



Earned Value Management

Marlene Hyde, EVP, CCE, PMP

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Before Earned Value Management

“The nice thing about not planning is that failure comes as a complete surprise and is not preceded by long periods of worry and depression.”



What is Earned Value Management?

- EVM is a systematic approach to the integration and measurement of cost, schedule, and technical scope accomplishment on a project or task.
- It looks at past data and current trends to be able to manage the future



What is the Value of EVM?

- An approach to measure the project plan (PV), actual work (EV), and the actual cost of finished work (AC) to see if a project is on track.
 - Provides accurate, reliable and timely data
 - Measures project progress and performance
 - Analyzes variances to improve future results
- “What did I get for the money I’ve spent”?***



Keys to Using EVM as a Management Tool (hint:it's not just another report)

- Trend forecasting – use graphs to show where you're headed
- Variance analysis – tells you why you're over budget or behind schedule



Analyze the past...to help control the future

PAST

PRESENT

FUTURE

Are we on schedule?

Are we on budget?

**What are the significant
variances?**

Why do we have variances?

Who is responsible?

What is the trend to date?

**What risks have been
reduced or added?**

What is the to go plan?

How is it resourced?

When will we finish?

What will it cost at the end?

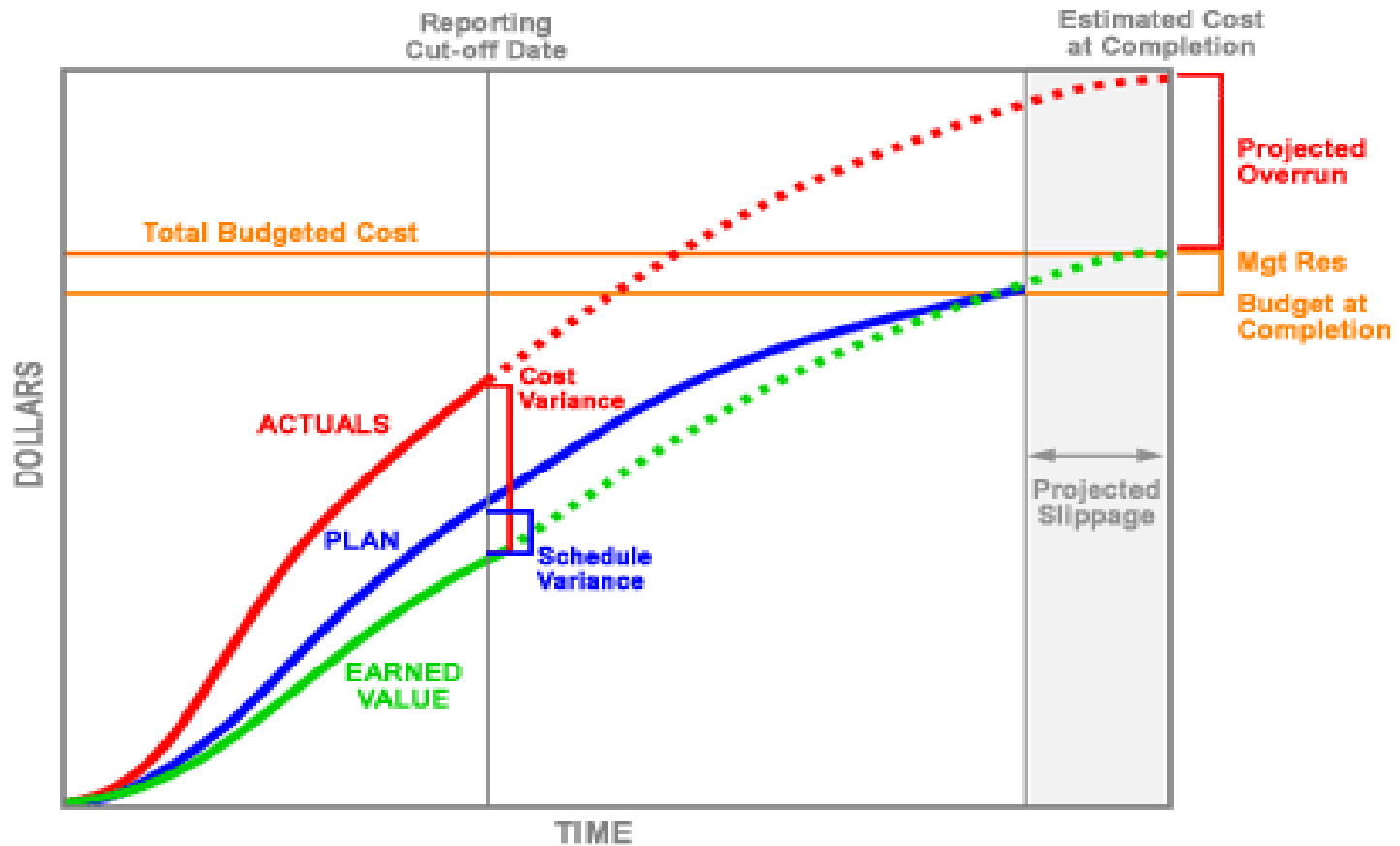
**How can we control the
trend?**

What is the trend to date?

How do we adjust for risk?

