Contingency Misuse and other Risk Management Pitfalls

By

Dr. Iqbal "Bob" Noor, P.E., CCE, PMP
Robert Tichacek, P.E.

Introduction

Over the past decade, project risk management has emerged as a key project management process and has been widely embraced by a variety of major corporations. With renewed emphasis on capital stewardship and transparent fiscal reporting the effective deployment of risk management processes has proven to be crucial for the economic viability of companies. Indeed, today it is not uncommon for corporations to designate the role of Chief Risk Officer as a key executive position.

Despite the growing acceptance of project risk management, there remain a number of common pitfalls that project managers should avoid. Among these pitfalls is the misuse of contingency funds for purposes other than the mitigation of potential risks. If ignored, these pitfalls could tarnish the image of project risk management and rescind some of the gains that have been made in recent years. To this end, the authors would like to share their over fifty years of combined experience in managing risks on projects and present some of the lessons that have been learned.

This paper will highlight some common risk management pitfalls by drawing on real examples and present steps that could be taken to avoid them. Specific issues such as the derivation of contingency funds as well as the management and control of these funds will be discussed. Special emphasis will be placed on the relationship between contracting arrangements and the management of contingency funds. The use of contingency funds for the daily management of project risks will be discussed. In addition, the use of drawdown plots to manage the use of contingency funds will be explained in detail.

Contingency Funds and Project Risk Management

To the uninitiated, sorting through the conundrum of risk management definitions can be frustrating. Contingencies Funds, Management Reserves and Budget Allowances are all key project risk management concepts and each serve a specific purpose. The interchangeable use of these terms and attempts to use them in cross-purpose situations can be disastrous. A proper understanding of the terms is crucial.

The idea of having contingency funds in a budget is not new. However, it is useful to remember why these funds are allocated so that they are not misused. A review of any cost estimate will reveal a number of key assumptions in the basis of cost estimate documentation.

During the execution a project, measures of performance and success are based on criteria that have been created for the project. These criteria – no matter how carefully and thoughtfully developed – do in fact assume:

That certain things *are* correct

- Budget estimates
- Activity durations and sequencing
- Resource requirement analysis

That certain things *will* happen

- Historical benchmarking or database inputs are appropriate and will be repeated
- Resources will be available
- Vendor cooperation and compliance
- Appropriate responses and inputs from stakeholders and/or third parties

That certain things *will not* happen

- Strikes
- Bankruptcies
- Calamitous weather
- Unbudgeted or unaccounted-for scope growth
- Interest rate increases

The forgoing assumptions can all lead to risks. We deal with this by budgeting sufficient additional time and/or money with which to compensate for and deal with the realization of these risks. While such additional inputs can be incorporated within the Work Breakdown Structure or detailed task level, it is preferable to establish a separate budget category for identifying and managing risks. This funding is referred to as a Contingency Fund or more simply Contingency.

Contingency is established to mitigate or eliminate the adverse impacts of the unforeseen or under-predicted events. As such, contingency should be utilized and managed exclusively within the framework for which it is established. While a project budget document might contain several different ‘Fund’ accounts as opposed to ‘Line’ allocations, contingency is very different in that it is a reserve and ‘hedge’ against risk.

Allowances are examples of a line item that are included in a budget. Allowances can be established to provide funding for project elements and events that are anticipated and within the scope of the project. An estimate prepared early in a project’s developmental phase may be the basis for project funding and approval. However, it may not include sufficient detail to have an accurate count of all items, elements, or deliverables. Because design development is still evolving, insufficient information may exist with which to develop detailed estimates based upon discreet quantities and counts. It is common to create allowances for such items as furnishings and fit-out, telecommunications equipment, or even for uncertainties in construction quantities.

Allowances differ from contingency in that they are not risk-based or dependent. Allowances are derived from events which are expected to occur, and are within the scope of the project.

On the other hand, Reserve Funds are common to project management. These funds are usually typified as discretionary funds that may be applied by the appropriate level of management for the purposes that they choose. Some projects may be susceptible to significant changes in scope or deliverables during the life of the project. Technological changes may make certain project elements obsolete even before they are delivered. In these cases management may use Reserves to fund the changing and evolving scope and deliverables. Reserves are controlled by upper management and are outside the purview of the Project Manager and are sometimes called Management Reserve. Contingency Funds on the other hand, are controlled by the Project Manager.

