

Project Management Using Earned Value

Fifth Edition



HUMPHREYS &
ASSOCIATES
Earned Value Management Consulting & Training

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PREFACE

This book is about integrated project management. It is not about all aspects of project management but it includes some of the most important aspects. All projects contain three elements; scope of work, a scheduled time frame in which the work must be accomplished, and a budget to perform the work. Integrating these three elements using Earned Value Management provides the basis for effective project management. The planning, control, and management of projects can be improved through the use of Earned Value.

This book is intended for anyone who desires to know more about project management planning and control and how to improve these processes through the use of Earned Value. Intended readers include project and program managers, schedulers, project control personnel, project technical personnel, and procurement personnel as well as stakeholders and owners of projects. While it is intended for a wide range of readers, each is assumed to have a basic familiarity with the requirements and the disciplines of project management. Readers new to this arena would be well advised to supplement this reading with a basic but general work on project management.

The material in this book has been drawn from the collective experiences of the authors and many of the professional personnel of Humphreys & Associates, Inc., consultants in project and program management for over forty years. This material has been presented in seminars and workshops, and successfully used in assisting our clients in the United States and around the world. While introductory theory is explained, time tested samples are provided. Examples are presented from specific industries. Please do not conclude an example does not apply to those of you in the construction, software, or other industries.

To facilitate the learning experience, the topics covered are linked together in a process flowchart. This flowchart is displayed at the beginning of most chapters and the elements of the flowchart addressed in that chapter are highlighted. In addition, the chapters have been grouped into Sections. Each Section represents a major topic in the planning and control process; Work Organization, Planning and Scheduling, Cost Estimating and Budgeting, and Incorporating Earned Value into Project Management. These are supplemented by a Section on the Implementation of an Earned Value Management System and integrating an Agile development approach with the Earned Value Management process. Finally, there is a Conclusion and References section. References include the Earned Value analysis formulas, abbreviations and acronyms, glossary, bibliography, and index.

As a further aid to the reader, there are a series of review questions at the conclusion of each chapter. The majority of chapters also include one or more Case Studies. These are practical exercises that have been drawn from our consulting experiences and presented in Humphreys & Associates seminars and workshops. The Case Studies have been found to reinforce the participant's learning. To obtain the answers to the Chapter Review Questions and suggested solutions to the Case Studies, please call the Humphreys & Associates office at (714) 685-1730.

PROJECT MANAGEMENT USING EARNED VALUE

CHAPTER

1

Objectives of this Chapter:

1. Define “project” and project management.
2. Describe the performance-oriented approach using an Earned Value Management System (EVMS) and explain why it is superior to actual versus budget comparisons.
3. Discuss factors affecting the appropriate level of detail for an EVMS implementation.
4. Introduce the process flowchart for the earned value project management process.

What is a Project?

Before delving into the intricacies of the earned value management process, projects and earned value management need to be defined first. A project consists of a defined objective to develop or produce a new product, capability, or to expand capacity within a specified time frame and budget. Examples of projects include large capital-intensive efforts such as highway construction, new commercial buildings, power and petrochemical plants, water treatment plants, flood control, dams, bridges, hospitals, schools, and churches. These are the obvious, highly visible projects.

They are not the only types of projects as new product development is also a project. A new automobile, engine, or communication satellite is a project. Other projects include research and development, definition of new information systems, design and installation of communication systems, creation of new software applications, and computer hardware advances.

Projects are so widespread it is difficult to get through the day without being involved in some way with a project, whether it is sitting in traffic while road work continues, finding a more efficient information flow for office communication, or managing a home improvement.

A well conceived project could also be characterized as any endeavor that has a well-defined scope of work and optimistic yet achievable schedule and cost objectives.

The words “project” and “program” are sometimes used interchangeably in industry, resulting in some confusion. A program is made up of individual projects to be accomplished. For example, the inertial guidance system for an aircraft may be a separate project on a program. Because projects and programs share the same characteristics they can be treated in a similar manner. For that reason, throughout this text, the term “project” is used generically to refer to both projects and programs.

Now that project has been defined, what is earned value management? It is the process of defining and controlling the project to ensure defined objectives are met. The controlling aspect includes scope, schedule, and budget control. It also includes the process of identifying and minimizing the potential negative impact of realized risks.

There are many aspects involved in earned value management, including development of the Earned Value Management System (EVMS). An EVMS is a set of processes and tools people use to facilitate the management of a project.

Managing Projects

Many projects result in highly successful completions. Successful projects contain many common characteristics: they were well defined and organized, had a closely monitored work scope, had optimistic yet achievable schedule and budget from the time of initiation, and were closely monitored and managed. Many projects have been successful for another reason: they benefited from mistakes on other projects. The primary factor observed on successfully managed projects is managing performance. The common thread throughout all of the topics in this textbook is exactly that.

The approaches and techniques discussed in this textbook have a performance measurement orientation, because the better something can be measured, the better it can be managed.

In a performance measurement system, schedule and cost targets are assigned to the project and each activity planned in the project; progress (performance) is measured against these targets. Deviations from the activity targets and the causes of the deviations are identified and action is taken to minimize adverse consequences to the project.

