National Defense Industrial Association
Integrated Program Management Division

Earned Value Management Systems Application Guide

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Abbreviations and Acronyms

ACWP	Actual Cost of Work Performed
ATP	Authorization to Proceed
BAC	Budget at Completion
BC	Business Case
BCWP	Budgeted Cost for Work Performed (sometimes called EV)
BCWS	Budgeted Cost for Work Scheduled (sometimes called PV)
BOE	Basis of Estimate
CAM	Control Account Manager
CAP	Capital Asset Plan
CAS	Cost Accounting Standards
CER	Compliance Evaluation Review
CPI	Cost Performance Index
CPR	Contract Performance Report
DFARS	Defense Federal Acquisition Regulation Supplement
DoD	Department of Defense
DoE	Department of Energy
EAC	Estimate at Completion
ETC	Estimate to Complete
EV	Earned Value
EVM	Earned Value Management
EVMS	Earned Value Management System
FAR	Federal Acquisition Regulation
FASA	Federal Acquisition Streamlining Act
FFP	Firm Fixed Price
GASP	Generally Accepted Scheduling Principles
HHS	Health & Human Services
IBR	Integrated Baseline Review
IMS	Integrated Master Schedule
IOT	Inter-Organizational Transfer
IPMD	Integrated Program Management Division
IPMR	Integrated Program Management Report
IPT	Integrated Product Team
LOE	Level of Effort

MR	Management Reserve
NASA	National Aeronautics and Space Administration
NDIA	National Defense Industrial Association
OMB	Office of Management and Budget
PAR	Progress Assessment Review
PASEG	Planning & Scheduling Excellence Guide
PB	Program (or Project) Budget
PBSA	Performance Based Service Acquisition
PM	Program (or Project) Manager
PMB	Performance Measurement Baseline
PRB	Program Risk-Adjusted Budget
R&O	Risk and Opportunity
SLPP	Summary Level Planning Package
SPI	Schedule Performance Index
T&M	Time and Material
UB	Undistributed Budget
WBS	Work Breakdown Structure

1 Introduction

Earned value management (EVM) is recommended for all programs where delivery of a product or other objectively measurable outcome is intended. In such programs, successful execution of performance objectives depends to a large degree on the quality of the planning effort for the application of EVM. EVM is an effective integrator of the work scope, schedule, resources, and risk that should be applied consistent with the program type, complexity, and size. The EIA-748 Standard for Earned Value Management Systems (EVMS) is a scalable EVM approach that can be adapted to any size project, program, or enterprise.

The purpose of this guide is to provide an overview of how EVM can be incorporated into the acquisition life cycle for any organization that intends to implement the EIA-748 Standard for Earned Value Management Systems (EIA-748). This guide provides the context for the application of EVM within a notional Federal Government agency acquisition life cycle, and as a result uses government acquisition terminology.

This guide elaborates on the performance-based management requirements defined by the Office of Management and Budget (OMB) in OMB Circular A-11, Part 7, Capital Programming Guide, a supplement to A-11, "Planning, Budgeting, Acquisition and Management of Capital Assets." Appendix A provides a summary of the EVMS contract clauses and agency policy documents that support the requirements in the A-11.

This guide also provides an overview of the NDIA Integrated Program Management Division (IPMD) guides that complement the EIA-748 Standard. The NDIA guides are intended to define and explain the EIA-748 32 guidelines in sufficient detail to allow an organization to implement an effective EVMS. The NDIA guides should not be interpreted as adding requirements that must be met.

This guide assists in:

- Applying EVM throughout the acquisition life cycle including EVM application planning, contracting for EVM, implementation and use of EVM, and EVMS review and acceptance. The EVMS review and acceptance process allows multiple government agencies to accept an EVMS (cross-agency acceptance or reciprocity) without imposing unnecessary duplication of acceptance reviews.
- Planning for a risk-based EVM application on a program by incorporating systems engineering, cost estimating, risk/opportunity management and contracting activities to develop and manage the cost, schedule, and performance goals and objectives on that program.
- Organizing to facilitate EVM governance and systems compliance.
- Measuring performance progress and managing change.

"Project", versus "Program", is used in this guide to identify all work authorized by a contract. Generally, a project involves a planned effort to achieve an outcome, the progress toward which is discretely measurable. A project will have an established scope, schedule and dollar value. A program may consist of just one project or multiple projects within a portfolio.

Users of this guide are encouraged to submit recommended revisions to the NDIA IPMD Board of Directors.

2 Definitions

Acceptance Authority (EVM System Acceptance Authority)	An organization or party within a Government Agency or contractor organization responsible for recognizing that a supplier's EVM system proposed for use on a prime or subcontract, or for in-house work, meets the intent of the 32 guidelines in the EIA-748.
Compliance Evaluation Review (CER)	A formal process used to verify that the EVM System Owner's proposed EVMS implemented on contracts complies with the EIA-748 32 guidelines, the system has been properly implemented by the system user in accordance with the requirements of the contract and system owner's policies, and the system produces reliable, timely, and actionable contract performance data.
Compliance Recognition Document	The generic title given to any document generated by the Acceptance Authority that communicates the formal recognition of the EVMS as having successfully demonstrated compliance with the EIA-748 32 guidelines on selected contracts within a corporation, division, facility, or Government Agency.
Contingency	Cost reserve owned by the government customer. It is held outside of the project scope, schedule, and budget already provided to the contractor. Also see Program Risk-Adjusted Budget (PRB).
Cost Risk	The likelihood a program will not accomplish planned tasks within the planned budget and may consist of inaccurate or unreasonable cost estimates, or fail to manage to cost, schedule, or performance objectives.
Discrete Work	Tasks that are related to the completion of specific end products or services, which can be separately planned and measured.
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). It provides an objective measure of the value of completed work expressed in terms of the budget assigned to that work.
Earned Value Management (EVM)	A management methodology, which integrates a program's technical scope, schedule, and resources with program risk in a baseline plan, against which progress is measured to provide metrics indicative of program progress and performance trends useful for management decision making.
Earned Value Management System (EVMS)	An integrated set of policies, processes, procedures, systems, practices, and tools for managing projects that meets the intent of the 32 guidelines in the EIA-748.
EVM System Owner	The organization or party responsible for the design and maintenance of an EVMS compliant with the EIA-748. In addition, the system owner is responsible for establishing policies regarding the implementation and use of the EVMS. The system owner may also be referred to as the EVMS process owner. Examples of EVM system owners include contractors, subcontractors, Government program offices, and Government activities.

Integrated Baseline Review (IBR)	A risk-based review conducted to ensure mutual understanding between the customer and the supplier of the risks inherent in the supplier's Performance Measurement Baseline (PMB) and to ensure the PMB is realistic for accomplishing all the authorized work within the authorized schedule.
Integrated Master Schedule (IMS)	An integrated, networked schedule containing all of the detailed activities necessary to accomplish project objectives. When coupled with the Integrated Master Plan, it provides the time spans needed to complete the accomplishments and criteria of the IMP events. The IMS is typically used to produce the various levels of schedules for the project (summary master, intermediate, and detailed).
Integrated Product Team	A multi-disciplinary team of acquisition professionals led by a program/project manager, which is responsible and accountable for planning, budgeting, procurement and life-cycle management of an investment to achieve its cost, schedule, and performance goals.
Management Reserve (MR)	An amount of the total budget set aside for unplanned, in scope effort that may arise during the course of the project, which cannot be identified in advance and is used to handle execution risk. Management reserve budget should be commensurate with the level of risk. It is not part of the Performance Measurement Baseline (PMB).
Performance Budget	A budget presentation that clearly links performance goals with costs for achieving a target level of performance. In general, a performance budget links strategic goals with related long-term and annual performance goals (outcomes) with the costs of specific activities to influence these outcomes about which budget decisions are made.
Performance Measurement	A method of determining progress and a means for evaluating efficiency, effectiveness, and results. Performance measurement should include program accomplishments in terms of outputs (quantity of products or services provided) and outcomes (results of providing outputs in terms of effectively meeting intended agency mission objectives), indicators, statistics, or metrics used to gauge program performance.
Performance Measurement Baseline (PMB)	The total time-phased budget plan (Budget at Completion) 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 PMB 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 PMB, as it is not designated for specific work scope. The PMB is traceable to the baseline dates in the Integrated Master Schedule (IMS).
Program	A major, independent part of a capital asset or system that involves a planned effort to achieve an outcome, the progress toward which

	is discretely measurable. A program may be comprised of multiple projects, delivery orders, task orders, or other recognized terms indicating a bilateral agreement between contracting parties.
Program Manager (PM)	The individual designated with responsibility for and authority to accomplish program objectives for planning, budgeting, acquisition, and management to meet the user's operational needs. Also may be identified as a Project Manager or Product Manager.
Program Budget (PB)	The total budget for the program including all allocated budget, management reserve, and undistributed budget. In this context, "program" includes all government and contracted resources used to perform all contracts and projects. It does not include program funding and schedule risk-adjusted contingencies.
Program Risk-Adjusted Budget (PRB)	The total program budget that includes an additional amount of funding and schedule above the PB that customer management determines may be necessary to ensure project/program success. The PRB for a government program should be established at a level of probability sufficient to provide acceptable confidence that a program can achieve 90% of its performance, cost, and schedule objectives within the approved budget as required by statute. The amount above the PB covers risk not identifiable through the IBR and other risk/opportunity management approaches, but that history on similar programs or the amount of total risk on the particular program indicates will likely be needed to ensure sufficient resources will be budgeted for project/program success. The difference between the PB and PRB is held at a level above the program level to be released to the program when justified to fund cost and schedule overruns from the PMB that happen through no fault of the program management process.
Project	A project has defined technical scope, schedule, and cost. Generally, a project comprises all effort authorized by a contract or other authorization document received from a customer, (e.g., a subcontract or inter-organizational transfer (IOT)), but it may also be an internally-defined and authorized effort. There may be multiple projects within a program.
Risk and Opportunity (R&O)	An uncertain future event or situation that could impact the ability to achieve overall program requirements within defined cost, schedule, and technical objectives. Risk has two components: 1) the probability (or likelihood) of a particular outcome and 2) the consequences (or impact) of that outcome. The consequences of risks are typically thought of as negative that may need to be mitigated to minimize the impact to the program. A risk event with positive consequences is referred to as an opportunity that may be captured as a benefit to the program.
Schedule Risk	The likelihood that the program actions cannot be accomplished in the planned program time frame. May result from unrealistic schedule estimates or problems with program execution.

Schedule Risk Assessment (SRA)	A formal process used to simulate the execution of a project hundreds or thousands of times to quantify schedule risk and predict the probability of completing events by specific dates.
Technical Risk	The likelihood that the program, as planned, will be unable to deliver a product to satisfy the technical or operational requirements.
Undistributed Budget	A temporary holding account for budget associated with specific work scope or contract changes that have not been assigned to a control account or summary level planning package (SLPP).
Work Breakdown Structure (WBS)	A product-oriented structure that depicts the subdivision of effort required to accomplish project objectives. It is an organized method to break down a product into sub-products and at the lowest level, the tasks to be accomplished. It is used for planning, budgeting, work authorization, performance measurement, tracking, and reporting purposes.

3 Acquisition Process and Earned Value Management

3.1 Acquisition Life Cycle

- Several acquisition disciplines are essential to establishing and operating an integrated EVM process within the acquisition life cycle, especially Program Management, Systems Engineering, Cost Estimating, Risk/Opportunity Management, and Procurement.
- Integrated Product Teams should devote the planning time needed to create an adequate Work Breakdown Structure at program initiation and to keep it current throughout program execution.

The program or project acquisition life cycle starts with concept analysis progressing through technology definition, requirements planning, acquisition, and finally through operations or management. Although the terminology may differ throughout government and industry, the processes are generally the same. These processes typically include decision points where executive boards review and approve a program's entry into the next phase or stage, based on satisfactory completion of exit criteria from the prior phase or stage.

The Capital Programming Guide supplement to OMB Circular A-11, Part 7 reflects three lifecycle phases of the capital programming process: Planning and Budgeting, Acquisition, and Management-In-Use. These three phases when viewed from a systems perspective may be identified as Pre-Systems Acquisition Planning, Systems Acquisition, and Systems Sustainment as shown in Figure 1.

Figure 1. Key Functional Activity Flow

Pre-Systems Acquisition Planning, for purposes of this guide, includes linking planning and budgeting for long-range planning of capital assets in a strategic annual plan that describe an organization's incremental progress toward achieving its strategic goals and objectives.

