National Defense Industrial Association
Integrated Program Management Division

Earned Value Management System Guideline Scalability Guide

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Revision 2

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Abbreviations and Acronyms

ACWP	Actual Cost of Work Performed
AUW	Authorized Unpriced Work
BAC	Budget at Completion
BCWP	Budgeted Cost for Work Performed (earned value)
BCWR	Budgeted Cost of Work Remaining
BCWS	Budgeted Cost for Work Scheduled
BOM	Bill of Material
CAIWG	Civilian Agency Industry Working Group
CAM	Control Account Manager
CAP	Control Account Plan
CAS	Cost Accounting Standards
CBB	Contract Budget Base
CPI	Cost Performance Index
CV	Cost Variance
DCAA	Defense Contract Audit Agency
EAC	Estimate at Completion
EV	Earned Value
EVM	Earned Value Management
EVMS	Earned Value Management System
EVT	Earned Value Technique
GAAP	Generally Accepted Accounting Principles
GAO	Government Accountability Office
IMS	Integrated Master Schedule
IPMD	Integrated Program Management Division
LCCE	Life-Cycle Cost Estimate
LOE	Level of Effort
M/ERP	Manufacturing/Enterprise Resource Planning
MR	Management Reserve
NDIA	National Defense Industrial Association
OBS	Organizational Breakdown Structure
ODC	Other Direct Costs
OTB	Over Target Baseline
OTS	Over Target Schedule
PASEG	Planning and Scheduling Excellence Guide
PM	Project Manager (or Program Manager)
PMB	Performance Measurement Baseline
POP	Period of Performance
RAM	Responsibility Assignment Matrix
SLPP	Summary Level Planning Package

SOW	Statement of Work
SPI	Schedule Performance Index
SV	Schedule Variance
TAB	Total Allocated Budget
UB	Undistributed Budget
VAC	Variance at Completion
WBS	Work Breakdown Structure

Introduction

Overview

Earned Value Management (EVM) is a proven project management practice that provides visibility into a project's technical scope, schedule, and cost progress. In use since the 1960s, the EIA-748 Standard for Earned Value Management Systems (EVMS), Section 2, provides a list of the 32 guidelines for use in establishing and applying an EVMS. Section 3 of the EVMS Standard includes additional discussion on applying earned value management practices using the 32 guidelines.

Historically EVMS has primarily been used as a contractual requirement on large development and production projects. As a result, an abundance of detailed guidance on implementing the EVMS Standard on large projects is available. However, little guidance exists on how to scale an EVMS for small to mid-size projects or contracts.

A scaled EVMS applies the 32 guidelines in a way that reflects the size, complexity, risk, and type of work necessary for the successful management of the project. This scalability allows any project to realize the benefits of earned value management. A scaled EVMS implementation recognizes small projects do not require the same level of data detail and project control discipline which is needed for large, complex projects. This is illustrated in Figure 1.
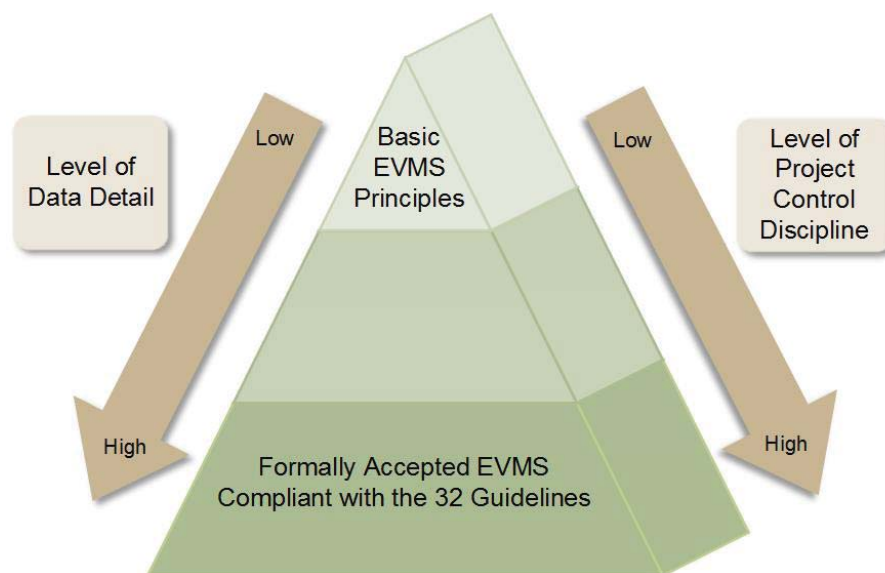
Figure 1: Scaling the EVM to Project Needs

For small projects or projects without contractual EVMS requirements, the seven basic EVMS principles, as discussed in the standard, are the foundation to establish an integrated project management system that incorporates the minimum requirements for an EVMS. When the size and complexity of a project increases, so does the level of data detail and project control requirements. The result is the functions of the integrated project management system become more extensive and rigorous. Projects with EVMS contractual requirements require the highest level of project control and formal compliance.

The design, operation, and implementation of a scaled EVMS requires that contractors have the capability to apply their management and control system in a manner appropriate to the size,

risk, and complexity of their projects. The system must also provide useful, timely, and actionable information for management decisions.

Purpose and Scope of the Guide

The NDIA IPMD Civilian Agency Industry Working Group (CAIWG) developed this guide to support the civilian government agencies and their suppliers in implementing EVM. The CAIWG was created to bring civilian agencies together to share best practices for implementing EVM in alignment with the EVMS Standard, and to promote consistency across agencies. The CAIWG is an open forum for discussing views on project management initiatives and performance-based management systems including EVMS within the civilian agencies.

This guide is intended to support any agency or organization which does not have a contractual requirement to implement EVMS, but would still benefit from using EVM practices by implementing a scaled EVMS. It is intended for industry or government project personnel within:

- Entities such as universities, laboratories, small businesses, suppliers, and vendors with small to mid-size projects.

- Large corporations with small projects/contracts or that issue contracts to small businesses, suppliers, and vendors.

- Any government agency with small contracts.

- Small companies with small to mid-size projects that are growing closer to the threshold requiring formal EVM compliance

Each organization and government agency has their own definition of what is considered to be a small project or non-major acquisition. These organization specific definitions should be used when identifying projects for applying EVM.

Although the concepts discussed in this guide often refer to contracts or contractors, per the Office of Management and Budget (OMB) Circular A-11, EVM is also required on government in-house projects.

Throughout this guide, the term "supplier" or "contractor" is used as a generic reference for the entities implementing a scaled EVMS on small or mid-size projects. The term "project" is used in this guide to identify all work authorized by a contract.

The guide assumes general familiarity with EVM concepts and the EVMS Standard 32 guidelines. For more information about the EVM concepts, intent and management value of the 32 guidelines, scheduling best practices, or performance metrics, suggested references for learning more about these topics include the:

- Government Accountability Office (GAO) Cost Estimating and Assessment Guide,[1] specifically Chapter 18, Managing Program Costs: Planning and Chapter 19, Managing Program Costs: Execution.

- GAO Schedule Assessment Guide.[2]

- NDIA IPMD EVMS EIA-748-D Intent Guide.

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[1] GAO *Cost Estimating and Assessment Guide*, Best Practices for Developing and Managing Capital Program Costs, GAO-09-3SP, March 2009.
[2] GAO *Schedule Assessment Guide*, Best Practices for Project Schedules, GAO-16-89G, December 2015.

- NDIA IPMD Planning & Scheduling Excellence Guide (PASEG).

- NDIA IPMD Guide to Managing Programs Using Predictive Measures.

Organization of the Guide – Project Management Processes

The EVMS Standard 32 guidelines are, by design, interdependent. Earned value management is intended to be one component of an integrated project management discipline. While the list of guidelines is useful for reference purposes, it is also useful to illustrate how the guidelines are applied during the implementation and execution phases of a project. This high-level process flow is illustrated in Figure 2 with cross references to the applicable guidelines.
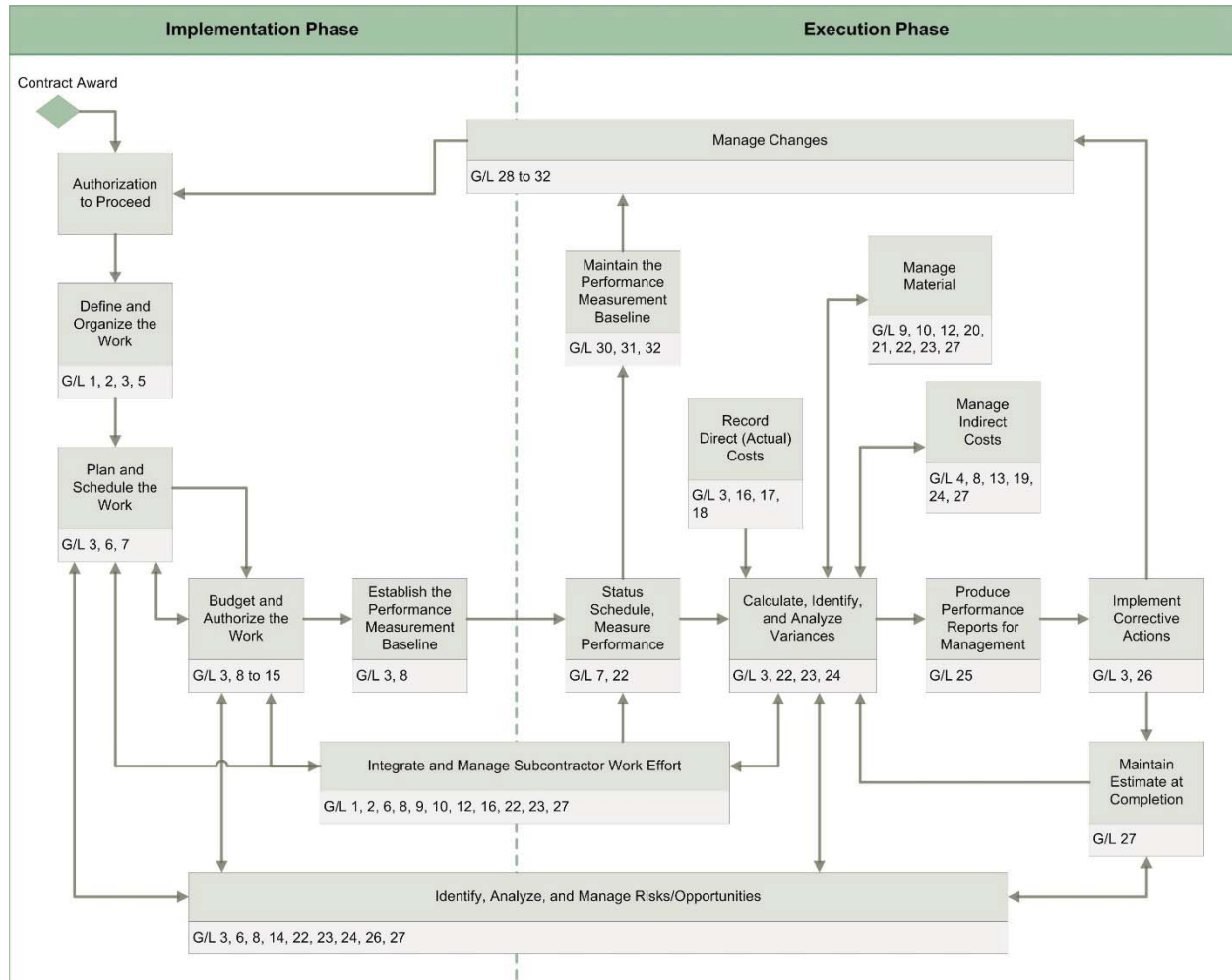
Figure 2: EVMS Guidelines and Project Phases

The guide is organized into the following nine project management processes:

1. Organizing for Project Management

2. Establishing and Maintaining an Integrated Project Schedule

3. Defining Budgets and Authorizing Work

4. Interfacing the EVMS with the Accounting System (actual costs)

5. Managing using Project Performance Information

6. Incorporating Approved Changes into the Project

7. Managing Project Material Items

8. Managing Subcontracted Work Effort

9. Managing Indirect Budgets and Costs

The project management processes 1 to 6 are the steps typically followed to establish a new project and to execute the planned work effort as illustrated in Figure 2. Processes 7 and 8 discuss managing material and subcontractor work effort separately as they may not apply to some projects. Process 9 discusses indirect costs separately as this is typically a corporate level function where the project manager is responsible for ensuring the project uses the approved indirect rates following established procedures.

For each process, the guide includes sections that discuss the related sub processes. This discussion includes:

- A reference to the applicable EVMS Standard primary guideline and secondary guidelines. The secondary guideline references are meant to highlight the interrelationships between the primary guideline's scaled implementation and the scaled implementation of the secondary guidelines.

- A description of the process and its underlying connection to project management.

- The benefits to be derived from effective implementation.

- Approaches for scaling the implementation of the process.

- Descriptions of typical products produced.

- Reference to best practice comments from the GAO Cost Estimating and Assessment Guide or Schedule Assessment Guide, where applicable.

Appendix A includes a list of the EVMS Standard 32 guidelines and guideline text for reference.

Appendix B includes referenced text excerpts from the GAO guides. The text was included to reinforce the process and management value discussion in the guide.

When scaling an EVMS implementation for a small project, also consider the following:

- The degree of scaling is often determined by how the project is initially organized and scheduled.

- In instances where the supplier is treated as a member of the prime project organization executing the work, the supplier's project management data may be incorporated into the prime's project management data and system.

- Compliance with contractual requirements as well as applicable industry and government regulations should be followed.

Users of this guide are encouraged to submit recommended revisions to the NDIA IPMD. The NDIA IPMD reviews and assesses the need for revisions to the IPMD guides every three years.

1 Process 1: Organizing for Project Management

While not always recognized as a project management "process", getting organized to perform work on any project usually follows a very logical sequence of steps. In this respect, it may be described as the process of "organizing." One of the unique aspects of this process is that it touches, in some way, every other process that will be implemented. Since organizing is the process of gathering the correct resources to take the project to successful conclusion, it is the heart of the EVMS. When the authorized work scope is incorrectly defined, or the wrong resource allocation or organizational assignments are established, it is doubtful the project will achieve its established goals.

In many cases, the project's organization is partially formed during the proposal or preparation phase of a project. Involving the appropriate functional disciplines ensures an adequate estimate is prepared for the work to be completed.

1.1 Establishing the Project Organization (Guideline 2)

Primary Guideline	Guideline 2 – Define the Project Organization (OBS)
Secondary	3, 5, 6, 8, 9, 10, 12, 15, 16, 18, 21, 22, 23, 25, 26, 27, 28, 29

Following contract award, a project team is identified. This team may be very small in number, but tends to be knowledgeable about the specifics of the recently awarded contract. Some members may have worked on the winning proposal, and are now charged with the development of a work team that can carry out the specific requirements of the project. This team ensures they follow what is outlined in the statement of work (SOW) and deliver the product according to the negotiated contractual objectives.

Benefit to Project Management

The organizational breakdown structure (OBS) helps management focus on establishing the most efficient organization. It takes into consideration the availability and capability of management and technical staff, including suppliers or vendors, to achieve the project objectives.

Scalability

The number of levels of the project OBS should be kept to a minimum and is determined by the management needs of the project. This requirement can be scaled by limiting the number of levels and overall size of the project organization. This can be as little as one level of an organizational structure or as many levels as necessary to ensure responsibility for the complete scope of work.

As the project progresses, the supplier, after considering contractual requirements, should adjust the OBS to reflect the changing needs of management and reporting.

The implementation of subsequent steps in the EVM processes are directly affected by the work breakdown structure (WBS) and OBS decisions.

Typical Products of Implementation

- Project organizational structure

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Identify Who Will Do the Work.[3]

1.2 Defining the Authorized Work (Guideline 1)

Primary Guideline	Guideline 1 – Define Work Scope (WBS)
Secondary	3, 5, 6, 8, 15, 16, 17, 20, 21, 22, 23, 25, 27, 28

Once the project has been authorized, it is necessary that all parties, both supplier and customer, understand the detailed scope of the project. A WBS is commonly used to accomplish this. The design and development of the WBS to levels beyond that in the request for proposal (RFP) and the contract is the supplier's responsibility. To do this, the contractor considers a number of factors, including the detail needed to accomplish the work, the visibility of work in process, and the requirements for cost and schedule reporting. The relationship between the WBS and the contract SOW is essential. The extension of the WBS should result in a logical grouping of SOW tasks. As part of this process, decisions are made regarding which efforts will be done in-house (make) or by subcontractors/vendors (buy).

Benefits to Project Management

Identifying the authorized work using a WBS is an industry best practice and is critical for all projects. It defines the basic building blocks of the project and is used for planning all authorized work. The WBS is a product-oriented family tree of project tasks depicting the decomposition of work scope for work authorization, tracking, and reporting purposes. It facilitates traceability and provides a control and communication framework for management.