Contingency, Allowances, and Reserves are all appropriate tools for use in budget management. The diagram shown in Figure 1 shows the relationship between these key terms. The Baseline cost estimate shown in Figure 1 does not include any funding for risk.

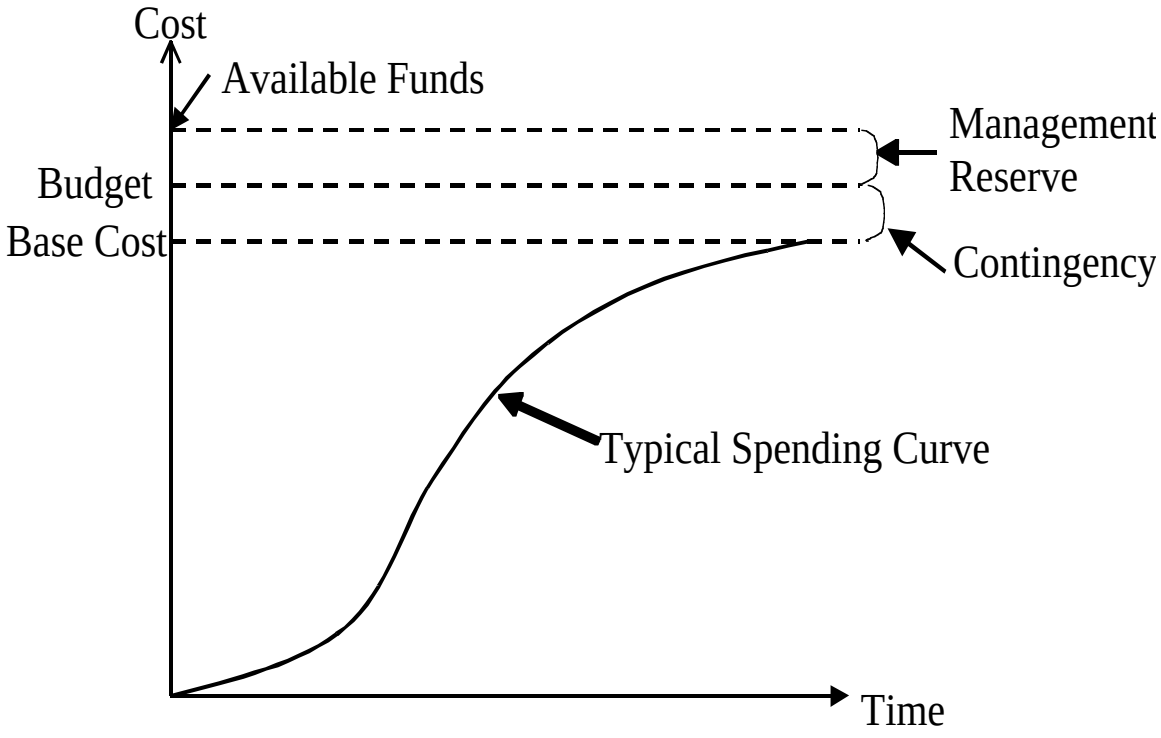

Figure 1: Relationship between the Budget, Contingency and Management Reserve

Development of Contingency Funding

The manner is which Contingency Funding is developed dictates the guidelines of how it should be effectively managed. As contingency is risk-based, it should be sufficient to manage the realization of risks. The manner in which risk affects a project is a combination of constants and key variables. These will change relative to each other and to the Project itself at different points throughout the project. Examples of these combinations are listed below.

Knowledge Variable - Proportionate to the Level of Knowledge existing at the time of the Estimate
Time Variable - Where risks diminish with passing time – (*But* the impact of such an occurrence might increase),
Status Variable - Where risk of occurrence diminishes with increasing completion of work and again the impact of such an occurrence might increase),
Constant throughout the project (a tornado or a Labor Action might just as readily occur on day 300 as on day 15).

Based on the forgoing discussion, it can be seen that the custom of adding a blanket line item in the cost estimate for contingency is not a sound practice. Adding an ad hoc 10 to 15 percent of the total budget for contingency poses two major problems. The most obvious problem is whether the line item contingency is adequate for the risks that are associated with the project. The second problem lies in determining when the contingency should be used. Holding contingency funds throughout the project and then looking for ways to spend the funds at the end of the project is not the most efficient use of project funds. This is especially the case where funds are limited and unused contingency funds could be used to fund other projects.