The Systems Acquisition phase begins after the agency has received funding for a segment, module, or the entire asset and ends when the asset is delivered and fully operational. It includes both in-house organization work as well as contracted work. The in-house work must be managed with the same rigor as contract work. In-house operations are expected to achieve the cost, schedule, and performance goals to ensure success of the project, just as with contracted work.

The Systems Sustainment phase begins after delivery of the first operational units of the system and continues until the end of the systems life-cycle. The Systems Sustainment phase is generally the longest phase of the investment or systems life cycle and represents the operations and management of the system as deployed.

3.1.1 Acquisition Planning

Several acquisition disciplines are essential to planning an acquisition through its life cycle. At initiation of a major acquisition, the acquisition planning team should include individuals with skills in the following areas: Project Management, Contracting, Cost Estimating, Risk/Opportunity Management, Sustainability, Scheduling, Users, Budget, Technical Experts, Information Resource Management, Value Management, and EVM. Staff with other appropriate skill sets should also participate.

Planning for EVM and risk/opportunity management begins at program inception with the definition of the work and extends through the assignment of the work to the performing organizations. Work is defined using a WBS that displays and defines the product(s) and relates the elements of work to each other and to the end products that completely define the program. Risks identified in the planning should be assigned to specific elements of the WBS. Risks should be identified in the risk register and referenced to the WBS Dictionary to serve as the basis for the development of the risk-adjusted baselines. Department of Defense (DoD) Military Standard 881 ((MIL-STD-881) "Work Breakdown Structures for Defense Materiel Items" is a widely used WBS reference which many non-defense organizations have adapted for use on their programs. Although the standard is DoD oriented, the concepts and approaches of good WBS development are applicable regardless of the defined end-item.

The evolution of a WBS during a program life cycle is illustrated in Figure 2. As program planning proceeds, all affected organizations – especially systems engineering, cost estimating, contracting, and program management – should work together to establish the program WBS, refine it as the program requirements firm up, and extend it to individual projects and contracts.

Organizations that have similar programs should consider using a standard WBS template to support consistent program definition and to facilitate an integrated program management process.

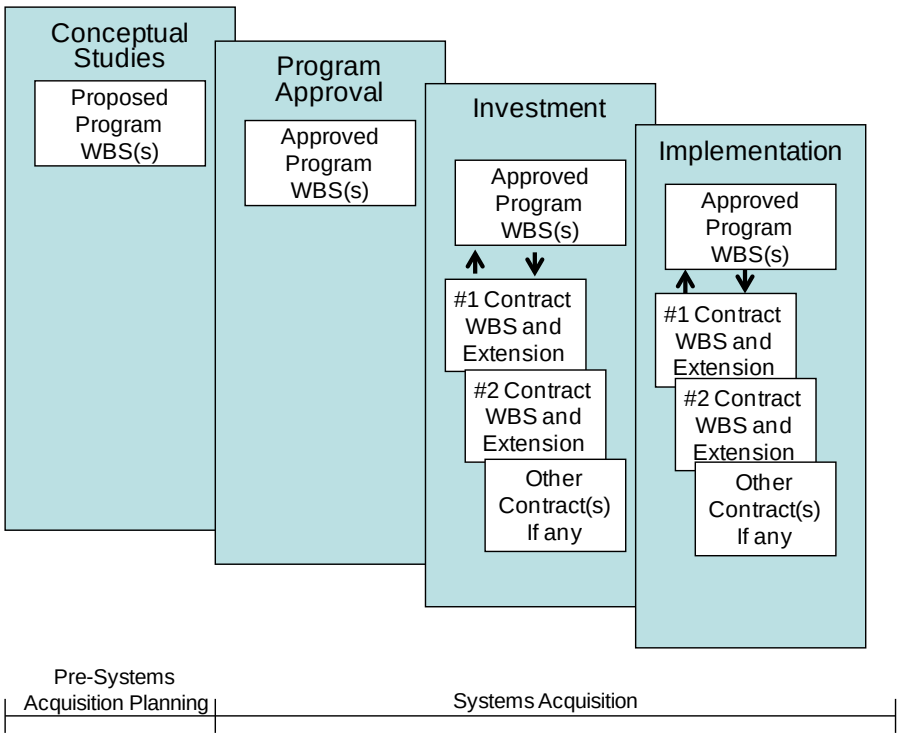

Figure 2. WBS Evolution

Even if the preferred solution has not been determined, it is essential program WBS planning begin promptly upon program initiation at the earliest stage of the planning phase. The importance of devoting adequate time to "up front" planning to create a well developed WBS and to keep it current throughout program execution cannot be overstated.

Program management's use of EVM depends on a well-developed WBS to ensure a program is completely defined. Program experts in collaboration with experts in the areas of Systems Engineering, Cost-Estimating, Procurement, Risk and Opportunity Management, Scheduling, and EVM need to develop a WBS as a common framework within a given program, among related programs, and across an organization's portfolio. For example, the program WBS established during concept definition will provide the framework for estimating the program's cost and risk during the pre-systems acquisition planning and for developing the program schedule. The cost estimate and program WBS provide the basis for suppliers to extend the WBS to achieve integrated cost, schedule, and technical performance management using EVM during systems acquisition.

3.1.2 Acquisition Management

Integration of work and performing organizations is achieved by identifying the organizational levels where responsibility for work scope, schedule, and resource management for each WBS element is assigned. This management control point, known as a "control account," is unique to each organization and varies depending on how the organization operates, as illustrated in Figure 3. For example, an organization that is functionally oriented may have more control accounts than an organization that manages with integrated product teams (IPTs) because these teams frequently have a broader span of control. Control accounts should be established at a level high enough to provide sufficient management flexibility, yet low enough to ensure that all significant variances are identified early enough to take corrective action. The level selected for control accounts may vary among programs and even within programs, for example, when a decision is made to manage a high risk WBS element at a relatively low level.

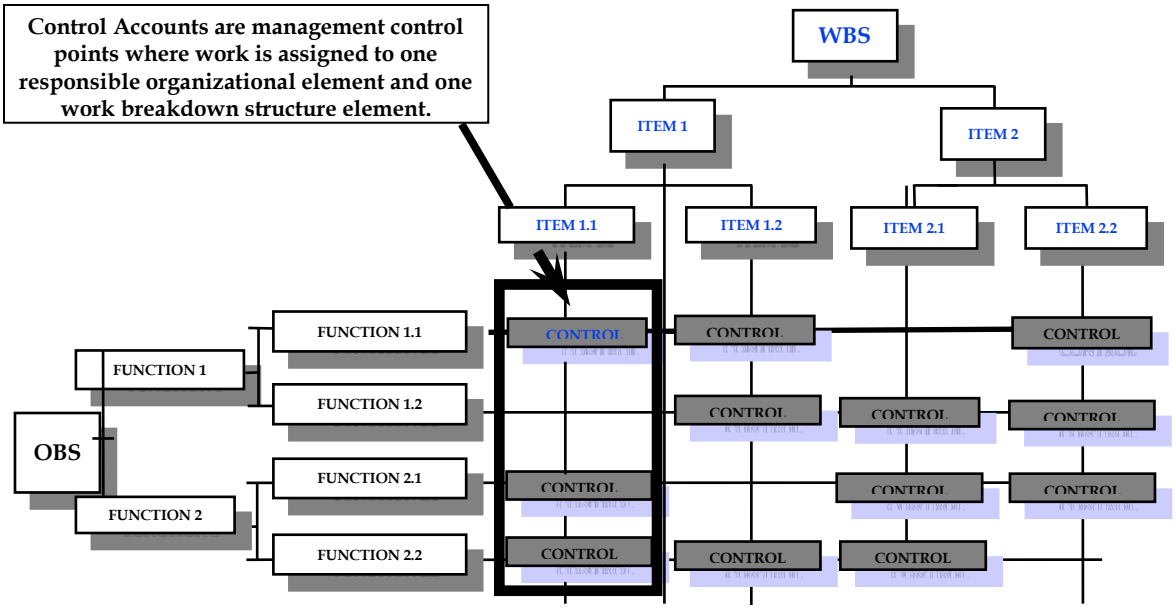

Figure 3. WBS/Organization Matrix

Managing a major investment takes a dedicated IPT of acquisition professionals along with personnel with other skills such as legal, budget, finance, personnel, and others needed to achieve a successful program. The size of the dedicated staff assigned to the IPT and their location will vary depending on the phase of the investment, but individuals with acquisition skill sets must be assigned to the team. They should be co-located during the planning phase and be available as needed throughout the remainder of the investment's life cycle. Control account managers (CAMs) and integrated product teams are an integral part of the acquisition process. They support the PM and operate in a spirit of teamwork with participants empowered to make commitments for organizations they represent, enabling decision-makers to make the right decisions at the right time. The entire team needs to be together to the extent possible during the planning phase, so all disciplines participate in the development of the statement of work and the cost estimates to ensure their concerns are addressed.

Once the program requirements and deliverables are defined, the cost estimator can use this information to develop the program cost and schedule estimates. This cannot be accomplished without first establishing an estimating structure and WBS, identifying cost drivers, and collecting cost, schedule, technical, and programmatic information to form the basis of estimate (BOE). Throughout this process, risk must be identified to ensure a range of possible outcomes is considered. This concept illustrated in Figure 4 shows the life cycle and its relationship to program management and risk assessment.

Managing these costs can be accomplished by ensuring the program has a clear integrated program execution plan and schedule as illustrated in Figure 5. This must include the probability of success associated with the total program with each element in the WBS if the program technical, schedule and cost objectives are to be met.

