Bringing service to life

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Utilization of EVM metrics In Developing Life Cycle Cost Estimates and Cost Benefit Analyses

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Areas of Discussion

- Life Cycle Cost Estimation (LCCE) and Cost Benefit Analysis (CBA) process improvement during transition to a Earned Value Management (EVM) centered organization

- Identifying Earned Value Management Metrics Related to the LCCE and CBA process areas.

- Assist Organizations in understanding the link between cost estimating and Earned Value Management (EVM).

- Develop feedback loops from EVM Performance Metrics to the LCCE & CBA processes.

- Promoting the use of EVM as a barometer to be applied to the LCCE and CBA processes.

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Definition of LCCE

What is LCCE?

- **Life Cycle Cost Estimation is concerned with deriving the likely costs of a specific future activity, program, project and/or proposal. The intent is to provide a *realistic* cost estimate so the decision-makers can judge the relative merits of the proposal against its costs.**

- EVM compartamalize the project into cost accounts and work packages. The relationship of cost, schedule and performance generate metrics that help to determine where to apply management attention and decisions.

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Definition of CBA

What is CBA?

- **From SCEA Glossary: 1) A technique for assessing the range of Costs and Benefits associated with a given option, usually to determine Feasibility. 2) A criterion for comparing programs and alternatives, when benefits can be valued in terms of dollars or costs. Cost Benefit Analysis is useful in the search for an optimal program mix, which produces the greatest number of benefits over costs.**

> ▪**A benefit discovered for the CBA and LCCE processes is the data reliability that comes with the use of EVM.**

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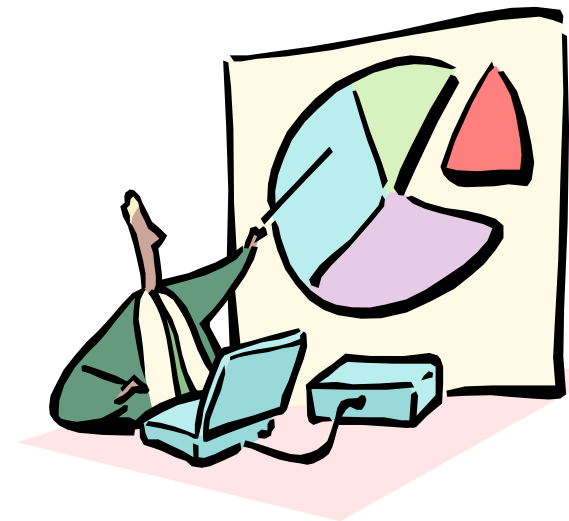
(Project Management & Performance Measurement)

"**You cannot manage what you cannot measure…and what gets measured gets done.**"   --- Bill Hewlett, Hewlett Packard

"Accurate estimates are the basis of sound Project Planning. Many processes have been developed to aid in making accurate estimates, such as"

1. compartmentalization (i.e., breakdown of tasks)

2. parametric estimating,

3. Structured planning (Ground Rules),

4. Educated assumptions,

5. Delphi method

6. Identifying dependencies

7. Examining historical data,

8. Estimating each task,

9. documenting the results.

--- From Wikipedia, the free encyclopedia

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Definition of Earned Value Management

What is EVM?

- EVM is an integrated management control system for assessing, understanding and quantifying performance for $ spent

- Integrates technical, cost, schedule and performance with risk management.

- Allows objective assessment and quantification of project performance

- Helps predict future performance based on trends and project plan execution.

- EVM provides project management with objective, accurate and timely data for effective decision making.

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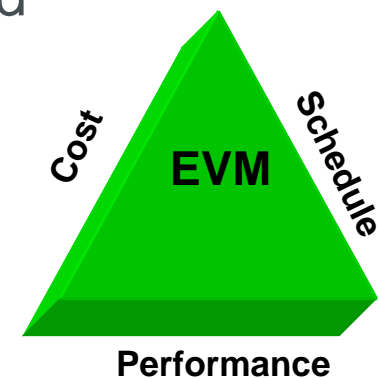
Basic EVM Information and Data

- Work Breakdown Structure (WBS)

- Organizational Breakdown Structure (OBS)

- Project Schedule

- Time-phased Baseline Budget

- Cost/Resource Control Plan

- Change Control Plan

- Cost Data (Budget, Actuals and Earned Value)

- Metrics and Performance Measurements

- Forecasting

- Contract Performance Report (CPR)
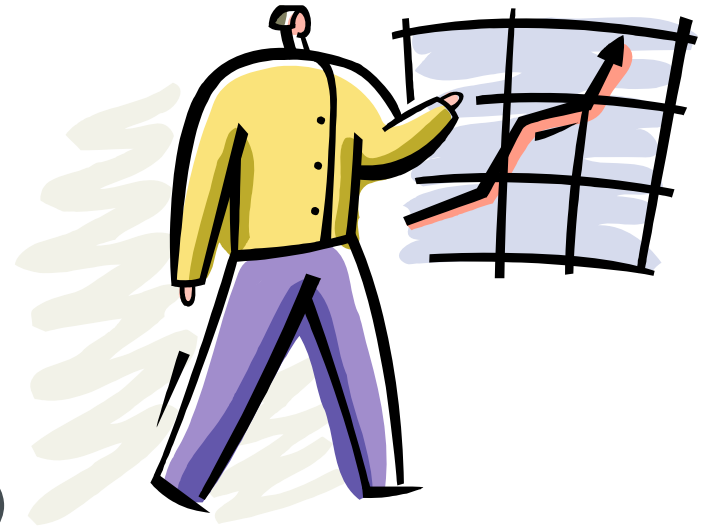
EVM readily Lends itself to the Estimating Process!

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Earned Value Management (Courtesy of The EVMIG)

 Proper EVM implementation ensures that the PM is provided contractor performance data that:

- Relates time-phased budgets to specific contract tasks and/or statements of work (SOW).

- Objectively measures work progress.

- Properly relates cost, schedule, and technical accomplishment.

- Allows for informed decision making and corrective action.

