EARNED VALUE MANAGEMENT

Current Solution and Roadmap to Adoption

By Kris Athey

1.0 INTRODUCTION

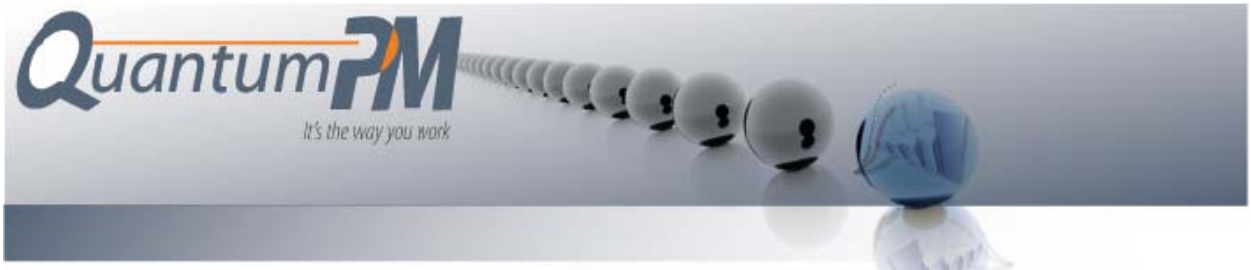
This paper is being written because of the current U.S. Executive Branch drive to take the next steps to implementing full Earned Value Management Systems in the Public Sector (and in those companies fulfilling on contracts for the Public Sector). Earned Value methods provide a project cost control that allows you to quantify the overall project progress in monetary terms. The techniques have been in use in the Space and Defense area since Project Management techniques were formalized in the early 1960s. They have proven extremely effective in understanding the true status of a project as well as projecting established cost trends to project completion to gain early insight into final total project cost. Earned Value can be compared to actual costs and planned costs to determine project performance and predict future performance trends.

This whitepaper provides a quick overview of Earned Value Management, describes the activities surrounding EVM in the Public Sector, and ends with our recommended roadmap to EVMS. In this paper, the terms program and project will be used interchangeably. Care will also be taken to differentiate between Earned Value (the metrics and the concept) and an Earned Value Management System (which includes the processes and procedures required to produce EV information for a program/project in a consistent way).

The views expressed within this whitepaper were developed from the combined experience of our project management consultant team and were refined over the course of developing a QuantumPM EVM System product enhancement to the Microsoft Enterprise Project Management Solution (MS EPM). The issues encountered while developing simple, practical, and supportive user scenarios helped to clarify specific needs and identify solutions, some of which are included in this paper.

2.0 EVM HISTORY

In the late 1950s and early 1960s the US Government was undertaking Defense projects worth hundreds of millions of dollars and spanning many years. The risk of these projects was born by the Government as the vendor contracts for these projects were cost-plus (meaning that vendor costs were reimbursed). To manage the huge risks shouldered by the government, a method was needed to ensure that progress was being made and that money was being spent effectively. Formalized project management was born. The Work Breakdown Structure (WBS) was developed as a strong



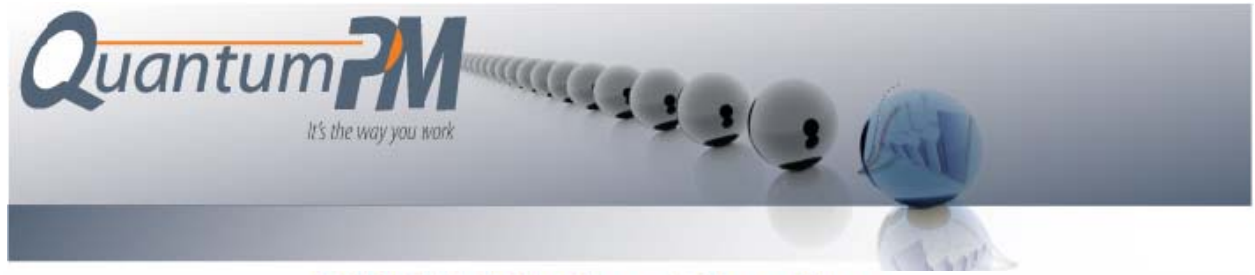
management centerpiece. In one structure, it provided a means to decompose a project to work packages, assign budget, communicate scope, and roll up status reporting back to the program level. Project scheduling and schedule management methods were defined. The concept of "Earned Value" (EV) was taken from the manufacturing floors, where it was adopted to measure and ensure that project value was being achieved and to allow performance to be evaluated.

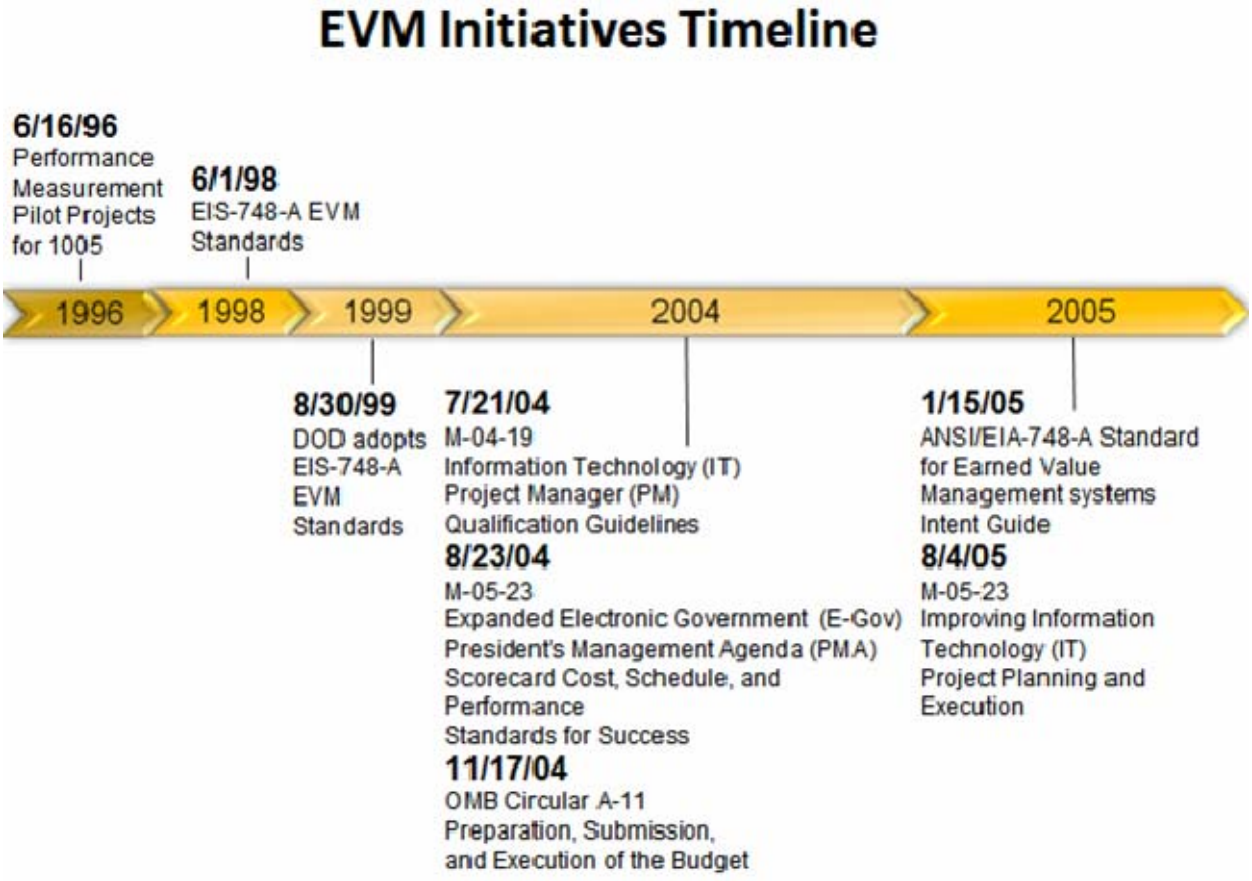
The project management techniques were very successful in the Space and Defense arenas and a large volume of statistical project information was amassed and studied verifying the positive impacts made. From early days, there was a desire for EVM techniques to be adopted by the private sector. Early efforts to formalize EVM usage were sensitive to private sector concerns and took care to formalize the requirements without proscribing expensive tools. The tenets of the system were described in only 35 criteria statements. Despite this sensitivity and the desire for improvement, adoption of EVM in the public and private sectors was very slow, almost non-existent. In part, this was due to a newly formed EVM practitioner community overlay that institutionalized/formalized the terms, processes, and reports used in EVM. The government continued its efforts and in 1992 was able to pass the EVM baton to the public and private sectors with the creation of ANSI/EIA-748. The new (private sector) standard which established 32 guidelines was accepted by the DoD very quickly (1994) and the DoD documentation was revised to reference the standard (1999).

