Best Practices Training

Module 1

WBS Components and Standards

MWH

BUILDING A BETTER WORLD

22 Dec 2009

Best Practices Training Modules

Module 1 - WBS Components and Standards

Module 2 - Project Scheduling

Module 3 - Earned Value Management

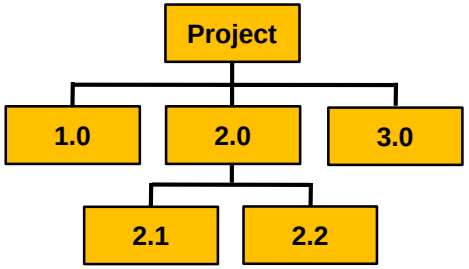
Module 4 - Risk and Contingency Management

Module 5 - Scope and Change Management

Module 6 – Quality Management

Questions on the Pre-Work Materials?

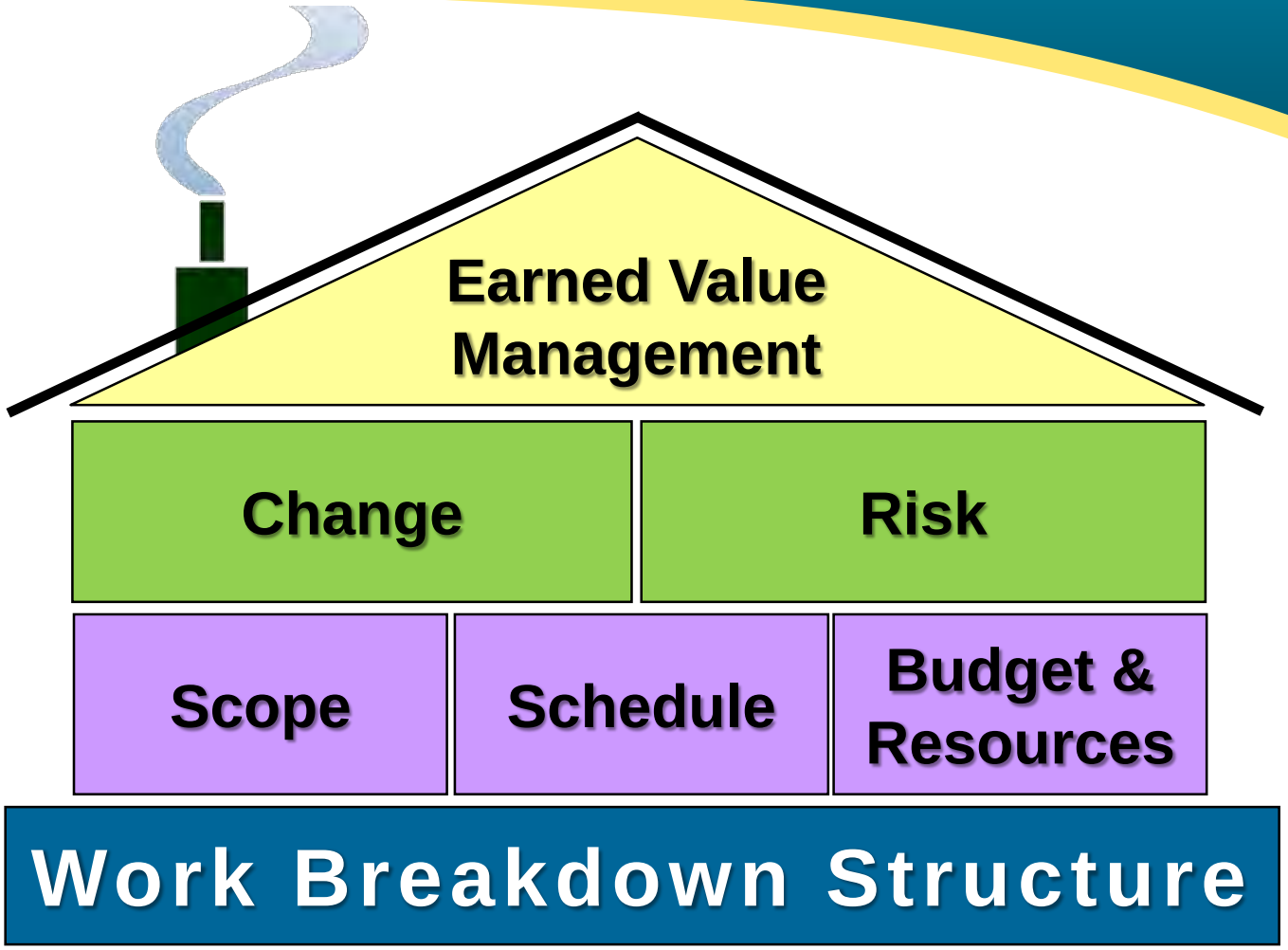
- MTP Reference Document Materials
- Wikipedia description of the WBS
- General Introduction to the WBS
- Quiz on Pre-reading



What is a Work Breakdown Structure?

- The Work Breakdown Structure (WBS) defines the project and organizes it into discrete work elements.
- The WBS provides the necessary framework for definition and control of project budget and schedule.
- The WBS is dynamic – it can be revised and updated as needed to reflect further elaboration of the project and approved changes to the project scope.

WBS is the Foundation for Successful Project Delivery



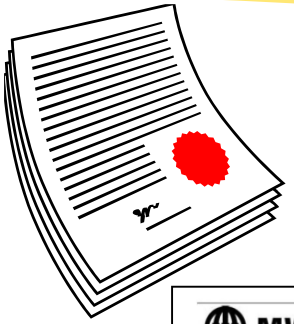
Scope Planning Practice

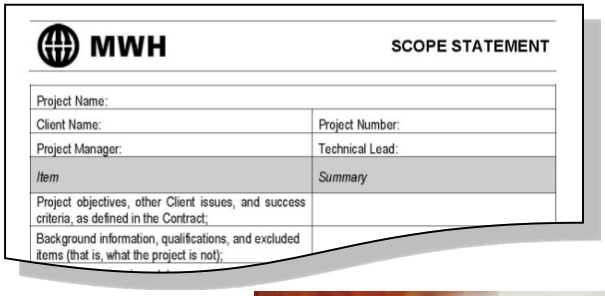
Review Contract

Prepare Scope Statement

Validate Scope Statement

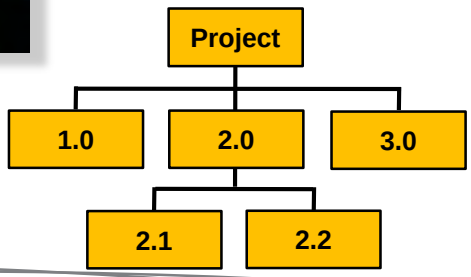
Create Work Breakdown Structure



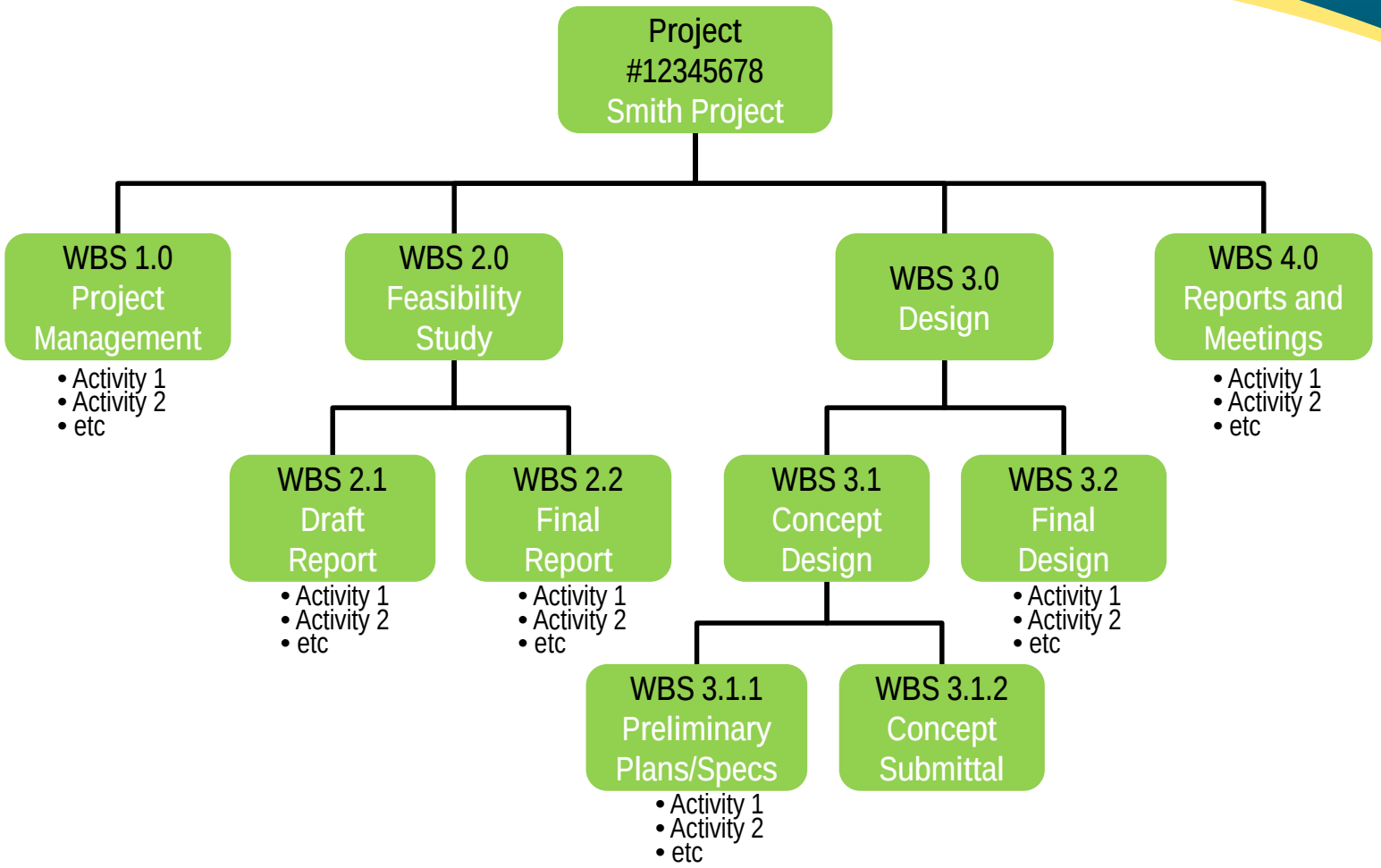


MWH SCOPE STATEMENT

Project Name:	
Client Name:	Project Number:
Project Manager:	Technical Lead:
Item	*Summary*
Project objectives, other Client issues, and success criteria, as defined in the Contract;	
Background information, qualifications, and excluded items (that is, what the project is not);	

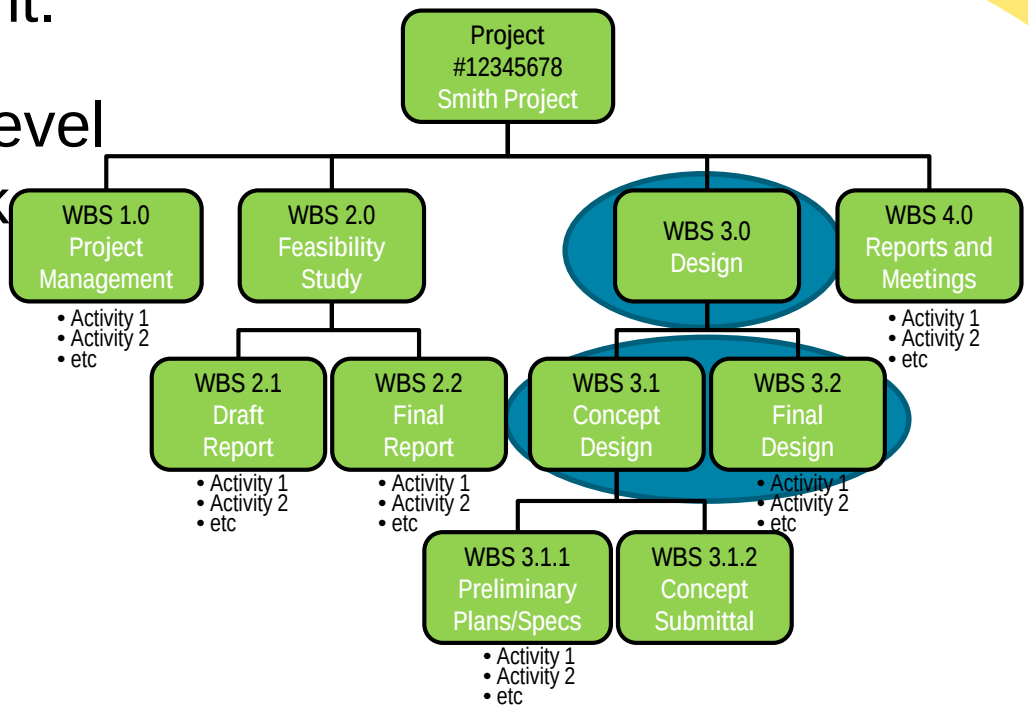


WBS Terminology



The 100 Percent Rule

- WBS must include 100% of the project scope and deliverables, including project management.
- Sum of the work at a Child Level must equal 100% of the work represented by its Parent.
- Any work not included in the WBS is outside the project scope.
- WBS elements are mutually exclusive – no overlap of scope between WBS elements.

