Earned Value Management (EVM)

Tracking cost and schedule performance on projects

“What are my chances?” / “Not good.” / “You mean, not good like one out of a hundred?” / “I’d say more like one out of a million.” / … “So you’re telling me there’s a chance!”

- Jim Carrey as Lloyd Christmas to Lauren Holly as Mary Swanson

Unit Index

Unit I - Cost Estimating
Unit II - Cost Analysis Techniques
Unit III - Analytical Methods
Unit IV - Specialized Costing
Unit V - Management Applications
  13. Economic Analysis
  14. Contract Pricing
  15. Earned Value Management (EVM)
  16. Cost Management
# EVM Overview

**Key Ideas**
- Integrated baseline
  - Resource-loaded schedule
- Earned value
  - Objective progressing
  - Extrapolation from Actuals
- Cost and schedule performance

**Practical Applications**
- EACs - risk-adjusted rollups
- EACs - alternative formulae
- Performance measurement
  - Contract vs. technical

**Analytical Constructs**
- AC (Actual Cost) = actuals to date
- EV (Earned Value) = value of work performed
- PV (Planned Value) = budget
- EAC = AC + \( \frac{(BAC-EV)}{PI} \)

**Related Topics**
- Risk Management
- Project Management
- Schedule Analysis / Risk

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**EVM and Cost Estimating**

**How should Cost Estimators be involved in EVM?**

**Verify Realistic Baselines**
- Control Accounts that trace to BOEs
- Cost Estimator participation in IBRs

**Develop Accurate EACs**
- Statistical and risk-based methods

**Gather Cost Data to Support Estimating**
- CPR and other EV data serve as data sources for estimating analogous efforts

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**Tip:** This formula, while intuitive, may not be the best predictor of EAC!
EVM Outline

• Core Knowledge
  - Introduction to Earned Value
  - Earned Value Management (EVM) Components
  - Earned Value Analysis
  - CPR Formats
• Summary
• Resources
• Related and Advanced Topics

Introduction to Earned Value

• What?
• Why?
• When? (or Who?)
• How?
What? - EVM Objectives

- **Earned Value Management** integrates Technical Scope, Schedule, and Cost for definitized contract work
- **Earned Value Management System (EVMS)**
  - Planning tool
  - Reporting tool
  - Analysis and Decision Making tool
- Provides for integrated management of program planning and execution, which can enable...
  - Accomplishment of Technical Scope within Cost and Schedule parameters
  - Reduced or Eliminated Schedule Delay
  - Reduced or Eliminated Cost Overrun

Why? - The Bottom Line

- Yeah, yeah...“integrated management” is great, but costs $$. Why should I really do it?
  - The cost avoidance window of opportunity is BEFORE contract is 15% complete
  - According to a study of more than 700 major DoD contracts, percent overrun at completion will be within 10% of percent overrun at 20% complete


- If you can’t plan the near-term work well, you won’t plan the far term work any better
- EVM requires all work on contract to be planned before beginning
  - Can provide early insight into areas of concern and opportunity
Why? - Key Benefits

• Imposes discipline on resource planning process through the development of work and planning packages
• Provides disciplined, standardized approach to measurement and terminology
• Ties cost and schedule performance to technical accomplishment of work
• Provide objective analysis of performance

Why? - Basic Example

• Managing projects without earned value provides only part of the picture
• Traditional approach:
  - Budget work
  - Record Actual expenses
• Example:
  - Budgeted for 4 Aquaria to be built in November at $100 each
  - At end of November, spent $300
  - Great! I am $100 under budget...or am I?
Why? - Basic Example

- Example (continued):
  - At the end of November I spent $300 but only completed 2 Aquaria

<table>
<thead>
<tr>
<th>Budget</th>
<th>Earned Value</th>
<th>Actual</th>
<th>Cost Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>$400</td>
<td>$200</td>
<td>$300</td>
<td>- $100</td>
</tr>
</tbody>
</table>

- So I am not only overrunning Cost, I am also behind schedule!