3.0 Current Situation

In parallel, beginning in 1987 with the Reagan administration and continuing through succeeding administrations (gaining considerable momentum in the Clinton administration), the Executive Branch began pushing better management practices in government.

Today, the Executive Branch continues the process of pushing out Project Management and EVM practices to the public sector through the Office of Management and Budget (OMB). Federal Agencies are all required (on large projects and high risk projects) to report Project Earned Value statistics twice annually to the OMB.



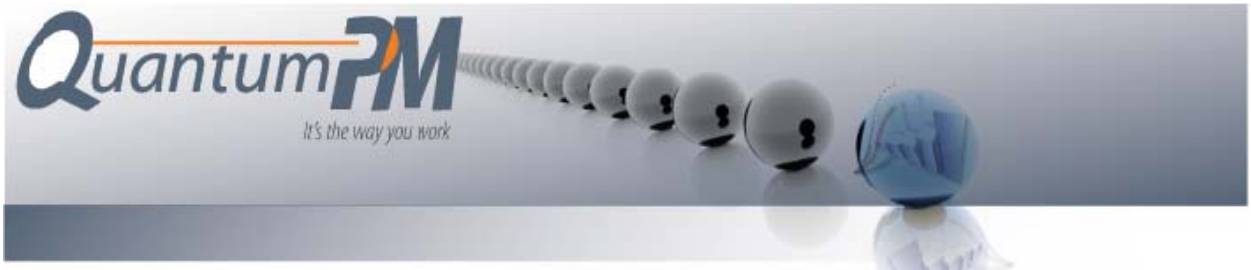


Reference: Defense Acquisitions University (http://acc.dau/mil/evm) See more in reference section of the paper.

The Defense Acquisition University (http://acc.dau.mil/evm) has an extensive set of EVM materials and training, including the OMB recommended references (NDIA ANSI EIA 748 Intent Guide, NDIA Surveillance Guide, and the NDIA's – The PM Guide to IBR Process). The current direction from the Executive Branch can be found at http://www.whitehouse.gov/omb/memoranda. As of the publish date of this document, the most recent of memorandum is at http://www.whitehouse.gov/omb/memoranda/fy2005/m05-23.pdf.

4.0 What is Earned Value?

Earned Value is a concept that, when implemented in an Earned Value Management System (EVMS), is a very effective status reporting technique. We need to differentiate EV as a concept from an EVM System (EVMS). EVMS includes the processes and procedures required to produce EV information in a consistent way. The criteria or guidelines required to be an EVMS are specified in the American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA) Standard-748-A – 1998, Earned Value Management Systems. This standard established a total of 32 guidelines covering



Organization, Planning and Budgeting, Accounting, Analysis and Management Reports, and Revisions and Data Maintenance. As you will see in the following sections, understanding EV is a much less complex concern than implementing the EVM System used to produce it consistently.

An EVMS effectively integrates the work scope of a project with the cost and schedule elements for optimum planning and control. When implemented and performed correctly, an EVMS provides accurate information on whether a project is ahead/behind on budget and schedule. Because EV is a statistical technique, it can also provide an estimate of cost at completion that has been shown to be accurate within 10% as early as 1/5th of the way into a project. This accuracy statement is real and is one of the primary benefits resulting from implementing an EVMS. The accuracy was established by examination of the huge volume of project EV reporting tracked by the U.S. Government over the course of decades.

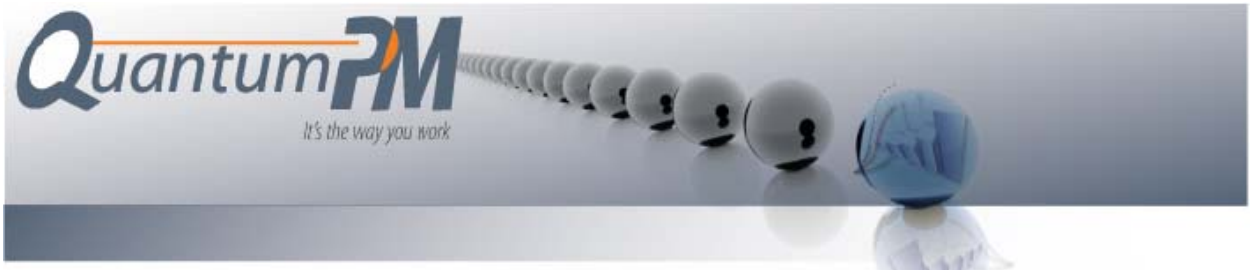
The earned value concept has been around a very long time. We use it to see if we are getting a good deal or not in our everyday lives. We assign a 'value' to things, and when we pay for things we naturally do a value assessment (value received vs. amount paid for that value) which results in our feeling that we got a good deal or not. Earned value is simply this principle used on projects.

4.1 How is Earned Value Useful?

EV measurements produced as a result of an EVM System are useful in two primary ways.

The first is as an ongoing analytical status test. If we are monitoring the value points a project is delivering and comparing the value earned vs. the value expected to be earned, we get a very early picture of whether our 'execution' of the project matches our 'planning' for the project (our expectations of performance of the project). The reason for any deviations is then the focus of further analysis to determine the cause of the deviation. This provides us early insight into planning misconceptions as well as builds increased understanding of estimation requirements for ongoing estimation improvement.

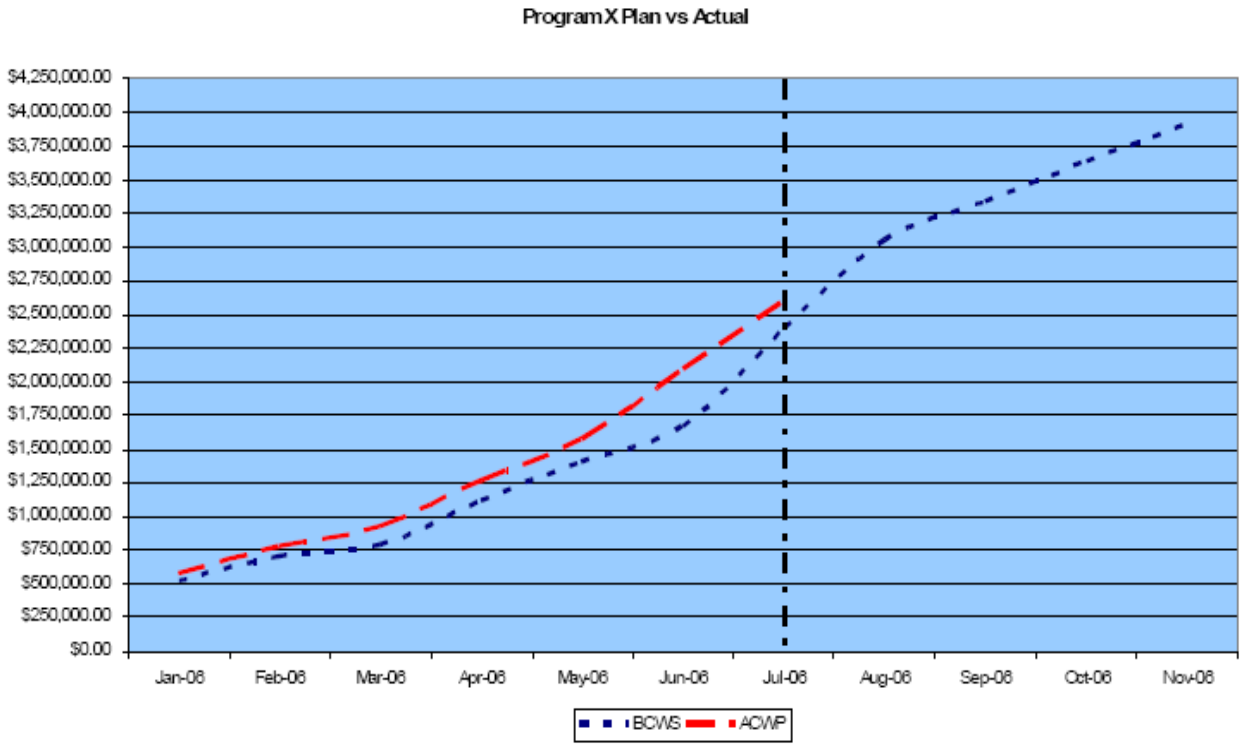
The second is as a forecast of the total cost of the project. The benefits of knowing what a project/program will cost at completion (to within 10%) when only 1/5th of the way through the project are enormous. This level of information allows executives to be proactive in fiscal project portfolio management. For example, they may be able to cancel projects of lower priority earlier to ensure that funding is available for critical projects all the way to their completion. EV as used in this mode relies heavily on proper planning of the project and properly maintaining the rigor of the EVM system (especially in regards to scope control).