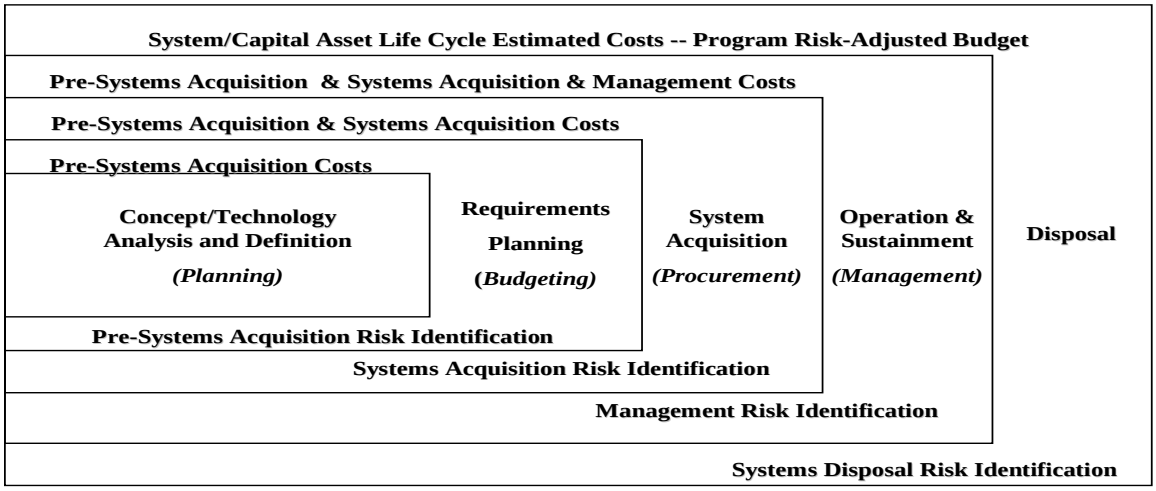

Figure 4. Capital Asset Life Cycle Cost and Risk Application

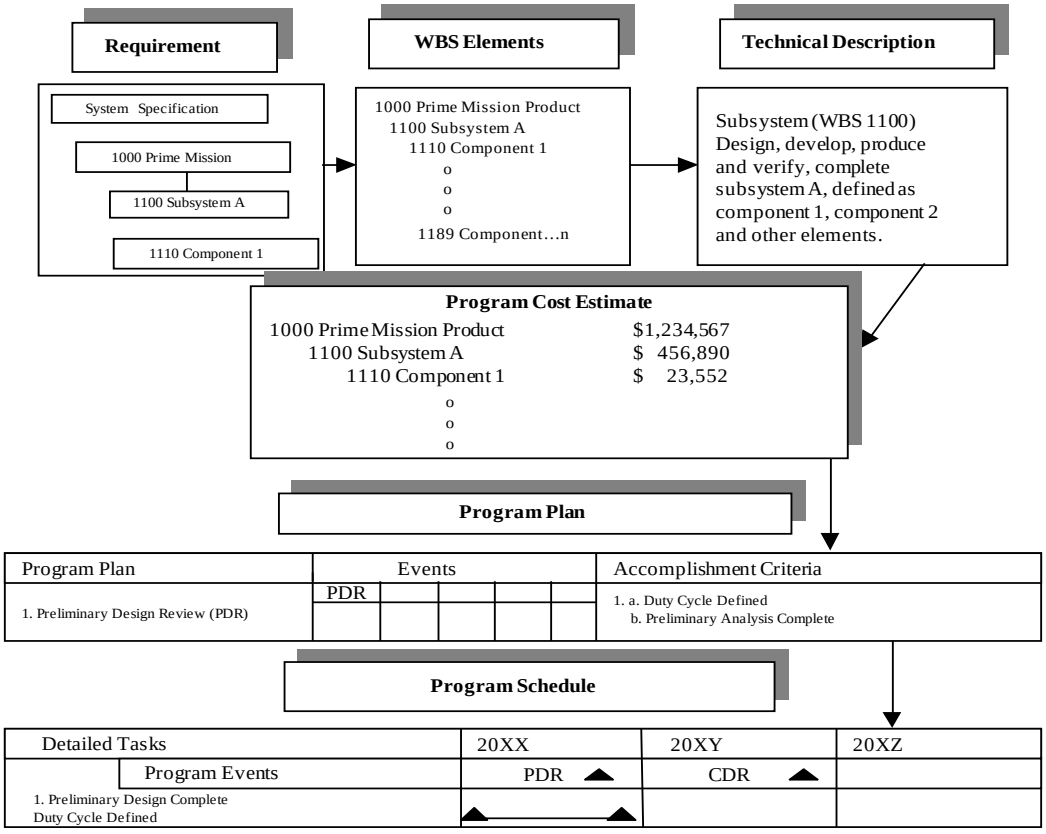

Figure 5. Relationships of Program Plan and Schedule with WBS

3.2 Earned Value Management

- Earned Value (EV) is 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).
- Earned Value Management (EVM) is a management methodology, which integrates a program's technical scope, schedule, and resources with program risk and opportunities in a schedule and cost baseline plan, against which progress is measured to provide metrics indicative of program progress and performance trends useful for management decision-making.
- An EVM System (EVMS) is an integrated set of policies, processes, procedures, systems, and tools for managing projects that meets the intent of the guidelines found in the EIA-748.

EVMS provides program management with a capability to integrate the work scope with the schedule and cost elements for effective program planning and control through the following principles.

- Planning all of a program's work scope to completion.
- Defining the work scope in logical components to assign management responsibility for technical, schedule, and cost objectives, and for risk and opportunity management.
- Integrating work scope, schedule, and cost objectives into a performance measurement baseline plan from which accomplishments may be measured and baseline changes controlled.
- Recording of actual (or estimated) costs incurred in the performance of work.
- Objectively assessing the accomplished work at the work performance level.
- Analyzing variances from the performance measurement baseline, forecast of impacts, and estimates at completion for schedule and cost.

Effective application of EVM provides customer and supplier program managers timely, reliable, and actionable integrated cost, schedule, and technical performance information for both the total capital investment program and the individual supporting projects or contracts.

- The nature of the work (e.g. inherent complexity, external dependencies, schedule, or cost risks) is a key consideration in establishing a performance management approach.
- EVM can be objectively applied to discrete work. Level of effort must be evaluated using other means that are not related to schedule milestones or objective measures of progress.

For the benefits of EVM to be fully achieved, comprehensive planning at the outset, combined with the establishment and disciplined maintenance of a performance measurement baseline, is required. The combination of comprehensive planning, baseline maintenance, and earned value yields earlier visibility into program performance and estimated completion projections than is provided by non-integrated program management methodologies for planning and control. Systematic implementation of EVM throughout the organization facilitates comparison of program performance, enabling managers to make better-informed decisions.

3.3 Risk and Opportunity Management

- The objective of the risk and opportunity management process is to identify risks and opportunities and manage them effectively to minimize cost, schedule, and performance impacts to the program.
- The risk and opportunity management process relies on inputs from program personnel, customers, and other sources, as well as program management and analysis tools used on the program.

The successful management of risk requires proactive identification and assessment of potential risks, plus the planning and execution necessary to respond to them. The objective is to identify program risks and opportunities. In addition, the process will aid in how to handle risk and opportunity plans or responses, allocate program resources for risk and opportunity activities, and manage them effectively to minimize the negative cost, schedule, and performance impacts to the program or to capture the opportunities. A basic risk and opportunity management process is illustrated in Figure 6.

The process allows the program team to identify and mitigate risks or capture opportunities relative to program cost, schedule, and performance objectives. Consequently, risks and opportunities are stated in terms of uncertainty relative to specific consequences, either positive or negative, and in terms of their potential impact on cost, schedule, or performance parameters of planned program tasks.

The risk and opportunity management process relies heavily on the free and open flow of information exchanged by all program team members. The Program Manager is responsible for risk and opportunity management, but usually delegates that responsibility to a designated Risk Manager for the program. The Risk Manager leads and facilitates the risk and opportunity management process. The risk and opportunity management process relies on inputs from program personnel, customers, and other sources, as well as program management and analysis tools used on the program.

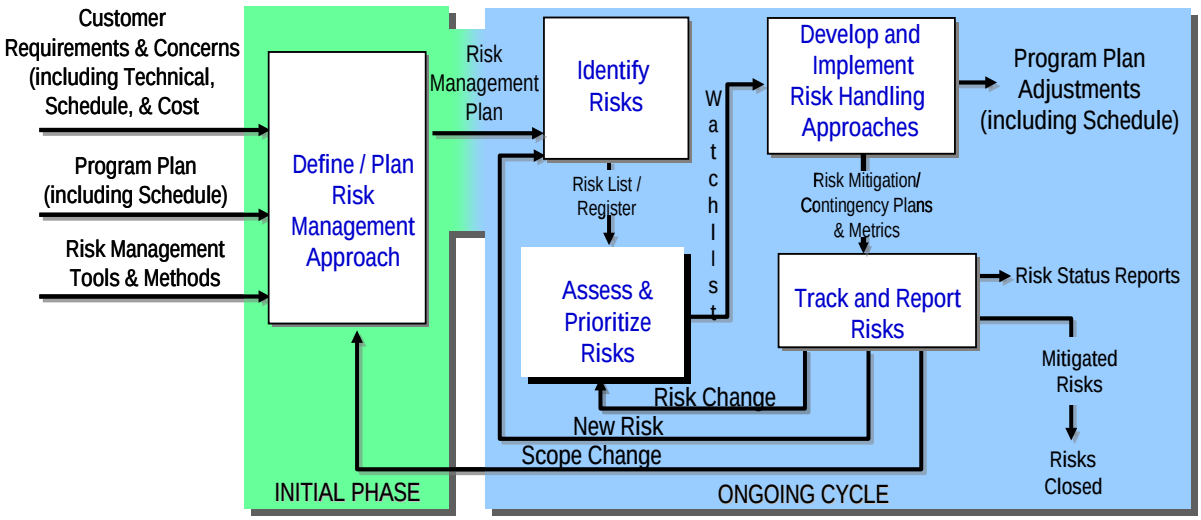

Figure 6. Risk and Opportunity Management Process

3.4 Integrating Risk and Opportunity Management with Earned Value Management

- Successful project management requires proactive identification and assessment of potential risks and opportunities in the planning and budgeting phase, plus the planning of actions necessary to respond to them.
- Risk and opportunity management is integrated with EVM processes during the planning and execution phases of the program to improve performance and enable more reliable predictions of project outcomes.

Because of the differences in the nature of the work and the objectives for each phase of the defined acquisition lifecycle, methodologies for executing, managing, and evaluating performance must be used. Identifying the deliverable product or service provides useful information for structuring a management system that facilitates delivery of that product or service. EVM is not necessarily appropriate for all phases, but is applicable where significant risks (uncertainty) in cost, schedule, and scope objectives are thought to exist.

Risk and opportunity management is integrated with EVM processes during the planning and execution phases of the program to improve performance and enable more reliable predictions of project outcomes as illustrated in Figure 7. During the planning phase, the PM must decide, given the risks and opportunities identified, how much budget to allocate and how much to hold in management reserve. Schedule risk assessments are performed to identify schedule risks. Budget for risk handling is allocated to the control accounts based on their significance and where in the WBS they exist. As the baseline plan is executed, the EVM metrics provide insight into the success of risk/opportunity handling plans, the realization of risks and the capture of opportunities. Management reserve is issued (or returned to replan future work) as needed to address realized risk or take advantage of captured opportunities. Quantified risks and opportunities are considered in maintaining the control account estimates to complete (ETC) and determining the overall project's best, worst, and most likely estimates at completion (EACs).

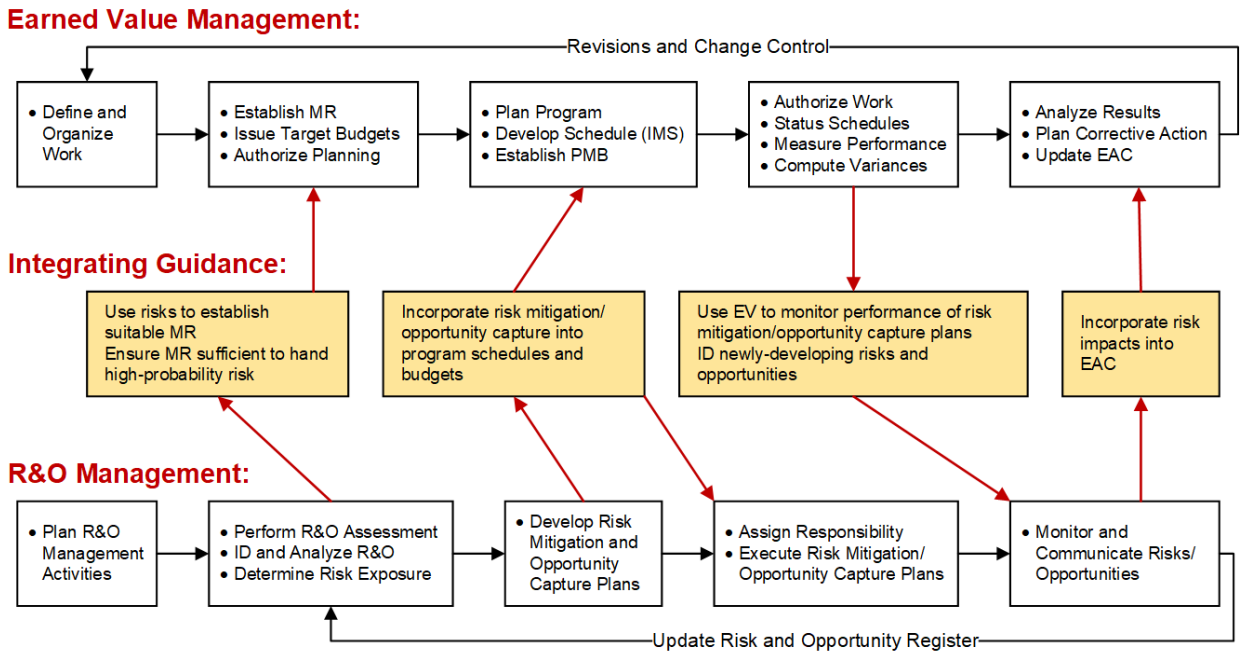

Figure 7. Project Level EVM and Risk/Opportunity Management Integration

4 EVM Application Planning

4.1 Organizing for EVM

- Organizing for EVM application begins at program inception with the definition of program work and the identification of the organizational elements responsible for planning and control.
- Integration of work and performing organizations is achieved by identifying the WBS and organizational elements where work scope, schedule, resource, and risk and opportunity management will occur.

EVM applies to the total program effort, including both customer resources and contracted work, to better manage complex, high-risk programs. EVM is applicable to the in-house (customer) portion of the program effort as well. All program work activities performed by any organization are derived from the program and extended WBS, which should be managed using EVM.

- Customer Organizations. Customer organizations and personnel, while commonly used to perform program management and oversight, also may perform engineering, testing, deployment, and logistics support functions. Customer organizations may act as system integrators.
- Major Suppliers. Major suppliers are commonly employed in the areas of design, engineering, development, deployment, and support functions.
- Support Suppliers. Support suppliers commonly perform support roles in one or more areas of program management, engineering, configuration management, test, and logistics. Support suppliers may provide services and logistics support functions.

4.1.1 Governance

Effective EVM implementation depends on several management disciplines. Typical EVM responsibilities performed by the PM, Contracting Officer, and EVM System Owner includes those listed below.