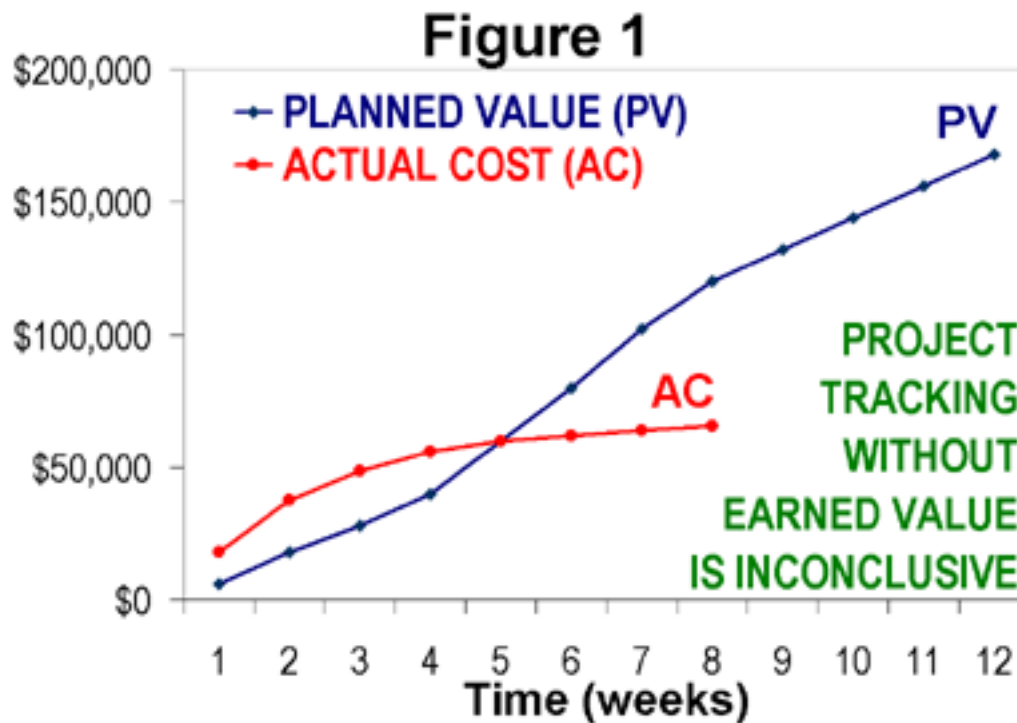


Earned Value Graphic



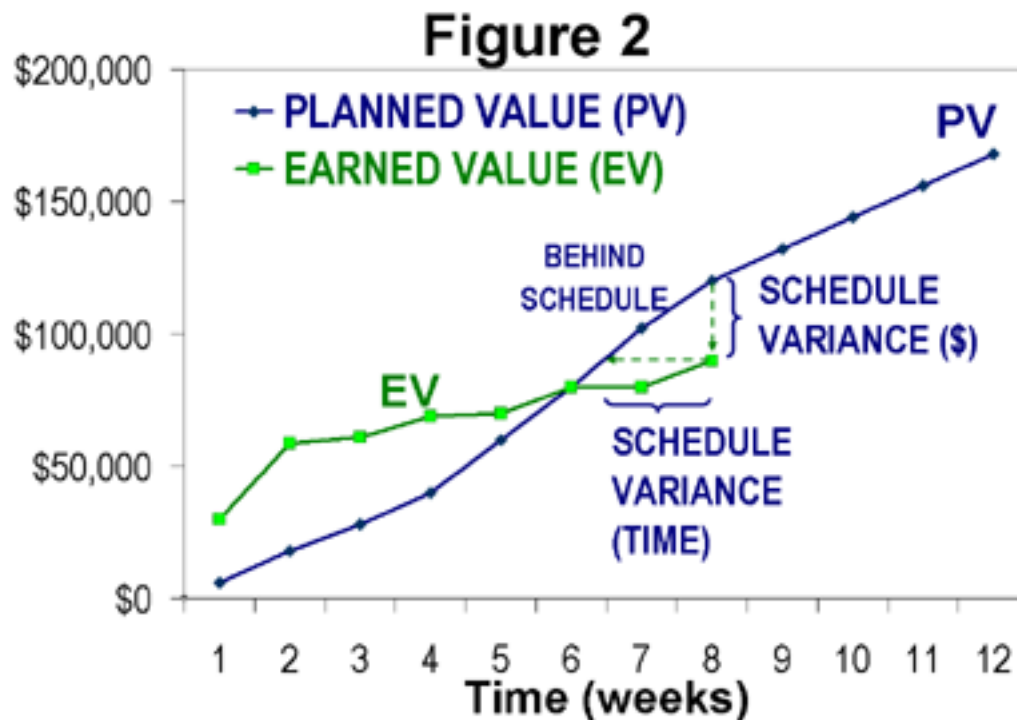


Without Earned Value – Results are Inconclusive



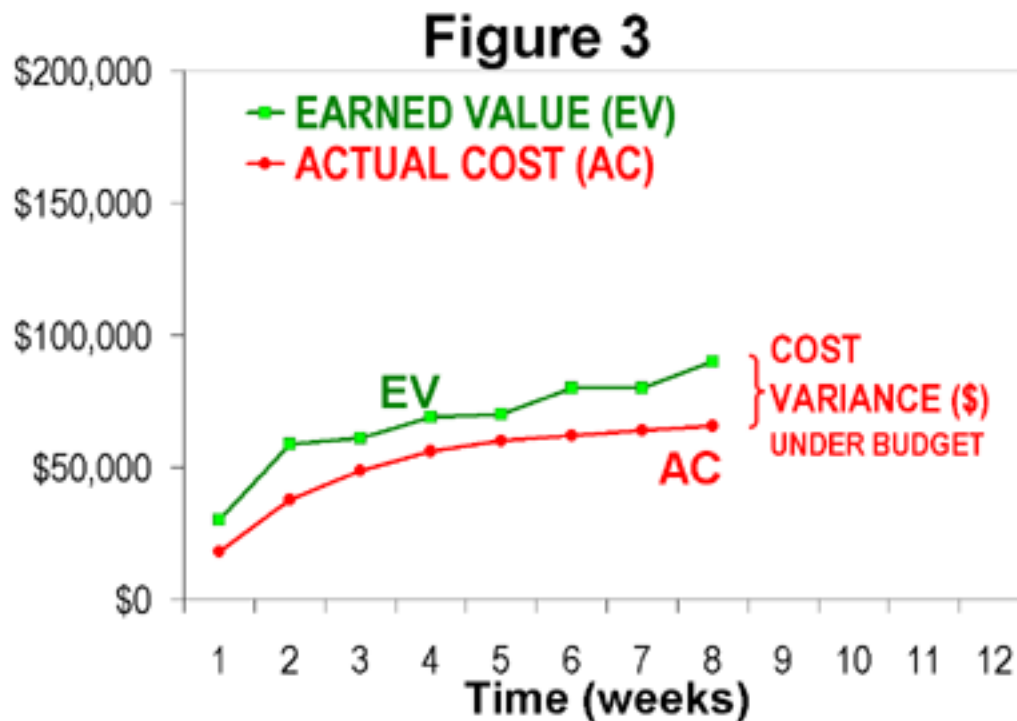


With Earned Value – Schedule Variance is Obvious





With Earned Value, Cost Variance is Obvious





Principles of EVM

- All work is planned to completion
- The work is broken down into finite product-oriented components that can be assigned to a responsible organization
- The scope, schedule and cost objectives are integrated into a plan against which progress can be measured
- Actual costs are recorded





Principles of EVM (contd)

- Performance is objectively measured
- Variances and deviations are analyzed, impacts are forecasted and estimates at completion are based on the actual performance to date
- Changes to the performance measurement baseline are controlled
- Earned Value formation is employed in the organization's management processes





When is EVM required on Department of Defense projects?

Required on all Projects > \$50 Million:

- Except not required on Firm-Fixed price contracts, Level of Effort, or Time & Material contracts.
- Not recommended for: Contracts <12 months
- Must use ANSI/EIA-748 compliant, validated EVMS
- Contract Performance Reports #1-5 required
- Integrated Master Schedule is required.
- Schedule Risk Assessment (SRA) is required



