	TECHNICAL REPORT	EIA-748	REV. C
		Issued 1998-06 Revised 2013-03	

TECHNICAL REPORT

EIA-748 **REV. C**

Issued 1998-06
Revised 2013-03

Earned Value Management Systems

NOTICE

This document has been taken directly from the original TechAmerica document and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE Technical Standards. The release of this document is intended to replace the original with the SAE International document. Any numbers established by the original document remain unchanged.

The original document was adopted as an SAE publication under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of specifications and standards. TSB rules provide for (a) the publication of portions of unrevised specifications and standards without consensus voting at the SAE committee level, and (b) the use of the existing specification or standard format.

TechAmerica
Standard

Earned Value Management Systems

EIA-748-C

March 2013

TechAmerica
WHERE THE FUTURE BEGINS
THE ASSOCIATION OF COMPANIES DRIVING INNOVATION WORLDWIDE

NOTICE

TechAmerica Engineering Standards and Publications are designed to serve the public interest by eliminating misunderstandings between manufacturers and purchasers, facilitating interchangeability and improvement of products, and assisting the purchaser in selecting and obtaining with minimum delay the proper product for his particular need. Existence of such Standards and Publications shall not in any respect preclude any member or nonmember of TechAmerica from manufacturing or selling products not conforming to such Standards and Publications, nor shall the existence of such Standards and Publications preclude their voluntary use by those other than TechAmerica members, whether the standard is to be used either domestically or internationally.

Standards and Publications are adopted by TechAmerica in accordance with the American National Standards Institute (ANSI) patent policy. By such action, TechAmerica does not assume any liability to any patent owner, nor does it assume any obligation whatever to parties adopting the Standard or Publication.

This TechAmerica Standard is considered to have International Standardization implications, but the ISO/IEC activity has not progressed to the point where a valid comparison between the TechAmerica Standard and the ISO/IEC document can be made.

This Standard does not purport to address all safety problems associated with its use or all applicable regulatory requirements. It is the responsibility of the user of this Standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations before its use.

(From Standards Proposal No. 4890, formulated under the cognizance of the ADPA/NSIA (now NDIA) Management Systems Subcommittee with association support from the ASA (American Shipbuilding Association), the EIA (Electronic Industries Alliance), the PMA (Performance Management Association), and the SCA (Shipbuilders Council of America). With authorization from the TechAmerica SSTC (Systems Standards & Technology Council).)

Published by

PLEASE!

**DON'T VIOLATE
THE
LAW!**

**This document is copyrighted by TechAmerica and may not be
reproduced without permission.**

**Organizations may obtain permission to reproduce a limited number of copies by
entering into a license agreement with our distributors.**

**For distributor information please see our web site <u>www. techamerica.org/</u> or contact
TechAmerica at 703-284-5355**

TechAmerica

Earned Value Management Systems

EIA-748

Revision	Description of change	Date
-	Initial Release	6/98
A	Document update	6/05
B	Document update	6/07
C	Document update	3/13

CONTENTS

Foreword

The earned value management system (EVMS) guidelines incorporate best business practices to provide strong benefits for program enterprise planning and control. The processes include: integration of program scope, schedule, and cost objectives; the establishment of a baseline plan for accomplishment of program objectives; and the use of earned value techniques for performance measurement during the execution of a program. The system provides a sound basis for problem identification, corrective actions, and management replanning as may be required.

Different organizations must have the flexibility to establish and apply an integrated management system that suits their management style and business environment. First and foremost, the system must meet the organization's needs and good business practices. Therefore, the guidelines in this document are purposely high level and goal oriented, as they are intended to state the qualities and operational considerations of an integrated program management system using earned value analysis methods without mandating detail system characteristics.

**A GUIDE FOR ESTABLISHMENT AND APPLICATION OF
AN INTEGRATED PROGRAM MANAGEMENT SYSTEM
WITH COORDINATION OF PROGRAM WORK SCOPE,
SCHEDULE, AND COST OBJECTIVES BY THE USE OF
EARNED VALUE METHODS FOR PROGRAM OR
ENTERPRISE PLANNING AND CONTROL**

(This page intentionally left Blank)

1.   **INTRODUCTION**

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.

The essence of earned value management is that a target planned value (i.e., budget) is established for each scheduled element of work at a level of detail appropriate for the degree of risk for the technical, schedule, and cost or uncertainty associated with the program. As these elements of work are completed, their target planned values are "earned".   As such, work progress is quantified and the earned value becomes a representation of accomplishment against which to measure what was spent to perform the work and what was scheduled..

Schedule variances, which cannot be seen in a stand-alone budget versus actual cost tracking system, are isolated and quantified, and the cost variances are true cost variances that are not distorted by schedule performance.   This provides for early identification of performance trends and variances from the management plan, and allows management decision making while there is adequate time to implement effective corrective actions. Without earned value, one can only compare planned expenditures with how much has been spent, which does not provide an objective indication of how much of the planned work was actually accomplished.