When & How? - Department of Defense (DoD) EVMS Policy

- Per DFARS 234.201 and 234.203, EVMS is required for cost and incentive contracts and subcontracts as follows:

$50M

Contracts > =$50M
EVMS must be determined ANSI/EIA-748 compliant by Cognizant Federal Agency
All formats mandatory

$20M

Contracts > $20M, < $50M
Formats 1 & 5 mandatory, 2 – 4 optional

Note: EVMS is less frequently used on Firm-Fixed Price, Level of Effort, and Time & Material efforts regardless of cost, as well as short duration contracts (e.g., < 1 yr)
Earned Value Management (EVM) Components

- Integrated Baseline Overview
- Work Breakdown Structure
- Assignment of Work
- Earned Value Data Elements
- Baseline Development
- Performance Measurement

Baseline Development

Price $110M

Cost (CBB) $100M

Fee $10M

Management Reserve $10M

Performance Measurement Baseline (PMB) $90M

Earned Value is measured against the PMB

MR covers unanticipated, in scope changes

Distributed Budget (Control Accounts) $85M

Undistributed Budget $5M

Work is tied to an activity, but is not detail-planned

Control Accounts are the management control point for the integration of scope, schedule & cost

Work Packages $40M

Planning Packages $45M

Work is tied to an activity, but is not detail-planned
Baseline Development - PMB

- Performance Measurement Baseline (PMB) developed
  - Sum of all Work/Planning Package Budgets + UB
  - Undistributed Budget (UB) is:
    • Work tied to an activity, but not detail-planned
    • Used most often when new work added to contract
- Earned Value is Measured against the PMB
- Work packages and related budget (BCWS) are time phased using logic-driven schedule
  - e.g., PERT chart showing dependencies

**Tip:** UB usually distributed within 60 days

Contract Budget Base (CBB)

* Image Source: http://humphreys-assoc.com
Integrated Baseline Overview

• Key component of EVM is the Resource Loaded Schedule
  - Elements of the Performance Measurement Baseline (PMB) defined early in acquisition process by Government and Contractor
    • WBS Structure
    • Schedule
    • BOEs (justification for time phased costs and effort)
  - Time-Phased Budget / Resource Loaded Schedule initially defined for proposal and refined/baselined post negotiations

• Government review of PMB occurs via Integrated Baseline Review (IBR)

WBS Definition/Overview

• Work Breakdown Structure (WBS): Product-oriented division of material and work tasks
• Used to organize and define product/work to be accomplished
• Different forms:
  - Program Summary WBS (Government), usually referred to as WBS
  - Contractor WBS, usually referred to as CWBS
  - Cost Element Structure (CES)
    • Level and scope may depend on who’s doing the estimate
  - WBS typically several levels higher than CWBS

OSD EVM Website: http://www.acq.osd.mil/pm
Organizational Breakdown Structure (OBS) Definition

- Functional breakdown of Organization
  - Identifies the program’s organizational structure
  - Supports the identification of the functional responsible for controlling overhead costs
- Typically aligns with Company’s Org Chart
- One piece of the framework used for planning resources
- One popular organization technique involved Integrated Product Teams (IPTs)
  - Multi-disciplined
  - Overarching IPT and Working-level IPT(s)

Assignment of Work - Control Accounts

- WBS cross-walked to OBS → Control Accounts
  - Identifies Responsibility
  - Result is Control Account (sometimes called a Cost Account)
- Control Account is the focal point for integration of scope, cost, and schedule
- Control Account Manager (CAM) is person responsible for:
  - Developing plan for Control Account (Technical Scope, Schedule Tasks, Budget/Resources)
    - Work Authorization Document (WAD)
  - Managing Earned Value performance within Control Account
    - Monitoring EVM metrics
    - Analyzing control account performance status
    - Reporting variances
  - Conducting risk management/mitigation as required
Assignment of Work - Work Packages