Program Manager

- Leads development of the program's technical approach, cost estimates, schedule, risk/opportunity management plans, and PMB;
- Determines the management approach for a program and applicable contracts based on program size, complexity, and risk;
- Manages the program budget and provides PMB performance information to higher management, including corrective actions and baseline change requests;
- In consultation with the contracting officer, develops the acquisition strategy for obtaining the selected solution and establishes the appropriate EVMS and reporting applications for each contract;
- In coordination with the contracting officer, conducts the Integrated Baseline Review (IBR);
- Prepares the program for an EVM System compliance evaluation review (CER), if required;
- Ensures the integrated product teams are adequately trained in program management, EVM, risk and opportunity management, and other program management disciplines;
- Incorporates supplier contract performance and risk/opportunity data into the program performance information using the program WBS;
- Estimates cost and schedule at completion based on performance data.

Contracting Officer

- In consultation with the PM, develops the acquisition strategy for obtaining the selected solution and establishes the appropriate EVM and performance data requirements for each contract and project;
- In coordination with the PM establishes contractual requirements for the IBR;
- Prepares the contract solicitation to include the proper EVMS contract clauses and associated reporting requirements (for a reference of applicable clauses, see Appendix A);
- Formally receives, delivers comments, and accepts contract deliverables;
- Coordinates with the EVMS owner to ensure the organization's EVMS meets the requirements of the contract.

EVM System Owner

- Assists PMs and business managers to apply EVMS requirements to programs and contracts in accordance with the applicable organization's policy/process;
- Coordinates EVMS activities with other government agencies and with industry;
- Develops policy and guidance for EVMS;

- Consults with teams on EVMS issues during planning and implementation phases;
- Advises and assists programs with IBRs;
- Coordinates EVMS surveillance and maintains information about acceptance of suppliers' EVMS;
- Coordinates EVMS reviews;
- Manages or provides EVMS training.

4.1.2 Risk-Based Application

Significant investments require a clearly understood process for ensuring that the program schedule, budget, expected outcomes, and cost/schedule performance measurements are integrated with risk and opportunity management. Risk and opportunity management begins with evaluating the WBS for cost, schedule, and technical risk/opportunity. Risks and opportunities in each of these areas for each WBS element should be identified, analyzed, and quantified in terms of potential cost, schedule, or other impact to the program. Risk and opportunity identification involves identifying and analyzing program areas and critical technical elements to identify and document the associated risk/opportunity. Assumptions and constraints also need to be identified and analyzed for cost and schedule impact. Risk and opportunity analysis involves examining each risk/opportunity to determine the probability of the risk/opportunity occurring and the cost, schedule and technical consequences/benefits, if the risk/opportunity occurs. To a degree acceptable to management, the cost of the risk/opportunity occurrence is added to the program budget (a risk) or subtracted from the program budget (an opportunity). The result of this analysis is a risk-adjusted cost estimate.

The program's milestone schedule should also be adjusted for risk. Measurable WBS elements significant to a project milestone should be analyzed for most optimistic, most pessimistic, and most likely durations. A risk-adjusted schedule will have finish dates that reflect the likelihood of a risk event occurring and its associated schedule impact. If schedule delays will affect cost, this should be reflected in a risk adjusted cost estimate.

A significant program investment demands a mechanism to ensure that the expected program schedule and cost outcomes and cost/schedule performance measurements are integrated with risk and opportunity management. Without this integration, budget may be expended without regard to specific events, products, or other deliverables. The decision to apply EVM should be based on the nature and characteristics of the work to be performed on the contracts and projects. Careful evaluation of the size, complexity, and estimated risk will influence decisions such as the type of contract(s) awarded, as well as the application requirements for an EVMS.

4.1.3 Scalability

EVM lends itself most readily to work that can be defined in terms of cost, schedule, and technical performance objectives. Such work occurs primarily in a program's development and production phase. However, the primary consideration should be the nature (type) of the work. For example, work done during a planning phase to develop a prototype or test article lends itself to performance management using EVM. Similarly, system upgrades or maintenance, repair, and overhaul work done during a program's operational or management-in-use phase is measurable using EVM techniques.

A program's planned duration should also be considered. For less complex projects (generally considered to be less than a year), it is still important that appropriate cost, schedule, and risk/opportunity management processes be applied for effective monitoring and control. Their implementation may be less detailed than required on more complex projects.

The guidelines in EIA-748 are “scalable”. That is, they describe the attributes of an effectively integrated program management system. They do not prescribe a specific method of implementation. In addition, one or more of the 32 guidelines may not apply to a given program or organization. This inherent flexibility is the strength of EVMS that has contributed to its continued management effectiveness. The NDIA IPMD Guideline Scalability Guide discusses applying the EIA-748 guidelines in a way that reflects the size, complexity, risk, and type of work necessary for the successful management of the project.

The following are examples of scalability in the application of the guidelines and in the implementation of an EVMS.

- Applicability. Some guidelines are unique to certain types of programs. For example, “Identify unit costs, equivalent unit costs, or lot costs when needed” refers to a manufacturing environment or to deliverables priced on a unit, equivalent unit, or lot basis. Another guideline requires that all indirect costs allocated to the contract be recorded. If indirect costs are not identifiable, or do not exist, the guideline would not apply.
- Frequency. Performance is measured at least monthly, or aligned with the organization’s normal accounting period. A best practice is to link the EVMS to an organization’s normal management business rhythm, which may be as frequent as weekly. Although actual cost information may not be available from an accounting system, the EVMS may use actual or estimated costs. Estimated costs should be based on labor hours, units, or similar measurable basis used for management and reconciled with the actual cost accounting data when they become available.
- Accounting Systems. The guidelines per se do not include requirements for accounting systems. Major federal suppliers meet well-established government accounting system requirements, which are specified in the Federal Acquisition Regulation (FAR) and the Cost Accounting Standards (CAS). These major suppliers use their accounting systems to accumulate actual costs consistent with budgets and earned value. They may also estimate actual costs to compare with earned value, when vendor billing and payments lag the earned value data. Most government organizations and many small and medium suppliers do not have equivalent accounting systems and must use alternative approaches for accumulating cost to provide timely actual cost information for EVMS.
- Program Size. Small contracts and projects may be no less critical to an organization than larger, more complex ones. In using EVM for such contracts and projects, organizations must consider the depth of implementation detail. For example, EIA-748 does not define a specific decomposition level for the WBS.
- Reporting. Customer reporting requirements should be limited to that essential for program oversight and contract administration. Electronic reporting or direct access to supplier data is preferable because they shorten the delivery cycle time. When integrated product teams use EVM data routinely to manage the program and record the actions taken, reporting may be seen as a by-product of the implemented management process.

4.2 Developing the Program Budgets

When programs, projects, and contracts contain cost and schedule risk, the risks are managed by selecting the appropriate contract type and by establishing cost management reserve and schedule margin at all management levels.

Many programs will need to develop two budgets, the Program Budget and the Program Risk-Adjusted Budget. The Program Budget (PB) is the budget for all government and contracted resources that will be used to perform all contracts and projects comprising the program. The PB includes the performance measurement baseline, along with management reserve and undistributed budget. The PB process is described in Section 4.2.1 below.

OMB's Capital Programming Guide also allows the use of a Program Risk-Adjusted Budget (PRB) when necessary because of the discipline and realism it brings to the budgeting process. A PRB allows managers to manage for success, by including budget for risks unknown at the time the acquisition is planned, within the statutory requirement that at least 90% of cost, schedule, and performance goals be achieved. OMB must approve the PRB and programs must ensure that OMB fully understands the rationale for the additional, contingent budget and schedule requested in excess of the approved Program Budget.

If a PRB is approved, the budget in excess of PB is retained at a level above the program for use only when fully justified. Bonuses for government personnel and incentives for suppliers are based on achieving the program goals at or below the PB. However, completing the program within the PRB is by definition a successful program. Not meeting the PRB would be considered a failed program, absent an approved change to the PRB. The following sections discuss the development of the PB and the use of PRB contingencies necessary when EVM indicates the PB will be breached.

4.2.1 Program Budget

Measuring the progress of a program cannot be accomplished without understanding the PB and PMB. The PMB should represent the entire program based on judgments concerning cost, schedule, and technical risk and comprise all of the technical requirements (size, weight, capability, performance, etc.). These requirements are defined through the systems engineering process that determines how the program will be conceived, developed, produced, and managed through its life cycle. This process provides a clear understanding of the program by defining the end products.

Figure 8 illustrates the result of a program planning phase, incorporating the results of systems engineering, cost estimating, and risk and opportunity planning to develop the overall cost, schedule, and performance goals for a program. It also illustrates how EVM supports the overall program cost and schedule risk/opportunity management consistent with industry and government needs for capital asset management.

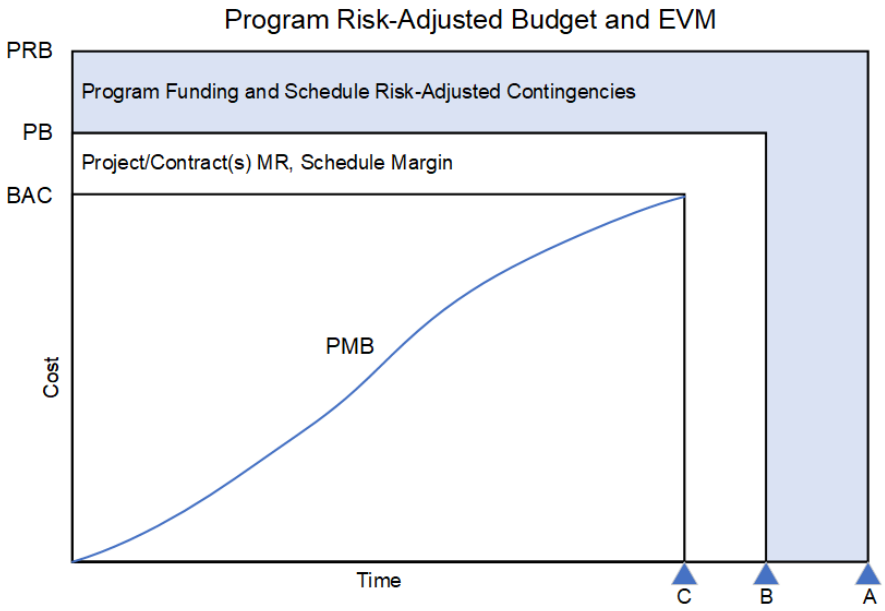

Figure 8. Planning Phase

The line labeled PB, "Program Budget", represents "the total budget for the program including all allocated budget and undistributed budget, i.e., the PMB, plus management reserve." In this context, "program" includes all organization resources and contracted supplier resources used to perform all contracts and projects. Organizations allocate budgets to their PMBs that include allowances for schedule and cost uncertainty, which provide challenging but achievable targets. Some of this allocated budget may be assigned for risk and opportunity handling activities that have been incorporated into the schedule and PMB. By implementing EVM at the program level, agencies can summarize in one PB all resources required to execute the program, whether performed by an organization or supplier. The schedule milestone "B" represents the required completion date for those projects and contracts.

Contracts and projects also include cost management reserve and schedule margin appropriate to the level of risk and contract type. Management reserves are established at appropriate confidence levels based on risk tolerance and represent the difference between the PB and the Budget at Completion (BAC). When time phased, the BAC establishes the PMB. Budget allocated to the PMB should reflect the PM's assessment of the potential for under runs or over runs due to the opportunities and risks. Cost management reserve is not time-phased. The time between schedule milestones "B" and "C" in Figure 8 illustrates the project/contract schedule margin. Milestone C represents an early finish or "challenge" schedule for the performing organizations.

4.2.2 Program Risk-Adjusted Budget

The shaded area in Figure 8, labeled "Program Funding and Schedule Risk-Adjusted Contingencies," represents funding and schedule contingencies in the program's approved risk adjusted budget earmarked to cover the risk of cost and schedule overruns on the program's contracts and projects.

OMB approval of a program's risk-adjusted budget establishes the goals for reporting to OMB on program performance and is represented by the Program Risk-Adjusted Budget (PRB) and schedule milestone "A." The Federal Acquisition Streamlining Act (FASA) Title V requires that programs be managed within 10% of the budget goals. In this context, "program" means the

approved capital investment or useful segment approved by OMB. By establishing PMBs that reflect challenging cost and schedule goals and adequate reserves, organizations can use EVM's ability to provide early visibility into program cost and schedule performance problems, allowing time to take corrective action and enhancing the probability of achieving cost, schedule, and performance goals within the PRB.