For the benefits of earned value to be fully realized, comprehensive planning at the outset that includes a thorough risk and opportunity analysis, combined with the establishment and disciplined maintenance of a baseline for performance measurement are required. This combination of comprehensive planning, baseline maintenance, and earned value analysis yields earlier and better visibility into program performance than is provided by non-integrated methods of planning and control. This enhances overall program management value through decisions based on the use of EVMS information.

The intent is to provide management information using the organization's resources and a properly scaled EVMS application that achieves the program requirements and is compliant with

the EVMS principles. EVMS scalability is viewed as a spectrum employing the principles of EVMS as fundamental to all programs and the EVMS guidelines (Section 2) as applicable to large complex or high risk programs. This scalability allows any program, regardless of size and complexity, to realize the benefits of earned value management.

Note 1: In the context of this standard, a program is a group of related projects supporting a mission that are managed in a coordinated way to obtain benefits not obtained from managing them individually. As the management principles are the same to achieve success, the two terms, program and project, are used interchangeably in this standard.

Note 2: An objective of this standard is the planning and performance measurement of program work scope in a manner that enables efficient integrated program management. As the management principles of planning and performance measurement are detailed throughout this standard, the terms "effort", "scope", "work," "work scope," and "program work scope" are used interchangeably.

Note 3: In the context of this standard, "organization" is used as a generic term and may include, but is not limited to: public and private corporations and companies, Federal government agencies, departments and activities, state and local government entities, Federally Funded Research and Development Centers (FFRDC) and similar organizations, educational institutions, and non-profit entities that are likely to be owners of earned value management systems.

2   EVMS GUIDELINES

This section provides basic guidelines for organizations to use in establishing and applying an integrated Earned Value Management System (EVMS). These guidelines are expressed in fundamental terms and provide flexibility for each organization to optimize its system and be fully accountable for the effectiveness of its usage. The process discussions in section 3 provide further information on application of these guidelines. The guidelines are grouped in five major categories as documented below. They are followed by a glossary of common terminology.

2.1   Organization

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

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.

c)   Provide for the integration of the 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.

d)   Identify the organization or function responsible for controlling overhead (indirect costs).

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

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.

b.   Identify physical products, milestones, technical performance goals, or other indicators that will be used to measure progress.

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. If an over-target baseline is used for performance measurement reporting purposes, prior notification must be provided to the customer.

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.

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.

f) Provide that the sum of all work package budgets plus planning package budgets within a control account equals the control account budget.

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.

h) Establish overhead budgets for each significant organizational component 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.

i) Identify management reserves and undistributed budget.

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

a) Record direct costs in a manner consistent with the budgets in a formal system controlled by the general books of account.

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.

c) Summarize direct costs from the control accounts into the organizational elements without allocation of a single control account to two or more organizational elements.

d) Record all indirect costs which will be allocated to the program consistent with the overhead budgets.

e) Identify unit costs, equivalent unit costs, or lot costs when needed.

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 program including the residual inventory.

2.4   Analysis and Management Reports

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.

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.

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.

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.

e)   Implement managerial actions taken as the result of earned value information.

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

a)   Incorporate authorized changes in a timely manner, recording the effects of such changes in 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.

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.

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.

d) Prevent revisions to the program budget except for authorized changes.

e) Document changes to the performance measurement baseline.

2.6   Common Terminology

ACTUAL COST (AC) - The costs actually incurred and recorded in accomplishing work performed, also referred to as Actual Cost of Work Performed (ACWP).

ACTUAL DATE - The date on which a milestone or scheduled work task is completed.

APPORTIONED EFFORT (AE) - Effort that by itself is not readily measured or divisible into discrete work packages but which is related in direct proportion to the planning and performance on other measured effort.

AUTHORIZED WORK – Effort (work scope) on contract or assigned by management.

BUDGET AT COMPLETION (BAC) - The total authorized budget for accomplishing the program scope of work. It is equal to the sum of all allocated budgets plus any undistributed budget. (Management Reserve is not included.) The Budget at Completion will form the Performance Measurement Baseline, as it is allocated and time-phased in accordance with program schedule requirements.

CONTROL ACCOUNT (CA) - A management control point at which budgets (resource plans) and actual costs are accumulated and compared to earned value for management control purposes. A control account is a natural management point for planning and control, since it represents the work assigned to one responsible organizational element on one program work breakdown structure element.

COST VARIANCE (CV) - A metric for the cost performance on a program as of a specified date. It is the difference between earned value and actual cost (Cost Variance = Earned Value – Actual Cost). A positive value indicates a favorable position and a negative value indicates an unfavorable condition.

CRITICAL PATH ANALYSIS - See NETWORK SCHEDULE.

