The Contingency Conundrum

Project Managers and Cost Estimators are often assigned the tricky task of calculating or allocating to a cost estimate the appropriate amount of project contingency. In the realm of cost estimating, whether performed by professional cost estimators, project managers, engineers, or other members of the project team, this is an area which can often lack proportionate focus, being completed with little or no demonstrable methodology. Diminished attention to the question of *How Much Contingency?* can take the shine off a detailed and painstakingly prepared estimate of the base scope.

The first step is to clearly understand what contingency is. This sounds very basic, but doing so will assist in qualitative and quantitative assessments of uncertainties and how contingency should be identified within the Cost Estimate.

The AACE's Total Cost Management framework defines contingency as follows: *Contingency is an amount added to an estimate to allow for unknown items, conditions, or events that experience shows will likely occur. Every project cost estimate should evaluate risk and uncertainty and include identifiable contingency costs in the estimate if needed*. Emphasis should be placed on contingency being *identifiable*. If not, project cost management and cost forecasting becomes challenging to say the least.

The American Society of Professional Estimators (ASPE) identifies distinct categories of contingency; Estimating and Contracting, Design, Owner's Construction Contingency (Change Orders) and Owner's Project Contingency.

Constraints to relative focus for calculation of contingency can include no funding or time allocated in the project budgeting phase for formal risk identification and quantification. The result is that often the estimator is left with the responsibility to unilaterally allocate contingency to the project estimate. Input from other team members, such as the project manager, architect or engineer, can be at best, limited and at worst, non-existent. This sounds far from a common sense approach let alone alignment with recommended best practices of professional bodies such as the PMI or AACE. However, it is more common than one would perhaps think.

Large, complex projects, particularly those which can be considered 'high-profile', often enjoy the level of stakeholder attention and sponsorship that brings with it formal risk identification and management processes. In such scenarios mature Risk Management procedures are implemented and the importance of cost contingency is elevated within the project management plan and communicated throughout the project team. However, smaller, *less complex* and perhaps *lower-profile* projects may not attract the same level of diligence and oversight, but nevertheless retain similar expectations from stakeholders and sponsors with regard to scope, budget and schedule performance. The cumulative value of 'small' to *mid-size* projects should not be under-estimated. Project size will be relative to an organization's funding capacity and past experience.

Use of a predetermined percentage, of say, 5%, 10%, 15% or 20%, is certainly not appropriate for complex, unique or project scopes unfamiliar to the project team or organization. Accurate and comprehensive historical data is required for use of predetermined percentages, but even this should be applied with care as specific project characteristics can vary even if design is replicated. For example, site specific soils conditions may be different, external political and economic conditions may have changed and permitting and land use regulations can vary across jurisdictions. Uncertainty is inherent in any project and identification and assessment should be encouraged.

Furthermore, predetermined allocation of contingency amounts may be the source of project cost over-runs if too low. They may tie up funds that can be allocated to other projects if too large and may be indefensible in the budget approval process. Therefore the risk is created that uninformed adjustments by senior management may occur to finalize funding levels because *it looks too high*. (This reaction is also very common, particularly when approvers are presented with no or little information regarding project uncertainty).

The Cost Estimator may complete risk identification and contingency calculations based upon project knowledge, experience and expert judgment, using deterministic expected value methodologies. These are based upon judgments of risk probability against estimated costs of potential impact. (Expected Value = Probability of Risk Occurring x Impact If It Occurs. Note that in such calculations, probability is always less than 1.00 (or 100%) otherwise the item is not a risk and should therefore be included in the estimate of the base scope). Risks by their definition are not certain. They have a chance or possibility of occurrence. The AACE defines risk as *an undesirable potential outcome and/or its probability of occurrence*.

Where possible, the Cost Estimator should engage other members of the project team for input. For smaller, fast-track projects, this can often be done through informal means. Dialogue with other project members can draw out experience and knowledge (historical and project related) that is valuable to the qualitative process.

Using the Cost Estimator's expert judgment (and input, where possible from other team members), a Contingency and Risk Worksheet can be developed to document and assess contingency amounts using the expected value method. The Contingency and Risk Worksheet documents identified risks, estimated values and assessed probability.

