A Model to Develop and Use Risk Contingency Reserve

Narendra K Shrivastava, MBA, PMP, RMP, ACP
CEO and Consultant, RefineM LLC
Chapter Vice President, PMI Southwest Missouri

Abstract

This paper describes a simple model that project managers and risk team members can implement immediately to begin using risk contingency reserve in their projects. Using the risk register and Expected Monetary Value (EMV) technique, project managers can easily develop a contingency reserve for their project and begin realizing the benefits of this powerful tool. The contingency reserve, which is time and/or money allocated to address identified risks, is a critical part of project risk management. With a contingency reserve, project managers can address risks that occur on the project, communicate the level of risk exposure to stakeholders, and increase the predictability of project outcomes.

The purpose is to spread awareness of the use of Expected Monetary Value (EMV) and data representation techniques to effectively use and communicate risk contingency reserve. This approach is relevant for any size project and is especially useful to communicate the value of risk management to sponsors and stakeholders. Limitations of the model are discussed, along with guidelines and best practices for getting started with risk contingency reserve.

Introduction

What is Risk Contingency Reserve?

An important part of project risk management is developing the contingency reserve. A contingency reserve is money or time set aside to respond to a known risk. As opposed to management reserve, which is allocated at a high-level for the "unknown unknowns," contingency reserve is allocated to respond to the "known unknowns" (PMI, 2013). These "known unknowns" are risks in the risk register that have planned responses. Many quantitative analysis tools exist to calculate contingency reserve, including Monte Carlo analysis. One simple method is Expected Monetary Value (EMV), which is the product of a risk's probability of occurrence and the impact its occurrence is expected to have. Once the contingency reserve has been developed, it is useful for communicating risks, addressing them, and improving the predictability of a project's outcome. This paper will demonstrate how to develop and use the contingency reserve model and what limitations exist with it.

Risks And Issues

First, it is important to establish a brief overview of risk management in order to communicate how risk contingency reserve falls into it. According to PMI's *Practice Standard for Project Risk Management,* a project risk is "an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives" (PMI, 2009, 9). As opposed to issues, which are incidents that are occurring or have already occurred, a risk is a possible future event with a probability of occurrence ranging between zero and one. For each known risk that is added to the risk register, some form of risk response should be planned. That way, if risks occur and become issues, there is a plan in place to deal with the impact swiftly and avoid too much damage to the project and its objectives.

Originally published as a part of the 2014 PMI Global Congress Proceedings – Phoenix, Arizona, USA

Contingency Reserve Versus Management Reserve

Contingency reserve and management reserve are options to respond to risks so that they do not compromise the project. As stated above, management reserve is kept aside to cover "unknown unknowns," or risks that occur but were not accounted for. For the "known unknowns," or risks that have been kept in the risk register, contingency reserve can be part of the overall risk response strategy.

The other key difference between contingency reserve and management reserve is who controls each one. As implied by the name, management reserve is typically set by upper management as a buffer against any unknown risks. Along with the cost baseline, the management reserve is the final piece of the cost budget (PMI, 2013). On the other hand, the project manager is typically authorized to spend what is in the contingency reserve to address risks as they occur. Therefore, the project manager is accountable for its use.

Exhibit 1 shows the cost aggregation technique and illustrates how contingency reserve and management reserve fit together with other project costs (PMI, 2013). Starting at the bottom, estimates are rolled up into the overall project estimate, and the contingency reserve is added to form the cost baseline. The cost baseline with management reserves is the cost budget for the project.

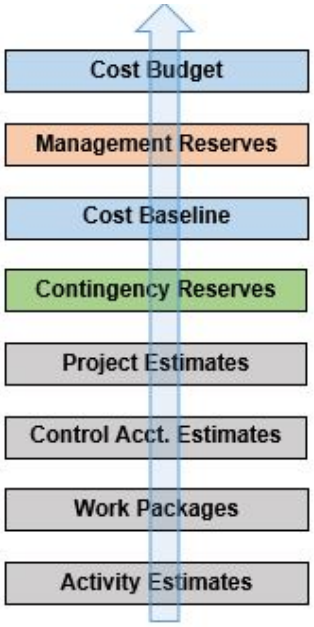

Exhibit 1—Cost Aggregation

Why Use the Contingency Reserve?

Why should project managers develop a contingency reserve? Primarily, it is a valuable risk response strategy that helps insure the project against debilitating time and monetary costs. The basic model works very similarly to insurance, in that a fraction of the time or monetary cost of a risk is added to the pool of risk contingency reserve so that the pool can "pay out" as any of the risks occur. This fraction is based on the Expected Monetary Value (EMV), or the product of probability and impact. Of course, if all the risks occur, then the pool will run dry, which is one limitation of the model that is discussed later.