DIRECT COSTS - The costs or resources expended in the accomplishment of work, which are directly charged to the affected program.

DISCRETE EFFORT - Tasks related to the completion of specific end products or services and can be directly planned and measured. (Also may be known as work packaged effort.)

DUE DATE - The date a milestone or task is scheduled to be completed.

EARNED VALUE (EV) - The value of completed work expressed in terms of the budget assigned to that work, also referred to as Budgeted Cost for Work Performed (BCWP).

ESTIMATE AT COMPLETION (EAC) - The current estimated total cost for program authorized work. It equals actual cost to a point in time plus the estimated costs to completion (Estimate To Complete).

ESTIMATE TO COMPLETE (ETC) - Estimate of costs to complete all work from a point in time to the end of the program.

ESTIMATED COST - An anticipated cost for specified work scope.

EXPECTED COMPLETION DATE - The date a scheduled milestone or task is currently expected to be completed.

INDIRECT COST - The cost for common or joint objectives that cannot be identified specifically with a particular program or activity. Also referred to as overhead cost or burden.

INTERNAL REPLANNING - Replanning actions for remaining work scope. A normal program control process accomplished within the scope, schedule, and cost objectives of the program.

LEVEL OF EFFORT (LOE) - Unmeasured effort of a general or supportive nature, usually without a deliverable end product. Examples are supervision, program administration and contract administration.

MANAGEMENT RESERVE (MR) - An amount of the total budget withheld for management control purposes rather than designated for the accomplishment of a specific task or set of tasks.

MILESTONE - A schedule event marking the due date for accomplishment of a specified effort (work scope) or objective. A milestone may mark the start, an interim step, or the end of one or more activities.

NETWORK SCHEDULE - A schedule format in which the activities and milestones are represented along with the interdependencies between activities. It expresses the logic of how the program will be accomplished. Network schedules are the basis for critical path analysis, a method for identification and assessment of schedule priorities and impacts.

ORGANIZATION STRUCTURE - The hierarchical arrangement for the management organization for a program, graphically depicting the reporting relationships. The organizational structure will be by work team, function, or whatever other units are used.

OTHER DIRECT COSTS (ODC) - Usually the remaining direct costs, such as travel and computer costs, other than labor and material.

OVER-TARGET BASELINE (OTB) - Replanning actions involving establishment of cost and/or schedule objectives that exceed the desired or contractual objectives on the program. An over-target baseline is a new baseline for management purposes, when the original objectives cannot be met and new goals are needed.

PERFORMANCE MEASUREMENT BASELINE (PMB) - The total time-phased budget plan against which program performance is measured. It is the schedule for expenditure of the resources allocated to accomplish program scope and schedule objectives, and is formed by the budgets assigned to control accounts and applicable indirect budgets. The Performance Measurement Baseline also includes budget for future effort assigned to higher level accounts, also referred to as summary level planning packages, plus any undistributed budget. Management Reserve is not included in the baseline, as it is not yet designated for specific work scope.

PERFORMING ORGANIZATION - The organization unit that applies resources to accomplish assigned work.

PLANNED VALUE (PV) - The time-phased budget plan for work currently scheduled, also referred to as Budgeted Cost for Work Scheduled (BCWS).

PLANNING PACKAGE (PP) - A logical aggregation of work within a control account, usually future efforts that can be identified and budgeted, but which is not yet planned in detail at the work package or task level.

PROGRAM BUDGET - The total budget for the program including all allocated budget, management reserve, and undistributed budget.

PROGRAM TARGET COST - The program cost objective based on the negotiated contract target cost, or the management goal value of the authorized work, plus the estimated cost of authorized unpriced work.

RESOURCE PLAN - The time-phased budget, which is the schedule for the planned expenditure of program resources for accomplishment of program work scope.

RESPONSIBLE ORGANIZATION - The organizational unit responsible for accomplishment of assigned work scope.

SCHEDULE - A plan that defines when specified work must be done to accomplish program objectives on time.

SCHEDULE TRACEABILITY - Compatibility between schedule due dates, status, and work scope requirements at all levels of schedule detail (vertical traceability) and between schedules at the same level of detail (horizontal traceability).

SCHEDULE VARIANCE (SV) - A metric for the schedule performance on a program. It is the difference between earned value and the budget (Schedule Variance = Earned Value – planned value). A positive value is a favorable condition, while a negative value is unfavorable.

STATEMENT OF WORK (SOW) - The document that defines the work scope requirements for a program.

UNDEFINITIZED WORK – Authorized work for which a firm contract value has not been negotiated or otherwise determined.

UNDISTRIBUTED BUDGET (UB) - Budget associated with specific work scope or contract changes that have not been assigned to a control account or summary level planning package.

WORK BREAKDOWN STRUCTURE (WBS) - A product-oriented division of program tasks depicting the breakdown of work scope for work authorization, tracking, and reporting purposes.

