



NATIONAL CONTRACT MANAGEMENT ASSOCIATION



*Association of Government Accountants  
San Diego Chapter*

# Earned Value Management System (EVMS)

Presented by

National Contract Management Association  
and Association of Government Accountants

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# Agenda

- 8:30 – NCMA/AGA Introduction
- 8:35 – Speaker Introduction
- 8:45 – EVM: history, terminology, formulas
- 9:25 – Setting up a project for EVM
- 10:15 – Break NCMA/AGA Chapter business
- 10:35 – Measuring performance, EVM guidelines, limitations, FAR
- 11:20 – Q&A

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# INSTRUCTOR

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Bio

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**PART 1**

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# EVM – what is it?

- It's really simple!
- A project management technique that measures progress objectively
  - Measures performance of the triple constraint (scope, schedule and cost)
  - Measures the earned value of work actually completed

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# EVM – more what is it?

- It's about performance measurement
  - Develop a plan
  - Measure variances regularly
  - Compare the budgeted cost of the work performed to the budgeted cost of work scheduled and actual cost of the work performed

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# EVM – what can it provide?

- Likely cause and magnitude of a variance
- Whether a variance require corrective action
- Actual and earned performance compared to the cost baseline
- What are we getting for what we are spending?
- An early warning alert of looming problems

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# More specifically – it tells us...

- Are we ahead or behind schedule?
- How efficiently are we using our time?
- When will the project be completed?
- Are we under or over budget?
- How efficient is use of resources?
- How much will remaining work cost?
- How much will the entire project cost?
- Will I be under or over budget at the end?

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# EVM - why is it good?

- Gives us really good insight into where we are
- You cannot run a project effectively without it
- The 20% rule
  - Performance has stabilized
  - Review where you are
  - Review where you should be
  - Do what's needed – no hoping!



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# Use is Dependent on Organization

- Large(er) companies do use it
  - Larger contracts
    - System/product development vice services
  - Infrastructure to support it
  - More government customer oversight
- Small(er) companies
  - Lack the personnel and infrastructure
  - Many contracts are service related (LOE)

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# EVM history – late 1880's

- Industrial engineers established measures of performance efficiency
  - Baseline called “planned standards”
  - Measured “earned standards” against “actual expenses” to measure performance
  - Defined “cost variance” – actual cost vs. “earned standards” achieved

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# EVM history – late 50's to early 60's

- PERT introduced by US Navy
  - Network scheduling and risk management tool
    - Used logic logic flow diagrams to develop plan
    - Assessed statistical probability of achieving plan
    - Navy expected industry compliance
    - Never as successful as Critical Path Method (CPM)
  - PERT/Cost
    - Added resources to the network to manage cost
  - Lack of automated tools limited PERT use
  - PERT legacy: value of work performed measured against actual costs

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# EVM history – mid 60's

- USAF forms the CSPPCS – next logical step from PERT
  - PERT/Time and PERT/Cost gurus found a new home
  - No imposition of a management control system on industry
    - meet specified criteria with existing management control systems
    - No intent to tell industry how to manage

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# EVM history – late 60's

- 1967: DoD established C/SCSC, EVM's predecessor
  - 35 criteria imposed on contractor's management control system
  - Appropriate for large DoD projects
    - Not applied to small(er) projects
  - Cost or incentive contracts – government risk
  - Use developed vast amounts of empirical data on project cost, schedule, scope performance
  - Endured for 30 years – users also “endured”

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# EVM comes to life!

- Early 1990's: C/SCSC persists – not user friendly and for few select, major projects
- Mid 1990's: OMB search for best practices and more “user friendly” EVM makes a trail to the Pentagon
- 1996: NDIA and DoD write, OMB approves, EVM guidance for all federal agencies – reduced to 32 criteria
- 1998: ANSI/EIA standard 748-A issued
- 2007: ANSI/EIA standard 748-B issued
  - This is where we are today!

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# Fitzgerald's first law...