- Work Packages are the lowest level at which resources are allocated
- Within Control Accounts, work and planning packages defined at lowest level of detail
  - Work packages for near-term work
  - Planning packages for far-term work
  - Planning packages become more detailed work packages as time progresses

- Resources allocated to each work/planning package
  - Direct Labor
  - Material
  - Other Direct Charges (ODCs)

Tip: Typically 4-6 weeks long
Tip: Detail plan typically 6 months out

Assignment of Work Illustration

Graphic adapted from EVMS Basics Concepts, Sean Alexander, Meridianet
Earned Value Data Elements

- Earned Value has five basic data elements:

<table>
<thead>
<tr>
<th>Element</th>
<th>Title</th>
<th>Common Terminology</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCWS</td>
<td>Budgeted Cost of Work Scheduled</td>
<td>Planned Value (PV), Performance Measurement Baseline (PMB), plan, baseline</td>
</tr>
<tr>
<td>BCWP</td>
<td>Budgeted Cost of Work Performed</td>
<td>Earned Value (EV)</td>
</tr>
<tr>
<td>ACWP</td>
<td>Actual Cost of Work Performed</td>
<td>Actual Cost (AC), actuals</td>
</tr>
<tr>
<td>BAC</td>
<td>Budget at Complete</td>
<td>Planned Cost</td>
</tr>
<tr>
<td>EAC / LRE</td>
<td>Estimate at Complete / Latest Revised Estimate</td>
<td>Forecasted Cost</td>
</tr>
</tbody>
</table>

Tip: EAC generally refers to the Government’s independent assessment of the estimate at complete while LRE refers to the Contractor’s estimate at complete.

BCWS (The Plan)

Budgeted Cost of Work Scheduled (BCWS): The sum of the budgets for all work packages, planning packages scheduled to be accomplished within a given time period
- The value of the work scheduled
- The baseline used to measure all performance
- The resource-loaded schedule
  - Picture a Gantt chart

![](BCWS_Gantt_chart.png)
BCWP (What Work Was Performed?)

**Budgeted Cost of Work Performed (BCWP):** The sum of all budgets for completed work packages and completed portions of open work packages
- The value of the work performed
- Dependent on BCWS - can only earn as much $ as is loaded in the completed BCWS tasks

ACWP (Cost Incurred)

**Actual Cost of Work Performed (ACWP):** The costs actually incurred to accomplish the work earned within a specified time frame

- AKA Actuals (AC), Actual Value
- General Ledger
- Labor
- Material
- Invoices
- Travel
- Contractor’s Accounting System
- Subcontract Invoices
- Export actuals to EVM database
- ODCs
BAC and LRE (End of Work)

- **Budget At Complete (BAC):** Cumulative BCWS at the end of the contract
- **Latest Revised Estimate (LRE):** The contractor’s best guess at how much the effort will actually cost at the end of the contract

<table>
<thead>
<tr>
<th>Time</th>
<th>$</th>
<th>BAC</th>
<th>BCWS</th>
<th>ACWP</th>
</tr>
</thead>
<tbody>
<tr>
<td>LRE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACWP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BCWP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Performance Measurement - EV Methods**

<table>
<thead>
<tr>
<th>EV Method</th>
<th>Description</th>
<th>Type of Tasks that Use Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milestone (Weighted)</td>
<td>Take performance as defined Milestones (MS) are accomplished. MSs can be weighted if one or more are considered more important</td>
<td>Tasks that can be planned using interim Milestones</td>
</tr>
<tr>
<td>Percent Complete</td>
<td>Performance is taken based on Percent of task completed</td>
<td>Work that does not have any reasonable interim measurable MSs</td>
</tr>
<tr>
<td>0/100</td>
<td>All performance is taken when task is complete</td>
<td>Short duration tasks - one month or less</td>
</tr>
<tr>
<td>50/50 Or X%/Y%</td>
<td>50% (X%) performance taken when task starts; 50% (Y%) performance taken when task is complete</td>
<td>Short duration tasks - two months or less</td>
</tr>
<tr>
<td>LOE</td>
<td>Plan based on resource expenditure plan – Performance always equals Plan</td>
<td>Used for tasks that are more time-oriented vice task oriented, such as Program Management</td>
</tr>
</tbody>
</table>
Example - Performance Measurement