Projects require expertise from many disciplines. Close coordination and communication are essential parts of successful execution of a project. To achieve these, a separate project team is typically assembled for accomplishing the project's scope of work. This team is organized using individuals from various disciplines such as accounting, purchasing, engineering, manufacturing, testing, operations, finance, contracts, construction, project controls, and may also include subcontractors. Some people provide part time support to a project. These might include any of those mentioned above and others such as the legal department, financial services, and executive management.

The job of managing all of these organizations and people is often assigned to a full time senior individual who is designated as the project manager. A project manager should meet several specific qualifications: many years of experience in the type of project being managed to be technically qualified; a degree to be academically qualified; and stamina to be physically qualified. In addition, project managers must have good processes and tools to effectively manage the people and the project.

The project manager must orchestrate the entire project to achieve the technical, schedule, and cost objectives. If a project is an internal endeavor, then a project manager's role is to manage the internal departmental interfaces and contractors, and possibly other owners and customers, in addition to all of the internal staff.

Unlike normal functional organizations, a project has a specific duration. Even as a project is initiated, its purpose is to accomplish defined objectives and disband. A project team's job is to quickly accomplish the technical scope of work, resource as efficiently as possible, and then move on to the next project. The project manager's job is inherently complex and challenging. Besides the interfaces that must be managed on a daily basis, they must often be a motivational expert since the many players involved may have different goals. For many reasons, a project manager has a great need for accurate status information. Only with reliable indication of project status can concerns be surfaced early enough to allow corrective action, preventing potential concerns from becoming real concerns that adversely impact technical, schedule, and cost objectives.

Examples used throughout this text are extracted from actual experiences. Frequently it is easier to illustrate a concept by showing what can or will happen if certain fundamentals are ignored than what happens when they are followed. When the principles in this text are followed, there is a good probability of executing a well-managed project. When they are ignored, unpleasant, career-limiting, unsuccessful experiences can occur.

Depending on project risk (technical, schedule, and cost), project duration, and cost, certain aspects may be implemented less stringently. The principles do not change. It is still necessary to define the scope of work, have a plan for accomplishing the work, and to manage the plan. However, the level of detail of the implementation can vary.

Unsuccessful applications of these principles have also happened when organizations went overboard on the level of detail of implementation. When common sense is forgotten, it is possible to create a management system that requires so much effort that it requires extensive staff just to produce and distribute data. The cost of the man-

agement system is then not worth the additional insight received regarding project status.

The earned value management practices that are recommended in this book have been effectively used to improve management on a multitude of projects. By selectively employing these practices, project teams can improve their management on current and future projects and thus, the prospects for project success.

There are several other topics related to earned value management that are not directly covered. These include contract administration, project administration, and material management. These are, however, incorporated within the discussions of related subjects generally performed by these functions.

The contract type has an impact on the extent of earned value management implementation, but all of the basic information is still necessary to ascertain project status regardless of the contracting arrangement. Experience shows that too much attention is often placed on the type of contract rather than incorporating all of the basic information at a different level of detail.

The human aspects of earned value management must not be forgotten. As mentioned before, the project manager needs to be a motivational expert. The project manager also needs a strong supporting staff. No single person can successfully perform all of the work involved in a major project. The project manager must rely on the support of many people. This makes the project a team effort. Even the best systems are less effective in the hands of individuals who do not cooperate with each other and do not work towards a common goal. An underlying assumption is that effective management tools facilitate better project management and minimize the confusion that results from a project that is not well defined and planned.

Impact of Lack of Visibility into Project Challenges

Many large projects in numerous industries experienced significant schedule delays and cost overruns. Nuclear power projects stretched for years beyond their original schedule and more than tripled in cost. Software development projects in most companies required so much lead-time the

intended users had to find alternative ways of accomplishing their goals. In other cases, competitors beat software development firms to the marketplace and millions of dollars were wasted. Water and sewer treatment plants soared in cost, with immediate impact on the consumer's water bill. Research and development projects and military projects were cancelled because of continually escalating schedule and cost projections. The U.S. auto industry suffered from a perceived lack of quality and unit prices increased. Many of these cases became highly visible to a large number of people.

For the project managers, the owners, and customers of these projects, this was not the objective envisioned in the project plan. How did this happen?

Causes were both internal and external. Scope changes occurred without being recognized and incorporated into a revised plan for accomplishing the work. Customer needs changed, sometimes because of a delay in finishing a product, thus resulting in obsolescence. Delays in material delivery occurred without properly reflecting the impact to other work activities. Regulations changed, frequently affecting the time needed to acquire permits or authority to proceed. Lack of coordination between contributing groups meant delays because of missing information, design or otherwise. When these and other disruptions occurred, resulting schedule slippage had large cost impacts because of high rates of escalation. Every delay was penalized with a significant negative economic consequence.

A domino effect is often observed. First, a technical problem occurs. This is followed by a negative schedule variance and ultimately a negative cost variance. Sometimes the dominos fall very fast, but problems could evolve over months.

Regardless of the source of difficulty, the underlying problem was that impacts were not recognized quickly enough when conditions changed. In some cases, project managers were ignoring variances from the plan and failing to take action because they did not believe the variances were real. In other cases, they were not informed well enough about the variances. The situation was much like that shown in Figure 1-1.