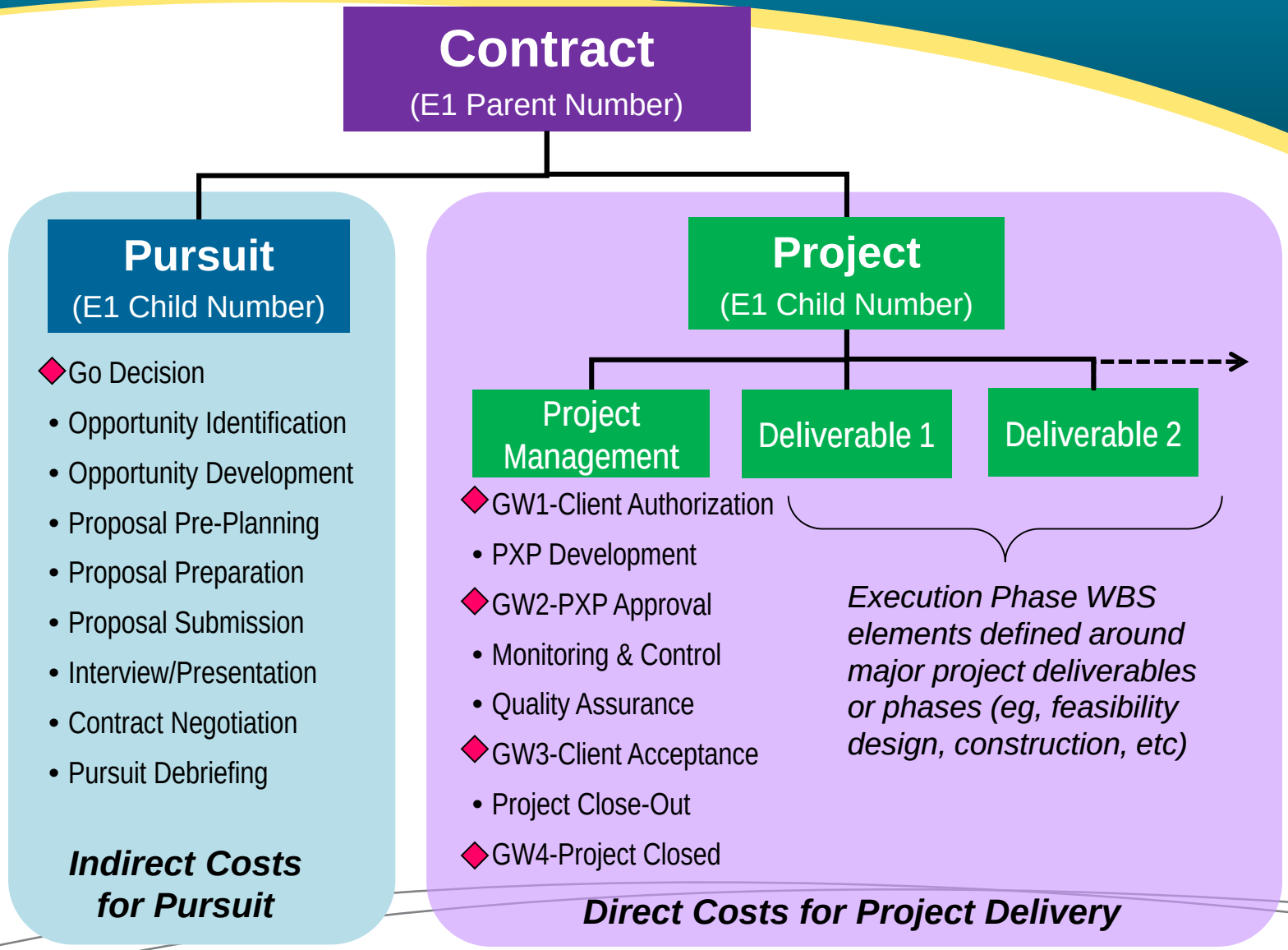


Activity Definition and "Rules of Thumb"

- Activities are the smallest definable unit of work on the project. They are assigned below the Work Package level.
- Resources, Budget and Duration are assigned at the Activity Level.
- Engage Technical Team Members in defining Activities.
- Outcomes of good Activity definition:
  - Better estimate of project cost and schedule
  - Easier to track progress and manage the project

Rule of Thumb	Level of Effort	Duration
Activity	< 80 Hours	< 2 Weeks
Work Package (2-10 Activities Total)	< 500 Hours	< 3 Months

MWH's Standard WBS



Scalability – WBS for Small Project

Marketing Acct
(E1 Parent Number)

Pursuit
(E1 Child Number)

Pursuit effort for Small Projects typically handled under a general Marketing Account

Indirect Costs for Pursuit

Contract
(E1 Parent Number)

Project
(E1 Child Number)

Single Work Package and Cost Code at Project Level

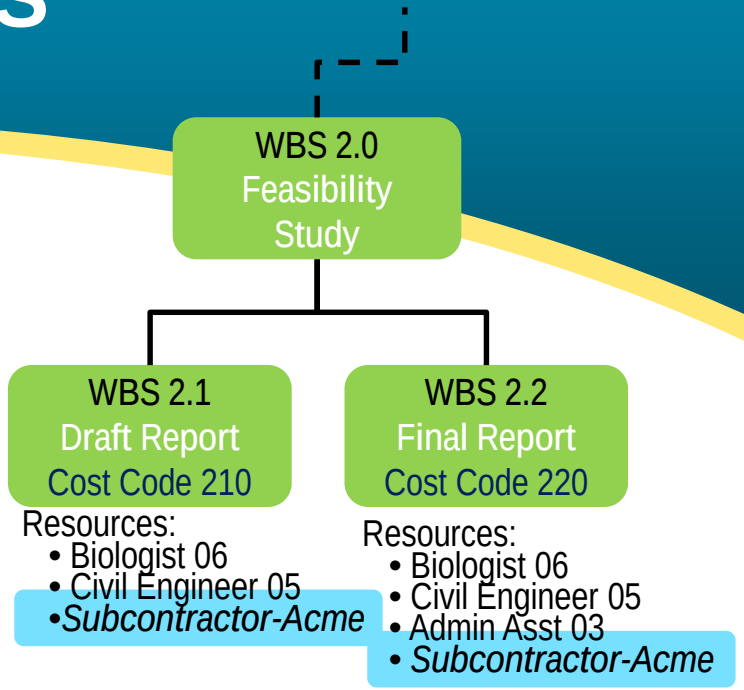
- GW1-Client Authorization
- PXP Development
- GW2-PXP Approval
- Monitoring & Control
- Quality Assurance
- Project-Specific Activities
- GW3-Client Acceptance
- Project Close-Out
- GW4-Project Closed

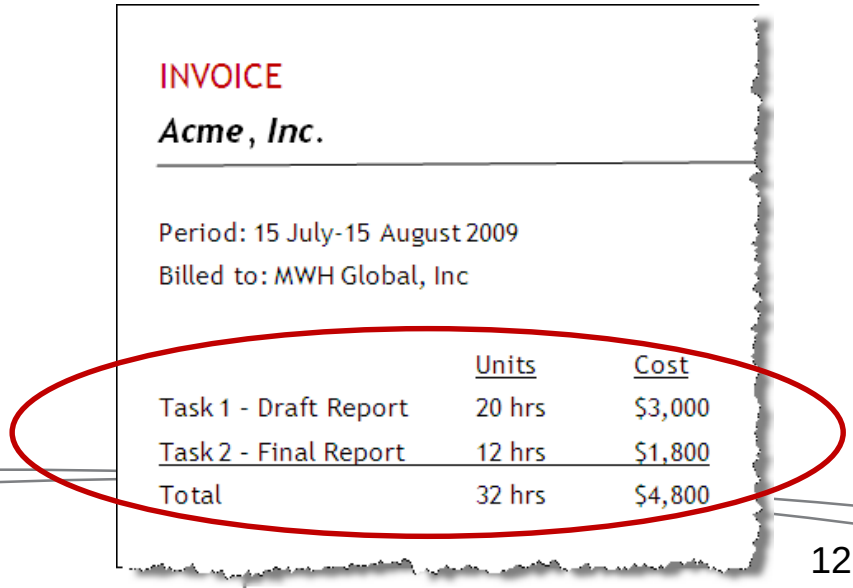
Specific activities relevant to the individual project

Direct Costs for Project Delivery

Subcontractors in the WBS

- Assign Subcontractors to the various Activities they will support, like other project resources.
- Don't put all Subcontract work in a single Work Package unless it is really a separate deliverable.
- Require invoices to break out the work performed in line with applicable Cost Codes.
- This will enable accurate progress measurement and application of EVM techniques.





INVOICE

Acme, Inc.

Period: 15 July-15 August 2009

Billed to: MWH Global, Inc

	Units	Cost
Task 1 - Draft Report	20 hrs	$3,000
Task 2 - Final Report	12 hrs	$1,800
Total	32 hrs	$4,800

Key Learning – WBS Definition and Standards

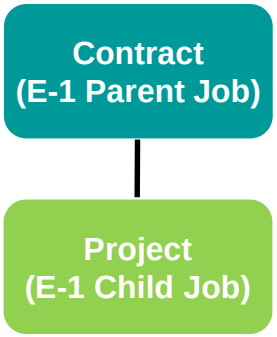
- Structure the WBS around major contract deliverables and other contractual requirements.
- The WBS should reflect how the PM intends to manage the project.
- The WBS should adhere to the 100% Rule.
- WBS elements should be mutually exclusive - no overlap in scope between any WBS elements.
- WBS should be revised as needed to reflect further elaboration or changes to the project scope.
- Involve Technical Team Members in Activity definition.

One Project - One E1 Child Job

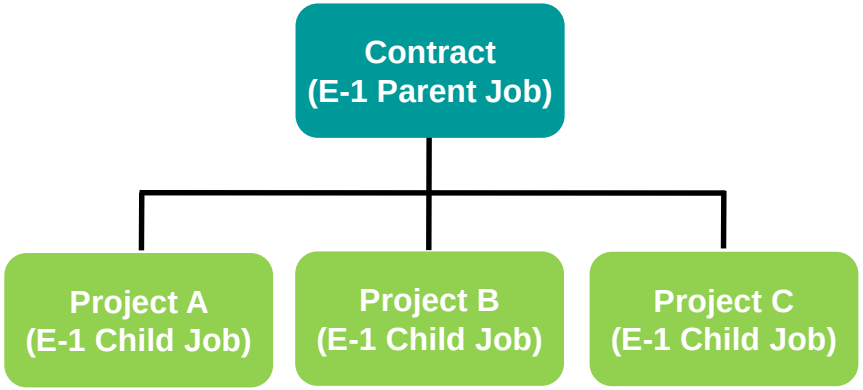
- Each Contract is set up in E-1 as a single Parent Job.
- Each Project is set up in E-1 as a single Child Job*.
- Contracts may include multiple projects or just one.
- All work related to a project must be tracked and managed as part of it.
- Amendments to the project scope must be included in the original E1 Child Job and by expanding or modifying the WBS.

** Except for projects with Multiple Contract Term Types until resolved as part of E1 Upgrade next year*

Contract with Single Project



Contract with Multiple Projects



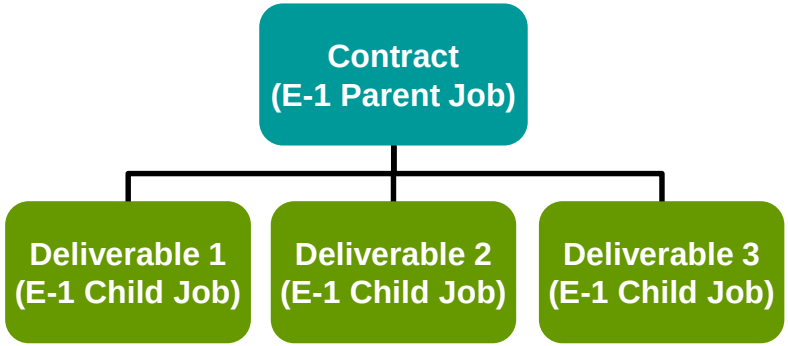
Remaining Exceptions to "One Project - One E1 Child Job" Rule

Efforts are underway to modify our practices and E-1 to eliminate the remaining exceptions:

1. Multiple Funding Sources - RESOLVED
2. Shared Revenue - RESOLVED
3. Inter-Company Agreements - IN PROGRESS
4. Multiple Contract Term Types - TO BE ADDRESSED NEXT YEAR

In the interim, projects with Multiple Contract Terms or ICAs will continue to be split into multiple E-1 Child Jobs.

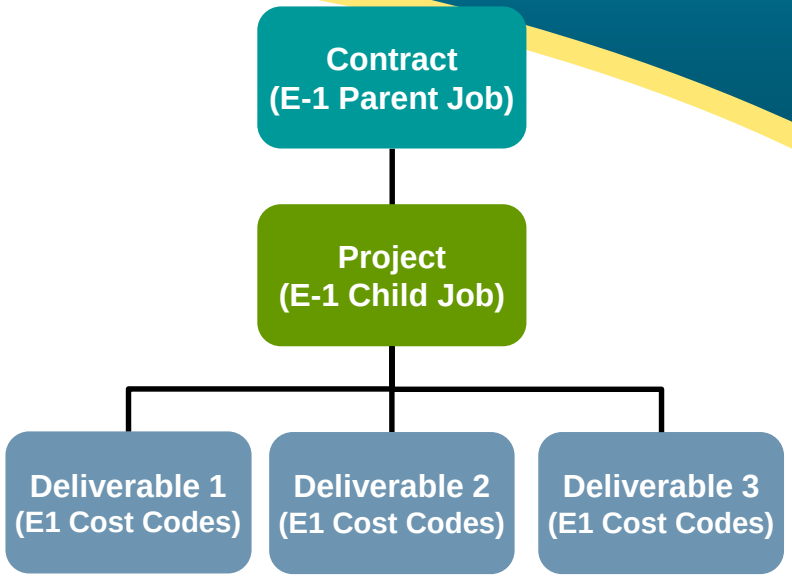
One Project = One E1 Child Job



INCORRECT

Do not use multiple E-1 Child Jobs in place of WBS Elements.

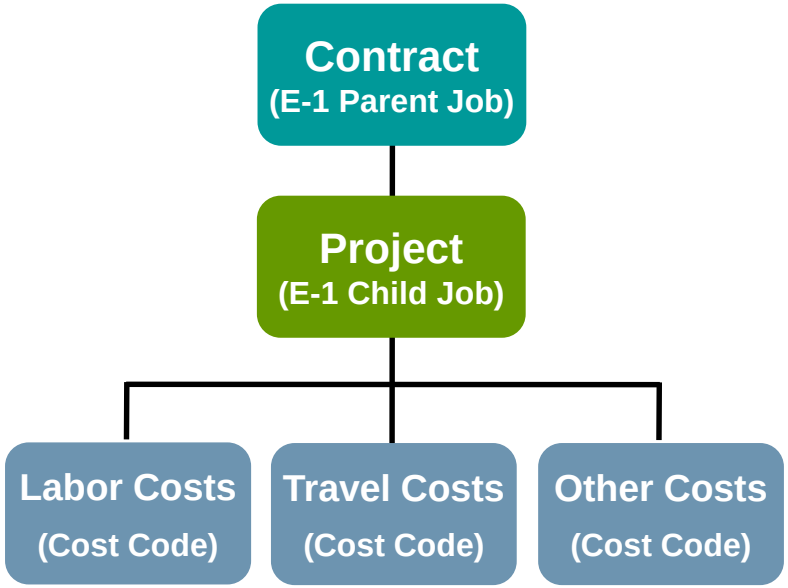
(Exception for projects with Multiple Contract Term Types until resolved as part of E1 Upgrade next year)



CORRECT

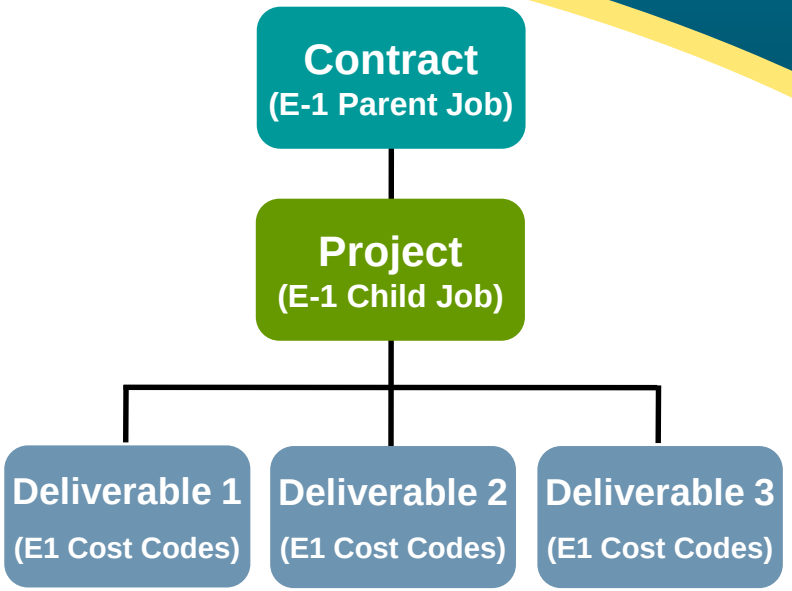
The Project must equate to a single E-1 Child Job. Deliverables should be separate WBS elements. Use Cost Codes to track actual costs under each part of the WBS.

