

How to Estimate and Use Management Reserve in an Earned Value Management System (EVMS)

Prepared for the 2011 ISPA/SCEA Joint Annual Conference and Training Workshop

June 7-10, 2011

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Abstract

When using an Earned Value Management System (EVMS), a Management Reserve (MR) is both expected and a 'best practice'. But the misunderstanding of how to establish it, what it is for and how to use it, extends from government agencies to contractors.

This paper will provide direction from the government and the industry best practices for the establishment, tracking, use, and reporting of MR.

Introduction

When using an Earned Value Management System (EVMS), Management Reserve (MR) is both expected and considered a best practice. But the lack of understanding of MR and its use extends from government agencies to contractors.

MR is an integral part of an EVMS, which provides a project manager with program progress and trend information necessary to effectively manage a project and achieve its technical, cost and schedule objectives.

This paper discusses how MR is established and subsequently used to keep a program on track.

Management Reserve Defined

MR is defined in ANSI/EIA 748-B, Earned Value Management Systems, the commercial standard for EVMS, as "An amount of the total budget withheld for management control purposes, rather than being designated for the accomplishment of a specific task or set of tasks." In most programs, particularly developmental efforts, there is considerable uncertainty regarding timing and/or magnitude of future difficulties such as;

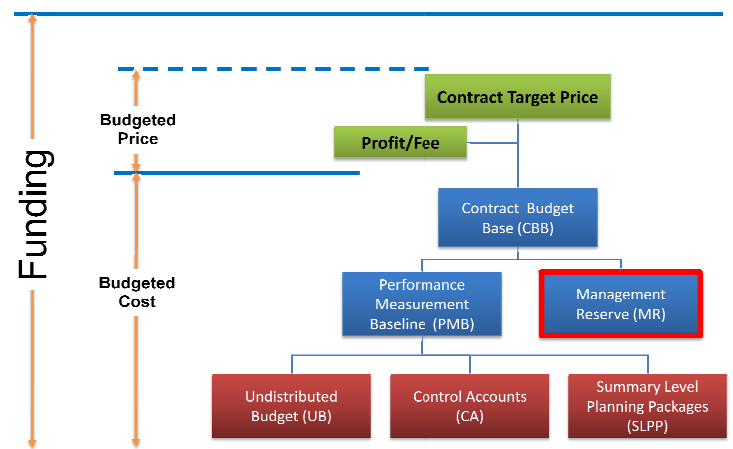
- Growth within currently authorized work scope
- Rate changes (labor, material, currency)
- Risk , its probability of occurrence and its impact
- Other program unknowns

Consequently, MR is established to provide a source of budget to plan and execute effort initially excluded from the project plan, which is necessary to overcome these difficulties and keep the project on track.

Many people incorrectly view MR as funding contingency. In order to better understand MR, the difference between funding and budget must be well understood. **Budget** is the estimated cost for the planned work agreed to by both contractor and customer. **Funding** is the amount of money held by the customer to reimburse the contractor's actual costs and fees or price (depending on the contract type).

Figure 1 illustrates the relationship between budget elements and funding.

Figure 1 Budget/Funding Relationships



A customer generally requires funds in excess of the contractor's budget to pay for contract changes and overruns (if the allowed by the contract). OMB encourages customers to establish program risk-adjusted budgets (PRB) to provide funding and schedule contingencies to cover the risk of cost and schedule overruns on a project.

Figure 2 shows how the MR, which is part of the contractor's budget, relates to the customer's contingencies comprising the program risk adjusted budget.

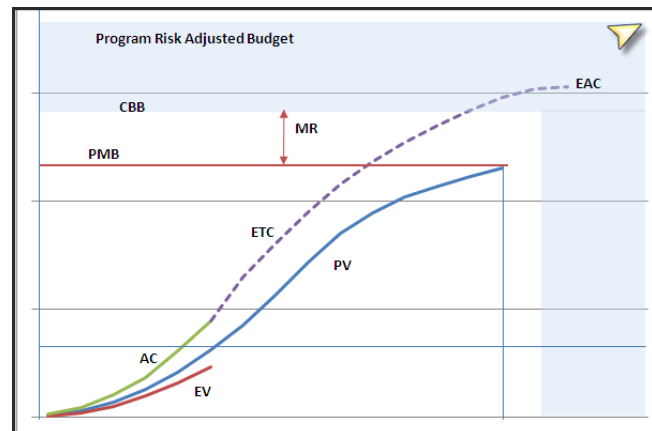


Figure 2 - Budget and Funding Profiles

In this diagram you can see the difference between the contractor's CBB and the customer's Program Risk Adjusted Budget (PRB), depicted by the shaded area. The PRB includes the amount of additional funds and time that the customer has available to handle cost and schedule growth that may occur on the project. As the name implies, it is based on the risks identified by the customer for the project, which are usually based upon the customer's history and experience with similar projects. The horizontal scale, representing time, shows that the PRB is planned to a date beyond the contract end date. This is the equivalent of schedule contingency or reserve that may be held by the customer.