• Determine the best earned value measurement technique:
  - Aquarium System Program Management
  - Aquarium Design
  - Aquarium Deployment to Site ATLANTIC

Example - Performance Measurement

• Valid earned value measurement techniques:
  - Aquarium System Program Management
    • LOE - most common method
    • Milestone
  - Aquarium Design
    • Most likely Design will be divided into smaller work packages and multiple methods will be employed
    • Milestone / Weighted Milestone - most common method
    • Percent Complete
  - Aquarium Deployment to Site ATLANTIC
    • 0/100
    • X%/Y%
    • Milestone

Multiple Answers are Justifiable
Earned Value Analysis

- Elementary EV Analysis
- Analysis of Past Performance
- Variance Reports
- Projection of Future Performance
- Earned Value Review Process

Elementary EV Analysis

- Common calculated Data Elements:
  - Schedule Variance (SV) = BCWP - BCWS
  - Cost Variance (CV) = BCWP - ACWP

A variance, in the context of earned value analysis, is often referred to as an accomplishment variance.
Elementary EV Analysis

• Common calculated Data Elements:
  - Variance at Complete (VAC) = BAC - LRE
  - Estimate at Complete (EAC)
    • Forecasting measure
    • Various methods applicable
    • Discussed in more detail later
  - Budgeted Cost of Work Remaining (BCWR)
    = BAC - BCWP

• Analysis of data, including sample problems, in next section

Analysis of Past Performance

• CV, SV, and VAC: Most common and simplest derived earned value data

• Current vs. Cumulative Data Points
  - Cumulative data points good for determining average performance
  - Current data points good for assessing current performance and for highlighting anomalies, errors in data, and error corrections
  - Trend lines good for assessing performance over time - Sudden trend changes should be examined
Example - Past Performance

• Sample problem:
  - Building 8 Aquaria
    • Budgeted for 4 to be built in Nov and 4 to be built in Dec at $100 each
  - At the end of Nov, contractor spent $300 and completed 2
  - Contractor now expects the project to cost a total of $1000
  - For Month-end (ME) Nov, what is cumulative BCWS? BCWP? ACWP?
  - For ME Nov, what is cumulative CV? SV? VAC?
  - What are those variances telling us?

• Answers:
  - BCWS = $400  BCWP = $200  ACWP = $300
  - CV = - $100  SV = - $200  VAC = - $200
  - What are those variances telling us?
    1. Overrunning now, accomplished less than planned, expect overrun at complete, if task on critical path then expect a delay at complete - Facts based on data provided
    2. Do not expect to repeat overrun for Aquaria #3-8 because VAC ≠ 4 * CV. Ask: Is this realistic? Why do they think overrun will not be repeated?
    3. Built 2 in one month, now expect to build 6 in next month - Unlikely - Ask: How do they plan to accomplish this and not spend more $/system than budgeted
  - Begin to plan for how to cover current overrun and expected future overrun
## Past Performance - Indices

- **Cost Performance Index (CPI) and Schedule Performance Index (SPI)** display variances on a units-free scale
  - CV of $100 out of $2M is nothing
  - CV of $100 out of $200 is significant
- **Cost Performance Index (CPI)**
  - Ratio of work performed to actual costs
  - BCWP / ACWP
  - Used to determine the value of every dollar of work accomplished (bang for the buck)
  - < 1.0 is unfavorable > 1.0 is favorable
- **Reciprocal of CPI**
  - Provides the final cost of dollar's worth of budgeted effort
  - EAC Calculations use reciprocal of CPI to scale budgeted effort up to an expected completion cost

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## Past Performance - Indices

