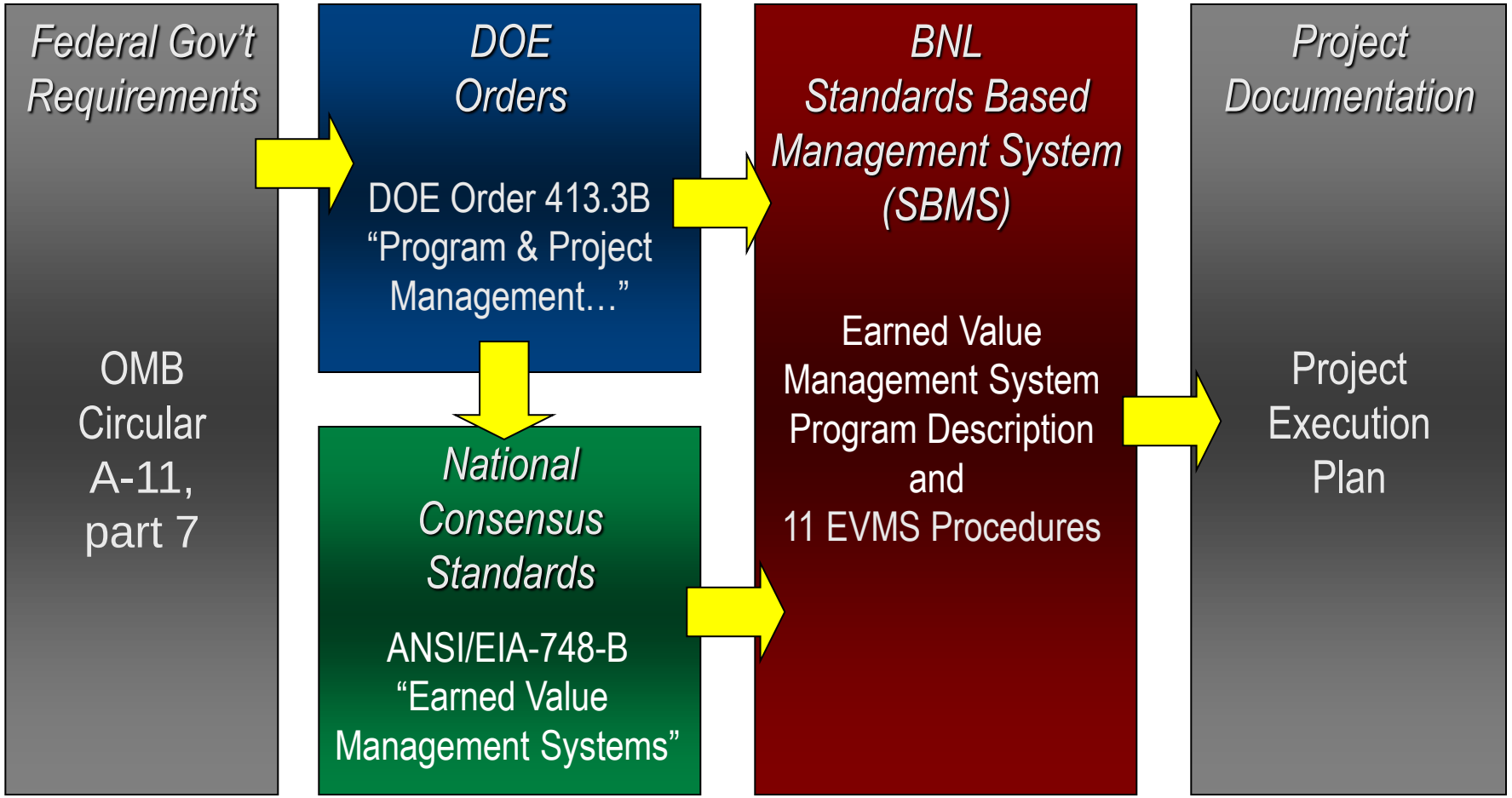
Integrated Project Management Using Earned Value

- Welcome, Introductions and Administrative Items
- 2 Important Questions:
  - Why are we doing EVMS?
  - Why are we doing this training?

Question #1 – Why are we doing EVMS?