The blue line is the total time phased budget or planned value (PV). The total of the entire planned budget is the Budget at Completion (BAC). Above that, is the contractor's Management Reserve (MR). The BAC + MR = the Contract Budget Base (CBB). This is the total estimated 'cost' of the project.

Above that is fee, which when added to the CBB yields the Contract Target Price (CTP), (not shown).

Upon completion of a contract, some MR often remains. This may be true whether the contractor's final actual cost was over or under the contractor's planned cost at completion or BAC. Many people find this bothersome due to their confusion over the differences between budget and funds. Ultimately, the contractor will be paid, from funding allocated to the contract, for all contractually allowable costs and fee incurred in performance of the project. This may end up being in excess of the budget (overrun) or less than the budget (under-run).

Estimating Management Reserve

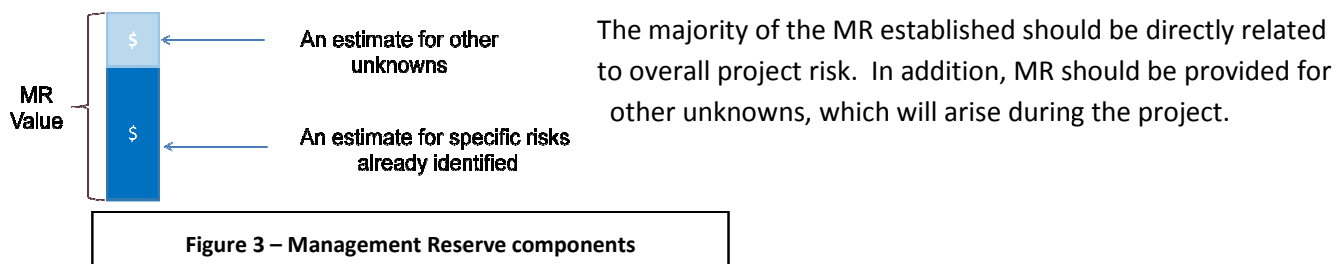
FAR 31.205-7 (c), defines contingency as a possible future event or condition arising from presently known or unknown causes, the outcome of which is indeterminable at the present time and indicates that costs for contingencies are generally not allowable. Those which are foreseeable within reasonable limits of accuracy, e.g., anticipated costs of rejects and defective work may be included in the estimates of future cost so as to provide the best estimate of performance cost. In contrast MR is not foreseeable and should not be included in the PMB. The challenge then is how to estimate the cost impact of risks, which are uncertain future events, in the proposal cost estimate, so that sufficient budget is available to plan the know work and set aside management reserves.

The ANSI 748 standard says "MR is not a contingency that can be eliminated from prices during subsequent negotiations or used to absorb the cost of program changes. The budget being held in reserve must not be viewed by a customer as source of funding for added work scope." (Unfortunately, this rule is often violated).

This conflict has perpetuated the mindset that MR should be "buried" within allowable cost elements proposed on a project, so that once the contract is negotiated, the contractor then sets aside an amount from the CBB for MR.

In the past, contractors would hold back a percentage, e.g., 10%, from the negotiated budget for MR and distribute the remainder to the Control Accounts. This is no longer considered a best practice. These days, risk management is well-integrated with both cost estimating and earned value management. Proposal costs are estimated by assessing and quantifying potential risks and opportunities, developing risk and opportunity handling plans, and including the cost of those handling plans in the proposal estimate. Through Monte Carlo and other risk analysis techniques, proposal estimates with specific confidence levels can be developed and proposed based upon a contractor's risk appetite.

Upon contract award, the risk assessment is updated, and budgets are allocated to control account plans based on the risk inherent in the control accounts' work scope. Overall budget allocation is typically made at a more challenging level of confidence than the proposal cost estimate, allowing the extra budget for the establishment of management reserve. The allocation of budget to individual control accounts is risk-based, with more budget allocated to high-risk project elements; less budget allocated to lower-risk elements.