Originally published as a part of the 2014 PMI Global Congress Proceedings – Phoenix, Arizona, USA

The second reason to use a risk contingency reserve is to improve the predictability of project outcomes. By pooling the risk contingency costs together so the cost of any risk occurrence can be absorbed, it is easier to track risk occurrence. Data representation, such as charts and graphs, can be used to track the use of the reserve over time and how it affects the project schedule and budget. Without the contingency reserve, those extra days and money come out of the actual schedule and budget, causing delays and cost overruns. If this happens, then the project will be derailed. With this data, it is also easier to see where risks are coming from. For example, if time delays due to training cause eight days to be spent from the risk contingency reserve, that can become a lesson learned for future projects.

Finally, another use of the contingency reserve is to communicate the project's risk profile to sponsors and stakeholders. In communicating the project's risk profile, the project manager is also communicating the value of risk management by showing how it affects the stability of the project and its outcome. In this way, adopting a risk contingency reserve model can help advance the maturity of risk management across the organization.

Developing the Contingency Reserve

The main inputs in developing the contingency reserve are the risk register and a quantitative analysis technique used to calculate the cost of each risk. Expected Monetary Value (EMV) is the quantitative analysis technique used in this article due to its simplicity and ease of implementation. Despite its name, EMV doesn't have to be just a monetary cost; it can also measure the expected time delay in terms of person-hours or person-days.

Monte Carlo analysis is another powerful tool that can be used to determine expected costs associated with risks in simulations of project schedules (PMI, 2013). Monte Carlo works by running projected schedule and cost data over thousands of simulations of a project and reporting the frequency of project results. For example, if work on a particular task is expected to last twenty hours, a Monte Carlo simulation can show how many times the work took longer or shorter than twenty hours in the simulated projects. This approach is also useful because a project manager can see not only the frequency of the project hitting its parameters, but also the outlying areas; for example, the longest or shortest task duration.

While Monte Carlo has many advantages, it can be costly and time-consuming to implement, so this model was developed using the more simple approach of EMV. Whatever approach is used, the advantage of having a quantitative analysis backing the contingency reserve is objectivity. In contrast, contingency reserve is commonly developed based on some percentage of project budget. While this is a more simple approach than the EMV-based model, it fails to take risks into account, leaving the project susceptible to delays and overruns.

The two inputs to EMV are the probability of a risk occurring (expressed as a percentage) and the impact of the risk occurring (expressed in some time or monetary measure). Obtaining this data through meetings with the project team and stakeholders makes it more realistic. The formula for EMV is:

EMV = probability x impact

For example, a risk has a 60 percent probability of occurring and a cost impact of $10,000. The EMV for this risk event is (0.6 * 10000), or $6,000. To compensate for this risk, the contingency reserve needs $6,000. Summing the EMV for each risk results in the total contingency reserve for the project. For example, on a project, there are five risks with two having an EMV of $10,000 and three having an EMV of $11,000. The sum of the risks is two times $10,000, or $20,000, plus three times $11,000, or $33,000. Adding these gives the total contingency reserve of $53,000.

Originally published as a part of the 2014 PMI Global Congress Proceedings – Phoenix, Arizona, USA

How does contingency reserve work with the project schedule? Consider the following examples. One, a project team on a project in development runs the risk of losing two key programmers for two weeks due to another project taking priority. The chance of this risk occurring is 75 percent, and the total loss of workdays would be 10. Multiplying these yields the product of 7.5 days, so the risk contingency reserve for the project schedule needs 7.5 days added to it. As another example, assume that the same project also runs the risk of development needing to stop for nine days while a computer system is upgraded. That risk has a 50 percent chance of occurring, which makes the EMV for this risk half of nine days, or 4.5 days. To account for both risks, the project schedule needs twelve days (7.5 plus 4.5) added to it, and the schedule reflecting these twelve days, along with the EMV of other risks, becomes the "no later than" schedule.

Beyond the sum of individual risks to obtain the total contingency reserve, there is one final input to consider: the organization's practices for cost and time management. Following set standards for allocating budget and schedule increases the chances of securing necessary approvals to implement the contingency reserve (PMI, 2009). In addition, following the predefined format for setting up project budget and project schedule helps in communicating the contingency reserve, increasing its profile to sponsors and stakeholders.