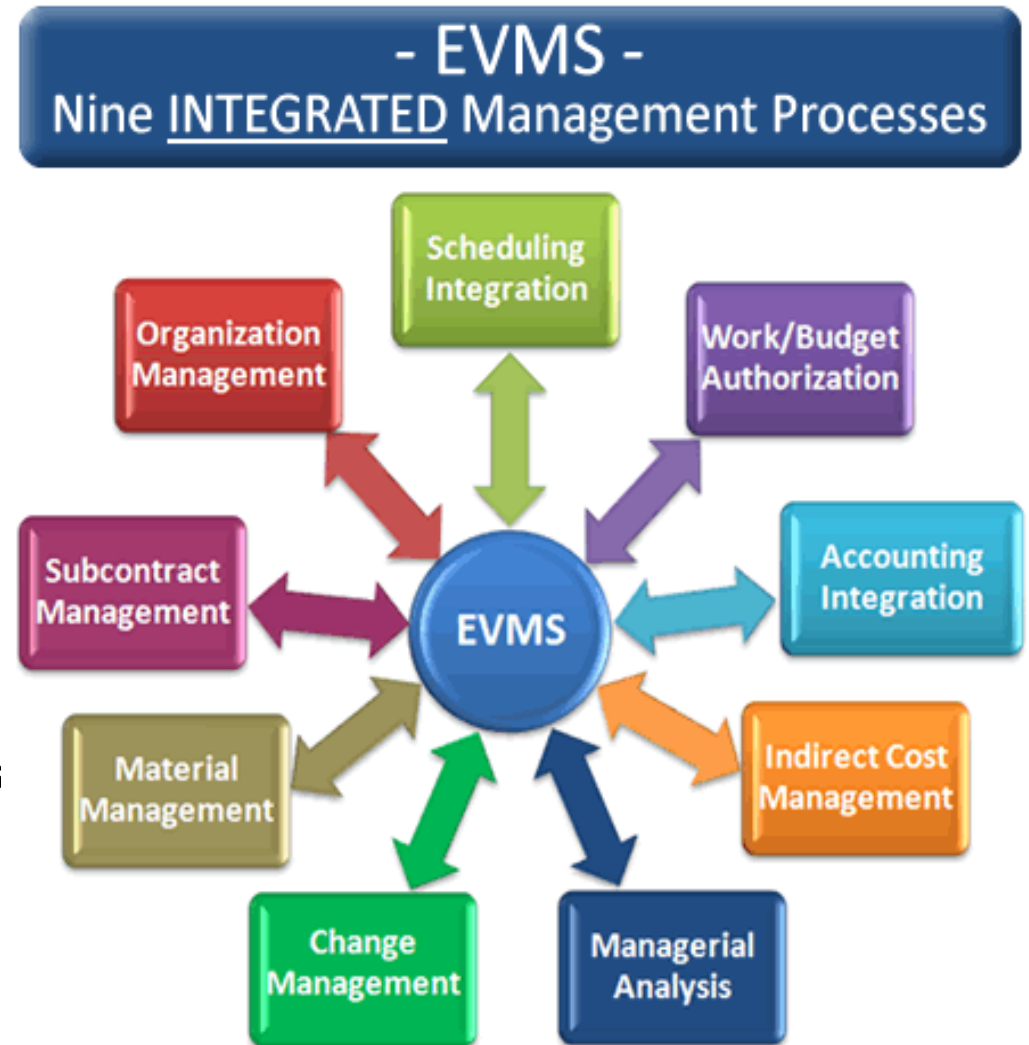- Is valid, timely, and able to be audited.

- Allows for statistical estimation of future costs.

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Earned Value Management System (EVMS)

The following project management process areas are those that are primarily related to EVMS:

• Measurement and Analysis

• Project Planning

• Project Monitoring and Control

• Requirements Development

• Requirements Management

• Integrated Project Management

EVMS also relates to specific practices in the following process areas:

• Supplier Agreement Management

• Risk Management

• Process and Product Quality Assurance

- EVMS -
Nine INTEGRATED Management Processes

Scheduling Integration
Organization Management
Work/Budget Authorization
Subcontract Management
Accounting Integration
Material Management
EVMS
Indirect Cost Management
Change Management
Managerial Analysis

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ANSI/EIA-748

American National Standards Institute/Electronic Industries Alliance standard 748 (ANSI/EIA-748) was created to provide consistency and guidance in EVM application across programs.

A Veritable Gold Mine For The
  Cost Analyst!

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ANSI/EIA-748

The EVM process is comprised of five functional components and 32 criteria guidelines that are discussed below:

- **Organization** - Entails the WBS, OBS, Control/Cost Account Plans, Indirect Costs, and the associated integration required to monitor project performance and estimate costs at completion.

- **Planning, Scheduling, and Budgeting -** Entails the project schedule, milestones, budgets, work packages, EV measurement, overhead budgets, management reserves, undistributed budgets, and overall allocation reso-lutions necessary to account for and budget all work and to cover all expenses in the execution of the project.

- **Accounting** - entails the recording of direct and indirect costs, unit or lot costs, and their summarization and accumulation over time.

- **Analysis and Management Report** – Entails the analysis and reporting of actual performance against the project baseline, and the actual cost based on the project baseline. Included are the variances, their causes, corrective actions, and associated revised estimates at completion.

- **Revision & Data Maintenance** - the incorporation of authorized changes to the baseline, reconciling budgets, controlling changes, minimizing changes, and documenting changes.

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The Need For The Business Case

- What's driving a need for a business case?

  – Government Mandates, Directives, and prudent business practices

- OMB demands that agencies include Exhibit 300 justifications for all IT initiatives in their annual budget requests.

  – LCCE and CBA gives credence

    to business case justifications

- The Executive Office is pushing agencies to apply Managerial Cost Accounting (MCA) methods.

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Government Mandates, Directives, and Guides

