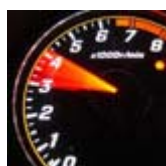


FinanceWeek

Cost Risk Analysis (3) Nine steps for staying on course

Concluding his series on cost risk analysis, project manager and trainer George Sifri of ESI International runs through the nine steps to assessing the risk of cost overruns, simulating the impact of active risks, and managing risks through consultation with those who own them.



As the project progresses from one phase to the next, cost estimates should reflect more definitive scope development for the near-term portions of work. This technique is often referred to as "rolling-wave" planning, where detailed planning of future work is done in increments or waves.

For example, cost estimates early in a project's life may include Definitive cost estimates and scope for more defined near-term work (e.g., the design and scope development phases); and Order of Magnitude cost estimates for the less defined long-term work (e.g., execution, construction, and project close-out phases)

Step 1 Set the base case

The cost risk analysis process starts with the development of the base-case estimate. This includes all the costs associated with the project based on the most likely costs. These costs are divided by relevant accounts. Each account represents a standard organization/industry cost. The base case should not include any contingency or unjustified allowance. Any allowance included in the base case estimate should be justified.

Step 2 Identify the risks holistically

Conduct a facilitated holistic risk identification event. Make sure that you have an integrated cross-discipline team that is looking at the project risks from different perspectives such as commercial/market, country/political, technology, project execution, health, safety, security, environment, etc. Identify risks, estimate probability and impact using scoring guidelines for probability, impact and risk rating similar to the ones shown in figures 5, 6, and 7, respectively.

Scale	Description	Probability	Narrative
Very High	The risk event is extremely likely	>50%	Based on individual experience the risk has occurred at least in every second project
High	The risk event is very likely	30-50%	Based on individual experience the risk has occurred in about two out of five projects
Medium	The risk event is likely	10-30%	Based on individual experience the risk has occurred in about one out of five projects
Low	The risk event is unlikely	2-10%	Based on individual experience the risk has occurred in about one out of ten projects
Very Low	The risk event is very unlikely	<2%	Based on individual experience the risk has occurred in about one out of hundred projects

Figure 5: Probability Scoring Guidelines

Scale	NPV	Cost	Duration	Safety	Technical	Reputation
Very High	>50% of project NPV	Cost impact (increase/savings) of risk event changes project NPV by more than 50%	Schedule impact (delay/acceleration) of risk event changes project NPV by more than 50%	Causing fatal injuries	T: Defects disable operation of the system O: Major enhancement of primary features of the system	T: Loss of many clients, adverse publicity O: New business with new clients, favorable publicity
High	30-50% of project NPV	Cost impact (increase/savings) of risk event changes project NPV by 30-50%	Schedule impact (delay/acceleration) of risk event changes project NPV by 30-50%	Causing serious injuries	T: Defects significantly disrupt operation of the system O: Minor enhancement of primary features of the system	T: Loss of a single client O: New business with existing client
Medium	10-30% of project NPV	Cost impact (increase/savings) of risk event changes project NPV by 10-30%	Schedule impact (delay/acceleration) of risk event changes project NPV by 10-30%	Causing slight injuries	T: Defects moderately disrupt operation of the system O: Major enhancement of secondary features of the system	T: High increase of complaints ratio O: High decrease of complaints ratio
Low	5-10% of project NPV	Cost impact (increase/savings) of risk event changes project NPV by 5-10%	Schedule impact (delay/acceleration) of risk event changes project NPV by 5-10%	Causing very slight injuries	T: Defects slightly disrupt operation of the system O: Minor enhancement of secondary features of the system	T: Small increase of complaints ratio O: Small decrease of complaints ratio
Very Low	<5% of project NPV	Cost impact (increase/savings) of risk event changes project NPV by less than 5%	Schedule impact (delay/acceleration) of risk event changes project NPV by less than 5%	Negligible impact	Negligible impact	Negligible impact

Figure 6: Impact Scoring Guidelines

		Probability				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
Impact	Very High 9	Medium 9	High 18	Very High 27	Very High 36	Very High 45
	High 7	Low 7	Medium 14	High 21	Very High 28	Very High 35
	Medium 5	Low 5	Medium 10	Medium 15	High 20	High 25
	Low 3	Very Low 3	Low 6	Medium 9	Medium 12	Medium 15
	Very Low 1	Very Low 1	Very Low 2	Very Low 3	Low 4	Low 5

Figure 7: Probability Impact Grid

Most risk events have a variety of potential outcomes, so that the impact can only be properly described by a range or a distribution. For the purpose of placing the risk on the Probability Impact Grid (PIG), a single deterministic value should be chosen. For consistency, select the pessimistic value for the risk, filter out trivial risks to discard from the risk register and develop responses to active risks.