EVM is also required on DoD projects

Between \$20 - \$50 million:

- May be tailored
- Use ANSI/EIA-748 compliant system/not validated
- CPR formats 1 and 5
- Integrated Master Schedule is required

On projects <\$20 million:

- Discretionary; CPR 1 and 5 recommended;
- IMS is optional



Benefits of EVM – Jan.09 Report to Congress

- EVM provides an integrated method for planning, budgeting, program mgmt & control
- EVM improves insight into Program Performance
- EVM reduces management risk to meet program objectives
- EVM promotes management by exception
- EVM fosters accountability and provides objective information
- EVM allows comparative analysis against completed projects



Department of Defense Regulatory Guidance for Earned Value

- Earned Value Implementation Guide -Oct.06
- ANSI/EIA 748-B -June 07
- ANSI/EIA 748-A Intent Guide- Nov.06
- DAU Earned Value Gold Card -Jan.09
- DoD Instruction 5000.2



32 Earned Value Criteria

grouped in ***5 Areas*** per ANSI/EIA 748-B

1. Organization (5)
2. Planning, Scheduling & Budgeting (10)
3. Accounting (6)
4. Analysis & Management (6)
5. Revisions & Data Management (5)



1. Organization

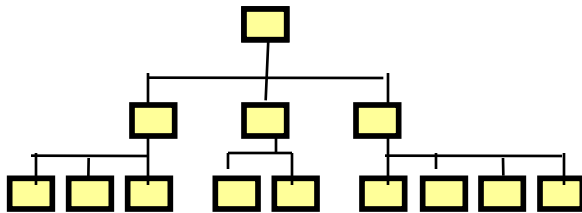
1. Define Work Breakdown Structure and WBS Dictionary
2. Organization Breakdown Structure
3. Integration of company's processes
4. Control Overhead (Indirect Costs)
5. WBS/OBS, Responsibility Assignment Matrix