Conversely, organizations that do not establish reserves increase performance risk, because nearly all programs contain some degree of cost and schedule uncertainty. Reserves held within a PM's authority should be related to authorized work scope risk and opportunity. Reserves held above the program permit senior management to balance resources as required within portfolios and among programs. Organizations that do not allow for reserves at both levels may inadvertently encourage managers to "bury" the reserves in the budgets, thus, effectively ensuring they will be expended and denying objective visibility into performance.

4.3 Contracting for EVM

- EVM may apply to all contract types when there is significant risk to achieving the cost, schedule, and performance goals.
- Placing incentives on achieving a Schedule Performance Index (SPI) or Cost Performance Index (CPI) at or near 1.0 likely will result in the reported data being managed to those objectives, thereby diminishing the value of the process by removing early warning signals.
- Compliance recognition documents establish a commitment to maintain and use the accepted EVMS as an integral management process on current as well as future contracts.
- PMs conduct IBRs on contracts with contractual and in-house EVMS requirements to achieve a mutual understanding of contract risks and opportunities and to determine whether the PMB includes the entire scope of work, is realistic, and, if executed as planned, will meet all of the contract's technical, schedule, and cost objectives.
- As part of their day-to-day management strategy, PMs should use EVM to ensure effective management of cost, schedule, and technical performance and to identify existing and emerging risks/opportunities.
- An EVMS surveillance approach is usually documented in a surveillance plan that is approved by appropriate internal management, recognized by customer management and, if necessary, jointly conducted with the assistance of the cognizant federal agency.

4.3.1 Contract Types

EVM may apply to all contract types regardless of the system or capital asset being acquired if there is significant risk to achieving the cost, schedule, and performance goals. This includes firm-fixed price (FFP) contracts if issued for development efforts. EVMS may also apply to service contracts that meet the requirements of a performance-based service acquisition (PBSA), when they have discrete performance, cost, and schedule requirements that can be measured.

However, EVMS may not be applicable to contracts issued in support of a program, e.g., those where the supplier will not control and manage the work scope and schedule, such as a staff augmentation contract. In such cases, EVMS requirements should not be applied to the staff

augmentation contract itself but can simply be applied at the program level where scope, schedule, and cost data are present. Applying EVM at the program level presents new challenges for the program organization incorporating FFP contracts and internal resources into their program EVMS, for example:

- FFP contracts normally do not provide for access to suppliers' cost data;
- Government accounting systems often cannot get the appropriate cost data to support EVM, so workarounds may have to be used, i.e., estimated actuals.

The customer and supplier must manage for program success. This means both the customer and supplier depend on the appropriate contract type and EVM data. When the nature of the work is complex, use of EVM is critical to controlling and managing the effort. Where the external or internal risks are great, the ability to plan and respond to those risks, including managing change, is essential to increase the likelihood of achieving the program objectives. Flexibly priced (cost type or fixed price incentive) contracts are used when the nature of the work is complex and costs cannot be estimated with sufficient confidence to use an FFP contract. Application of EVM to these contracts is well documented in the EIA-748 and the NDIA IPMD EVMS Intent Guide.

A time and material (T&M) contract should be used only when it is not possible at the time of placing the contract to estimate accurately the extent or duration of the work or to anticipate costs with any reasonable degree of confidence. The visibility into actual costs in a T&M environment is accomplished by exploiting the standard component of T&M contracts – labor hours. If desired, the hours delivered can be translated into financial terms by using the labor hour rates established for billing purposes. In this manner the customer and supplier can provide program EVM information to their senior management and external organizations.

FFP contracts are suitable when cost risk is low. Even though FFP contracts may not provide visibility into the supplier's actual costs, EVM provides the means to objectively assess schedule progress, for example by using performance-based milestones as the EVM technique, and correlate the performance achieved with the program objectives. FFP contracts should seldom be used for development efforts.

4.3.2 Incentives

EVM supports contract incentives in two ways. First, EVM provides objective information to determine overrun or underrun status on flexibly priced contracts where the customer shares cost risk with the supplier. Second, EVM provides a means to assess the ability of the supplier's management team to achieve the desired technical, schedule, and cost objectives.

CAMs assess the performance to date, analyze variances from the PMB, estimate the contract cost at completion, and implement actions required to achieve technical, schedule, and cost objectives. Variances are an important element of the EVM process and need to be recognized as early warnings of deviations from the PMB. A desirable outcome may be compromised if the contract includes incentives for reporting a monthly Schedule Performance Index (SPI) and Cost Performance Index (CPI) near 1.0 (no variance). If the customer believes the contract is executable within such narrow bounds, the appropriate contract type would be FFP to reflect the low risk as opposed to cost type or fixed price incentive.

If EVM reporting incentives are desired, a customer may elect to use incentive fees to "look back" at key milestones, such as preliminary design reviews or critical design reviews, at the end of the contract or contract phase, to determine if performance data reported depicted contract status objectively and if estimated contract outcomes that were reported were reasonable based on performance to date. Such performance-based reporting would support

performance-based contracting and reward contractors for managing effectively, thus reducing the need for oversight.

Performance-based incentives are recommended as they encourage early visibility into problems and management actions that in turn support the objectives of performance-based acquisition. When incentives are used in this way, it is possible – indeed likely – that a project could overrun a flexibly-priced contract, incurring a reduction in profit, while at the same time earning a maximum award fee for having submitted timely, reliable, and actionable program management information.

Earned value may be used as the basis for contract payments. Earned value data reflect the value of completed work in the terms of the budget assigned, which presents an attractive rationale for paying on that basis, especially on FFP contracts that incorporate performance based payments. The completion of a milestone on which a payment will be based is objectively reflected by the earned value; in effect, performance based milestone payments and earned value is synonymous when both are characterized by demonstrable performance or completion criteria such as delivery. All contract activity must be included in the total value of payment milestones (i.e., the sum of all the payment milestones should equal the contract value).

4.3.3 Pre-Systems Acquisition Planning

EVMS documentation should be established in the standard form or forms used by the organization for process documentation, policies, and procedures. EIA-748 does not require or suggest that descriptive documentation be created outside the normal organizational requirements, nor does it restrict the ability to effectively implement desired system changes.

Organizations will normally evaluate their internal management systems in accordance with their policies and good business practices to assure they meet the guideline requirements in the EIA-748. The guidelines are high-level and goal-oriented. They state the qualities and operational considerations of an integrated management system using earned value methods without mandating detailed system characteristics. They also enable implementation on large and small programs, projects, or contracts. EVM System Owners have sufficient flexibility within the guidelines to implement EVM in a manner that employs the most effective and efficient performance management methods and techniques.

The NDIA IPMD EVMS Intent Guide is meant to be used by the EVM System Owner to complete a compliance map of the EVMS to the EIA-748. Prior to receiving system acceptance, an organizational entity should prepare a compliance map documenting how its business processes conform to the guidelines to satisfy a contractual requirement that its system meets the intent of EIA-748. This compliance map verifies for both internal management and external customers or reviewers that the organization has done a comprehensive job of describing an EVMS that meets the intent of the EIA-748. A compliance map is a best practice method to demonstrate that the EVMS meets the intent of the EIA-748 guidelines.

An executed EVMS compliance recognition document between an organization and its supplier acknowledges that the supplier's EVMS meets the intent of EIA-748 and that it will be maintained and used as an integral management process on current as well as future contracts. When a compliance recognition document has not been provided, an organization could document its EVMS using the NDIA IPMD EVMS Intent Guide Compliance Map and provide the map in its proposal to describe the EVMS it plans to use to manage the program.

A compliance evaluation review (CER) is conducted following the design and implementation of the EVMS to verify that the system being reviewed meets the intent of EIA-748. The CER may occur prior to program award or contractual authorization to proceed (ATP) or may occur after

these events. When the CER occurs prior to a project award or ATP, a viable alternative is to complete a compliance map using the NDIA IPMD EVMS Intent Guide template, to map the proposed EVMS with the EIA-748 32 guidelines, and obtain customer recognition that the EVMS meets the intent of those guidelines.

Implementation of the approved EVMS is subsequently verified and accepted by the contract or project customer through a joint surveillance process that is described in the NDIA IPMD Surveillance Guide. A separate acceptance for realigned organizations or newly established sites adopting a compliant EVMS may or may not be required depending on the EVM System Acceptance Authority. For example, a corporate level EVMS could be implemented by an organization within the corporation without an additional CER. Implementation of a previously accepted EVMS on a specific program or project should be verified through joint surveillance.

Cross-agency acceptance is best accomplished through the establishment of reciprocal agreements between agencies and organizations to mutually recognize EVM System compliance recognition documents. Alternative acceptance methods include the acceptance by one agency of another agency's EVMS, followed by verification via surveillance, or for an agency to review the documentation from the EVM System Owner's compliance evaluation review as the basis for acceptance.

4.3.4 EVM Systems Acceptance

EVM System Acceptance is a process that involves reviewing an EVMS to determine that it meets the intent of the 32 guidelines in the EIA-748. The NDIA IPMD System Acceptance Guide includes process guidance for EVMS acceptance.

Once the project selected for compliance evaluation has implemented the EVMS, the compliance evaluation review (CER) occurs. The EVMS Owner may elect to conduct or may have conducted a progress assessment review (PAR) to prepare for the compliance evaluation review. The PAR affords an opportunity for the EVMS Owner to address any shortfalls in the design or implementation of the EVMS prior to the actual CER.

The purpose of the EVMS CER is to determine if the EVMS, as implemented on the project, meets the intent of the EIA-748 guidelines. A CER may occur prior to project approval or ATP; if so, an alternative approach that uses the NDIA IPMD EVMS Intent Guide template to map the EVMS to the EIA-748 guidelines can be used to determine whether the EVMS, as documented, meets the intent of EIA-748. Following contract award or ATP, implementation of the EVMS can be verified and accepted by the customer via joint surveillance as discussed in the NDIA IPMD Surveillance Guide. A separate EVMS acceptance for another site, subsidiary, or realigned organization applying a previously-accepted EVMS may or may not be required depending on the EVM System Acceptance Authority. For example, an accepted corporate level EVMS could be implemented by an organization within the corporation without an additional CER. Implementation and use of the accepted EVMS by that site or organization should be subsequently verified by surveillance.

4.3.5 Integrated Baseline Review

The Integrated Baseline Review (IBR) process provides an invaluable opportunity to compare customer and supplier PMs' expectations and to address differences before problems arise. It provides project management teams with a thorough understanding of the contract or project plan and its risks and opportunities, allowing early intervention and application of resources to address project challenges. As a result both PMs increase their confidence in the PMB. Following the IBR, the initial risk register and risk/opportunity handling plans should be updated, if necessary, including additions or changes to the original list of risks/opportunities or their attributes, based on the results of the IBR.

The objective of the IBR is to confirm the following:

- All known program risks and opportunities are identified; acceptable risk and opportunity handling plans are established and incorporated into the PMB or provided for in management reserve;
- Adequate management reserve and schedule margin has been established consistent with project risk not accounted for in the PMB;
- The technical scope of work is fully included and consistent with authorizing documents;
- Key schedule milestones are identified;
- Supporting schedules reflect a logical flow to accomplish the technical work scope;
- Resources (budgets, facilities, personnel, skills, etc.) are adequate and available for the assigned tasks;
- Tasks are planned and can be measured objectively, relative to technical progress;
- Underlying PMB rationales are reasonable; and
- Managers have identified appropriate techniques to measure their progress.

A summary of the purpose, scope, and applicability of the IBR is discussed in the NDIA IPMD Integrated Baseline Review (IBR) Guide. This guide includes a complete process overview and guidance for planning and executing IBRs.

4.3.6 Surveillance

Surveillance is the continuous process of reviewing the health of the earned value management system (EVMS) as applied to one or more projects. The purpose of surveillance is to ensure the EVMS is effectively used to manage cost, schedule, and technical performance, and that the performance data generated are accurate and reliable. An effective surveillance process ensures the key elements of the system are maintained over time and on subsequent applications. Prime suppliers are responsible for surveillance of subcontractors.

Program surveillance results are summarized to determine overall compliance and identify areas in need of corrective action. Findings may be categorized as either systemic or individual in nature. A systemic finding, occurring on more than one program, is considered serious, and requires prompt corrective action to regain compliance with the organization's accepted EVMS. The perceived severity of an individual (non-systemic) finding is based primarily on the nature of the finding and its impact upon the overall effectiveness of a program's integrated performance management processes and the reliability of the management data they generate.

