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Earned Value Management Systems

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Earned Value Management Systems

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Foreword

The earned value management system guidelines incorporate best business practices to provide strong benefits for program or enterprise planning and control. The processes include integration of program scope, schedule, and cost objectives, establishment of a baseline plan for accomplishment of program objectives, and 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.

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 management system using earned value analysis methods without mandating detail system characteristics. Different companies must have the flexibility to establish and apply a management system that suits their management style and business environment. The system must, first and foremost, meet company needs and good business practices.

Appreciation is extended to the team that drafted this standard and to the individuals and professional organizations that supported the initial development efforts. The team that prepared and coordinated the original guidelines was an industry team staffed and chaired by members of the Management Systems Subcommittee of the National Defense Industrial Association. The EVMS work team that drafted the initial guidelines included Bob Pattie (Boeing Aerospace), John Pakiz (McDonnell Douglas), Gary Humphreys (Humphreys and Assoc.), Tom Jennings (Lockheed Martin) Paul Solomon (Northrop Grumman), Gail Saltzman (Rockwell), Harry Sparrow (Performance Management Associates), and Bob Surrency (Lockheed Martin) who chaired the team. This team reported to Art Anderson (Texas Instruments), chairman of the Management Systems Subcommittee. Their efforts were supported by the American Shipbuilding Association, Electronic Industries Association, Performance Management Association, and the Shipbuilders Council of America. Each of these organizations provided valuable inputs and encouragement to the industry team efforts. Notable individual contributors were Tom Shaw (EIA), Frank Losey (SCA). Appreciation is also extended to the representatives of the Department of Defense and Defense Contract Management Command who have supported implementation of these same guidelines in the government sector. Special appreciation is extended to Gary Christle (DoD), Wayne Abba (DoD), and Kevin Kane (DCMC). Others have since become involved, organizations have changed and people have changed positions, but this notice of appreciation recognizes the names and business units who contributed so much to the origination of this standard.

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

1. INTRODUCTION

An Earned Value Management System (EVMS) for 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 program management. The system is owned by the company and is governed by company 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 can be 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 may be 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 work to be performed.
- Use EVMS information in the company's management processes.

The essence of earned value management is that at some level of detail appropriate for the degree of technical, schedule, and cost risk or uncertainty associated with the program, a target planned value (i.e., budget) is established for each scheduled element of work. 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 metric against which to measure both what was spent to perform the work and what was scheduled to have been accomplished.

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. It is this ability to generate variances that differentiates EVM from traditional "budget versus actual cost" tracking systems. 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, 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 existing company resources and a scaled EVMS application that achieves the program requirements and is compliant with the EVMS principles. EVMS scalability is viewed as spectrum employing the principles of EVMS as fundamental to all programs and the EVMS guidelines (Section 2) as applicable to large complex

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and/or high risk programs allowing any program regardless of size and complexity to realize the benefits of earned value management.

2 EVMS GUIDELINES

This section provides basic guidelines for companies 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 company 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 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.
- d) Identify the company 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. On government contracts, 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 unmeasurable or for which measurement is impracticable may be classified as level of effort.
- 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.
- 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 contractor's 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 contract.
- 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 performance measurement at the point in time most suitable for the category of material involved, but no earlier than the time of progress payments or 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 - The costs actually incurred and recorded in accomplishing work performed.

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

APPORTIONED EFFORT - 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 - 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 - 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 - A metric for the cost performance on a program. It is the algebraic difference between earned value and actual cost ($\text{Cost Variance} = \text{Earned Value} - \text{Actual Cost}$.) 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 that are 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 by which a milestone or task is scheduled to be completed.

EARNED VALUE - The value of completed work expressed in terms of the budget assigned to that work.

ESTIMATE AT COMPLETION - 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 - 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 on which 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 - Unmeasured effort of a general or supportive nature usually without a deliverable end product. Examples are supervision, program administration and contract administration.

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

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 organization units are used by the company.