Align WBS Around Major Deliverables



INCORRECT

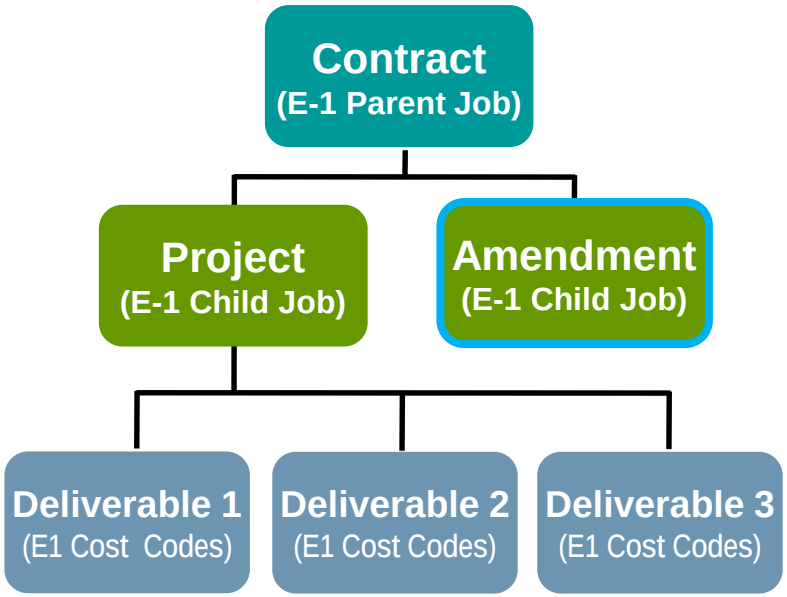
Do not divide the WBS by cost type. Reports of actual costs by type can easily be obtained from E1 without structuring the WBS around them.



CORRECT

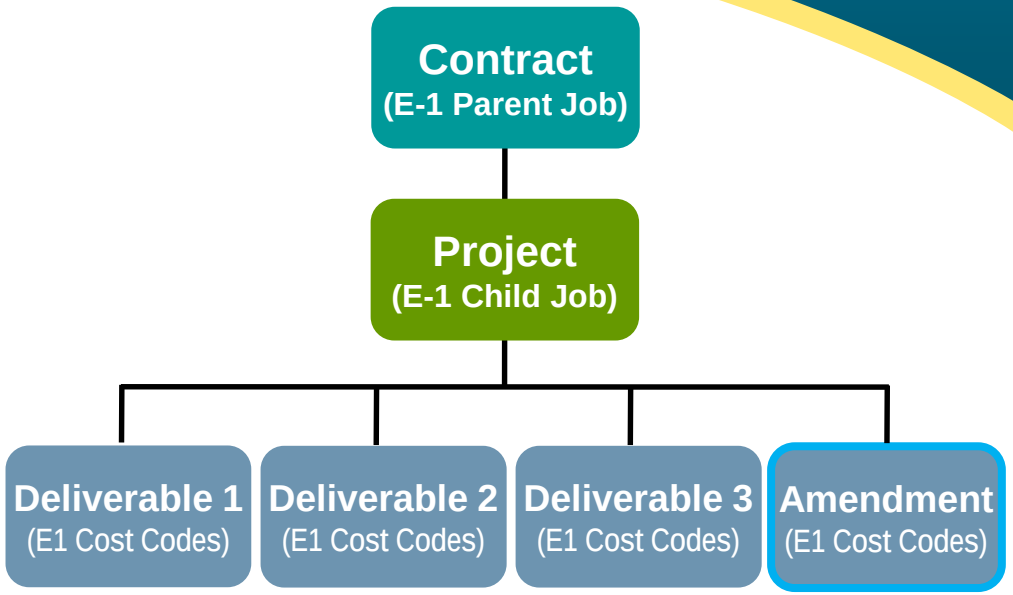
The WBS should be aligned with major project deliverables or phases, and reflect how the PM intends to carry out the work.

Incorporating Project Scope Amendments



INCORRECT

Do not add a new E-1 Child Job for a contract amendment to the project scope. Create a new Child Job only if the amendment results in an entirely new project.

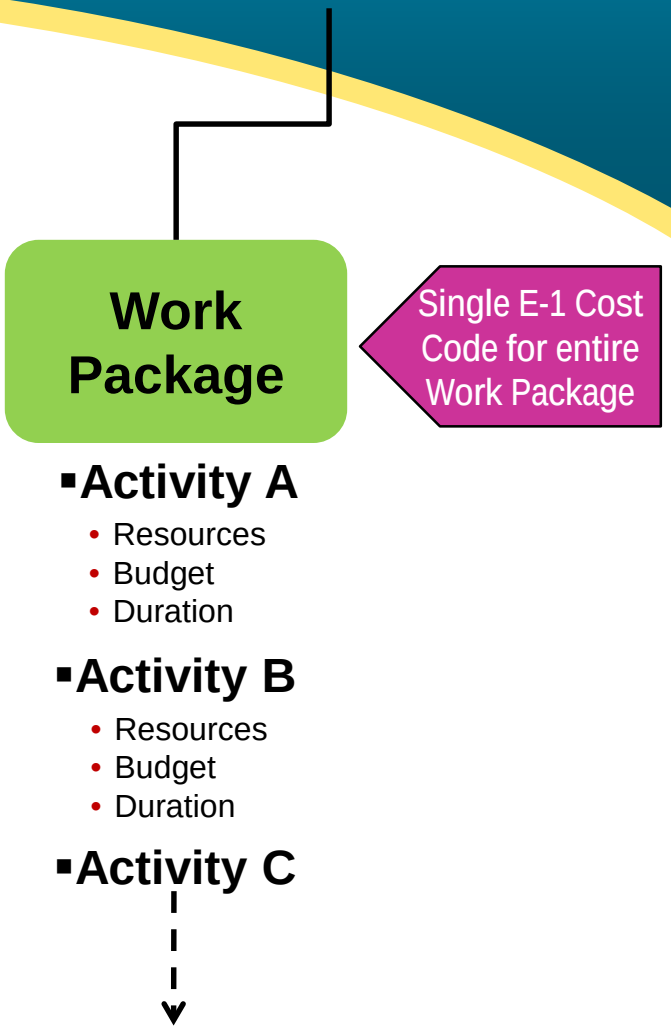


CORRECT

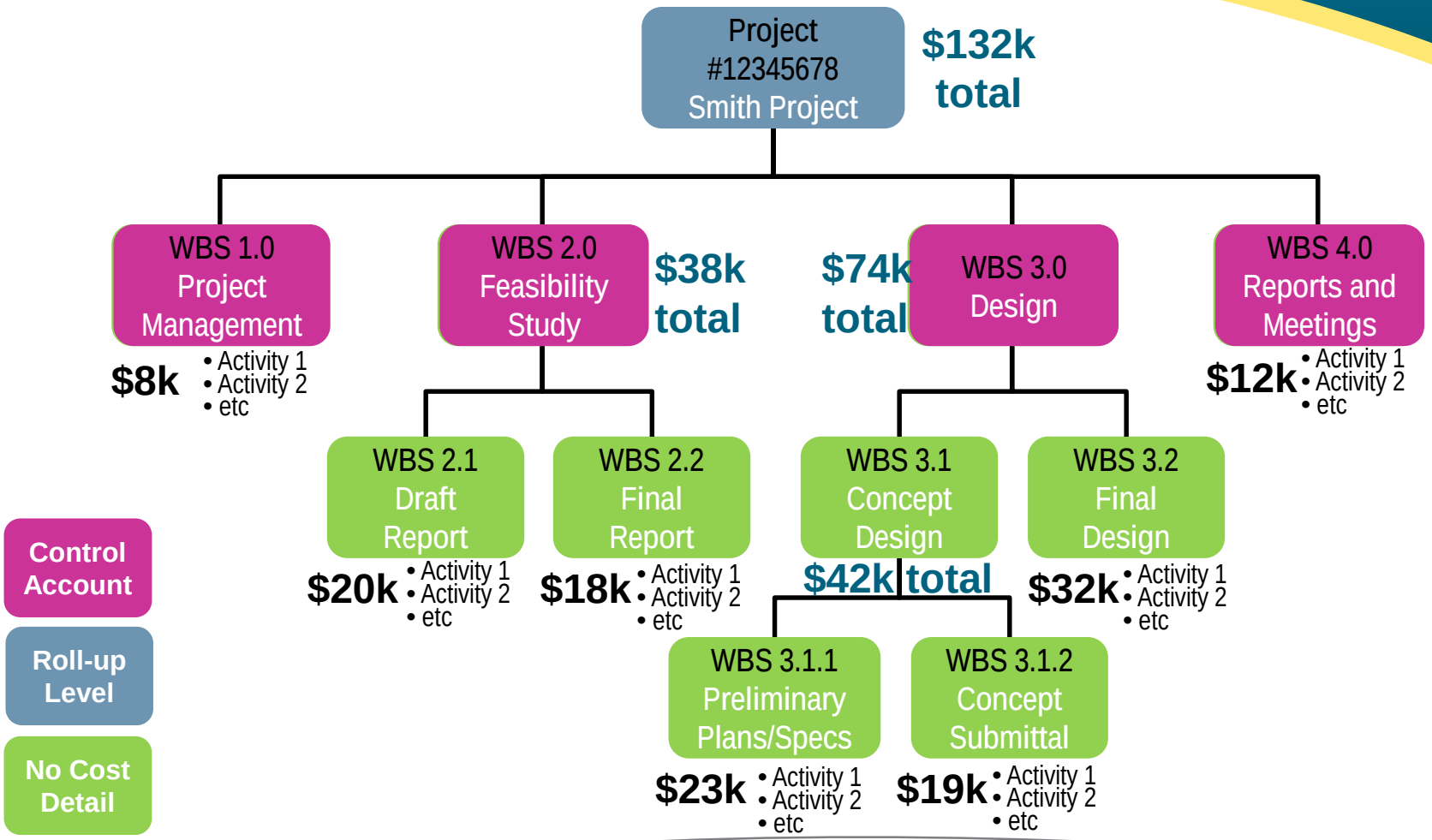
Incorporate contract amendments to the project by adding a new WBS Element or revising existing WBS Element(s) to add the new scope.

Control Account = E1 Cost Code

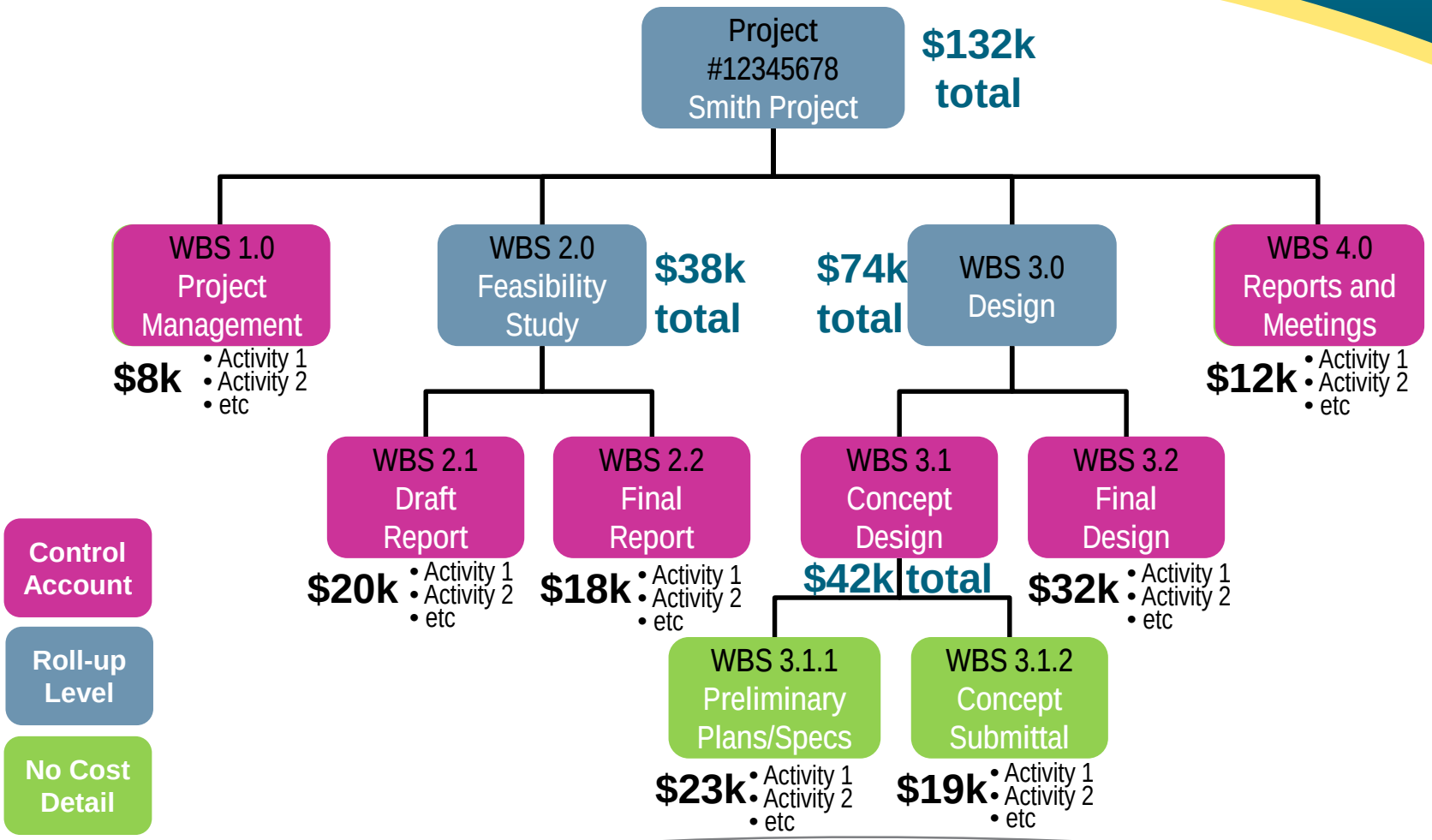
- Projects are planned down to the Activity Level, and managed at the Control Account Level.
- Control Accounts are the WBS Elements where Cost Codes are assigned for tracking and reporting actual costs.
- Cost Codes can be assigned at the Work Package level or above – not on individual Activities.
- Actual costs for all work below will roll up to the Control Account/Cost Code level.
- Control Accounts can be at any level of the WBS, but only one per branch.



Assigning Control Accounts



Assigning Control Accounts



Key Learning – E1 Alignment and Cost Codes

- Client Contract = E1 Parent Job
- Project = E1 Child Job
- Project scope amendments get incorporated into the WBS and original E1 Child Job.
- Cost Codes can be assigned at the Work Package Level or above.
- Only one Cost Code in any Branch of the WBS.
- Set Control Accounts/Cost Codes at level needed to provide appropriate detail for tracking and reporting actual costs.

Exercise 1

Perform in Class

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Exercise 1 – WBS Components and Standards

- This is an individual exercise.
- You will have 20 minutes to complete it.
- You will create a WBS that is consistent with the Contract Scope, Best Practices, and MWH Standards.
- Be prepared to show your WBS to the class and to explain your rationale.