Scalability

No matter what the characteristics of a small project, the WBS would be implemented. Scaling a product-oriented WBS would be based on size (number of levels), type of project, and complexity of the scope. This is illustrated in Figure 3.
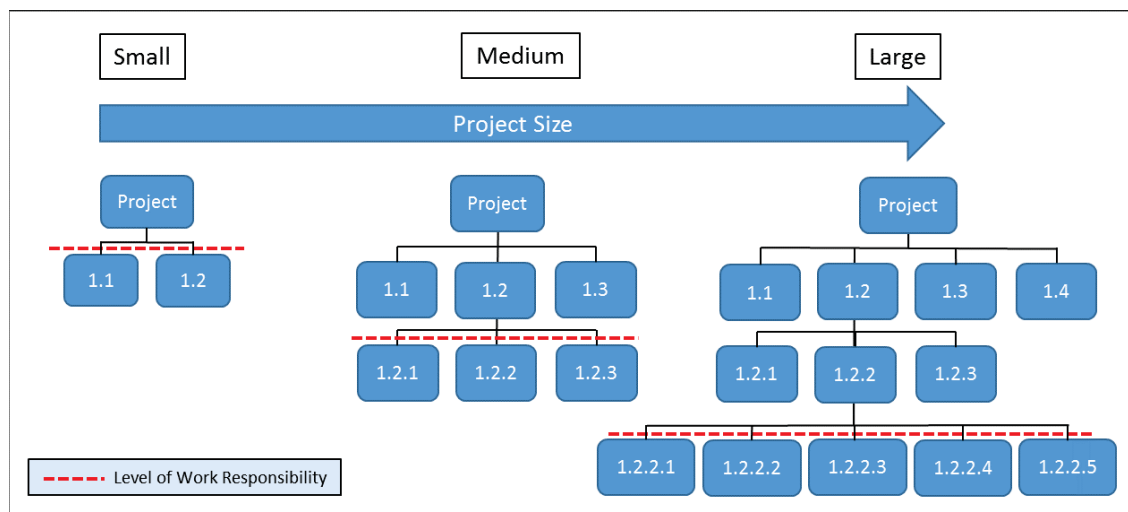
Figure 3: WBS Scaling Illustration

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[3] GAO Cost Estimating and Assessment Guide, page 216.

The number of levels of the WBS should be determined by the management needs of the project, with risk and project complexity as the primary driving factors. This requirement can be scaled by limiting the number of levels and elements in the overall size of the WBS. This can be as little as two levels of a product-oriented structure or as many levels as necessary to define all work scope to be completed.

Each additional level of detail increases the number of the next lower level WBS elements as well as the administrative cost of maintaining the responsibility and performance measurement information (i.e., the number of control accounts). Only extend each leg of the WBS to the level necessary for risk and management visibility.

Typical Products of Implementation

- WBS
- WBS Dictionary (may or may not be used, but a method is needed to document a common understanding of the project's scope of work as well as to reconcile the SOW to the WBS). The WBS dictionary or equivalent document should also state what is not included in a particular WBS element to further clarify what is in scope. This can lower the effort later for change control related negotiations.

GAO Best Practices

GAO Schedule Assessment Guide, Best Practice 1, Capturing All Activities, Work Breakdown Structure.[4]

1.3 Assigning Organizational Responsibility for Work (Guideline 5)

Primary Guideline	Guideline 5 – Integrate WBS/OBS to Create Control Accounts
Secondary	1, 2, 3, 8, 9, 16, 17, 18, 22, 23, 26, 28

The OBS reflects the way the project is functionally organized. To assign work responsibility to appropriate organizational elements, the authorized work, usually defined by the WBS, and the organizational structure must be interrelated with each other. In other words, organizational responsibility must be established for identified units of work. The assignment of lower level work segments to responsible managers provides a key control point, a control account, for management purposes and cost collection. Control accounts may be at different levels in the WBS for specific elements of work depending on risk and other management needs.

A responsibility assignment matrix (RAM) displaying the segment of work and the organizational entity responsible for completing it, typically at the WBS/OBS intersection, identifies the control accounts. It is at this level of management responsibility where the planning of authorized work, the measuring of the work performed, and the collecting of the actual costs occurs.

When effort is to be subcontracted, the applicable subcontractor is identified and related to the appropriate WBS element or organization charged with acquiring the subcontracted item. See Process 8 for more discussion on managing subcontracted work effort.

Benefits to Project Management

Integration of the WBS and OBS establishes the control accounts where the performance measurement necessary for project management is performed. This intersection results in designation of a focal point for management control and accountability, known as the control

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[4] GAO Schedule Assessment Guide, page 20.

account manager (CAM). This integration activity provides assurance that all aspects of the work scope have been assigned to an organization responsible for its execution.

Scalability
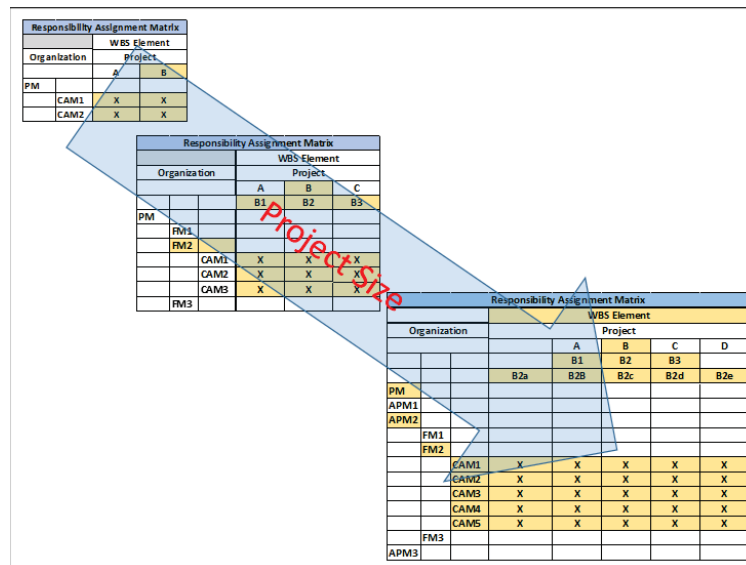
Figure 4: Responsibility Assignment Matrix Illustration

The size and detail of the RAM or similar matrix is a function of the levels contained in the WBS and the OBS. The lower the levels in either structure, the greater the number of control accounts are created. For example, if the OBS has four level 2 elements and the WBS has four level 2 elements, then a maximum of 16 intersections is possible. If, however, each structure is increased by only one level 2 element each, the maximum number of intersections increases to 25. Proper scaling of the WBS and the OBS results in the optimum relationship between the work elements and the responsible managers.

Typical Products of Implementation

- Control accounts
- RAM or similar matrix

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Identify Who Will Do the Work.[5]

1.4   Integrating EVMS Processes (Guideline 3)

Primary Guideline	Guideline 3 – Integrate Processes
Secondary	1, 2, 6, 8, 16, 17, 18, 22, 28, 29

The control account is the main action point for planning and control of work effort. All aspects of the EVMS come together at this point including budgets, schedules, work assignments, cost collection, progress assessment, problem identification, and corrective actions. Most management actions occur as a result of significant problems identified at this level. The intent is to build a framework that interrelates the processes so they support the effective project

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[5] GAO Cost Estimating and Assessment Guide, page 216.

management by accurately integrating technical, schedule, and cost information derived from the execution of the contract.

The establishment of a unique coding or ID structure (work order, job order, or task code charge number structure) facilitates the integration of the performance measurement processes. It also facilitates the correct assignment of work to a single OBS and WBS element.

Benefits to Project Management

The effective integration of planning, scheduling, budgeting, work authorization, and cost accumulation processes provides the capability for establishing the performance measurement baseline (PMB), the plan against which progress will be measured. It also supports the identification of work progress and the collection of actual costs. The analysis of this information facilitates management decision-making and corrective actions. The integration of the subsystems in relation to WBS and OBS allow summarization of cost data from the detail level up through these structures to the appropriate project level needed for management insight and control.

Scalability

Small projects should determine a logical level of integration. The level of detail can be modified; however, a balance needs to be maintained in the granularity of estimating, planning, scheduling, work authorization, and cost accumulation processes. This functional integration provides future performance reporting by responsibility.
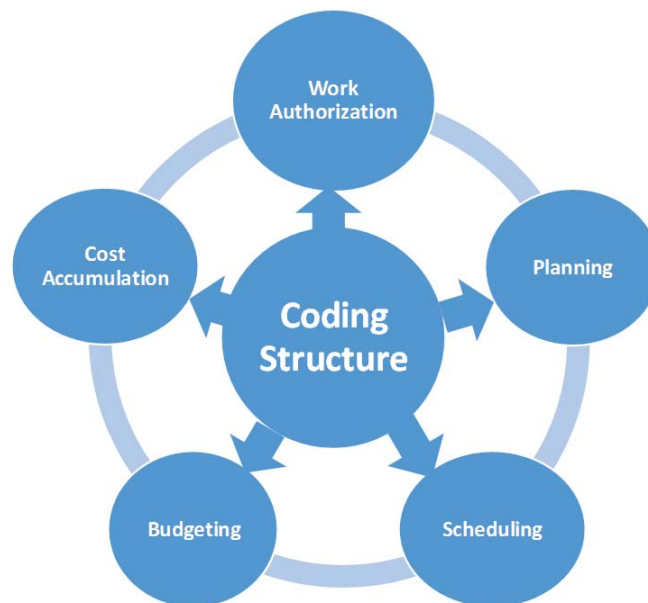
Figure 5: Establishing the Coding Structure for Process Integration

The organization and work scope relationship established in the previous step determined the level of the control account. Establishing one ID number for each control account links the planning and execution of the work effort to the associated charge number in the accounting system. See Figure 5. In some cases, there is a need to collect actual costs at a level below the control account level. Care should be taken to only do this when absolutely necessary as the proliferation of charge numbers leads to additional administrative costs and increases the possibility of data errors. A general guideline is for an employee to charge three or less charge numbers a week.

Typical Products of Implementation

- Schedules linked to the budget and cost information in the EVMS
- Coding structure mapping that identifies the interrelationships between the various EVMS processes to verify data traceability

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Table 29: Key Benefits of Implementing EVM.[6]

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[6] GAO Cost Estimating and Assessment Guide, page 206.

2 Process 2: Establishing and Maintaining an Integrated Project Schedule

Following the establishment of a project organization and the definition of the authorized work, the next step is to create an integrated project schedule. Successful management requires the integration of the project's technical, schedule, and projected budget. When projects experience problems in technical performance, then schedule delays, cost problems, or both may follow.

An adequate scheduling system facilitates the depiction of the plan to accomplish the technical scope, the actual technical progress against that plan, and estimate of the time required to complete the remaining technical scope. The schedule baseline, progress, and estimated time to complete should all readily integrate with the financial depiction (budgets, earned value, and estimated cost to complete) of the technical scope.

2.1 Identifying Schedule Content and Requirements (Guideline 6)

Primary Guideline	Guideline 6 – Schedule the Work
Secondary	1, 2, 3, 7, 8, 10, 22, 23, 26, 28, 29, 32

The scheduling system should contain either:

- A project master schedule and related subordinate schedules which provide a logical sequence from the detail/working level schedules to the master schedule level. Intermediate schedules should be established, if needed, to provide a logical sequence from the detail level schedules to the project master schedule, or

- An integrated master schedule (IMS) which incorporates all levels of schedule information, from detail to master level, into one fully integrated schedule.

The scheduling system provides for the identification of interdependencies between organizations and WBS elements at the level appropriate for efficient project management.

Benefits to Project Management

Scheduling all work to be performed facilitates effective planning, statusing, and forecasting. This is critical to the success of all projects. Time phasing the integrated technical and budget baselines result in the expected sequence of work, task interdependencies, and insight into potential schedule slippages.

Scalability

Scalability should be based on the type of project and not the organization. As a core process for project management, schedules are required for small projects. All elements and the level of detail of the schedule should be agreed upon by the supplier and customer. The schedule should be detailed enough so the critical paths can be determined for the project's entire period of performance. Limiting the WBS and OBS levels and their intersections, as previously described, will also reduce the lines of detail required in the schedule.

The establishment of the schedule is ultimately tied to the level at which work is accomplished. The control accounts created in the organizing process establish the basic framework of the schedules. The detail in the schedule will ultimately be reflected in the control account plans (CAPs).

At a minimum, the schedule of small projects should contain the expected sequence of work, significant interdependencies between segments of work, and time phasing of authorized measurable work at a level of detail which reflects the risk of the effort being managed.

Typical Products of Implementation

- Integrated network schedules or integrated master schedule
- Control account plans (may be separate plans or detailed schedules)

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Schedule the Work to a Timeline.[7]

GAO Schedule Assessment Guide, Best Practice 2, Sequencing All Activities.[8]

2.2 Integrating Schedules with the WBS and OBS (Guideline 6)

Primary Guideline	Guideline 6 – Schedule the Work
Secondary:	1, 2, 3, 7, 8, 10, 22, 23, 26, 28, 29, 32

The scheduling process covers all specified work from the lowest defined WBS elements to the project level milestones. At the control account level, responsibility for accomplishing the work is assigned to a specific organization. Detail schedules are used to correlate the activities of the working level organizations within a function, a WBS element, and between lower level functions.

These schedules may take any form as long as they support upper level schedules, ensure that performing organizations are planning their efforts to support intermediate (if appropriate) and project level milestones, and provide the basis for establishing the performance measurement baseline when resources are applied to them. Often, horizontal relationships are established at this level to ensure that organizational inputs and outputs correlate and that major project requirements are met. If there are intermediate schedules, either by WBS with functional breakouts or by function with WBS relationships, horizontal interdependencies may be appropriate at this level. See Figure 6.
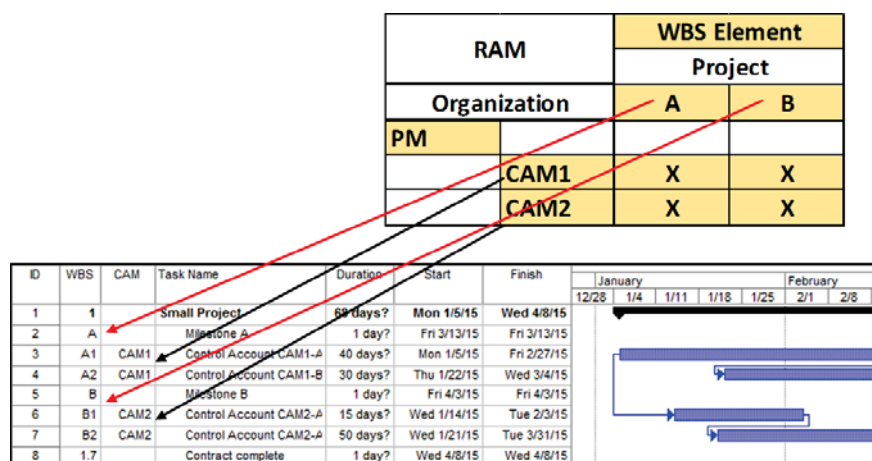
Figure 6: Schedule Activity Integration with the WBS and OBS Illustration

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[7] GAO Cost Estimating and Assessment Guide, page 218.
[8] GAO Schedule Assessment Guide, page 27.

Benefits to Project Management

Scheduling all work to be performed facilitates effective planning, statusing, and forecasting. This is critical to the success of all projects. Integrating and time phasing the technical and budget baselines result in the expected sequence of work, task interdependencies and insight into potential schedule slippages.

Scalability

On small projects, the need for detail level integration may be satisfied at the control account level for those efforts deemed to have the highest risk for success. The project manager's need for visibility into performance on critical activities determines the extent of detail level integration required. Care must be taken to minimize the amount of required schedule maintenance related to non-risk elements.

Typical Products of Implementation

- Integrated network schedules or integrated master schedule
- Control account plans (may be separate plans or detailed schedules)
- Work authorization documents

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Schedule the Work to a Timeline.[9]

GAO Schedule Assessment Guide, Best Practice 2, Sequencing All Activities.[10]

2.3 Structuring Schedules for Progress Statusing and Forecasting (Guideline 7)

Primary Guideline	Guideline 7 – Identify Products/Milestones for Progress Assessment
Secondary	6, 8, 10, 12, 22, 26, 28, 29, 32

The scheduling system should cover all specified work and incorporate project milestones that are meaningful in terms of the technical requirements of the contract. It should provide schedules where actual progress can be related to the plan and contain forecasts of expected future progress. Such schedules should identify key milestones and activities which recognize significant constraints and relationships. A key feature of the scheduling system is it establishes and maintains the relationship between technical achievement and progress statusing. Figure 7 illustrates the use of various earned value techniques (EVTs) to determine physical progress.[11]

ID	Task Name	EVT	Notes	Status	1/18	1/25	2/1	2/8	2/15	2/22	3/1	3/8	3/15
1	Control Account A1												
2	WP1	0 - 100	Design Complete	Complete									
3	WP2	50 - 50	Design Start/Design Complete	Started									
4	WP3	25 - 75	Design Start/Design Complete	Late									
5	WP4	% Complete	CAM Assessment	30%									
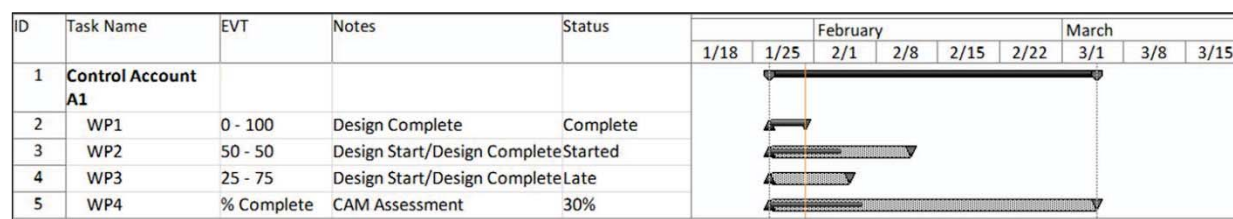
Figure 7: Assigning Earned Value Techniques to Work Package Activities

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[9] GAO Cost Estimating and Assessment Guide, page 218.
[10] GAO Schedule Assessment Guide, page 27.
[11] For an introduction to earned value techniques, see Table 33: Typical Methods for Measuring Earned Value Performance in the GAO Cost Estimating and Assessment Guide, pages 225-226.