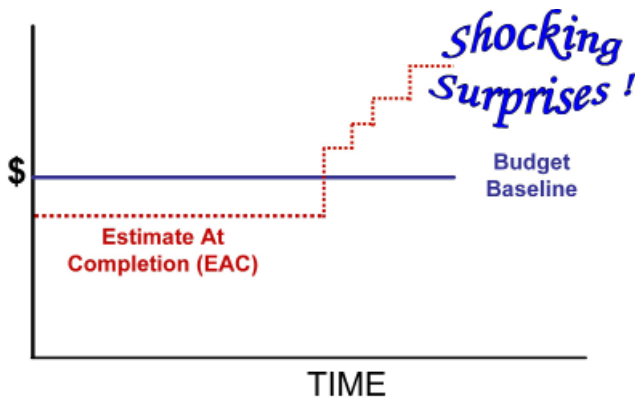


Figure 1-1 Shocking Surprises

In Figure 1-1, the Estimate at Completion (EAC) is below budget throughout most of the life of the project. While challenges were faced daily in the management process, there was no way to quantitatively assess the impact in a timely manner. By the time a schedule slip or an overrun was forecast, it was too late to do anything to minimize its impact. The result was shocking surprises.

This scenario occurred often enough that there was a heightened awareness of the negative impact of realized technical, schedule, and cost risks associated with projects. Because of this negative impact, many organizations reacted by creating better management systems. These systems provided the capability of integrating all of the available data into a cohesive form for better visibility. One of the greatest challenges for these systems was timeliness. When information is not available until after the fact, all that would be accomplished was a well documented history of what went wrong rather than an effective tool for management during the life of the project. This improved visibility must allow for earlier identification of trends to prevent situations like the one pictured in Figure 1-1.

Most projects develop a time phased plan to accomplish the work. This resembles an S-curve shape. In the early stages, staffing and progress may be slow. In the middle part of the curve, both staffing and progress should be at their peak. At the end of the curve, progress slows while actual staffing may still be at peak or near-peak levels. The implications are obvious: identify and address the problems earlier in the project life and there is a much greater chance of avoiding schedule slips and large cost overruns. Early in the project, it takes very few additional resources to acceler-

ate and resolve variant conditions. At the peak of the project activity, it takes enormous resources just to stay even with the progress curve, making catch-up very difficult. At the end of a project, even great cost expenditures may do little to accelerate technical and schedule progress. Improved early visibility is a primary objective of any project management system.

The Performance Oriented Approach

Every company has some sort of tracking system to indicate how it is performing. Unfortunately, in many cases, the tracking may have been no more sophisticated than what is shown in Figure 1-2, Budget Plan versus Actual Cost. This was the traditional approach used for many years in companies and is still used in many organizations.

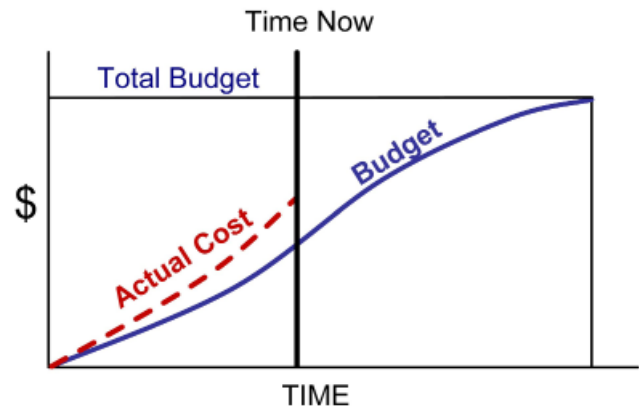


Figure 1-2 Budget Plan vs. Actual Cost

Actual costs are collected and compared with budgeted costs. This is done in the only common denominator available for resources - dollars in the U.S., Canada, and Australia, or the corresponding local currency in other countries. Does this approach provide improved visibility?

A good system must provide status and the necessary visibility into progress. The graph shown in Figure 1-2 at least allows comparison of expenditures with what was planned to be spent. However, there is no assurance that project status is known. Actual cost to date is higher than planned, but does that indicate a cost overrun or is the project ahead of schedule? This situation is shown in Figure 1-3.

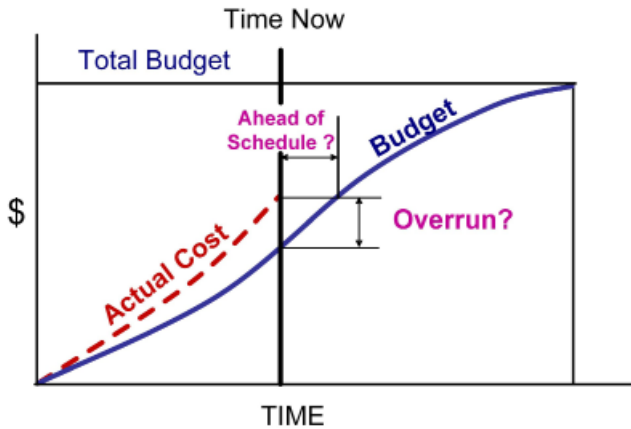


Figure 1-3 Overrun or Ahead of Schedule?

A budget versus actual comparison is shown in Figure 1-4. This may appear to indicate that a cost overrun is occurring. However, there is no basis for projecting what the status will be at project completion. It may be that the project is incurring a cost overrun, but it may also be that the project is behind schedule and future expenditures will accelerate significantly. This is shown in Figure 1-5.