Exercise 1 – WBS for Lift Station Design

Validated scope of work for a $280,000 fee contract:

- 10 Month contract period, 2,800 hours total level of effort.
- 30% Deliverable (drawings and specifications) due at end of Month 3.
- 70% Deliverable (drawings and specifications) due at end of Month 7.
- Final Deliverable (drawings, specifications, cost estimate) due at end of Month 10.
- Monthly Client meetings, reports and administrative activities.

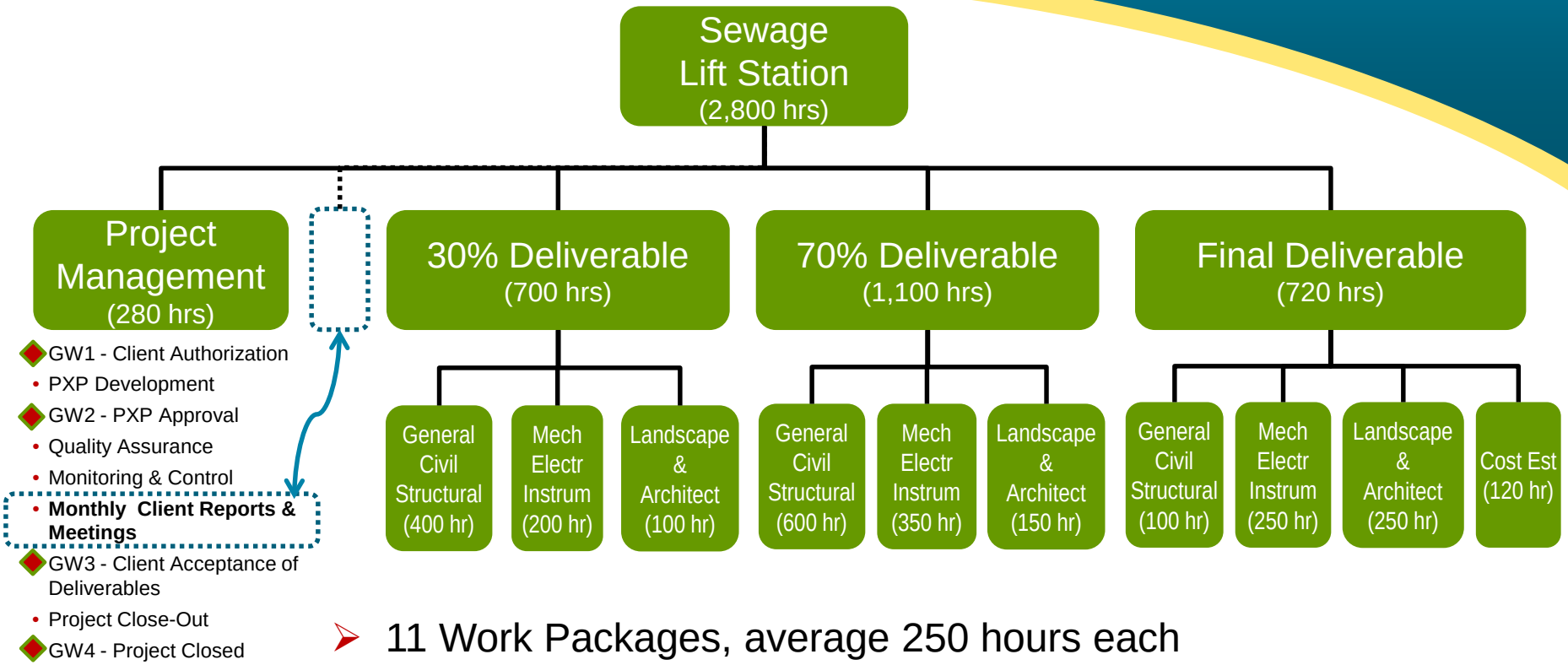
The validated scope statement assumes a total of 24 drawings:

2 General drawings	3 Architectural drawings (subcontract)	3 Electrical & Instrumentation drawings
4 Civil drawings	2 Landscape drawing (subcontract)	5 Mechanical drawings
5 Structural drawings		

Based on this information, develop a basic WBS (3 levels) in a graphical “tree” format consistent with MWH’s standards and guidelines.

- Identify the Work Packages and estimated size (hours / dollars) for each,
- Indicate the approximate number of activities for the entire Project, and the number of activities per work package,
- Be prepared to explain your rationale to the class.

“Best Practice” Response to Exercise 1



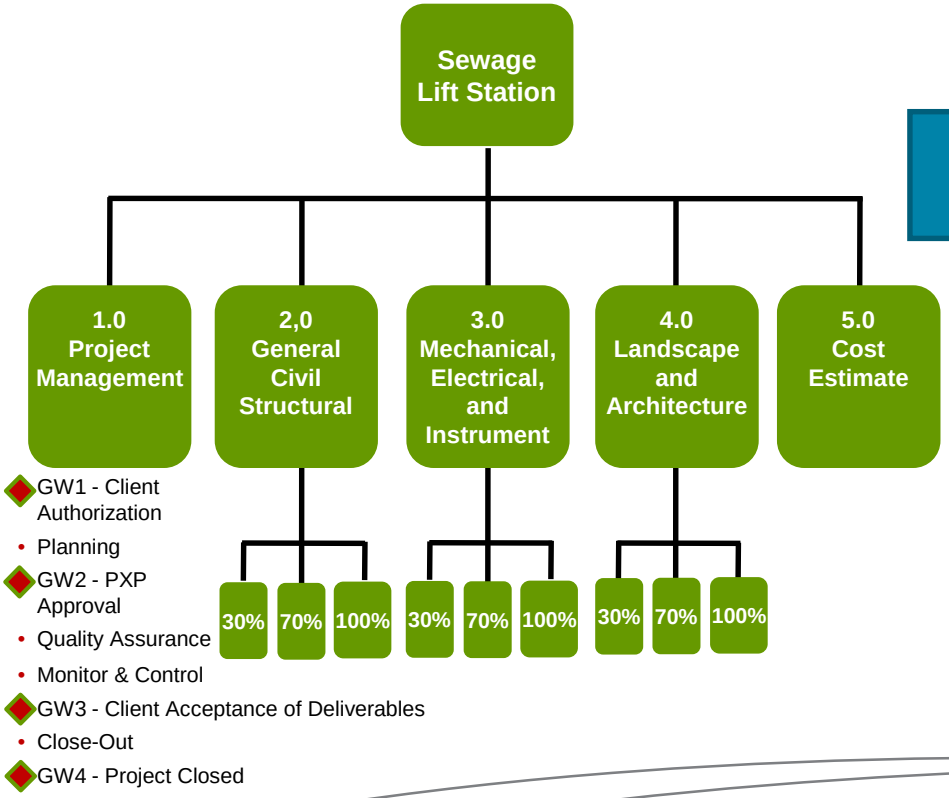
- 11 Work Packages, average 250 hours each
- 5-10 Activities per Work Package
- 60-80 Activities averaging 40 hours each
- Monthly Client Reports/Meetings could be 2nd Level WBS or included under Project Management

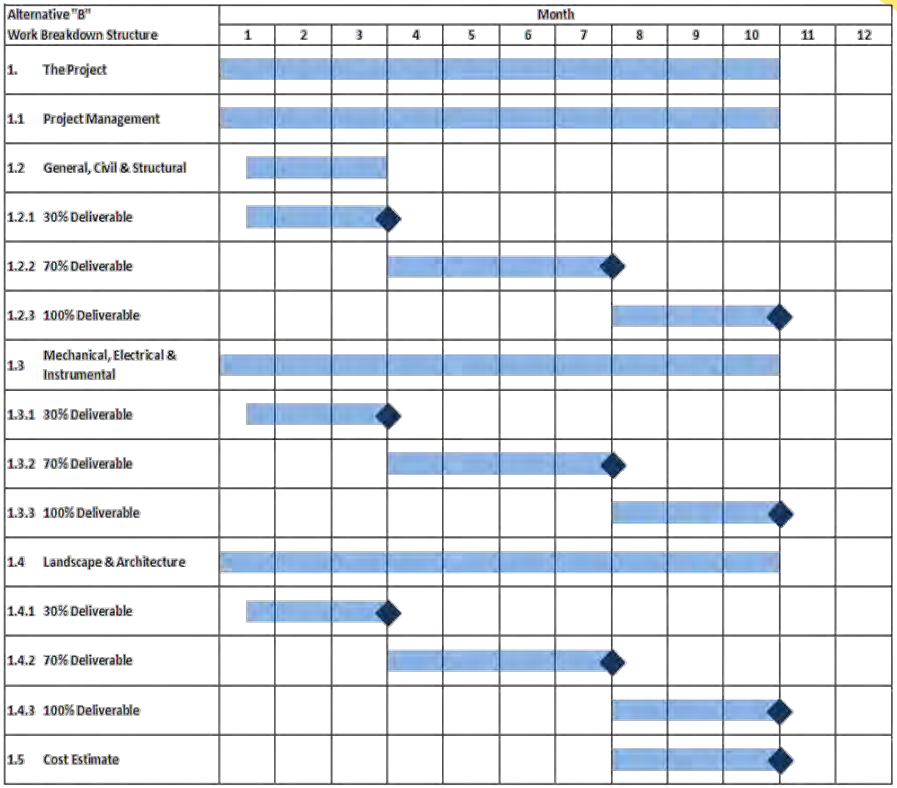
Key Learning from Exercise 1:

- Structure WBS around contract deliverables and other contract requirements, like reports.
- Include a WBS element for Project Management.
- Include all 4 MTP Gateway Milestones.
- WBS should reflect how the PM intends to execute the work.
- Size and duration of work packages and activities should generally fit with the following ranges:
  - Work Packages: Level of Effort < 500 Hours; Duration < 3 Months
  - Activities: Level of Effort < 80 Hours; Duration < 2 weeks
- Subcontractors - not necessary to put all subcontractor work in a single Work Package or Cost Code. Package it to fit with how the overall project will be managed and reported to ensure we can properly apply EVM techniques.

Why Not Organize WBS Around Disciplines?

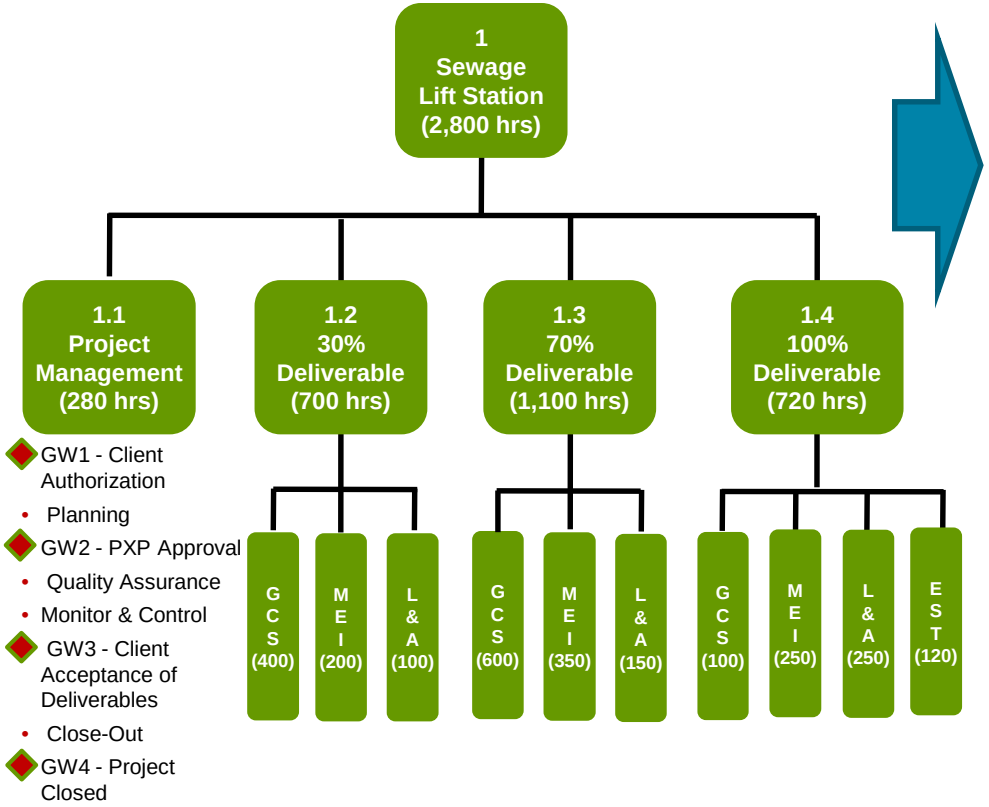
Schedule is more difficult to read, harder to evaluate status of each deliverable