Using Contingency Reserve

Contingency reserve is used when a risk occurs as part of the risk response strategy. The actual impact of the risk is added to the cost or schedule, the estimates are updated, and contingency reserve decreases. The baseline, however, does not change. If risks do not occur, the contingency reserve associated with those risks is not spent, and the project comes in before time and under budget.

The contingency reserve tends to be higher near the beginning of the project and lower near the end. This effect is consistent with project risk, which tends to be greater at the beginning of the project due to more unknowns and will recede near the end of the project. Also, as the project proceeds and risks either happen or do not happen, the reserves associated with those risks either are spent or not spent, lowering the overall reserve. As risks are reassessed, reserve analysis can also be performed again to reallocate some reserve to a risk or take some away based on the new risk probability and impact.

Exhibit 2 shows the relationship between the cost baseline and remaining contingency reserve and how this relationship varies throughout the project. In this example, the contingency reserve starts at $2,000 in January 2014, and then risks with an EMV of $500 each occur in February and March. The blue bar is project estimate, which, with the orange bar of remaining contingency reserve, makes up the cost baseline. Even though the remaining contingency reserve falls from $2,000 to $1,000, the overall cost baseline of $12,000 remains the same.

Originally published as a part of the 2014 PMI Global Congress Proceedings – Phoenix, Arizona, USA

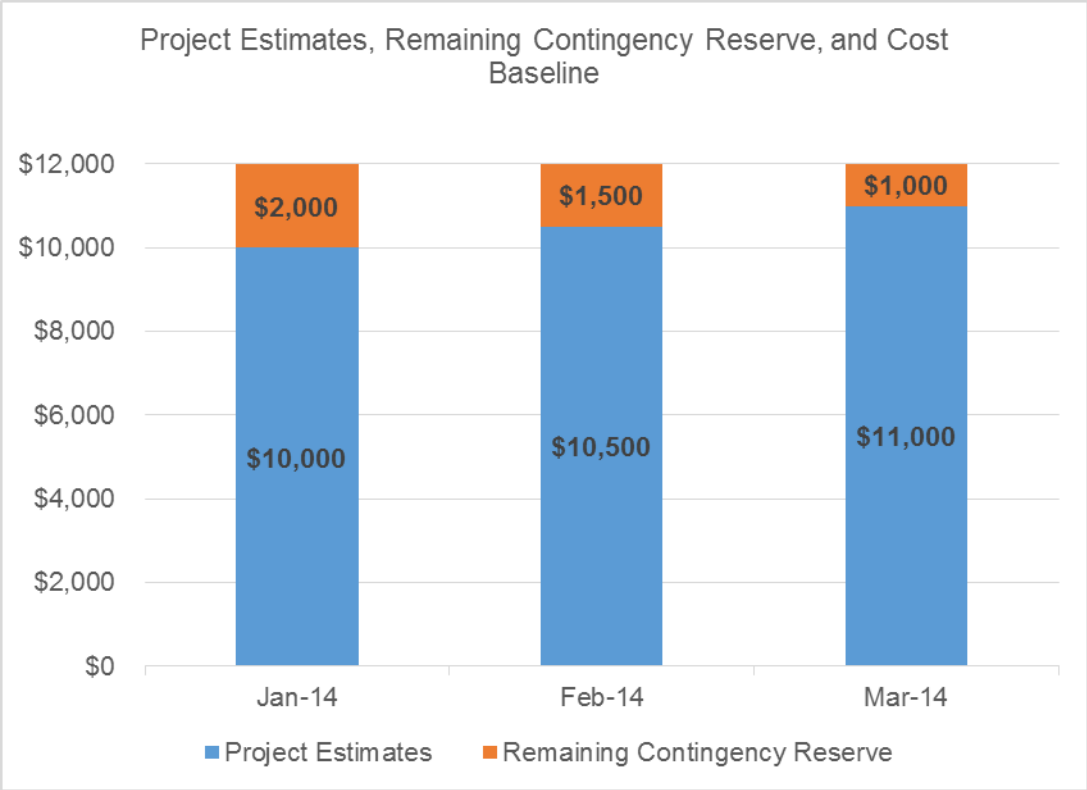

Exhibit 2—Project Estimates, Remaining Contingency Reserve, and Cost Baseline

Communicating the Contingency Reserve

Once calculated, the contingency reserves are added to schedule and budget estimates. The project finish date adjusted for contingency reserve becomes the "No Later Than" date, while the budget adjusted for contingency reserve becomes the "Not To Exceed" budget. It is important that the contingency reserve is communicated in this way and not as the new finish date or project budget. While some contingency reserve will almost certainly be used, it is based off the EMV and will not adequately cover all project risks should they occur. Keep in mind that the EMV of a risk event is not the same as the actual impact. For example, if the EMV of a risk is $5,000 with an impact of $7,000, the actual cost of the risk occurring is $7,000.