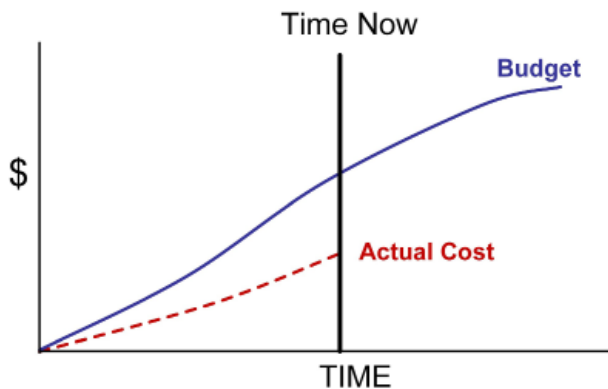


Figure 1-4 Underrun or Behind Schedule?

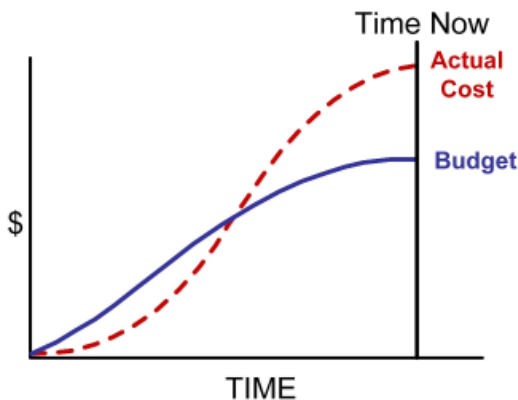


Figure 1-5 Significant Overrun or Accelerated Schedule?

What is missing from the comparison shown in Figures 1-4 and 1-5? There is no measure of what has actually been accomplished for what has been spent. The fact that money was being spent slower than planned could mean that there would be a cost overrun. It could just as easily mean that the project is behind schedule, or both, or neither.

The key to knowing what the true progress and status actually are requires the addition of a third line to the curve that reflects the value for the work that has been completed.

This third line results from a performance oriented approach. This approach shifts the emphasis from expenditures to work accomplishment. The project objective should be to accomplish all of the work rather than to spend all of the money. The third line that represents work accomplishment has been added to Figure 1-6.

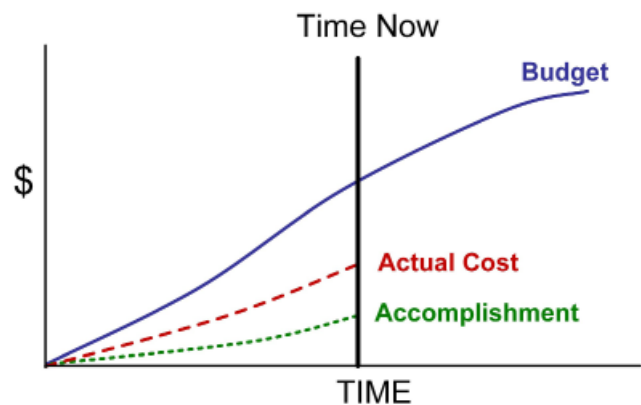


Figure 1-6 A Performance Oriented Approach Provides Better Visibility

When using a performance oriented approach, work scope and associated responsibilities must be defined in the initial planning phase of the project. This is a far better approach than defining responsibility in some form of finger-pointing exercise of guilt determination after a crisis occurs. It allows the person responsible for an emerging variance to take action before it becomes a problem.

The entire organization benefits from this approach. When action cannot be taken in time to entirely avoid a problem, at least the impact can be accurately assessed when an objective method of measuring progress was used. By setting variance standards or thresholds, the system can be used as a high level management by exception indica-

tor. A result is the ability to develop improved forecasts of technical performance, scheduled completion, and final cost earlier in the project.

Figure 1-6 provides a completely different picture of the project status. This figure depicts the value of the work scheduled to be accomplished, the value of the work accomplished, and how much the accomplished work actually cost. Actual costs to date are still below the budget line, but the value of work accomplished is even less. In other words, cost is not underrunning, but in fact is overrunning relative to the value of the work accomplished. Similarly, a behind schedule condition is apparent. The various methods for measuring the accomplishment of work is presented in later chapters of this text, but the important point is that it can be measured and compared with an approved plan.

With this type of information, it is possible to forecast a schedule slippage or cost overrun in the early stages of the effort. This early warning feature is one of the most important advantages of including a measure of work accomplished. Figure 1-7 illustrates how these projections might be represented.

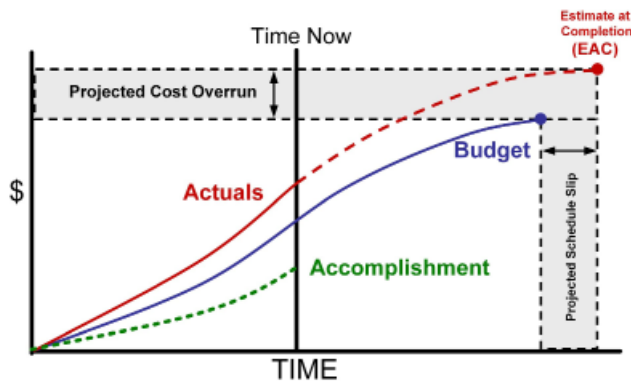


Figure 1-7 Cost and Schedule Impacts

Chapter 12 provides a more extensive explanation of earned value and how it is used as a measure of work accomplished.