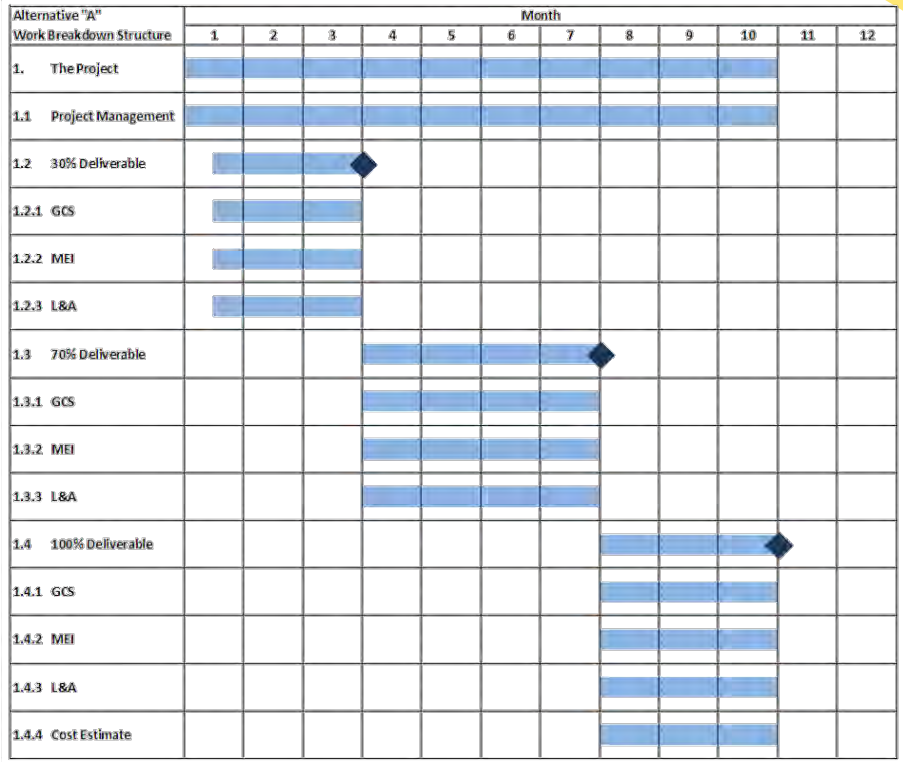


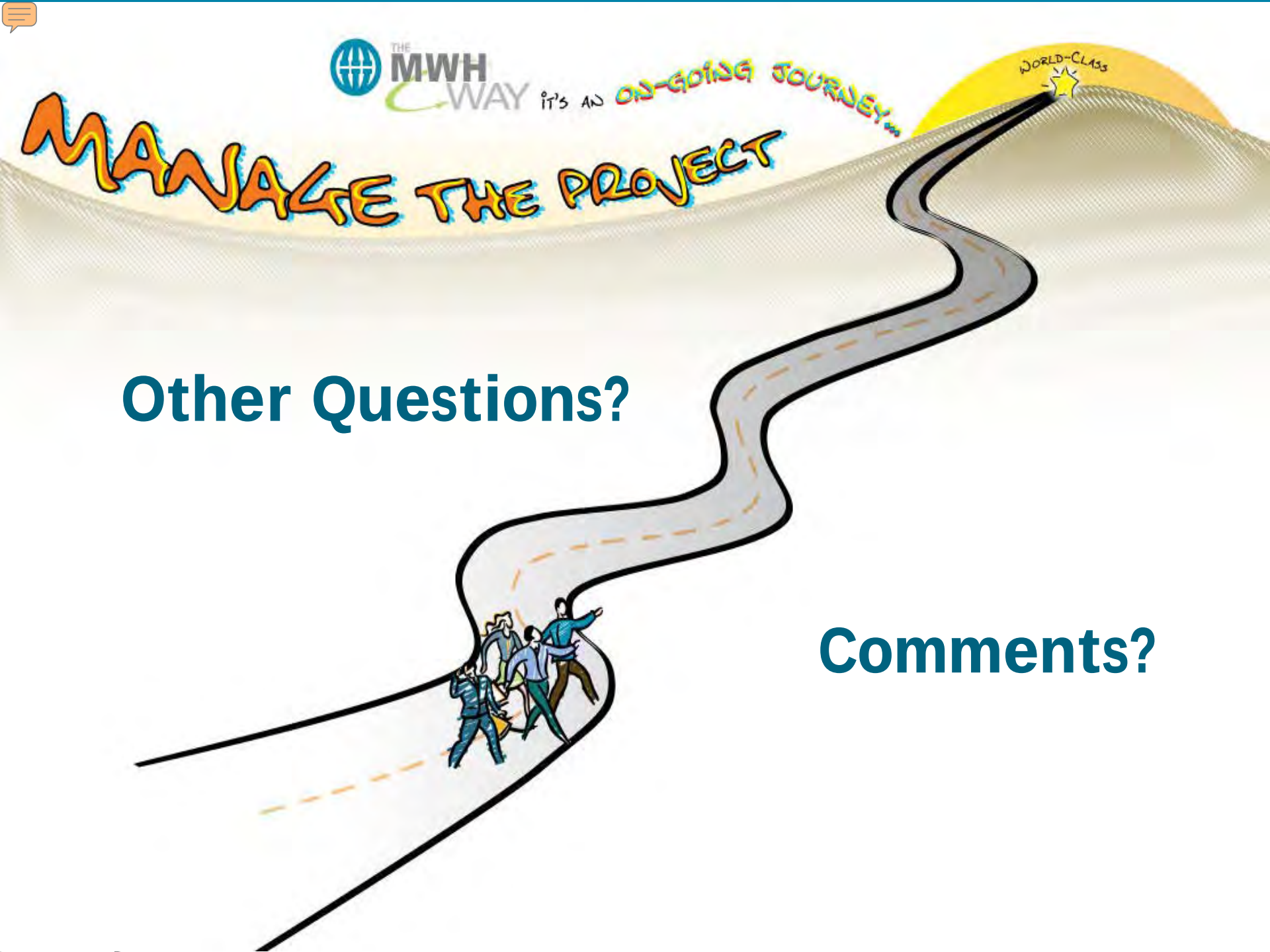


WBS Structured Around Deliverables

Schedule is easier to read. Can clearly see where problems are on each deliverable.







Other Questions?

Comments?

Best Practices Training

Module 3

Earned Value Management

23 November 2009

BUILDING A BETTER WORLD

Best Practices Training Modules

Module 1 - WBS Components and Standards

Module 2 - Project Scheduling

Module 3 - Earned Value Management

Module 4 - Risk and Contingency Management

Module 5 - Scope and Change Management

Module 6 – Quality Management

Agenda

- Review of Earned Value Basics
- Analyzing the Project Schedule
- Analyzing Performance with the EVM Curve
- Calculating Estimate At Completion (EAC)
- Cost and Schedule Performance Indices
- Exercise

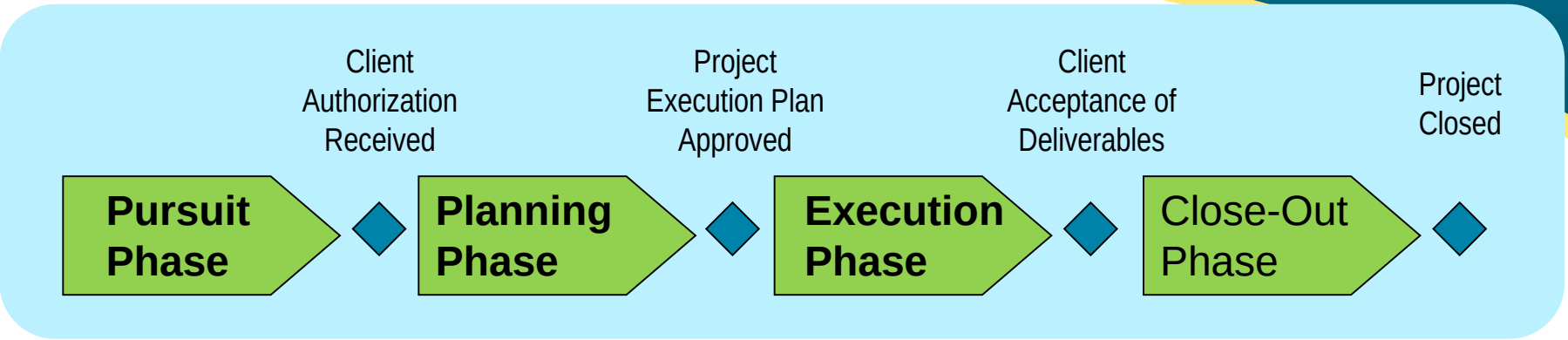
What is Earned Value Management?

- EVM integrates project scope, time and cost objectives and measures these against a baseline plan during execution of the project.
- EVM **predicts project outcomes** based on actual performance to date.
- EVM facilitates **proactive** project management, by identifying problems early on, in time to plan and implement corrective actions.

Earned Value Management Process

- Define the Scope of Work
- Develop the Baseline Plan (Cost and Schedule)
- Measure Actual Performance against the Baseline Plan
- Analyze Variances (Actual vs. Planned)
- Forecast Cost and Schedule Performance
- Identify and implement any Corrective Actions needed
- Evaluate impacts of Corrective Actions

Earned Value Management during the Project Life Cycle

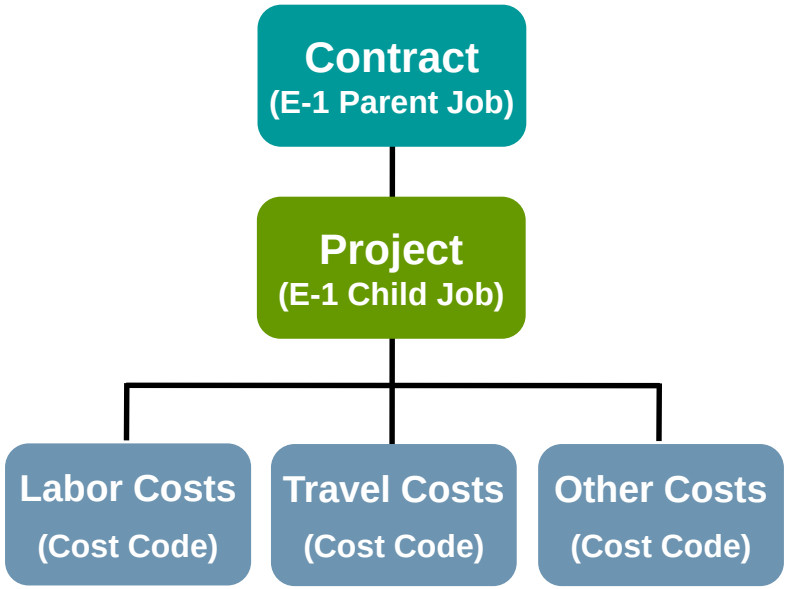


During the **Pursuit** and **Planning Phases**, the Project Manager prepares for EVM by:

- Considering how the work will be performed and managed.
- Developing a WBS that is oriented around major deliverables and/or phases of work.
- Establishing the Baseline for performance measurement.

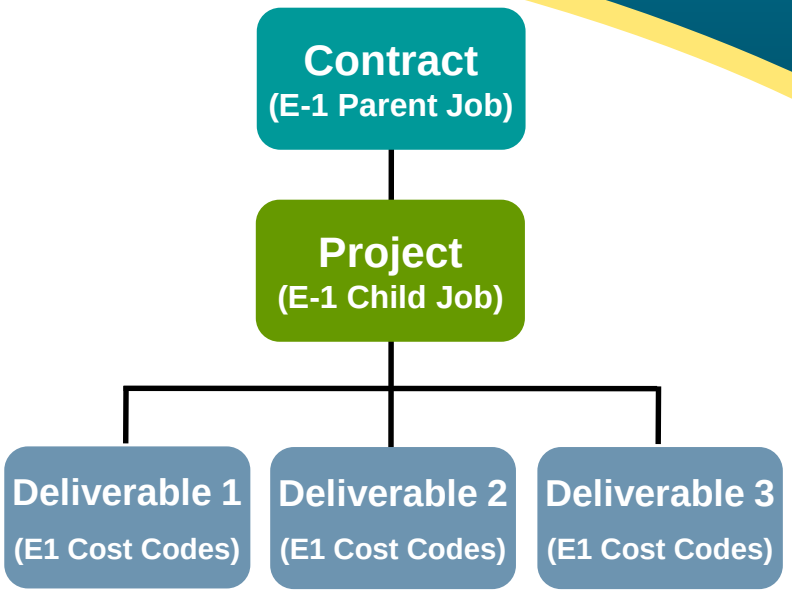
During the **Execution Phase**, the Project Manager will use EVM Measurement and Analysis techniques to assess performance and identify problems.

Align WBS Around Major Deliverables to Facilitate Earned Value Management



INCORRECT

Dividing the WBS by cost type or discipline inhibits effective application of EVM techniques during execution.



CORRECT

The WBS should be aligned with major project deliverables or phases, reflecting how the work will be performed. This enables effective use of EVM during execution.

Estimating Percent Complete

- Accurate estimates of Percent Complete are essential for effective use of Earned Value Management techniques.
- Percent Complete progress can be measured in a number of ways:
  - Fixed Formula
  - Weighted Milestone
  - Physical Percent Complete
  - Level of Effort
- When defining WBS and Activities, ensure work is broken down sufficiently to allow accurate estimation of Percent Complete during execution.

Key Definitions

- **Actual Costs (AC):**

  Costs incurred for work performed to date.

- **Planned Value (PV):**

  Budgeted cost of work originally planned to be performed through current date.

  PV = Budget x Scheduled % Complete

- **Earned Value (EV):**

  Value of work performed to date.

  EV = Budget x Physical % Complete

Key Definitions (continued)

- **Estimate To Complete (ETC):**

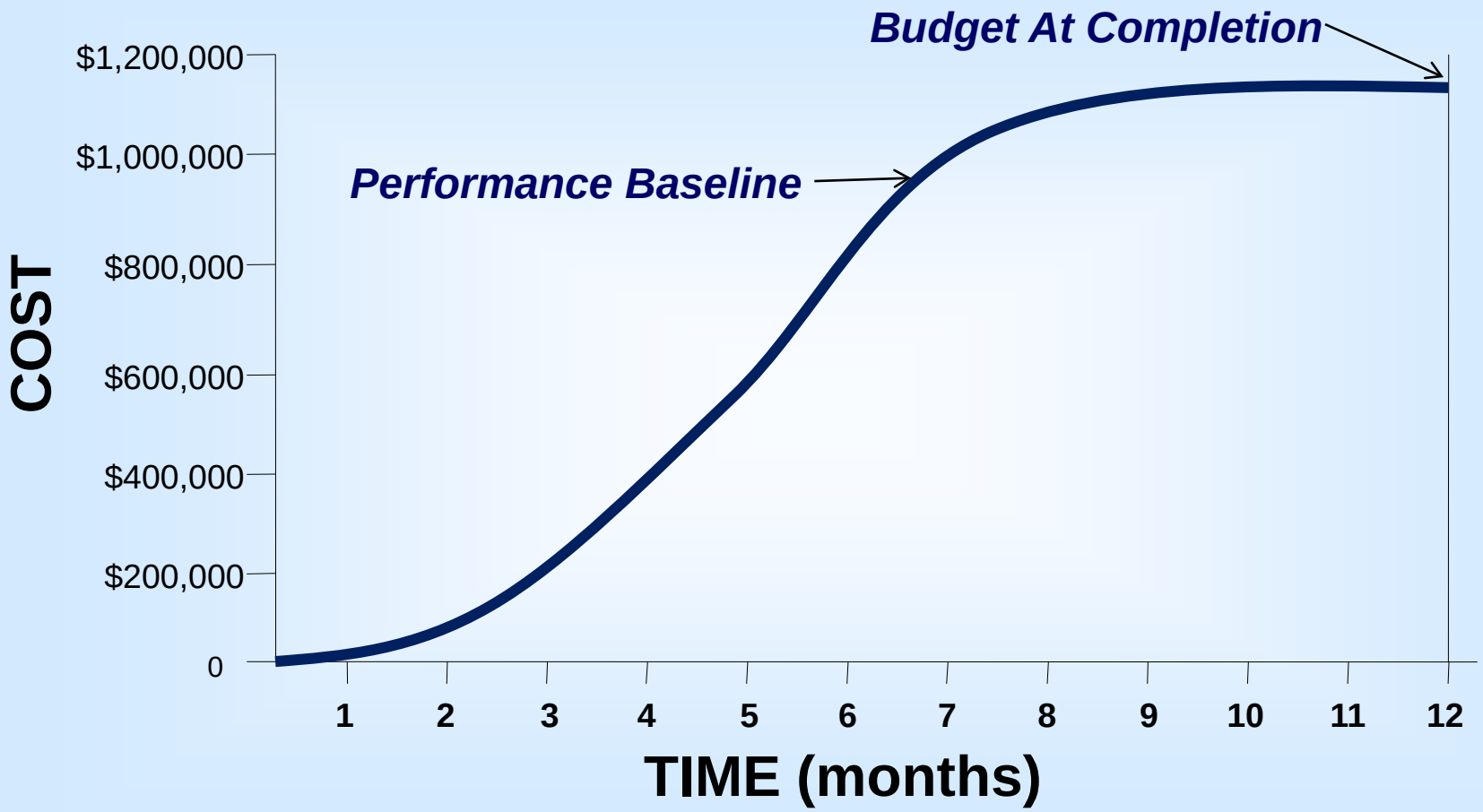
  Expected cost to complete remaining scope of work.

- **Estimate At Completion (EAC):**

  Projected final cost of all the work.