- OMB Circular A-11, Part 7:
  - **"All major acquisitions with development effort** will include the requirement for the contractor to use an Earned Value Management System (EVMS) that meets the guidelines in ANSI/EIA Standard—748 to monitor contract performance."
  - "EVMS is normally used on Fixed-Price Incentive contracts and Cost Reimbursement contracts for major acquisitions. EVM **shall also be used on Firm-Fixed Price** and any other type of contract or task order that meets the major acquisition threshold if that contract or task order contains a significant amount of development effort."
  - **"Agencies should have well documented thresholds** clearly disseminated and implemented across the organization. Earned Value is required on all of these contracts because of their inherent risk."

EVMS Requirements Flow-down



http://energy.gov/management/office-management/operational-management/project-management/earned-value-management

DOE EVMS Compliance

Projects with Total Project Cost (TPC) ≥ $50M but < $100M

- Requires contractor self-assessment
- Requires certification by Office of Science
- New Contractors who have replaced contractors with certified EVMS require re-certification
- >$100M: APM participation in Certification Review

Requirements

- Must use ANSI-748 Compliant Management System by Critical Decision (CD) 2
- Must attain certification no later than by CD-3
- Contract Performance Report (CPR) formats - DOE Guide 413.3-10 does not require CPR formats; tailoring suggested

DOE EVMS Compliance

Projects with Total Project Cost (TPC) ≥ $20M but < $50M

- Requires contractor self-certification

Requirements

- Must use ANSI-748 Compliant Management System by Critical Decision (CD) 2
- Contract Performance Report (CPR) formats - DOE Guide 413.3-10 does not require CPR formats; tailoring suggested

EVMS Certification

Department of Energy
Washington, DC 20585

SEP 1 5 2008

Dr. Samuel H. Aronson
Director, Brookhaven National Laboratory
President, Brookhaven Science Associates, LLC
Brookhaven National Laboratory
Directors Office, Building 460
Upton, New York 11973-5000

Dear Dr. Aronson:

It is a pleasure to inform you that Brookhaven Science Associates, LLC (BSA, LLC) at the Department of Energy Brookhaven National Laboratory has successfully demonstrated compliance of its Earned Value Management System (EVMS) for non-information technology capital asset projects greater than $20 million with the American National Standards Institute/Electronic Industries Alliance (ANSI/EIA)-748-A.

This certification is based on the Department of Energy's EVMS review of Earned Value Management System Program Description, Version 1.4, dated April 2008. Your team is to be commended for attaining this EVMS certification. The acceptance of the BSA, LLC EVMS will apply to all company acquisition projects requiring EVMS.

The Department of Energy expects BSA, LLC to maintain its EVMS through surveillance programs. Recognizing that management systems are dynamic to meet changing business needs and to improve effectiveness, we encourage continuous improvement as long as compliance with the ANSI/EIA-748-A is maintained. BSA, LLC shall notify Office of Engineering and Construction Mangement of any changes to its EVM System.

The Department of Energy congratulates BSA, LLC on this certification. BSA, LLC has achieved a significant milestone by demonstrating a performance measurement system that provides valid data and is effective in managing project performance.

Sincerely,

Paul Bosco
Director, Office of Engineering and
Construction Management

cc: Daniel Lehman, SC-28
Jack Surash, EM-50
Tom Brown, SC-22.3
Frank Crescenzo, FPD-BSO

- BSA Contractor Certification for BNL Site Received Sept 15, 2008
- DOE Recertified EVMS with Surveillance Review held December 2011
- Annual EVMS Internal Surveillance Reviews Conducted