OTHER DIRECT COSTS - Usually the remaining direct costs, other than labor and materiel, like travel and computer costs.

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

PERFORMANCE MEASUREMENT BASELINE - 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 Work Breakdown Structure levels (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.

PLANNING PACKAGE - A logical aggregation of work, 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 - A metric for the schedule performance on a program. It is the algebraic difference between earned value and the budget (Schedule Variance = Earned Value - Budget). A positive value is a favorable condition while a negative value is unfavorable.

STATEMENT OF WORK - 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 - 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 - 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 - 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 establishment of program schedules and budgets. If the work scope can only be defined in general terms, it will be necessary to maintain added flexibility in program plans and controls to allow for future developments.

3.2 Work Breakdown Structure

A Work Breakdown Structure (WBS) may be 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 extent of detail (breakout and levels) in the WBS will be determined by program management needs, company 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, 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 company may elect to prepare a WBS dictionary. 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

A company will organize 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 company 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, that is another control account.

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. 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.

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 should 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 organization within a company.

3.3.3 Subcontract Management

A company will apply its own established process for management of subcontracts. Major or critical subcontractors, normally excluding those with a fixed price contract, should be required to comply either with the provisions of this standard or other appropriate requirements such as DoD C/SSR. Reporting requirements should be consistent with program risk, size, complexity, and other factors. Major or critical subcontractors with a fixed price agreement should have minimum cost reporting obligations, but should be required to provide schedule and technical plans and progress reports as needed by the prime contractor for overall program management. Subcontractor data can be integrated with prime contractor data for total program performance analysis and reporting.

3.3.4 Inter Company Work Transfers

Management of effort assigned to another component within a corporation will be done in accordance with standard company 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 prime contractor. Alternatively, the work can be managed like subcontracted effort (see 3.3.3).

3.4 Program Schedule

The program schedule is the time-oriented plan for accomplishment of work scope requirements on a program. Schedule planning and control, along with work scope definition, are necessary prerequisites for basic program management and effective cost control. The scheduling process begins during original program definition and overall schedule plans are typically established during the preplanning for a program. Supporting plans and detail schedules are subsequently developed, maintained and statused as necessary during the performance phase of the program. The scheduling process must support integration of the cost and schedule objectives of the program to provide for resource planning, performance measurement and other program management requirements.

Network schedules and critical path analysis are proven scheduling 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. The selection of scheduling techniques and the levels at which they are applied depend on the affected company 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 company policies.

3.4.2 Supporting Schedules

Master schedule requirements must be extended as necessary for a company 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 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 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, and organization. These elements are integrated in the performance measurement baseline.

Setting a budget for a program involves allocation of company 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 negotiated contract cost or internal management goals. Management reserve may be withheld before the budget is distributed to lower accounts. The budget will change as contract 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 company 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, a company may elect to establish a program budget that exceeds the program target cost. If customer performance reporting is required on the program, the customer will be consulted prior to implementation of the changes.

3.5.2 Elements of Control

A company 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 company will determine the appropriate point of responsibility in their control system for rate application for financial analysis and reporting.

3.5.3 Budget Rates

A company will apply the budget rates necessary for establishment of a valid performance measurement baseline. Usage 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

A company may establish a management reserve to be used in accordance with company policy. Management reserve is held for growth within the currently authorized work scope, rate changes, and other program unknowns. Generally, 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, a company should be able to account for all reserve at the total contract level.

Management reserve is not a contingency that can be eliminated from contract prices during subsequent negotiations or used to absorb the cost of contract 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. This provides a documented trail of work authorization from the program office 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 company 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 company will decide on the flow of the work authorizations and the approvals that are needed. The authorizations may be communicated electronically or on paper. Authorized work should be clearly identified and assigned to responsible organizations. 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

company 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 Summary Level Planning Packages

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 summary level planning package 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 summary level planning package 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 companies 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 company. 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 company operations.