- OMB Circular A-94

- OMB 300

- GAO Cost Assessment Guide

- AIR-4.2 Process Diagram

- NASA Cost Estimating Handbook

- NASA ARC Cost Estimating Process

- DOD 5000.2

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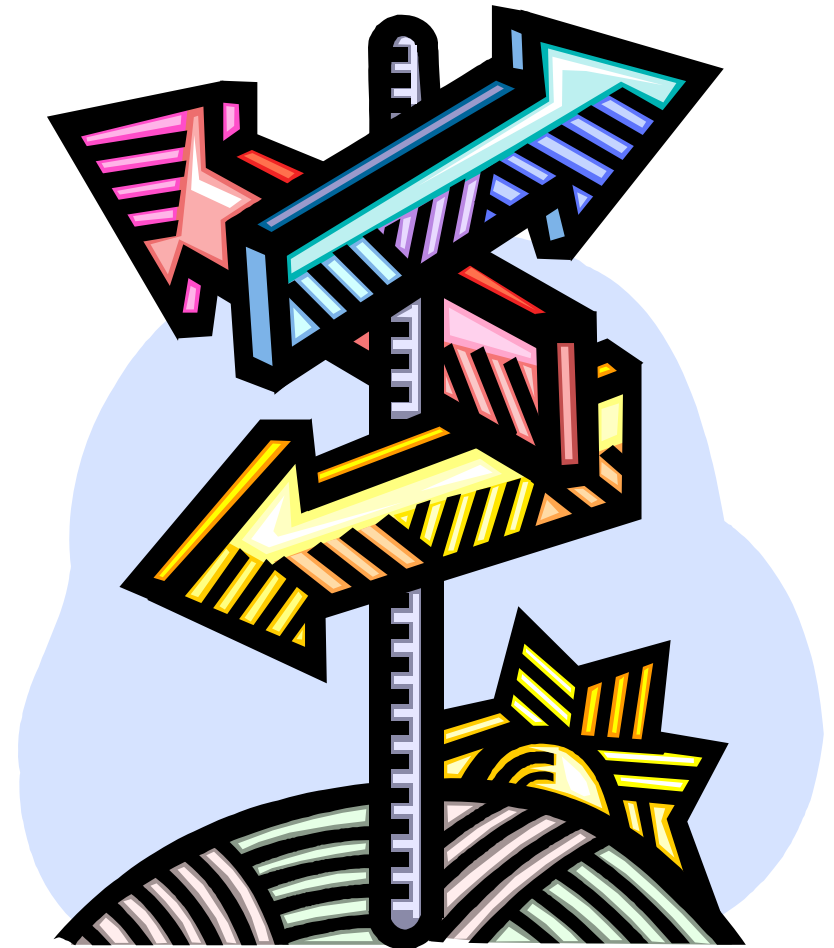
Government Mandates, Directives, and Guides

- **OMB Circular A-94:**

  - *Benefit-cost analysis* is recommended as the technique to use in a formal economic analysis of government programs or projects.

  - *Cost-effectiveness analysis* is a less comprehensive technique, but it can be appropriate when the benefits from competing alternatives are the same or where a policy decision has been made that the benefits must be provided.

  - ***Integrates technical, cost, schedule and performance with risk management***

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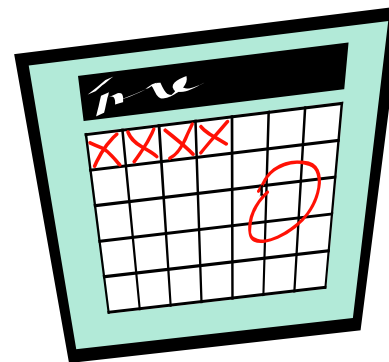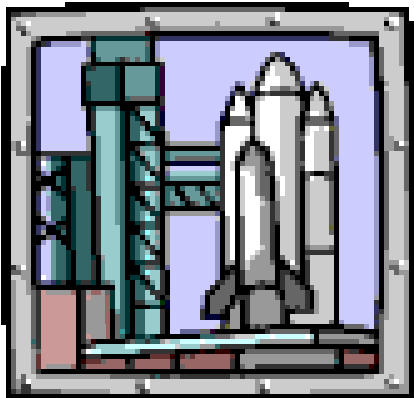
Government Mandates, Directives, and Guides

OMB 300

- Part 7 (section 300) of this Circular (A-11) establishes policy for planning, budgeting, acquisition and management of Federal capital assets, and instructs you on budget justification and reporting requirements for major information technology (IT) investments.

- For non IT capital assets contact your Resource Management Offices (RMOs) at OMB to determine any additional budget justification and reporting requirements.

- The policy and budget justification and reporting requirements in this section apply to all agencies of the Executive Branch of the Government subject to Executive Branch review. An exhibit 300 must be submitted for all major investments in accordance with this section.

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Government Mandates, Directives, and Guides

EVM as described by OMB 300:

"***Earned value management (EVM)*** is a project (investment) management tool effectively integrating the investment scope of work with schedule and cost elements for optimum investment planning and control."

- **CIRCULAR NO. A–11, PART 7**

"SECTION 300—PLANNING, BUDGETING, ACQUISITION, AND MANAGEMENT OF CAPITAL ASSETS"

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OMB 300 (Baseline Changes)

- ***For Cost and Schedule Performance baseline changes***

- OMB 300 (Baseline Changes)

  - All proposed changes to baselines should be submitted to OMB prior to your FY10 budget request; proposed changes should not be assumed approved. If your agency has any questions, please contact your OMB representative. All current approved baselines should be reflected in the exhibit 300.

- EVM through the use of the Cost Performance Report (CPR) Format 3 and the Baseline Control Log tracks changes to the performance baseline.

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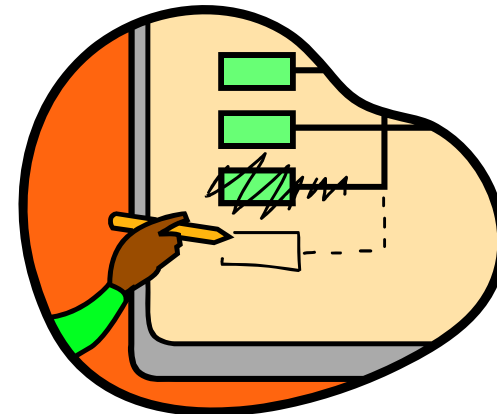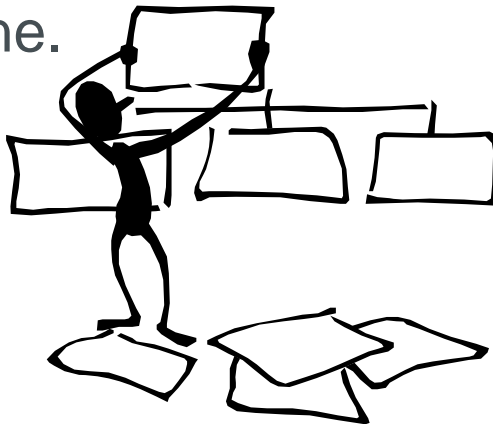
Government Mandates, Directives, and Guides

■ **GAO Cost Assessment Guide:**

– *Basic characteristics of a credible cost estimate:*

▶ Clear identification of task

▶ Broad participation in preparing estimate

▶ Availability of valid data

▶ Standardized structure for the estimate

▶ Provision for program uncertainties

▶ Recognition of inflation

▶ Recognition of excluded costs

▶ Independent review of estimates

▶ Revision of estimates for significant program changes

– **Taken from the GAO Cost Assessment Guide "Best Practices for Estimating and Managing Program Costs".**