- **Schedule Performance Index (SPI)**
  - Ratio of value of work performed to value of work planned
  - BCWP / BCWS
  - Used to determine the efficiency at which scheduled work is being accomplished
  - < 1.0 is unfavorable > 1.0 is favorable
- **Analysis using CPI, SPI similar to that using CV, SV**

Tip: Examine cost and schedule together graphically to assess visually how variances may be impacting one another.
Past Performance - MR

• Use of Management Reserve:
  - Should have a technical reason to apply MR
  - Should not be used to fix negative cost variances
  - MR usage could be an indicator of problems
  - Helpful MR graphs:
    • MR use with CV and SV to assess visually if MR being used to cover problems
    • % MR remaining with % PMB remaining to assess visually if MR is expended at rate similar to how program is executing (Alternative: MR Balance vs. BCWR)
    • Graph CBB vs. PMB - As MR is used and incorporated into the PMB, the CBB and PMB lines will merge

Tip: It is good to have some MR left at end of contract to cover approved rate changes that can occur 3-4 years later

Past Performance - Percentages

• Other useful data:
  - % planned = BCWS / BAC
  - % complete = BCWP / BAC
  - % spent = ACWP / BAC

• Conduct analysis such as
  - % planned >> % complete? Problem!
  - % spent >> % complete? Problem!
  - % of MR used >> % complete? Problem! (unless % complete close to 100%)
  - Master schedule shows % complete >> or << Earned Value % complete? Possible problem - an indication that Schedule and EV are not in sync
Example - Past Performance

- Sample Problem:
  BCWS = $400  BCWP = $200  ACWP = $300  
  BAC = $800  LRE = $1000
  - What percent of my budget has been spent to date?
  - For every $ I spend, how much value am I receiving?
  - I have used 50% of my MR to date. Should I be concerned about having sufficient MR to complete program?

Example - Past Performance

- Answers:
  - What % of my budget has been spent to date?
    • % spent = ACWP / BAC = $300/$800 = 37.5%
  - For every $ I spend, how much value am I receiving?
    • CPI = BCWP / ACWP = $200/$300 = 0.67
    • For every $1 spent, I receive 67 cents of value
  - I have used 50% of my MR to date. Should I be concerned about having sufficient MR to complete program?
    • % complete = BCWP / BAC = $200/$800 = 25%
    • Yes, I should be concerned
      - Using MR twice as fast as I am completing work
      - Only ¼ of the way through the program (relatively early)
Future Performance - EAC

- Objective, mathematical Estimates At Complete (EACs) can be calculated
- Most common are CPI and CPI * SPI
  - CPI Forecast
    - ACWP + BCWR / CPI = BAC / CPI
    - Assumes even cost performance across the entire project equal to performance experienced to date
    - Referred to as “best case” EAC
  - CPI * SPI Forecast
    - ACWP + BCWR / (CPI*SPI)
    - Also assumes that past cost and schedule performance are indicative of future performance
    - Adjusts estimate to account for schedule performance experienced to date
    - Referred to as “worst case” EAC

Future Performance - TCPI

- What is our (implicit) predicted future performance based on data reported?
- Use the To-complete Cost Performance Index (TCPI)
  - TCPI\textsubscript{BAC} and TCPI\textsubscript{LRE}
    - Ratio of remaining work to complete to remaining $ available to be spent to achieve the BAC (or LRE)
    - TCPI\textsubscript{BAC} = BCWR / (BAC - ACWP)
    - TCPI\textsubscript{LRE} = BCWR / (LRE - ACWP)
    - Can also calculate TCPI for EAC forecasts
- “Indicator of the goodness” of the LRE/EAC
Future Performance - TCPI and LRE

- $\text{TCPI}_{\text{LRE}}$ most common to analyze because it reflects what the contractor thinks about their future performance
- Compare TCPI to CPI
  - TCPI < CPI
    - Implies lower productivity is assumed for remaining work
    - If significantly lower, Ask: What additional overrun are you anticipating in the future?
  - TCPI > CPI
    - Implies higher productivity is assumed for remaining work
    - If significantly higher, Ask: What measures are you taking to improve productivity so greatly?
    - Significantly higher TCPI causes validity of EAC to be in question