Earned value management using standard hour methods is commonly used in manufacturing organizations. Measured work is effort that 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 company 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 (i.e., a planning “horizon” or “window”) for conversion of planning packages into work packages that is appropriate for all programs or conditions. Each Company must determine 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 schedule for expenditure of company 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 summary level planning packages plus applicable indirect budgets and any undistributed budget. Management reserve is not included in the 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.

3.6 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 company accounting system as appropriate for accurate reporting of program costs and performance. 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.

3.6.1 Material Costs

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

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 methodologies applicable to discrete/work packaged efforts (efforts with definable scope and objectives that can be scheduled and on which progress can be measured). The basic methodologies 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 productive inventory materials.

The valued milestone method 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 methodology (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 methods (valued milestone or standard hours) are preferred, but each method has its own merits and a company should use the methods 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 a value added metric that is computed on the basis of the resources assigned to the completed work scope as budget.

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 company. 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.

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.)

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.

3.8.3 Apportioned Effort

The schedule status on an apportioned account will mirror the status of the base accounts and the schedule variance analysis for the base accounts will apply to the apportioned accounts as well. The cost variance is not driven by the base accounts and reflects the cost of resources spent for the value earned in the affected apportioned account.

3.8.4 LOE Effort

Since the earned value for LOE is equal to the budget for the same time period, performance analysis reverts to a simple budget to actual cost comparison for LOE.

3.8.5 Price/Usage Analysis (Material)

A company may elect to conduct price/usage analyses on program materials. Price variance is determined by comparison of the planned unit prices with the actual costs. Usage variance is generally based on comparison of the planned quantities with the quantities used. This analysis may be meaningful on programs with on-going production requirements. It is not generally useful on development programs or limited run or low rate production efforts.

3.8.6 Performance Analysis/Exception Reports

Earned value analysis will evaluate program performance and identify problems for more effective management actions. Earned value analysis segregates schedule and cost problems for early and improved visibility of program performance. Analysis and control begins at the lowest practical level; however, for most program management purposes, the control accounts will be the natural focal points for analysis and exception reporting. While performance analysis necessarily involves examination of what has occurred, the focus should be on the control of current actions and assessment of future plans. The control account data is summarized for higher level analysis. The

frequency and style of reports for internal management is a company option. Standardized reports and formats may be used for customer reports on subcontracts or government contracts per mutual agreements.

3.9 Estimates at Completion

A company should periodically reassess the remaining requirements on a program and maintain a most likely estimate of the cost to complete the program objectives. This estimate is added to the costs incurred to date to determine the total estimate at completion. The process of reassessment should focus on the control accounts, but a company will apply its own methodology to ensure that all resource requirements are considered.

3.9.1 Frequency

The schedule for establishment and maintenance of EAC data depends on program management needs and overall company or corporate financial review requirements. A company may elect to conduct periodic (at least annual) EAC reassessments. Alternatively, a company may prefer to establish an on-going process of EAC review and maintenance. In either case, significant EAC changes should be incorporated whenever they are identified.

3.9.2 Content

The EAC should be the most likely estimate of the total costs for all authorized program efforts and should be time-phased in accordance with the expected completion dates on program schedules. The basis for the EAC and the reasons for changes from the last estimate should be identified.

3.10 Revisions and Data Maintenance

Revisions to program plans must be carefully controlled. The performance measurement baseline should reflect the current program management plan for accomplishment of program objectives. It must be up to date and should include all authorized changes. It is equally important that unauthorized changes are not introduced. If the maintenance of baseline plans is compromised, the information on management reports will be degraded.

3.10.1 Retroactive Changes

A company must be able to make routine accounting adjustments and correct data errors, but it should also control changes to prior and current period data to prevent inappropriate changes from being made in the performance measurement baseline. Corrections should always be made if wrong data is affecting the management value of the system, but management reports will also be compromised if current plans or program history (performance to date information) is constantly changing. A company will determine the process it deems necessary for control of retroactive changes.