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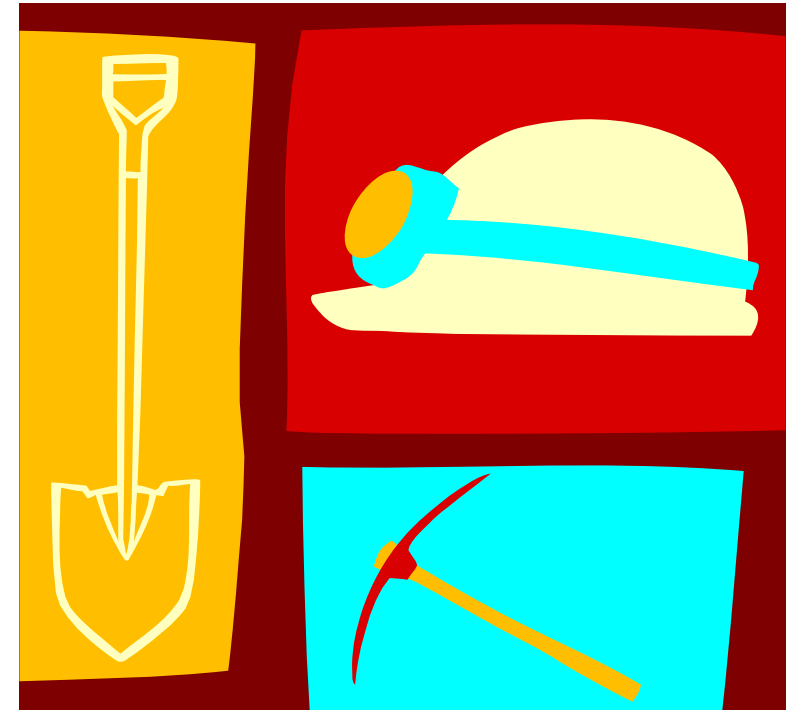
Government Mandates, Directives, and Guides

AIR-4.2 PERFORM LIFE CYCLE COST ESTIMATING
Process Universe

1.0 Perform Life Cycle Cost Estimating	2.0 Perform Source Selection Cost Evaluation	3.0 Perform Earned Value Management	4.0 Establish/Maintain Databases & Methods	5.0 Develop Work Breakdown Structure & Dictionary

1.1 Establish Needs with Customer
1.2 Establish Cost Tech & Prog Baseline
1.3 Develop Cost Estimate
1.4 Validate & Verify Cost Estimate
1.5 Present/ Defend Estimate

1.1.1 Identify Purpose
1.1.2 Define Scope/Work Content
1.1.3 Determine Resource Requirements
1.1.4 Evaluate Availability of Resources
1.1.5 Identify/ Resolve Issues

1.2.1 Identify/Request Baseline Parameters
1.2.2 Collect & Evaluate Baseline Parameters
1.2.3 Document Tech/Prog Baseline
1.2.4 Conduct 4.0 TPB Review Meeting

1.3.1 Develop Estimating Approach
1.3.2 Collect/Analyze Cost/Tech/ Prog Data
1.3.3 Develop/ Refine Cost Model
1.3.4 Execute Model

1.3.1.1 Determine Estimating Level
1.3.1.2 Identify Alternative Estimating Approaches
1.3.1.3 Evaluate Alternatives
1..3.1.4 Determine Primary & Secondary Approaches
1.3.1.5 Develop CEMM
1.3.16 Document CEMM
1.3.1.7 Conduct 4.2 CEMM Review Meeting

1.3.2.1 Establish/ Maintain Databases & Methods
1.3.2.2 Analyze Data
1.3.2.3 Develop/Select CERs (with associated risk)
1.3.2.4 Document CERs
1.3.2.5 Conduct 4.2 CER Review Meeting

1.3.3.1 Analyze Modeling Requirements
1.3.3.2 Choose Modeling Medium
1.3.3.3 Design/Refine Model Architecture
1.3.3.4 Create Model
1.3.3.5 Validate/ Verify Model
1.3.3.6 Document Model

1.3.4.1 Select & Verify Input Parameters
1.3.4.2 Conduct 4.0 Review Of TPB Parameters
1.3.4.3 Generate Output

1.4.1 Compare Output to Previous Cost Estimate(s)
1.4.2 Compare Output to Analogous System(s)
1.4.3 Prepare Cross-Checks
1.4.4 Perform Risk Analysis
1.4.5 Discuss with Technical Experts
1.4.6 Conduct 4.2 Estimate and Documentation Review Meeting

1.5.1 Develop/ Coordinate Presentation
1.5.2 Conduct Presentation

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NASA ARC Cost Estimating Process

NASA ARC Cost Estimating Process

Other Acts & Directives

- The Federal Acquisition Streamlining Act of 1994, Title V (FASA V), which requires agencies to establish cost, schedule and measurable performance goals for all major acquisition programs, and achieve on average 90 percent of those goals.

THE PRESIDENT'S MANAGEMENT AGENDA

- *Competitive Sourcing and Expanded E-government*

- *Strategic Management of Human Capital*

- *Budget and Performance Integration*

- *Improved Financial Management*

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EVM In Relationship To The LCCE and CBA Processes

EVM metrics can be used to fine tune the LCCE and bring greater insight to the CBA.

Mandates & Directives

Business Requirements, Goals & Objectives

System Architecture, Design and Program Decisions (Development of Alternatives)

Funding

Status Quo

Status Quo EVM Metrics

Alt. 1

Alt. 2

Alt. 3

$ Cost & Benefits $ LCC CBA (Comparative Analysis)

Solution

ANSI/EIA-748

Cost

Schedule

EVM

Performance

Manage Risks

Maximize Benefits

Cost Benefit Analyses (CBA) Process

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Implementation Of the Solution

Cost estimating process:

Cost estimating process:

Initiation and research

Assessment

Define the Estimate's Purpose	Develop the Estimating Plan

Define the Program	Determine the Estimating Approach	Identify Ground Rules & Assumptions

EVM

Obtain the Data	Develop the Point Estimate

Analysis

Presentation

Conduct Sensitivity	Conduct Risk And Uncertainty Analysis	Document the Estimate

Present Estimate To Management For Approval	Update Estimate To Reflect Actual Cost Changes

EVM intersects several points of the LCCE Process

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Work Breakdown Structure (WBS)

- **Program WBS**

  - The Program WBS provides a framework for specifying program objectives. It defines the program in terms of hierarchically related, product-oriented elements and includes "other Government" elements (i.e., Program Office Operations, Manpower, Government Furnished Equipment (GFE), Government Testing). Each element provides logical summary levels for assessing technical accomplishments, supporting the required event-based technical reviews, and for measuring cost and schedule performance.

- **Contract WBS**

  - The Contract WBS is the Government-approved WBS for program reporting purposes and includes all product elements (hardware, software, data, or services), which are the contractor's responsibility. It includes the contractor's discretionary extension to lower levels, in accordance with Government direction and the Contract Statement of Work (SOW).