Applying Earned Value Practices to Projects

Earned value management practices are appropriate for use in any single project or multi-project environment. On any type of project in any industry, regardless of how small it is, a project must be effectively defined to be effectively accomplished.

A project cannot be completed when its scope is not understood. Individuals or organizations must be identified with responsibility for completing the work, and a time frame must be established for accomplishing the work. Budgets and other resources allocated to the project need to be identified.

In other words, a plan for accomplishing the work is needed. Then progress must be measured against that plan. When variances and their impacts are identified, corrective action should be identified, evaluated, and implemented in the most cost effective manner. These are standard techniques that apply in any situation.

Experience shows small, short duration projects are often managed far worse than highly visible large projects. Because small projects are considered less significant towards the overall profit picture, they are sometimes overlooked with very unfavorable results. When small projects ignore basic management concepts, they commonly miss their budgets by 100 to 300 percent. The accumulation of absolute dollars may be more than a large project that misses its budget by 10 percent. The point is that the summation of many poorly managed small projects could exceed the impact of a large project.

A convenient aspect of the performance oriented approach is that it works in all environments including research and development, manufacturing, testing, construction, procurement, software development, and design. It also works on all types of contracts, regardless of whether they are firm fixed price, cost plus, or some other type between these two extremes. However, these factors play an important part in deciding on the level of detail and rigor of project controls for adequate visibility and control.

Management System Implementation Factors

Among the factors that impact the level of detail and rigor of project controls for a particular application include the:

- Project size and duration.
- Technical, schedule, and cost risk.
- Project contract environment.
- Management involvement level.

The size and duration of a project are critical considerations when making decisions on desired management system characteristics.

For complex, long duration, high cost projects, it is not surprising when it takes six months to develop a detailed plan for accomplishing the project objectives. Smaller projects often do not have a total of six months duration. This does not suggest the smaller project needs no plan, but rather it will have a less detailed plan featuring the same general requirements. Similarly, it does not make sense to set up an elaborate monthly reporting scheme with variance analysis reports and corrective action plans since the project will be completed before the process can even be properly established. Variances still need to be identified and actions taken to correct them, but it will be a far less formal process, probably involving little documentation.

Risk is another important consideration and relates to maturity of the technology involved. If the project were the tenth in a long series of similar products or services, some simple indicators of progress over time may be all that is required. But if it were the development of a new technology, greater detail is needed for monitoring and managing progress against the goal.

The project contract environment may impact the emphasis of controls. On a firm fixed price contract, cost monitoring and evaluation is typically not emphasized by the customer. However, the contractor will be very cost conscious, since it is responsible for any overruns when this contract type is used. From a customer's perspective, technical and schedule considerations are also important for firm fixed price contracts with its support contractors, especially on a multiple contractor program as the interfaces between contractors and projects must be managed. Productivity may still be a concern since it relates to whether the schedule can be met. In a cost reimbursable environment, cost controls are a paramount consideration since the contractor can maximize income by increasing the hours required to complete the work. The level of detail for cost and schedule control systems will vary in detail accordingly.

The level of management involvement is another contributing factor to decisions regarding implementation detail. In many cases, both owner/customer and contractor have their own systems

for determining project status. The contractor responsible for accomplishing the work needs a detailed system. However, the owner/customer should need a far less involved reporting system and could track progress on a higher level. There are exceptions to this. If the owner/customer were hiring the labor for the project and operating in a hands-on management situation, then detailed controls may be needed in the owner's/customer's organization.

Common sense and reason must be used when developing and implementing an EVMS. Implementing systems at too low a level of detail with unnecessary complexity has probably caused nearly as many problems as having no system at all. While that may be a slight exaggeration to make a point, the objective of improved visibility can be clouded just as easily by too much data (and not enough information) as it can by lacking enough input.

Accepted Best Practice

Earned value management has not always been enthusiastically embraced by all project participants for various reasons. Some do not want extra visibility into the status of their work when that same information is in the hands of their boss and/or their customer. Typically, managers prefer to attempt resolution of problems before they are discovered by others. While this is understandable from a human nature standpoint, it is entirely unacceptable from a project manager's viewpoint.

When problems are hidden and not satisfactorily resolved, they will later have increasingly substantial impacts to the project schedule and cost. It is essential the project manager has the information and tools to assess status accurately for rapid, effective management decisions.

Industry created the EIA-748 Standard for Earned Value Management Systems¹ Guidelines in 1995 to document the set of best business practices for performance oriented project management systems that have proven to provide strong benefits for project planning and control. The processes include integrating project scope, schedule, and cost objectives, establishing a baseline plan to

1 SAE International, Systems Management Standard, EIA-748 Earned Value Management Systems.

accomplish project objectives, and using earned value techniques for performance measurement throughout the project execution phase. A performance oriented system provides a sound basis for problem identification, corrective actions, and management replanning as required.

In addition to becoming an industry-wide standard, U.S. Government agencies use the EIA-748 Standard for EVMS Guideline requirements as the basis to perform contractor EVMS compliance reviews and recurring surveillance reviews when an EVMS is contractually required.