WBS & WBS Dictionary

Work Breakdown Structure



WBS Dictionary

_____	_____
_____	_____
_____	_____
_____	_____

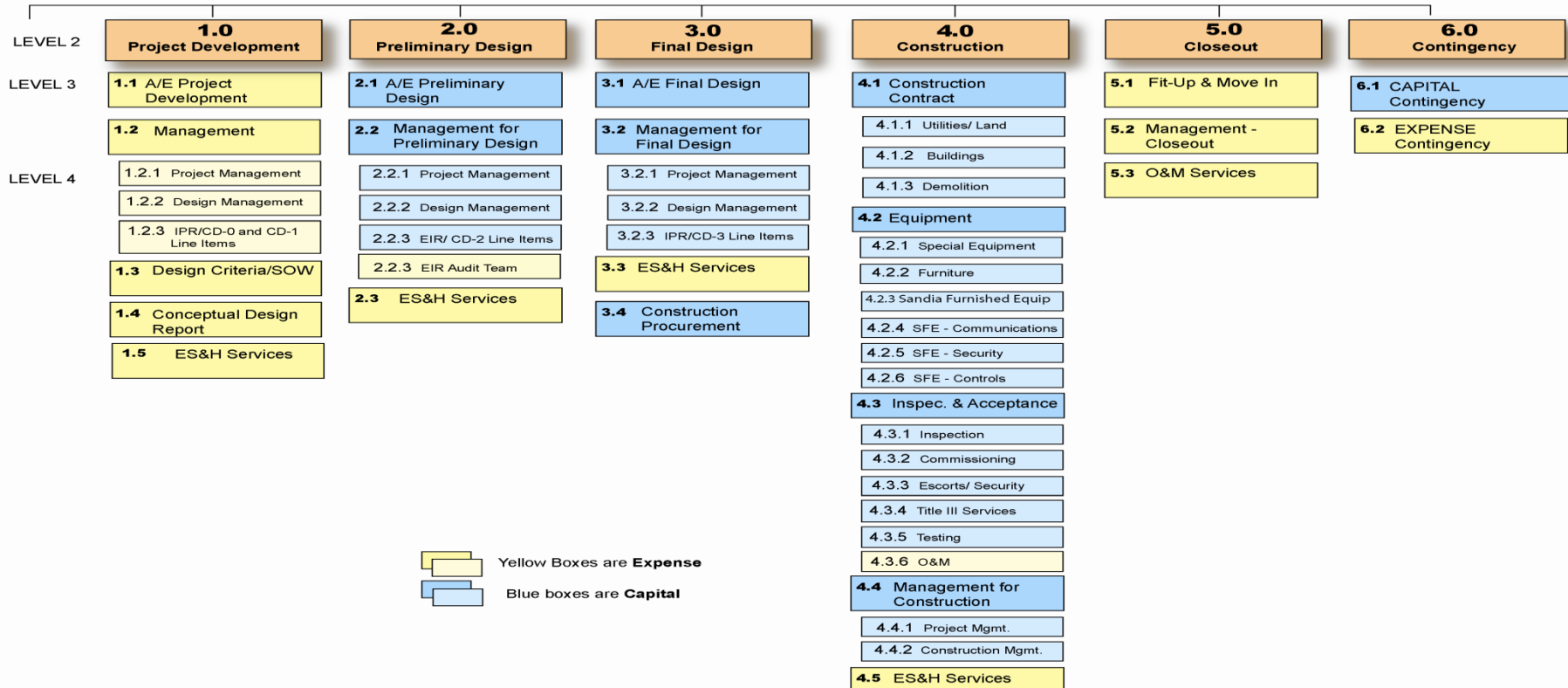
- Entry needed for each box on the WBS tree
- WBS scope must equal Project Scope
- WBS Dictionary is the Task Description
- Work scope can also be presented as IMP/IMS