Benefits to Project Management

Identifying interim and completion milestones as objective indicators of work accomplished enables accurate comparisons to planned work. Performance metrics provide better management insight into the root cause of performance issues (see Process 5). This insight ensures maximum consideration can be given to assessing the impact of performance issues, allowing appropriate and timely corrective action development and implementation.

Scalability

The two drivers for determining the appropriate project milestones to include in the schedule are a) the number and level of the control accounts established during project set-up and b) the number of work packages created within those control accounts.

This requirement can be scaled by constructing the schedule to include the least number of milestones needed to objectively measure progress. For the purpose of determining earned value (EV), small projects with low risk could be scaled by using longer or larger work packages and planning packages with fewer interim milestones, and the percent complete could be used as the primary EV measurement technique.

As another example of scaling, a 100-line work effort to install 100 widgets over eight months could be summarized into a single work package eight months long. The earned value technique would be units percent complete (0/100 widgets) where the numerator represents the number of units that have met the objective completion criteria (Section 3.5).

Small projects with higher risk could create shorter work packages or add more interim milestones for assessing performance. This increases the number of tasks/activities and milestones to be maintained/statused and simplifies the process of determining work completion – the work is either finished or not. Using interim and completion milestones scheduled no more than one month apart is highly recommended as these interim milestones provide the means to objectively measure accomplishments each month. This allows for simple 0/100 and 50/50 earned value techniques to be applied (Section 3.5). Otherwise, performance may be misstated, resulting in artificial variances that must be reported and explained.

Typical Products of Implementation

- Integrated schedules that identify contract products, deliverables, milestones and key events
- Control account plans (may be separate plans or detail schedules)

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Determine an Objective Measure for Earned Value.[12]

2.4 Maintaining Baseline and Forecast Schedules (Guideline 23)

Primary Guideline	Guideline 23 – Identify Significant Variances for Analysis
Secondary	1, 2, 3, 5, 6, 7, 9, 22, 26, 30

Scheduling should interface with other elements of the EVMS to the extent necessary for measurement and evaluation of project status. The project schedule should have an original plan (the baseline) against which the current status (work progress and the forecast) can be

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[12] GAO Cost Estimating and Assessment Guide, page 225.

compared. The ability to compare the baseline to the forecast dates provides a useful tool for understanding the current state of the project, historic trends, and the time and effort required to complete the remaining work.

The scheduling system should provide current status and forecasts of completion dates for all authorized work. The summary and detailed schedules should enable a comparison of planned and actual status of project accomplishment based on milestones or other indicators used for control purposes. The ability to modify future scheduled efforts based on current progress assessments and evaluations is critical to successful project management.

The baseline and the forecast schedules are under frequent maintenance. The baseline schedule is subject to change control and changes less frequently while the forecast schedule changes with each status cycle. Activities in the project schedule should have both baseline and forecast dates.

It is important that a verifiable relationship is maintained between the baseline schedule and the forecast schedule so valid comparisons and analysis of deviations can be made. Also, the implementation of a schedule change control process ensures that this relationship, once established, is maintained and traceable to previous versions of the schedules.

Benefits to Project Management

Project schedules are a primary communication tool between the supplier and the customer. Maintaining a baseline project schedule and forecast project schedule that consistently reflects the current status as well as projections of future conditions that will lead to project completion is essential for effective project management.

Scalability

When establishing schedules, small projects should focus specific detail planning on near-term efforts and maintain future work in larger, scheduled packages for management flexibility. This approach reduces the amount of schedule changes that would be necessary when the detailed planning horizons are extended further out into the future. The focus is on limiting the amount of detail information in the schedule which is required for the day-to-day management of the effort. However, there should be sufficient planning of future work to encompass all the authorized work within the project timeframe.

Typical Products of Implementation

- A baseline project schedule that is consistently maintained following an established change control process.
- A current or forecast project schedule with progress status and forecast of future project activities.

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 19, Managing Program Costs: Execution, Analyze Performance, Probe Schedule Variances for Activities on the Critical Path.[13]

GAO *Schedule Assessment Guide*, Best Practice 9, Updating the Schedule Using Actual Progress and Logic.[14]

GAO *Schedule Assessment Guide*, Best Practice 10, Maintaining a Baseline Schedule.[15]

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[13] GAO Cost Estimating and Assessment Guide, page 258.
[14] GAO Schedule Assessment Guide, page 121.
[15] GAO Schedule Assessment Guide, page 135.

3   Process 3:   Defining Budgets and Authorizing Work

The organizing and scheduling processes serve as the basis for defining budgets and authorizing all work at the appropriate levels within the WBS/OBS framework. Once the contractual effort is defined and scheduled, resources for accomplishing the work are assigned through the internal work authorization and budgeting process.

Just as scheduling is an iterative process to sequence all work within a prescribed period of performance, budgeting is also an iterative process for distributing or time phasing the budget to accomplish the work within the authorized project value. Funding should not be confused with budget on government contracts. The current and future funding profile can impact the budget time phasing. The result of these processes is the establishment of the performance measurement baseline (PMB).

The establishment of a PMB is essential for earned value management. Small projects must be able to demonstrate that they can establish and maintain a PMB. The time-phased PMB represents the planned scope of all authorized work and schedule, and provides the project manager with the capability to assess project performance. It is critical to establish a performance baseline to determine whether the project objectives can be met within known constraints (scope, schedule, budget, and resources).

3.1 Authorizing Work Scope and Budget for Resources (Guideline 9)

Primary Guideline	Guideline 9 – Authorize and Budget by Cost Elements
Secondary	1, 2, 5, 8, 10, 12, 13, 16, 19, 21, 23, 27, 28, 29, 32

The work authorization process defines and identifies the work required to be accomplished by the responsible organization. Budget values, representing the time-phased resources authorized to complete the work within a scheduled period of performance are also assigned to the responsible organizations. Schedules and budgets should be established and approved for all authorized work at the level the supplier determines appropriate. This is typically accomplished with a control account work authorization. At a minimum, the work authorization process should ensure that the elements shown in Figure 8 are present irrespective of the chosen approach.
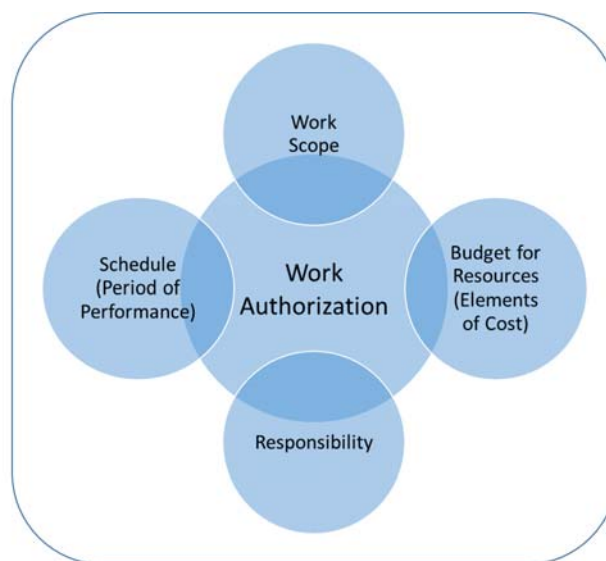
Figure 8: Work Authorization Elements

Benefits to Project Management

The authorization of work identifies who is responsible for the work effort, the technical work to be accomplished, the approved budget for the required resources, and schedule to complete the work. This is essential to control project cost and schedule as well as to identify when the work is complete.

Scalability

At a minimum, small projects should have a work authorization process at the control account level with budgets planned by elements of cost, using varying degrees of formal documentation. If a WBS Dictionary is developed for a small project, it could serve as a work authorization document by including information such as charge numbers, period of performance, responsible manager, and associated budget.

Typical Products of Implementation

- Control account plans by element of cost
- Work authorization documents
- Performance measurement baseline
- Bill of materials (BOM)
- Dollarized responsibility assignment matrix
- Schedules, preferably resource loaded

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 4, Cost Analysis Overview, Life-Cycle Cost Estimate.[16]

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Estimate Resources and Authorize Budgets.[17]

3.2 Planning Resource Budgets for Control Accounts (Guideline 10)

Primary Guideline	Guideline 10 – Determine Discrete Work and Objective Measures
Secondary	2, 6, 7, 8, 9, 11, 13, 22, 27, 28, 29, 32

Each control account includes the resources necessary to complete the assigned effort. The time phased performance measurement baseline reflects the budget values of those resources. Budgets established at the control account level must be planned against the approved schedule by element of cost such as labor, material, subcontracts, and other direct costs (ODCs). The control account work effort is broken down into either work packages or planning packages.

A work package is used to identify discrete tasks which have definable results. The resource requirements to complete the work package tasks are time phased in accordance with the approved schedule, and assigned to a performing organization for completion. Work package descriptions must clearly distinguish one work package effort from other work packages. There may be a one-to-one or many-to-one relationship between schedule activities and a work package.

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[16] GAO Cost Estimating and Assessment Guide, page 32.
[17] GAO Cost Estimating and Assessment Guide, page 224.

Work for a control account which cannot be planned in detail at the outset should be divided into larger segments and placed in planning packages within the control account. Planning packages aggregate future tasks and resources that are time-phased per the agreed to schedule beyond the near-term detail plan. Planning packages are converted into work packages at the earliest practical time. Time-phased budgets assigned to planning packages must be supported by a specified scope of work and this relationship must be maintained when detail planning the work effort.

Benefits to Project Management

The establishment of a near-term, detailed plan provides project management and the project team with an integrated measurement tool for assessing both physical progress (scheduled work accomplishment) and costs of work accomplishment (cost accumulation) for purposes of making and implementing management actions to meet project technical, schedule, and budget objectives.

Scalability

On small projects, it may be impractical to identify the cost or budget for authorized work below the control account level; however, the supplier should be able to demonstrate that work can be subdivided within the context of its schedule.

Scaling could be accomplished by allocating control account budgets to work packages represented in the IMS by using either a weighted milestone or percent complete EV technique. For instance, a work package with a three-month duration could have budget spread over three months with three weighted milestones (one for each month) for measuring EV. Work packages should be resource loaded consistent with the scheduled work to avoid significant distortion in the resultant performance data.

Typical Products of Implementation

- Control account plans divided into work packages and planning packages
- Control account schedules and control account time-phased budgets

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Identify Who Will Do the Work.[18]

3.3 Planning Resource Budgets for Future Effort (Guideline 8)

Primary Guideline	Guideline 8 – Establish the Performance Measurement Baseline
Secondary	1, 2, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 28, 29, 31, 32

When all of the work for a given project cannot be planned in detail at the outset, it can be initially divided into larger segments so that the entire project requirement may be viewed as a sum of all identified parts. This is a means to establish the project's performance measurement baseline. On some projects, because of work scope and funding uncertainties, it may be impractical to identify future work beyond a significant phase or event milestone, e.g., design approval, test results, etc.

These milestones should be events of primary interest to the project managers from the standpoint of assessing the adequacy of the design approach, the achievement of major

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[18] GAO Cost Estimating and Assessment Guide, page 217.

technical milestones, or any other point where a technical evaluation of the project is warranted. The customer and contractor PMs should concurrently identify these major technical review points. In such cases, detail planning would be required for the control accounts, work packages, and planning packages for the first review point. All planning beyond this point would be done in larger increments at a summary level, but in enough detail to permit resource requirement analysis for down-stream work.

Benefits to Project Management

The flexibility to hold future efforts in control account planning packages and higher level summary level planning packages facilitates accurate near-term work planning and helps avoid replanning future effort when project situations change. Small projects should take maximum advantage of these tools when creating the PMB for their projects.

Scalability

Small projects should create a near-term planning window based on project milestone definitions, within which detailed control accounts and work packages are created. Any effort beyond that window should be placed, along with appropriate resource requirements, in higher level summary level planning packages (SLPP) or control account planning packages until sufficient visibility into the detailed work content is available.

Typical Products of Implementation

- Summary level planning package (work scope, schedule, budget, and resources) to be divided into control accounts as the project progresses
- Summary level planning package schedule activities
- Summary level planning package time-phased budgets

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Develop the Performance Measurement Baseline.[19]

3.4 Confirming Accurate Budget Distribution (Guideline 11)

Primary Guideline	Guideline 11 – Sum Detail Budgets to Control Account
Secondary	8, 10, 12, 13, 15, 28, 29

Ensure the budgets assigned to work packages and planning packages accurately reflect the value of the resources assigned to the control account for execution of the work scope. The sum of those budgets, once planned, must add up to the total budget value authorized on the work authorization document.

Benefits to Project Management

The integrity of the PMB is essential to the effective management of the project. This requires that the budget for a control account must equal the sum of its work package and planning package budgets.

Scalability

The establishment of the control accounts and, if appropriate, summary level planning packages in the organizing process directly impacts this guideline. Each control account, once created,

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[19] GAO Cost Estimating and Assessment Guide, page 228.

must summarize properly to the authorized amount or the total value of the project will not reconcile with the value authorized by the customer.

Products of Implementation

- Control account plan total budget
- Work package budget
- Planning package budget

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 8, Work Breakdown Structure, Best Practice: Product-Oriented WBS.[20]

3.5 Establishing Objective Measures of Work Progress (Guideline 7)

Primary Guideline	Guideline 7 – Identify Products/Milestones for Progress Assessment
Secondary	6, 8, 10, 12, 22, 26, 28, 29, 32

When work packages are detail planned, meaningful indicators of progress and objective completion criteria must be identified for use in measuring work progress. For measurable or discrete effort work packages, the CAM must specify the start, interim, and completion milestones or the units of work that will be used to measure accomplishment of the task. Work package milestones must portray the beginning or end of discretely measurable pieces of work. Whenever possible, discrete work packages are measured using earned value techniques such as 0/100, 50/50, or weighted milestones. The earned value technique chosen for each work package should provide the most objective and accurate assessment of work accomplishment – the budgeted cost for work performed (BCWP).

Benefits to Project Management

Valid indicators of progress at the work package level lead to accurate earned value data for making proactive project management decisions. The summarization of this information provides visibility into progress towards completing project milestones included in the project schedule (master and intermediate schedule levels or the integrated master schedule).

Scalability

Small projects could be scaled in the following ways:

- Small, low risk projects could use longer duration or larger dollar value work packages or control accounts.
- For travel or material:
  - A single control account could be used, with future out-year budget contained in a single planning package.
  - A high level WBS element or charge code could be used for all travel or material.
  - Annual budgets by organization could be developed for each fiscal year, and EV performance could be taken as travel occurs or material is purchased.
  - Level of effort (LOE) could be used as the EV measurement technique; however, it is not the preferred approach.

Typical Products of Implementation

- Control account or work package plans

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[20] GAO Cost Estimating and Assessment Guide, page 67.

- Progress indicators at the work package level

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Determine an Objective Measure for Earned Value.[21]

3.6 Planning Resource Budgets for Non-Measureable Effort (Guideline 12)

Primary Guideline	Guideline 12 – Level of Effort Planning and Control
Secondary	8, 11, 13, 15, 23, 28, 29, 32

On every project, level of effort (LOE) tasks are used for work effort that either cannot be measured in terms of physical progress, or for which the measurement of the effort is impractical or provides little to no value in terms of project progress. Because LOE represents tasks or activities for which there is no definable end product or measurement is impractical, the budgets for these tasks represent a resource plan which, by definition, cannot have a schedule variance (i.e., cannot be ahead of or behind schedule).

Benefits to Project Management

LOE work packages should be used for tasks of a general or supportive nature that do not produce definite end products. Although meaningful product-oriented or management-oriented events are critical for performance measurement, not all activities lend themselves to objective measurement.

Scalability

For small projects, each task must be assessed to determine the best method to budget and measure its progress toward completion. The number of LOE tasks in a small project should be held to a minimum, ensuring most tasks are being identified as discrete or apportioned effort. Scalability could be achieved by placing all LOE scope within one or a few work packages or control accounts.

Products of Implementation

- Control account plans which identify LOE work packages and budgets

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Determine an Objective Measure for Earned Value.[22]

3.7 Creating Holding Accounts for Work Scope and Budget (Guideline 14)

Primary Guideline	Guideline 14 – Identify Management Reserve and Undistributed Budget
Secondary	8, 15, 28, 29, 32

In most projects, particularly for development activities, uncertainty or risk, regarding the timing or magnitude of future difficulties is considerable. Establishing a management reserve (MR) budget provides the PM with the capability to plan for these uncertainties within the project's scope of work. When necessary during the execution of a project, an amount of management

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[21] GAO Cost Estimating and Assessment Guide, page 225.
[22] GAO Cost Estimating and Assessment Guide, page 226.

reserve may be allocated to a control account to handle realized risks. Because management reserve is budget not yet tied to work, it is not part of the performance measurement baseline. The management reserve budget which is set aside should be commensurate with the level of project risk.