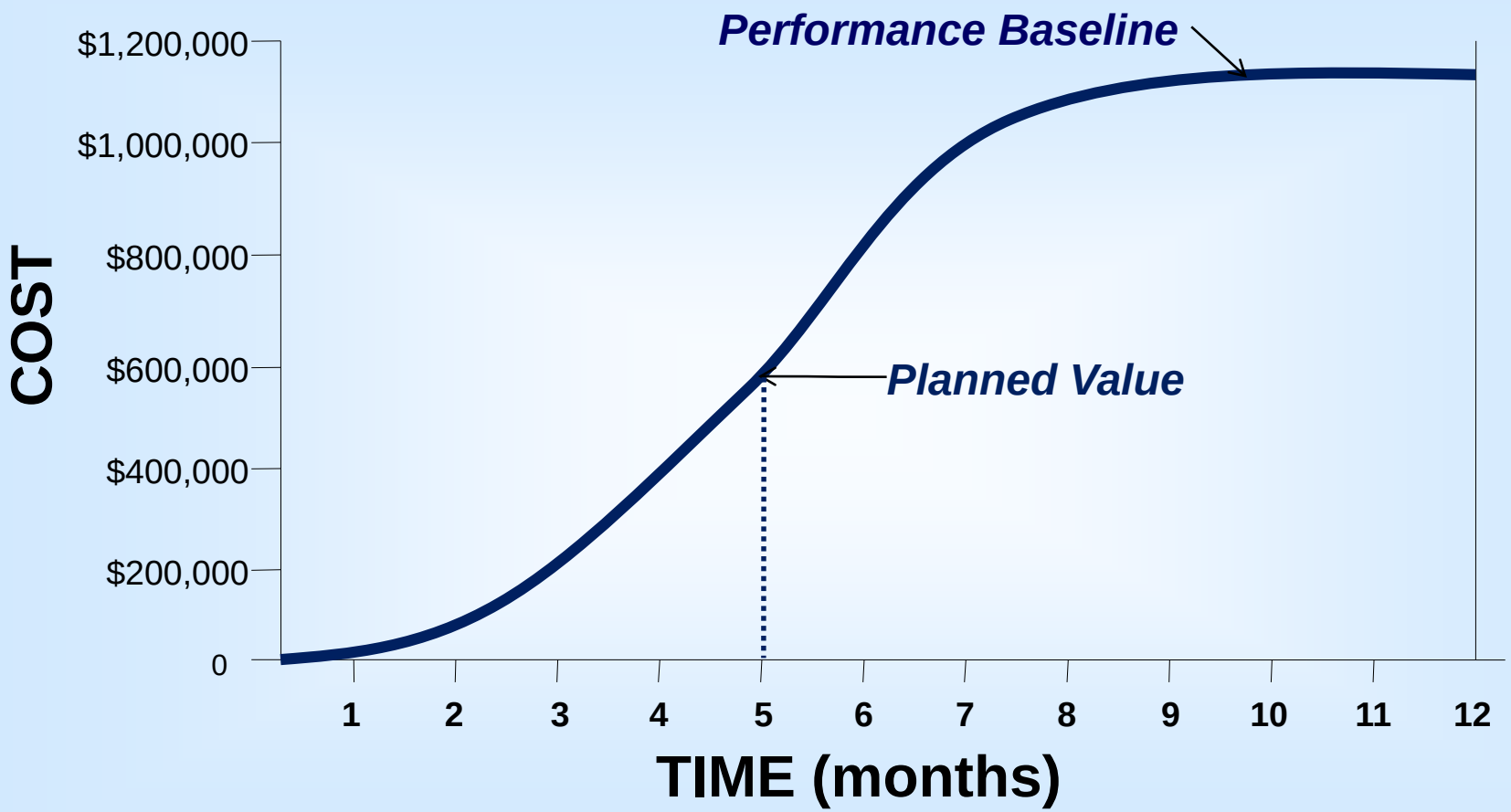
  EAC = ETC + AC

Performance Measurement Baseline



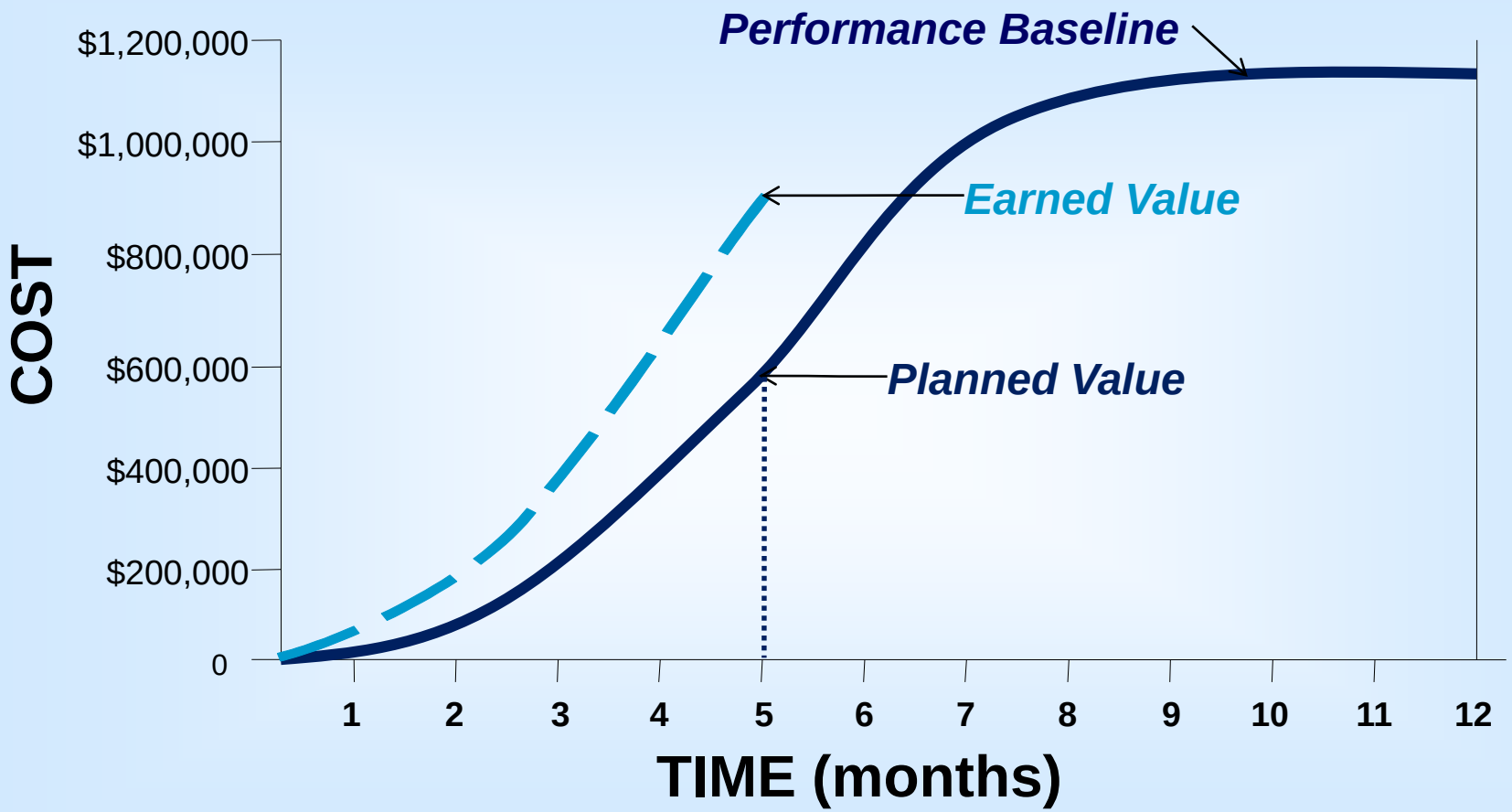
The Baseline Plan can be graphed to show the time-phased project budget.

Planned Value



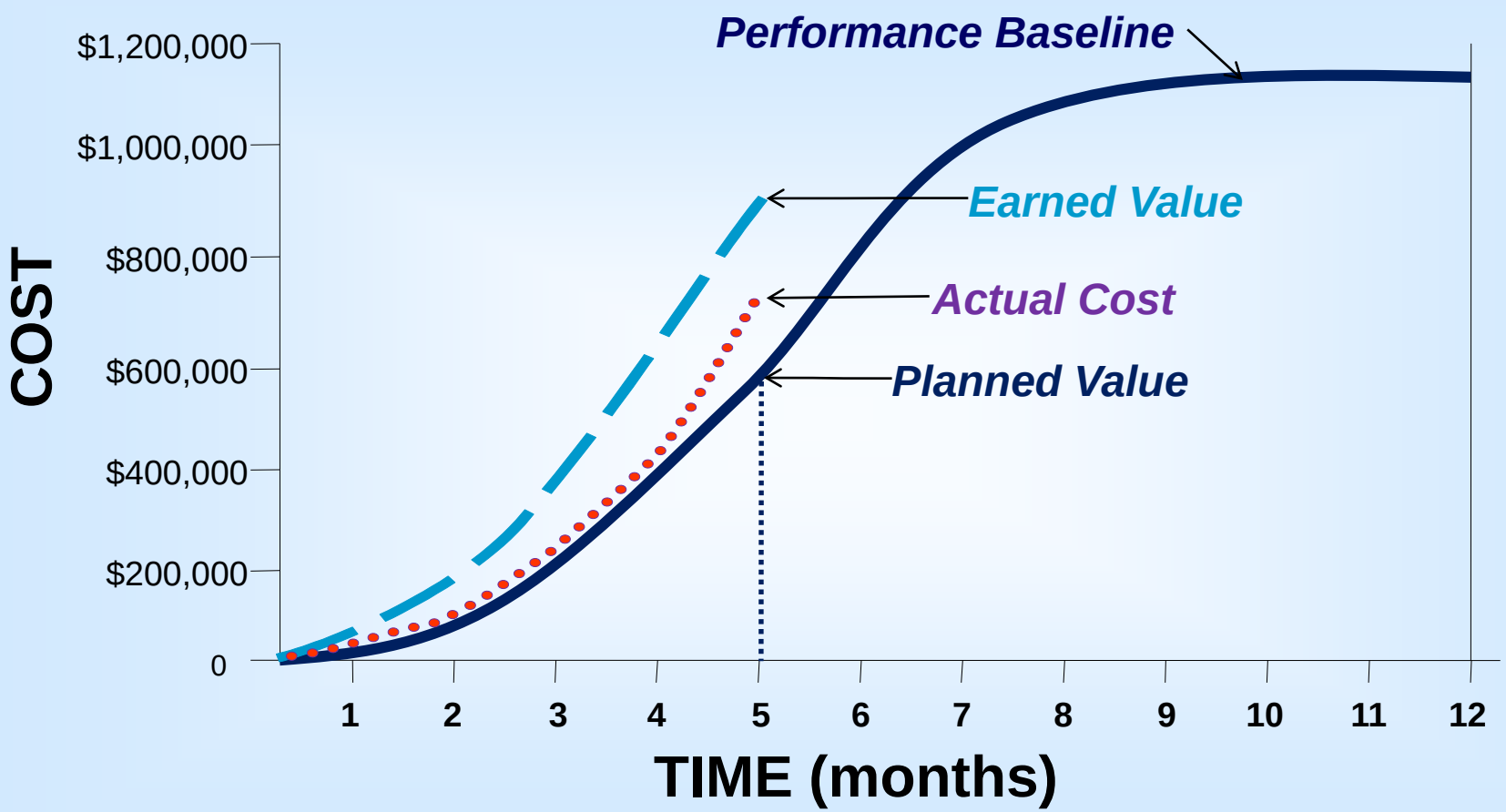
Planned Value is the Budget for work originally planned to be performed to date.

Earned Value



Earned Value is the value of work actually performed to date.

Actual Cost



Actual Cost is cost incurred for work actually performed through current date.

Cost and Schedule Variance

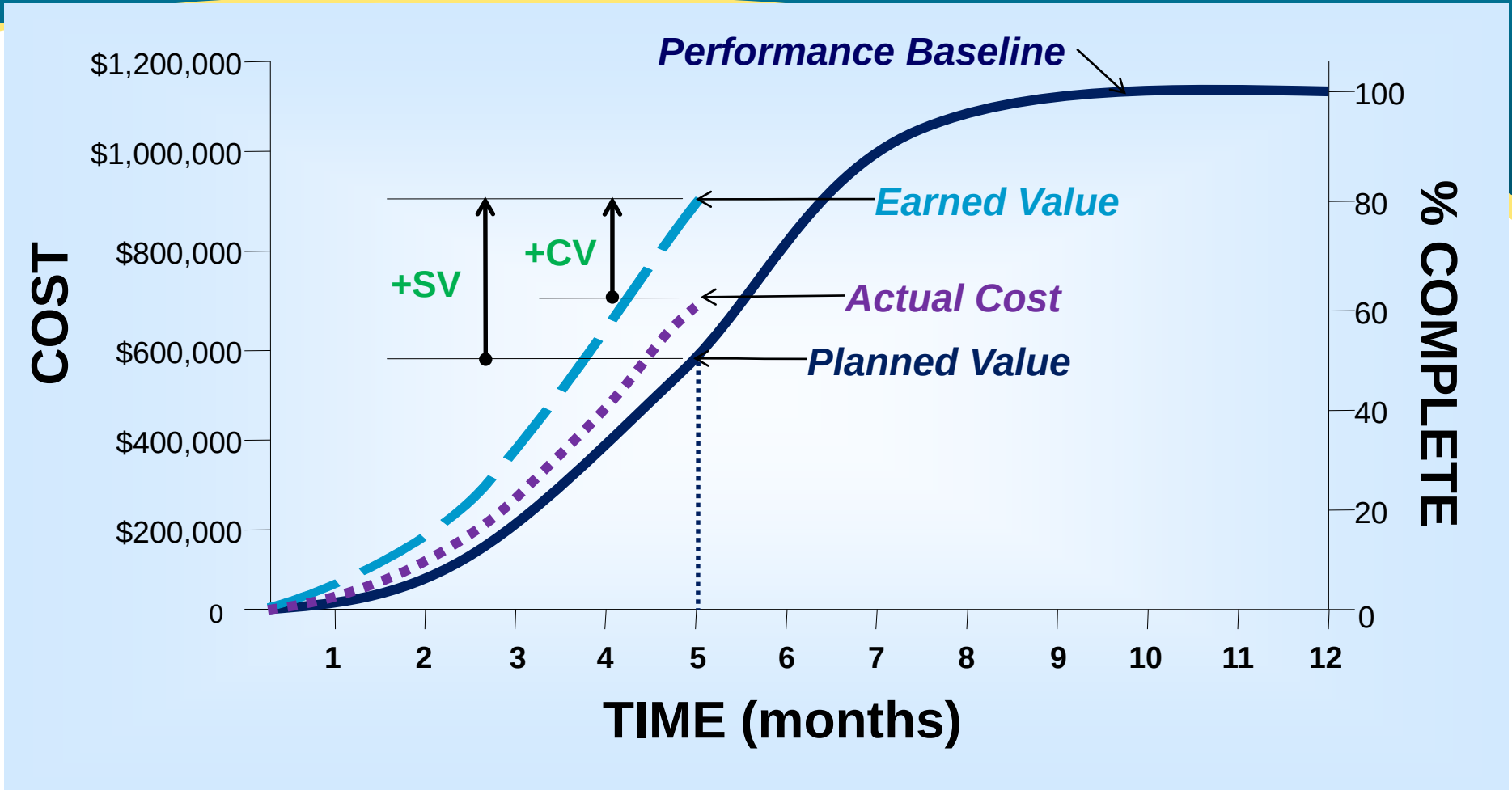
Cost Variance (CV)

- *Are we within budget?*
- *CV = EV - AC*
- Positive CV: Under Budget
- Negative CV: Over Budget

Schedule Variance (SV)