WBS – Design & Construction

VERSION - Final

LEVEL 1 **PROJECT**



 Yellow Boxes are **Expense**
 Blue boxes are **Capital**



2. Planning, Scheduling, Budgeting

6. Schedule work

7. ID Products/milestones

8. Set time-phased budget baseline

9. Cost elements – labor, material as needed
for internal & subcontractor control

10. ID Discrete work packages





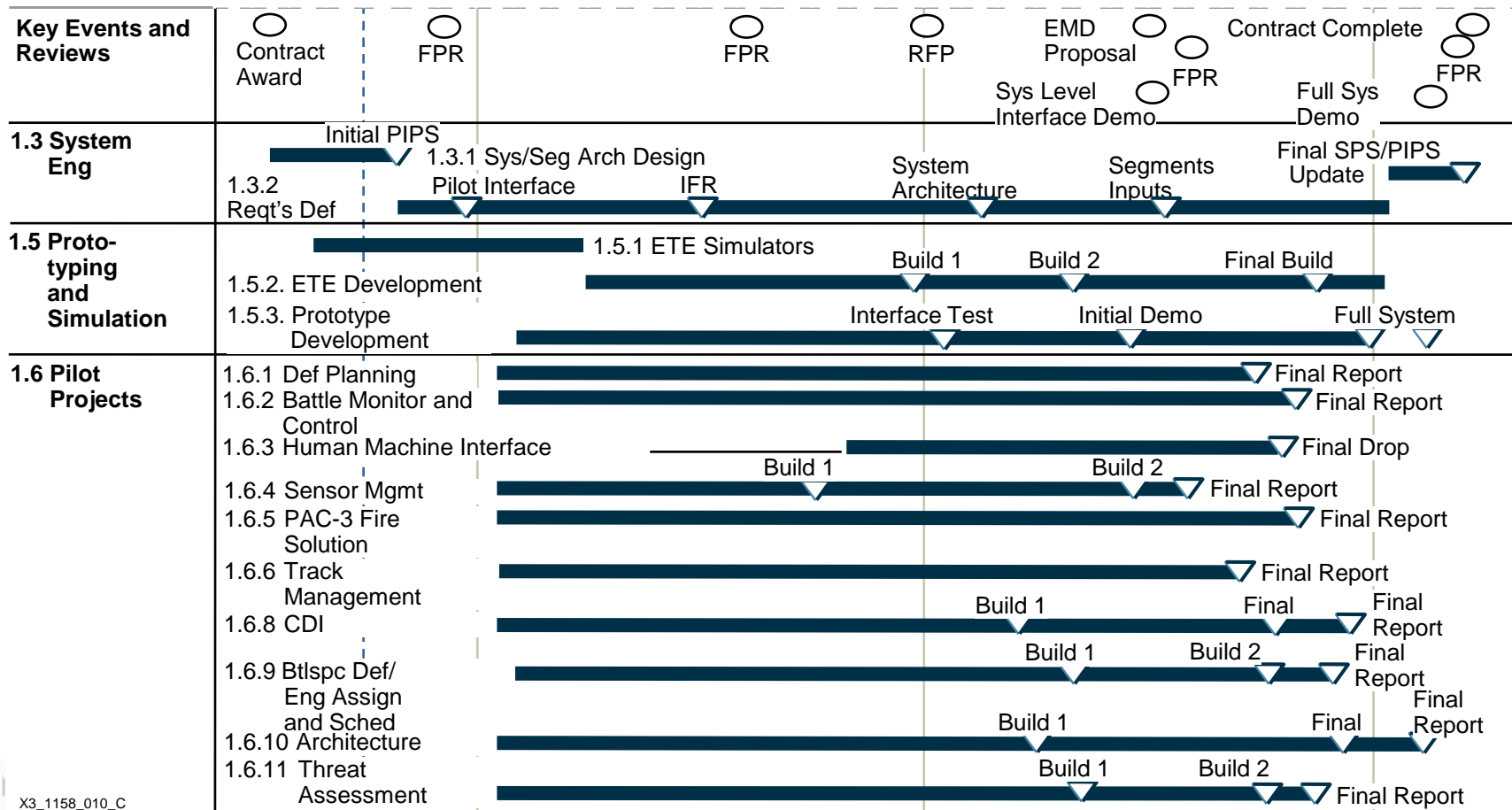
Baseline Schedule Development

- Control accounts are identified via RAM
- CAMs are assigned to control accounts
- WADs are issued to CAMs defining CAMs' assignments
- CAMs generate Control Account Plans
- Approval must be obtained
- All planning is then input to cost & schedule tools, establishing baseline plan for program





Program Master Schedule





Critical Path

- Critical Path (CP) is longest computed path through a program's schedule network
- Delays or early completion of an activity on critical path will impact it
- "Critical" refers to schedule criticality only; it identifies what's required to keep project on schedule



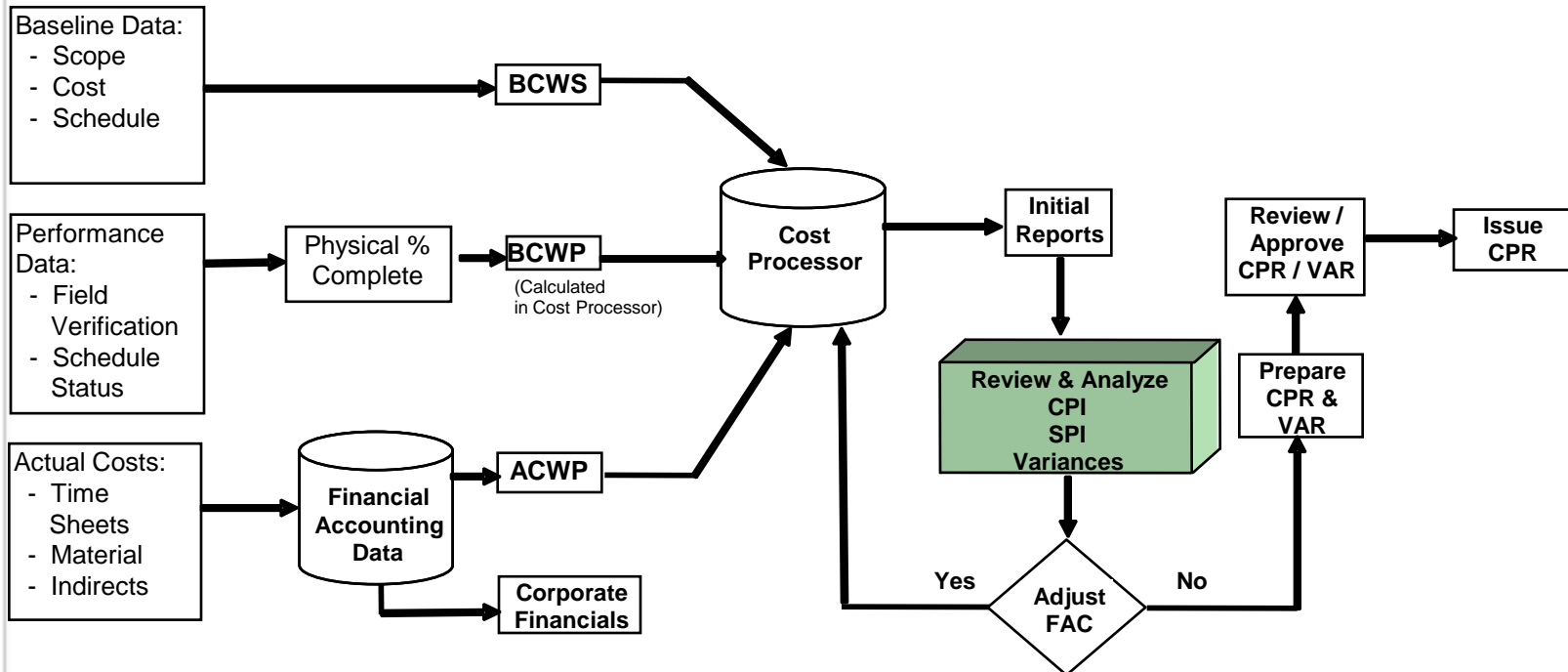
Integrated Master Plan

- Based on Scope of Work
- Describes milestones, accomplishments
- Does not have any calendar dates
- Becomes basis for Integrated Master Schedule