WORK BREAKDOWN STRUCTURE DICTIONARY - A listing of work breakdown structure elements with a description of the work scope content in each element. The work descriptions are normally summary level and provide for clear segregation of work for work authorization and accounting purposes.

WORK PACKAGE (WP) - A task or set of tasks performed within a control account.

3   EVMS PROCESS DISCUSSION

This section provides additional information relative to the EVMS guidelines in Section 2. This information is provided as an aid in understanding and applying earned value management methods.

3.1   Statement of Work (SOW)

The SOW communicates the work scope requirements for a program and should define the requirements to the fullest extent practicable. It is a basic element of control used in the processes of work assignment and the establishment of program schedules and budgets.
If the work scope can only be defined in general terms (as in the case when an exploratory phase is necessary to define the full extent of the work), it will be necessary to understand the additional program risk and to maintain added flexibility in program plans and controls to allow for future developments.

3.2   Work Breakdown Structure

A Work Breakdown Structure (WBS), developed for effective management control, is commonly used to segregate the work scope requirements of the program into definable product elements and related services and data. The WBS is a direct representation of the work scope defined in the program statement of work and breaks that work scope into appropriate elements for cost accounting and work authorization. It is a multi-level hierarchical breakdown that shows how program costs are summarized from the lower elements to the total program level. The WBS is extended, at a minimum, to the level(s) at which control accounts are established. The extent of detail (breakout and levels) in the WBS will be determined by program management needs, organizational policies, and contractual agreements.

As a program progresses from one phase to another, it is a normal process to reassess the WBS. As a case in point, the product breakdown during a development phase may be different from the product breakdown, or the assembly sequence, used in the production phase. If program requirements change, the WBS will evolve with the program.

3.2.1   WBS Dictionary

A program may elect to prepare a WBS dictionary, if not contractually required. The dictionary defines the work scope represented in each element of the WBS. This can be done by summary work scope descriptions or by references to the applicable sections of the statement of work. The WBS dictionary does not replace the statement of work, but can provide a logical cross reference between it and the WBS. Direct costs are clearly segregated by WBS element without further allocation.

3.3   Program Organization

An organization will structure programs as it needs to for optimal management of its business. This includes decisions such as the use of work teams or functional organizations and staffing by direct (projectized) or matrix assignment. It is important for the organization to be defined at the onset of the program so that work assignments can be made and responsibilities are clear. This process includes identification and coordination of subcontracted work, as well as internal efforts. A program organization is dynamic and may change as a program evolves.

3.3.1   Control Accounts

The program involved will determine the organizational level(s) at which to establish control accounts. The control accounts are then defined by integration of the program organization and the work breakdown structure. A control account thus represents a defined work scope (with the associated charge number or numbers) given to a single organizational unit (and single manager) for work performance. When control accounts are assigned in this manner, there may be multiple accounts within a WBS element depending on the number of organizations authorized to do work within the scope of that WBS element. If an organization is also assigned work under another WBS element, it may be supporting multiple control accounts.

There also may be multiple control accounts within a responsible OBS element when the effort within a WBS element must be segregated for management control purposes driven by scope, and exit criteria (i.e., completion of task scope). The establishment of multiple control accounts should be determined by the control account's scope of the management tasks and consideration for planning and control of budgets, schedules, work assignments, progress assessment, problem identification, and corrective actions. One of the benefits of multiple control accounts at the WBS OBS intersection is to simplify variance analysis and management of the effort.

The control account is where program cost, schedule and work scope requirements are integrated, planned and managed. Resource planning through integration of schedule and budget objectives, and performance measurement will be accomplished within the control accounts. At a minimum, actual costs are collected at the control account level to enable summarization of cost by both the WBS and OBS. Under some circumstances additional levels of detail may be needed to segregate into separate control accounts the LOE versus Discrete effort, multiple elements of cost, and multi-functional elements. Control account data is then collected and summarized for higher levels of visibility of program plans and performance. Since the accounts were defined by integration of the organization and the WBS, program data can be summarized by either path.

In summary, the purpose of defining control accounts is to break the program, the total job at hand, into manageable subdivisions. The size and duration of a control account depends on what is necessary and reasonable for program planning and control. The one normal guideline is that a control account shall not span multiple WBS elements.

3.3.2 Control Account Managers

A control account must be assigned to a single manager or team leader who has the responsibility for management of the account. While a control account will have a single manager, a manager may have responsibility for a number of accounts on one or more programs depending on the organizational structure.

3.3.3 Earned Value Management Flow Down

An organization will apply its own established process to ensure flow down of earned value management to internal work and subcontracted work. Major or critical work that is flowed down should be required to comply either with the provisions of this standard or other appropriate requirements. Reporting requirements should be consistent with program risk, size, complexity, and other factors including contract clauses and provisions. Supplier and internal data can be combined using a common integrated program process for the total program performance analysis and reporting.