- Only two phases to large military programs
  - Too early to tell and...
  - Too late to stop!
  - Project Managers tend to keep bad news covered up until they have spent so much money that they can advance the sunk-cost argument
    - “It’s too late to cancel the program because we’ve spent too much already.”

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# Some differences between...

- Traditional management

- Two data sources – budgeted and actual expenditures – no measure of “value earned” and...

- Earned Value Management

- Three data sources – budgeted expenditures, actual expenditures, and the “earned value” of completed work – what’s been accomplished for the money expended
  - How much it will really cost to complete the project



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# EVM terminology

- Planned Value (PV) – the authorized budget assigned to scheduled work to be completed for a schedule activity or WBS component (BCWS)
- Actual Cost (AC) – total cost incurred in accomplishing work for a schedule activity or WBS component (ACWP)
- Earned Value (EV) - the value of the work performed expressed in terms of the approved budget assigned to that work for a schedule activity or WBS component (BCWP)

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# More EVM terminology

- Cost Variance (CV) – a measure of cost performance on a project
- Schedule Variance (SV) – a measure of schedule performance on a project
  
- Cost Performance Index (CPI) – a measure of cost efficiency on a project
- Schedule Performance Index (SPI) – a measure of schedule efficiency on a project

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# Yet more EVM terminology

- Estimate At Completion (EAC)

- the expected total cost of a schedule activity, WBS component or project

- Estimate To Complete (ETC)

- the expected cost required to complete all the remaining work for a schedule activity, WBS component or project

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# Again, more EVM terminology

- Budget At Completion (BAC)
  - the sum of all the budgets established for the work to be performed on schedule activities, WBS components or a project

- Variance At Completion (VAC)
  - the expected difference between the Budget At Completion (BAC) and the Estimate At Completion (EAC)

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# Lets' summarize acronyms

- PV – Planned Value
- AC – Actual Cost
- EV – Earned Value
- CV – Cost Variance
- CPI – Cost Performance Index
- SV – Schedule Variance
- SPI – Schedule Performance Index

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# Yet more acronyms

- EAC – Estimate At Completion
- ETC – Estimate To Complete
- BAC - Budget At Completion
- VAC – Variance At Completion

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# Now, formulas!

- $CV = EV - AC$
- $SV = EV - PV$
- $CPI = EV/AC$
- $SPI = EV/PV$
- $EAC = BAC/CPI$
- $ETC = EAC - AC$
- $VAC = BAC - EAC$

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# Things to Remember

- Positive numbers are good
  - Negative numbers are bad
- CPI and SPI greater than 1 are good
  - Less than 1 is not so good
- On the mark!