Undistributed budget (UB) is a short-term holding account for budget of corresponding work scope at the project level, until such time sufficient work definition and organizational responsibility are identified. Once this occurs, the work scope and budget are transferred from undistributed budget to summary level planning packages or control accounts with lower level work packages or planning packages where the budget is time phased for the work. The undistributed budget holding account should be cleared in a timely manner as work scope is finalized.

Benefits to Project Management

Incorporation of project risks and opportunities is essential for executing updates to the baseline. The PMB planning process provides an opportunity to identify risk and should quantify those risks by identifying an appropriate level of MR for unplanned activities within the project scope. Unexpected work scope growth within the contract SOW, changes in rates, or schedule slips are examples of situations that may make the amount of the budget allocated to an individual control account inadequate.

Scalability

A small project's management reserve should be commensurate with the level of risks and opportunities identified by the project manager. Management reserve may not apply for short duration projects where risk is minimal. Undistributed budget may not apply when the work scope is easily identified to all the control accounts.

Typical Products of Implementation

- Project control logs showing the contract budget base (CBB), PMB, MR, and UB along with record of changes as MR and UB are distributed to control accounts
- Monthly performance reports to verify that starting and ending values are consistent with various logs

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Develop the Performance Measurement Baseline.[23]

3.8 Maintaining Control of the Performance Measurement Baseline (Guidelines 32, 15)

Primary Guideline	Guideline 32 – Document PMB Changes
Secondary	6, 7, 8, 9, 10, 12, 13, 14, 15, 26, 29
Primary Guideline	Guideline 15 – Reconcile to Target Costs
Secondary	1, 2, 8, 11, 14, 28, 31, 32

The performance measurement baseline (PMB) represents the cumulative, time-phased, budgeted cost for work scheduled. The PMB is the sum of the control account budgets,

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[23] GAO Cost Estimating and Assessment Guide, page 228.

budgets for higher level WBS elements (SLPPs), and undistributed budget. The PMB includes all of the budget values assigned to identified components of work (the WBS). This includes budget values for indirect costs that are expected to be allocated to the project based on the overhead pool allocation procedures described in the supplier's Cost Accounting Standards (CAS) disclosure statement (see Process 9).

The sum of the PMB and management reserve is known as the project contract budget base (CBB). The contract budget base represents the value of all authorized work – the sum of the PMB and MR must always reconcile to the CBB. The contract budget base is also equal to negotiated contract cost plus any authorized unpriced work (AUW). The budget distribution flow down is illustrated in Figure 9.
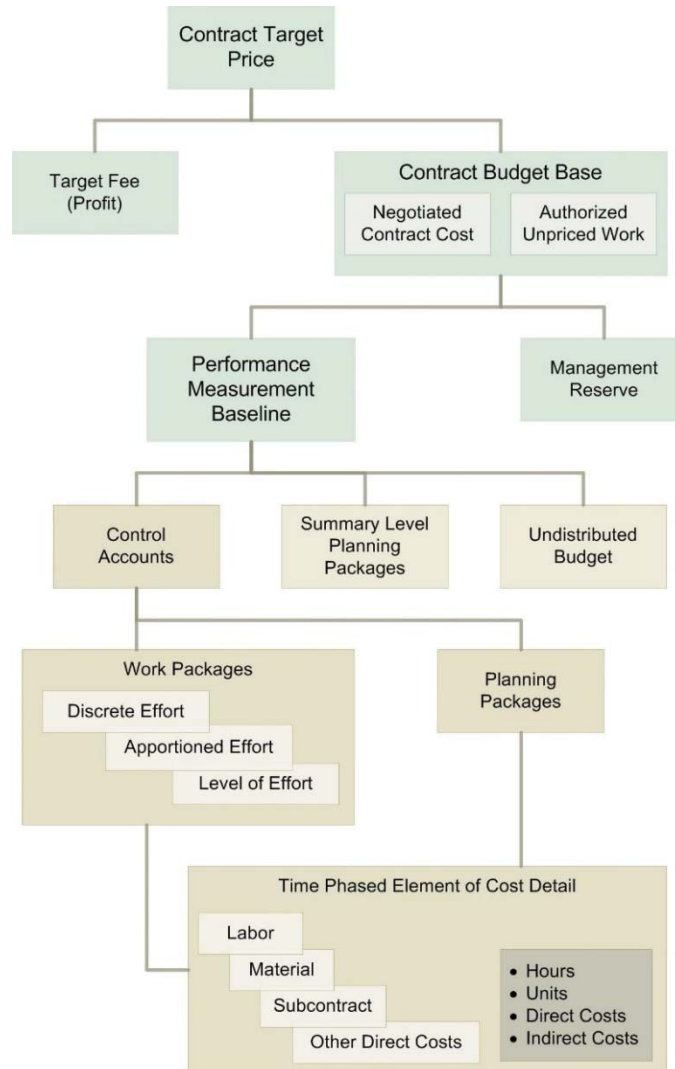
Figure 9: Budget Distribution Flow Down

As changes occur to the CBB or PMB, whether because of internal replanning or project changes directed by the customer, the documentation supporting the current value and time-phasing of the PMB must be accurately maintained. See Process 6 for more discussion on change control.

Benefits to Project Management

A disciplined change control process is required to ensure that the CBB, the PMB, and performance measurement data are accurate and reliable, and all changes are captured.

Scalability

Regardless of project size, all changes to the project baseline must be documented in accordance with the project's change control process.

A small project's change control process may incorporate less formal documentation, such as financial spreadsheets, the grouping of change documents in a single form, or other electronic media.

Typical Products of Implementation

- Change control log
- Project control logs showing the contract budget base (CBB), PMB, MR, and UB along with record of changes
- Control account, work package, planning package plans
- Master, intermediate, and detail level schedules or integrated master schedule
- SOW, WBS, WBS dictionary
- Work authorization documents
- Management performance reports

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Update the PMB as Changes Occur.[24]

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[24] GAO Cost Estimating and Assessment Guide, page 231.

4 Process 4: Interfacing the EVMS with the Accounting System

The ability of the accounting system to accurately accumulate actual costs is critical to the accurate establishment of performance measurement information for project management. The guidelines applicable to this section are focused on establishing an effective relationship between the accounting system and the EVMS. Nothing in these guidelines requires the contractor to modify their accounting system or processes.

The accounting system must be formally structured and maintained, and must have books of account that comply with Generally Accepted Accounting Principles (GAAP). The accounting system accumulates actual costs, by element of cost, for transfer to the EVMS based on the coding structure created for each project. Within the EVMS, the use of the coding structure enables the actual costs from the accounting system to match the budgets established within the control accounts.

4.1 Ensuring Actual Costs are Comparable to Project Budgets (Guideline 16)

Primary Guideline	Guideline 16 – Record Direct Costs
Secondary	1, 2, 3, 8, 10, 23, 28, 29, 32

The accounting system must be capable of accounting for all resource expenditures on a project. The coding structure established during the organizing process, when linked to the accounting system and the control accounts in the EVMS, creates this capability. In the application of this guideline, the supplier should have a disclosure statement from the Defense Contract Audit Agency (DCAA) that identifies the treatment of direct actual costs (direct labor, material, miscellaneous ODCs, and subcontract costs), indirect costs, depreciation, capitalization, etc.

The accumulation of direct costs should be accomplished through the supplier's formal accounting system. The accumulation of direct costs should be consistent with the way the work is planned and budgeted in the EVMS. The actual costs reflected in the monthly EVM reports should reconcile with the project management reports which are based on the actual costs collected from the formal accounting system. See Figure 10. In some cases these reports will be the same.
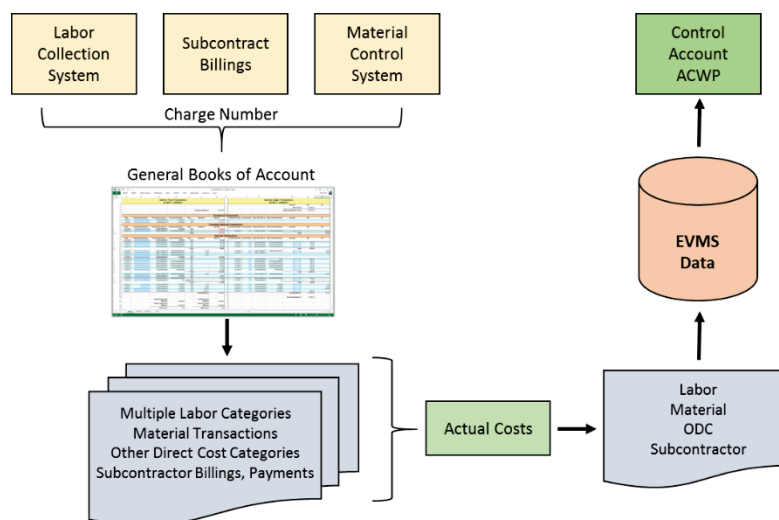
Figure 10: Accounting System and EVMS Actual Costs Interface Illustration

Benefits to Project Management

The establishment of a valid comparison of planned costs for completed work with the actual costs for that same work provides the basis for realistic evaluation of cost deviations and ultimately facilitates estimate at completion (EAC) projections.

Scalability

At a minimum, a small project should collect and report actual direct costs at the control account level by WBS. If internal management or the customer requires information by OBS element, then the cost collection structure should also support this requirement (see Section 1.1).

In instances where the accounting system used by a small project's supplier does not accommodate cost collection at the control account level, estimated actuals could be used for analyzing and reporting current performance, followed by subsequent reconciliation with actual costs on a regular basis. In the absence of a formal accounting system, a financial spreadsheet could be used to accumulate hours, work in progress, invoices, travel and material costs, and other expenses. Rates could then be applied to determine actual costs on a monthly basis, followed by year-end reconciliation to recognize adjustments in applied rates.

Typical Products of Implementation

- Reconciliation of project costs with the accounting system
- Actual costs reported at the control account level (at a minimum)
- Reconciliation of subcontract reported actual costs to subcontract payments
- Internal and external performance reports for suppliers
- Supplier control account plans, when used

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Execute the Work Plan and Record All Costs.[25]

4.2 Establishing a Cost Collection Structure to Support Management Requirements (Guidelines 17, 18)

Primary Guideline	Guideline 17 – Summarize Direct Costs by WBS Elements
Secondary	1, 3, 5, 16, 21, 22, 25, 27, 28, 29, 30
Primary Guideline	Guideline 18 – Summarize Direct Costs by OBS Elements
Secondary	2, 3, 5, 11, 16, 21, 22, 25, 27, 28, 29, 30

The performance information generated by the EVMS, using actual costs collected from the accounting system, supports both internal and external management in the execution of the project. This cannot be accomplished without associating the accounting charge numbers with the coding structure established in the organizing process. The costs from the accounting system should be integrated into the EVMS to support management reporting at the control account level.

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[25] GAO Cost Estimating and Assessment Guide, page 230.
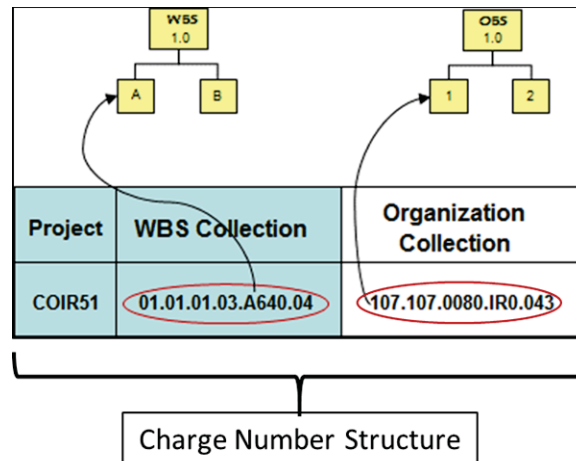
Figure 11: Charge Number Structure Illustration

Benefits to Project Management

Ensuring the accurate summarization of accounting system data provides the project team with timely and auditable information to make effective management decisions.

Scalability

Regardless of project size, the direct costs in a control account must summarize into only one higher-level WBS element and one OBS element. However, if the accounting system is not capable of capturing costs at the control account level, then a separate mapping of cost collection accounts should be developed to ensure data integrity of the summarized information. To reduce administrative costs, consider summarizing the costs from the accounting system to the control account level before importing the data into the EVMS. If lower level cost visibility is needed on occasion, a detail report can be produced from the accounting system.

Typical Products of Implementation

- Cost collection account structure
- WBS/OBS cost collection mapping
- WBS/OBS (roll-up scheme)
- Management performance reports

4.3 Collecting Actual Unit/Lot Cost for Deliverable Items (Guideline 20)

Primary Guideline	Guideline 20 – Identify Unit and Lot Costs
Secondary	1, 2, 3, 16, 17, 18, 19, 27, 28

On projects with multiple units required for delivery to the customer, it may be necessary to determine the cost of each unit or for a group of units (lot). This information is useful when there is a potential for future procurements of the same item, when there are multiple customers for the units being delivered, or when there are multiple suppliers of the deliverable units to the customer. If this information is required, either by the customer or internal management, the contractor must have a system (accounting, material, or other) that supports the collection of this information.

Benefits to Project Management

The project is able to identify unit and lot costs for the flexibility to plan, measure performance, and forecast.

Scalability

Typically, this guideline does not apply for a small project in a non-manufacturing environment. When the guideline does apply, a small project should have the capability through its charge number structure to isolate unit costs or equivalent unit costs. Isolation of these costs could be accomplished by using a financial spreadsheet that is separate from the accounting system, and should be able to differentiate between completed units and work-in-process. A logical average-cost methodology could also be employed after a number of units are in progress or have been completed.

Products of Implementation

- Project cost collection structure
- Enterprise requirements planning (ERP) system supports the identification of unit costs, equivalent unit costs, or lot costs when needed, including differentiation of work in process.

5 Process 5: Managing Using Project Performance Information

As the work scope on the project is completed and resources consumed in achieving progress, the output of the EVMS reflects that progress and whether the project is meeting schedule and budget objectives. As the project deviates from the established performance measurement baseline, management must evaluate these deviations (variances), both positive and negative for the current reporting period and cumulative to date, and determine the impact on future project execution. Projects typically define variance thresholds that are used to determine what is considered to be a significant variance.

This process also includes an evaluation and update of the project estimate at completion (EAC). If necessary and possible, actions must be taken to bring the project back to within acceptable schedule and cost parameters.[26]

5.1 Providing Performance and Cost Variances for Project Analysis (Guideline 22)

Primary Guideline	Guideline 22 – Calculate Schedule Variance and Cost Variance
Secondary	1, 2, 3, 5, 7, 9, 16, 23, 30

At the end of each reporting cycle, the responsible managers, at the control account level, assess the status of in-progress work and determine the appropriate value to be "earned" based on the earned value technique established when planning the effort. The EVMS calculates the earned value or budgeted cost for work performed (BCWP). The earned value is compared to the value that was originally budgeted for that work – the budgeted cost for work scheduled (BCWS) and the actual cost of work performed (ACWP).

This comparison results in a dollarized schedule variance (SV) that represents the value of work completed on, behind, or ahead of schedule. A dollarized cost variance (CV) is also calculated to determine whether the value of the work completed is equal to, above, or below the actual costs for completing the planned work. These values can be calculated for the current reporting period and cumulative to date.

The two variance formulas are:

$$Schedule\ Variance\ (SV) = BCWP - BCWS$$

$$Cost\ Variance\ (CV) = BCWP - ACWP$$

A variance at completion can also be calculated to determine whether the budget at completion (BAC) is equal to, above, or below the estimate at completion (EAC). The formula is:

$$Variance\ at\ Completion\ (VAC) = BAC - EAC$$

Benefits to Project Management

The monthly analysis of deviations from the plan for both schedule and cost provides management at all levels the ability to rapidly and effectively implement corrective actions to accomplish the project objectives with an understanding of the risks to the project and the root cause of the risk.

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[26] For additional discussion on managing using project performance information, see the GAO Cost Estimating and Assessment Guide, Chapter 19, Managing Program Costs: Execution, beginning with the Monthly EVM Analysis section on page 255. Also see the NDIA IPMD Guide to Managing Programs Using Predictive Measures.

Scalability

Small projects are responsible for ensuring that schedule and cost analyses are performed at the end of each reporting cycle and variances are identified that have tripped internal or external thresholds (SV, CV, VAC). Scaling can be accomplished by revising thresholds for a small project and by establishing external and internal variance analysis requirements that are at different WBS levels based on high cost, schedule drivers, or project risk. Additionally, focusing on cumulative variances only (not current period) and focusing on only the most important variances, can also reduce the administrative impact on the project.