Execution of Work using EVMS For performance measurement





3. Accounting Considerations

16. Record direct costs
17. Summarize costs into WBS without allocating a single control acct. to 2 WBS
18. Summarize costs from CA into OBS
19. Record indirect costs
20. ID equivalent/unit/lot costs
21. Material accounting system





Control Accounts

- Establish Control Accounts to integrate, plan and manage scope, cost, schedule
- Control accounts are lowest level of WBS & OBS, as shown in RAM
- Are subdivided into Work Packages (near-term work) & Planning Packages (future work), based on rolling wave planning





Work Authorization Documents

- WADS are used to authorize work
- The WAD contains work scope, budget & schedule for period of performance
- Must be signed by Issuer & Receiver
- Typically issued by PM to a CAM



Management Reserves

- MR is held at program level
- MR is controlled by Program Manager for program contingencies
- For example: *rate changes*
- Transactions are tracked in logs



Undistributed Budget

- UB is temporary holding place for authorized work & budget, not yet distributed to cost accounts
- UB is for un-negotiated changes, not yet distributed to CAMS
- It is held above reportable WBS level & transactions are tracked





Contingency

- Contingency is based on risk analysis
- Have both schedule and cost contingency
- Typically excludes: major scope changes, natural disasters, escalation, & management reserves
- Contingency is expected to be expended during course of project





4. Analysis & Management Reports

- 22. Monthly info (Cntrl Acct.level): AC, EV, PV
- 23. ID & explain cost and schedule variances
- 24. ID budgeted & actual indirect costs
- 25. Summarize data and variances
- 26. Implement Management Action from EV
- 27. Revise Estimate at Completion (EAC)





Calculations – Schedule Analysis

- Schedule Variance (SV) compares what was done to what was planned

$$SV = EV - PV \text{ (in \$)}$$

$SV > 0$ is good

- Schedule Performance Index (SPI)

$$SPI = EV/PV$$

- $SPI > 1$ = Ahead of schedule
- $SPI < 1$ = Behind schedule



Calculations – Cost Analysis

- Cost Variance (CV) compares what was done to actual cost incurred

$$CV = EV - AC \text{ (in \$)}$$

CV > 0 is good

- Cost Performance Index (CPI)

$$CPI = EV / AC$$

- CPI > 1 = Under Budget
- CPI < 1 = Over Budget





Summary of Performance Indices

- $SPI = EV/PV$

>1.0 Project ahead of schedule

<1.0 Project behind schedule

- $SV = EV - PV$

- $SV > 0$ is good

- $CPI = EV/AC$

>1.0 Cost is less than budgeted

<1.0 Cost is more than budgeted

- $CV = EV - AC$

- $CV > 0$ is good



Variance Analysis is Critical

- Variance analysis is not just doing the calculations
- The important part is to evaluate what caused the variance, how to overcome it, and take management action to get back on track!





Cost & Schedule Variance Example 1

- Project budget is \$480k; done in 12 months
- After 4 months you have finished 25% at a cost of \$150k; should have been 33% done = PV of \$160k
- $CV = EV - AC = \$120k - \$150k = \$-30k$
- $CPI = EV / AC = 120 / 150 = .80$
- $SV = EV - PV = \$120k - \$160k = \$-40k$
- $SPI = EV / PV = 120 / 160 = .75$
- OH NO! You are over budget and behind schedule



Cost & Schedule Variance Example 2

- Project budget is \$480k; to be done in 12 months
- After 4 months you have finished 40% at a cost of \$180k; should have been 33% done= PV of \$160k
- $CV = EV - AC = \$192k - \$180k = \$12k$
- $CPI = EV / AC = 192 / 180 = 1.07$
- $SV = EV - PV = \$192k - \$160k = \$32k$
- $SPI = EV / PV = 192 / 160 = 1.2$
- YEAH! Below cost and ahead of schedule!



More EVMS Terminology

- **Budget at Completion (BAC)** – the sum of all budgets established for the work to be performed on the project; which includes Undistributed Budget. The total planned value for the project. It is synonymous with the term “Performance Measurement Baseline” (PMB).
- **Estimate at Completion (EAC)** – is the expected cost of completing project work. EAC is equal to the ACWP plus the Estimate to Complete for all remaining work.
- **Estimate to Complete (ETC)** – the estimated cost of completing the remaining work.





Estimate at Completion

$$EAC = ETC + AC$$

If past results are typical of expected results:

$$EAC = BAC/CPI$$

If past results are not typical:

$$EAC = AC + (BAC - EV)$$

How often are EACs performed on your projects?

IMPORTANT: Is it a real EAC or just a pencil exercise? This is a critical management tool!