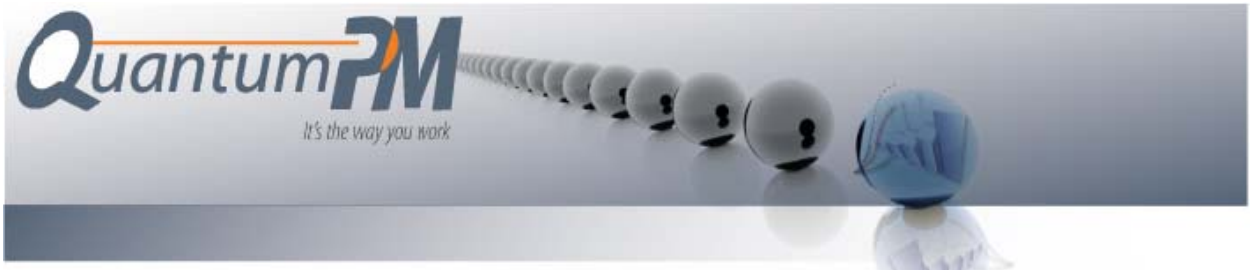
4.2 Earned Value (EV) Basics

A typical graph used for tracking a project, without using EV, is the Planned versus Actual Cost graph shown below. The vertical bar indicates the current status date; the red tracking line indicates actual costs accrued while the blue tracking line indicates the planned cost profile. This value of this graph, without further information, is limited. There is no indication of whether the project is ahead or behind schedule, or whether the work that was planned to be accomplished by the status date has actually been accomplished. An understanding at this level must be accomplished through other means.

Diagram 4.2 – A: Planned Versus Actual Cost Graph

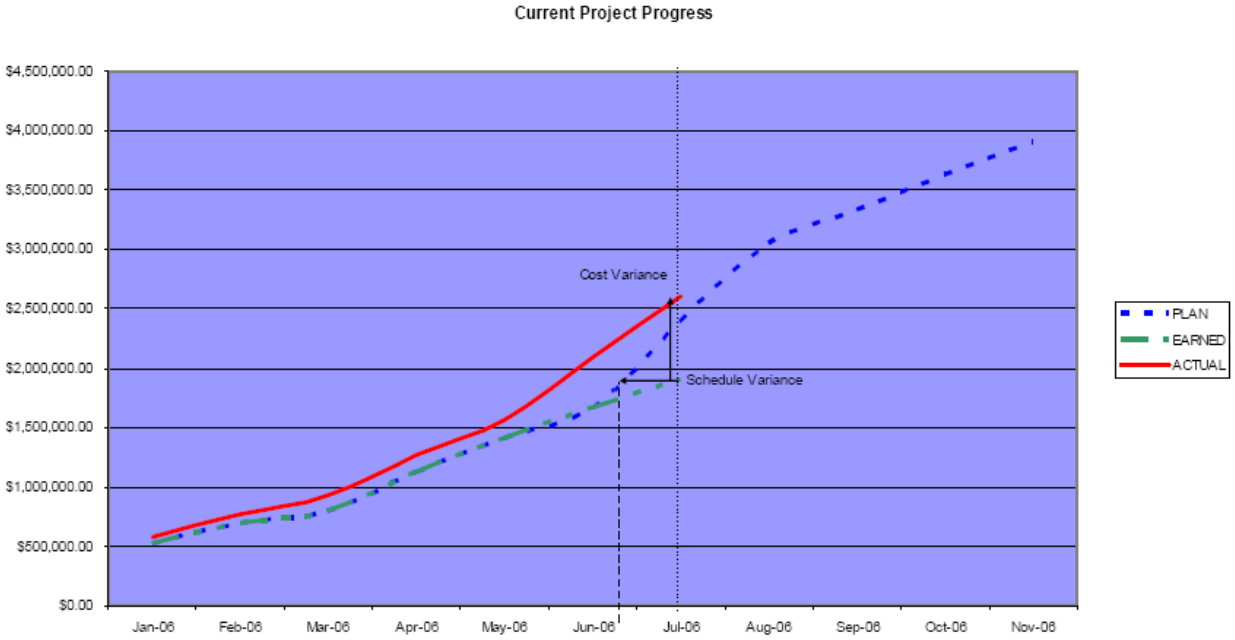


When you add Earned Value analysis, you are able to fill in the gaps. In the following diagram, a third tracking line has been added – Earned Value. We can clearly see the cost difference between the Cost of the Value Earned (end of the green line) and the Actual Cost (end of the



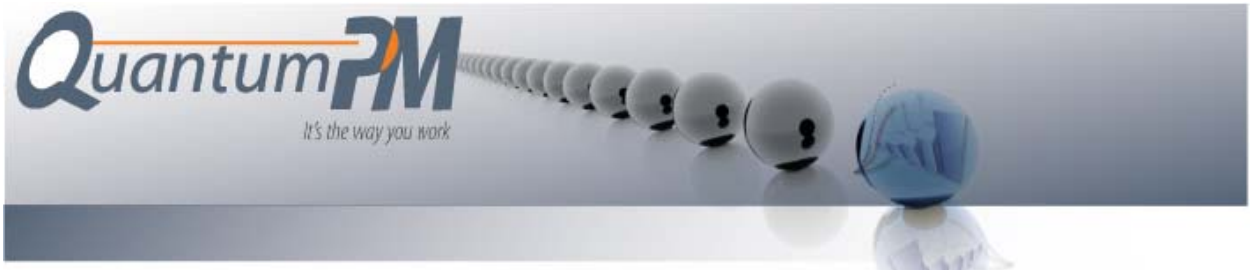
red line). The vertical gap that exists (on the status date) tells us, in essence, that we have achieved $1,900,000 in value but spent $2,600,000 to get it - $700,000 overage. Or put in another way, we are getting $0.73 of value for every $1.00 spent. This graph also tells us (by looking at the amount of earned value we have on the status date and looking horizontally to the left to find the date on which we originally planned to achieve this earned value) that we are delivering that value about 1 month behind schedule.

Diagram 4.2 – B: Cost and converted Schedule Variance with EV



These statements are very powerful and provide a much more complete picture of how our current status on the project relates to our planned status on the project as of the status date. The statements also nicely frame the EV definitions in the table below. The difference in Earned Value and Actual Cost is called the "Cost Variance." The difference between the "Planned Cost" and the "Earned Value" is called the "Schedule Variance." The "Schedule Variance" is converted to a timeframe by drawing a horizontal line from the "Earned Value" endpoint to the intersection of the "Planned Cost" line; the difference between the status date and the date of the intersection point is the converted Schedule Variance. The ratio of Earned Value to Planned Cost ($0.73 earned for every $1.00 spent or .73) is called the Cost Performance Index (CPI).

Note that all of these comparisons are in dollars. This is very important; it is what makes



earned value work. Physical progress (value) is measured in dollars so schedule and cost performance can be analyzed in the same terms.

The EV terms are defined in the table below. Note that the EV terms as originally defined by the Department of Defense (DoD) in the 1960s are listed in the "Old Terms" column.

Table 4.2 – C: EV Terms & Definitions*

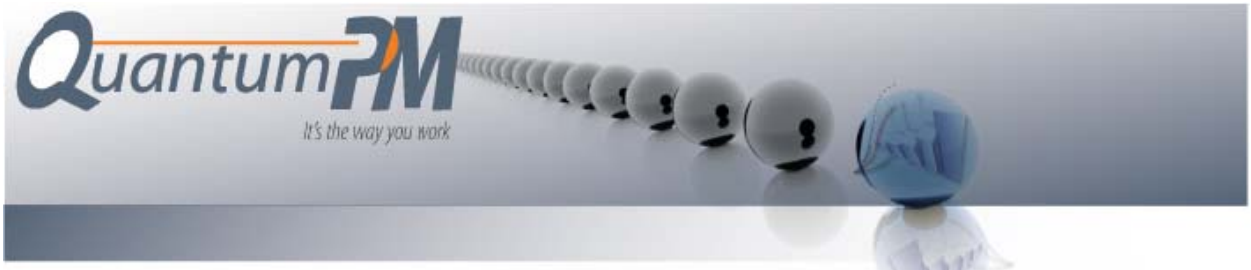
Old Terms	New Terms	Definition
BCWS	Planned Value (PV)	Budgeted Cost of the Work as Scheduled
ACWP	Actual Cost (AC)	Actual Cost of Work Performed
BCWP	Earned Value (EV)	Budgeted Cost of Work Performed
CV	Cost Variance	BCWP – ACWP or EV – AC
SV	Schedule Variance	BCWP – BCWS or EV – PV
BAC		Budget At Complete = total project budget
EAC		Estimate At Complete = estimated cost at project completion
CPI	Cost Performance Index	The ratio of EV to AC (greater than 1 is good) (Earned Value)/(Actual Cost)
SPI	Schedule Performance Index	The ratio of EV to PV (greater than 1 is good) (Earned Value)/(Planned Value)

** The EV terms as originally defined by the Department of Defense (DoD) are listed in the "Old Term" column.*

Let's reiterate the EV statements we have made and associate them directly with the EV terms.