Typical Products of Implementation

- Variance analyses (cost-based schedule variance, cost variance, and variance at completion)
- Management action plans
- Updated schedule task completion and cost at completion forecasts
- Project schedules and schedule analysis outputs

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Analyze EVM Performance Data and Record Variances from the Performance Measurement Baseline Plan.[27]

5.2 Analyzing Significant Variances (Guideline 23)

Primary Guideline	Guideline 23 – Identify Significant Variances for Analysis
Secondary	1, 2, 3, 5, 6, 7, 9, 22, 26, 30

Establish reasonable selection criteria for what is considered to be a significant variance to avoid creating an excessive burden on the control account manager and mid-level managers. Performing the required data analysis on significant variances can be accomplished by using meeting notes, minutes, or other material generated as a normal function of the management process. The selection criteria should ensure all significant variances are analyzed and any external reporting requirements are supported.

Example approaches for establishing significant variance thresholds and data analysis formulas include:

- Variance thresholds that are based on:
    - Criticality;
    - Project risk;
    - Size (dollar value or percentage);
    - Customer reporting requirements.

- Data analysis formulas such as:
    - Schedule variance percentage (SV %) or cost variance percentage (CV %);
    - Schedule performance index (SPI) or cost performance index (CPI);
    - Percent complete versus percent spent;
    - Trend analysis.

Once a significant variance has been identified, it should be analyzed to show the causal effects of the variance along with an accurate assessment of projected future cost impacts. For

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[27] GAO Cost Estimating and Assessment Guide, page 230.

example, in analyzing schedule variance, the earned value generated by the EVMS should be compared to the current schedule to determine whether they correlate and whether there is an impact to the critical path.

The analysis of the cost variance should include the various cost element components of the variance. This includes labor variance analysis, material variance analysis (Process 7), and indirect costs analysis (Process 9).

The formulas used for the direct cost labor rate and efficiency cost variance analysis are:

$$Labor\ Rate\ Variance = (BCWP\ Rate - ACWP\ Rate)\ x\ ACWP\ Hours$$

$$Labor\ Efficiency\ Variance = (BCWP\ Hours - ACWP\ Hours)\ x\ BCWP\ Rate$$

An example application of these formulas is shown in the following table.

Labor Rate and Efficiency Cost Variance Analysis					
	Hours	Labor Rate	Cost Value	SV	CV
BCWS	100	$75	$7,500		
BCWP	40	$75	$3,000		
ACWP	75	$85	$6,375		
				- $4,500	- $3,375
Rate Variance = ($75 – $85) x 75 hours					- $750
Efficiency Variance = (40 – 75) x $75					- $2,625
Total Cost Variance = Rate Variance + Efficiency Variance					- $3,375

Figure 12: Labor Rate and Efficiency Cost Variance Analysis

Rate variances are rarely recoverable. Management actions can include using less expensive labor categories or reducing the number of hours of the more expensive labor categories. Efficiency variances may not represent recurring instances of the level of performance and should be evaluated in this light. The ability to reduce efficiency variances can also contribute to reducing the impact of rate variances. The results of these analyses should be applied to the EAC update.

Benefits to Project Management

The monthly analysis of deviations from plan for schedule and cost provides management the ability to implement corrective actions rapidly and effectively. The results provide a better understanding of the risks to the project and the root causes of that risk in meeting the project objectives.

Scalability

Scaling could be accomplished by:

- Revising the variance thresholds for a small project,
- Establishing external and internal variance thresholds at different WBS levels based on the top cost and schedule drivers or risk factors,
- Generating and reporting on cumulative variances only (not current period),
- Analyzing only the most important variances not driven by the variance thresholds,

- Increasing the dollar value and/or percentage,
- Using both a dollar value and a percentage (compound conditional),
- Using looser thresholds during execution and tighter thresholds at completion, and
- Setting the dollar threshold for a control account as a variable based on one month's worth of work for that control account.

Typical Products of Implementation

- Variance analysis (cost and schedule variances)
- Management action plans
- Schedule and cost at completion forecasts
- Project schedules and schedule analysis outputs

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Analyze EVM Performance Data and Record Variances from the Performance Measurement Baseline Plan.[28]

5.3 Preparing Summarized Information for Management Evaluations (Guideline 25)

Primary Guideline	Guideline 25 – Summarize Performance Data and Variances for Management
Secondary	1, 2, 3, 15, 17, 26, 27, 28, 29, 30

For each reporting cycle, performance measurement information is developed at the control account level at a minimum, and summarized in a series of data views, reports, charts, and graphs for different levels of the WBS and OBS. This integration of system data and its subsequent roll up and reporting are significant elements of information feedback essential to effective management and control. For the PM and intermediate levels of management, this summarized information focuses on variances that may require broader corrective actions at a higher level than the control account level.

Benefits to Project Management

Variance analyses provide an understanding of current status of project performance, allowing the PM to properly allocate available resources to mitigate project risk and take appropriate corrective actions. Variances also identify significant problem areas generated from all levels of the organization and WBS, and provide valuable management information for decision making.

Scalability

Small projects, based on the WBS and OBS, can focus on summarized information at the project level for analysis and corrective action implementation. As the project size increases, the level of management attention should also increase to levels lower than the project level, and will require intermediate managers to evaluate the impact of variances on portions of the project as well as coordinate corrective actions across the project.

Typical Products of Implementation

- Variance analyses
- Schedule and cost performance reports

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[28] GAO Cost Estimating and Assessment Guide, page 230.

- Management action plans
- Updated schedule and cost forecasts
- Risk and opportunity management plans

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Analyze EVM Performance Data and Record Variances from the Performance Measurement Baseline Plan.[29]

5.4 Determining and Implementing Appropriate Corrective Actions (Guideline 26)

Primary Guideline	Guideline 26 – Implement Corrective Actions
Secondary	2, 5, 23, 25, 27, 29, 32

The results of variance analysis provide an understanding of how and why variances from the plan occur. The analyses should lead to the implementation of actions that correct or mitigate the effect of the variances on the future plan for the project. These actions, once approved and implemented, should be monitored for progress and completion. Figure 12 provides an example of a correction action log.

Date Entered	No.	Activity Description	CAM	CA #	Disposition	Disp. Date
04/29	1	Contact S/C for revised ETC.	J. Smith	16L450.50	Received ETC.	06/10
05/05	2	Hire Technician for additional testing rqmts.	L. Wilson	09A475.30	Hired.	06/05
05/05	3	Resolve interface problem with NUBS.	I.M. Smart	21A640.10	Working with customer.	
05/05	4	Retest Work Station 1	J.J. Jones	34X120.20	Retest copmplete. Successful.	06/01
05/15	5	Integrate new COTS s/w.	I.M. Smart	21A640.30	Integrated.	11/20
05/29	6	Resolve test plan issue w/customer.	B. Homer	44M565.50	Working.	

CORRECTIVE ACTION LOG

Figure 13: Example Corrective Action Log

Benefits to Project Management

Early identification of problems permits management to react in a timely fashion. The more timely and more accurate the data and its analysis are, the better the management decision-making will be. When the project management team has identified the root cause of the variance, corrective action plans can be executed to mitigate significant variances and any negative trends impacting project performance.

Scalability

Regardless of project size, effective project management requires executing corrective action plans (whether formal or informal) and mitigating issues as soon as they are identified, and tracking their resolutions to closure.

By identifying corrective actions at the previously established control account or intermediate levels, the overall impact on project resources of implementing and tracking these actions to conclusion is reduced.

Typical Products of Implementation

- Variance analyses

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[29] GAO Cost Estimating and Assessment Guide, page 230.

- Independent completion estimates
- Risk and opportunity management data and similar metrics
- Management action plans and review briefings

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Analyze EVM Performance Data and Record Variances from the Performance Measurement Baseline Plan.[30]

5.5 Evaluating and Updating Estimates of Project Costs (Guideline 27)

Primary Guideline	Guideline 27 – Maintain Estimate At Completion (EAC)
Secondary	5, 8, 9, 10, 14, 16, 19, 21, 23, 24, 26, 28, 29, 30

Periodically, every project should develop a comprehensive estimate of total project costs – the estimate at completion (EAC). This is normally accomplished at the control account level by:

1. Evaluating the efficiency achieved by performing organizations for completed work and comparing it to the complexity of the remaining efforts;

2. Establishing a schedule forecast that reflects the expected time frame for completing the remaining work;

3. Considering all remaining risk areas on the project versus cost avoidance possibilities;

4. Ensuring the most current rate structure is used to value the projected resource requirements; and

5. Summarizing the results to derive the most accurate estimate.

Benefits to Project Management

To effectively manage the project, the ability to make accurate and timely forecasts of the final cost is required. Accurate and timely forecasts ensure continuing visibility into resource needs and lead to project success for both the customer and the supplier. They also support the customer's ability to provide sufficient funding to the project and enhance internal management's visibility into critical resource requirements.

Scalability

Regardless of size, projects should generate performance to date data at the control account level. With this data, EACs are produced on a regular basis for the remaining work at or below the control account level, taking into account future schedule, cost, risk, and resource requirements. These estimates should be summarized up through the WBS and the OBS to the project level for management visibility and control. All performance to date data should be consistent with the reporting requirements established at the outset of the project or contract.

Scaling, as with previous requirements, is first achieved through limiting the depth and breadth of the WBS, which reduces the number of control accounts requiring EAC updates. Further scaling can be achieved by reducing the frequency of developing EACs, for example, quarterly at the control account level. The total project EAC using a bottom-up estimating approach should be completed semi-annually or annually depending on the risk and duration of the project. Finally, limiting the amount of required supporting documentation reduces the

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[30] GAO Cost Estimating and Assessment Guide, page 230.

administrative burden of this activity. Reporting the results of EAC updates is done as required by internal procedures and external contractual requirements.

Typical Products of Implementation

- Basis of estimate
- Risk and opportunity management plans
- Operational metrics
- EV metrics
- Performance data specific to the elements of cost such as labor (see Section 5.2) and material (see Section 7.5)
- Updated schedule and cost at completion forecasts

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Forecast Estimates at Completion Using EVM.[31]

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[31] GAO Cost Estimating and Assessment Guide, page 230.

6 Process 6: Incorporating Approved Changes into the Project

Once a project has been planned and execution of the effort started, there will be changes to the original plan to compensate for the realities of both external and internal impacts on the project. These changes can occur based on customer decisions relative to content, schedule, or the ability to provide funds for the estimated cost to complete the project. There can also be internal changes resulting from management decisions concerning the path forward as well as the need to mitigate risks or take advantage of opportunities during the life of the project. Necessary changes must be approved and made in a timely manner to maintain the validity of the baseline plan for future efforts.

6.1 Making Changes to Project Plans and Budgets (Guideline 28, 29)

Primary Guideline	Guideline 28 – Incorporate Changes in a Timely Manner
Secondary	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 27
Primary Guideline	Guideline 29 – Maintain Baseline and Reconcile Budgets
Secondary	1, 2, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 17, 18, 21, 25, 27, 28

Customer-directed changes to the project's performance measurement baseline can impact all aspects of the internal planning and control system, including the organization structures, work authorizations, budgets, schedules, and EACs. External changes can be of two types:

- Fully negotiated changes where scope, schedule, and price (cost plus profits/fees) have been mutually agreed upon by both customer and supplier. In this case, the negotiated value is added to the baseline total and the work scope is planned using normal, internal processes.

- Authorized unpriced work (AUW) where negotiations continue while the execution of authorized work scope begins. The value of the AUW is the value of the scope coordinated between the supplier and customer. The initial value added to the plan is typically the project's initial estimate of expected costs where only the near-term effort is planned at the control account level until the work effort is fully negotiated and finalized with the customer. The remaining effort (work scope and budget) may be held in undistributed budget or in a summary level planning package (SLPP) until negotiations are completed.

Internal replanning decisions can also result in changes to the performance measurement baseline. This includes actions such as control account replanning, planning package conversion, or the issuance of management reserve for unforeseen scope growth within the contract SOW or technical issues. Internal replanning may be required in response to specific conditions related to the elements of cost. Examples include:

- Changes in labor hours, skill mix, or rates: A number of factors can drive changes in the time-phasing of labor hours such as work occurring earlier or later than planned, issues with securing the necessary resources when needed causing the work effort to be extended, a different mix of resources with higher or lower labor rates than planned, or the temporary use of expert resources to resolve an issue.

- Changes in material items or quantities: As the project progresses, design improvements, advances in material technologies, or price changes can cause the original bill of material (BOM) to be updated. A change in make or buy decisions can

also impact the project. See Process 7 for additional discussion on managing project material items.

- Changes to subcontractor scope of work: Similar to the changes for material items, as the project progresses, design improvements, advances in technology, or price changes can cause the subcontract scope of work to require updating. See Process 8 for additional discussion on managing subcontracted work effort.

Regardless of the source of the changes, incorporating authorized changes should be made as quickly as possible and strictly controlled. This ensures the PMB is accurately maintained.

Benefits to Project Management

A properly maintained PMB is crucial to effective project management. The timely and accurate incorporation of contractual changes as well as internally driven changes to the PMB ensures that the information generated from the execution of the baseline plan continues to provide an accurate picture of project progress and supports management decision making.

Scalability

Regardless of project size, projects should incorporate all approved internal and contractual changes to the PMB in a documented, disciplined, and timely manner. For scaling purposes, a small project's use of informal documentation, such as a financial spreadsheet or other electronic media, to capture changes to scope, schedule, and budget is acceptable. Reducing or streamlining the number and level of approvals required on baseline change documentation can also facilitate timely approval and change incorporation into the PMB.

Typical Products of Implementation

- Contractual/internal change documents
- Subcontract change documentation
- Change control log
- Project control logs showing the contract budget base (CBB), PMB, MR, and UB along with record of changes
- New or revised control account, work package, or planning package plans
- Revised master, intermediate, and detail level schedules
- Updated SOW, WBS, and WBS Dictionary
- New or revised work authorization documents

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Update the PMB as Changes Occur.[32]

6.2 Maintaining Correlation for Approved Project Values (Guideline 30)

Primary Guideline	Guideline 30 – Control Retroactive Changes
Secondary	16, 17, 18, 19, 21, 22, 23, 24, 25, 27

One of the key elements of an EVMS implementation is the relationship between the value established for the project baseline plan and the customer authorizing document such as the contract, task order, or internal company authorization. Internal adjustments to plans for future

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[32] GAO Cost Estimating and Assessment Guide, page 231.

actions are a normal management process as project execution proceeds and situations change.

It is important to ensure the overall project scope, schedule, and budget baselines as well as retroactive changes are properly controlled to maintain the integrity of project performance data. Typically, retroactive changes are only allowed for routine accounting adjustments, customer approved contract actions, rate changes, economic price adjustments, or to correct errors. As long as both parties to the project recognize the same "target" value for the project, then the performance measurement data provided by the EVMS will continue to support management actions based on its analysis.

Benefits to Project Management

Controlling retroactive changes is imperative because they could arbitrarily eliminate or create cost or schedule variances and thus degrade the usefulness of the performance measurement data.

Scalability

All changes to authorized work, schedule, or budget must be traceable to the original baseline, regardless of project size. In small projects, change control documentation can be simplified by using a single document, such as a financial spreadsheet or other informal electronic media, which includes, at a minimum, sections for the contract budget base (CBB), performance measurement baseline (PMB), management reserve (MR), undistributed budget (UB), and estimate at completion (EAC).

Typical Products of Implementation

- Change control log
- Project control logs showing the contract budget base (CBB), PMB, MR, and UB along with record of changes
- Retroactive change control process, including approval

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Update the PMB as Changes Occur.[33]

6.3 Establishing Procedures for PMB in Excess of Authorized Project Value (Guideline 31)

Primary Guideline	Guideline 31 – Prevent Unauthorized Changes
Secondary	8, 15

One benefit of a disciplined change control process is it helps to ensure a project is being managed using performance measurement data that reflects the authorized contractual scope of work. The process is used to verify the total allocated budget (TAB) does not exceed the contract budget base (CBB) which is a controlled, authorized project value. Unauthorized revisions to the baseline could inadvertently result in baseline budgets or schedules that exceed the CBB.

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[33] GAO Cost Estimating and Assessment Guide, page 231.

As discussed in Sections 6.1 and 6.2, replanning remaining work effort, whether customer-directed or in response to internal management decisions to complete the work effort, is a normal activity for all projects to accurately maintain the PMB.

The exception to this is situations where the available budgets for the remaining work are insufficient for the successful execution of the current plan. The current plan is unrealistic or cannot be executed to complete the scope of work and the PMB no longer provides meaningful cost and schedule performance data.