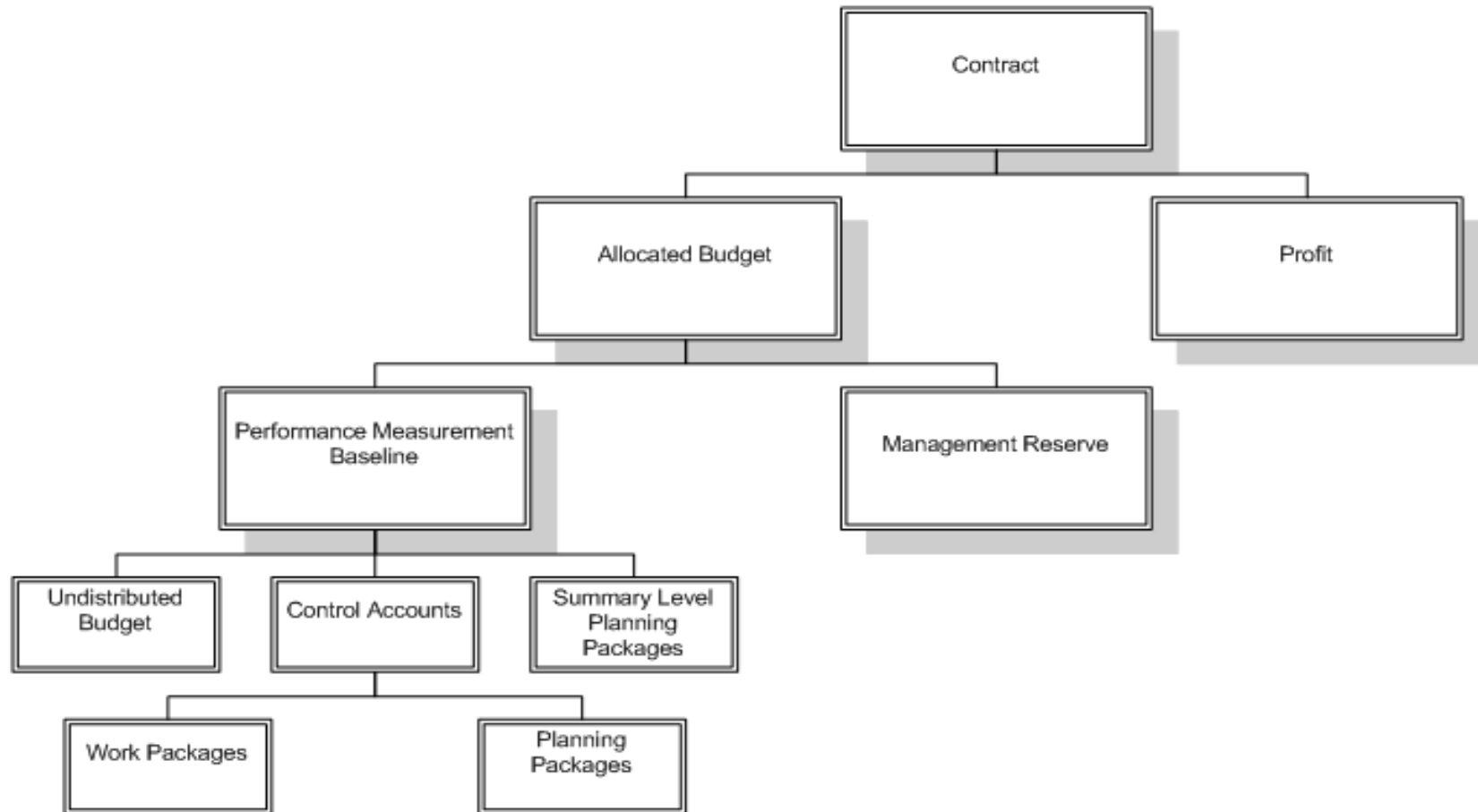


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# What we need to implement/use EVM

- Inputs (WBS, schedule, budget)
  - Results of *planning*
- Formulas & metrics (CPI, SPI, etc.)
- Outputs (reports, preventive and corrective actions)

# The Contract Breakdown



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# More Definitions

- Performance Measurement Baseline (PMB) – time phased budget to accomplish work – the baseline against which you will measure performance
- Undistributed Budget – temporary holding place for budget that will ultimately be assigned to either Summary Level Planning Packages or Control Accounts
- Control Account – management control point where budgets and actual costs are accumulated and compared to earned value

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# More Definitions

- Summary Level Planning Package – a holding account for longer term future work
- Planning Package – holding account for near term future work that is not yet decomposed to Work Packages
- Work Package – detailed breakdown of a task – the lowest level of a WBS – the point at which work is planned, progress is measured, and earned value is computed

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# Scope

- Defining the Scope of a project is the first step to defining the PMB
- Scope – project work to be completed
  - Defined in the PWS/SOW...but
    - Expertise required to define Requirements
    - Requirements lead to Scope
    - Scope leads to the WBS