The customer should consider the effectiveness of the supplier's surveillance process when deciding whether to observe, review the findings of internal surveillance, or engage in joint surveillance. When joint surveillance is conducted the customers are members of the surveillance team and assigned responsibilities. Objectives of this process are identical whether the surveillance is conducted by a Government customer on a prime supplier, or by a prime supplier on a subcontractor.

Joint surveillance is an approach usually documented in a surveillance plan that is approved by appropriate supplier and customer management. The plan typically spans multiple years and is supplemented by an annual schedule containing the programs selected for surveillance in that year.

Management's surveillance planning objective should be to select EVMS guidelines or sub processes for review based upon the risk associated with the remaining work and content specific to the programs that will be reviewed. The selection of EVM guidelines and processes reviewed should be relevant to the program phase and should provide an opportunity for coaching or mentoring during the surveillance process. Factors influencing the need for contract/project selection include risk, maturity of implementation, size and complexity, and the independence of the company's surveillance team.

Summarized metrics are used to identify and characterize process and systemic problems across multiple programs. These are subsequently addressed by updating training or EVMS process improvements. This is also known as system surveillance.

A summary of the purpose, scope, and applicability of surveillance is discussed in the NDIA IPMD Surveillance Guide

5 Integrated Performance Measurement and Management

5.1 Measuring Performance Progress

> Variances are neither "good" nor "bad"; they are the early warning indicators of emerging problems and quantifiers of deviations from the plan useful for managing complex projects.

The strength of EVM as a management tool lies in obtaining objective measurements of work accomplished at the level of the organization where integration of work scope, schedule, cost, and risk and opportunity management occurs (the control account). Schedules are statused with progress based on work accomplished in accordance with technical completion or exit criteria. Progress (EV) is measured at least monthly, but may be done more frequently to coincide with the organization's business practice (for example, when schedules are statused weekly or biweekly). Comparison of actual program performance to the schedule provides a means to determine and evaluate potential program schedule risks.

The timing of schedule progress assessment should coincide with EVM performance measurement to provide meaningful performance data. Control account managers (CAMs) assess schedule progress by reporting their accomplishments on assigned tasks, the remaining task durations, or estimated completion dates for any tasks in progress but not yet complete and revise, as necessary, the start and completion dates for work not yet started.

EVM provides visibility into key performance measurement data at time now as illustrated in Figure 9. The EVM data at time now includes the planned budget in the PMB, the work completed expressed in terms of the PMB budget assigned to that work, and the actual cost incurred for completing that work.

The EVM data provide insight into these management questions:

- How much of the work in the budget plan (planned value) has been accomplished or "earned" (EV)?
- How much did the work accomplished actually cost (actual cost)?
- How does the actual cost of the work accomplished compare with its earned value?
- When will the contract or project be finished and how much will it cost?

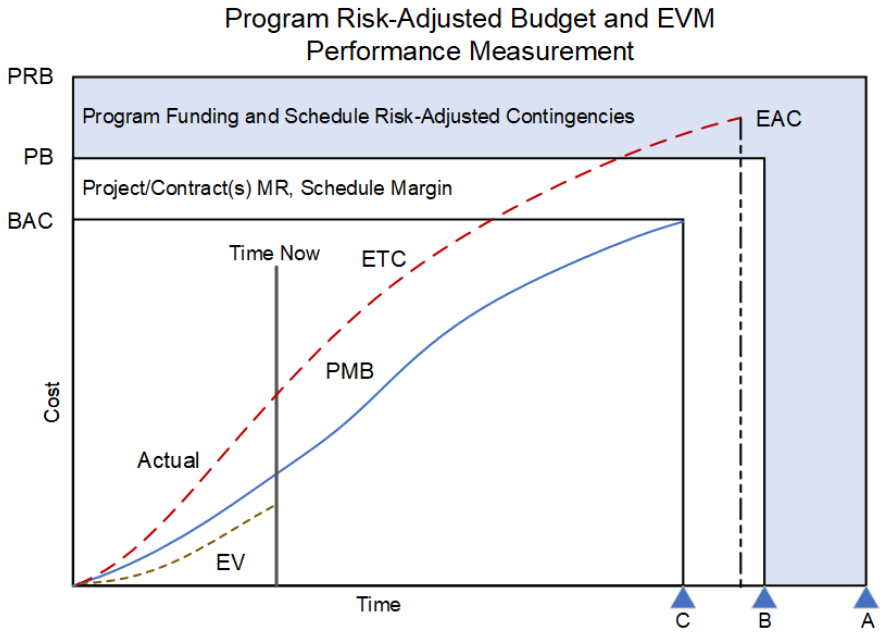

Figure 9. Earned Value Management Data

5.2 Management Analysis

- Performance data provide PMs the answer to the questions “Where am I?” and “How much planned effort remains?”
- The Estimate to Complete (ETC), for the effort included in the scheduled tasks and budget for the work remaining, addresses the questions “When will I complete the work?” and “How much will it cost to complete the contract or project?”
- The analysis of variances informs the PM about deviations from plan, as well as risks and opportunities (realized, retired, and identified) in the remaining work scope, schedule, and cost.
- The program management team must implement corrective actions, as needed, to achieve program technical, schedule, and cost objectives.

CAMs analyze their variances and, where possible, develop corrective action plans to reduce or eliminate unfavorable variances and restore positive performance trends. Variances may be favorable or unfavorable. Favorable variances may represent opportunities (the flip side of risk), while unfavorable variances may quantify the effect of realized risk on cost and schedule performance. PMs should be alert to the possibility that favorable variances may offset overruns. Also, while EIA-748 emphasizes strict controls on PMB changes that erase current period or historical variances, it does not prohibit replanning future work to enable the capture and return to MR of excess budget associated with realized opportunities.

Variance analysis provides CAMs the ability to communicate deviations from the plan in terms of schedule, cost, and at completion variances. This analysis should summarize significant schedule and cost problems and their causes, actions needed to achieve the projected outcomes, and major challenges to achieving project performance objectives. As control

account trends become evident, any risks or opportunities identified should be incorporated into the project risk and opportunity management process.

At each management review point (typically monthly), CAMs review the control account cost and schedule data and assess the ETC and estimate at completion (EAC) for their control accounts. CAMs make their assessments based on historical performance, current performance metrics, and future work scope remaining to be completed, considering potential process improvements, risk assessments, risk and opportunity handling plans, and other applicable factors that may affect remaining work. Schedule performance and risk are analyzed with respect to "behind schedule," "on schedule" or "ahead-of-schedule" conditions and projections.

When integrated product team members identify needed corrective actions that cannot be immediately taken, they should be assigned to a responsible team member for planning and execution.

PMs should review control account schedule and cost variances periodically for the total contract or project impacts and to provide to management indications of overall program performance. Based on this review, the program EAC is updated.

Potential risks and opportunities may be identified at any WBS level. Once accepted by management they are tracked along with their estimated technical, schedule, and cost impacts. If the PM determines a risk (or opportunity) handling task should be included in the PMB, the necessary resources may be authorized through the use of MR. EVM is then used to manage and measure performance on the task as needed to achieve project objectives.

5.3 Program Progress Communication

- Communicating program status is an essential activity for all projects.
- Its two primary purposes are to provide essential control account information facilitating informed management decisions and to communicate performance status to senior leadership and stakeholders.

Performance or progress assessment using EVM information is most useful when the EV data are provided by CAMs who are actively managing cost, schedule, and scope within the project or contract. The EV data provide the details at the control account level where progress is achieved and corrective actions are taken when variances from the PMB occur. Timeliness in communicating the integrated performance information among the program CAMs and the PM is essential in establishing confidence in the actions proposed as a result of performance analysis and risk monitoring.

Monitoring progress on risk handling and opportunity capture plans is required to ensure the plans are being effectively implemented and are in fact eliminating/reducing the risk or capturing the opportunity. Corrective action plans should be implemented if a risk handling or opportunity capture plan is not effective in reducing the risk or capturing the opportunity. Analysis may also result in additional risk mitigation/opportunity capture measures, the identification of new risk or opportunity, or revisions to the risk and opportunity management plan.

The customer can benefit most when engaged in the program reviews where the team addresses the performance data, variance analysis, risk/opportunity tracking, and corrective action plans taken to achieve program objectives. Even though there are provisions for formal preparation and reporting of variance analysis, performance analysis is a continuous program management activity. Waiting for information from a supplier's reports does not promote timely

and effective project management decision making. The performance reports should reflect the management analysis and actions identified in the program management reviews.

Organizations should establish a capability for contract and project performance status that includes technical, schedule, cost, performance (EVM) data, and risk/opportunity that is consistently summarized for use in decision making at all levels of program management and the stakeholder organizations. The use of Integrated Program Management Reports (IPMR), Contract Performance Reports (CPR), Integrated Master Schedule (IMS), or other EVM reports does not constitute the entire universe of available contract or project information. Daily and weekly reports, meetings, design and program reviews, risk/opportunity review boards, and other avenues for obtaining accurate information, including technical performance, should be used as appropriate.

For reporting to senior decision makers, EVM facilitates timely, accurate, and integrated schedule, cost, and technical performance information. It is important that EVM and risk/opportunity measurement data are available from a single source and that the data provide insight to support decision making at the program level, as well as for higher organizational levels.

5.4 Change Management

- Changes in all programs are inevitable.
- The integrity of the PMB is maintained through a change management process that ensures the PMB accurately represents only the authorized work to be accomplished.

The primary objective of change management is to maintain the integrity of the PMB and performance information. Because the change management process is intended to control replanning of the remaining future work, PMB changes must not be used as a means to modify actual performance and progress information. Changes to performance and progress information may sometimes be necessary to correct accounting and other errors significant to the accuracy of the EVM information. Acceptable retroactive changes are those that correct errors, make routine accounting adjustments, or improve the accuracy of the performance measurement data and all such changes must be justified, explained, and documented.

Corrections should always be made if incorrect data are eroding the management value of the system, but management reports will be compromised if current plans or program history (performance to date information) are constantly being changed. If the objective of replanning becomes a routine to eliminate variances or to attain a specific performance index (e.g., SPI or CPI), then EVMS will not only lose its value for objective progress assessment and management decision making, but it will also compromise organizational compliance with its implementation of EIA-748. Regardless of the scope of the replanning effort, a complete historical record of the original PMB and all changes must be maintained for analytical, reporting, and lessons learned purposes.

The change management process must be able to accommodate the routine “replanning” (prospective, internal changes within the PMB), external, customer-directed changes (contract modifications), and reprogramming (changes within existing contract scope that result in an over-target baseline). The same process is applicable for in-house efforts.

The objective of replanning within the PMB is to reflect a revised program plan for in-scope (i.e., within the project target cost or approved total allocated budget) changes to future budgets. Some examples of appropriate replanning include:

- Changes resulting from a design review that modifies requirements;
- A major shift in the resource profile required to accomplish the remaining effort;
- Funding restrictions or modifications that affect future resource availability;
- Rate changes (including overhead rates), which are significant enough to warrant replanning;
- Changes to future budget, which will not be required due to the realization of opportunities, to return it to MR;
- Issuance of MR budget for the purpose of planning a prospective risk handling activity resulting from the identification of a new risk or one whose potential consequence or impact has become elevated.

Figure 10 illustrates the use of management reserve applied to the PMB where the BAC increased but the program schedule completion, Point C, remains unchanged.

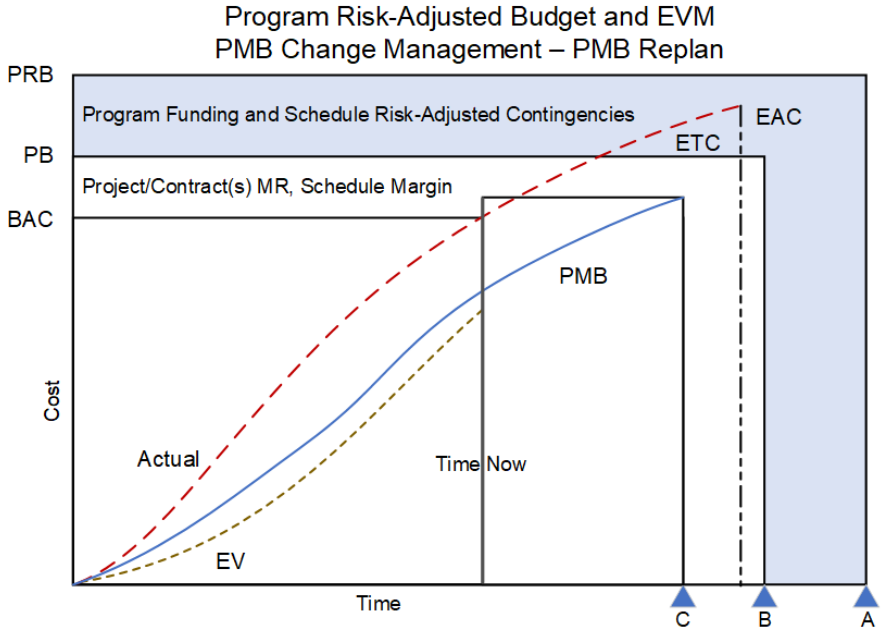

Figure 10. PMB Replan

When a program is unable to stay within the threshold of scope, schedule, and budget objectives defined in the PB (the intersection of the PB and Point B illustrated in Figure 10), the agency may decide to change the technical objectives, extend the schedule, or make additional budget or funding available to the program (for example, by reprioritizing its missions), which may result in a modification to the PMB. When additional scope, schedule, or budget is applied to the program PMB it must be done through the change management process. An IBR is required by OMB on the new PMB before program goals may be changed.