Estimate to Complete

If past results are typical:

$$ETC = (BAC - EV) / CPI$$

If past results are Not typical:

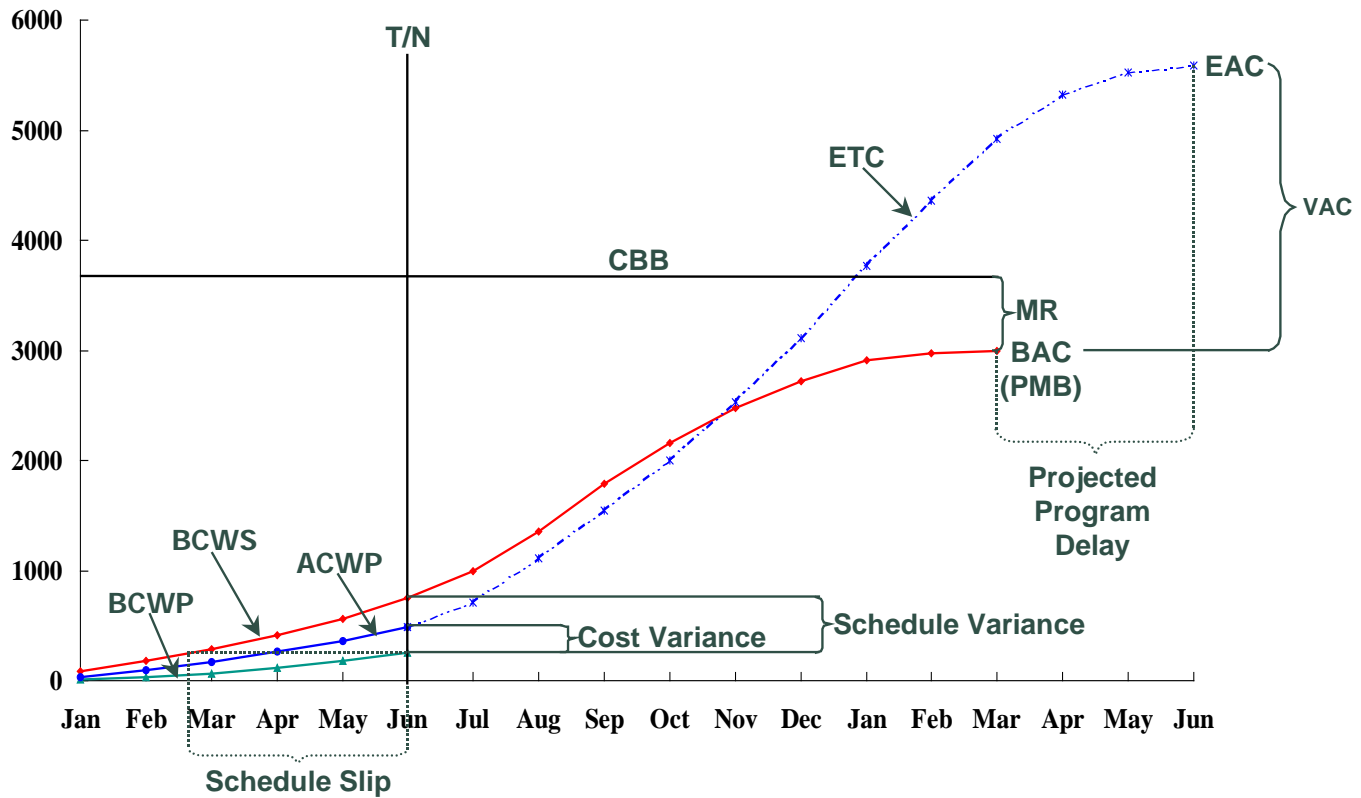
$$ETC = BAC - EV$$

When past results are flawed:

Re-estimate all remaining work!



Earned Value Metric





THE GREAT COOKIE PROJECT

THE “PLAN” (PV)

40 COOKIES PER BATCH

**5 BATCHES PER HOUR (12 min./batch or 200
COOKIES PER HOUR)**

SCHEDULE: 5 HOURS TO MAKE 1000 COOKIES

BUDGETED COST PER COOKIE = \$0.05

TOTAL BUDGET = \$50.00



THE GREAT COOKIE PROJECT

- **THE RESULTS = “PERFORMANCE” (EV)**
- **After 1 hour of baking:**
 - Only 150 cookies
 - What happened?
 - The phone rang...some burned
 - - Some dropped on the floor
 - - Kids came in and ate some
 - - The dog got a few as well
- **ACTUAL COST of ingredients after one hour (AC) = \$12.00**
- **Added chocolate chips and nuts – not part of the original scope**



The Great Cookie Project -Exercise

Using the formulas provided in the previous slides, determine the following:

- Schedule Variance (SV)**
- Cost Variance (CV)**
- Schedule Performance Index (SPI)**
- Cost Performance Index (CPI)**



THE GREAT COOKIE PROJECT

- Simple EVMS
 - PV = 200 Cookies @ \$0.05/Cookie = \$10.00
 - EV = 150 Cookies @ \$0.05/Cookie = \$7.50
 - AC = \$12.00
- Cost and Schedule Variance Analysis
 - SV = EV - PV = \$7.50 - \$10.00 = **-\$2.50** (we're behind schedule)
 - CV = EV - AC = \$7.50 - \$12.00 = **-\$4.50** (we're over budget)
 - SPI = EV/PV = 0.75
 - CPI = EV/AC = 0.625



Where is this project headed?

- $EAC = BAC / CPI = \$50.00 / 0.625 = \80.00
- $VAC = BAC - EAC = \$50 - \$80 = \text{\$30}$ over budget
- $Schedule = Planned\ hour[5] / SPI = 5 / .75 = 6.67$ or 6 hours 40 min.
- What does this mean?
- It will take 6 hours, 40 min. and \$80.00 to make 1000 edible cookies if the productivity of The Great Cookie Project doesn't improve.