3.3.4 Internal Work Transfers

Management of effort assigned to another component within an organization will be done in accordance with standard policy. The other component may be treated as an in-house organization and the effort may be planned and tracked within the earned value management

system of the program. Alternatively, the work can be managed like subcontracted work (see Section 3.3.3).

3.4   Program Schedule

The program schedule and budget are an integrated time-oriented plan for accomplishment of work scope requirements on a program. Schedule planning and control, budget planning and control, work scope definition, and program handling of risk and opportunities are necessary prerequisites for basic and effective integrated program management. The scheduling process begins during original program definition and overall schedule plans are typically established during the preplanning for a program. The time-phased budgeting process discussed in Section 3.5 occurs subsequent to the schedule planning phase with budgets being time-phased consistent with the scheduled program work scope. The integrated schedule and budget plans should take into account risk and opportunity handling plans.

Supporting plans, including detail schedules and budgets, are subsequently developed, maintained, and statused as necessary during the performance phase of the program. The iterative planning process must support integration of the risk adjusted cost and schedule objectives of the program to provide for resource planning, performance measurement, and other integrated program management requirements.

The selection of scheduling techniques and the levels at which they are applied depends on the affected organization and its program management needs.

3.4.1   Master Schedule

A master schedule is the top level schedule for accomplishment of program objectives. The master schedule should include the key program and contractual requirements. Beyond this, the level of detail in the master schedule depends on program management needs and organization policies.

3.4.2   Supporting Schedules

Master schedule requirements must be extended as necessary for an organization to effectively plan and manage. Lower level schedules may be maintained as separate entities or integrated with the master schedule in a single module. The basic principle is that all lower level schedules, if they exist, must support the master schedule requirements and provide for program interdependencies as necessary.

3.4.3   Subcontract/Procurement Schedules

Subcontract and critical procurement schedule requirements should be fully integrated into the overall program schedule. It is important to plan and track all critical and high risk schedule requirements that constrain the successful conclusion of procurement actions.

3.5 Budget Allocation and Resource Planning

The process of budget allocation and resource planning depends on having definition of program work scope, schedules, risk, and organization. These elements are integrated in the performance measurement baseline.

Setting a budget for a program involves allocation of resources to performing organizations for accomplishment of program objectives. A key attribute of an earned value management system is that budget is provided for specific work scope and is only allocated for authorized efforts.

3.5.1 Program Budget

The program budget is maintained as a working management tool for the life of the program. The initial program budget is normally tied directly to the initial program cost estimates, the negotiated contract cost, risk, or internal management goals. Management reserve may be withheld before the budget is distributed to lower accounts. The budget will be revised as program changes are authorized and incorporated or as internal replanning actions are taken. Rate changes and economic price adjustments may also be made as appropriate. The program budget, at any level and for any organization or task, will only contain budget for specific authorized work.

If a customer authorizes additional work and the value of the added work is still to be negotiated, the organization may increase the program budget as needed for the newly authorized work. The budget applied may be adjusted when the authorized change is finalized.

For management reasons, an organization may elect to establish a program budget that exceeds the program target cost. If customer performance reporting is required on the program, the customer must be consulted prior to implementation of the changes.

3.5.2 Elements of Control

An organization will use the elements of control it deems most effective for internal management. Budgets may be expressed in dollars, labor hours, or other measurable units. When units other than dollars are used, the organization will determine the appropriate point of responsibility in their control system for rate application for financial analysis and reporting.

3.5.3 Budget Rates

An organization will apply the budget rates necessary for establishment of a valid performance measurement baseline. Use of average rates for an extended period of time is not usually recommended as budgets in the beginning of the period will be overstated and later budgets will be understated. Rate changes may be incorporated in the program budget as they occur. The rates used for budgets will also be used for computation of earned value data.

3.5.4 Management Reserve

An organization may establish a schedule and/or cost reserve to be used for management control purposes in accordance with organizational policy and program risk. Management reserve is held for unexpected growth within the currently authorized work scope, rate changes, risk and opportunity handling, and other program unknowns. Reserve is held for current and future needs and is not used to offset accumulated overruns or under runs. Reserve may be held at the total program level or distributed and controlled at lower management levels. In any case, an organization shall be able to account for all of its management reserve.

Management reserve is not a contingency that can be eliminated from prices during subsequent negotiations or used to absorb the cost of program changes. The budget being held in reserve must not be viewed by a customer as a source of funding for added work scope.

3.5.5 Undistributed Budget

This is budget that is not allocated either to working budgets or to management reserve. Undistributed budget should be appropriately allocated as quickly as practicable.

3.5.6 Work Authorization

Within a program, formal work authorizations are normally issued to communicate work assignments. These authorizations provide a documented trail of work approved that clearly assigns program work requirements to the responsible organizations.