Figure 11 illustrates a reprogramming example where program funding and schedule contingencies are used. The schedule completion date is extended beyond the program's schedule margin, Point B, but remains within the program risk-adjusted schedule contingency, Point A. The PMB is increased by the use of the program management reserve up to the PB. The EAC now extends above the PB due to performance overruns prior to time now but remains within the program funding risk-adjusted contingency of the PRB.

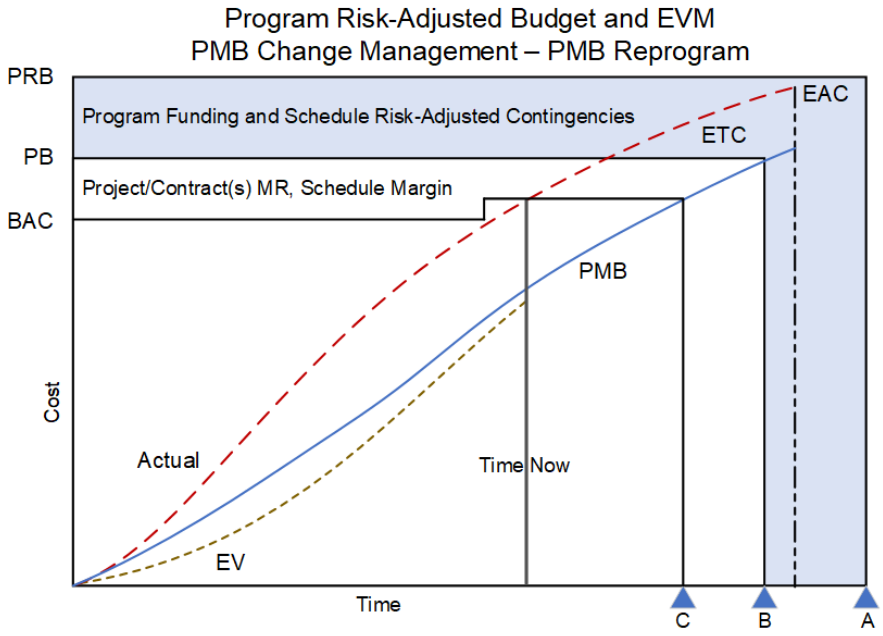

Figure 11. PMB Reprogram

6 EVM Application Guidance

This section discusses the various NDIA IPMD guides within the context of applying EVM in the acquisition life cycle.

It is important to recognize that EVMS requirements should be implemented to provide the management information needed for effective management of the contract or project. In addition, it is important to recognize that no single EVMS application can meet every management need for performance measurement because of variations in organizations, products, processes, and working relationships

During Pre-Systems Acquisition, organizations should plan for EVM application to work performed by suppliers as well as work performed in house. Both the supplier and customer organizations should ensure EVM is integrated with other documented program management processes and understood by those who will implement and use EVM. Supplier and internal EVM data may be integrated using a common integrated program process for effective and efficient program performance analysis and reporting.

Once a contract is awarded or a project is authorized to proceed, it typically requires 60 to 90 days to implement the EVMS where documented business processes integrating EVM capability have previously been institutionalized. Surveillance begins after completion of implementation and continues through the contract or project life cycle.

In Figure 12, the NDIA IPMD Guides supporting EVMS application in accordance with EIA-748 are identified with the applicable acquisition life cycle for the customer and supplier organizations. The number in parentheses after each guide name identifies the section below where each guide and its intended use are discussed.

Acquisition Life Cycle	Acceptance Authority or Customer	EVM System Owner or Supplier
Pre-Systems Acquisition Approval or Award	**Recognize:** Application Guide (6.2)	**Document and Assess:** Application Guide (6.2) Intent Guide (6.3)
After Systems Acquisition Approval or Award	**Accept:** Intent Guide (6.3) Acceptance Guide (6.4)	**Implement:** Intent Guide (6.3) PASEG (6.7) Agile and EVM Guide (6.9) Scalability Guide (6.10)
	Execution and Surveillance: IBR Guide (6.5) Surveillance Guide (6.6) PASEG (6.7) Predictive Measures (6.8) Agile and EVM Guide (6.9) Scalability Guide (6.10)	**Execution and Surveillance:** IBR Guide (6.5) Surveillance Guide (6.6) PASEG (6.7) Predictive Measures (6.8) Agile and EVM Guide (6.9) Scalability Guide (6.10)

Figure 12. NDIA IPMD Guide Applicability

While there is no formal hierarchy for the NDIA IPMD guides, the EIA-748 Standard is the basis for the guides. This Application Guide provides the overall context for the guides. This is illustrated in Figure 13.

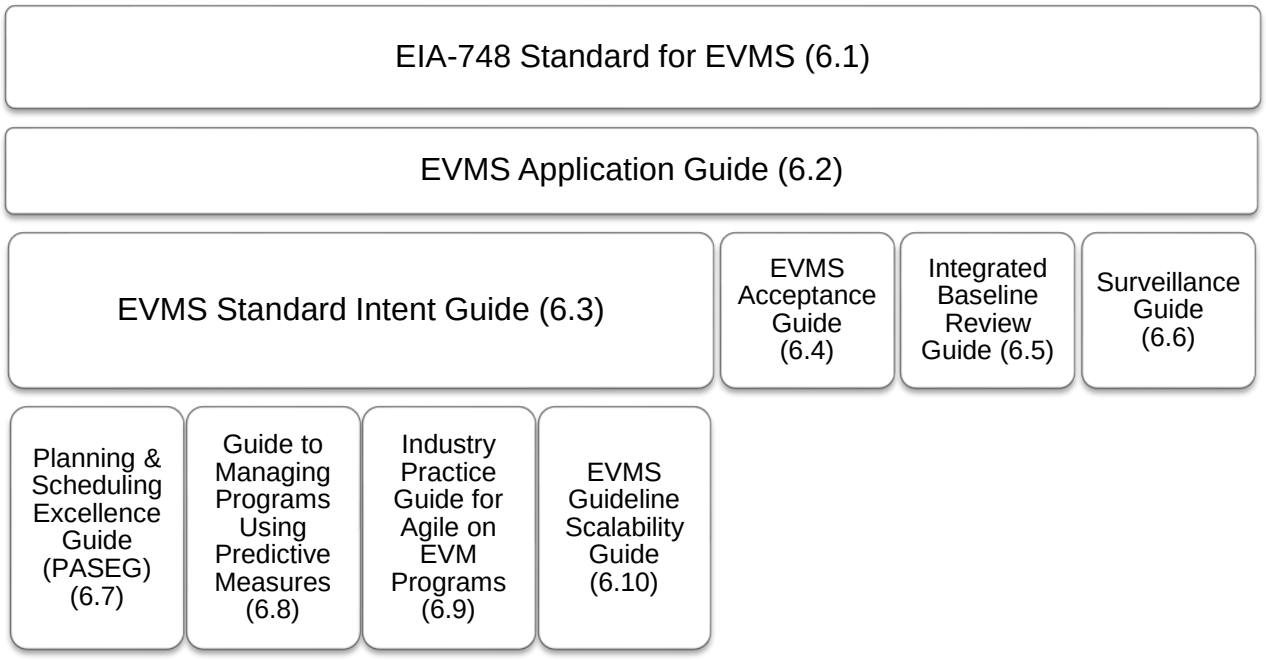

Figure 13. Relationship between the NDIA IPMD Guides

The discussion in this section begins with an overview of the EIA-748 Standard which is essential for the effective application of EVM.

6.1 EIA-748 Standard for Earned Value Management Systems

EIA-748 is a commercial standard containing the earned value management system 32 guidelines, which incorporate best business practices to provide strong benefits for program or enterprise planning and control. These guidelines describe processes for integrating program scope, schedule, and cost objectives, and use of earned value practices for performance measurement during program execution. EVMS provides a sound basis for problem identification, corrective actions, and management replanning as may be required. EIA-748 also recognizes that the principles of EVMS and the EVMS guidelines, which are applicable to large complex or high risk programs, can be scaled, as appropriate, to enable any program regardless of its size and complexity to realize the benefits of EVM.

The EVMS guidelines in Section 2 of EIA-748 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. Different organizations establish and apply a management system that best suits their management styles and business environments. In accordance with EIA-748, an EVMS must, “first and foremost, meet the organization’s needs and good business practices.”

6.2 NDIA IPMD Earned Value Management Systems Application Guide

As noted earlier, the purpose of this EVMS Application Guide is to provide an overview of the application and use of EVM during all phases of the acquisition lifecycle. In addition, this Application Guide provides an overview of all of the NDIA Integrated Program Management Division (IPMD) Guides within the overall context of this guide.

6.3 NDIA IPMD Earned Value Management Systems Intent Guide

The primary purpose of the EVMS Intent Guide is to define the management value and intent of each of the EVMS guidelines found in EIA-748. It also lists typical attributes and typical outputs associated with each guideline, which provide objective evidence indicative of an EVM system’s acceptability. Note that these attributes and outputs are provided as typical examples only. Because the EIA-748 does not mandate specific requirements for EVM systems, attributes and outputs will vary depending on the individual business needs and characteristics of the organizations employing them.

An example for developing a process compliance map useful for demonstrating that an EVMS meets the intent of EIA-748 can be found in the Intent Guide’s Section 3. A separate Intent Guide appendix document provides a compliance map template that can assist in the development of a compliance map. The objective of the compliance map is to demonstrate that the EVM System Owner has thought through each guideline and can describe how its business process meets the intent of the guideline.

The Intent Guide can be used by either a government or supplier organization whenever the documentation, implementation, and use of an EVMS meeting the guidelines in EIA-748 are required. It is recommended for use in performing an initial EVMS compliance evaluation review (CER) in preparation for obtaining system acceptance. A customer or independent reviewer may use the compliance map as the basis for verifying that the EVMS meets the intent of the guidelines.

To be most effective, the EIA-748 compliant business process and system documentation should be implemented on an organizational basis instead of program by program, and the implemented level of detail should be commensurate with the management needs of the

program. The objective is to provide integrated program management information using the organization's resources and an EVMS implementation scaled to meet program requirements.

6.4 NDIA IPMD Earned Value Management Systems Acceptance Guide

System Acceptance is a formal process that involves the design, implementation, review, demonstration, and approval of an EVMS that is used to manage capital asset projects and meets the intent of the EIA-748 32 guidelines.

The intent of the System Acceptance Guide is to establish a process and provide guidance for the design, implementation, review, demonstration, and formal acceptance of an EVMS. The guide defines an evaluation and acceptance process whereby an EVM system owner/user (government or industry) with a first-time requirement to comply with the 32 guidelines can accomplish the following:

- Understand the need for and effectively design an EVMS;
- Evaluate the EVMS user's capability to demonstrate compliance with the 32 guidelines;
- Successfully implement the EVMS;
- Prepare and provide substantiating implementation documentation for evaluation and implementation;
- Obtain EVMS compliance recognition to satisfy current and future requirements for an approved EVMS;
- Perform self-evaluations to ensure readiness prior to a compliance evaluation review (CER).

The guide includes appendices that provide guidelines for compliance evaluation review team selection, an example CER report outline, review execution considerations, examples of documentation subject to review, an example of a compliance recognition document, and an example of a cross agency EVMS reciprocity agreement.

6.5 NDIA IPMD Integrated Baseline Review (IBR) Guide

Integrated Baseline Reviews (IBRs) are a critical part of the contract award and management process for major acquisitions and inter/intra agency or organization agreements. IBRs are required, either pre-award or post-award, to ensure that authorized work is adequately planned and resourced, and to establish a mutual understanding of the risks and opportunities inherent in the performance measurement baseline (PMB) and in the management processes used during project execution. IBRs are performed on the initial contract baseline and whenever there is a significant change to the baseline. The customer may require an IBR when the customer PM wants to review the PMB to assure both parties are in agreement on the scope of work as well as the resources and schedule to meet the customer's needs.