Table 4.2 – D: Mapping an EV Statement to EV Terms

EV Metric		Statement
Earned Value	→	As the status date, we have achieved $1,900,000 n value
Planned Value	→	against an expected value at this point of $2,400,000
Actual Cost	→	but we have spent a total of $2,600,000.
Cost Variance	→	A $700,000 overage
Converted Schedule Variance	→	on value that is 1 month behind schedule.
CPI	→	We are getting $0.73 of value for every $1.00 spent.



Statements like that in Table 4.2-D allow the project manager to see if the project is playing out in reality anything like how it was initially planned/estimated. The first thing done when discrepancies are noted is to determine what is causing them. Why is reality not bearing out the planned vision? Once the discrepancies are understood, actions can be taken to either address the discrepancies directly (in the hope of correcting them) or to adjust the remaining planning to account for the discrepancies (readjust our planning vision). In either of these cases, when the planning is deemed to be back in sync with reality again, the total project cost at project end can be used for higher level executive decision support.

Note that this maps to the two primary ways that earned value is useful: ongoing analysis & correction and cost forecasting. Also note that you cannot get to cost forecasting until you have performed analysis & correction.

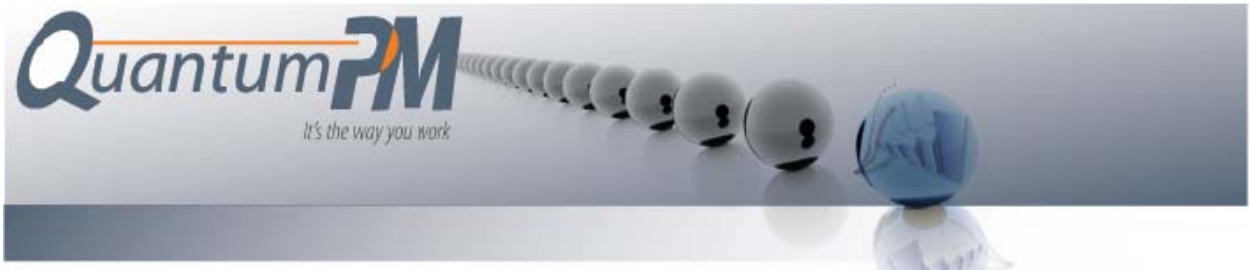
Analysis & Correction:

After generation of the EV tracking data and determination of the status of the project in EV terms (see table 4.2-D), we are left with trying to figure out why our position is as it is. For the "planned" view to be exactly the same as the "reality" view of the project that is playing out, we would require a complete understanding and capture of scope, costs (and therefore budget), and timelines (and therefore schedule). This complete understanding must be maintained throughout the duration of the project. This is the purpose of the EVM System. Reality is never exactly as planned. Well thought out battle strategies only exist up to the first battle. There will always be a need to identify and research the causes of differences. The goal of a full EVM System is to categorize and understand the points of difference (and correct them). When the EVM System processes are well defined and maintained rigorously, determining the cause of deviation is much simpler. However, in the early days of an EVM System implementation, before process structure and quality have stabilized, the analysis of deviations is much more complex as the processes themselves must be analyzed as potential contributors to the deviations.

Even though this is a transitional state, it is extremely beneficial as it will help you stabilize the process!

For example, untracked changes in scope (due to a lack of a well defined and practiced EVM process) will cause deviations to the original cost and schedule. If scope increases without knowledge (and therefore, associated budget remains the same), then the $ value earned for every $1.00 spent will get smaller and smaller. And, because untracked scope change does not typically occur in predictable value increments at a regular frequency, but rather in large, unforeseen infrequent clumps, it can impact the quality of your EAC calculations.

Another possible EVM process lapse issue is caused by a failure to standardize the



timeframe when costs are received from finance with the timeframe when the status of the project is captured. For example, financial cost inputs may lag 15 days, so when received it is important to remember that the project status should be as of 15 days prior. In addition, there may be issues because cost information is booked and the finance reporting criteria itself is not standardized.

These examples are based on typical experiences in project management. Gathering earned value metrics which identify them as causes of variance helps to make the EVM processes better.

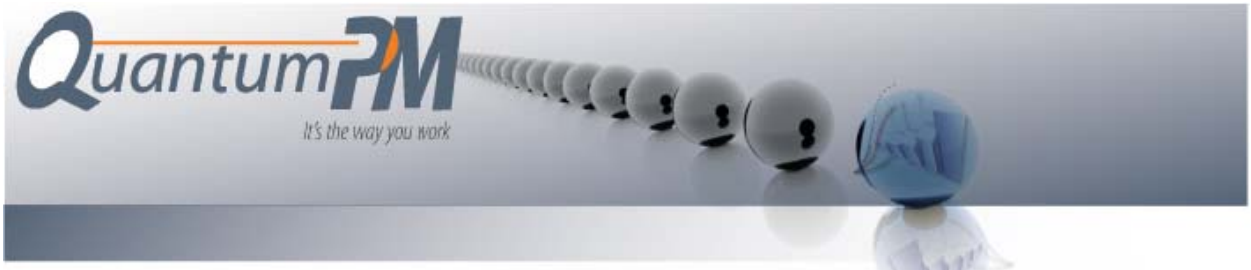
Once the quality of the EVM processes have stabilized, more direct project issues can be seen and proactively dealt with. Things like Sub-Contractor cost differences, Environmental or external impacts on performance, individual provider performance differences, and so on.

COST FORECASTING:

After analysis & correction have been performed and matured to the point where the EVM System processes are stable and of good quality, total project cost projection becomes reliable, too. The cumulative Cost Performance Index (CPI) becomes a good projection from which to calculate total project cost given an expectation that the current project performance will continue. Note the use of "cumulative" CPI (the CPI across all of the project to-date) instead of a period based CPI (the CPI as calculated by the performance over some specific smaller period, for example "the last week"). Period based CPI is not a stable metric across periods and therefore not a good metric to forecast total project cost.

The following formulas show the typical calculations used for best-case, worst-case, and most-likely-case. Note that the best-case assumes that the plan will be achieved in reality; i.e., no matter what performance has been realized to date, we will achieve $1 of planned value for every $1 spent for the remainder of the program. One might question the fact that this is really a best-case because the overage up to the status date is not recovered in the remainder of the project (i.e., there is no consideration given for loss recovery that would allow the project to come in at the original budget). This is not considered for the simple reason that the evaluation of the huge amount of DoD EV contract history shows that projects NEVER catch-up on cost once incurred.

A second question might consider why the Schedule Performance Index (SPI) is used in combination with the CPI in the worst-case projection. The reason is a natural human tendency to "want to catch up" to the scheduled dates. This tendency is often realized by adding resources to the project in an effort to catch up to the schedule. The addition of resources increases the project costs. Multiplying the CPI by the SPI results in a combined index that reflects the increased cost (via reduced cost performance). This is typically thought of as the worst-case cost projection.



The graph in Table 4.2-F reflects the formulas commonly used to estimate the final total cost ranges, as shown in Table 4.2 – E:

Table 4.2 – E: Cost Projection Formulas

EAC: Worst-Case:

$$\text{Actual Cost} + \frac{\text{Remaining Budget}}{\text{CPI} * \text{SPI}}$$

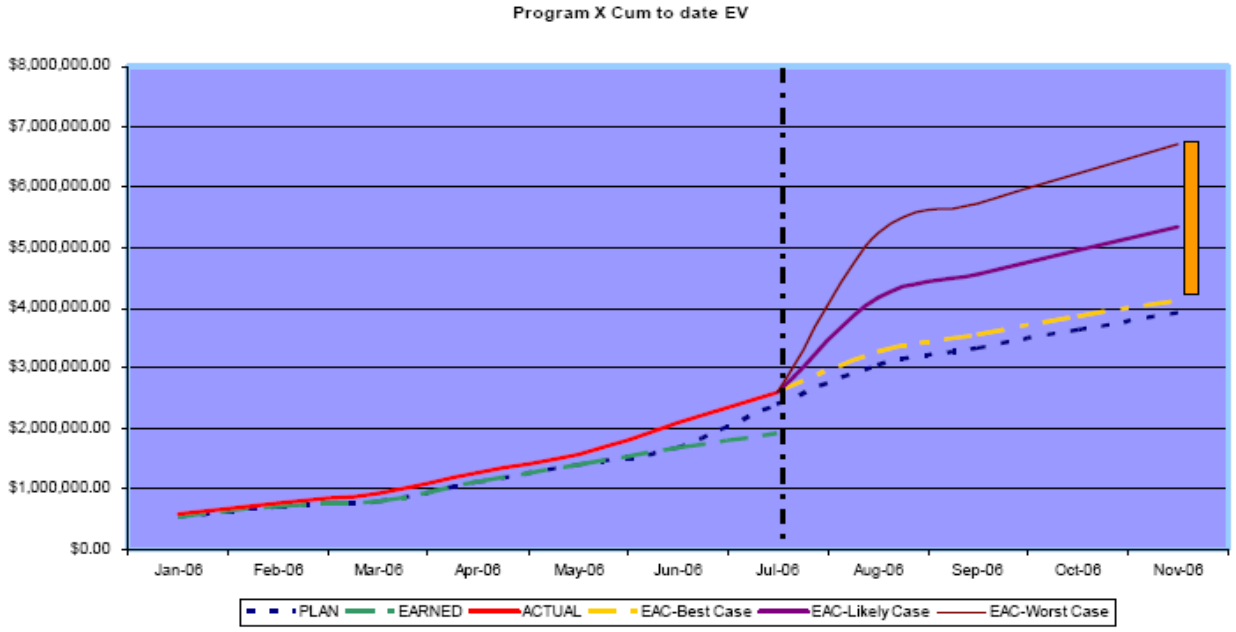
EAC: Most-Likely-Case:

$$\text{Actual Cost} + \frac{\text{Remaining Budget}}{\text{CPI}}$$

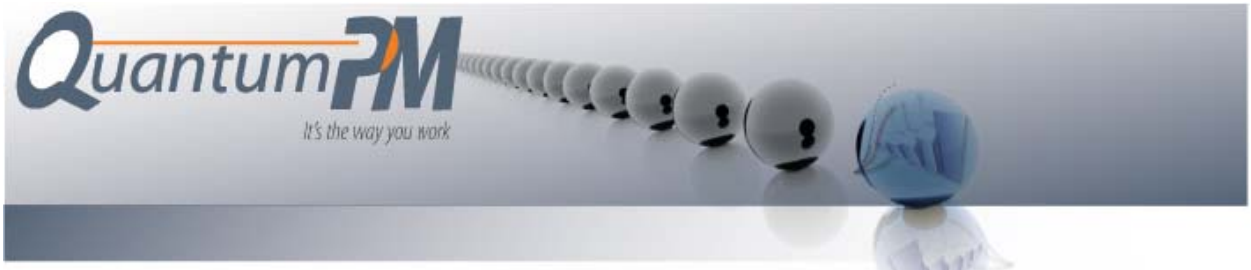
EAC: Best-Case:

$$\text{Actual Cost} + \frac{\text{Remaining Budget}}{1}$$

Table 4.2 – F: Graph of Project Cost Projections:



EVM Indexes used to estimate Cost at Completion



When we can forecast total project costs, we have the ability to react to changing situations in a project lifecycle. After analysis & correction, several going forward choices can be made by several different roles.

The Project Manager can use the results of the analysis & correction activities and brainstorm different possibilities to address performance deficiencies (new vendor relationships, contract modifications, resource replacements or augmentation, etc). If no alternatives are possible (or the remedies are not really achievable), then the PM will communicate the current project state and performance and its impact on future project cost and schedule projections. Once this is communicated, scope adjustment or deferment can be entertained (reducing the scope of one or more parts of the project to bring the whole project back into initial budget/timeframe goals). If this is not possible, then the project/program supervisors can decide the relative importance of the project in relationship to other projects, and either allocate more funds or cut the project. If the decision is made to go forward with the project, other (less critical) projects may be cut to ensure that adequate funding (as projected via EV) is available through project completion.

It is worthwhile to note that we have focused on "cost projection" and not mentioned "schedule projection." Schedule projection (or the calculation of the projected project end-date) can be done by applying the Schedule Performance Index (SPI) to the schedule duration in the same manner that the CPI was applied to the project costs. However, this is not typically done in this manner. The reason for this is because these calculations take no regard for the "critical path." The critical path is the sequence of predecessor-to-successor linked tasks that drive the duration of the project. The critical path usually is a subset of the total set of tasks. Performance on any of these tasks directly affects the total project duration, while performance on tasks not on the critical path does not affect the total project duration. As SPI calculations do not differentiate between those tasks on or off of the critical path, schedule duration calculations based solely on SPI are not as reliable as schedule duration calculations based on Critical Path Methodology (CPM) or Critical Chain Methodology (CCM). These methodologies are outside of the scope of this whitepaper.

5.0 What is Required to Produce Earned Value Metrics?

Very simply, an Earned Value Management System (EVMS) is required to produce reliable EV metrics.

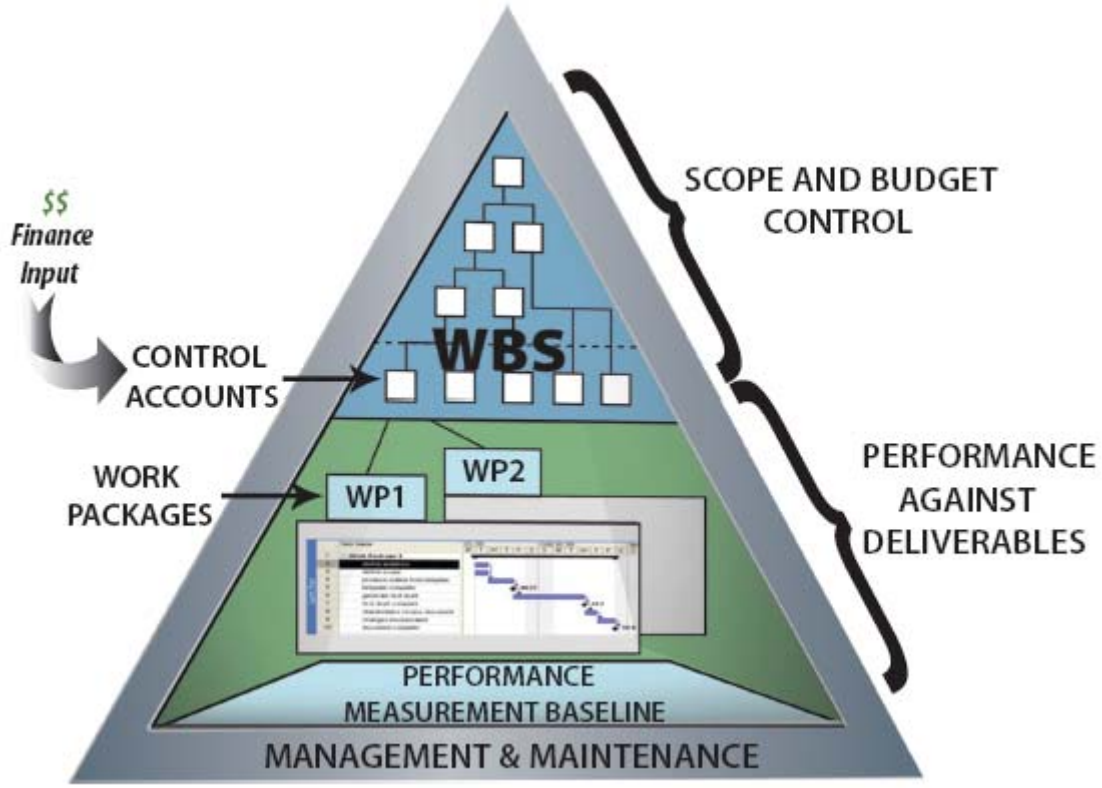
As stated before, an EVM System encompasses the processes and procedures required to produce EV information in a consistent way. The criteria or guidelines required to be an EVMS are specified in the American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA) Standard-748-A – 1998, Earned Value Management Systems.

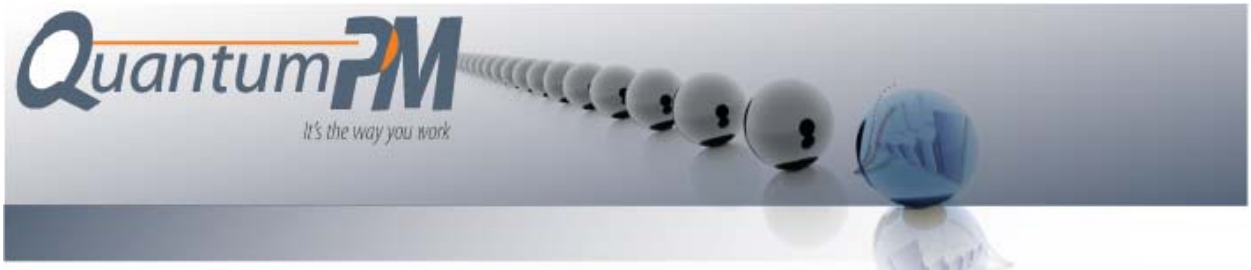
The fundamental requirements of a solid EVM System are:

- A WBS that reflects 100% of the project scope and 100% of the project budget.
- An effective scope and budget management plan (ongoing) to clearly identify new scope and its associated budget… or removed scope and impact on budget.
- A baselined schedule reflecting the scope, budget, and timelines for all WBS elements and their associated activities.

Earned Value Management (EVM) techniques rely heavily on the solid Project Management foundation of good WBS and Project Schedule development and maintenance.