The Earned Value Management Process

Successful management of a project involves many concepts and implementation concerns. A project is any endeavor that has a well understood statement of work and optimistic, yet achievable, schedule, and cost targets. An EVMS is an integrated control system used to facilitate management of a project. There are many considerations in this complex discipline. A series of flowcharts are used throughout the text to exhibit how the various chapters interrelate.

The master flowchart is shown in Figure 1-8, "Earned Value Project Management: The Process." This chart is repeated at the beginning of most chapters to show where that chapter fits into the overall process.

The fundamental concept of this entire book is that the earned value management process should be logical, well-defined, and integrate all of the pertinent information relating to a project's status into a comprehensive picture. Every organization implements many of the concepts; few of them integrate those concepts into a unified status.

That is the primary challenge: to use all of the tools in the tool box in a coordinated manner to improve project visibility and to enable earlier management decisions based on timely and accurate information. This provides a project manager the best opportunity to meet project schedule and cost objectives while achieving the technical requirements.

The earned value management process is illustrated in Figure 1-8. The following is an overview of these process steps.

The Process Steps

Step 1 – Project Objectives, Work Scope Definition

The first step in the process is definition of the project objectives. These objectives include a general description of the technical requirements of the project, the time frame for the work to be completed, and its budget. A targeted start date and a completion date are included in this description.

There may even be some guidance provided as to whether this is a technical, schedule, or cost critical project. These can be critical pieces of information. As an example, at one of the major auto manufacturers, a project to design a new bumper system was being initiated. The time for this product to reach the market was critical, with a goal of eight months. However, the contractor's project manager assumed the project was more cost critical than schedule critical. This resulted in the project plan being stretched to 18 months to lower the peak cost requirements.

When the owners and customers reviewed the contractor's plan, they realized the primary objectives had not been explained clearly enough. The contractor was sent back to completely redo the plan to support the eight month requirement. If this project had been managed to the 18-month plan, it would have lost much of its commercial appeal.

The project plan is the set of documentation and directives that formalize the entire management process described in this text, including project objectives, general scope, project organization, desired schedule/cost goals, and a description of management systems and procedures to be used in completing the project. The project plan reflects the project specific internal as well as customer management, reporting, and analysis requirements. The approach used to code and organize the project data is an important up front activity to establish a standard approach to integrate the technical, schedule, cost, and risk/opportunity data to generate reliable information for effective management, reporting, and analysis for the life of the project.

Once the project objectives have been defined, the next task is to delineate, capture, and define the entire scope of the project. This is the best