The key point to communicate to sponsors and stakeholders is that the project is likely to finish between the planned date/budget and the "No Later Than / Not to Exceed" plan or budget. As long as the contingency reserve is developed well enough to account for known risks, the project will not exceed the "No Later Than / Not to Exceed" plan or budget. It is unrealistic to expect that no risks will occur on a project, but stakeholders and sponsors need an indicator that the project will not go out of control. Communicating the contingency reserve is a way to show that the project can proceed despite risks that might occur. Exhibit 3 shows a project finishing in between its planned finish and "No Later Than" Date.

Originally published as a part of the 2014 PMI Global Congress Proceedings – Phoenix, Arizona, USA

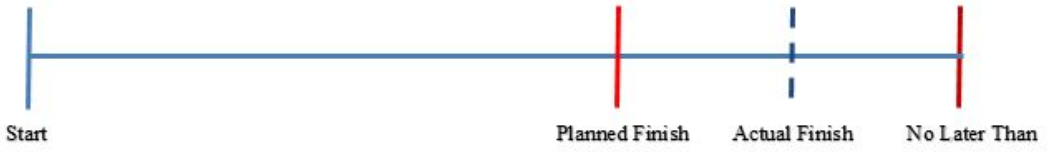

Exhibit 3—Project Finish with Planned and "No Later Than" Dates

Another key part of communicating this contingency reserve model is how this approach deviates from typical usage. It is common practices for project managers to ask for some percentage of overall budget, such as ten percent, to be used as contingency reserve. This model is more objective; while it may not be perfect, it is a closer estimate of how risk might impact the project than a percentage of total budget.

Plotting contingency reserve against the schedule or budget is a good way to keep track of both. Exhibit 4 shows the movement of project estimates and remaining contingency reserve over six months of a sample project. As contingency reserve is used, the amount available decreases while the project estimates simultaneously increase. The cost baseline, which is the sum of estimates and the contingency reserve, stays the same as long as the contingency reserve does not fall below zero. If the contingency reserve were overspent, then the expenditures would overrun the cost baseline.

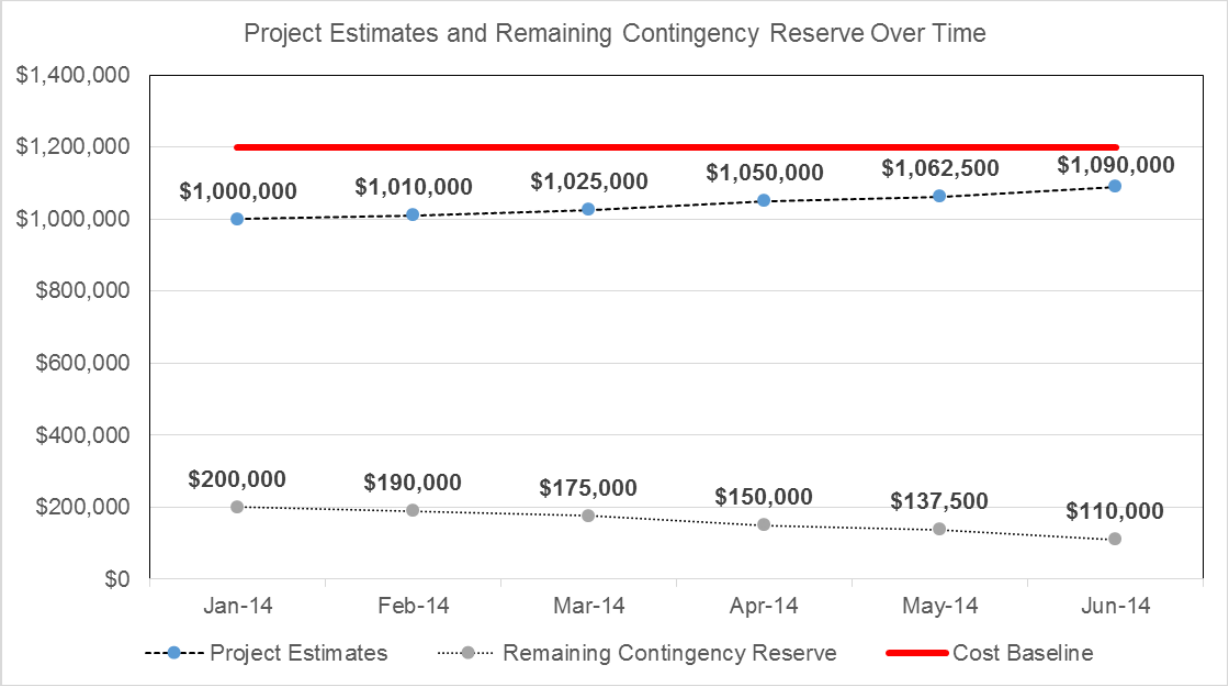

Exhibit 4—Project Estimates and Contingency Reserve Over Time

Originally published as a part of the 2014 PMI Global Congress Proceedings – Phoenix, Arizona, USA