Table 5.0 – A: EVMS Planning & Reporting Hierarchy





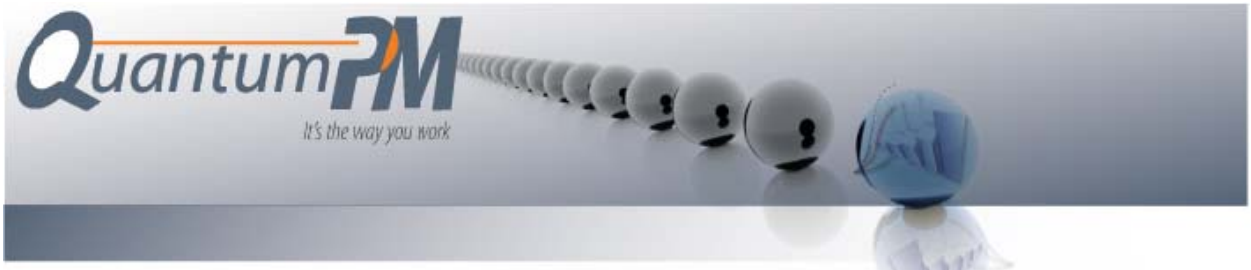
The figure above (5.0-A) shows the necessary EVM System components in a simple overview. When a project is begun, it is decomposed into elements, each element successively decomposed into component elements, etc., until a full understanding of the scope of work is developed. The cost of each of the lowest level elements is then estimated and aggregated back up the element decomposition hierarchy to generate the total project cost estimation (the project budget). This hierarchy is called the Work Breakdown Structure (WBS) and is the primary mechanism used to communicate and control project scope and budget. A project scope statement is most easily facilitated by documenting individual scope statements for each element in the WBS hierarchy. Such a document is called a WBS Dictionary.

The WBS structure is critical in the planning and tracking modes of the project as it serves both to support initial project decomposition and understanding, and then later as an ongoing reporting aggregation structure. Its lowest level elements (those decomposed the furthest by the project planners) are called “Control Accounts” or CAs. Control Accounts are described in more detail in section 5.2.

Beyond scope and budget, EV requires a projected project timeline or schedule. The CAs define what the physical components of the project. The work to build each CA component is defined in one or more “Work Packages” (WP). A Work Package specifies the set of activities required to accomplish one or more aspects of a Control Account. Each activity (or task) within a Work Package is typically reflected in the project schedule. Activities (also called tasks) are assigned to one or more resources to produce low level effort and cost estimates. Each activity to resource assignment (one to one) is called an “assignment.” A single activity or task will create multiple “assignments” when assigned to more than one resource (one “assignment” per resource). The overall durations of the set of assignments (mapped to activities) within a Work Package define the duration of the Work Package. After all work packages are scheduled, the overall duration of the set of Work Packages defining the work in a Control Account establishes the duration of the Control Account WBS element. The durations of the Control Accounts are rolled up successively into their parent WBS elements until finally the total project duration is produced.

This is the scheduling process. The scheduling process creates a set of information that can then be used as the baseline for tracking actual project schedule/task performance. Each Work Package must also establish how it will report on “Value Earned” (a critical function as this is fundamental to Earned Value!). This will be discussed more in section 5.3.

When all components of a project/program have been decomposed and scheduled, the resulting set of information is “baselined” (captured and retained) into what is called the “Performance Measurement Baseline” (PMB).



The process of creating this initial baseline is called the "Integrated Baseline Review" (IBR) process. This process is not covered in detail in this whitepaper.

Once the PMB has been captured, the project moves into tracking mode. In tracking mode, the project is managed in an ongoing manner. Scope, budget, and schedule are all managed and reported on. In regards to scope, any scope increases must be managed through a change request process that documents the changes in scope and associated changes in budget that must be associated to scope changes. Significant Scope (and therefore budget) or schedule changes must be re-captured into the baseline (PMB) via subsequent Integrated Baseline Reviews.

Projects in the tracking stage should report on their project status (including EV information) at least monthly. The EV information gathered is not complete without integrating actual cost information from project Finance reporting. The integration of actual costs is performed at the Control Account level. The lowest level WBS elements are called Control Accounts because they are the nexus for EV reporting. The Control Account is the point where Finance cost information is integrated with performance information from the component Work Packages and the status reported from the "performance method" associated to each. The WBS structure is then used to aggregate the status information up the WBS hierarchy to get total project performance.

5.1 Work Breakdown Structure (WBS)

The intent of a WBS is to provide a mechanism to divide a project into achievable components, decompose them for budget estimation, and integrate ongoing status back up into a project reporting hierarchy. The WBS does this extremely well. Traditional WBS development requires the use of 'nouns' only in WBS Elements. When a WBS Element is broken down into Work Packages, then activities, and subsequently 'verbs,' are used. The lowest WBS element is typically the Control Account. Each Control Account consists of 1 or many Work Packages. Scope is guarded through the use of a WBS Dictionary, which is in essence a word description of the scope initially desired for a specific WBS Element.

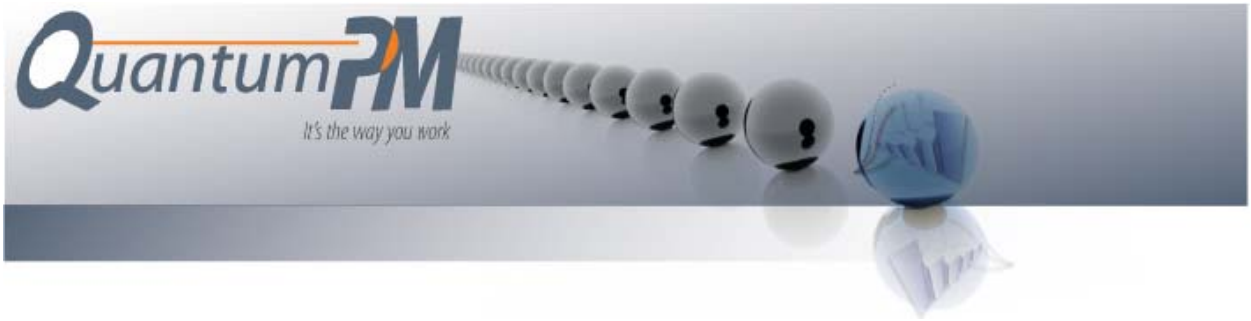
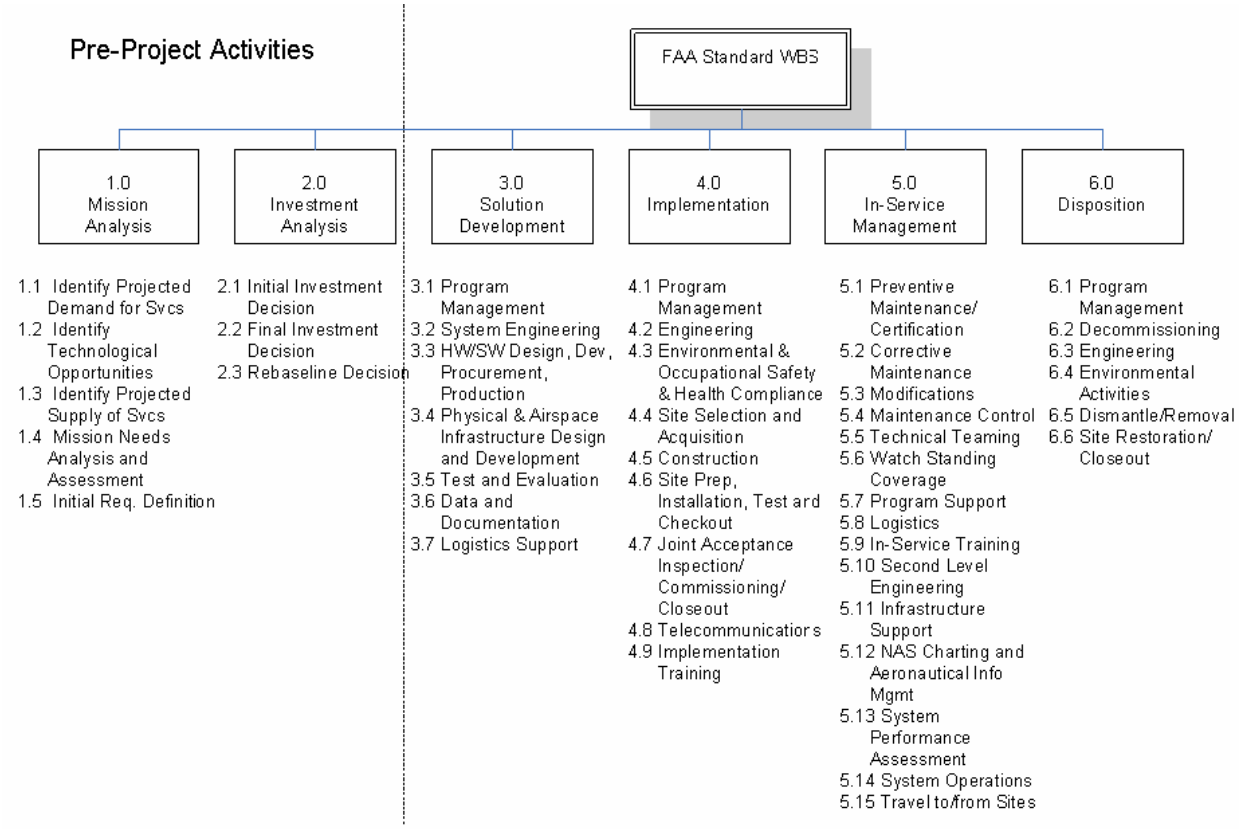