Step 3 Plan responses to active risks

Integrate the responses to active risks into the project plans (Work Breakdown Structure, Schedule, Contracts, etc.) and include the costs of mitigation/enhancement strategies in your base case. These are definite costs that

the project will incur.

Step 4 Assess impact on the base case

Consider including the impact of a risk in your base case if the probability of occurrence is considerably more than 50 percent. This will help in defining more realistic business cases.

Step 5 Talk to the risk 'owners'

Consult with each risk owner (the person who knows best about a particular risk). Through conversation, determine how to translate the residual risk into values. For example, a major energy company is planning to enter a new market. They require permits from the local government to operate in this country. If a political risk indicated that permits might not be available in time, the country expert might indicate that production would be pushed back at least one year and that additional CAPEX would have to be spent in the first two years to resolve the issue. The financial analyst is interested in the impact of the uncertainty in the time and CAPEX needed to get the required permits on the NPV of this opportunity.

Step 6 Establish ranges for risks and their probabilities

Both probability and impact (consequence) can be expressed in an uncertain manner – that is, using ranges (distributions). For example, the country expert in the example above might consider that the time delay due to late permits could range from one week to 70 weeks, most likely 52 weeks. He/she also might consider that the probability of the risk actually happening might be between 5 percent and 30 percent, most likely 15 percent.

Step 7 Select the appropriate distribution

The facilitator should choose the appropriate distribution to represent uncertainties in cost estimate elements and outcomes of risk events. He should select the distribution that he can defend based on a discussion with the risk owner and the team. The discussion should focus on a typical scenario.

Step 8 Code the simulation

All the above information is fed into a computer simulation engine such as Crystal Ball™.

Step 9 Run the simulation

A Monte Carlo simulation engine is a software application that performs the calculation described below 10,000 times. Each time, it will choose different random numbers to compare to the probabilities and different random selections from the distributions. In the end, the application will have 10,000 answers. In calculating these 10,000 answers the factors representing uncertainties will have been included every time while the factors representing risks will have been included with a frequency that represents their probability.

For example, a risk with a probability of 30% will have been included in about 3,000 of the answers. Each time a factor is included in an answer a different value will have been selected from the distribution. A few of these values will be near the worst case, a few will be near the best case and the majority will be near the most likely case. These 10,000 answers themselves make up a distribution and represent the universe of likely answers. This method of repeatedly solving the equation using different values randomly drawn from the inputs is called Monte Carlo analysis. Figure 8 shows a typical output of a Monte Carlo analysis which is the cumulative probability distribution curve.