Limitations of the Risk Contingency Reserve Model

The risk contingency reserve model works well if many risks are identified and there is a diverse range of probabilities and expected risk impact. Earlier, risk contingency reserve was compared to insurance. To be successful, an insurance company needs a large risk profile where there are not too many risks that are high-probability.

There are some limitations of the risk contingency reserve model that are important to keep in mind. First, the model is not as useful when only a few risks have been identified. Second, the model is not as useful when all risks that have been identified have a high probability. Both of these can cause erroneous results because the total contingency reserve is based on the sum of EMV products for each risk, not the actual impact. If all the risks occurred, then the contingency reserve would be overrun, causing problems. If too few risks are defined, and the risks that are defined have high probability of occurrence, then this model may not produce correct results. Going back to Exhibit 2, if the risk that occurred in March 2014 had an impact of $5,000 instead of $500, then the remaining contingency reserve of $1,500 would be overrun and the cost baseline would increase by $3,500.

In the case of the first problem of too few risks being defined, one solution is to re-examine risk management processes. It is highly possible that the risk identification was not robust enough and there are other risks out there that need to be identified and analyzed. A risk breakdown structure, or RBS, is one tool that a project manager can use to identify risks from other categories he or she had not previously considered with the team (PMI, 2013). The RBS is a hierarchical structure where project risks are broken into levels, with the overall project risk starting at level 0 and high-level categories starting at level 1. Like the WBS with scope, the RBS is a good way to break risk categories down into individual risks. Exhibit 5 is a sample RBS.

RBS Level 0	RBS Level 1	RBS Level 2
ALL SOURCES OF PROJECT RISK	1. TECHNICAL RISK	1.1 Scope Definition
		1.2 Requirement Definition
		1.3 Estimates, Assumptions, and constraints
		1.4 Technical processes
		1.5 Technology
		1.6 Technical Interfaces
		Etc.
	2. MANAGEMENT RISK	2.1 Project Management
		2.2 Program/Portfolio Management
		2.3 Operations Management
		2.4 Organization
		2.5 Resourcing
		2.6 Communication
		Etc.
	3. COMMERCIAL RISK	3.1 Contractual terms and conditions
		3.2 Internal Procurement
		3.3 Suppliers and vendors
		3.4 Subcontracts
		3.5 Client/Customer Stability
		3.6 Partnership and joint ventures
		Etc.
	4. EXTERNAL RISK	4.1 Legislation
		4.2 Exchange rates
		4.3 Sites/Facilities
		4.4 Environmental/weather
		4.5 Competition
		4.6 Regulatory
		Etc.

Exhibit 5—Sample Risk Breakdown Structure

Originally published as a part of the 2014 PMI Global Congress Proceedings – Phoenix, Arizona, USA

In the case of too many high probability risks, deploying risk management to find other risks with lower probability to balance out the profile may also work, but another response is to adopt more response strategies rather than rely solely on the risk contingency reserve. Earlier, risk contingency reserve was compared to insurance, which also applies here as well. The more risks, and the more diverse the overall risk profile, the better. Handling too many high-probability risks is in itself a major risk.

Conclusion

In summary, the contingency reserve is a critical component of quantitative risk analysis. Developing a risk contingency reserve, including it in cost and schedule baselines, and tracking its use as the project progresses will help increase the predictability of project outcomes. In addition, it becomes a powerful tool in demonstrating the value of risk management to project sponsors and stakeholders. Used properly, risk contingency reserve can act as a shield against the damage that a project can sustain through the occurrence of risks. Using EMV to calculate contingency reserve is a simple way to harness the benefits of this powerful tool.

References

Project Management Institute (PMI) (2009). *Practice Standard for Project Risk Management*. Newtown Square, PA: Project Management Institute, Inc.

Project Management Institute (PMI) (2013). *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, Fifth Edition. Newtown Square, PA: Project Management Institute, Inc.

Originally published as a part of the 2014 PMI Global Congress Proceedings – Phoenix, Arizona, USA