The process for assessing and quantifying risk and opportunities and using this information to establish management reserve is as follows:

1. During the proposal stage, perform a risk analysis. Quantify the probability of occurrence and the consequences of identified risk events. Identify risk/opportunity handling plans to mitigate or eliminate risk and capture opportunities. Include the cost of risk/opportunity handling plans in the proposal cost estimate. For risks that will be accepted, include the cost of their consequences. Perform additional analysis to determine the level of confidence in the cost estimate. Determine the confidence level required for the acquisition based on management's risk tolerance, for instance you may decide to bid a high-risk project with a cost estimate having an 80% confidence level in order to ensure project success.
2. When the contract is awarded, budget the Control Accounts at a lower overall confidence level, i.e., selectively issue target budgets lower than the high-confidence estimate, to the control accounts based on their inherent risk, and retain the remaining budget in MR.
 - a. For example; if a task will cost \$110,000 with an 80% probability of success; and
 - b. The Control Account may be budgeted at \$100,000 (based on a 50% probability of success)
 - c. The remaining \$10,000 is maintained in MR
3. Some of the allocated control account budgets should be used to plan risk/opportunity handling activities. Generally, not all risk/opportunity handling activities are included in the PMB; usually the handling activities for risks with a high probability of occurrence and consequences will be initially planned. The remainder of the risks/opportunities will be carefully monitored. When it becomes obvious that they are elevating in probability or impact, MR can be issued to prospectively plan risk handling activities. Therefore, MR initially set aside should be carefully reviewed to determine if it is sufficient to handle risks and opportunities not included in the initial PMB. In addition, some amount of MR is also required for unknown unknowns that typically occur on any project and must be based on management judgment, the type work, and past experience with this type of project.
4. In the past contractors would just hold back a percentage (10%) from the negotiated budget for MR and distribute the remainder to the Control Accounts. That is not a best practice.

Management reserve can be replenished in two ways.

1. Via changes to the contract
2. Via prospective replanning, to remove budget that will no longer be required due to the result of opportunity realization.

Planning for contract changes is done exactly the same way as planning the initial PMB. An amount of the contract target cost is set aside in MR based on the risk inherent in the added contract scope. Every time you estimate a change that has risks associated with the new work scope, you should perform a risk analysis, evaluate the cost of the risk and when approved, withhold the risk amount for MR. It is just as valid for a change, as it is for the original project planning.

The realization of opportunities, which are identified in the initial risk/opportunity assessment, and subsequently managed proactively in order to realize them, often results in the elimination of future work that had been planned in the PMB. Budget for this work, which will no longer be required, can be transferred back to MR when the work/planning package containing it is replanned.

The amount of MR needed for a project depends entirely upon the amount of risk it entails. However, data are available to help a PM determine how much is typically required on several types of projects. These data can be used as a benchmark. One of the questions often asked is; "How much MR should I have?" That is an impossible question to answer in general, but here is some background.

Management Reserve Study

There was a study done on Industry Averages for MR that was published in the *Acquisition Quarterly Review - Summer 2000* by; David Christiansen and Carl Templin. They reviewed data from the Defense Acquisition Executive Summary (DAES) for the period 1975-1998. This study included over 500 completed and ongoing contracts. The DAES reports reflect summarization of information from contractor Contract Performance Reports (CPRs).

In that report they charted the median percentage of MR by contract category and by acquisition phase. Here are the charts. Figure 4 shows the median percent of MR by contract category and Figure 5 shows the median percentage of MR by acquisition phase.

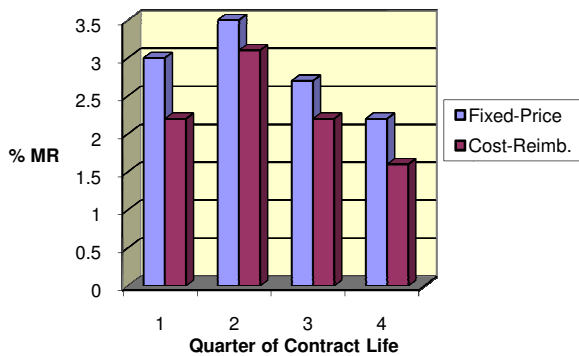


Figure 4 – Median % MR by Contract Category

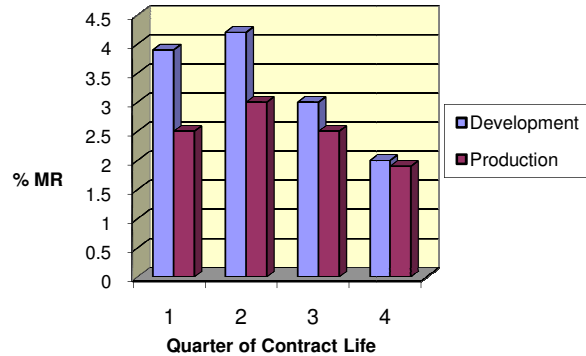


Figure 5 – Median % MR by Acquisition Phase

These are median numbers, not averages. That means there are an equal number of data points above the median as there are below it. The range for the MR percentage was 2.2% to 6.1% where:

$$\text{MR\%} = \text{MR budget} / \text{Total allocated budget}$$

Notice that for fixed price contracts the percentage is higher. Hopefully that is obvious, as the risk is all on the contractor so the contractor would plan additional MR.