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Organizational Breakdown Structure (OBS), Responsibility Assignment Matrix (RAM) & Control Accounts

- OBS is the hierarchical arrangement for a company's management organization, graphically depicting the reporting relationships. The OBS indicates the organizational relationships and is used as the framework for assigning work responsibilities.

- RAM is a graphic representation that reflects the integration of the WBS and the OBS. Merging the WBS and OBS, the project manager creates a Responsibility Assignment Matrix (RAM). The RAM displays the lowest level of both the WBS and the OBS.

- Control Account

  - Control accounts are the primary method of delegating responsibility and authority to various parts of the performing organization.
  - Control accounts are cells of a responsibility assignment matrix, which is intersection of the project WBS and the organizational breakdown structure (OBS).

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Mapping the Benefits to the WBS or OBS

- Most project failures today involve attempts to implement new IT systems or processes . A proven capability is needed to run systems that deliver the benefits promised in business cases and funding justifications. Managing the delivery of benefits need to be tied or at least correlated to the project's WBS, OBS, milestones, deliveries and/or phases.

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Work Packages

- Work Package:

  - ANSI 748 defines a work package as: "A task or set of tasks performed within a control account."

  - SCEA Glossary: Detailed short span jobs, or material items, identified by the contractor for accomplishing work required to complete the contract.

    ▶ (a) it represents units of work at levels where the work is performed;

    ▶ (b) it is clearly distinguishable from all other work packages;

    ▶ (c) it is assignable to a single organizational Element;

    ▶ (d) it has scheduled start and completion dates and, as applicable, interim milestones, all of which are representative of physical accomplishment;

    ▶ (e) it has a Budget or assigned value expressed in terms of dollars, man-hours, or other measurable units;

    ▶ (f) its duration is limited to a relatively short span of time, or it is subdivided by Discrete value milestones to facilitate the objective measurement of work performed; and

    ▶ (g) it is integrated with detailed Engineering, manufacturing, or other schedules.

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The Gold Card

CONTRACT PERFORMANCE REPORT
DI-MGMT-81466A

DATA ITEM DESCRIPTION

TITLE: CONTRACT PERFORMANCE REPORT (CPR)

NUMBER: DI-MGMT-81466A   APPROVAL DATE: 20050330

AMSC NUMBER: D7549   LIMITATION:

DTIC APPLICABLE: GIDEP APPLICABLE:

PREPARING ACTIVITY: OUSD(AT&L)ARA/AM(SO)

APPLICABLE FORMS: DD Forms are available and shall be used to submit required formats as follows:

CPR Format	DD Form Number	Sample Format No.
Work Breakdown Structure	2734/1	1
Organizational Categories	2734/2	2
Baseline	2734/3	3
Staffing	2734/4	4
Explanations and Problem Analyses	2734/5	5

The CPR report consists of five formats containing data for measuring contractors' cost and schedule performance. The CPR is used for Earned Value Management (EVM) reporting and analysis.

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CPR Format 1 – Work Breakdown Structure

The CPR Format 1 includes current period, cumulative, and estimate at complete values for each WBS element. It also contains header data showing quantity, targets, ceilings, and Estimate At Completion (EAC) calculations. This report also contains data about budget, price, Management Reserve (MR), Undistributed Budget (UB), and EAC cases (Best, Most, Worse).

A road Map for the Cost Estimate!

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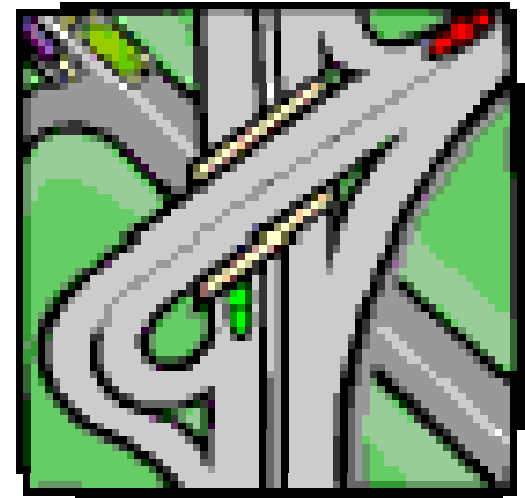
CPR Format 2 – Organizational

The CPR Format 2 includes current period, cumulative, and at complete values for each Organization. The reporting details in CPR Format 2 are the same as on the CPR Format 1 accept that it is structured by organization.

Can be used to help identify the project's resident Gurus and Subject Matter Experts!

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CPR Format 3 – Baseline

CPR Format 3 displays a forecast of monthly changes to the Baseline, Management Reserve, and Undistributed Budget for the entire project, and contains header data showing schedule dates for the contract and the project.

Can be used to estimate costs of Engineering

Change Proposals (ECPs)!

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CPR Format 4 – Staffing

CPR Format 4 displays a forecast of hours and person-months by Organization and contains header data showing schedule dates for the contract and the project. This report also contains program variance thresholds for month, cumulative, and at-complete percents and values.

Can be used to calibrate cost models used in the LCCE!

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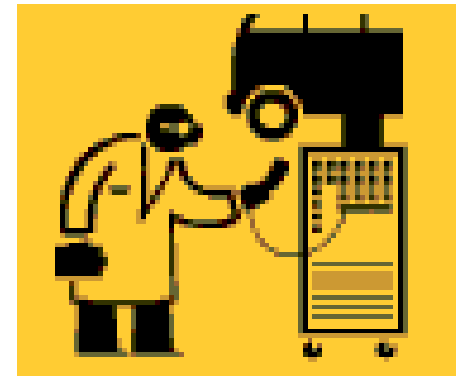
CPR Format 5 – Explanation of Variances

CPR Format 5 provides a narrative explanations of variances. The variance reporting thresholds are pre-determined prior to the start of the program.

- This report shows variance drivers, abnormal conditions and factors creating variances, and other issues, problems, and concerns.

- The Task/Project Impact section explains the impact to the Control Account and overall Project.

- The Corrective Action Plan section explains the recovery and/or risk mitigation plan

Can be used in the LCCE and CBA risk analysis!

Explanation of variances should link back to the original basis of estimate for project

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Operation & Maintenance (O &M)

- **Service Level Agreement** (**SLA**) is that part of a service contract where the level of service is formally defined in terms of delivery or performance.
  - Establish Milestones and Metrics
    - ▶ Use EVM Metrics, Performance Factors, Efficiency Factors and Trend Analysis to project/estimate Operation and Maintenance Costs in the LCCE.
    - ▶ Operational and Maintenance Metrics collected can be used in the Cost Benefit Analysis.