In these situations, it may be appropriate to establish a new baseline that permits an increase to the amount of budget, and where applicable, extend the project completion date. When the total allocated budget to complete the work exceeds the recognized contract budget base (the authorized project value), this is referred to as an over target baseline (OTB). When the planned completion date extends beyond the contractual period of performance, this is referred to as an over target schedule (OTS). This is illustrated in Figure 13.
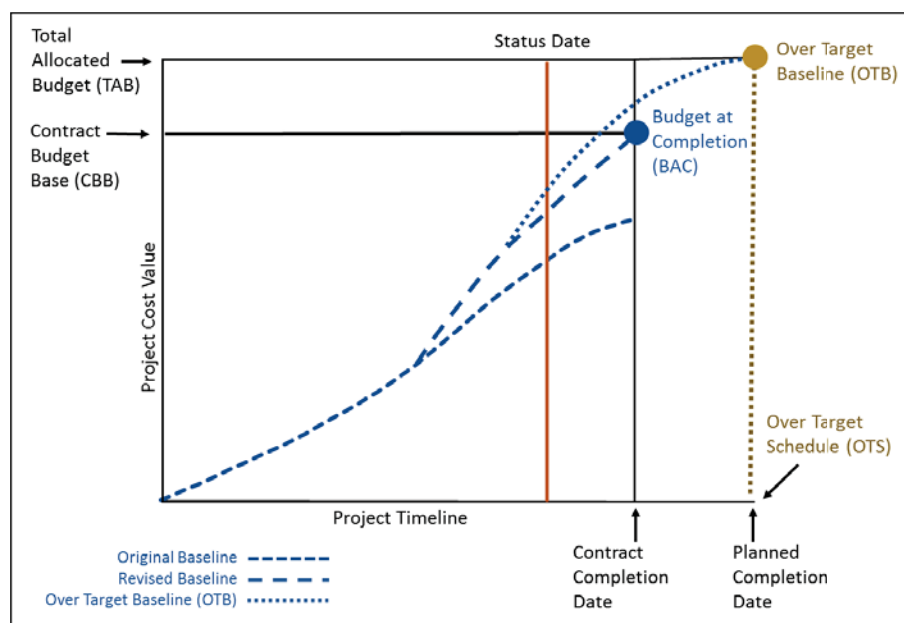
Figure 14: Over Target Baseline and Over Target Schedule Illustration

A replanning process is executed to establish a more realistic plan to manage and complete the remaining work as well as to measure performance. This is referred to as formal replanning as it is a more extensive replanning effort that requires internal management and the customer to have a common understanding of why the replanning is required and the impact on performance measurement metrics. At a minimum, customer notification of the formal replanning is required. For higher risk projects, or projects with more customer involvement or oversight, customer approval may be required.

The new baseline budget plan should be based on a comprehensive estimate of the resources required to finish the project scope, valued at future expected rates and factors, and time-phased in accordance with the new baseline project schedule.

When the replanning is completed for the remaining work, this over target baseline and, where applicable, the over target schedule, is used for determining cost and schedule progress as well as forecasting future completion dates and costs.

Benefits to Project Management

To maintain a valid PMB, avoid changes made outside the authorized baseline control processes which compromises the integrity of performance trend data and delays visibility into overall project variance from plan, thus reducing the alternatives available to managers for project redirection or revisions. The use of a mutually recognized OTB/OTS, which impacts past performance data, ensures future data provides visibility in project progress and supports effective management decisions.

Scalability

The need to execute formal replanning may not apply for small or short duration projects with minimal risk.

In situations where the decision is made to proceed with an OTB/OTS, small projects could limit the impact of the process on the project by evaluating resource needs at a high WBS level, based on lower-level inputs for establishing the new plan.

Typical Products of Implementation

- Contractual/internal change documents and change control log
- Project control logs showing the contract budget base (CBB), PMB, MR, and UB along with record of changes
- New or revised control account, work package, or planning package plans
- Revised master, intermediate, and detail level schedules
- Updated SOW, WBS, and WBS Dictionary
- New or revised work authorization documents
- Revised management performance reports

7 Process 7: Managing Project Material Items

The term "material" includes any property incorporated into or attached to an end item to be delivered under a contract. Material also consists of any property consumed in the performance of a contract. Material includes raw and processed items, manufactured parts and equipment re purchased in accordance with specifications, or small common items held in inventory. It may also include purchased services. Material can be associated with engineering effort such as design and testing or with the production of deliverable hardware.

Material is normally purchased from outside vendors but it may also be supplied by other divisions of the contractor's company. For interdivisional transfers of material, a contractor's material control system should have formal procedures that address dollar value thresholds for material transfers and provisions pertaining to profit for performing organization material transfers.

Small projects typically do not involve the delivery of multiple units of the same product; i.e., manufacturing or production. Hence, many of the concepts that apply to manufacturing or production contracts are not covered in this document.

Note: The GAO Cost Estimating and Assessment Guide does not specifically address EVM for material.

7.1 Identifying all Material Items Required to Execute the SOW (Guideline 1)

Primary Guideline	Guideline 1 – Define Work Scope (WBS)
Secondary	3, 5, 6, 8, 15, 16, 17, 20, 21, 22, 23, 25, 27, 28

The control account budget for material items should be based on defined/expected quantities of material items necessary to meet the requirements of the project. Material budget planning begins with the development of a projected materials list or bill of materials (BOM) during the proposal phase. In the case of a development effort, this may be the offeror's "best guess" of material requirements based on similar procurements or customer information provided in the proposal request. On projects where an approved design exists, the BOM is based on the parts list associated with the design factored by the number of units to be built. The BOM should be structured in such a way as to identify specific material items to the WBS work scope where they will be consumed.

Benefits to Project Management

The early and accurate identification of project material requirements leads to greater stability in the resource budgeting process and establishing realistic lead times for critical and long-lead material items.

Scalability

Scalability of this activity is dependent on the WBS that was prepared in Process 1. A review of the work scope for each of the lowest level WBS elements should reveal the types and quantities of material items needed to complete the work effort. This process should be supportive of creating the BOM for the project.

Typical Products of Implementation

- Project BOM
- Material requirements by WBS

7.2 Scheduling Material Requirements (Guideline 6)

Primary Guideline	Guideline 6 – Schedule the Work
Secondary	1, 2, 3, 7, 8, 10, 22, 23, 26, 28, 29, 32

Material schedules should be planned according to the engineering development or production schedule. Detail scheduling is done in terms of a "set back" schedule where "need-by" dates are established, and the time needed for delivery and ordering are set back from the time the material is required to complete work requirements. This set-back time must also take into account the lead time for the material item to be procured. This is the time between purchase order issuance and material delivery and may vary from several days to several years depending on the type of material involved. See Figure 14.

ID	Task Name	Duration	Start	Finish
1	User Need Date	1 day	Tue 3/31/15	Tue 3/31/15
2	**Material Required**	43 days	Thu 1/29/1!	Mon 3/30/1
3	Purchase Request Processir	5 days	Thu 1/29/15	Wed 2/4/15
4	Purchase Order Processing	5 days	Thu 2/5/15	Wed 2/11/1
5	Material Delivery Time	30 days	Thu 2/12/15	Wed 3/25/1
6	Receipt and Acceptance	2 days	Thu 3/26/15	Fri 3/27/15
7	Deliver to User	1 day	Mon 3/30/1	Mon 3/30/1

Figure 15: Scheduling Material Requirements Illustration

Benefits to Project Management

As with the identification of required types and quantities of labor resources, the need to accurately identify material requirements and ensure they are available when needed, as well as supports project objectives and accurate analysis of project status.

Scalability

An approach to reduce the amount of time and effort expended on managing material items is to acquire all needed material items early in the project and maintain them in a dedicated storage area. This approach, however, should only be taken when material requirements are firmly established and confirmed.

Typical Products of Implementation

- Integrated master schedule
- Control account plans containing material requirements

7.3 Establishing Budget Values for Material Items (Guideline 10)

Primary Guideline	Guideline 10 – Determine Discrete Work and Objective Measures
Secondary	2, 6, 7, 8, 9, 11, 13, 22, 27, 28, 29, 32

The establishment of material work packages or planning packages for development material and production material can differ significantly. For development, most material is consumed by the engineering organizations in the design and testing of potential hardware items. The budgets for these work packages or planning packages should be substantiated and segregated in some manner to ensure that budget designated for material procurement is not inadvertently used for other requirements. In the event a small project has a requirement to produce multiple

copies of the product, an assembly-line environment exists and the normal factory planning process would be used. Material requirements scheduling must support the factory schedule for producing the items.

Benefits to Project Management

Identification of material items in separate work packages enhances visibility into their status and ensures they are time-phased in support of user requirements.

Scalability

These material work packages may be established within the same control account as the labor work packages that will consume the material. Planning packages should be established for development material items when design work has not progressed sufficiently to permit adequate definition of parts required. Where a Manufacturing/Enterprise Resource Planning (M/ERP) system is used, the work packages and planning packages should be established at a higher level to avoid unnecessarily duplicating the M/ERP details in the IMS.

Typical Products of Implementation

- Control account plans with work packages and planning packages established for the different categories of cost elements such as labor and material
- Control account schedules
- Control account time-phased budgets

7.4 Ensuring Accounting System Interface Supports Project Management Needs (Guideline 21)

Primary Guideline	Guideline 21 – Track and Report Material Costs and Quantities
Secondary	1, 2, 3, 5, 9, 10, 12, 16, 17, 18, 20, 22, 23, 27, 30

Acceptable costing techniques should be used to fully account for all material purchased for the project. The accounting system should ensure accurate cost accumulation which assigns material costs to the appropriate control accounts in a manner consistent with the budget. Actual costs for material items should be reported in the same accounting period that EV is taken for the material to facilitate management analysis.

When actual costs are not available in a timely manner, enter accounting accruals and/or estimated actual costs for the material item in the EVMS and make adjustments in the EVMS when actual costs are recorded later in the accounting system.

Benefits to Project Management

Having the actual cost for material items available in the same accounting period as the EV information establishes a valid comparison of the value of the planned work completed versus actual costs and supports estimates of future cost for similar activities.

Scalability

For small projects, assignment of these costs to control accounts could be accomplished using a financial spreadsheet that is separate from the accounting system, with costs recorded at point of receipt (acceptance), or point of stock (inventory), or point of issue to work-in-process (consumption), and taking into consideration residual or scrap inventory.

Small projects should define a material planning and control approach that differentiates high value/critical material from low value/non-critical material. The high value/critical material

should be planned and tracked with greater rigor than low value/non-critical material. Scaling could also be accomplished by planning and tracking low value/non-critical material in a single control account.

Typical Products of Implementation

- Material system reports
- Material cost reconciliation to accounting records

7.5 Providing Performance and Cost Variances for Project Analysis (Guideline 23)

Primary Guideline	Guideline 23 – Identify Significant Variances for Analysis
Secondary	1, 2, 3, 5, 6, 7, 9, 22, 26, 30

Budgets should be scheduled in accordance with how the work is planned to be executed and earned as work is accomplished. Budget is earned using an acceptable definition of point of material usage such as the point of receipt (acceptance), point of stock (inventory), or point of issue to work in progress (consumption). To avoid distortion, actual costs should be recorded/reported when the budget is earned. Analysis of variances for material accounts should focus on significant concerns such as high value or critical material items. This may include usage incurred above or below the normal or exact quantities plus normal attrition amounts, as well as variances in the expected price of the material.

The formulas used for material price and usage cost variance analysis are:

$$Material\ Price\ Variance = (BCWP\ Unit\ Price - ACWP\ Unit\ Price)\ x\ ACWP\ Quantity$$

$$Material\ Usage\ Variance = (BCWP\ Quantity - ACWP\ Quantity)\ x\ BCWP\ Unit\ Price$$

An example application of these formulas is shown in the following table.

Material Price and Usage Cost Variance Analysis					
	Quantity	Price	Cost Value	SV	CV
BCWS	100	$212	$21,200		
BCWP	40	$212	$8,480		
ACWP	42	$210	$8,820		
				- $12,720	- $340
Price Variance = ($212 – $210) x 42					$84
Usage Variance = (40 – 42) x $212					- $424
Total Cost Variance = Price Variance + Usage Variance					- $340

Figure 16: Material Price and Usage Variance Analysis

Price variances are rarely recoverable and management actions could be to find other sources for subsequent procurements of the material items. Quantity variances may not represent recurring instances of the level of performance and should be evaluated in this light. The ability

to reduce quantity variances will also contribute to reducing the impact of price variances. The results of these analyses should be applied to the EAC update.

Benefits to Project Management

The monthly analysis of deviations from plan for material items – schedule as well as price and usage cost variances provide management at all levels the ability to rapidly and effectively implement corrective actions to accomplish the project objectives.

Scalability

Scaling could be accomplished by:

- Revising the variance thresholds for a small project,

- Establishing external and internal variance thresholds at different WBS levels based on the top cost and schedule drivers or risk factors,

- Generating and reporting on cumulative variances only (not current period), and

- Analyzing only the most important variances not driven by the variance thresholds.

Typical Products of Implementation

- Variance analyses (cost and schedule variances)
- Management action plans
- Schedule and cost at completion forecasts
- Project schedules and schedule analysis outputs

7.6   Determining and Implementing Appropriate Corrective Actions (Guideline 26)

Primary Guideline	Guideline 26 – Implement Corrective Actions
Secondary	2, 5, 23, 25, 27, 29, 32

Based on the results of variance analysis for material items, corrective actions are relatively simple. If material items are late and are impacting deliveries, then efforts to expedite subsequent material deliveries must be taken. If material items are costing more than planned, then actions may involve finding a second, less expensive source.

See Section 5.4 for the related discussion on project management benefits, scalability, and typical implementation products.

7.7   Evaluating and Updating Estimates of Project Costs for Material (Guideline 27)

Primary Guideline	Guideline 27 – Maintain Estimate at Completion (EAC)
Secondary	5, 8, 9, 10, 14, 16, 19, 21, 23, 24, 26, 28, 29, 30

Information relative to price and usage variances should be used to support an update to the EAC. This provides timely notification to management of expected/incurred price changes, which may affect future costs on the current project, as well as future procurements. On production contracts, the evaluation of excess usage can lead to identification of increased material requirements needed to maintain the production line at optimum capacity and to meet the contractual requirements.

See Section 5.5 for the related discussion on project management benefits, scalability, and typical implementation products.

8 Process 8: Managing Subcontracted Work Effort

Subcontractors often perform a significant portion of a project. Subcontract arrangements are generally with other companies but may also include other organizational entities within the prime contractor's company. For this process, the term "subcontractor" also refers to inter-divisional work; i.e., effort performed by another profit center within the prime contractor's company. While purchased material items are off-the-shelf hardware, subcontracts generally involve one or more of the following elements:

- Design and development
- Manufacturing effort
- Requirement to meet a performance specification
- A defined SOW
- Substantial technical, schedule, or cost risk

A subcontract procurement requires more comprehensive management techniques for schedule and technical control than do bill of material (BOM) items. Because of this, the application of EVM to a subcontracted effort can require unique process implementations.

From an EVM perspective, a distinction must be made between subcontractors considered to be "major" – those delivering critical, high-risk, or high-dollar items to the project, or "minor" – those that do not meet the definition of a major subcontractor.

Major subcontractors are normally expected to provide reports to the project that contain all elements of EV information in support of customer reporting requirements. This includes BCWS, BCWP, ACWP, associated schedule and cost variances, budget at completion, EAC, variances at completion, and analysis of all variances designated as significant. When a subcontractor is unable to provide these reports (for example a minor subcontractor), the project should generate this information based on information gathered by the assigned subcontract manager and/or CAM.

Note: The GAO Cost Estimating and Assessment Guide does not specifically address EVM for subcontracts.

8.1 Identifying all Subcontract Items Required to Execute the SOW (Guideline 1)

Primary Guideline	Guideline 1 – Define Work Scope (WBS)
Secondary	3, 5, 6, 8, 15, 16, 17, 20, 21, 22, 23, 25, 27, 28

All subcontracted effort must be identified to a WBS element and described in a WBS dictionary or similar document. All major subcontracted efforts should be identified in separate control accounts and the appropriate control account documentation developed.

Benefits to Project Management

The WBS is required for all projects and is used as the basic building block for the planning of all authorized work. Identifying and including subcontracted effort in the WBS facilitates tracking and reporting of these externally managed activities and provides a control framework for project management.

Scalability

Once the decision has been made to subcontract for a project requirement, and the distinction between major/critical and minor subcontractors is made, the extent of subcontractor EV

information required can be limited in the same way as the project by limiting the size or extension of the subcontractor's WBS against which reporting will be required.

Typical Products of Implementation

- WBS
- WBS Dictionary or similar document containing subcontract work definition.

8.2 Establish Subcontract Management Organizations (Guideline 2)

Primary Guideline	Guideline 2 – Define Project Organization (OBS)
Secondary	3, 5, 6, 8, 9, 10, 12, 15, 16, 18, 21, 22, 23, 25, 26, 27, 28, 29

When designating the internal organization responsible for managing subcontracted work effort, the project must assign a manager with sufficient authority and responsibility to be able to ensure the subcontractor performs to the terms and conditions of the subcontract.   Whatever arrangement the prime contractor makes, the person assigned should have all of the same responsibilities as other CAMs within the project's organization.

Benefits to Project Management

The OBS helps management to focus on establishing the most efficient organization to achieve project objectives taking into consideration the availability and capability of management and technical staff, including subcontractors, and allowing the subcontractors to report to those organizations.

Scalability

A small project could scale this requirement by establishing a single individual or team to manage all subcontracted efforts within the project. The person or team must have the requisite technical skills to effectively interface with the subcontractors and understand the support for physical progress represented by the subcontractor's BCWP information.

Typical Products of Implementation

- OBS

8.3 Scheduling Subcontractor Requirements (Guideline 6)

Primary Guideline	Guideline 6 – Schedule the Work
Secondary	1, 2, 3, 7, 8, 10, 22, 23, 26, 28, 29, 32

One aspect of schedule integration that creates unique problems is the integration of subcontractor schedule information into the prime contractor's schedule. This integration should be accomplished in a manner that provides an accurate depiction of the impact of subcontractor performance on the project's schedule.