Table 5.1 – A: Example Work Breakdown Structure (WBS)

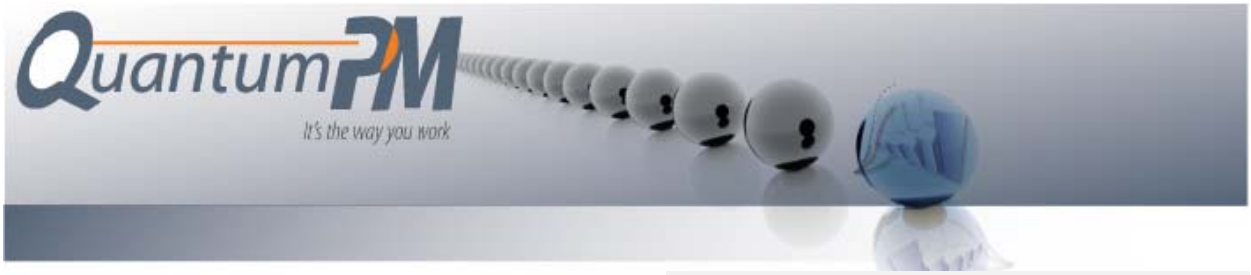


FAA Standard WBS structure (from http://fast.faa.gov)

Some published works maintain that a WBS element can itself be an activity… this begins to defeat the purpose of having a 'noun' based WBS. A 'noun' based WBS forces thinking in terms of Value that can be Earned. If at all possible (and for some niche projects it may not be possible), the WBS should be 'noun' based. In addition, the WBS with a WBS dictionary is the simplest way to communicate scope (and eventually budget) to a team, vendor, or sponsor. Some form of WBS dictionary is critical to the ability to guard scope.

5.2 Control Accounts

Control Accounts are the lowest level in a Work Breakdown Structure. They are the control point where planned WBS product-definition meets planned Work Package activity definition



and where actual Work Package performance status meets actual financial cost (materials and resource) reporting. This is the point at which work orders are established. The financial cost information is especially important. An EVM System is not an accounting system but does use actual cost from the accounting system. The Control Account must be a mapping point that is understood by both the financial accounting system and the project planning, scheduling, and performance system. Care must be taken to ensure that the date to which the project performance is measured (not the current date) is the same date up to which there is valid financial input. In other words, the collection lags in the two systems (schedule performance and finance accounting) must be reconciled to match. If the finance information is reported on the first of each month for up through the 15th day of the previous month, then the project schedule status used in conjunction should be for the 15th of the previous month.

Furthermore, material costs must be recorded/accrued against Control Accounts in a consistent manner. The ANSI/EIA 748-A standard states that:

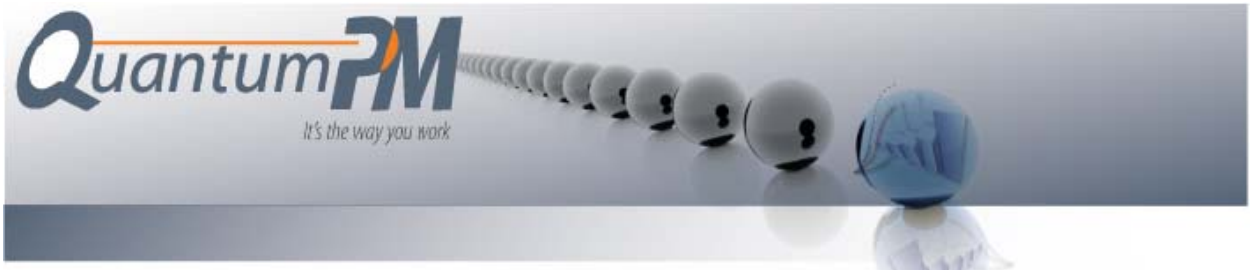
"Material costs are usually recorded on an as applied basis, but there may be exceptions. Earned value for material will usually be credited in the same period that the costs are applied, but in situations where earned value is credited and the invoice has not been paid, the company may elect to use estimated costs on management and customer reports for performance measurement."

5.3 Work Packages

Work Packages are defined as the set of activities required to complete a designated unit of work. They are easily visualized because they are the sets of activities seen in what some might say is the most visible project artifact… the project schedule. To support EV reporting, each Work Package must define how it will report its status in terms of Value Earned. This calculation is done in two steps: first, calculation of the percent complete status of the Work Package, then translation of the percent complete into a dollar amount (calculated by applying the percent complete to the Work Package budget) for rollup reporting.

The ANSI/EIA 748-A standard defines 5 methods to identify work package percent complete:

- **Discrete Effort as measured by Valued Milestones**
  A set of some number of standard milestones is established. Achievement of each milestone equates to a specific completion percentage of the Work Package. For Example, 20/75/100 would indicate 3 milestones; the achievement of the first would indicate 20% complete, the second 75% complete; the last 100% complete.
- **Discrete Effort as measured by Standard Hours**
  Budget is time-phased and earned in relation to a standard hour plan. For example, a 5000 mile tune-up at a dealer



consists of a set of Standard Jobs – each associated with a historical Standard Hour value. Completion of each Standard Job accrues the equivalent Standard Hour value at the Work Package level. The Work Package % complete is the % Standard Hours completed against the total Work Package Standard Hours.

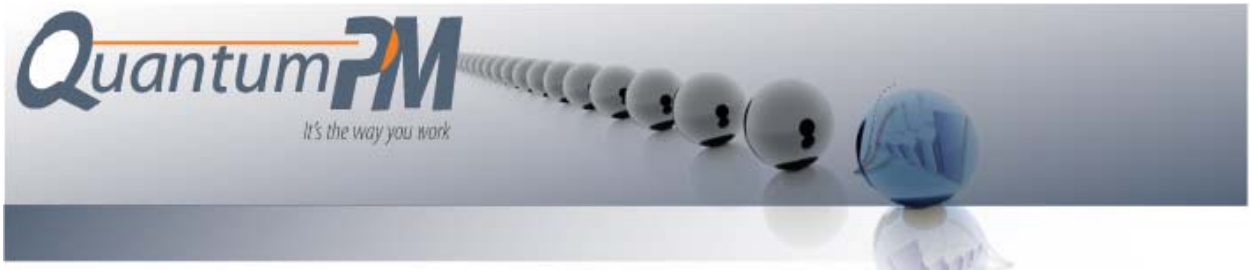
- **Discrete Effort as measured by Management Assessment**
  This is the % complete as determined by the Manager's subjective assessment.
- **Apportioned Effort**
  Work for which planning and progress is tied to sub-components. This is an aggregation of what might be called sub-Work Packages.
- **Level of Effort**
  Work scope for which performance cannot be measured. For example, general support of an application once in production cannot be measured in this manner. There is no 'success criteria' for the work, so there is no way that performance can be measured. So value is earned by the passage of time and is equal to the budget allocated for each period of time.
  Performance is a simple comparison of budget to actual cost.

Frequently, Management Assessment is used in combination with Valued Milestones as phase gate boundaries of the manager's subjective assessment. For example, Management Assessment in combination with 20/75/100 valued milestones would limit the managers assessment to 0-19% complete until the first valued milestone is achieved, 20-74% until the second valued milestone is achieved, and 75-99% until the final valued milestone is achieved.