- *Are we on schedule?*
- *SV = EV – PV*
- Positive SV: Ahead of Schedule
- Negative SV: Behind Schedule

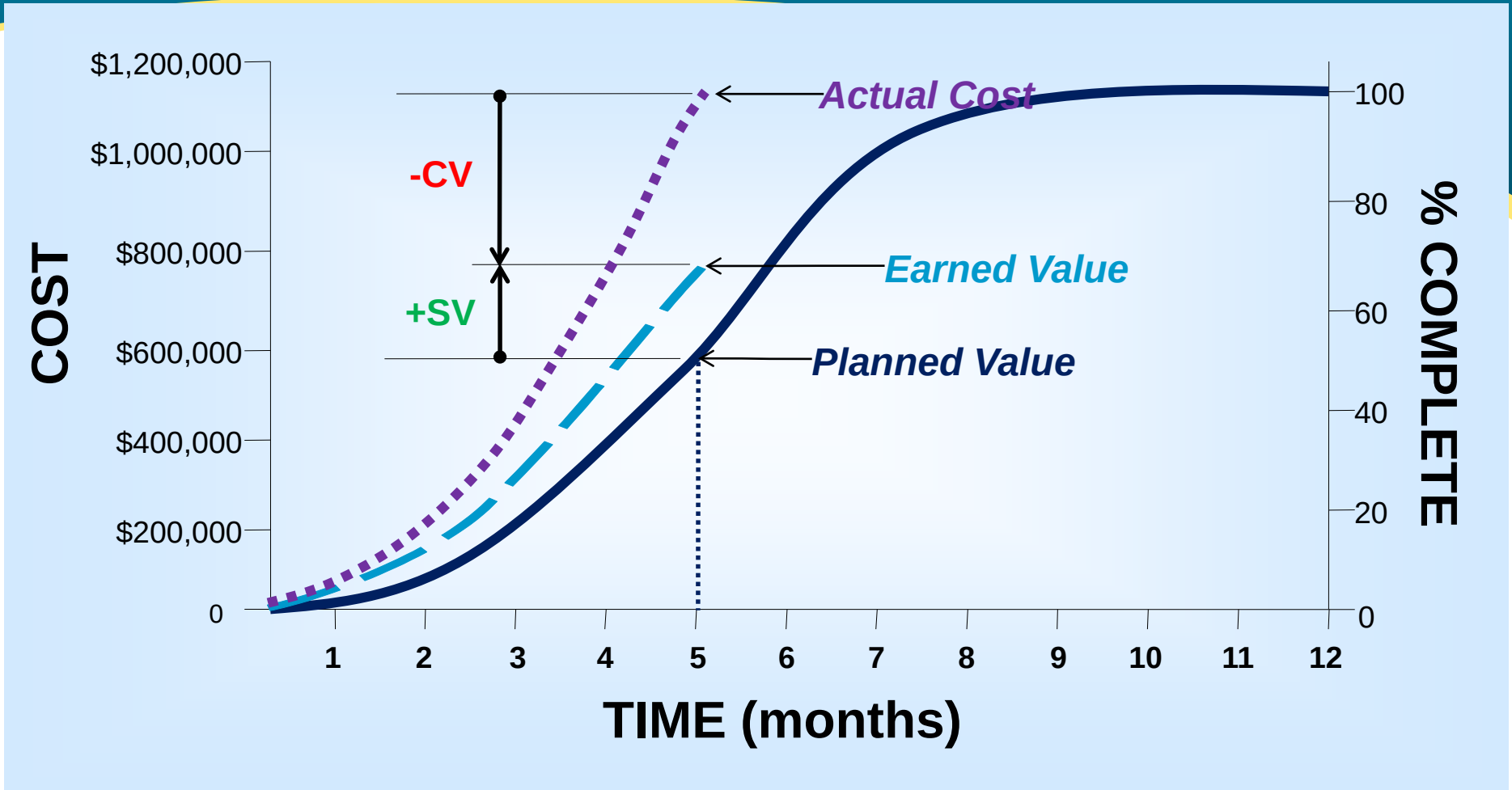
Variance Analysis:
Ahead of Schedule, Under Budget



SV - Positive

CV - Positive

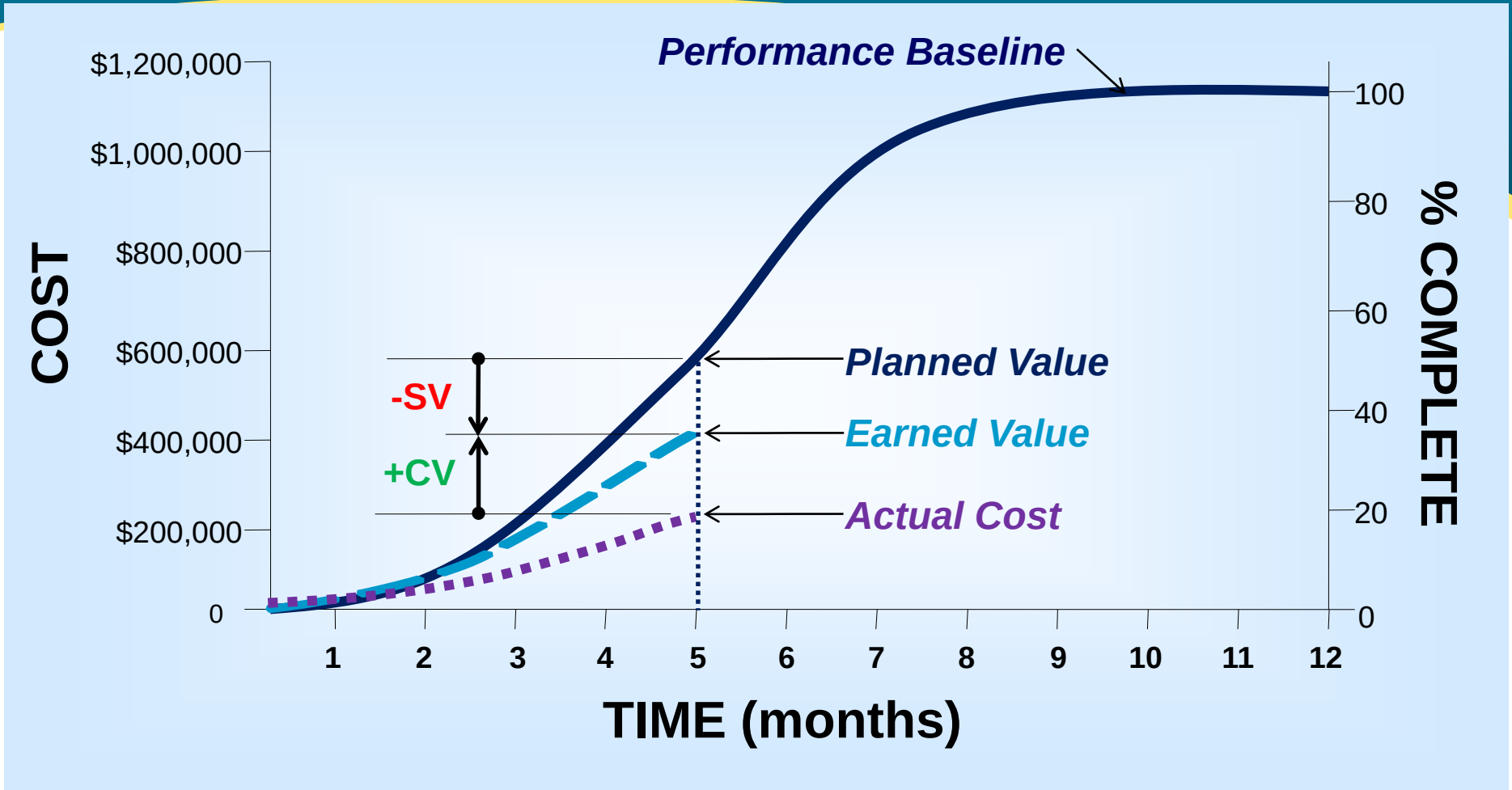
Variance Analysis:
Ahead of Schedule, Over Budget



SV - Positive

CV - Negative

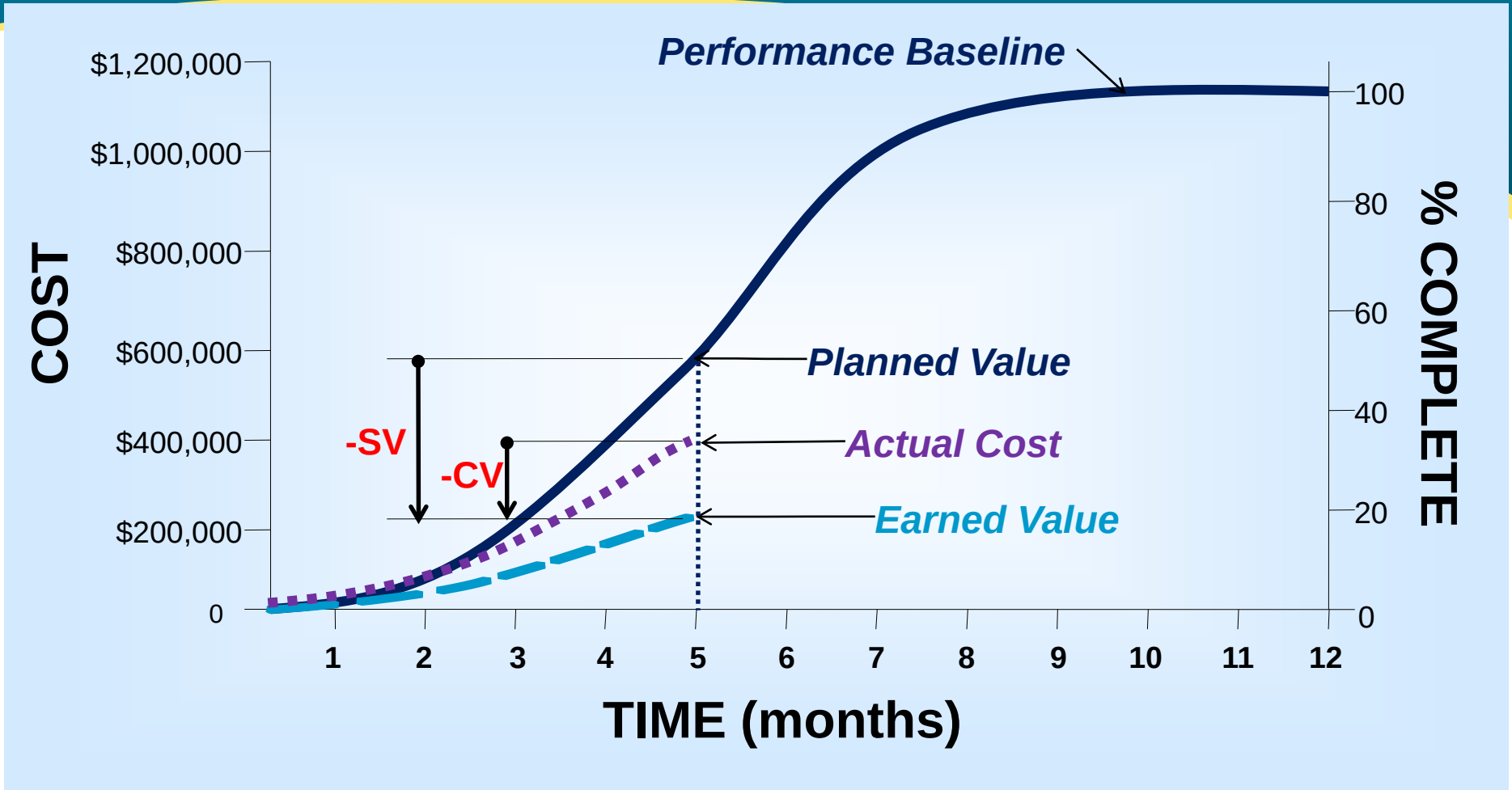
Variance Analysis:
Behind Schedule, Under Budget



SV - Negative

CV - Positive

Variance Analysis:
Behind Schedule, Over Budget



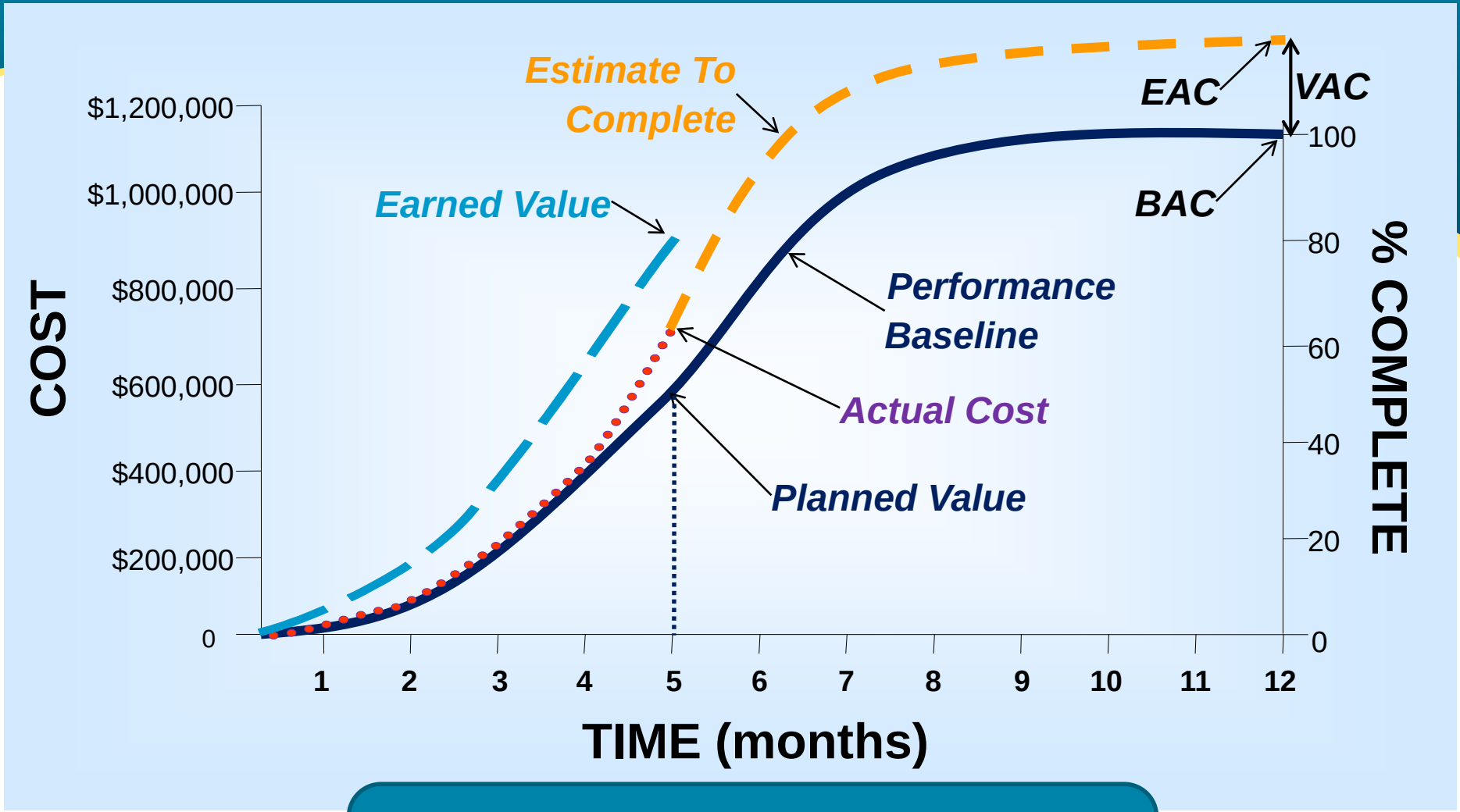
SV - Negative

CV - Negative

Calculating Estimates At Completion

- **Bottom Up Method**
  - EAC = AC + ETC
  - Revalidates original assumptions.
- **Remaining Budget Method**
  - EAC = AC + BAC – EV
  - Useful when trends are <u>not</u> expected to continue.
- **Cumulative CPI Method**
  - EAC = BAC / Cumulative CPI
  - Useful when trends/variances are expected to continue.
- **Combined SPI / CPI Method**
  - EAC =AC+[(BAC – EV) / (Cumulative CPI + Cumulative SPI)
  - Useful when execution will be adjusted to maintain schedule.