The process of work authorization, the approvals necessary, and the form will vary based on individual organization policies and procedures. Work authorizations do not need to duplicate the statement of work and can refer to that document for work scope definition. The organization will decide on the flow of the work authorizations and the approvals that are needed. The authorizations may be communicated electronically or on paper. Work authorizations should be issued before work is due to begin for improved control and advance planning.

Normal business practices provide for documentation of job or task requirements at the performing organization level. This documentation should suffice for management needs. The work authorization process should make use of and avoid duplication of working level job documentation.

3.5.7 Resource Plan/Time-Phased Budgets

A resource plan must be developed for every control account and summary level planning package. The resource plan is the time-phased budget that is developed in accordance with assigned work scope and schedule requirements (due dates).

The resource plan for current requirements on discrete (measured) efforts must be supported by appropriate work package plans. Future resource requirements may be represented by a summary time-phased budget (i.e., a planning package). The resource plan for apportioned efforts will be in accordance with the plans of the base accounts.

The resource plan for unmeasured or LOE efforts may be a simple time-phased budget for all current and future requirements.

3.5.8 Planning Packages

A planning package is a holding account (within a control account) for budget for future work that it is not yet practicable to plan at the work package level. The planning package budget is time-phased in accordance with known schedule requirements (due dates) for resource planning, and the plans are refined as detail requirements become clearer and the time to begin work draws nearer. A program may elect to break the work assigned to a control account into smaller groupings of tasks, i.e., multiple planning packages, for internal planning and control reasons.

3.5.9 Higher Level Accounts

A higher level account, also referred to as a summary level planning package, may be used to establish a high level holding account for budget that is identified to some work scope; but which, for business reasons, is not yet allocated to responsible control accounts. The higher level account budget must be allocated to specific control accounts before the work is scheduled to start or actually begins. A basic difference compared to management reserve or undistributed budget is that the higher level account budget is identified to specific work scope elements and is time-phased for interim resource planning.

3.5.10 Work Packages

Work packages are natural subdivisions of control accounts. A work package is simply a task or grouping of work. A work package is the point at which work is planned, progress is measured, and earned value is computed.

"Work Package" is a generic term that translates into different terms in different organizations and functions. It can be a design job, a tool design package, a build-to-package, a shop order, a part number, a purchase order, or any other definable task at whatever level of control is normal for program management within the organization. The concept of work packages does not impose a new or unusual level of planning and control as the work packages should represent working level jobs, tasks, or processes that are natural to organizational operations.

Earned value management using standard hour methods is commonly used in manufacturing organizations. Manufacturing work is scheduled and tracked on the basis of physical accomplishment. The techniques applied include the usage of learning curves and realization factors for planning and performance measurement. Usage of planned and sold (or earned) standards is a proven earned value methodology with natural work packages.

Work packages are an element of control within control accounts. The number, content, size, and duration of work packages needed in an account will vary subject to internal management needs and organizational policies along with the size and complexity of the program. In some cases, a control account may not need to break the assigned work into multiple work packages for effective planning and control.

3.5.11 Planning Package Conversion

There is no standard advance planning look-ahead period (e.g., mandated "rolling wave cycle", planning "horizon" or "window") for conversion of planning packages into work packages that is appropriate for all programs or conditions. Although flexibility of future planning is encouraged, programs must not have planning packages scheduled to start in the "current" period. Each organization must establish its own policies in this regard.

3.5.12   Performance Measurement Baseline

The performance measurement baseline is the total time-phased budget for the program. It is the plan for expenditure of organizational resources as necessary to meet program scope and schedule objectives. The program baseline is the summation of the time-phased budgets for all of the control accounts and higher level accounts plus applicable indirect budgets and any undistributed budget. Management reserve is not included in the performance measurement baseline, as it has not been allocated for specific work scope.

The performance measurement baseline is a working management tool. It is a representation of current program plans which will and must change as program plans are refined and revised. Proper maintenance of the baseline will prevent performance measurement against an outdated or unauthorized plan.

3.5.13 Funding Issues

Changes in the funding projections for a program may affect both the schedule and the cost for a program. The movement of budget to meet a new funding profile requires a reassessment of the schedule for the associated work. There may also be cost impact due to rate differences in the affected time periods.