Benefits to Project Management

Scheduling all work to be performed facilitates effective planning, statusing, and forecasting. This is critical to the success of all projects. Integrating and time phasing the technical and budget baselines result in the expected sequence of work, task interdependencies, and insight into potential schedule slippages.

Scalability

As a core process for project management, schedules are required for small projects. All elements and the level of detail of the schedule should be agreed upon by the supplier (the prime contractor) and customer; this extends to the major subcontractors performing work on the project. Limiting the WBS and OBS levels and their intersections, as previously described, also reduces the lines of detail required in the schedule.

The detail in the schedule for subcontracted work effort is ultimately a function of the in-house control accounts plans created for subcontracted effort. For subcontracted work effort, the project schedule should contain, at a minimum, the expected sequence of work, significant interdependencies between segments of work, and time-phasing of authorized measurable work at a level of detail which reflects the risk of the effort being managed.

Typical Products of Implementation

- Integrated network schedules or integrated master schedule (including subcontractor schedule information)
- Control account plans for subcontracted work effort

8.4 Establishing Subcontract Budget Values (Guideline 9)

Primary Guideline	Guideline 9 – Authorize and Budget by Cost Elements
Secondary	1, 2, 5, 8, 10, 12, 13, 19, 21, 23, 27, 28, 29, 32

The identification of budgets for subcontracted work effort is a result of establishing the requirement for the item to be procured as a subcontract rather than purchased as a material item. This involves identification of the subcontractor, the establishment of an estimated value for the subcontract, and, ultimately, negotiating the subcontract scope, schedule, and value. The project budget for the subcontract is based on the value (cost plus profit) of the subcontract, as subcontractor profit is a cost to the prime contractor.

Benefits to Project Management

Knowing the value of the subcontractor effort allows project management to assess both physical progress (scheduled work accomplishment) and the actual costs of work accomplishment (cost accumulation) for purposes of making and implementing management decisions.

Scalability

Scalability options are minimal. Whatever the subcontract value is negotiated to be is the budget that must be established for that subcontract. Tracking the subcontractor profits/fees in separate work packages would facilitate the analysis of subcontractor performance by allowing the managers to focus on cost performance.

Typical Products of Implementation

- Control account plans dividing subcontractor effort into work packages or planning packages
- Control account schedules
- Time-phased subcontract budgets at the control account level

8.5 Ensuring Accounting System Interface Supports Project Management Needs (Guideline 16)

Primary Guideline	Guideline 16 – Record Direct Costs
Secondary	1, 2, 3, 5, 17, 18, 21, 22, 27, 30

The relationship between subcontractor actual costs and what is reported in the prime contractor's accounting system is a function of the timeliness of subcontractor invoicing and prime contractor processing. Frequently there is a time delay between when the subcontractor's invoice is received and payment is processed in the prime contractor's accounting system and when earned value is taken in the EVMS.

It is not unusual for subcontractor actual costs in the prime contractor's accounting system to be significantly lower than what the subcontractor is reporting for their ACWP. It is the prime contractor's responsibility to integrate the subcontractor's data into their performance reports prepared for their customer. The prime contractor is responsible for verifying the ACWP in the subcontractor's report is current for the cost to accomplish the work represented by BCWP. When there is concern that the actual costs may be under or overstated, or there is a timing delay, then the prime contractor should utilize accounting accruals and/or create estimated actuals for reporting to the customer and reconcile the estimated actuals to the invoiced actual costs from the subcontractor.

Benefits to Project Management

Establishing a valid comparison of planned costs (BCWS) for completed subcontractor work (BCWP) with the actual costs (ACWP) for that same work provides the basis for realistic evaluation of cost deviations and ultimately facilitates EAC projections for comparison to the subcontractor's EAC.

Scalability

At a minimum, a small project should collect and report actual direct costs at the control account level by WBS. If internal management or the customer requires information by OBS element, then the cost collection structure must also support this requirement.

When the accounting system used by a subcontractor does not accommodate cost collection at the control account level, estimated actuals could be used for analyzing and reporting current performance, followed by subsequent reconciliation with actual costs on a regular basis.

In the absence of a formal accounting system, a financial spreadsheet could be used to accumulate hours, work in progress, invoices, travel and material or subcontractor costs, and other expenses. Rates could then be applied to determine actual costs on a monthly basis, followed by year-end reconciliation to recognize adjustments in applied rates.

Typical Products of Implementation

- Reconciliation of subcontract reported actual costs to subcontractor payments
- Internal and external performance reports for subcontractor performance

8.6 Providing Performance and Cost Variances for Project Analysis (Guideline 23)

Primary Guideline	Guideline 23 – Identify Significant Variances for Analysis

Secondary	1, 2, 3, 5, 6, 7, 9, 22, 26, 30

Prime contractor procedures for measuring the performance of the subcontractor must consider:

- The requirement to review the subcontractor's performance report for accuracy and adequacy. This includes an independent analysis of the performance measurement data and an evaluation of the variance analysis information contained in the report.

- Where a performance report is not submitted, the prime contractor must determine the subcontractor's progress against the internally established baseline, calculate ACWP based on accounting system actual costs or estimate the actual costs, as appropriate.

- The requirement to ensure that variances for subcontract work effort generated internally accurately reflect the subcontractor's performance and evaluation of those variances.

- The capability to incorporate the subcontractor's management information, including analysis of significant variances, into the information submitted to the customer.

During the time period between subcontract authority to proceed (ATP) and definitization, the prime contractor must make provisions to perform the above actions based on best available information.

Benefits to Project Management

The monthly analysis of deviations from plan for both major and minor subcontracts provides management at all levels the ability to rapidly and effectively evaluate subcontractor corrective actions and to provide needed assistance, if necessary, to accomplish the project objectives with an understanding of the project risk and the causes of the risk.

Scalability

Scaling could be accomplished by:

- Revising the variance thresholds for a small project,

- Establishing external and internal variance thresholds at different WBS levels based on the top cost and schedule drivers or risk factors,

- Generating and reporting on cumulative variances only (not current period), and

- Analyzing only the most important variances not driven by the variance thresholds.

Typical Products of Implementation

- Subcontract variance analyses based on schedule and cost performance
- Management action plans in support of subcontractor corrective actions
- Updated project schedules

8.7 Determining and Implementing Appropriate Corrective Actions (Guideline 26)

Primary Guideline	Guideline 26 – Implement Corrective Actions
Secondary	2, 5, 23, 25, 27, 29, 32

Based on the analysis of the subcontractor's data, the project subcontract management team or CAM can determine what types of actions are appropriate to assist the subcontractor in completing work requirements on cost and schedule. This could include providing technical

assistance, expediting material to be delivered to the subcontractor, or other actions appropriate to the prime/subcontractor relationship.

See Section 5.4 for the related discussion on project management benefits, scalability, and typical implementation products.

8.8 Evaluating and Updating Estimates of Project Costs for Subcontracts (Guideline 27)

Primary Guideline	Guideline 27 – Maintain Estimate at Completion (EAC)
Secondary	5, 8, 9, 10, 14, 16, 19, 21, 23, 24, 26, 28, 29, 30

The primary responsibility for generating subcontract estimates at completion lies with the subcontractor. Whatever the prime contractor's responsibility is for calculating and updating the project EAC, the subcontractor's EACs must be completed to support this requirement. Once completed, the project subcontract management team or control account manager must evaluate the accuracy and supportability of the estimate before it is incorporated into the prime contractor's project EAC and is submitted to both internal and external management.

Benefits to Project Management

To effectively manage the project, the ability to make accurate and timely forecasts of the final cost is required. Accurate and timely forecasts in-house and subcontracted work effort ensures continuing visibility into resource needs and leads to project success for both the customer and the supplier. Accurate and timely estimates support the customer's ability to provide sufficient funding to the project and enhance internal management's visibility into critical resource requirements.

Scalability

The subcontractor must create the subcontract EAC in accordance with their internal procedures. The project level analysis of the submitted EAC can be conducted at the subcontract level using technical knowledge of the subcontract progress and performance measurement metrics.

Typical Products of Implementation

- Basis of estimate
- Risk and opportunity management plans
- Operational metrics
- EV metrics
- Updated schedule and cost at completion forecasts

9 Process 9: Managing Indirect Budgets and Costs

This process applies to establishing, implementing, controlling, and evaluating indirect budgets and indirect costs that are incurred and allocated to the individual projects. Since indirect costs are not usually project specific, there should be some method for assigning the appropriate values for indirect budgets and indirect actual costs to all affected projects.

Indirect budgets and indirect costs should be managed and controlled. The contractor should assign responsibility for all aspects of the indirect system by designating the organizations or individuals with responsibility for:

1. Indirect budget development and assignment of resources;
2. Indirect performance and control;
3. Analysis of indirect variances (cumulative to date and at completion);
4. Indirect budget revisions; and
5. Development of indirect rate forecasts.

9.1 Identifying Functional Responsibility for Indirect Management (Guideline 4)

Primary Guideline	Guideline 4 – Identify Overhead Management
Secondary	13, 19, 24

The contractor must establish an indirect budgeting process which includes the formal assignment of duties and limits of responsibility, a description of the indirect system, and policies and procedures applicable to the establishment and control of indirect costs. Assignment and control of the indirect resources must be clearly defined and should be commensurate with the authority to approve or to avoid the expenditure of resources.

Benefits to Project Management

Visibility into direct and indirect costs is essential for successful management of a project. It is important to have a documented process and an organization established specifically to manage and control indirect costs.

Scalability

Regardless of project size, the manager with the responsibility and authority for controlling indirect costs should be clearly identified. The process for managing indirect costs, including responsibility, is typically documented in the organization's accounting procedures.

For small projects, responsibility for controlling indirect costs can be assigned to a single person, in many cases within the office of the Chief Financial Officer.

Typical Products of Implementation

- CAS disclosure statement (if applicable)
- Organizational chart
- Cost accounting activities in accordance with applicable regulatory requirements
- DCAA audits, if applicable

9.2 Ensuring Proper Allocation of Indirect Budgets in the PMB (Guideline 13)

Primary Guideline	Guideline 13 – Establish Overhead Budgets
Secondary	4, 8, 9, 10, 12, 14, 19, 24, 28, 29, 32

The performance measurement baseline should include indirect budgets. Realistic time-phased budgets and forecasts for indirect costs must be established by the responsible functional organization. The supplier should apply the most appropriate indirect rates to project direct budgets so a valid PMB containing both direct and indirect budgets can be established. Indirect budgets should be reviewed at least annually or when major changes are identified in factors affecting indirect costs.

Benefits to Project Management

The overall value of establishing indirect budgets lies in the ability of the supplier to manage cost elements that cannot be directly assigned to individual cost objectives (projects). By comparing actual indirect expenses to established indirect budgets, the supplier can determine if the absorption of indirect expense based on existing documented allocation schemes is on track or if allocation rates need to be adjusted. The accurate assignment of indirect expenses ensures that each project receives its fair share of indirect costs.

Indirect budgets play an important role in budgetary control and management of any project. Indirect costs can account for a major portion of the cost of any project. Indirect budgets must be applied, in some circumstances, to be compliant with cost accounting standards (CAS).

Scalability

A small project's indirect budget should be established in accordance with the project's direct budget, using an allocation method consistent with the manner in which actual indirect costs will subsequently be applied to the project.

Typical Products of Implementation

- Documented process for managing indirect costs (e.g., CAS Disclosure Statement)
- Indirect cost policies and procedures
- Chart of accounts
- Indirect budget and performance reports

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 18, Managing Program Costs: Planning, Develop the Performance Measurement Baseline.[34]

9.3 Providing Appropriate Allocation of Indirect Costs to Projects (Guideline 19)

Primary Guideline	Guideline 19 – Record/Allocated Indirect Costs
Secondary	2, 4, 13, 24, 26, 27, 30

Indirect costs represent expenses which benefit more than a single project. The accounting process should record all allocable indirect costs consistent with the provisions of the contractor's CAS Disclosure Statement or documented accounting procedures. The

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[34] GAO Cost Estimating and Assessment Guide, page 228.

contractor's procedures or EVMS description should specify the level at which indirect costs are allocated to individual projects.

Benefits to Project Management

Visibility into direct and indirect costs is essential for successful management of a project. It is important to have a documented process and organizations specifically assigned to manage and control indirect costs. Indirect costs are for common activities that cannot be identified specifically with a particular project or activity and should typically be budgeted and controlled separately at the functional or organization manager level.

Scalability

If the cost collection system of a small project does not segregate direct and indirect costs, the customer and the supplier may agree in advance to fixed indirect rates for the duration of the project.

In the absence of a formal accounting system, a financial spreadsheet could be used to budget, then collect or generate all indirect costs on a monthly basis, followed by year-end reconciliation to recognize adjustments in applied overheads.

Typical Products of Implementation

- Cost collection account structure
- WBS and cost collection mapping
- WBS (roll-up scheme)
- CAS disclosure statement, if applicable

GAO Best Practices

GAO Cost Estimating and Assessment Guide, Chapter 2, Why Government Programs Need Cost Estimates and the Challenges in Developing Them.[35]

GAO Cost Estimating and Assessment Guide, Chapter 15, Validating the Estimate, 3. Determine That the Estimate is Accurate.[36]

9.4 Providing Analysis of Indirect Performance to Projects (Guideline 24)

Primary Guideline	Guideline 24 – Analyze Indirect Cost Variances
Secondary	4, 13, 19, 27, 30

Indirect cost performance against budget must be analyzed at the organization level responsible for indirect cost control. Significant indirect cost variances resulting from differences between planned and actual rates should be identified, documented, and reported to the appropriate level of management. The causes of these variances must be identified and possible corrective actions considered. Corrective actions should be implemented promptly, which increases the likelihood that budget objectives will be met. The results of this analysis are supplied to the affected projects for their use in (a) reporting to their customer and (b) updating the EAC for projected indirect cost performance.

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[35] GAO Cost Estimating and Assessment Guide, page 16.
[36] GAO Cost Estimating and Assessment Guide, page 182.

Benefits to Project Management

The supplier's cost accumulation system should segregate direct and indirect cost, thus allowing for on-going indirect cost analysis, which would provide visibility into potential indirect cost overruns. Additionally, this analysis would provide the opportunity to develop and implement management corrective action plans to meet project cost and schedule objectives.

Scalability

When the cost collection system of a small project segregates direct and indirect costs, indirect cost analyses should be conducted and reported in a consistent manner. In the absence of a formal accounting system, a financial spreadsheet could be used to budget, then collect or generate all indirect costs on a monthly basis, thus allowing for generation of variance analyses.

When direct and indirect costs are not segregated on small projects, analyses should be performed in accordance with cost allocation methodologies established at the outset of the project.

Typical Products of Implementation

- Indirect cost variance analyses
- Indirect cost management action plans
- Indirect cost updated schedule and cost forecasts

Appendix A – EVMS Standard Guidelines Reference

This appendix provides reference information about the EIA-748 Standard for Earned Value Management Systems (EVMS) principles and 32 guidelines.

The EIA-748 Standard for EVMS is the copyright of SAE International. The current edition of the standard is Version D. A complete copy of the EIA-748-D Standard can be purchased from SAE International. For a complete discussion about the management value, intent, typical attributes, and objective evidence for each guideline, see the NDIA IPMD EVMS EIA-748-D Intent Guide.

Seven Basic EVMS Principles

The introduction to the EVMS Standard lists the seven principles of an EVMS.

"An Earned Value Management System (EVMS) for integrated program management will effectively integrate the work scope of a program with the schedule and cost elements for optimum program planning and control. The primary purpose of the system is to support integrated program management. The system is owned by the organization and is governed by the organization's policies and procedures. The principles of an EVMS are:

- Plan all work scope for the program to completion.
- Break down the program work scope into finite pieces that are assigned to a responsible person or organization for control of technical schedule, and cost objectives.
- Integrate program work scope, schedule, and cost objectives into a performance measurement baseline plan against which accomplishments are measured. Control changes to the baseline.
- Use actual costs incurred and recorded in accomplishing the work performed.
- Objectively assess accomplishments at the work performance level.
- Analyze significant variances from the plan, forecast impacts, and prepare an estimate at completion based on performance to date and the remaining work to be performed.
- Use the EVMS information in the organization's management processes."

EVMS Standard 32 Guidelines

Section 2 in the EVMS Standard lists the 32 guidelines and the text for each guideline is excerpted below. A short name was added to each guideline for ease of reference.

2.1 Organization		
Guideline 1 – Define Work Scope (WBS)	a)	Define the authorized work elements for the program. A work breakdown structure (WBS), tailored for effective internal management control, is commonly used in this process.
Guideline 2 – Define Project Organization (OBS)	b)	Identify the program organizational structure, including the major subcontractors responsible for accomplishing the authorized work, and define the organizational elements in which work will be planned and controlled.
Guideline 3 – Integrate Processes	c)	Provide for the integration of the company's planning, scheduling, budgeting, work authorization and cost accumulation processes with each other, and as appropriate, the program work breakdown structure and the program organizational structure.
Guideline 4 – Identify Overhead Management	d)	Identify the company organization or function responsible for controlling overhead (indirect costs).