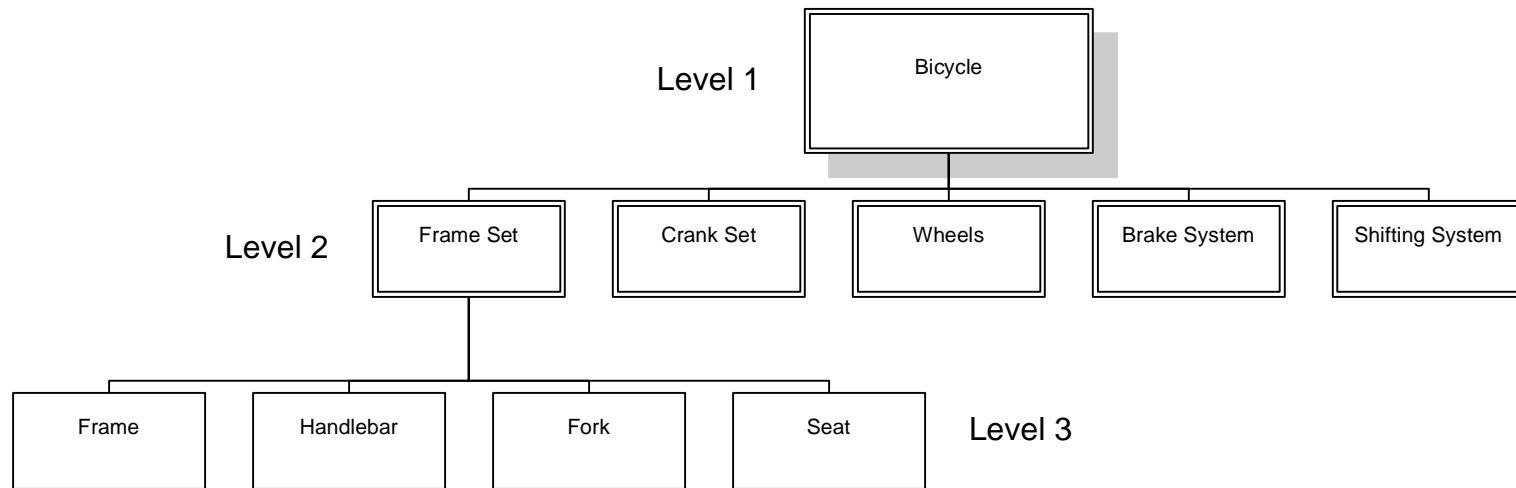
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# Work Breakdown Structure (WBS)