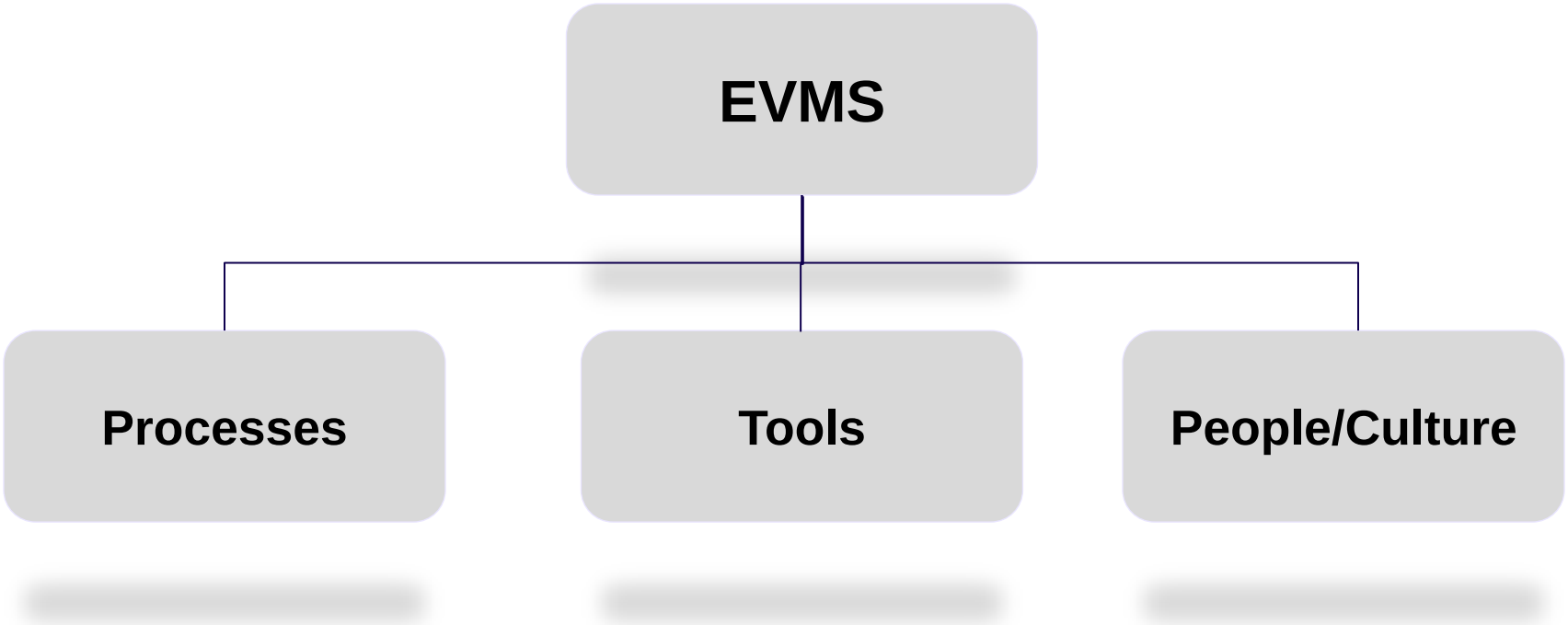
EVMS History

- **1950's**:
  - Program Evaluation Review Techniques [PERT] Implemented
- **1960's**
  - 1960 - Implementation of PERT resulted in 11 reporting formats, including "cost of work report
  - 1964 - PERT Cost
  - 1967: Cost/Schedule Control Systems Criteria (C/SCSC)Effort led by U.S. Air Force; Department of Defense (DoD) implemented 35 Criteria for work over certain funding thresholds
- **1970's**:
  - DOE—Performance Measurement System (PMS)
- **1990's**:
  - 36 C/SCS Criteria revised down to 32 and ANSI/EIA-748 officially issued in 1998
- **2000's**:
  - Oct 00 - DOE Order 413.3
  - Mar 09 - GAO Cost Estimating Guide
  - June 09 - NDIA ANSI-748 Intent Guide
  - Nov 10 - DOE Order 413.3B
  - Mar 13 - ANSI-748C