3.10.2 Authorized Changes

Authorized changes should be incorporated in the performance measurement baseline as soon as practicable. This includes revisions to schedules, budgets, work authorizing documents, and any

other appropriate changes (including retroactive changes) necessary to properly reflect authorized revisions. Unless there are compelling reasons otherwise, changes may be incorporated into the affected basic control account structure that was established for optimum administrative and management utility.

3.10.3 Internal Replanning

Internal adjustments to plans for future actions is a normal management process as things happen and situations changes. It is important to ensure that overall program scope, cost, and schedule objectives are supported and retroactive changes are properly controlled to maintain the integrity of program performance data.

3.10.4 Operating Schedules/Plans

Normally, a performing organization should not have an internal operating plan that is different from the baseline plan for that work. On occasion, an organization may find it advantageous to have an internal recovery plan when there are problems. A recovery plan will not replace the baseline as a basis for performance measurement.

3.10.5 Over-Target Baseline (OTB)

Over-target baseline is a term used, normally on a government contract, to describe a situation where the budget or schedule in the performance measurement baseline exceeds the program targets. An OTB may be applied by a company when it is determined that current program conditions do not permit the performing organizations to have realistic plans for completing the program on schedule. The need for an OTB could result from a major event or program review.

If multiple OTBs are necessary on a program, they will normally be more than a year apart. The customer must be consulted in advance whenever an OTB is implemented on a government contract.

4 SYSTEM DOCUMENTATION

EVMS documentation should be established in the standard form or forms used by the affected company for systems documentation and communication of policies and procedures. This EVMS standard does not require or suggest a company should create a descriptive document that is outside of normal company requirements or restricts a company's ability to effectively implement desired system changes. At the same time, it is duly noted that it is good business practice to provide adequate policies and procedures where the subject processes are expected to be implemented and applied effectively enterprise wide. A company is hereby authorized to use materials from this standard, in whole or part including the guidance, definitions and discussions, in their system documentation.

Government contracts may include a requirement for the contractor to provide a system description document. If a company does not maintain this type of document, a brief general description with a road map to the internal documents that are used is acceptable.

5 SYSTEM EVALUATION

A company will normally evaluate the utility of internal management systems in accordance with standing policies and good business practice. For some purposes a visible and documented process of system evaluation may be needed when a company must attest to the capabilities and usage of its program management system. Assurance of conformity with EVMS guidelines may be contractually required on selected contracts for certain customers such as U.S. or other military customers, NASA, or other government agencies. This requirement may be applied in conjunction with performance measurement reporting on programs of significant size and nature as determined by contractual agreement with the customer.

5.1 Evaluation Process

The evaluation process for customer requirements provides for documented corporate assurance that the company program management system meets the full intentions of the guidelines presented in this EVMS industry standard. The company is responsible for the evaluation of its system. The process includes self evaluation of the system, documentation of conformity with this standard, and notification of any significant system changes. Once done, the self evaluation may be cited on additional contracts as appropriate.

The self evaluation may take one of several forms at the option of the affected company. The following are examples of possible approaches to meet the needs of different companies with different levels of earned valued management experience:

- A company may perform the self evaluation internally using only its own resources.
- A company may perform the self evaluation using a peer group from its own corporate resources and/or other companies.
- A company may engage an outside organization to assist them with the evaluation.
- A company may ask customer representatives to participate in the evaluation.

For its own reasons, a company may enlist outside assistance as noted, but the company still retains system ownership and responsibility. However the evaluation is done, the company should

document the process and the results, and any necessary notification of EVMS compliance should be signed by the chief executive officer of the company component involved. If the notice is corporation wide, it should be signed by an appropriate corporate officer.

5.2 Prior C/SCSC Acceptance

For government contracts, if a company has an appropriate prior system acceptance, the company may elect to cite that acceptance in lieu of providing a statement of EVMS compliance.

5.3 System Surveillance

Surveillance of the management system will be accomplished in accordance with company policies to ensure continued compliance with EVMS guidelines.