Analytical methods for the derivation of contingency funds offer the project manager some flexibility on the management of contingency funds. The theoretical aspects of the analytical methods are well documented [1,2]. However, there are a number of key prerequisites for the success of the analytical approaches. These include a baseline cost estimate with the accompanying Basis of Estimate (BOE) documentation and a facilitated risk assessment session.

Before the impact of risks on the cost and schedule of a project can be rationally assessed, an understanding of the assumptions made in the cost estimate and in the schedule is needed. The lead times for procured items, activity sequencing and durations (based on assumed productivities) must be made available for review. The BOE documentation should outline the major cost assumptions. Some of these assumptions include the type of contract vehicle that is to be used, price quotations from vendors, productivity rates, engineering design options and construction planning. Project assumptions can lead to risks and these are usually identified in a risk assessment session. Risk assessments can be done in a facilitated workshop environment in which all or sufficient stakeholders participate [1,2,3]. There are many risk elements to a project, and stakeholders are quite usually adept at recognizing and articulating them. A workshop environment encourages participants to interact and exchange ideas regarding risks. Although at times for logistical reasons it may be prudent to interview stakeholders individually, the full synergistic benefits from working in a group may not be realized.

During the project risk assessment session, stakeholders are encouraged to identify risks by challenging project assumptions, drawing upon their past experiences, specialized knowledge or expertise, and good old-fashioned ‘gut’ instincts. It is important to reiterate that the participants in a risk identification workshop should include all stakeholders. This group should include representation from all organizations or departments who have

any vested interest in the project's success or who would be affected by its failure. Far too often risk identification workshops include only a few participants – Contractors, Architects, and the Project Manager for instance. Failure to include representation from the corporate organization, especially Departments such as Finance, Operations & Maintenance and End Users, deprive the project organization of unique insights and risks that while external to the project or project execution do pose threats to it.

There are a number of techniques that could be used to analyze the data from a project risk assessment. These range from the sophisticated and statistical based Monte Carlo methods to the robust "bootstrap" methods that assign contingency based on the probability and impact of risk events.

Description	Base Cost X1000 In US$		1 Design Uncertainties	2 Testing Uncertainties	3 Schedule Conflicts	4 Contract Uncertainties
DESIGN						
Site Investigations	545	-	65		0	75% (0)
		+	150		1,500	25% (1300)
Electrical Design	500	-	150		120	
		+	200		500	
Relay Design	500	-	100		600	
		+	495		200	
Relay Settings	1,355	-	110		100	
		+	380		0	
CONSTRUCTION						
Site Work	1,540	-		85	175	
		+		390	35	
Equipment Installation	275	-		500		
		+		275		
Commissioning	285	-	200	200		
		+	142	200		
Effect on Total Estimate						
	5,000	-	625	785	1,030	75% (0)
		+	1,267	865	2,270	25% (1300)

Figure 2: Example of a Cost-Influence Matrix

In the Monte Carlo approach [1,4], the impacts of the various risk events are randomly combined to generate a range of outcomes for the project costs. The data used in the simulation model is obtained from a cost-influence matrix that is completed during the typical risk assessment. An example of a typical cost-influence matrix is shown in Figure 2.

The alternative to the Monte Carlo approach is the approach of assigning a probability and impact to each risk event. Based on the combination of the probability of the risk event and its impact, the amount of contingency for a risk is determined. Using the inputs

from the risk assessment, a project risk scorecard is completed. An example of the Probability-Impact matrix used to develop a project risk scorecard is shown in Figure 3.

Risk		Impact				
		None	Minimal	Moderate	Large	Major
		0	1	2	3	4
None	**0**	0	0	0	0	0
Slight ("could happen")	**1**	0	1	2	3	4
Moderate (50-50)	**2**	0	2	4	6	8
High (has happened)	**3**	0	3	6	9	12
Near Certain	**4**	0	4	8	12	16

Figure 3: Probability-Impact Matrix used to develop Risk Scorecard

In developing the risk scorecard, specific risk events relating to the various aspects of project such as Design, Procurement, Construction and Closeout will be identified. Each risk will assigned a risk score based the product of its probability and impact.