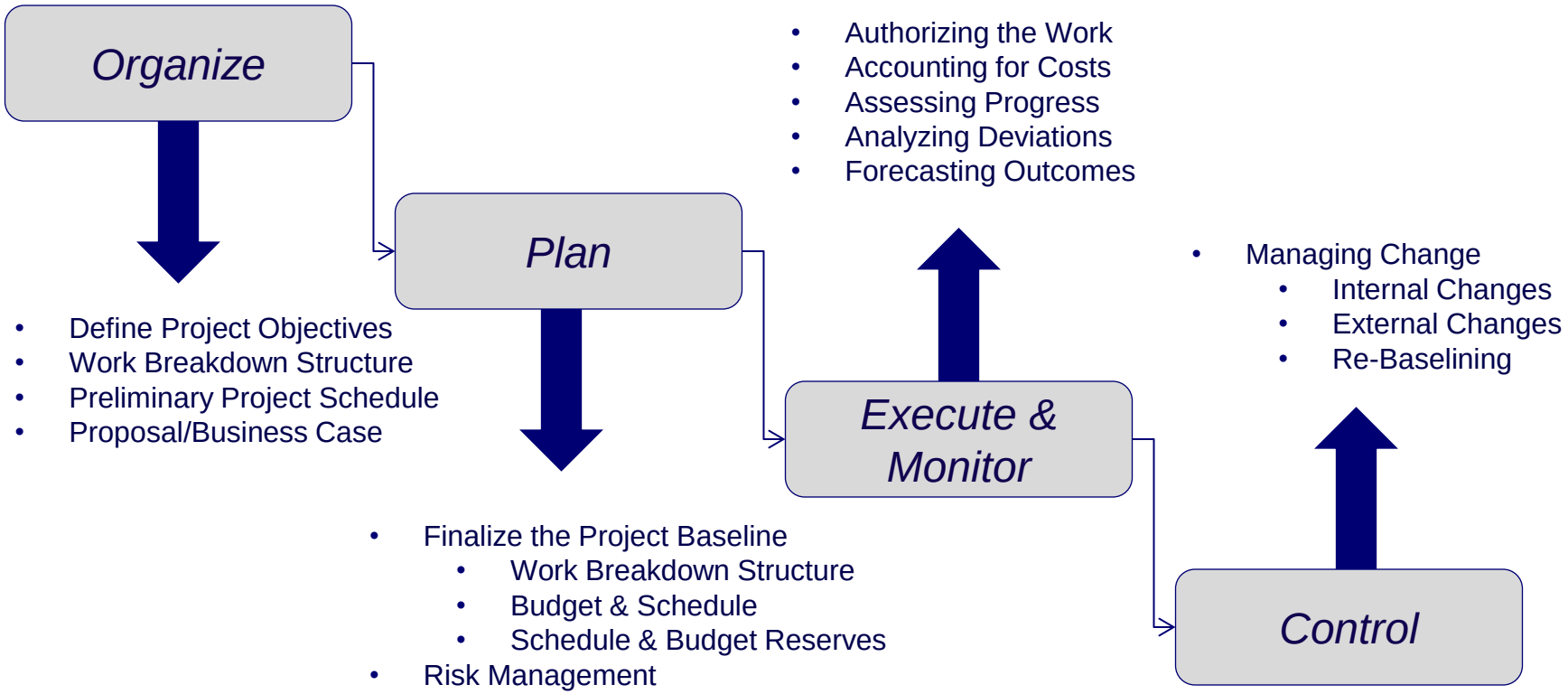
Question #2 –
Why are we doing this training?

- This training is intended to provide the Project Managers, Control Account Managers, and the Project Controls Staff with a clear understanding of the BNL Earned Value Management System
- BNL conducts annual self-surveillance reviews
- BNL periodically undergoes a formal Surveillance Review by Office of Science.

EVM System Elements



EVMS Processes



Principles of EVMS (from ANSI/EIA-748C)

- **Plan all work scope** for the program from inception to completion
- **Break down the program work scope into finite pieces** that can be assigned to a responsible person or organization for control of technical, schedule, and cost objectives
- **Integrate program work scope, schedule, and cost objectives into a performance measurement baseline** plan against which accomplishments may be measured
- **Use actual costs incurred** and recorded in accomplishing the work performed

Principles of EVMS (cont'd)

- **Objectively assess accomplishments** at the work performance level
- **Analyze significant variances** from the plan, forecast impacts, and prepare an estimate at completion based on performance to date and work to be performed
- **Control changes to the baseline** and maintain the baseline throughout contract execution
- **Use EVMS information** in the organization's management processes

EVMS Program Description

- **Organized into six sections:**
  1. Project Organization and Baseline Planning
  2. Earned Value Analysis and Progress Reporting
  3. Accounting
  4. Subcontract Management
  5. Change Control
  6. Surveillance and Maintenance
- **And four appendices:**
  A. Crosswalk of the ANSI/EIA-748-B 32 Guidelines
  B. Abbreviations, Acronyms and Glossary of Terms
  C. Roles and Responsibilities
  D. EVMS Procedures
- **On April 13, 2007, incorporated in BNL/BSA's:**

as Program Description document (became BSA/BNL policy).