3.5.14 Budgeting Element Hierarchy

Budgeting is the process of distributing or allocating cost targets to individual segments of work. Strict budget element relationships must exist at all times in order to assure that the sum of the parts is equal to the whole. The hierarchy of budget elements is shown in Figure 3.5-1 below. This shows how the intermediate summations are defined leading to the Performance Measurement Baseline, Contract Budget Base, and the Contract Target Price. For internally funded programs companies may use an alternative term for "contract."
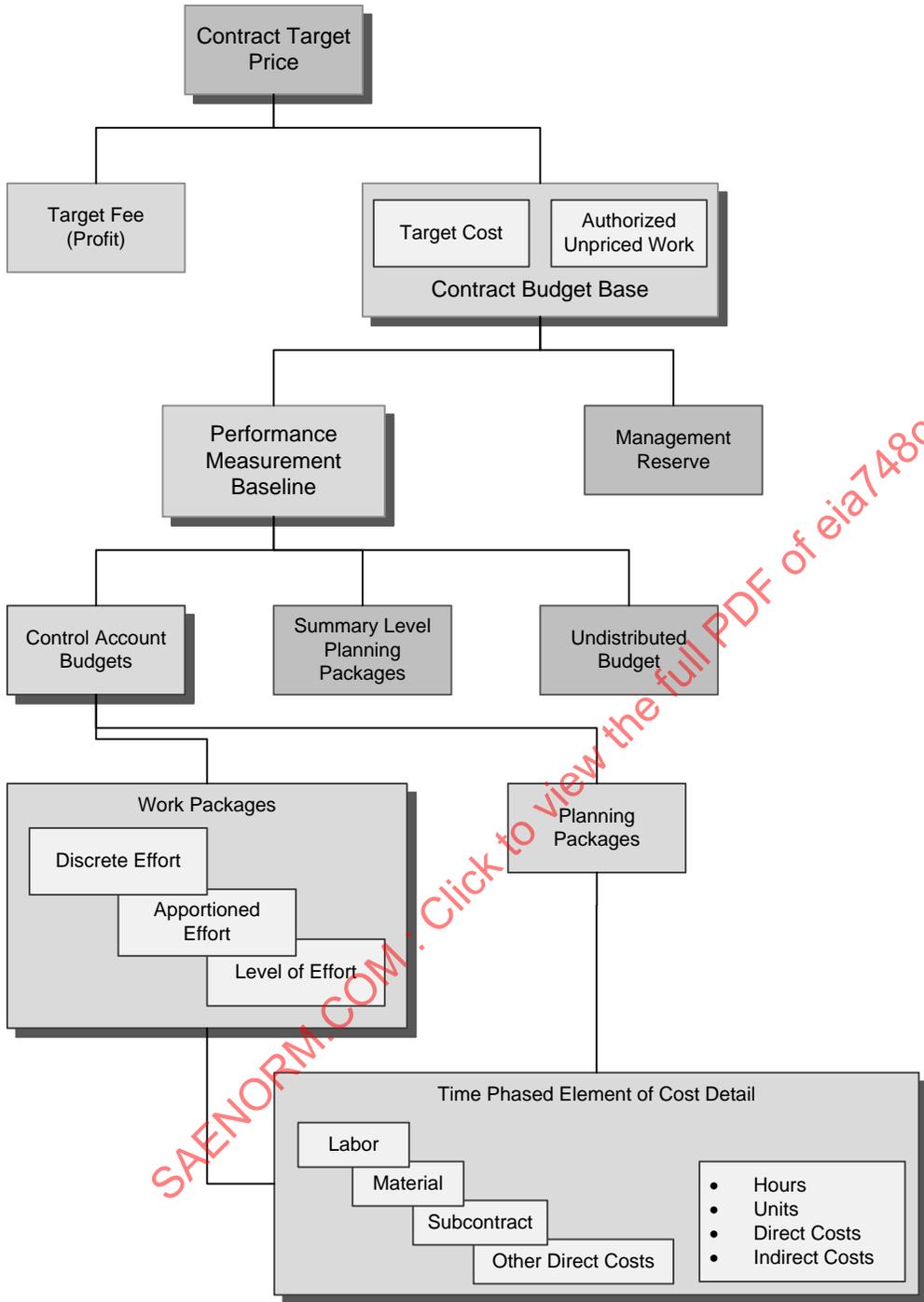
Figure 3.5-1 — Budget Element Hierarchy

3.6 Accounting Considerations

The EVMS is not an accounting system, and EVMS guidelines do not suggest changes to accepted accounting practice. The EVMS will use actual cost data from the organization's accounting system and as appropriate estimates for the costs of work accomplished that do not have actual costs recorded in the accounting system for accurate reporting of program costs. The establishment of work orders and other aspects of the accounting process must be coordinated with the establishment of control accounts and other aspects of the budgeting process so that direct comparison and analysis can be done. The actual cost of work performed in the earned value management system is reconcilable with the actual costs in the accounting system.

3.6.1 Costs Associated with Material

Material costs are usually recorded on an as-applied basis, i.e., at the point in time where the material is applied to work in progress, but there may be exceptions. Earned value for material will usually be credited no earlier than the point of receipt, in the same period the work is completed and that the costs are applied. The generally acceptable points for measuring material progress are: (1) point of receipt; (2) point of stock; and (3) point of issue to work in process. In situations where earned value is credited and corresponding actual costs have not been recorded in the accounting system, the organization should use estimates for the actual costs in management and customer performance measurement reports. Long lead critical material items may require special considerations for planning and measuring progress. Programs should consider contracting methods that promote the use of progress methods and objectives that best meet the needs of good program management decisions.