Setting Contingencies

Care must be exercised when setting contingencies for risks. Contingency should be sufficient to cover the costs or time required to avoid, transfer, mitigate, or bear the realization of risks. Risk changes with time and completion progress. The available contingency should reflect these changes by readjustments through periodic reassessment and quantification of risk. It is not enough to have a Contingency Fund that is large enough. It is equally important for the Contingency Funds not exceed needs. Over budgeting of contingency has two undesirable effects:

- The company is deprived of funds that might be better utilized in other ways or on other projects
- Unspent contingency monies will find their way to funding scope changes, enhancements, and other elements that should properly be purchased with Allowance or Reserve resources.

Based on the forgoing discussion, it is imperative that clear rules be established regarding how much contingency is approved in the budget. Figure 4 shows a typical risk-weighted cost estimate for a project. For a “one-off” or one time project in which it is imperative that the budget not be exceeded, the budget can be set a higher point on the distribution than the mean value. For example, to be 80% confident that you will not exceed the budget you can set the budget (and hence the contingency) at the appropriate point along the distribution shown in Figure 4. The higher the confidences in the budget estimate, the higher will be the contingency.

However, in most corporations, there are multiple projects being executed at any given point in time. In this scenario, funding for the portfolio of projects needs to be examined. To establish consistency, all projects within the portfolio of projects could be funded at

the same level; for example, at the mean of the distribution shown in Figure 4. Such a measure allows a corporation the opportunity to hedge against the risks on the their portfolio of projects. Thus, by setting the budget at the mean of each distribution, some projects may come under the budget and others may fall over the budget, thereby minimizing the net effect on the total budget for all the projects.

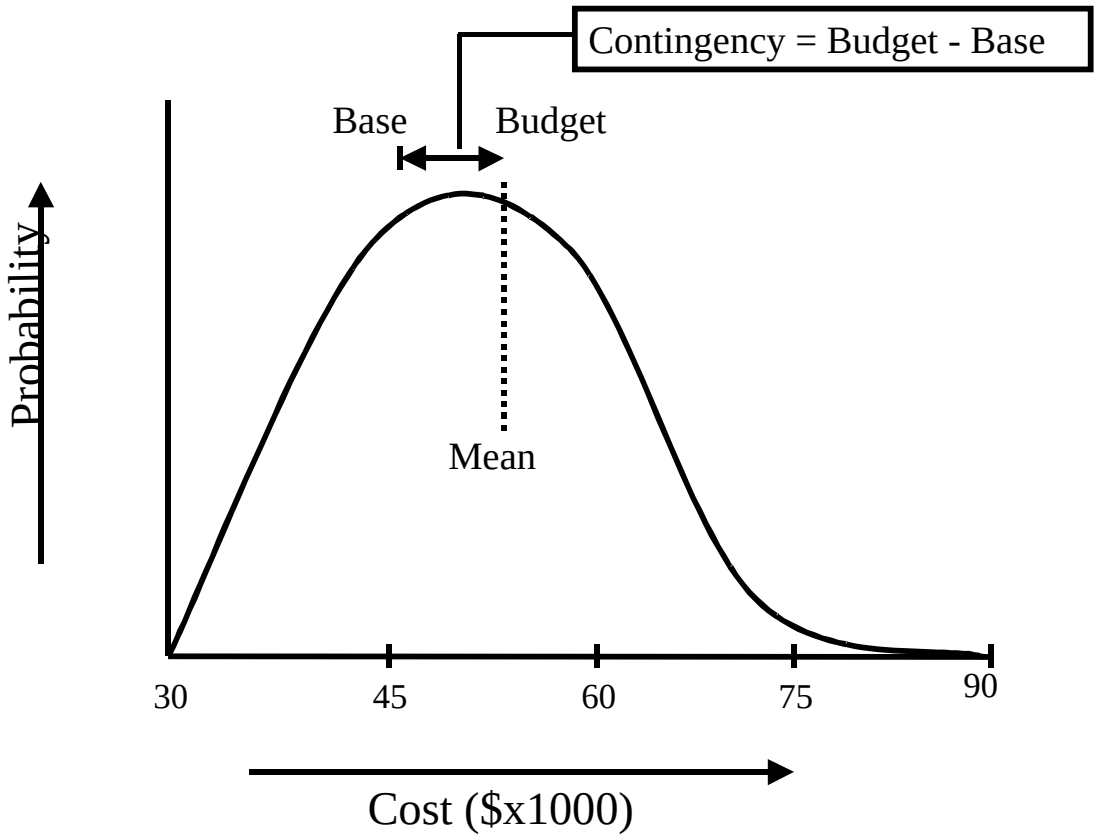

Figure 4: Setting Budgets from Monte Carlo Outputs

Using Contingency

Projects can be broken down into different phases and can be managed by work packages. Thus, it is prudent that portions of the overall contingency be assigned against specific project activities or work packages based on the risks that were identified in the risk assessment.