**Tip:** $\text{TCPI}_{\text{LRE}}$ greater than Cum CPI by more than 5% (0.05) is excessively optimistic

Example - Future Performance

- Sample Problem:
  - BCWS = $400  BCWP = $200  ACWP = $300
  - BAC = $800  LRE = $1000

- What is the TCPI to achieve the LRE?
- Is the LRE reasonable?
- Using independent forecasts, what is the “best case” EAC? The “worst case” EAC?
Example - Future Performance

• Answers:
  - What is the TCPI to achieve the LRE?
    • $\text{TCP}_{\text{LRE}} = \frac{\text{BCWR}}{(\text{LRE} - \text{ACWP})}$
      $= \frac{(800 - 200)}{(1000 - 300)}$
      $= 600 / 700 = 0.86$
  - Is the LRE reasonable?
    • CPI = 0.67; $\text{TCP}_{\text{LRE}}$ = 0.86
    • $\text{TCP}_{\text{LRE}}$ is more than 5% higher than CPI
    • LRE may not be reasonable
      - Need to investigate reasoning behind CPI and assess the reasonableness of the plans for improving performance so drastically

Example - Future Performance

• Answers (continued):
  - Using independent forecasts, what is the "best case" EAC? The "worst case" EAC?
    • Best Case EAC = CPI Forecast
      $= \frac{\text{BAC}}{\text{CPI}}$
      $= 800 / 0.67 = 1200$
    • Worst Case EAC = CPI*SPI Forecast
      $= \frac{\text{ACWP} + \text{BCWR}}{\text{CPI} \times \text{SPI}}$
      $= 300 + \frac{(800 - 200)}{(0.67) \times (0.5)}$
      $= 2100$
Summary

• Summary
• Gold Card

EVM Summary

• EVM is a management technique
  - Integrates technical, cost, and schedule data
  - Facilitates objective, realistic management decisions

• Earned Value Management System (EVMS) is a multi-faceted EVM tool
  - Planning tool
  - Reporting tool
  - Analysis and Decision Making tool
EVM Summary

• Major Benefits of using EVM include:
  - Improved planning
    • Clear definition of work prior to beginning work
    • Accurate level of resources
    • Quick, early problem identification
    • Reduced cost and schedule risks
    • Reduced propensity to add work without adding budget (out of scope changes)
  - Objective performance measurement
    • Provides true cost and schedule condition
    • Encourages accurate forecasting of cost to complete

DAU EVM Gold Card
EVM Data Reports Overview

CPR Formats 1-6

Contract Performance Report (CPR)

- The CPR is a management report that provides timely and reliable summary level data to assess current and projected contract performance.
- There are six formats (Formats 1 - 6) with which to measure contractors’ cost and schedule performance on DoD acquisition contracts.
  - Format 1: Work Breakdown Structure
  - Format 2: Organizational Categories
  - Format 3: Baseline
  - Format 4: Staffing
  - Format 5: Explanations and Problem Analyses
  - Format 6: Integrated Master Schedule
- CPR Formats 1 - 6 are regulated by Data Item Description (DID) number DI-MGMT-81861 for the Integrated Program Management Report (IPMR)
## CPR Formats Summary