The purpose of the IBR Guide is to provide guidance for customer and supplier PMs and their teams for the preparation and execution of IBRs. In addition, the guide identifies the need for an IBR, the types of IBRs, when and how each should be conducted, and the necessity to make the IBR an element of the ongoing project management process. This guide discusses the IBR process flow and integrates the IBR process with risk and opportunity management practices. The guide is intended to improve the consistency of the IBR process for all users.

6.6 NDIA IPMD Surveillance Guide

Surveillance is the continuous process of reviewing the health of the EVMS applied to one or more contracts or projects. Surveillance focuses on ensuring that the key elements of the EVMS process are maintained over time and on subsequent applications to effectively manage cost, schedule, and technical performance.

The Surveillance Guide provides surveillance guidance and characteristics of successful EVMS surveillance programs. It is intended to assist suppliers in the planning and execution of both internal surveillance and subcontractor surveillance as well as to provide guidance for customers and organizations with EVMS oversight responsibility.

The Surveillance Guide defines a standard surveillance approach for all parties because it ensures a common understanding of expectations, encourages efficiencies through the use of a uniform process, and provides consistent guidance for all stakeholders in the EVMS process.

An organization working in an EVMS environment can use this guide as a model for establishing a cost-effective EVMS surveillance process. It can also be used by organizations with existing EVMS processes seeking to make surveillance more effective and to standardize approaches on all programs.

6.7 NDIA IPMD Planning & Scheduling Excellence Guide (PASEG)

The Planning & Scheduling Excellence Guide (PASEG) provides the program management team, including new and experienced master planner/schedulers, with practical approaches for building, using, and maintaining an integrated master schedule (IMS). It also identifies knowledge, awareness, and processes that promote consistency and a standardized approach to project planning, scheduling, and analysis.

Sound schedules merge cost and technical data to influence program management decisions and actions. Realistic schedules help stakeholders make key go-ahead decisions, track and assess past performance, and predict future performance and costs. Industry and Government agree that improving IMS integrity has a multiplier effect on improved program management. Program teams can benefit from this guide to gain a common understanding of key scheduling terms, concepts, and practices. The guide also provides practical tips and caveats for scheduling techniques that apply for any scheduling software tool or environment. Using this guide, program teams can build and maintain more robust and dynamic schedules that provide a roadmap for improved program execution.

The PASEG is a comprehensive how-to guide that captures the extensive knowledge of experienced Government and Industry professionals. Major topics include the Generally Accepted Scheduling Principles (GASP), schedule architecture, standard modeling techniques, cost and schedule resource integration, external schedule integration, horizontal and vertical traceability, schedule maintenance, schedule analysis including schedule risk assessment (SRA) and execution metrics, and program/contract phase considerations.

6.8 NDIA IPMD Guide to Managing Programs Using Predictive Measures

The Predictive Measures Guide is a compilation of more than 30 Industry and Government measures that assists a Program Manager in meeting program objectives. These measures provide a comparison of current program status against the planned measures. Earned Value Management (EVM) is a project management control technique which effectively integrates actual accomplishment in terms of cost, schedule, and scope. However, EVM as a management approach should be supplemented with additional measures and metrics during the monitoring and controlling phase to attain a more comprehensive understanding of current

performance and to help management make well-informed decisions. These additional measures and metrics can provide valuable predictive indicators that can be used to develop and implement effective mitigation plans.

The intended audience for the guide are organizations that are looking for standard approaches to manage programs. The guide is not intended to provide a new set of standards that would be required to assess program performance, but instead provide a "menu" of typical measures that could be applied. Some metrics are better suited for certain applications than are others. Each organization should decide which measures are most appropriate for its environment and select only those measures suitable for its purposes.

Metrics discussed in the guide include schedule, cost, staffing, risk and opportunity, requirements, technical performance measures, contract health, and supply chain metrics. There is also a section on the Rayleigh Estimator. For each metric, the discussion includes a definition of the metric, how it is defined, how it is calculated, what the output of the calculation provides, what predictive information it provides, possible questions to consider when analyzing the metric, and any caveats, limitations, or notes about the metric.

6.9 NDIA IPMD Industry Practice Guide for Agile on EVMS Programs

Agile has emerged as the leading industry software development methodology, and has seen growing adoption across the DoD and other federal agencies. Agile implements the needed method by focusing on small, frequent capability releases, working software through demonstration of capabilities, responding rapidly to changes in operations, technology, and budgets, and actively involving users throughout development to ensure high operational value,

The Industry Practice Guide for Agile on EVMS Programs discusses best practices drawn from lessons learned by multiple aerospace and defense firms and their software development activities. Agile and EVM are complementary when properly implemented together, and help enable a robust overall management process. Integrating Agile performance data with the EVMS provides a vertical integrated view of cost, schedule, and scope, from development activities to program performance measures. Agile development can be used to incrementally deliver functionality to the customer while EVM provides a standard method for measuring progress.

The content in the guide is organized into the following sections:

- Agile Program Planning. Overview of the Agile planning process and levels. Includes an illustration of the Agile planning levels and their relationship to EVM processes.
- Agile EVM Performance Measurement Baseline (PMB). Discusses recommended approach for the Work Breakdown Structure (WBS), Integrated Master Plan (IMP), and Integrated Master Schedule (IMS) for Agile programs. Also discusses freeze period considerations.
- Structures for Performance Metrics. Discusses best practices to plan and then measure work package earned value performance using Agile progress measures. Also discusses using Agile metrics to forecast the estimate to complete.
- Managing Baseline Change on Agile Program. Discusses best practices to manage baseline changes on Agile development programs also using EVM. Provides example baseline and forecast change scenarios to illustrate recommended approaches.
- Contracting for Agile and EVM. Discusses contracting best practices when Agile and EVM apply.

Appendices include an EVM and Agile Data Dictionary; example of Agile EVMS progress tracking charts; references for more information about the topics in the guide; more discussion on the product roadmap, release planning, and rolling wave planning products; a complete integrated master plan (IMP) example for an Agile program; and a framework for conducting an IBR on an Agile program.

6.10 NDIA IPMD EVMS Guideline Scalability Guide

A scaled EVMS applies the EIA-748 Standard for EVMS 32 guidelines in a way that reflects the size, complexity, risk, and type of work necessary for the successful management of the project. This scalability allows any project to realize the benefits of earned value management. A scaled EVMS implementation recognizes small projects do not require the same level of data detail and project control discipline that is needed for large, complex projects.

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

- Entities such as universities, laboratories, small businesses, suppliers, and vendors with small to mid-size projects.
- Large corporations with small projects/contracts or that issue contracts to small businesses, suppliers, and vendors.
- Any government agency with small contracts.

The guide is organized into nine project management processes: For each process, the guide includes sections that discuss the related sub processes. This discussion includes:

- A reference to the applicable EVMS Standard guideline.
- A description of the process and its underlying connection to project management.
- The benefits to be derived from effective implementation.
- Approaches for scaling the implementation of the process.
- Descriptions of typical products produced.
- Reference to best practice comments from the GAO Cost Estimating and Assessment Guide or Schedule Assessment Guide, where applicable.

Appendix A – EVMS Contract Clauses and Agency Policy Documents

The source of all government acquisition requirements for an EVMS is the Capital Programming Guide supplement to OMB Circular A-11, Part 7. All subsequent federal and agency specific acquisition requirements reference the A-11. Figure A-1 below summarizes the federal and agency specific acquisition documents that apply the A-11 EVMS requirements.

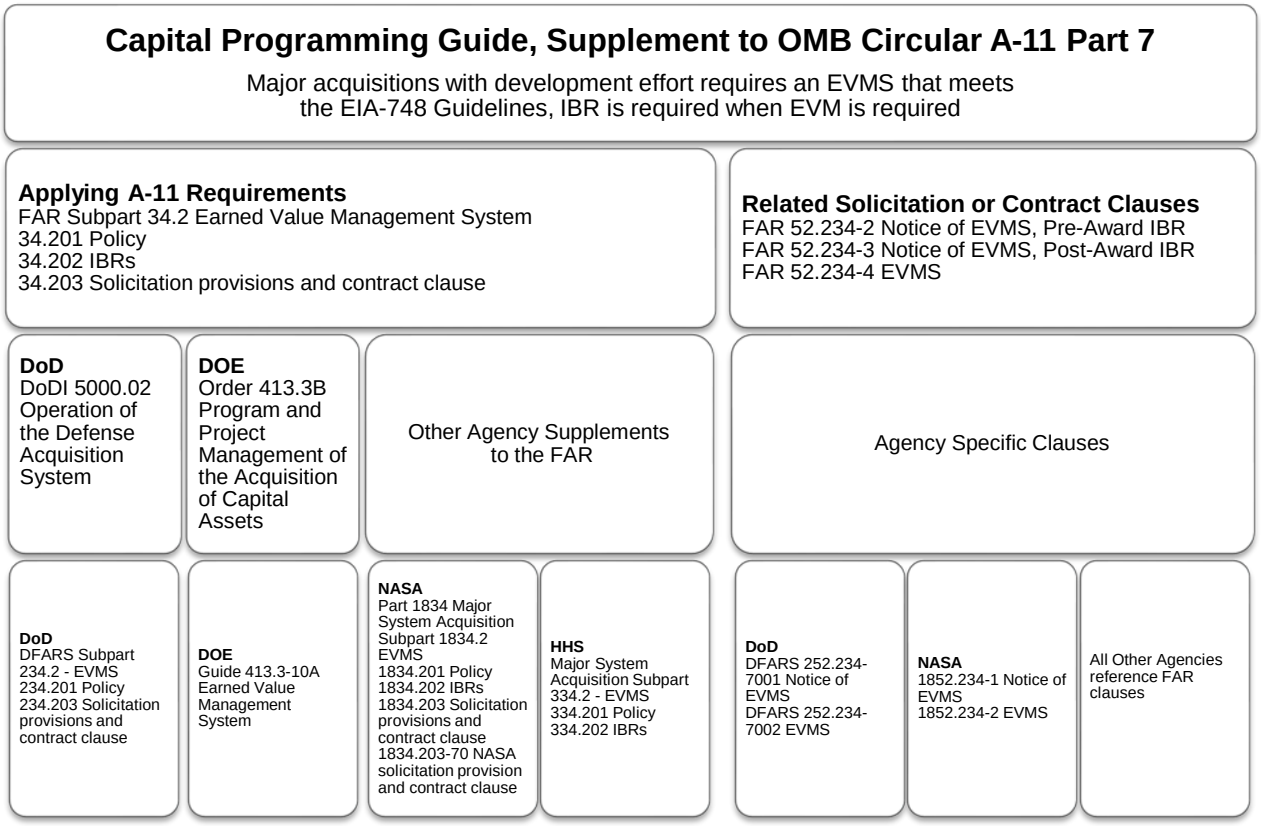

Figure A-1. OMB A-11 Foundation for EVMS Federal Acquisition Requirements

The Federal Acquisition Regulation (FAR) Subpart 34.2 (34.201, Policy) states: "An Earned Value Management System (EVMS) is required for major acquisitions for development, in accordance with OMB Circular A-11. The Government may also require an EVMS for other acquisitions, in accordance with agency procedures." Agencies may define their EVMS requirements in agency supplements to the FAR with specific instructions, orders, and guides in accordance with the A-11. Agencies without supplemental guidance reference FAR Subpart 34.2 and the related FAR solicitation or contract clauses.

Agency specific notes:

- DoD applies the A-11 and FAR with the Department of Defense Instruction (DoDI) 5000.02. The DoDI references the applicable Defense Federal Acquisition Regulation Supplement (DFARS) paragraphs that define DoD's EVMS policy and contract clause requirements. DoDI 5000.02 Table 8 summarizes the EVM application requirements and documents the applicable thresholds. DoDI 5000.02 Table 9 summarizes the thresholds for EVM reporting requirements. DFARS 234.201 repeats the threshold requirements found in the DoDI Table 8.

- DOE applies the A-11 with DOE Order 413.3B. This order sets the thresholds for EVMS certification and surveillance reviews. DOE Guide 413.3-10A describes how DOE implements EVM on DOE programs.
- NASA applies the A-11 with FAR supplements to fit NASA's mission objectives. NASA's supplement Part 1834 Major System Acquisition, Subpart 1834.2 EVMS, sets the thresholds for EVM requirements.