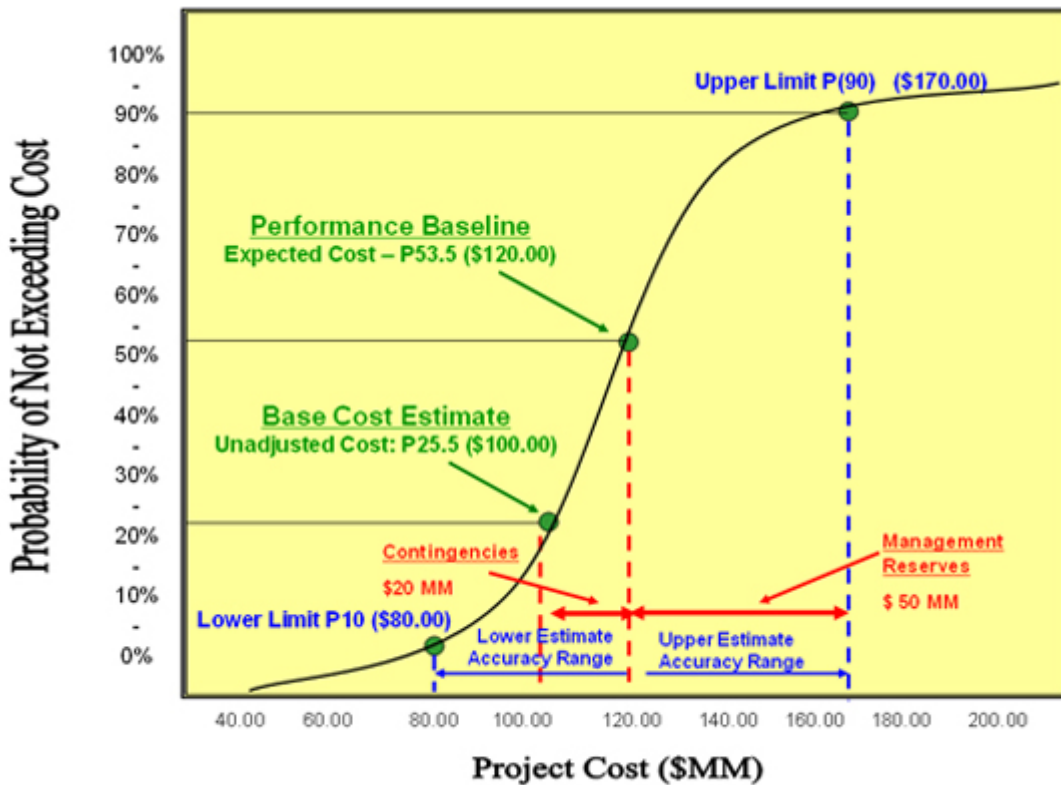


Figure 8: Cumulative Probability Distribution Curve

The Cumulative Probability Distribution Curve

The cumulative probability distribution curve enables the decision maker to assess the probability of completing the project within a certain budget (forward curve). In the scenario shown in figure 8, the base case (\$100M) has about 26 percent probability. In other words, there is a 26 percent probability of completing the project within a budget of \$100M.

In many organizations, the project performance baseline is set at the expected value. In figure 4 from Part 3 (reproduced below), this is \$120M and has probability of approximately 54% of being achieved. The difference between the expected value and the unadjusted base case is called "contingencies" or "unallocated provisions". These are under the control of the project manager and are designed to accommodate for the inherent uncertainties that we have in the estimates. We know from experience that we will use them, but we do not know at this point in time in which cost elements. They are not designed to deal with changes in scope. The project manager needs to make sure that the scope of the contingencies – what is included and what is excluded – is clearly defined and agreed upon between the key stakeholders.

	Primary characteristic	Secondary Characteristic			
ESTIMATE CLASS	LEVEL OF PROJECT DEFINITION Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE Typical +/- range relative to best index [a]	PREPARATION EFFORT Typical degree of effort relative to least cost index of 1 [b]
Class 5	0% to 2%	Screening or Feasibility	Stochastic or Judgment	4 to 20	1
Class 4	1% to 15%	Concept Study or Feasibility	Primarily Stochastic	3 to 12	2 to 4
Class 3	10% to 40%	Budget Authorization or Control	Mixed but Primarily Stochastic	2 to 6	3 to 10
Class 2	30% to 70%	Control or Bid/Tender	Primarily Deterministic	1 to 3	5 to 20
Class 1	50% to 100%	Check Estimate or Bid/Tender	Deterministic	1	10 to 100

Notes: [a] If the range index value of "1" represents +10/-5%, then an index value of 10 represents +100/-50%
 [b] If the cost index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%.

Figure 4: Classification of Estimates

Management reserves, some times referred to as additional unallocated provisions, are under the control of upper management. If the project manager requires additional resources beyond the contingencies, he/she needs to raise a request for additional resources and get the approval of upper management before having access to management reserves. Under no circumstances should the total costs of the project go beyond the P90 value without reevaluation of the business case of the project to check if the project is still attractive. In figure 4, the project has a 90% probability of being achieved within a budget of \$170M. In many organizations, they refer to this point as the "Not to Exceed" value.

As for the accuracy of this estimate, we can say that there is an 80% probability of completing the project with a budget between \$80M and \$170M. If the decision maker is not satisfied with this range, then he may request more work to be done in the areas of technical definition and project execution planning in order to lower the uncertainty.

Final Remarks

The Monte Carlo simulation technique is not designed to enhance the accuracy of a low quality estimate. The good old saying of "Garbage In, Garbage Out" still applies. The quality of any estimate is based on several factors such as the competency of the estimator, the quality of the data sources, the methodology used and the level of project definition.

Risks should be identified, assessed and responses formulated and integrated into the project plans. Sources of uncertainties in the project should be identified, analyzed and managed. Without performing these essential tasks, the quality of the estimate will suffer. Finally, control mechanisms should be implemented to keep the project on track. When this roadmap is followed, project managers in the financial industry will achieve success.

About the author

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

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