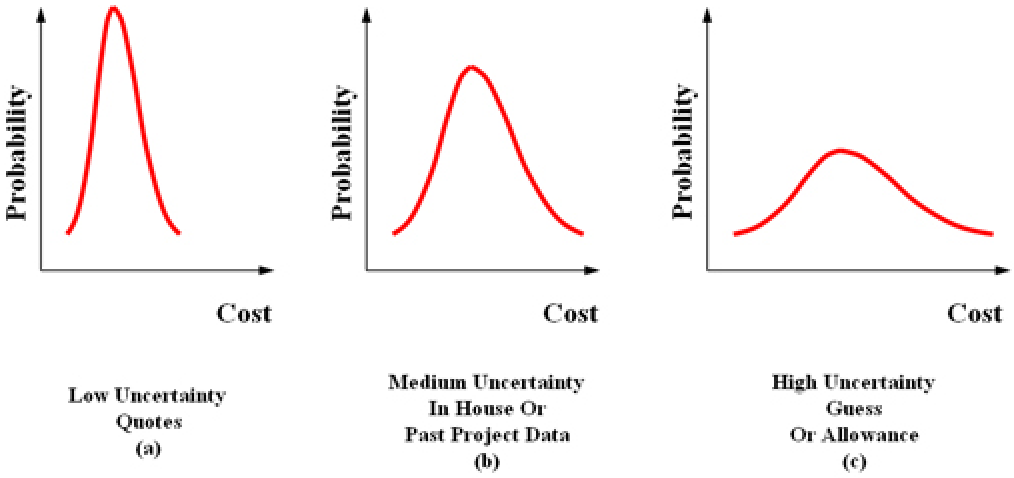


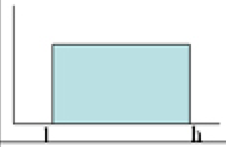
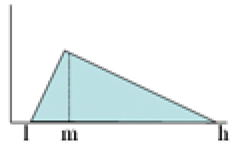
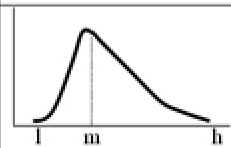
Figure 1: Probability Distribution Examples

Identifying and applying distributions

We can use different types of probability distribution curves to represent uncertainty. The best distribution is one that can be defended based on the scenario being analyzed. It should originate in a "story" that describes a particular set of circumstances. For example, if we identify a potential delay in construction activities caused by a labour strike, we might imagine a worst case where no agreement is possible and the strike has to be settled by arbitration. It might take four months to reach a settlement in this case. We might imagine a best case where we are able to reach a settlement with the strikers in two weeks. Our best guess might be that we could settle a strike in three months.

A financial analyst is interested in analysing the impact of this risk if it materializes on the Net Present Value (NPV) of this investment. Delaying the project, will delay the revenues and increase certain costs thus lowering NPV. The uncertainty in the potential outcome of the labor strike translated to an uncertainty in the NPV of the business opportunity.

Figure 2 shows examples of different types of distributions. A uniform distribution is used when you are certain of a cost element. For example, cost of rent which is fixed over a number of years. A triangular or a beta distribution is used when you expect that the there is a higher probability that the final actual cost will exceed the most likely cost.

Distribution	Mean	Variance	Shape
Uniform	(l+h) / 2	$(h-l)^2$ / 12	
Triangular	(l+m+h) / 2	$(l^2 + m^2 + h^2 - lm - lh - mh)$ / 18	
PERT - Beta	(l + 4m+ h) / 6	$(h - l)^2$ / 36	

Where m = most likely outcome, l = optimistic estimate, h = pessimistic estimate

Figure 2: Statistical Distributions

Risk and uncertainty pervade projects. In every project, we encounter different categories of risks, such as commercial risks, country risks or technical risks, all of which could lead to different facets and levels of impact. Not all uncertainties in a project translate to risks. Only if the range of outcomes of an uncertainty could cause key decisions to change will the uncertainty translate to a specific risk event. For example, lower than anticipated market demand leads to a reduction in the required capacity of the production facility.

About the author

Dr. George Sifri is a certified Project Management Professional and an instructor for ESI International (www.esi-emea.com), a global training consultancy. He delivers project management courses on five continents for some of the world's largest corporations.

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