As an example, let us assume that during the risk assessment, a risk was identified and associated with the Site Preparation or Substructure Phase of work at a site having uncertain subsurface conditions. In this case, contingency can be assigned to the work package that pertains to Site Preparation & Remediation or Subsurface & Substructure. In this scenario, contingency allocation becomes more meaningful and does not follow a straight-line depletion path along the project schedule.

The data that can be used to determine how much contingency to assign to each risk factor or to each phase of a project can be obtained from the risk assessment. As an example, Figure 5 shows a sensitivity diagram or tornado diagram that is an output from a Monte Carlo analysis.

In Figure 5, the relative contribution of each risk factor to the overall uncertainty on the project is provided. According to Figure 5, about 74% of the total contingency could be applied to Foundations. Similar drawdown of contingency could be made for the other risk factors as shown in Figure 6. Thus, if the total contingency as determined from the risk assessment was $100, 000, the contingency drawdown plot will be as shown in Figure 6.

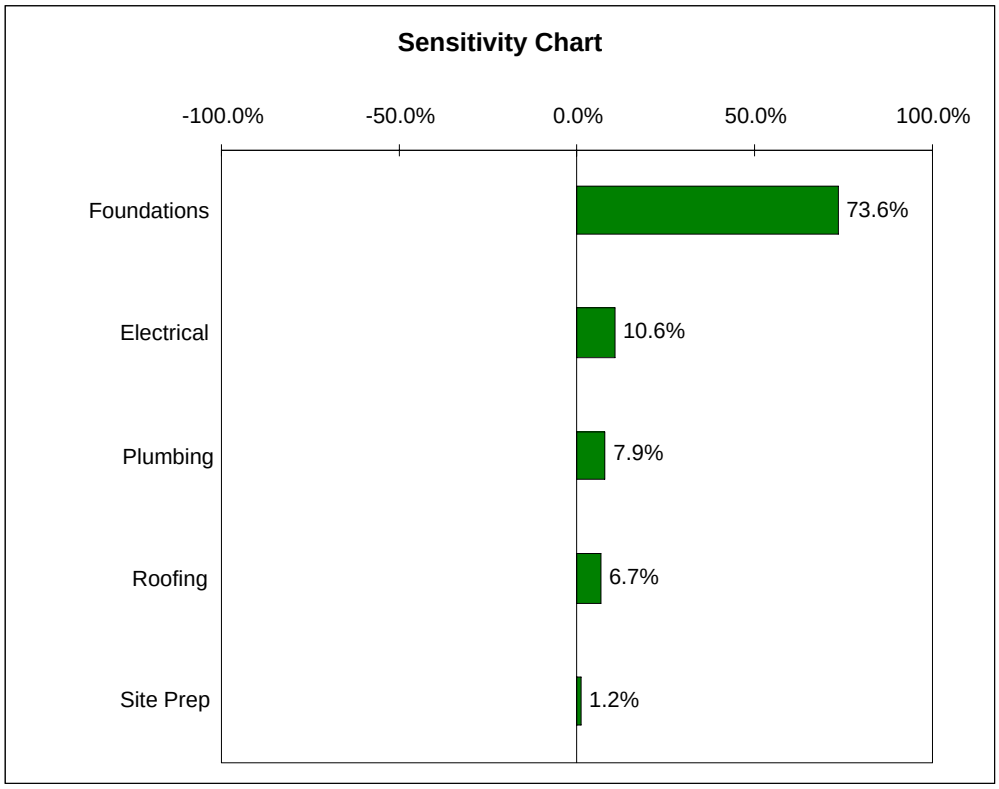

Figure 5: Example of Sensitivity Chart from Monte Carlo Analysis

The management of contingency funds using the drawdown plots provides management with quicker and more accurate information regarding the adequacy of the current contingency fund. Thus, they are better able to make decisions regarding redistribution or return of unspent funds. This is crucial for the success of a portfolio management strategy as projects that were previously unfunded at the start of the fiscal year could be reactivated based on the return of unused contingency funds.