<table>
<thead>
<tr>
<th>#</th>
<th>Format Name</th>
<th>Performance Data</th>
<th>Common Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Work Breakdown Structure</td>
<td>Period &amp; Cumulative EVM Metrics measured against product-oriented work breakdown structure</td>
<td>“Gold Card” Analysis</td>
</tr>
<tr>
<td>2</td>
<td>Organizational Categories</td>
<td>Period &amp; Cumulative EVM Metrics measured against contractor’s internal management structure</td>
<td>“Gold Card” Analysis, Staffing Analysis</td>
</tr>
<tr>
<td>3</td>
<td>Baseline</td>
<td>Total program budget baseline plan for beginning and end of period, including actual/planned/estimated schedule dates</td>
<td>Analysis of baseline stability and reasonableness of future planned work</td>
</tr>
<tr>
<td>4</td>
<td>Staffing</td>
<td>Actual and planned staffing, in terms of hours and person-months, measured against contractor’s internal management structure</td>
<td>Staffing Performance Analysis (plan vs. actual; reasonableness of planned staffing), Used in conjunction with Format 2</td>
</tr>
<tr>
<td>5</td>
<td>Explanation &amp; Problem Analyses</td>
<td>Summary analysis - changes in EAC, UB, MR, significant shifts in plans, Analysis of variances</td>
<td>Root Cause Analysis, Risk Analysis</td>
</tr>
<tr>
<td>6</td>
<td>Integrated Master Schedule</td>
<td>Total float (slack) and relation to the critical path. Task and milestone actuals/forecasts measured against their baseline.</td>
<td>Schedule / Critical Path, “Gold Card” Analysis</td>
</tr>
</tbody>
</table>

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**CPR Format 1 Template**

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**CPR Format 1 Template**

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**CPR Format 1 Template**
CPR Format 2 Template

CPR Format 3 Template
CPR Format 4 Template

EVM Metrics

Data Elements

CPR Format 5

- Narrative report used to explain significant cost and schedule variances and other identified contract problems
  - Variance thresholds are defined prior to the start of the program
  - If thresholds are exceeded, problem analysis and narrative explanations are required
- Summary of overall cost, schedule and EAC variances
- Differences between best case, worst case, and most likely EACs - Format 1
- Changes in Undistributed Budget or Management Reserve
- Significant time-phasing shifts in Baseline (BCWS) - Format 3
- Significant time-phasing shifts or overall changes in Forecasted Staffing - Format 4
- Discussion of Over Target Baseline and/or Over Target Schedule incorporation
CPR Format 6

- An IMS constitutes a program schedule that includes the entire required scope of effort.
- Collection of logically linked sequences of activities that clearly show how portions of work depend on one another.
- Must be complete and dynamic. Successor activities forecast dates are automatically recalculated when an activity changes.
- Critical activities are those which cannot be delayed without delaying the end date of the program. The amount of time an activity can slip before the program’s end date is affected is known as “total float” or “total slack.”
- Planning and scheduling are continual processes throughout the life of a project. Planning precedes scheduling as work and execution strategies must be devised before they may be scheduled. Planning done in stages as stakeholders learn more is known as rolling wave planning.

Example Schedule

- Below shows a sequence of activities necessary to complete framing in a house construction project.
Fields and DCMA Metrics

- Common Data Fields:

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Predecessors</th>
<th>Total Float (Total Slack)</th>
<th>WBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Starts/Finishes</td>
<td>Successors</td>
<td>Critical</td>
<td>Unique ID</td>
</tr>
<tr>
<td>Actual Starts/Finishes</td>
<td>Duration % Complete</td>
<td>Primary Constraint</td>
<td>Duration</td>
</tr>
<tr>
<td>Forecast Starts/Finishes</td>
<td>Physical % Complete</td>
<td>Primary Constraint Date</td>
<td>Activity Type</td>
</tr>
</tbody>
</table>

- DCMA Metrics:

**Metric**

**Baseline Execution Index (BEI)**

Total # Tasks Complete / (Total # of Tasks Completed Before Now + Total # of Tasks Missing Baseline Finish Date)

**Critical Path Length Index (CPLI)**

(Critical Path Length +/- Total Float) / Critical Path Length

**Hit/Miss**

Month’s Tasks Completed ON or AHEAD Baseline / Month’s Tasks Scheduled to Complete

**Remarks**

Invalid Dates

Calculation of The Critical Path Length Index (CPLI)

Hit/Miss: Month’s Tasks Completed ON or AHEAD Baseline / Month’s Tasks Scheduled to Complete

* DCMA Metrics Source: DCMA Earned Value Management System (EVMS) Program Analysis Pamphlet (PAP), July 2012