The MR percentage is higher for development contracts than for production contracts. That seems obvious also, as there are a lot more risks in development work than in a production project.

There are a few considerations in establishing and maintaining the MR;

1. Once a contract is awarded, refine / reassess mitigation measure(s) included for each risk event. Things may have changed since you proposed the contract which will affect future decisions
 - a. Reduce / transfer value of high cost risk to MR if mitigation effort was successful
2. Reevaluate risks and associated MR throughout execution of the contract

- a. Risks change. When risks are retired, the associated MR is either formally transferred to other risks or retained as “non-specific”
3. MR allocated during execution of contract should be directly tied to amount associated with each identified risk
4. MR allocations are part of the change control system. They are internal changes but require that a change request is issued and the project manager authorizes the change to the CA(s).

Using Management Reserve

Now we have defined what it is and discussed how it is estimated. Now we need to address how it is used. The easy response; “it is to plan for new work scope that has not been planned in the PMB, and is not out of scope to the contract”.

Once you know how much MR that is available, how do you identify and report it?

MR is reported on the Contract Performance Report (CPR) as a lump sum on formats 1 & 2. All uses of the MR would be seen in the baseline change in CPR Format 3 and the description of the uses would be explained in Format 5. MR usage should be maintained in an MR Log that tracks all of the additions to and uses of, MR. This log and process should be identified in your change control procedures.

The MR log is an internal document but is the basis for changes to the baseline reported on CPR format 3. If you are audited, this is your backup. Inside the log is a cross reference to the risk log that can support the estimate for all MR in the log.

For an EVM approach to be effective, all work must be planned with a budget. MR allows you to make sure that this rule is followed. But it is still required to be formally authorized, planned and tracked in the log.

Here are 2 examples of cases which require MR;

Example #1 – as part of the development plan, an initial build of a prototype unit was to be shipped to another facility for testing. While in shipment, the unit sustained \$300,000 worth of damage. The unit will have to be rebuilt and the entire schedule now has to be changed. Tracking this in-scope change requires that the new work be planned and scheduled.

The budget for the rebuild needs to be planned in the appropriate Control Accounts so the rebuild progress can be measured, like any other work in the project. It is not a contract change; you cannot go to the customer for additional budget. This is where MR is used. This assumes no one identified the accident as a risk, so this change was budgeted from the non-specific portion of the MR.

Example #2 – the source code development testing and correcting cycle was estimated to require three repetitions for a 60% probability of success, but could require up to six cycles. If each of these cycles takes a month and \$100,000, each repetition will have a significant impact on the project and needs to be tracked. At the end of three cycles, the code was still not error free enough to pass testing and it was determined that it would take 2 more cycles.

The contract said “test to X standard”, not how many times to test and fix; so it will not be a contract change. Each additional cycle that is required to meet the technical specifications for delivery will need to be planned in

all the control accounts affected and the budget will come from MR. Since this was probably identified as a risk to the code development, this MR should come from the portion estimated for code development risk.

In addition to the types of changes addressed in the two examples above, there are times when all Control Accounts are affected by an unexpected change. For instance, the labor union won a 10% pay increase over the increase amount planned. This means that every production Control Account is likely to incur a 10% cost variance. If the variance reporting threshold is 10%, every CAM is likely to have to provide a variance analysis based on something that they had no control over. In this case, the PM may choose to allocate MR to all affected CA's to negate the issue. This "replanning" will have to follow change procedures but is within the purview of the PM.

Conclusion

The use of Management Reserve is a best practice recognized by everyone that uses EVM systems and by the ANSI standard, NDIA PMSC EVMS Guides and the DCMA Surveillance guidance. There is no question about its validity.

The only questions that arise, stem from a misunderstanding of the use of MR. In today's cost cutting environment, there are customers that will want to see a contractor use MR to budget contract changes and contractors that will try to use MR to cover variances. These misuses of the MR must be avoided and understanding what it is for will help.

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