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Contingency and Risk Worksheet

Estimate Title:	TBD	**Estimated Project (Direct):**	$ 25,000,000
Estimate Rev:	TBD	**Total Contingency (Direct):**	$ 565,250
Estimate Date:	TBD	**% of Total Est Direct Cost:**	2.26%
Estimator:	TBD	**Estimated Project (Indirect):**	$ 1,000,000
Reference No.:	TBD	**Total Contingency (Indirect):**	$ 31,250
Design Status:	TBD	**% of Total Est Indirect Cost:**	3.13%

Guidance Notes

1. Enter risk "**Driver**", "**Event**" and "**Impact**" for each Risk Item
2. Describe how the "**Estimated Risk Impact ($)**" was derived in "**Basis of Estimated Risk Impact**" i.e. Judgment based ROM, based on estimate detail etc.,
3. **Risk Rank** is derived from assigned Probability levels i.e. high probability of occurance + high potential cost impact

Risk Item	CSI Division	Risk Owner	Risk Description			Risk and Contingency Evaluation				Risk Rank
			Driver	Event	Impact	Basis of Estimated Risk Impact	Estimated Risk Impact ($)	Probability of Risk Occurring (%)	Expected Risk Value ($)	
A1	03 Concrete	CM/GC	Weather	Extreme Cold	Poor Productivity	craft manhours x $/hr	$ 65,000	35%	$ 22,750	LOW
A2	02 Ex Conditions	Owner	No geo-tech report	Lack of bearing capacity	Piling req'd	ROM for piling costs	$ 2,000,000	25%	$ 500,000	MED
A3	26 Electrical	Sub	Asian const boom	Shortage of copper	Wire prices ↑	value of wiring in est	$ 50,000	85%	$ 42,500	MED
A4							$ -	0%	$ -	
A5							$ -	0%	$ -	
A6							$ -	0%	$ -	
A7							$ -	0%	$ -	
A8							$ -	0%	$ -	
A9							$ -	0%	$ -	
						TOTAL RISK AND CONTINGENCY AMOUNT ($): **DIRECT COSTS**			$ 565,250	

Risks are identified by Item number, categorized by CSI Division and assigned a Risk Owner.

Risk Item	CSI Division	Risk Owner
A1	03 Concrete	CM/GC
A2	02 Ex Conditions	Owner
A3	26 Electrical	Sub
A4		
A5		
A6		
A7		
A8		
A9		

Note, the inclusion of a 'Risk Owner' in the worksheet may facilitate introduction of the first steps to risk management during the project lifecycle, but is not essential to the contingency calculation process.

Additionally, while the example shown here illustrates a CSI coding structure, this can be modified to suit projects requirements.

The Risk Description is broken down to identify Driver, Event and Impact.

Three examples of Risk

Risk Description		
Driver	**Event**	**Impact**
Weather	Extreme Cold	Poor Productivity
No geo-tech report	Lack of bearing capacity	Piling req'd
Asian const boom	Shortage of copper	Wire prices ↑

Breakdown the risk description into Driver, Event and Impact helps build an understanding of what is related to probability (Event) in the equation and what is the occurrence that requires value estimation (Impact).

For each Risk Item, the value of risk is estimated and then assigned a "Probability of Occurrence" using "Expert Judgment". The basis used to estimate the risk impact is summarized.

Three examples of Risk

Risk and Contingency Evaluation			
Basis of Estimated Risk Impact	**Estimated Risk Impact ($)**	**Probability of Risk Occurring (%)**	**Expected Risk Value ($)**
craft manhours x $/hr	$ 65,000	35%	$ 22,750
ROM for piling costs	$ 2,000,000	25%	$ 500,000
value of wiring in est	$ 50,000	85%	$ 42,500
	$ -	0%	$ -
	$ -	0%	$ -
	$ -	0%	$ -
	$ -	0%	$ -
	$ -	0%	$ -
	$ -	0%	$ -
TOTAL RISK AND CONTINGENCY AMOUNT ($): **DIRECT COSTS**			$ 565,250

In the example shown here, probability is expressed as a percentage. It may also be expressed as decimal value, if desired.