DCMA 14 Point Check

- DCMA 14 Point Check:

<table>
<thead>
<tr>
<th>Check</th>
<th>Description</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Logic</td>
<td>The number of activities that are logically predecessor, a successor or both. The number should not exceed 5% of the activities within the schedule. A core schedule quality check.</td>
</tr>
<tr>
<td>2</td>
<td>Leads</td>
<td>Activities which define or are followed by activities that carry a lead (also known as negative lag). Leads or negative lags are often used to adjust the successor start or end date relative to the logic link applied.</td>
</tr>
<tr>
<td>3</td>
<td>Lags</td>
<td>The number of activities with lags. Lagging activities should be at least 60% of the logic within the schedule.</td>
</tr>
<tr>
<td>4</td>
<td>FS Relations</td>
<td>The total number of activities with Finish to Start (FS) logic links. The number should be at least 90%.</td>
</tr>
<tr>
<td>5</td>
<td>Hard Constrained</td>
<td>Number of activities with hard or two-way constraints. Should not exceed 5% of the activities within the schedule.</td>
</tr>
<tr>
<td>6</td>
<td>High Float</td>
<td>Number of activities with total float greater than two months. Should not exceed 5%. Schedule pads with high amounts of float typically arise due to artificially constrained activities (see check # 5).</td>
</tr>
<tr>
<td>7</td>
<td>Negative Float</td>
<td>Total activity that is incomplete and total float is less than zero working days. Negative float is a result of an unbalanced or uncoordinated schedule. Negative float indicates that the schedule is not possible based on the current completion dates.</td>
</tr>
<tr>
<td>8</td>
<td>High Duration</td>
<td>Total number of activities that have a duration longer than two months. The number should not exceed 5%. High duration activities are generally an indication that a plan is too high level for adequate planning and controls.</td>
</tr>
<tr>
<td>9</td>
<td>Re-scheduled</td>
<td>Activities with planned work in the past or actual work in the future. These activities should not be updated directly in the schedule. Re-scheduled activities are a reflection of less robust scheduling engines not correctly enforcing standard schedule logic. It is impossible to have planned activities prior to the time scheduled data, and similarly, activities cannot be entered into the future.</td>
</tr>
<tr>
<td>10</td>
<td>Resources</td>
<td>Number of resources that have been over-reacted to. A core schedule quality check. Over-reacting resources is a schedule that has more resources than tasks or activities.</td>
</tr>
<tr>
<td>11</td>
<td>Missed Activities</td>
<td>The number of activities that have been completed behind the baseline completion date in a good indication of execution performance.</td>
</tr>
<tr>
<td>12</td>
<td>Critical Path Test</td>
<td>This check tests the integrity of the project’s network logic, particularly the critical path. The Critical Path Test verifies that the project’s critical path is the actual path to the project completion date. If the project completion date is not delayed in direct proportion to the amount of total float (100 days ~ 3 years) that is introduced into the schedule as part of this test, then there is broken logic somewhere in the network.</td>
</tr>
<tr>
<td>13</td>
<td>CPLI Calculation of The Critical Path Length Index (CPLI)</td>
<td>The Critical Path Length Index (CPLI) is a measure of the relative efficiency required to complete a project. It reflects the critical path to the project target completion date. A project with an aggressive or conservative completion date may not carry the same overall risk as that of the critical path through the network. CPLI of greater than one indicates that a schedule is conservative with a very high chance of early completion. A CPLI of less than one is very aggressive with a very high chance that completion will overrun beyond the target project completion date.</td>
</tr>
<tr>
<td>14</td>
<td>BEI Calculation of the Baseline Execution Index (BEI)</td>
<td>A reflection of the efficiency with which actual work has been accomplished since measured against the baseline. The more activities that are completed either on time or ahead of the baseline schedule will reflect a BEI of one or more. Conversely, a BEI of less than one indicates less than expected schedule execution.</td>
</tr>
</tbody>
</table>