Guideline 5 – Integrate WBS/OBS to Create Control Accounts	e)	Provide for integration of the program work breakdown structure and the program organizational structure in a manner that permits cost and schedule performance measurement by elements of either or both structures as needed.
2.2 Planning, Scheduling, and Budgeting		
Guideline 6 – Schedule the Work	a)	Schedule the authorized work in a manner which describes the sequence of work and identifies significant task interdependencies required to meet the requirements of the program.
Guideline 7 – Identify Products/Milestones for Progress Assessment	b)	Identify physical products, milestones, technical performance goals, or other indicators that will be used to measure progress.
Guideline 8 – Establish the Performance Measurement Baseline	c)	Establish and maintain a time-phased budget baseline, at the control account level, against which program performance can be measured. Initial budgets established for performance measurement will be based on either internal management goals or the external customer negotiated target cost including estimates for authorized but undefinitized work. Budget for far-term efforts may be held in higher level accounts until an appropriate time for allocation at the control account level. On government contracts, if an over-target baseline is used for performance measurement reporting purposes, prior notification must be provided to the customer.
Guideline 9 – Authorize and Budget by Cost Elements	d)	Establish budgets for authorized work with identification of significant cost elements (labor, material, etc.) as needed for internal management and for control of subcontractors.
Guideline 10 – Determine Discrete Work and Objective Measures	e)	To the extent it is practicable to identify the authorized work in discrete work packages, establish budgets for this work in terms of dollars, hours, or other measurable units. Where the entire control account is not subdivided into work packages, identify the far term effort in larger planning packages for budget and scheduling purposes.
Guideline 11 – Sum Detail Budgets to Control Account	f)	Provide that the sum of all work package budgets plus planning package budgets within a control account equals the control account budget.
Guideline 12 – Level of Effort Planning and Control	g)	Identify and control level of effort activity by time-phased budgets established for this purpose. Only that effort which is not measurable or for which measurement is impracticable may be classified as level of effort.
Guideline 13 – Establish Overhead Budgets	h)	Establish overhead budgets for each significant organizational component of the company for expenses which will become indirect costs. Reflect in the program budgets, at the appropriate level, the amounts in overhead pools that are planned to be allocated to the program as indirect costs.
Guideline 14 – Identify Management Reserve and Undistributed Budget	i)	Identify management reserves and undistributed budget.
Guideline 15 – Reconcile to Target Costs	j)	Provide that the program target cost goal is reconciled with the sum of all internal program budgets and management reserves.

2.3 Accounting Considerations		
Guideline 16 – Record Direct Costs	a)	Record direct costs in a manner consistent with the budgets in a formal system controlled by the general books of account.
Guideline 17 – Summarize Direct Costs by WBS Elements	b)	When a work breakdown structure is used, summarize direct costs from control accounts into the work breakdown structure without allocation of a single control account to two or more work breakdown structure elements.
Guideline 18 – Summarize Direct Costs by OBS Elements	c)	Summarize direct costs from the control accounts into the contractor's organizational elements without allocation of a single control account to two or more organizational elements.
Guideline 19 – Record/Allocate Indirect Costs	d)	Record all indirect costs which will be allocated to the program consistent with the overhead budgets.
Guideline 20 – Identify Unit and Lot Costs	e)	Identify unit costs, equivalent unit costs, or lot costs when needed.
Guideline 21 – Track and Report Material Costs and Quantities	f)	For EVMS, the material accounting system will provide for: 1) Accurate cost accumulation and assignment of costs to control accounts in a manner consistent with the budgets using recognized, acceptable, costing techniques. 2) Cost recorded for accomplishing work performed in the same period that earned value is measured and at the point in time most suitable for the category of material involved, but no earlier than the time of actual receipt of material. 3) Full accountability of all material purchased for the project including the residual inventory.
2.4 Analysis and Management Reports		
Guideline 22 – Calculate Schedule Variance and Cost Variance	a)	At least on a monthly basis, generate the following information at the control account and other levels as necessary for management control using actual cost data from, or reconcilable with, the accounting system: 1) Comparison of the amount of planned budget and the amount of budget earned for work accomplished. This comparison provides the schedule variance. 2) Comparison of the amount of the budget earned and the actual (applied where appropriate) direct costs for the same work. This comparison provides the cost variance.
Guideline 23 – Identify Significant Variances for Analysis	b)	Identify, at least monthly, the significant differences between both planned and actual schedule performance and planned and actual cost performance, and provide the reasons for the variances in the detail needed by program management.
Guideline 24 – Analyze Indirect Cost Variances	c)	Identify budgeted and applied (or actual) indirect costs at the level and frequency needed by management for effective control, along with the reasons for any significant variances.
Guideline 25 – Summarize Performance Data and Variances for Management	d)	Summarize the data elements and associated variances through the program organization and/or work breakdown structure to support management needs and any customer reporting specified in the contract.

Guideline 26 – Implement Corrective Actions	e)	Implement managerial action taken as the result of earned value information.
Guideline 27 – Maintain Estimate at Completion (EAC)	f)	Develop revised estimates of cost at completion based on performance to date, commitment values for material, and estimates of future conditions. Compare this information with the performance measurement baseline to identify variances at completion important to company management and any applicable customer reporting requirements including statements of funding requirements.
2.5 Revisions and Data Maintenance		
Guideline 28 – Incorporate Changes in a Timely Manner	a)	Incorporate authorized changes in a timely manner, recording the effects of such changes in the budgets and schedules. In the directed effort prior to negotiation of a change, base such revisions on the amount estimated and budgeted to the program organizations.
Guideline 29 – Maintain Baseline and Reconcile Budgets	b)	Reconcile current budgets to prior budgets in terms of changes to the authorized work and internal replanning in the detail needed by management for effective control.
Guideline 30 – Control Retroactive Changes	c)	Control retroactive changes to records pertaining to work performed that would change previously reported amounts for actual costs, earned value, or budgets. Adjustments should be made only for correction of errors, routine accounting adjustments, effects of customer or management directed changes, or to improve the baseline integrity and accuracy of performance measurement data.
Guideline 31 – Prevent Unauthorized Revisions	d)	Prevent revisions to the program budget except for authorized changes.
Guideline 32 – Document PMB Changes	e)	Document changes to the performance measurement baseline.

Appendix B – GAO Guide References

This appendix provides cross references between the process sections in this guide to text excerpts from the Government Accountability Office (GAO) Cost Estimating and Assessment Guide, Best Practices for Developing and Managing Capital Program Costs (GAO-09-3SP, March 2009) and the GAO Schedule Assessment Guide, Best Practices for Project Schedules (GAO-16-89G, December 2015).

The GAO guides are important references for the civilian government agencies as the GAO regularly assesses agency program management and EVMS implementations.

GAO Cost Estimating and Assessment Guide

Scalability Guide Section	GAO Guide Reference	GAO Best Practice Description
1.1, 1.3	Chapter 18, Managing Program Costs: Planning Identify Who Will Do the Work, pg. 216	Once the WBS has been established, the next step is to assign someone to do the work. Typically, someone from the organization is assigned to perform a specific task identified in the WBS. To ensure that someone is accountable for every WBS element, it is useful to determine levels of accountability, or control accounts, at the points of intersection between the organization breakdown structure and the WBS. The control account becomes the management focus of an EVM system and the focal point for performance measurement.
1.4	Chapter 18, Managing Program Costs: Planning Identify Who Will Do the Work, Table 29, pg. 206	Key Benefit: Provides a single management control system: • The criteria for developing an EVM system promote the integration of cost, schedule, and technical processes with risk management, improving the efficiency and effectiveness of program management; they require measuring progress, accumulating actual costs, analyzing variances, forecasting costs at completion, and incorporating changes in a timely manner • Implemented correctly, EVM provides a single management control system that prevents organizations from managing with one system and reporting from another. The concept that all work should be scheduled and traceable from the master plan to the details demonstrates that no specific scheduling software is required.
2.1, 2.2	Chapter 18, Managing Program Costs: Planning Schedule the Work to a Timeline, pg. 218	Developing a schedule provides a time sequence for the duration of the program's activities and helps everyone understand both the dates for major milestones and the activities, often called "critical and near-critical activities," that drive the schedule. A program schedule also provides the vehicle for developing a time-phased budget baseline.
2.3, 3.5	Chapter 18, Managing Program Costs: Planning Determine an Objective Measure for Earned Value, pg. 225	Performance measurement is key to earned value because performance represents the value of work accomplished. Before any work is started, the control account managers or teams should determine which performance measures will be used to objectively determine when work is completed. These measures are used to report progress in achieving milestones and should be integrated with technical performance

Scalability Guide Section	GAO Guide Reference	GAO Best Practice Description
		measures. Examples of objective measures are requirements traced, reviews successfully completed, software units coded satisfactorily, and number of units integrated.
2.4	Chapter 19, Managing Program Costs: Execution Analyze Performance, Probe Schedule Variances for Activities on the Critical Path, pg. 258	A good network schedule that is kept current is a critical tool for monitoring program performance. Carefully monitoring the contractor's network schedule will allow for quickly determining when forecasted completion dates differ from the planned dates. Tasks may be re-sequenced or resources realigned to reduce the schedule condition. It is also important to determine whether schedule variances are affecting downstream work. For example, a schedule variance may compress remaining activities' duration times or cause "stacking" of activities toward the end of the program, to the point at which it is no longer realistic to predict success.
3.1	Chapter 4, Cost Analysis Overview Life-Cycle Cost Estimate, pg. 32	A life-cycle cost estimate provides an exhaustive and structured accounting of all resources and associated cost elements required to develop, produce, deploy, and sustain a particular program. Life cycle can be thought of as a "cradle to grave" approach to managing a program throughout its useful life. This entails identifying all cost elements that pertain to the program from initial concept all the way through operations, support, and disposal. The LCCE usually becomes the program's budget baseline. Using the LCCE to determine the budget helps to ensure that all costs are fully accounted for so that resources are adequate to support the program.
	Chapter 18, Managing Program Costs: Planning Estimate Resources and Authorize Budgets, pg. 224	Budgets should be authorized as part of the EVM process, and they must authorize the resources needed to do the work. They should not be limited to labor and material costs. All required resources should be accounted for, such as the costs for special laboratories, facilities, equipment, and tools. It is imperative that staff with the right skills have access to the necessary equipment, facilities, and laboratories.
3.2	Chapter 18, Managing Program Costs: Planning Identify Who Will Do the Work, pg. 217	Work packages – detailed tasks typically 4 to 6 weeks long – require specific effort to meet control account objectives and are defined by who authorizes the effort and how the work will be measured and tracked. They reflect near-term effort. Planning packages are far-term work and usually planned at higher levels. Budgets for direct labor, overhead, and material are assigned to both work and planning packages so that total costs to complete the program are identified at the outset. As time passes, planning packages are broken down into detailed work packages. This conversion of work from a planning to a work package, commonly known as "rolling wave" planning, occurs for the entire life of the program until all work has been planned in detail.
3.3, 9.2	Chapter 18, Managing Program Costs: Planning	The performance measurement baseline includes all budgets for resources associated with completing the program, including direct and indirect labor costs, material costs, and

Scalability Guide Section	GAO Guide Reference	GAO Best Practice Description
	Develop the Performance Measurement Baseline, pg. 228	other direct costs associated with the authorized work. It represents the formal baseline plan for accomplishing all work in a certain time and at a specific cost.
3.4	Chapter 8, Work Breakdown Structure Best Practice: Product-Oriented WBS, pg. 67	In constructing a WBS, the 100 percent rule always applies. That is, the sum of a parent's children must always equal the parent. … In this way, the WBS makes sure that each element is defined and related to only one work effort, so that all activities are included and accounted for. It also helps identify the specialists who are needed to complete the work and who will be responsible so that effort is not duplicated.
3.6	Chapter 18, Managing Program Costs: Planning Determine an Objective Measure for Earned Value, pg. 226	No one method for measuring earned value status is perfect for every program. … What is important is that the method be the most objective approach for measuring true progress. Therefore, level of effort should be used sparingly; programs that report using a high level of effort for measuring earned value are not providing objective data and the EVM system will not perform as expected.
3.7	Chapter 18, Managing Program Costs: Planning Develop the Performance Measurement Baseline, pg. 228	The performance measurement baseline includes all budgets for resources associated with completing the program, It includes any undistributed budget, used as a short-term holding account for new work until it has been planned in detail and distributed to a particular control account. To help ensure timely performance measurement, it is important that undistributed budget be distributed to specific control accounts as soon as practicable. The performance measurement baseline does not equal the program contract value because it does not include management reserve or any fee. The budget for management reserve is accounted for outside the performance measurement baseline, since it cannot be associated with any particular effort until it is distributed to a particular control account when a risk occurs and leads to a recovery action.
3.8, 6.1, 6.2	Chapter 18, Managing Program Costs: Planning Update the PMB as Changes Occur, pg. 231	Because changes are normal, the EVMS Standard guidelines allow for incorporating changes – unless it is a retroactive change to the performance data (with the exception of error correction). However, it is imperative that changes be incorporated into the EVM system as soon as possible to maintain the validity of the performance measurement baseline. When they occur, both budgets and schedules are reviewed and updated so that the EVM data stay current. Furthermore, the EVM system should outline procedures for maintaining a log of all changes and for incorporating those into the performance measurement baseline, and the log should be maintained so that changes can be tracked.
4.1	Chapter 18, Managing Program Costs: Planning,	For this step, project personnel execute their tasks according to the performance measurement baseline and the underlying detailed work plans. Actual costs are recorded by the accounting system and are reconciled with the value of the

Scalability Guide Section	GAO Guide Reference	GAO Best Practice Description
	Execute the Work Plan and Record All Costs, pg. 230	work performed so that effective performance measurement can occur. A program cost-charging structure must be set up before the work begins to ensure that actual costs can be compared with the associated budgets for each active control account.
5.1, 5.2, 5.3, 5.4	Chapter 18, Managing Program Costs: Planning Analyze EVM Performance Data and Record Variances from the Performance Measurement Baseline Plan, pg. 230	Because programs all carry some degree of risk and uncertainty, cost and schedule variances are normal. Variances provide management with essential information on which to assess program performance and estimate cost and schedule outcomes. EVM guidelines provide for examining cost and schedule variances at the control account level at least monthly and for focusing management attention on variances with the most risk to the program. This means that for EVM data to be of any use, they must be regularly reviewed. In addition, management must identify solutions for problems early if there is any hope of averting degradation of program performance.
5.5	Chapter 18, Managing Program Costs: Planning Forecast Estimates at Completion Using EVM, pg. 230	…managers should rely on EVM data to generate EACs at least monthly. EACs are derived from the cost of work completed along with an estimate of what it will cost to complete all unaccomplished work. A best practice is to continually reassess the EAC, obviating the need for periodic bottoms-up estimating. It should be noted, however, that DOD requires an annual comprehensive EAC.
9.3	Chapter 2, Why Government Programs Need Cost Estimates and the Challenges in Developing Them, pg. 16	…, the (OMB) Capital Programming Guide requires an agency to develop a baseline assessment for each major program it plans to acquire. As part of this baseline, a full accounting of life-cycle cost estimates, including all direct and indirect costs for planning, procurement, operations and maintenance, and disposal, is expected.
	Chapter 15, Validating the Estimate 3. Determine That the Estimate is Accurate, pg. 182	Validating that a cost estimate is accurate requires thoroughly understanding and investigating how the cost model was constructed. For example, all WBS cost estimates should be checked to verify that calculations are accurate and account for all costs, including indirect costs.

GAO Schedule Assessment Guide

Scalability Guide Section	GAO Best Practice	GAO Best Practice Description
1.2	Best Practice #1: Capturing All Activities Work Breakdown Structure, pg. 20	A work breakdown structure is the cornerstone of every program, because it defines in detail the work necessary to accomplish a program's objectives. For example, a typical WBS reflects the requirements to be accomplished to develop a program, and it provides a basis for identifying resources and activities necessary to produce deliverables. A WBS is also a valuable communication tool between systems engineering, project management, and other functional organizations because it provides a picture of what has to be accomplished by decomposing the project scope into finite deliverables.
2.1, 2.2	Best Practice # 2: Sequencing All Activities, pg. 27	The schedule should be planned so that critical program dates can be met. To do this, activities must be logically sequenced and linked – that is, listed in the order in which they are to be carried out and joined with logic. In particular, a predecessor activity must start or finish before its successor. Date constraints and lags should be minimized and justified. This helps ensure that the interdependence of activities that collectively lead to the completion of activities or milestones can be established and used to guide work and measure progress.
2.4	Best Practice #9, Updating the Schedule Using Actual Progress and Logic, pg. 121	Progress updates and logic provide a realistic forecast of start and completion dates for program activities. Maintaining the integrity of the schedule logic is necessary to reflect the true status of the program.
	Best Practice #10, Maintaining a Baseline Schedule, pg. 135	A baseline schedule is the basis for managing the program scope, the time period for accomplishing it, and the required resources. The baseline schedule is designated the target schedule and is subjected to a configuration management control process. Program performance is measured, monitored, and reported against the baseline schedule. The schedule should be continually monitored so as to reveal when forecasted completion dates differ from baseline dates and whether schedule variances affect downstream work.