Each Risk item can be assigned a Risk Ranking to indicate the potential magnitude of impact to the project. This is achieved through application of an established scoring criterion. Below is an example, but can vary by organization.

Risk Scoring Criteria Matrix			
High (3)	**Medium (2)**	**Low (1)**	
> 75%	50 - 74%	< 49%	Probability of Risk
> 51%	26 - 50%	< 25%	Expected Value (as a % of Total Assessed Risks)

Risk Rank	Total Risk Score
V.HIGH	6
HIGH	5
MED	4
LOW	3
V.LOW	2

Application of the scoring criteria to our three example risks is then completed.

Total Risk Score = Expected Value Score + Probability Score

Risk and Contingency Evaluation: of Estimated Risk Impact	Estimated Risk Impact ($)	Probability of Risk Occurring (%)	Expected Risk Value ($)	Risk Rank
manhours x $/hr	$ 65,000	35%	$ 22,750	LOW
for piling costs	$ 2,000,000	25%	$ 500,000	MED
of wiring in est	$ 50,000	85%	$ 42,500	MED
	$ -	0%	$ -	
	$ -	0%	$ -	
	$ -	0%	$ -	
	$ -	0%	$ -	
	$ -	0%	$ -	
	$ -	0%	$ -	
L RISK AND CONTINGENCY AMOUNT ($): DIRECT COSTS			$ 565,250	

Expected Value (% of Total Risks)	Expected Value Score	Probability %	Probability Score	Total Risk Score
4.02%	1	35%	2	3
88.46%	3	25%	1	4
7.52%	1	85%	3	4
0.00%	0	0%	0	0
0.00%	[illegible]	[illegible]	0	0
0.00%	[illegible]	[illegible]	0	0
0.00%	[illegible]	[illegible]	0	0
0.00%	[illegible]	[illegible]	0	0
0.00%	0	0%	0	0

Expected Value (% of Total Risks) = Expected Value / Total Amount

As can be seen above, based upon the scoring criteria, it is the combination of value and probability that will determine the overall Risk Score for each Item.

The Contingency and Risk Worksheet is completed for both Direct and Indirect Costs with the resultant values carried forward to the Estimate Summary Sheet.

Risk and Contingency Evaluation: Basis of Estimated Risk Impact	Estimated Risk Impact ($)	Probability of Risk Occurring (%)	Expected Risk Value ($)	Risk Rank
craft manhours x $/hr	$ 65,000	35%	$ 22,750	LOW
ROM for piling costs	$ 2,000,000	25%	$ 500,000	MED
value of wiring in est	$ 50,000	85%	$ 42,500	MED
	$ -	0%	$ -	
	$ -	0%	$ -	
	$ -	0%	$ -	
	$ -	0%	$ -	
	$ -	0%	$ -	
	$ -	0%	$ -	
TOTAL RISK AND CONTINGENCY AMOUNT ($): DIRECT COSTS			$ 565,250	
Eng manhours x $/hr	$ 125,000	25%	$ 31,250	MED
	$ -	0%	$ -	
	$ -	0%	$ -	
	$ -	0%	$ -	
	$ -	0%	$ -	
	$ -	0%	$ -	
	$ -	0%	$ -	
TOTAL RISK AND CONTINGENCY AMOUNT ($): INDIRECT COSTS			$ 31,250	

The application of a simple Contingency and Risk Worksheet is a tool with which the Cost Estimator can communicate his expert judgment with regard to uncertainty and provide demonstrable back-up for the amount of contingency stated within the Estimate. Use of such worksheets may also provide a catalyst within project teams to engage in further dialogue and participation in contingency assessments where this did not previously exist. Communication regarding such matters should be continually encouraged throughout the project to support an iterative process.

In keeping with recognized industry best practices, the Contingency and Risk Worksheet should be updated with each cost estimate prepared within the project lifecycle. It may also be adopted as a low-key and informal risk register for the project execution phase.

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