6.0 Roadmap to Adoption

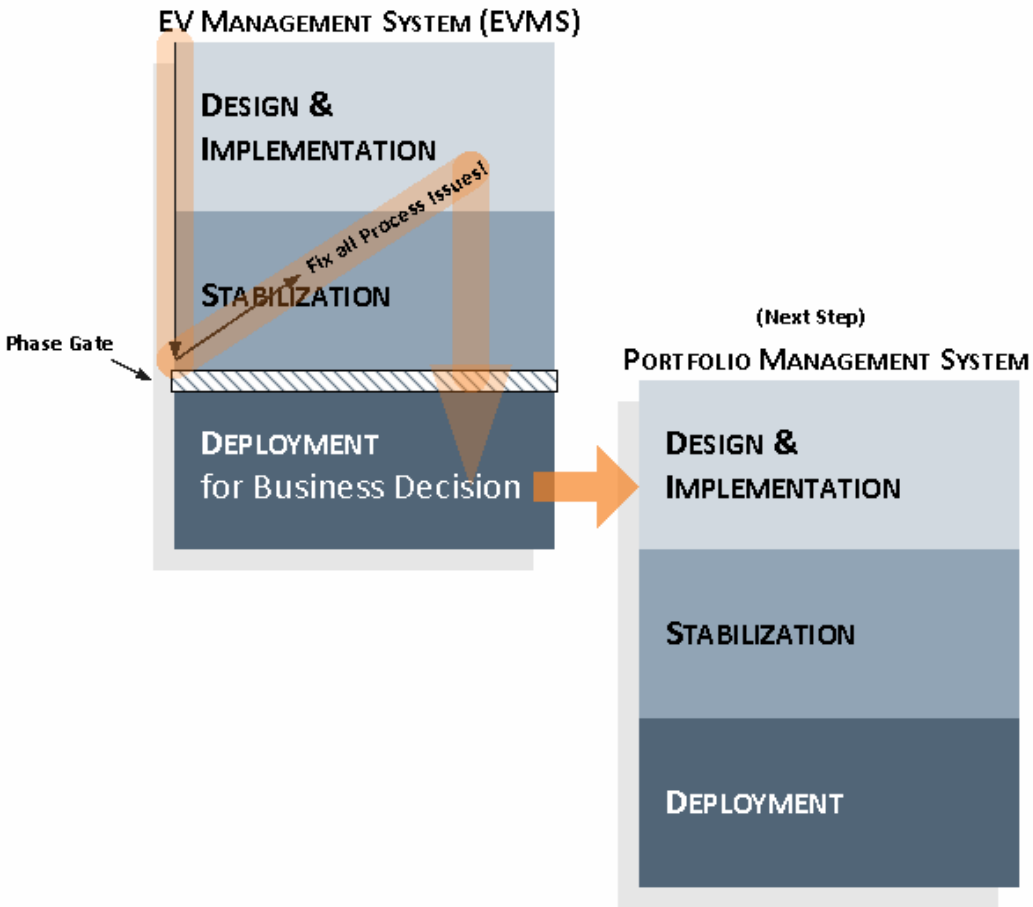
To implement Earned Value, we have to implement the EVM System. The DoD and its contractor community were very successful at setting up EVM Systems when contracts were "cost plus," but we no longer live in "cost plus" times. Implementing the process infrastructure behind an EVM System is not a simple undertaking. On the other hand, the people directly touched by an EVM System are generally limited to Project Planners, Project Managers, Finance, and Executives. This keeps the total number of people who must be trained and knowledgeable small. A second simplifying factor is that you will typically initiate the EVM System approach only on new projects, not retrofit ongoing projects. The only way it is possible to retrofit existing projects is if the project was initiated and is being tracked with rigorous Scope, Budget, and Scheduling practices, and an initial Performance Measurement Baseline capture was created. If this was not done for the existing project, then there will be significant overhead in getting to this point.

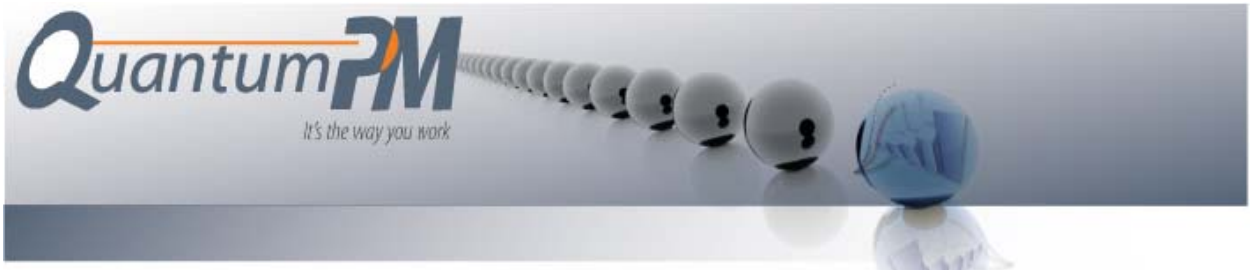
An EVM System implementation involves going through standard project phases according to your methodology. For the purposes of discussion we will use "Design, Implement, Stabilize, and Deploy" as our sequence and for diagram simplicity we will lump Design and Implement together. General steps that will be undertaken are:



1. Develop a set of template WBS structures. These embody the normal project types undertaken by the organization and role up in the way the organization desires for tracking and reporting purposes.
2. Create a project initiation process that uses the WBS to initially start a project (down to Control Accounts), then passes the CA elements to PMs to define work packages in support of the CAs.
3. Define the integration to Finance.
4. Train PMs on step 2 and their role in ongoing project maintenance.
5. Go through the process on new projects with a mentoring organization (likely the Program Management Office).
6. Regularly report EV and perform Analysis & Correction activities.
7. Validate process quality for the purpose of Business Decision Support.
8. Use EV cost projection information once process quality has been validated.

Table 6.0 – A: EVM System Implementation Flow Table



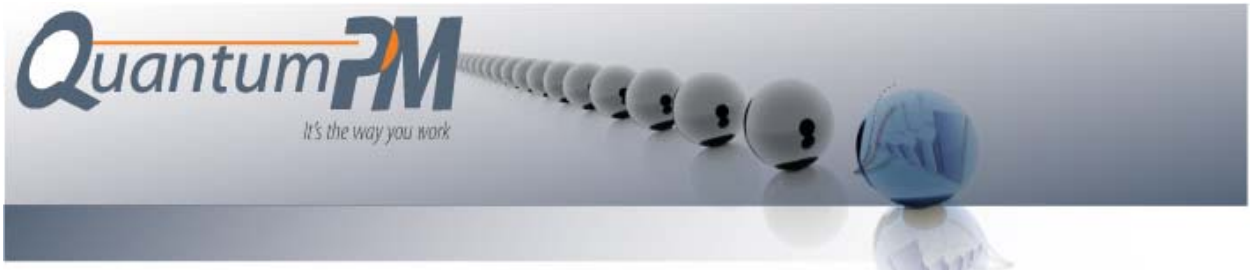


In diagram 6.0-A, two implementations are shown. Focusing on the first one, implementation of EVMS, the red arrow indicates a typical implementation flow (what we see in many organizations). Design and Implementation is performed and in the stabilization phase, the Analysis & Correction activities are performed. However, when initially implemented, the first things that the Analysis & Correction activities make visible are usually process issues with the EVM System implementation! This is normal. Unplanned situations with Finance inputs lead to out of sync performance. Cost accrual is a good example. When these process issues are identified, the phase gates to enter Deployment are not met.

The Deployment phase gates include quality that supports Cost Projections. While process issues are being encountered, this quality cannot be met, so frequently the implementation must return to design/implementation again to address them. This may at first appear to be a bad situation; however, this is simply a reflection of real-life and should actually be embraced. The Analysis & Correction activities are doing their job. Performance reports are actively being utilized and reviewed to kick-off the Analysis & Correction activities. The EVM System is working. EV users are beginning to understand the system processes and are identifying issues with them. The only thing it is not yet provided is actionable cost projection information. The process, however, is self-righting. Continual Analysis & Correction activities will correct the process itself. Process issue areas with the biggest potential impact are misunderstood financial accrual mapping, misunderstood job/contract mechanisms, and bad estimation.

Of course, all of this assumes that we are in a solid scope-controlled project environment (with strong change identification and control practices). While the Military and associated vendor communities have strong histories in these areas, public sector entities are still coming up to speed and it takes a long time to develop the discipline these practice areas require. This is a period best used for organizational experience development. Use of experienced mentoring can have a very positive impact.

Once the process quality is up to standards for deploying the information to business decision makers, you have a full EVM System producing quality information. It is time to Celebrate! But wait, the information you have worked hard to develop is not yet being used effectively. At this point (if not before), kickoff of Portfolio Management System process development should begin. It makes no sense to go to all the effort to gather quality EV project cost projections without acting on them. But before acting on them, a thoughtful process should be defined that encompasses how to act on them and when.



This process will incorporate guidance on when to cut an underperforming project or when and how to identify other less-critical projects, to cancel, or to postpone projects to preserve budget for projected overages. Care must be taken to ensure that Business Decision Makers understand the value of the EV information presented and how to best use it.

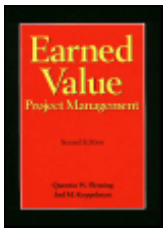
7.0 Topics Not Covered and Additional Resources

The following topics were not covered in detail in this whitepaper:

- WBS Template Definition
- Critical Path Method (CPM)
- Critical Chain Method (CCM)
- Organizational Breakdown Structure (OBS)
- Control Account Manager (CAM)
- Undistributed Budget
- Management Reserve
- Planning Packages
- Integrated Baseline Process (IBR)

The following are references that provide the basis for our EVM Systems thinking and are highly recommended for additional information:

American National Standards Institute/EIA, Earned Value Management Systems (ANSI/EIA-748-A-1998, reaffirmed August 28, 2002).



Earned Value Project Management, 2nd Edition
by Quentin W. Fleming and Joel M. Koppelman

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The Work Breakdown Structure in Government Contracting
by Gregory T. Haugan

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