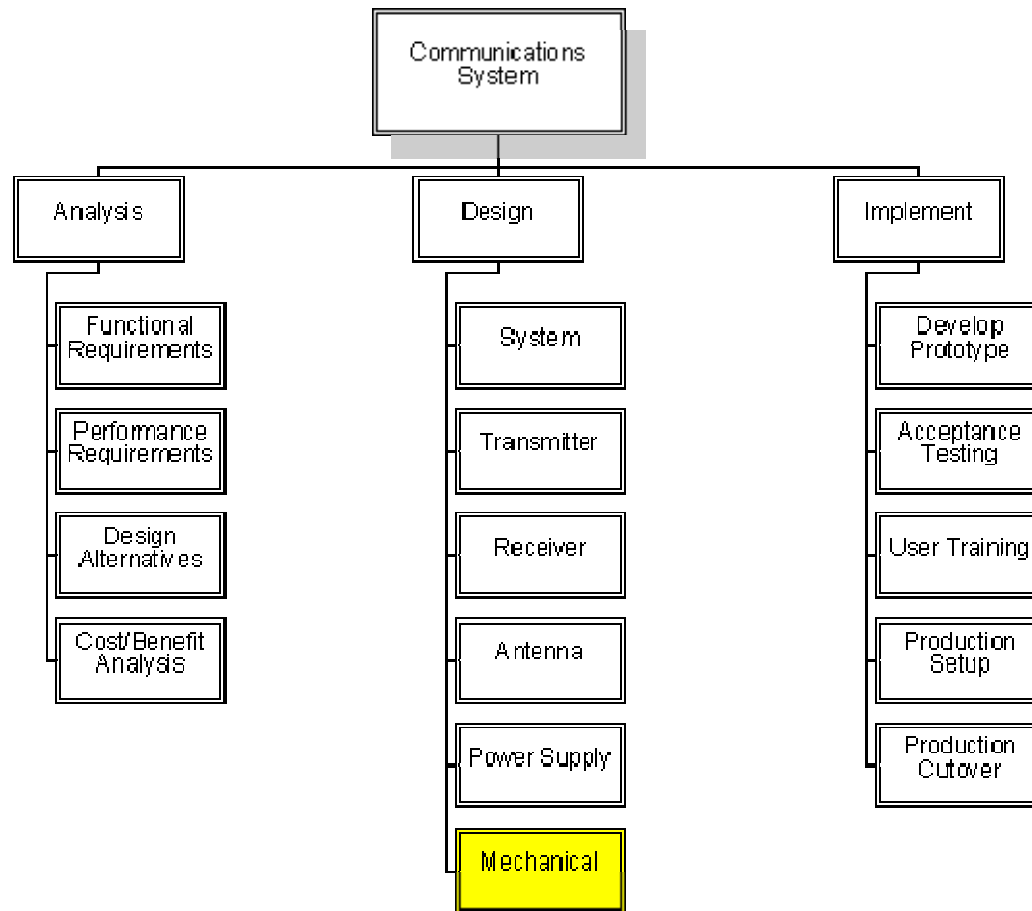
## ■ WBS

- A deliverable oriented hierarchy
  - Decomposes deliverables into smaller, more manageable pieces of work
  - WBS provides the framework for EVM
    - Control Accounts
    - Planning Packages
    - Work Packages
  - WBS dictionary

# An Example of WBS Decomposition

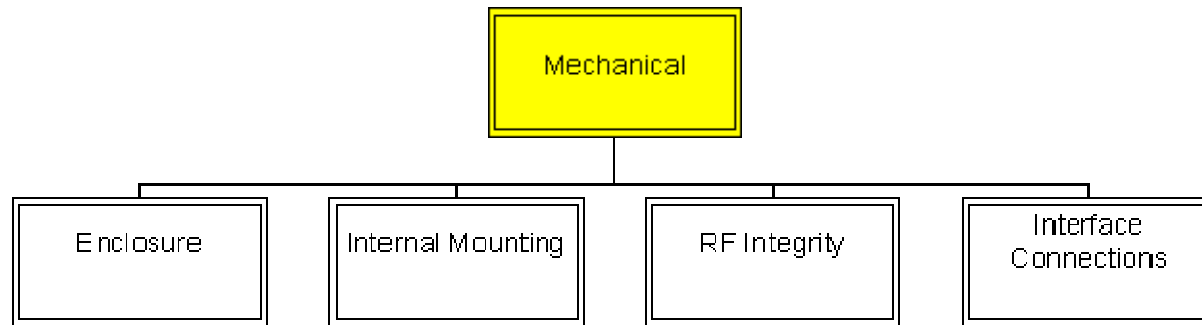


# Setting up EVM for a Project





# Develop activities from the WBS



Task Name	Duration	December					January					February				
		11/25	12/2	12/9	12/16	12/23	12/30	1/6	1/13	1/20	1/27	2/3	2/10	2/17	2/24	
<b>Mechanical Design</b>	<b>55 days</b>	[Gantt bar from 11/25 to 2/18]														
<b>Enclosure</b>	<b>55 days</b>	[Gantt bar from 11/25 to 2/18]														
Material Selection	5 days	[Gantt bar from 12/2 to 12/9]														
CAD	15 days	[Gantt bar from 12/9 to 12/23]														
Fabricate Prototype	20 days	[Gantt bar from 12/30 to 1/27]														
Fit Check	5 days	[Gantt bar from 1/27 to 2/3]														
Modifications	10 days	[Gantt bar from 2/3 to 2/17]														
Freeze Design	0 days	[Gantt bar from 2/17 to 2/18]														