Supportability or Service Level

Schedule

Performance

E V M

Cost

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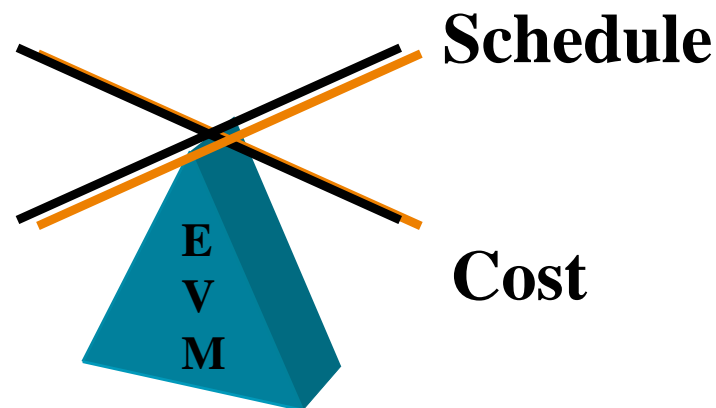
Estimate At Completion (EAC), Estimate-To-Complete (ETC), Performance Indexes and Efficiency Factors

EAC - The expected total cost of a schedule activity, a work breakdown structure component, or the project when the defined scope of work will be completed. EAC is equal to the actual cost of work performed (ACWP) plus the estimate to complete (ETC) for all of the remaining work.

ETC - The expected cost needed to complete all the remaining work for a schedule activity, work breakdown structure component, or the project.

Cost Performance Index (CPI) - A measure of cost efficiency on a project. It is the ratio of earned value (EV) to actual cost of work performed (ACWP).

Schedule Performance Index (SPI) - A measure of schedule efficiency on a project. It is the ratio of earned value (EV) to planned value (PV).

To Complete Performance Index (TCPI) - allows a projection of the anticipated performance required to achieve either the Budget at Completion (BAC) or the EAC.

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Risk Assessment and Risk Management

- **Risk assessment** is considered as the initial and periodical step in a risk management process.   Risk assessment is the determination of quantitative or qualitative value of risk.

- **Risk management** is a structured approach to managing uncertainty through risk assessment, developing strategies to manage it, and mitigation of risk using managerial resources.

Cost · **EVM** · **Schedule** · **Performance**
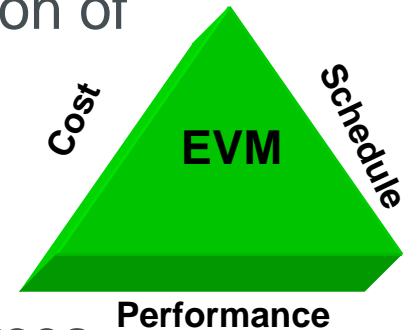
- **Integrating Risk Management with Earned Value Management**

  – An Integrating Risk Management with Earned Value Management study was conducted by the National Defense Industrial Association Program management Systems Committee's Risk Management Working Group

  – *Earned Value Management Process* – 65% of respondents in the NDIA study said that there was integrity in the information derived from their EVM processes. In programs there are typically three components of risk: technical, schedule and cost.

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The LCCE and Risks

- When the Integrated Baseline Review (IBR) was initiated by DoD, one objective was to improve the integration of EVM and Risk Management.

- EVM metrics can be used in the Risk Analysis of the LCCE. The CPR Format 5 narratives may lend itself to the CBA

Integration of EVM and RM

8   How do you plan, manage, and track your risks?

			Count	Frequency
a	*Risk Management Plan	1	94	78%
b	*Schedule	2	88	73%
c	Undistributed budget		22	18%
d	Management Reserve		72	60%
e	Regular Meetings	3	87	72%
f	*Tracking software		68	56%
g	*Estimate at Completion		77	64%
h	*Incorporated into the EVM baseline		45	37%
I	*Project budget		45	37%
j	*Variance Analysis		71	59%
k	*Work Breakdown Structure		51	42%
l	**None		13	11%
m	Other		9	7%

* These respondents were more successful integrators
** These respondents were less successful integrators

Methods Used to Plan, Manage, Track Risk

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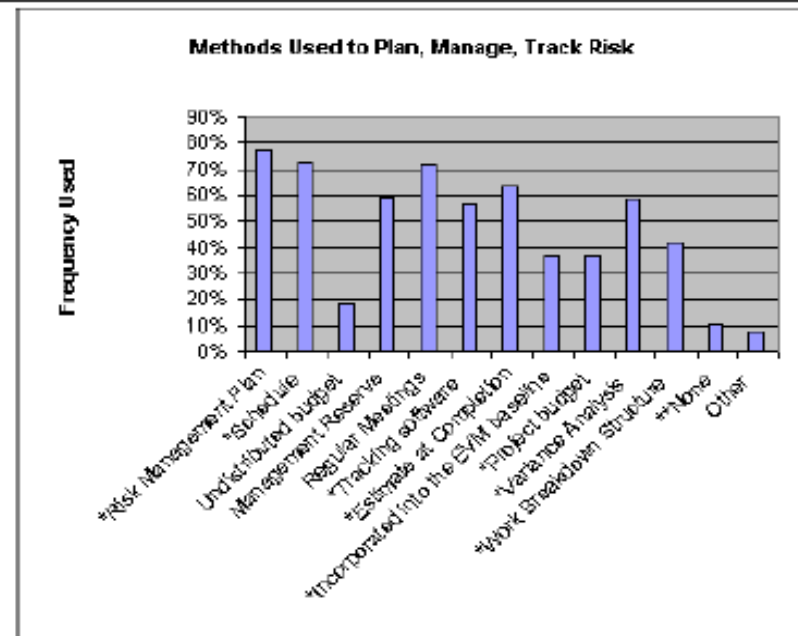
Policies, Needed Players, Roles and Responsibilities

- Look beyond the initial procurement when considering costs and results. LCCE and CBA business case justifications should use the initial contract value as the starting point.

- An EVM centered LCCE requires input from a diverse team consisting of a Program Manager, Cost Analyst/Estimator, Contractors, Budget Analyst, Accounting, Technical SME(s) and Cost Account Managers (CAMs).

- Use regular face-to-face meetings early on to gleam data from the SMEs and EVM reports.

- Anticipate the associated costs of changes in needs, rates, schedule and performance measurements that inevitably occur throughout a projects Life Cycle.