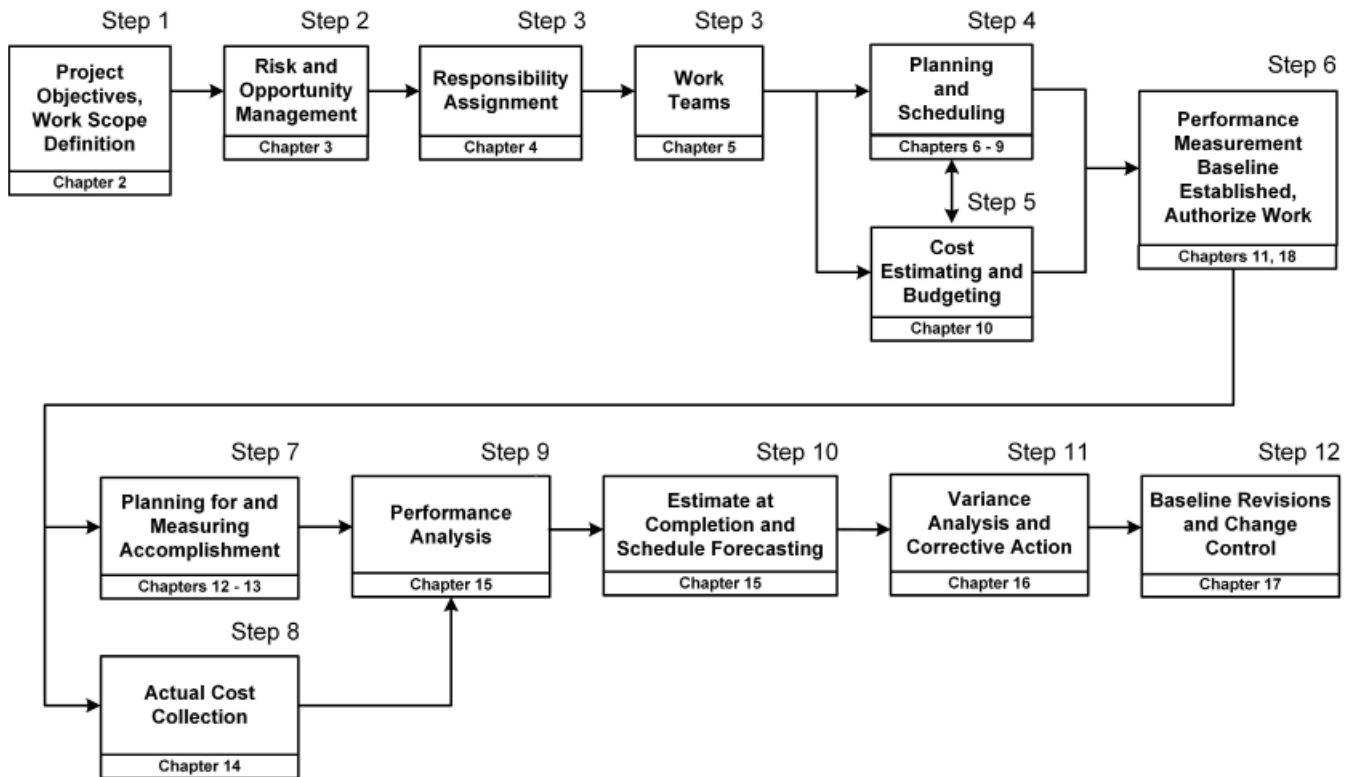


Figure 1-8 Earned Value Project Management: The Process

opportunity to assure understanding among the various project participants. It also is the best chance to avoid later nightmares with numerous scope changes and possible litigation. The Work Breakdown Structure (WBS) and WBS Dictionary are the tools used to decompose the work into manageable components: the control account level where responsibility assignments are identified and smaller segments of work called work packages. Each work package is assigned a scope of work with scheduled start/finish dates, and a budget to complete the control account work effort.

Step 2 – Risk and Opportunity Management

A risk assessment of the technical, schedule, and cost goals is an important part of this process. Risks or threats that could negatively impact the project are identified and mitigation plans are developed. Any opportunities that could positively impact the project are also identified and capture plans are developed. Establishing the risk and opportunity management plan and strategy for a project should be part of the earned value management process.

Each of the technical, schedule, and cost risk components has its own considerations and impacts. Like the overall earned value management process, these are also interrelated.

Project risk and opportunity management is an ongoing process and is addressed in several chapters. Risk intersects with the EVMS in numerous ways including planning and scheduling (Chapter 7), developing cost estimates and budgets (Chapter 10), determining management reserve (Chapter 11), estimates at completion (Chapter 15), and variance analysis (Chapter 16).

Step 3 – Responsibility Assignment, Work Teams

Once the scope is crisply defined, the next step is to document who is responsible for the work. The WBS control account level is where the defined element of work is assigned to one individual responsible for the scope, schedule, and budget to establish a responsibility assignment matrix.

It takes an entire project team working together to make the project a success, however, a single individual can cause it to fail. This explains some of

the reason for the popularity of work teams that help break down the barriers between functional work areas (i.e., departments which can also include subcontractors) and encourage a team spirit. Work teams are composed of the functional elements necessary to develop or produce the end product. This work team structure has advantages in that fewer management accounts are needed, there is improved communication and efficiency, and potential risks often are surfaced earlier.

Once the work definition and organizational concerns have been addressed, the particulars of the earned value management process must be developed. These include the functions of planning and scheduling, estimating, budgeting, and planning for performance measurement. These functions must all be performed and integrated for the baseline plan to be developed.

Step 4 – Planning and Scheduling

The planning and scheduling process is defined as what must be done in a planned sequence of activities and when it must be done with the required resources in the correct time frame to accomplish the project objectives on time.

Step 5 – Cost Estimating and Budgeting

The cost estimating process is defined as a forecast of how much it will cost to perform the work as scheduled with the required resources such as labor, material, facilities, and subcontractors. Once finalized, it becomes the time phased budget to accomplish the project objectives as scheduled within the cost target.

Step 6 – Performance Measurement Baseline Established, Authorize Work

This step is central to the overall earned value management process, developing and establishing the Performance Measurement Baseline (PMB). The PMB is the official, documented plan that shows in detail how the project objectives are to be achieved. It is also the basis to measure completed work that has been decomposed into work package activities with assigned earned value techniques.

All of the activities described thus far and the processes displayed on the Figure 1-8 flowchart are needed to achieve a well-planned PMB.

At the completion of this step, the technical, schedule, and budget baselines have been established and integrated. The schedule reflects the time frame where all of the work scope is planned to be performed. The budget is distributed and time phased based on the schedule requirements and resource availability. The work is authorized to the responsible manager and the technical work commences.

Subcontract management is a critical element for many projects. The subcontractor's technical, schedule, and budget baseline must be integrated with the prime contractor's baseline. Since the integrated baseline must include this element, a separate chapter on subcontract management (Chapter 18), is included in this step.

Step 7 – Planning for and Measuring Accomplishment

At this point, there is a shift from the planning phase to the control phase. Once the PMB has been established, the main objective is determining work progress.

Measuring performance against the baseline plan is accomplished through the use of earned value techniques, which is central to the entire earned value management process. While this definition has been given earlier, it is important enough to repeat here. It provides a critical element of information when project status is assessed by providing insight into what has actually been accomplished compared to the cost of performing that work. What has been accomplished can also be compared with what was planned to be accomplished to provide an accurate picture of the current schedule and cost position.

Earned value is determined through numerous techniques. The techniques selected for a project depends on each application, but objective guidelines are available to help the selection process.

Progress is measured using the same earned value techniques assigned as part of the schedule and budget planning process. The techniques used when the PMB was established must be applied consistently when progress is determined. Progress is compared with the plan, and this comparison provides the schedule variance.