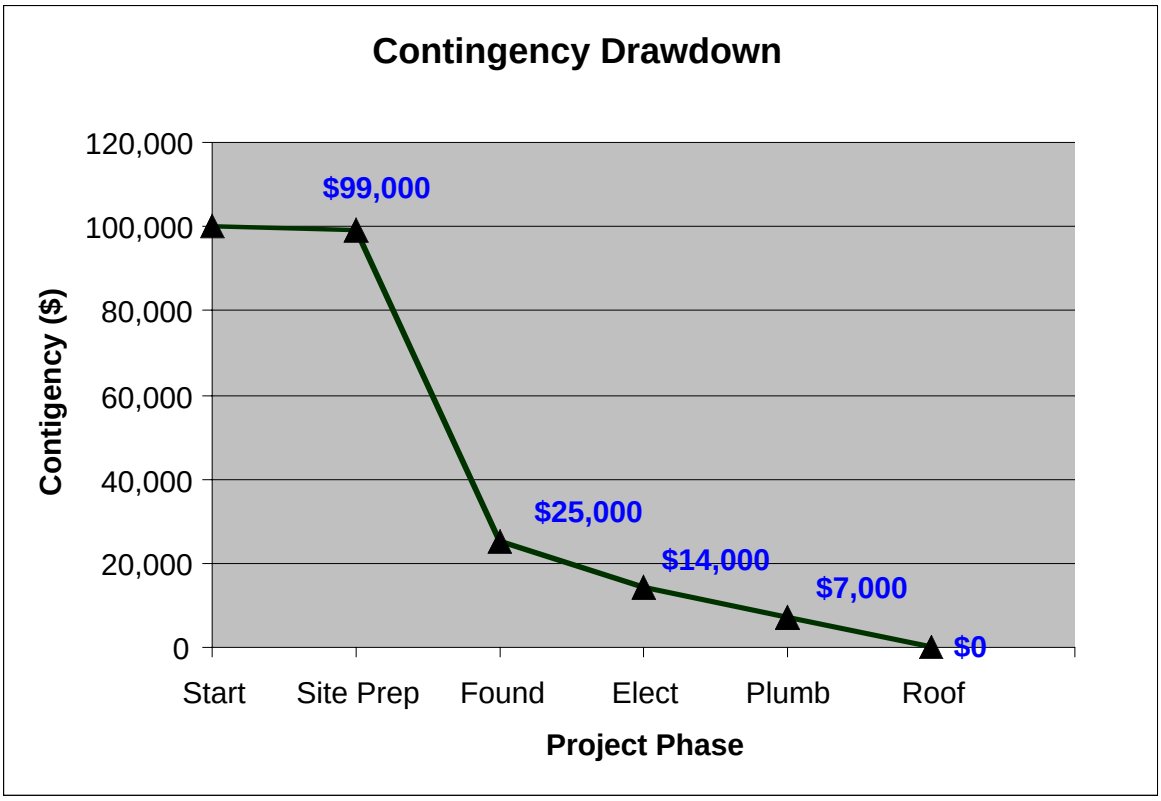

Figure 6: Example of Contingency Drawdown Plot

Continuous Issue and Risk Management

It should be noted that project risk management is not a one-time activity that is completed once a contingency is determined [3]. The drawdown plot shown in Figure 6 provides funding for continuous management of issues and risks. A model that could be used for continuous issue and risk management is shown in Figure 7. The five-step process shown in Figure 7 allows risks to be continuously assessed and prioritized.

Contract Types and their Relationship to Project Risk Management

Depending on the type of contract, the burden of contingency funding and its management may fall to different entities. The key point is that whoever underwrites the risk of Budget and/or Schedule overruns must be capable of applying or utilizing contingency. Regardless of the contractual arrangement, the principles of contingency derivation and its management remain unchanged. Some of the typical contractual arrangements are discussed below.

In Lump Sum contracts, the contractor undertakes the project for a stipulated price. Any expenditures exceeding this price (save for reimbursable scope changes) are to the account of the Contractor. The owner is not at risk.