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EVM/Cost Analysis Activity Flow - Courtesy of NDIA

FUNCTIONAL ACTIVITY FLOW
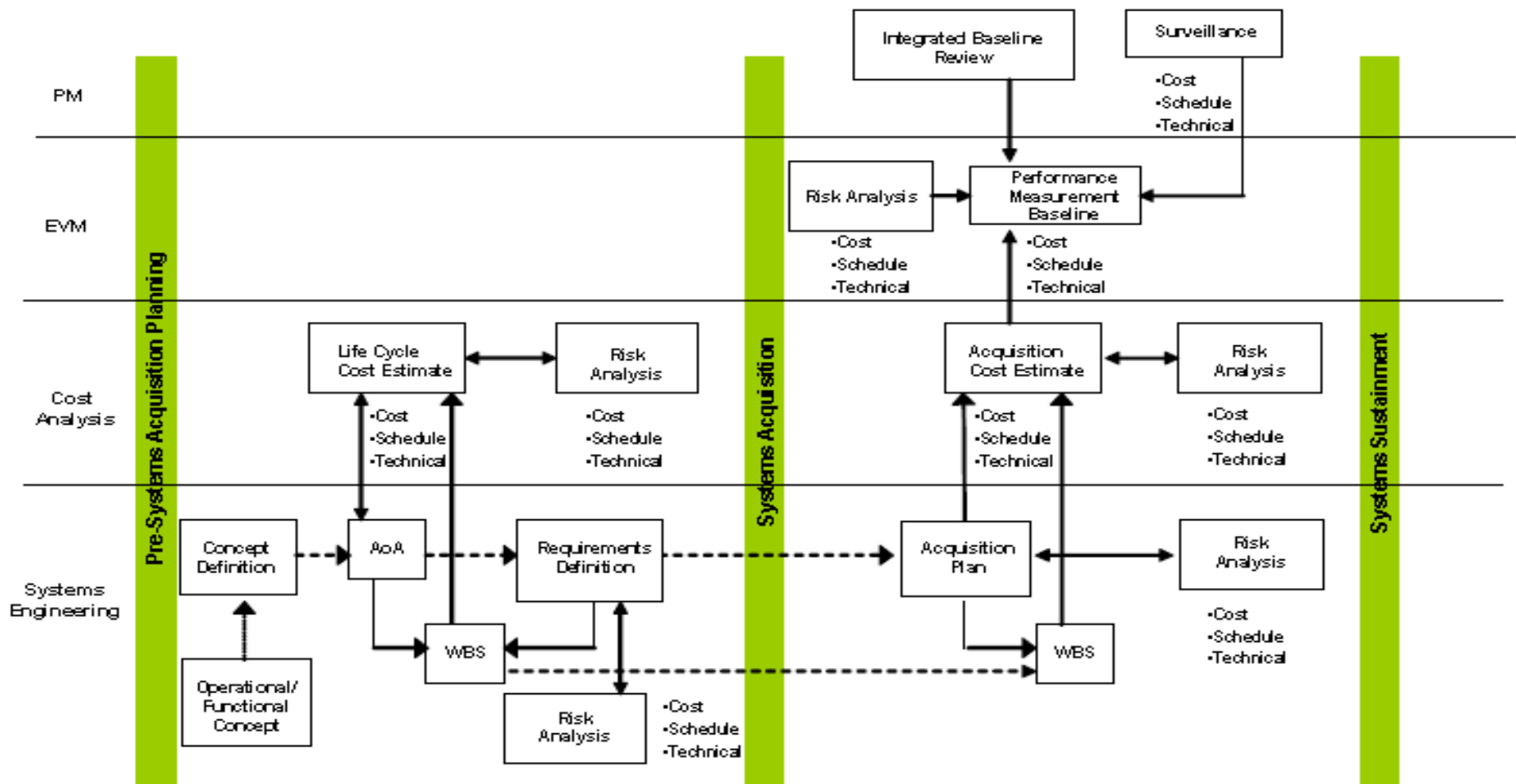
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Process improvement during transition to a Earned Value Management (EVM) centered organization

- **Knowledge Management System –**

  – Assist in the Establishment/Maintenance of automated archival of completed products/projects applying EVM.

  – Assist in the Establishment/Maintenance of a EVM Library of reference materials and periodicals

- **Process Improvement During Transition to an Organization applying EVM tools in LCCE and CBA.**

  – Creation and maintenance of historical projects in which EVM was applied**.**

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Conclusion

- Life Cycle Cost Estimating and Cost Benefit Analysis Process improvement during transition to a Earned Value Management (EVM) centered organization is possible!

- The Government Accountability Office is about to release a first-of-its-kind guide for project cost estimating and earned value management.

- The CPR is essential to doing a LCCE. Use of EVM metrics are accepted best practices for generating credible cost estimates.

- Adherence to a LCCE and CBA process that looks at cost, schedule and performance metrics (EVM) is prudent.

- Understanding and applying the links between cost estimating and earned value management.

- Stringent and proper Initial Cost Analysis & Estimation keeps your program off the Management Watch List and High-Risk List.

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Conclusion

- Utilizing EVM in a project's Life Cycle Cost Estimate, allows the LCCE to take into account a project's scope, schedule and budget so an accurate predictions about final cost and schedule can be made.

- Use of EVM in developing the LCCE may also allow the salvaging of much of the original scope of a troubled project and the ability to make critical adjustments in not only the acquisition phase of the life cycle but the Operations & Maintenance as well.

- Business cases or justifications for a project are often complex and may require financial analysis, technical analysis, organization impact analysis, and a feasibility study. LCCE and CBA provide a basis for a written justification for a project.   EVM metrics can be mined for a Basis Of Estimate (BOE) for the LCCE and avenues of analysis for the CBA.

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Back-up

Back Up

Slides

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Additional Sources of Guidance

- OMB Circular No. A-11,"Preparation and Submission of Annual Budget Estimates."

- OMB Circular No. A-19,"Legislative Coordination and Clearance."

- OMB Circular No. A-70,"Federal Credit Policy."

- OMB Circular No. A-76,"Performance of Commercial Activities."

- OMB Circular No. A-109,"Policies to Be Followed in the Acquisition of Major Systems."

- OMB Circular No. A-130,"Management of Federal Information Resources."

- "Joint OMB and Treasury Guidelines to the Department of Defense Covering Lease or Charter Arrangements for Aircraft and Naval Vessels."

- Executive Order 12291, "Federal Regulation."

- "Regulatory Impact Analysis Guidance," in *Regulatory Program of the United States Government.*

- "Federal Energy Management and Planning Programs; Life Cycle Cost Methodology and Procedures,"

- Federal Register, Vol. 55, No. 17, January 25, 1990, and Vol. 55, No. 224, November 20, 1990.

- Presidential Memorandum of April 29, 1992, "Benefits and Costs of Legislative Proposals."