# Develop cost estimates of activities

Task	Duration (Hours)	Labor Rate	Cost/Planned Value (PV)
Material Selection	40	\$32	\$1,280
CAD	120	\$50	\$6,000
Fabricate Prototype	160	\$28	\$4,480
Fit Check	40	\$48	\$1,920
Modifications	80	\$50	\$4,000
Freeze Design			
<b>Total</b>	<b>440</b>		<b>\$17,680</b>

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# Pro forma results

- Planned Value (PV) for Material Selection was \$1,280
- Actual Cost (AC) was \$1,500
- What's the:
  - EV when complete? When 50% complete?
  - CPI when complete? When 50% complete with AC = \$900?
  - SPI when complete?

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# Measuring Performance

- Milestones with weighted values
  - Used when some work packages exceed a short span – running over multiple performance periods
  - Convert longer work packages into multiple milestones – perhaps one in each performance period – and assign a budgeted value or % to each

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# Measuring performance

- Fixed formula by task
  - Requires short(er) span tasks to work
  - Assign a % complete at start and a % complete at finish
    - 25/75 – good for tasks starting and finishing in the same performance period
    - 50/50
    - 75/25 – good for purchased materials

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# Measuring Performance

- Percent complete
  - Can be easy to administer
  - Requires performer to estimate % completion for a task
  - Best if used on longer tasks that have been divided into shorter subtasks

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# Level Of Effort (LOE) tasks

- Efforts that commence at project start and finish at project end
- No measurable performance basis
- Planned Value (PV) is automatically Earned Value (EV)
- Schedule Variance (SV) is always zero
- LOE tasks distort overall project performance measurement

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# Level Of Effort (LOE) tasks

- How to mingle LOE with quantifiable tasks
  - Quantify the value of LOE
    - $(\text{LOE value} / \text{BAC value}) \times 100 = \% \text{ LOE}$
    - Best if below 10% of allocated baseline
    - High LOE % indicates poor adoption of EVM
  - Quarantine the value of LOE
    - Keep them outside the allocated baseline being measured



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# EVMS Guidelines (ANSI /EIA-748-B)

- 32 EVM criteria
  - Group 1 – Organization Criteria (5)
  - Group 2 – Planning, Scheduling and Budgeting Criteria (10)
  - Group 3 – Accounting Criteria (6)
  - Group 4 – Analysis Criteria (6)
  - Group 5 – Revisions Criteria (5)

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# Group 1 – Organization Criteria (5)

- Purpose

- Define scope; make vs. buy decisions
- Develop integrated project baseline (scope, schedule, cost) with WBS
- Establish Control Account Plans

- Example

- Define the authorized work elements for the program. A Work Breakdown Structure (WBS), tailored for effective internal management control, is commonly used in this process.

- Issues

- Starting work without scope definition
- Rejection of WBS by “fiefdoms”

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# Group 2 – Planning, Scheduling and Budgeting Criteria (10)

- Purpose

- Use of a formal planning, scheduling and budgeting system
- Development of a project baseline

- Example:

- Schedule the authorized work in a manner which describes the sequence of work and identifies significant task interdependencies required to meet the requirements of the program.

- Issues

- Lack of discipline within the company
- One can “game” the EVM process

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# Group 3 – Accounting Criteria (6)

- Purpose

- Accurate and timely cost reports
- Costs recorded as incurred
- Require that the accounting system measure planned value, earned value and actual costs

- Example:

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

- Issues

- Difficulty in measuring earned value for procured items

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# Group 4 – Analysis Criteria (6)

- Purpose

- Require measurement and analysis of actual performance against authorized baseline
- Forecast of final results based on actual performance

- Example:

- Comparison of the amount of planned budget and the amount of budget earned for work accomplished. This comparison provides the schedule variance.