3.6.2 Cost Associated with Flow Down Effort

Although cost associated with flow down effort is usually recorded upon payment of invoices, which typically lag the completion of work effort, earned value for the flow down effort should be credited in the same period the work is completed. The "estimated actual cost of work performed" is used until such time that the invoice payment is recorded in the accounting system and for performance measurement in management and customer reports.

3.7 Earned Value Methodology

The determination of earned value will depend on the type of effort, whether it is discrete, apportioned, or LOE. The most common methods are as follows:

3.7.1 Discrete Effort

There are three basic earned value techniques applicable to discrete/work package efforts (efforts with definable scope and objectives that can be scheduled and on which progress can be measured). The basic techniques are valued milestones, standard hours, and management assessment. There are many variations and combinations of these techniques. Also, quantitative formulae may be used to compute earned value for cases such as work in process or production inventory materials.

The valued milestone involves the assignment of budget to specific work objectives (schedule milestones). That value is earned as the milestones are completed. It is important for the milestones to be natural and meaningful points of accomplishment.

The use of standard hours (equivalent units is a similar process) is common in manufacturing accounts. Budget is time-phased in relation to the standard hour plan. Earned value is accrued in proportion to the standard hour status as earned standards are sold in the shops.

Management assessment may be used to determine the percentage of work completed for a task or group of tasks. Earned value is then calculated by applying that percentage to the total budget for the work. Management assessment may include the use of metrics for work measurement.

Generally, the objective earned value techniques (valued milestone or standard hours) are preferred, but each has its own merits and an organization should use those that best suit its management needs. A note of caution is to avoid artificial constraints on earnings such as a percentage limit on earnings in a work package pending closure of the ending milestone.

3.7.2 Apportioned Effort

Apportioned effort is work for which the planning and progress is tied to other efforts. The budget for the apportioned account will be time-phased in relation with the resource plans for the base account(s). Status and the taking of earned value are driven by the status on the base account(s). If the base account(s) are on schedule, the apportioned account will be on schedule and an appropriate amount of value will be earned.

3.7.3 Level of Effort

LOE is work scope of a general or supportive nature for which performance cannot be measured or is impracticable to measure. Resource requirements are represented by a time-phased budget scheduled in accordance with the time the support will likely be needed. The earned value is earned by the passage of time and is equal to the budget scheduled in each time period. The performance data provided is simply a comparison of budget to actual cost.

3.8 Performance Measurement

Earned value is a direct measurement of the quantity of work accomplished. The quality and technical content of work performed is controlled by other processes. Earned value is computed based on the budget assigned to the completed work scope.

3.8.1 Schedule Performance

The time-phased budget is the schedule (plan) for expenditure of the resources necessary to accomplish program work scope requirements. The budget for a period is compared to the earned value for the same period to determine and quantify the schedule performance for the program. The resultant metric is the schedule variance. It represents the quantity, i.e., the value, of the work that is ahead of or behind schedule. The specific activities and events that are contributing to the variance can be identified in program schedules.

Program schedules will involve time-oriented listings or graphic representations of the work to be done on the program. The schedule activities and events are monitored for management information. Each process provides useful and valuable information that aids in comprehending program conditions. The schedule variance metric provides early insight into detail schedule conditions and overall schedule performance and should be used in conjunction with milestone status reports, critical path data, and other schedule status information used by the organization. The schedule variance metric considers both ahead-of-schedule and behind-schedule data in the computation of an overall schedule position. Other techniques, such as critical path analysis, are preferred indicators of long-range projections; but a trend analysis of the changes in the schedule variance metric can provide a valid and useful indication of current performance and near-term projections.

Network schedules and critical path analysis are proven schedule techniques that are preferred for some purposes. While these methods are quite capable, the application of basic earned value management techniques does not require the use of any particular scheduling methods.

3.8.2   Cost Performance

Cost performance is determined by comparison of the actual costs and the earned value for the same work scope. The resultant metric is the cost variance. The cost variance is a true measure of cost performance as it compares the actual costs incurred to the value of work accomplished and eliminates the effects of schedule status variations, which are inherently present in a simple comparison of actual costs to a budget. (Rate analysis and analysis of prime costs, e.g., labor hours, may be segregated to isolate rate changes and efficiency factors as calculated using the following:)

- **Labor Rate Variance Calculation =** Actual Hours x (Budget Rate – Actual Rate)

- **Efficiency Variance Calculation =** Budgeted Rate x (Earned Hours – Actual hours)

A comparison of actual costs to budgets or prior forecasts may still be useful for evaluation of actual vs. planned program staffing levels. An analysis of actual costs and time-phased EAC data may be more relevant for evaluation of current and future staffing requirements. A typical depiction is provided in Figure 3.8-1, below.