Step 8 – Actual Cost Collection

All projects have a system for collecting actual costs. Regardless of how unsophisticated a system may be, this component must be included. The challenge is to define account structures that can be used for consistently comparing budgets, performance (earned value), and actual costs. This could mean modification to existing accounting structures. Actual costs are necessary so they can be compared with progress or earned value, and this comparison provides the cost variance.

Step 9 – Performance Analysis

After progress is measured against the plan and the actual costs are collected, the three components necessary for data analyses are available: budget, earned value, and actual costs. There are many calculations that aid in assessing the project status and assist the manager in targeting problem areas for corrective action. These calculations also assist in determining the estimate at completion and variance analysis reporting.

Step 10 – Estimate at Completion and Schedule Forecasting

Organizations are very concerned with bottom line performance. One of the essential pieces of information needed to evaluate an ongoing project is, “When is it going to finish and what is it finally going to cost?”

This answer is used for many purposes, ranging from rewarding project participants with better positions on new projects to project cancellation. The estimate at completion is so important that it can become a highly political number. A well-defined EVMS includes objective means of determining and evaluating estimates at completion to improve their accuracy even in the early stages of a project. This can only be achieved with defined performance factors that provide an accurate picture of what has happened to date and what is forecast to happen.

Step 11 – Variance Analysis and Corrective Action

Variance analysis and corrective action are very important to the overall process. Much time and effort are invested in baseline establishment, and now the baseline information can be used as a ba-

sis for determining the course of the project. The tools defined in the previous two steps directly feed variance analysis and corrective action. By comparing earned value to budget, schedule variances can be determined. By comparing earned value to actual costs, cost variances can be determined.

The second element, corrective action, is a critical part of the control phase. At this point in the process, there is a strong basis for determining the project’s true position versus the approved plan to proactively address exceptions. A well-defined EVMS provides immediate feedback as to whether the corrective action was successful.

Step 12 – Baseline Revisions and Change Control

An essential aspect of the earned value management process is managing change. After all of the effort that goes into developing the schedule and budget baseline plan and determining current status, it is always a disruption to change that plan. Nevertheless, changes are a part of every project and must be addressed as to how they will be reviewed, approved, and incorporated into the baseline plan. Procedures are required to manage the change control process or, over time, the project’s reports relate less and less to the current scope, schedule, and budget as well as the true status. As much attention is needed for processing baseline changes as was used in developing the original baseline plan.

Earned Value Management System Implementation

Chapter 19 provides information useful for implementing a project management process that incorporates earned value management practices. Topics such as the EVMS design, development of the EVM System Description and supporting procedures, flowcharting and storyboarding, and system training are discussed. This chapter provides an introduction to common EVMS reviews such as Integrated Baseline Reviews (IBRs), EVMS compliance reviews, and surveillance reviews. A contractor with an EVMS that has been approved or certified as being compliant with the EIA-748 Standard for EVMS Guideline requirements should also establish an annual self-surveillance or self-governance process.

Other business systems and methodologies such as Agile often interface with the EVMS. Chapter 20 discusses how Agile processes and earned value management practices can be integrated to establish a standard method for measuring progress and reporting project performance.

Conclusion

A project is any endeavor that has a scope of work and optimistic yet achievable schedule and cost targets. A project is typically managed by a single individual known as a project manager, who must be able to coordinate a multi-functional team towards the achievement of all of the project objectives. One of the greatest needs of the project manager is accurate, reliable, and timely information to enable effective management decisions. The information needs to include a valid assessment of project progress and status.

Projects were historically monitored by comparing planned expenditures against actual expenditures. This approach lacks the most important element of status: a measure of work accomplished. This shortcoming can be overcome by including a third data element that determines an objective value of work completed. This is known as the performance oriented approach. The performance oriented approach allows early identification of trends that indicate whether a project's objectives are in jeopardy. This early warning system allows a timely response on the part of management to mitigate unfavorable outcomes by making informed decisions.

It is important that the trade off between adequate project status visibility and excessive data collection are recognized and addressed. This is accomplished by setting an appropriate level of detail in the implementation process. Factors that affect level of detail include project size and duration, risk (technical, schedule and cost), type of contract, and desired level of management involvement.

The entire process of managing projects must be a logical one. Each of the steps of the earned value management process is illustrated by the flowchart in Figure 1-8 and is discussed in detail in subsequent chapters.

Review Questions

- 1-1. Explain the difference between a project and a program.
- 1-2. What aspects of a project are managed during the controlling phase of earned value management?
- 1-3. How is a project organized differently from a functional organization?
- 1-4. What are some frequent causes of project delays?
- 1-5. Why is a comparison of actual costs to date versus budgeted costs not adequate from an earned value management standpoint?
- 1-6. List at least three factors that will affect the level of detail appropriate for implementation of an EVMS on a project.

True or False

- 1-7. The earned value management process is only applicable for large projects.
- 1-8. The fact that more money has been spent at a point in time than was planned to be spent means that an overrun in final cost is indicated.
- 1-9. A program may be made up of multiple projects.
- 1-10. Performance measurement can be successfully applied in engineering, construction, manufacturing, and software development applications, among others.
- 1-11. Using a measure of performance allows earlier indication of potential increases in final cost.
- 1-12. From the customer's viewpoint, a firm fixed price contract suggests the need for tight cost controls.

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