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EVM METRICS

- **BASELINE EXECUTION INDEX (BEI) (Schedule Metric)**

  – BEI   = # of Baseline Tasks Actually Completed / # of Baseline Tasks Scheduled for Completion

- **CRITICAL PATH LENGTH INDEX (CPLI) (Schedule Metric)**

  – CPLI = (Critical Path Baseline Duration + Float Duration) / Critical Path Baseline Duration

- **TO COMPLETE PERFORMANCE INDEX (TCPI) # §**

  – TCPIEAC = Work Remaining / Cost Remaining = (BAC – BCWPCUM) / (EAC – ACWPCUM)

To Determine a Contract Level TCPI or EAC; You May Replace BAC with TAB

§   To Determine the TCPI BAC,LRE Replace EAC with either BAC or LRE

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EVM METRICS

- **DoD TRIPWIRE METRICS** Favorable is > 1.0, Unfavorable is < 1.0
  - Cost Efficiency   CPI   = BCWP / ACWP
  - Schedule Efficiency   SPI   = BCWP / BCWS

- **VARIANCES** Favorable is Positive, Unfavorable is Negative
  - Cost Variance   CV   = BCWP – ACWP   CV % = (CV / BCWP) *100
  - Schedule Variance   SV = BCWP – BCWS   SV % = (SV / BCWS) * 100
  - Variance at Completion   VAC   = BAC   –   EAC

- **OVERALL STATUS**
  - % Schedule = (BCWSCUM / BAC) * 100
  - % Complete = (BCWPCUM / BAC) * 100
  - % Spent   = (ACWPCUM / BAC) * 100

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EVM METRICS

■ **<u>ESTIMATE AT COMPLETION</u> #**

- – EAC = Actuals to Date + [(Remaining Work) / (Efficiency Factor)]
- – EACCPI = ACWPCUM + [(BAC – BCWPCUM) / CPICUM] = BAC / CPICUM
- – EACComposite = ACWPCUM + [(BAC – BCWPCUM) / (CPICUM * SPICUM)]

 # To Determine a Contract Level TCPI or EAC; You May Replace BAC with TAB

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CPR Reports

Format Title	Frequency	Description	Use of Format	Selection
1. Work Breakdown Structure	Monthly or weekly basis as provided in contract	Reports performance data (BCWS, BCWP and ACWP) by reporting WBS elements for the current reporting period as well as cumulative to date data. Cost and schedule variances are calculated and reported. Identifies any reprogramming adjustment, budget at completion, estimate at completion, and variance at completion by element. Also shows management reserve and undistributed budget. It can also show indirect costs if requested.	Isolate key cost and schedule variances, quantify the impact, analyze and project future performance. Performance issues isolated at lowest level and analyzed for impact to overall cost and schedule variances.	$20M contracts: Mandatory. Recommended for small contracts <$20M.
2. Organizational Categories	Monthly or weekly basis as provided in contract	Reports the same data as Format 1 but identified by contractor functional labor categories, major subcontractors, and material.	Same uses as Format 1, but provides for analysis of internal (labor) variances or external (subcontractor/material) variances.	$50M contracts: Mandatory. $20M but <$50M contracts: Optional, but recommended for development contracts or contracts with significant outsourcing efforts.
3. Baseline	Monthly, quarterly or semi-annually. Monthly recommended for development or high risk contracts.	Budgeted time-phased baseline costs to end of program. This format shows significant baseline changes authorized during the reporting period. Data includes contract budget base, total allocated baseline, completion dates, and management reserve.	Data can be plotted to determine if there has been a shift in the baseline curve since the previous report. Analysis can focus on the distribution of cost for authorized changes to the baseline during the period. Used to determine if Over Target Baseline or Over Target Schedule has been incorporated into the program.	$20M but <$50M contracts: Optional, but recommended for development contracts.
4. Staffing	Monthly, quarterly or semi-annually. Monthly recommended for development or high risk contracts.	Staffing forecasts in months by functional category until the end of the contract.	Staffing data plotted over time and correlated to major milestones and activities on the contract schedule shows accuracy of labor estimates. Projected staffing levels should be analyzed for consistency with scheduled activities. Correlate this analysis with Formats 2 and 3.	$50M contracts: Mandatory. Not useful for shorter duration contracts (less than two years). $20M but <$50M contracts: Optional, but recommended for development contracts.
5. Explanation and Problem Analyses	Monthly	Narrative explanation of key cost, schedule, and variance at completion variances. Contractor describes underlying reasons, program impacts, and corrective action plans for significant drivers at the lowest specified level and at the total contract level. Includes analysis of MR, undistributed budget, and overall risk.	Correlated with data from Formats 1 and 2 to understand reasons for the variances. Understanding the underlying reasons and the contractor's get well plans help the analyst prepare an integrated assessment of past and future trends and analyze overall executability. PM can then make informed decisions.	$20M contracts: Mandatory. Not useful for shorter duration contracts (less than two years). Recommended for small contracts <$20M.

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Definition of LCCE and CBA

- **Parts of a LCCE/CBA**

  - **Policy Rationale**: Justification for the program i.e. mission needs, increased readiness, decrease cost, etc.

  - **Explicit assumptions**: statement of assumptions, rationale behind the assumptions, and a review of the strengths and weaknesses of the assumptions should be included.

  - **Evaluation of Alternatives**: Analyses should also consider alternative means of achieving program objectives by examining different program scales, different methods of provision, and different degrees of government involvement.

  - **Verification**: Retrospective studies to determine whether anticipated benefits and costs have been realized

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Definition of LCCE and CBA

■ **Parts of a LCCE/CBA continued**

– **Identifying and Measuring Cost and Benefits**: Both intangible and tangible benefits and costs should be recognized. The relevant cost concept is broader than private-sector production and compliance costs or government cash expenditures. Costs should reflect the opportunity cost of any resources used, measured by the return to those resources in their most productive application elsewhere.

– **Treatment of Uncertainty**: Estimates of benefits and costs are typically uncertain because of imprecision in both underlying data and modeling assumptions. Because such uncertainty is basic to many analyses, its effects should be analyzed and reported.

– **Incidence and Distributional Effects**: The principle of maximizing net present value of benefits is based on the premise that gainers could fully compensate the losers and still be better off. The presence or absence of such compensation should be indicated in the analysis.

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Government Mandates, Directives, and Guides

- **Cost estimating process:**

Initiation and research

| Define the Estimate's Purpose | Develop the Estimating Plan |

Assessment

| Define the Program | Determine the Estimating Approach | Identify Ground Rules & Assumptions |

| Obtain the Data | Develop the Point Estimate |

Analysis

| Conduct Sensitivity | Conduct Risk And Uncertainty Analysis | Document the Estimate |

Presentation

| Present Estimate To Management For Approval | Update Estimate To Reflect Actual Cost Changes |

Analysis, Presentation, and Updating the estimate can lead to repeating previous assessment steps

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