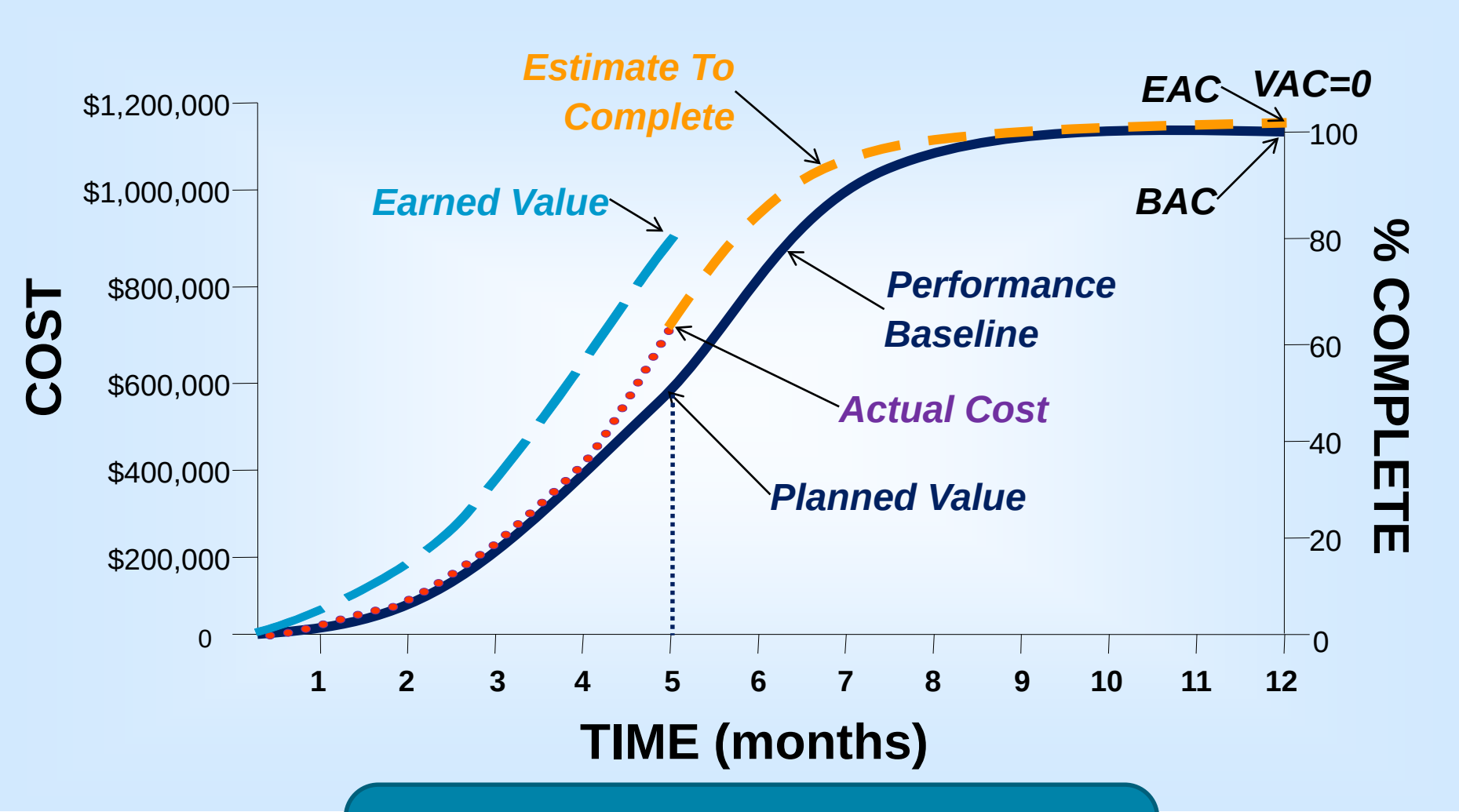
Variance at Completion



EAC = ETC + AC

VAC = BAC - EAC

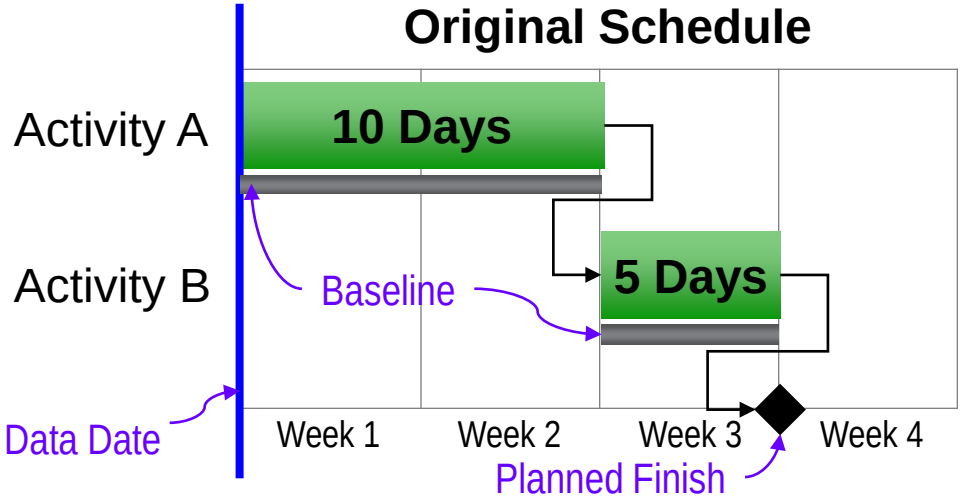
VAC After Corrective Action



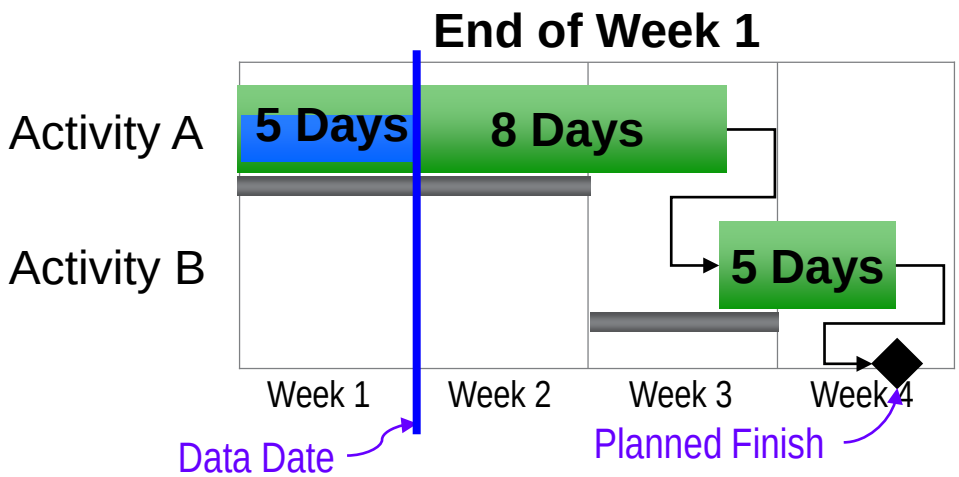
EAC = ETC + AC

VAC = BAC - EAC

Earned Value Analysis in Primavera



Activity Details	Budget
10 Day Duration Resource: George Bean Available 4 hrs/day, $100/hr	$4,000
5 Day Duration Resource: Del Kumar Available 4 hrs/day, $150/hr	$3,000
Budget at Completion:	$7,000



Actual Cost: 5d x 4h/d x $100	$2,000
Physical % Complete = 40%	
Remaining Duration: 8 Days	
Est to Compl: 8d x 4h/d x $100	$3,200
Activity B: No change	$3,000
Estimate at Completion:	$8,200

Planned Value: Scheduled % Complete x Budget (50% x $4000) = $2,000

Earned Value: Physical % Complete x Budget (40% x $4000) = $1,600

Cost Performance Index (CPI)

CPI measures cost efficiency. It indicates how much work is being accomplished per unit of currency on the project.

$$CPI = \frac{\textit{Earned Value}}{\textit{Actual Costs}}$$

CPI > 1.0 Getting more work done per $ than planned

CPI = 1.0 Work done exactly to budget*

CPI < 1.0 Getting less work done per $ than planned

** Really?*

Schedule Performance Index (SPI)

SPI measures schedule efficiency. It indicates how closely work is proceeding to the planned schedule .

$$SPI = \frac{\textit{Earned Value}}{\textit{Planned Value}}$$

SPI > 1.0 Getting work done faster than planned

SPI = 1.0 Work is exactly on schedule*

SPI < 1.0 Work is taking longer than planned

** Really?*

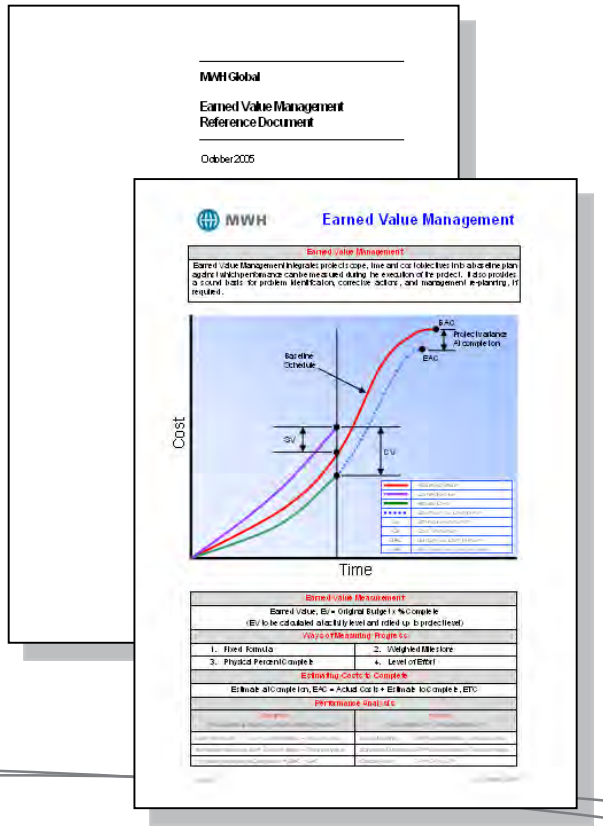
Corrective Action

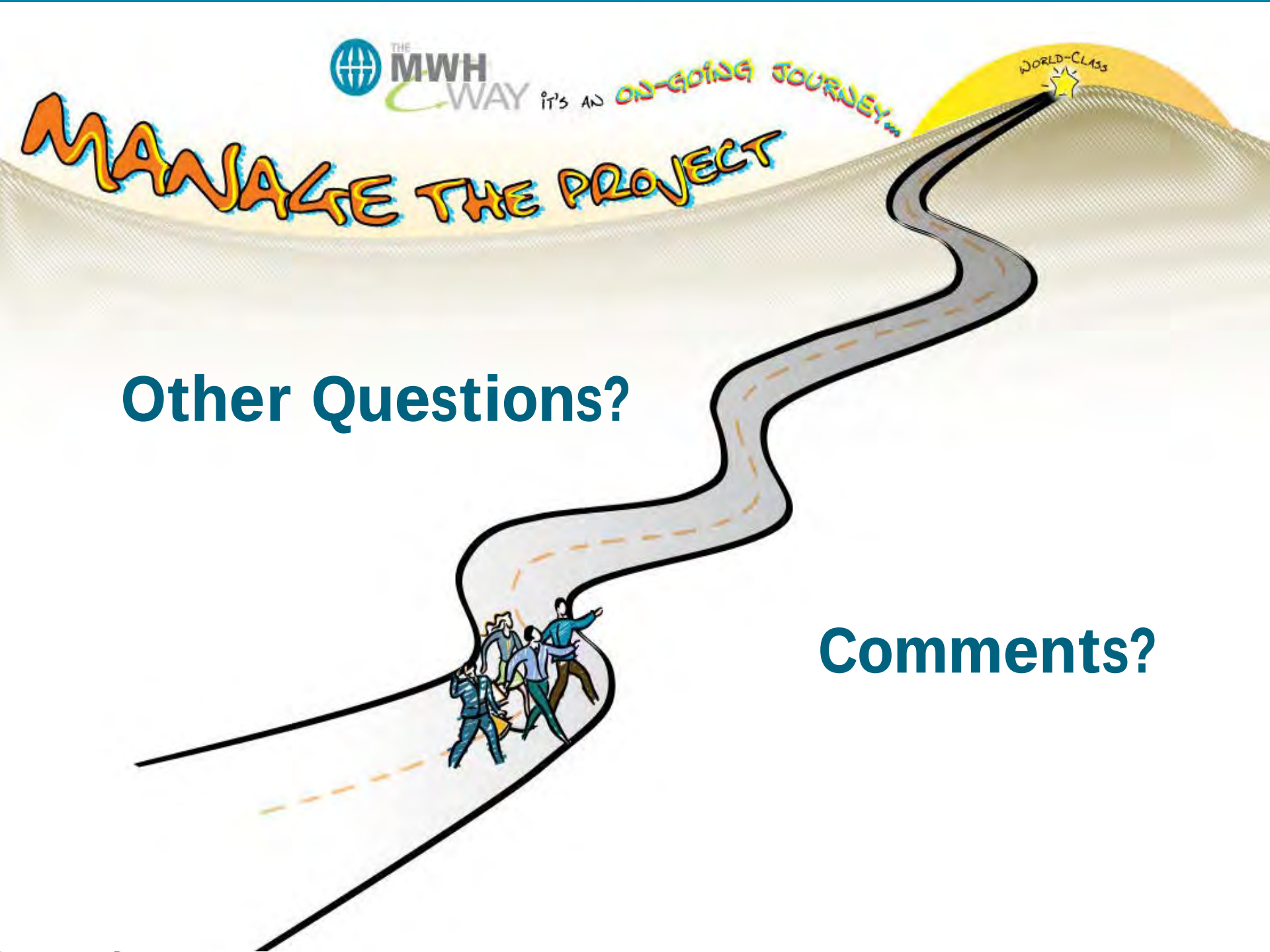
- EVM and forecasting indicates how the project is performing.
- If performance is not as planned, Corrective Action may be needed.
- Corrective Action steps:
  - Prepare corrective action plan.
  - Implement corrective action.
  - Confirm effectiveness, take additional action as required .

Further Information

Additional information on Earned Value Management is available on the new Project Management tab on kNet:

- EVM Reference Document
- EVM Quick Reference Guide





Other Questions?

Comments?