Corrective Action – Cookie Project

$$\text{TCPI} = (\text{PV} - \text{EV} / \text{EAC} - \text{AC}) = (50 - 7.5) / (80 - 12) = 42.5 / 68 = .625 \text{ efficiency}$$

To finish on schedule, must perform at 106.5%

We must either do better or do more:

Bake 213 usable cookies per hour for the next 4 hours to complete 1000 cookies in 5 hours.

- ...or produce a higher number of usable cookies per batch.
- ...or produce a higher number of batches per hour.



Progress Measurement Techniques

- Incremental Milestones
- Units completed
- Start/Finish of a task
- Percent complete
- Weighted or equivalent units
- Level of Effort (LOE)



Milestones

- A Measurable Activity is 100% complete
- Larger/longer efforts should be broken into smaller milestones:
 - Conceptual Design complete
 - Schematics finalized
 - Preliminary design complete
 - Working drawings complete



50-50%

- Used when a discrete activity is scheduled to start and end during 2 accounting periods
- 50% of total task is earned at start and remaining 50% is earned at completion

Month	Jan	Feb
Budget	200	200
Percent	50%	50%



Level of Effort

- Has no definite or deliverable product
- EV is earned based on passage of time
- $EV = PV$
- Used for general or support activities
- LOE NEVER HAS A SCHEDULE VARIANCE
- LOE should be limited in EVM schedules



Sample Earned Value Report





5. Revisions and Data Maintenance

- 28. Incorporate authorized changes
- 29. Reconcile current and prior budgets
- 30. Control retroactive changes
- 31. Prevent budget changes unless authorized
- 32. Document changes to PMB



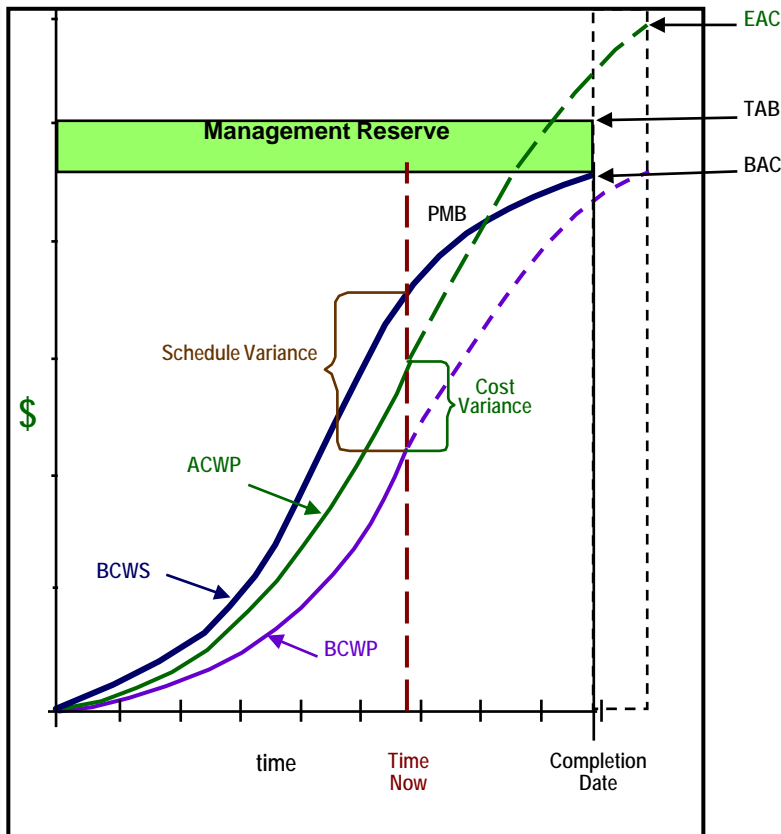
Baseline Change Control

- Changes must be formally approved & signed by Baseline Change Control Board
- Once approved, resource-loaded baseline schedule is updated and original PMB is maintained in files.
- Retroactive changes are not allowed except for accounting adjustments, to correct data errors, or to incorporate client-directed changes





DAU Earned Value Management Gold Card



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

$$VAC = BAC - EAC$$



From DAU Gold Card:

Components of Contract Price

- $\text{Contract Price} = \text{TAB} + \text{Profit/Fees}$
- $\text{Total Alloc. Budget} = \text{PMB} + \text{Mgmt. Reserve}$
- $\text{PMB} = \text{Undistributed Budget} + \text{Control Accounts} + \text{Summary Level Planning Pkgs}$
- $\text{Control Accounts} = \text{Work Packages} + \text{Planning Packages}$



Cautions against using EVM incorrectly:

- It should be used as a management tool, not just a monthly report
- Don't circumvent good EVM practices just to keep the metrics favorable (i.e. management must be willing to accept bad news)
- Bad practice: Front-loading the PMBs
- Take time to use analytical abilities to convert CPR and IMS into actionable management information
- Solution: PMs and IPT leads must advocate for EVM & take ownership





5 pitfalls that derail EVM success*

- Executive ambivalence
- Poor data – incorrect or outdated
- Data overload – focus on indicators that reveal trends
- Poorly chosen software – don't build processes to fit the tool
- Inexperienced contractors

* per Nov.6 2009 article in Federal Computer week





Conclusion

- EVM isn't just a federal mandate - it's good business practice!
- EVM is an excellent management tool but it must be used correctly and must be driven from top management