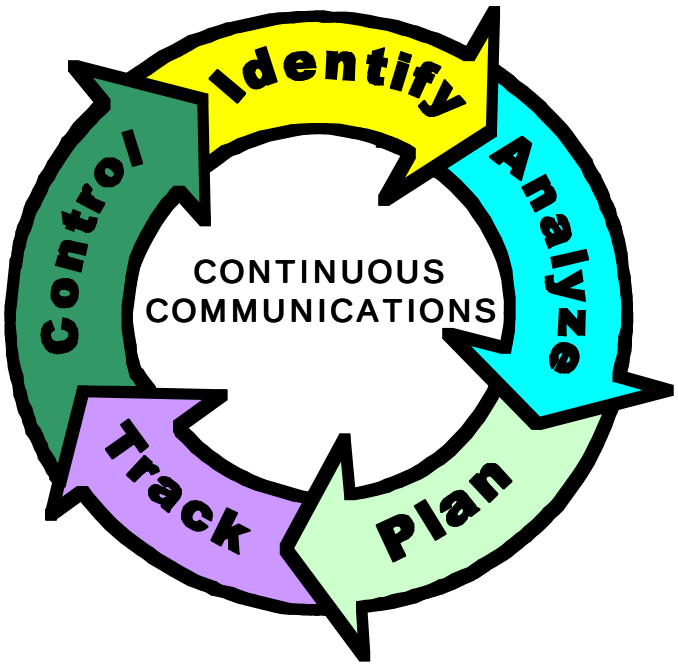

Figure 7: Continuous Risk Management Model

On the other hand, in Time and Material or Cost Plus contracts, the Contractor undertakes the Project and is reimbursed for all costs encountered. Any expenditure exceeding the Project Budget Estimate is borne by Owner. Any underruns are returned to Owner. In this case, the Owner is the sole party at risk.

In a Guaranteed Maximum Price (GMP) contract, the contractor undertakes the project for a stipulated Not to Exceed price. Any expenditures exceeding this price (save for reimbursable scope changes) are to the account of the Contractor. Any underruns are returned to Owner. The Owner, while not at risk of an overrun, has an opportunity risk of forfeiting potential underruns. In Target with Incentives contracts, the Contractor undertakes the Project for a Target Price in which both Owner and the Contractor participate in overruns or underruns. Both Parties share risks on an equal basis.

Conclusions

The methodology that is to be used for the derivation of contingency funds should be based on the level of risks on a project. Contingency funds should be used to address specific risks as they occur along the project execution schedule. Any unspent funds should be returned for possible use on other projects or to fund other activities. Based on the results of the project risk assessments, contingency drawdown plots could be used to manage the contingency funds and to improve the project budgetary process. The type of contract chosen for a project may shift the burden for contingency funding and management. However, the principles by which contingency is derived and managed should be strictly followed in order to ensure a successful project risk management deployment.

References

1. Noor, I., and Rye, T., *Guidelines For Successful Risk Facilitating and Analysis*, 43rd Annual AACE International Meeting, Denver, Colorado, June, 1999
2. Hall, Elaine M. *Managing Risk*. Reading, MA: Addison Wesley Longman, 1997
3. Noor, I., *Issue and Risk Management – A Practitioner's Guide*, International Conference on Practical Software Testing/Quality Techniques, New Orleans, Louisiana, March 2002.
4. Campbell, D.W., *Risk Analysis*, AACE Bulletin 13, nos. 4 &5 (August-October 1971).

Bibliography

1. Williams, Ray C.; Walker, Julie A.; and Dorofee, Audrey J. "Putting Risk Management into Practice," *IEEE Software*, May/June 1997
2. Wright, P.A., and T.V. Hill. *Cost Estimating —Dealing With Uncertainty*. 1986 AACE International Transactions. Morgantown, WV: AACE International, 1986.
3. Wearne, S.H. *Control of Engineering Projects*. Edward Arnold, 1974.
4. Flanagan, R., A. Kendell, G. Norman, and G.D. Robinson. *Life Cycle Costing and Risk Management*. Construction Management and Economics**,** no. 5 (1987): S53-S-71.
5. Kaplan, Stanley; & Garrick, John B. "*On The Quantitative Definition of Risk*." Risk Analysis, 1, (1981): 11-27.