- Issues

- Subjective, vice objective, measurement of actual performance
- Too much LOE in PMB
- Management influence over final forecasted numbers

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# Group 5 – Revisions Criteria (5)

- Purpose

- Management of all changes to the approved project baseline
- Timely approval or rejection of incorporation of approved changes

- Example:

- Incorporate authorized changes in a timely manner, recording the effects of such changes in budgets and schedules. In the directed effort prior to negotiation of a change, base such revisions on the amount estimated and budgeted to the program organizations

- Issues

- Work completed without approval
- Slow to incorporate approved changes
- Poor estimates for scope changes

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# Some EVM limitations

- Plan must be thorough – not flawed
- Task delays can affect other tasks starts
  - Cost and schedule can get out of whack, requiring re-baselining
    - Sponsor approval may be required
- Does not measure quality
- Most stakeholders are not EVM savvy
- % complete can be subjective

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# What FAR Says!

- Subpart 34.2—Earned Value Management System
  - 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.



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# DoD EVMS Contract Requirements

- Compliance with guidelines of ANSI/EIA-748 required on all cost/incentive contracts of \$20M or greater
- If \$50M or greater, EVMS must be determined to be in compliance with ANSI/EIA-748 by the cognizant Federal agency (DCMA when DoD is the Federal agency)

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# Integrated Baseline Review (IBR)

- When an EVMS is required, the Government will conduct an Integrated Baseline Review (IBR).
  - The purpose of the IBR is to verify the technical content and the realism of the related performance budgets, resources, and schedules. It should provide a mutual understanding of the inherent risks in offerors'/contractors' performance plans and the underlying management control systems, and it should formulate a plan to handle these risks.
- IBR follows development of the PMB

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# The Detail of the IBR

- The IBR is a joint assessment by the offeror or contractor, and the Government, of the:
  - Ability of the project's technical plan to achieve the objectives of the scope of work
  - Adequacy of the time allocated for performing the defined tasks to successfully achieve the project schedule objectives
  - Ability of the Performance Measurement Baseline (PMB) to successfully execute the project and attain cost objectives, recognizing the relationship between budget resources, funding, schedule, and scope of work
  - Availability of personnel, facilities, and equipment when required, to perform the defined tasks needed to execute the program successfully, and
  - The degree to which the management process provides effective and integrated technical/schedule/cost planning and baseline control.

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# Earned Schedule

- Developed by Walt Lipke
- Former Deputy Chief of the Software Division at the Oklahoma City Air Logistics Centre
- Extracts schedule information from earned value data

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# Earned Schedule

- EVM measures schedule performance in terms of cost, not in units of time
- A peculiarity of EVM: at the completion of a project behind schedule,  $SV$  is zero and  $SPI$  is one.
  - Yet, the project completed late – is this perfect schedule performance?

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# Earned Schedule

- Earned Schedule is an analytical technique that resolves this EVM issue
  - No additional data needed – only EVM data
  - Instead of a cost-based indicator (SV or SPI) to reflect schedule status, Earned Schedule performance indicators are time-based
  - They provide a more meaningful status and predictive ability for schedule – as good as EVM provides for cost

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# Earned Schedule

- The PMI Earned Value Management Practice Standard includes Earned Schedule as an emerging practice

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# References

- Earned Value Project Management
  - Fleming & Koppelman
  - ISBN: 978945589082
- Project Management Body Of Knowledge (PMBOK)
  - Project Management Institute
  - ISBN: 9781933890517
- Practice Standard for EVM
  - Project Management Institute
  - ISBN: 1930699425



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# More References

- Earned Schedule
  - Walt Lipke
  - ISBN: 9780557177387
  - <http://www.earnedschedule.com>
- WBS: MIL-HDBK-881A
- Earned Value Management Using Microsoft® Office Project
  - Sham Dayal
  - ISBN: 9781932159981
- Defense Acquisition University/Acquisition Community Connection – for EVMS information
  - <https://acc.dau.mil/evm>

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# Questions?