EVMS Procedures

- **Eleven EVMS implementing procedures supplement the EVMS Program Description:**

PM-1.0 Preparation & Control of EVMS Procedures

PM-1.1 Project Execution Plan

PM-1.2 Project Work Breakdown Structure

PM-1.3 Project Organizational Breakdown (OBS) & Responsibility Assignment Matrix (RAM)

PM-1.4 Control Accounts, Work Packages & Planning Packages

PM-1.5 Work Authorization

PM-1.6 Project Schedule

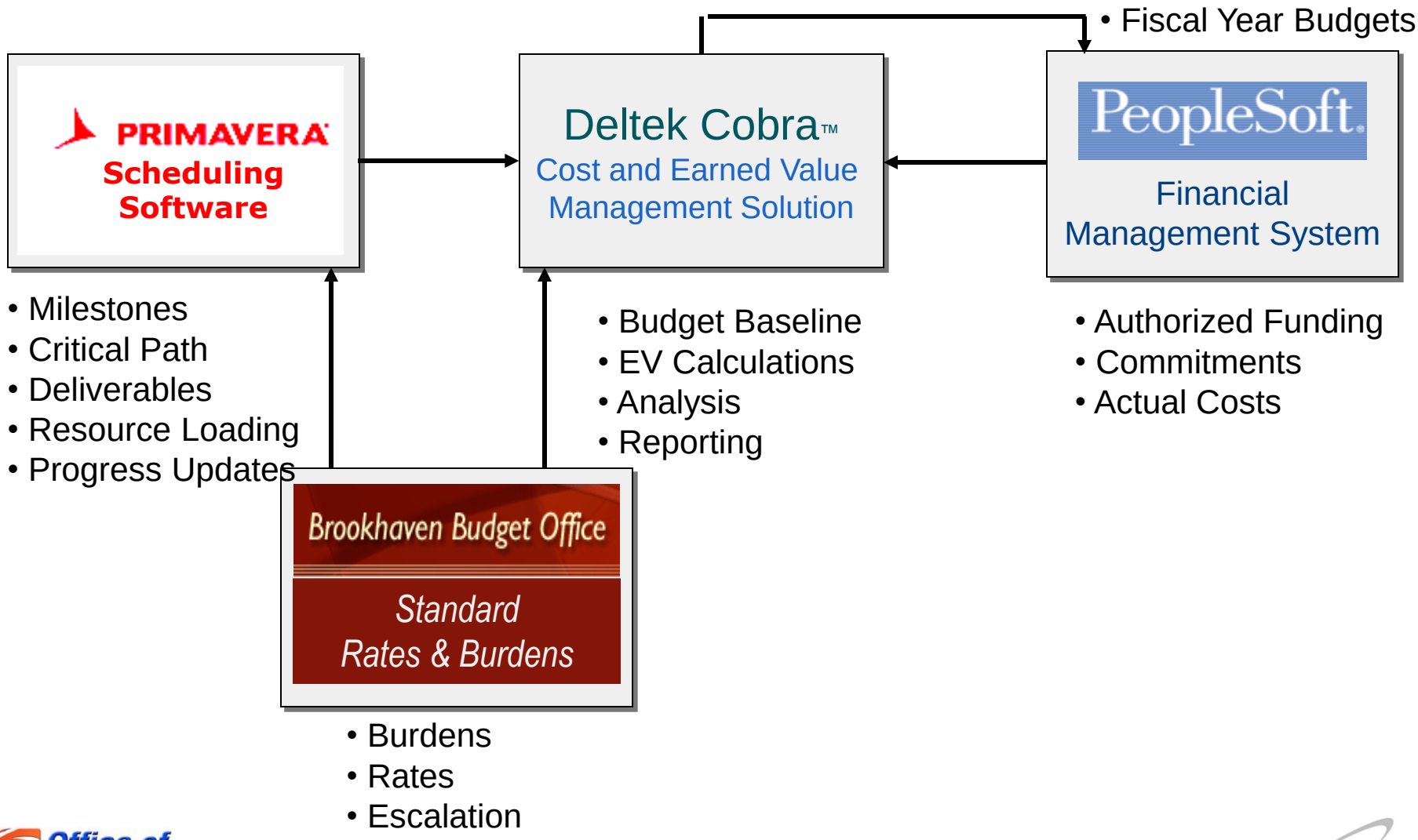
PM-1.7 Cost Estimating

PM-1.8 Performance Measurement & Monthly Status/Reporting

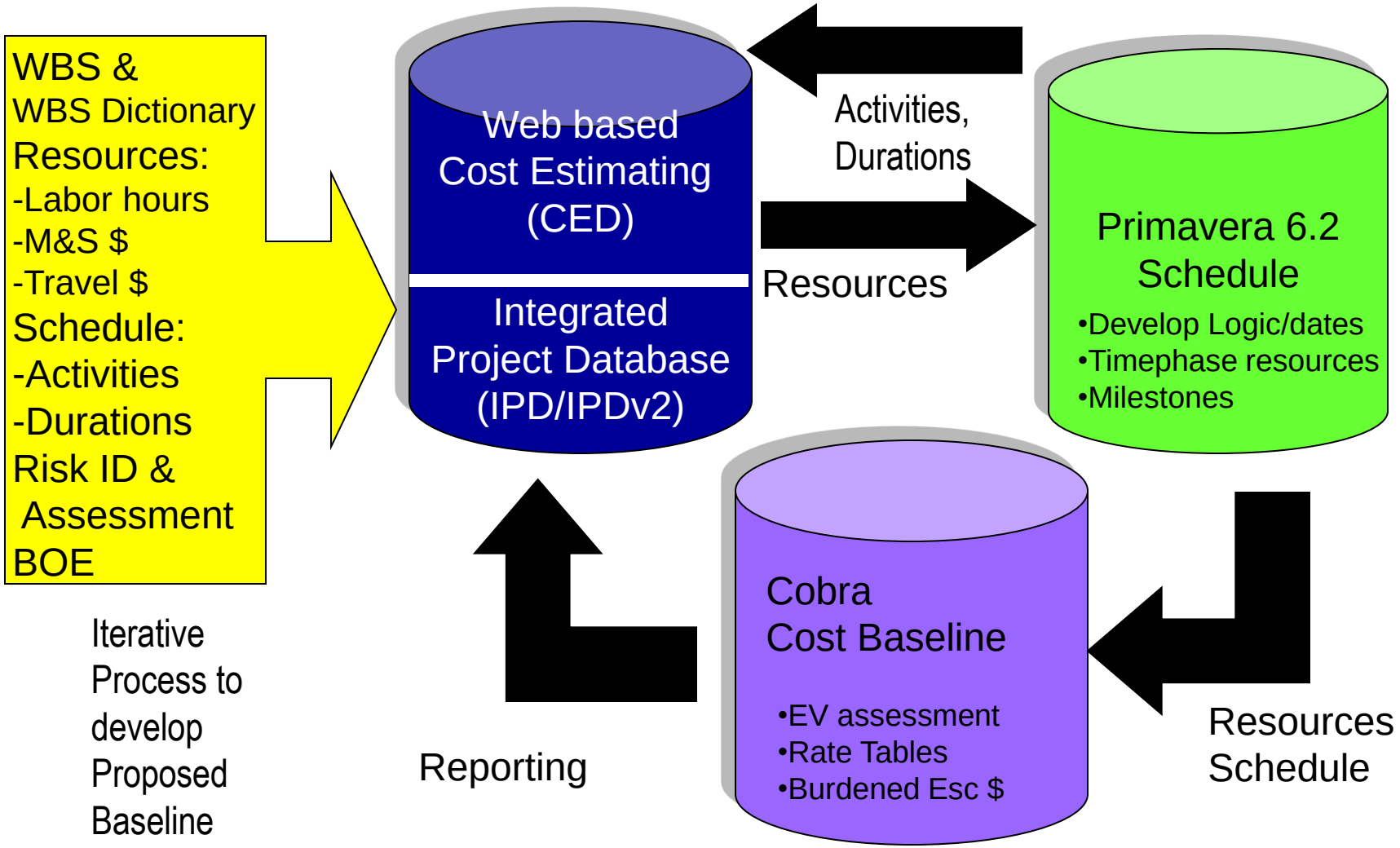
PM-1.9 Change Control

PM-1.10 EVMS Surveillance & Maintenance

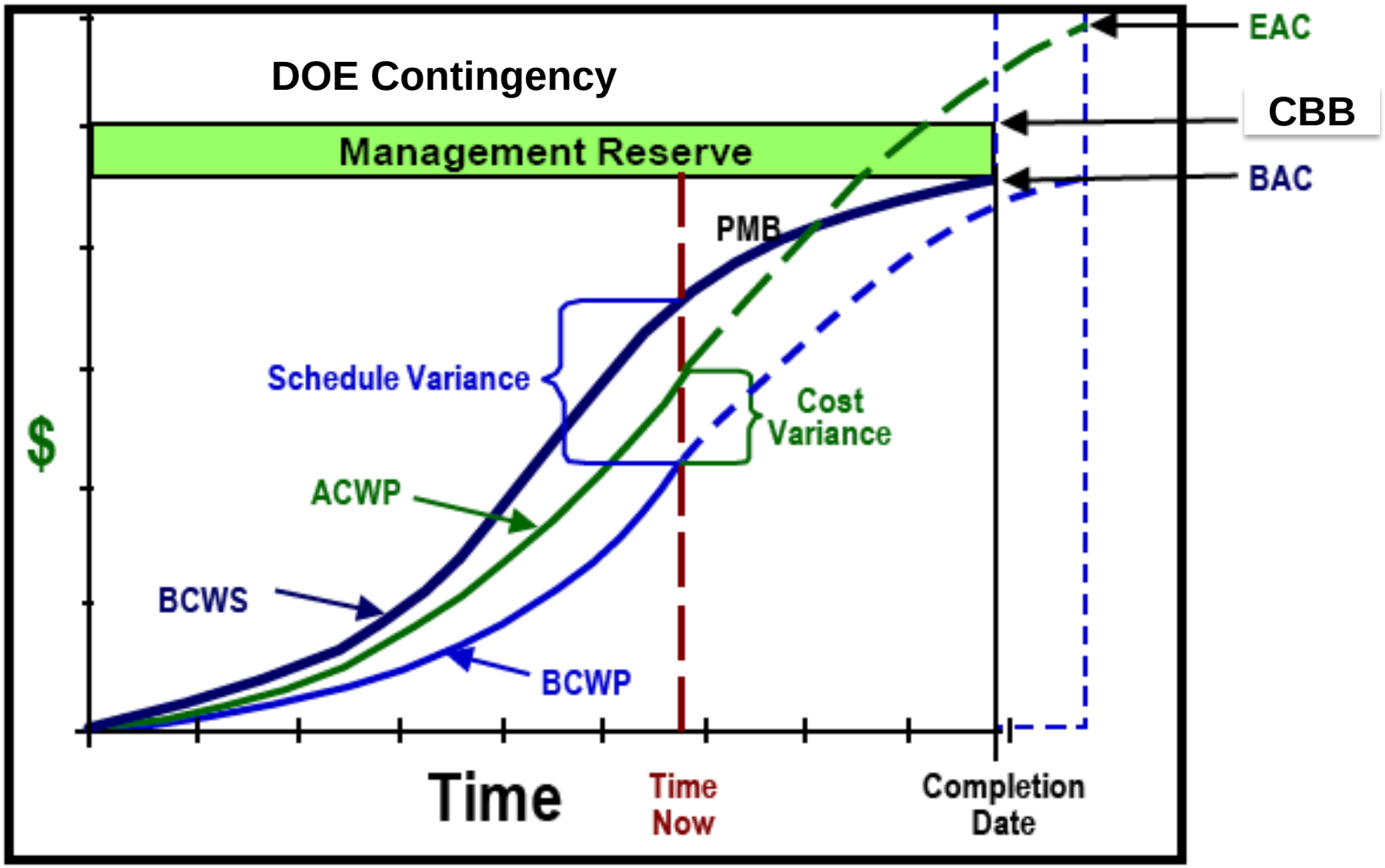
BNL Manages Projects with Proven Systems and Software



Cost/Schedule Baseline Development & Measurement



Key EVMS Terms



EVMS Terminology

- BCWS – Budget Cost for Work Scheduled [PV]
- BCWP – Budgeted Cost for Work Performed [EV]
- ACWP – Actual Cost of Work Performed
- SV – Schedule Variance [BCWP-BCWS]
- CV – Cost Variance [BCWP-ACWP]
- BAC – Budget at Completion
- EAC – Estimate at Completion
- VAC – Variance at Completion [BAC-EAC]
- PMB – Performance Measurement Baseline
- CBB – Contract Budget Base

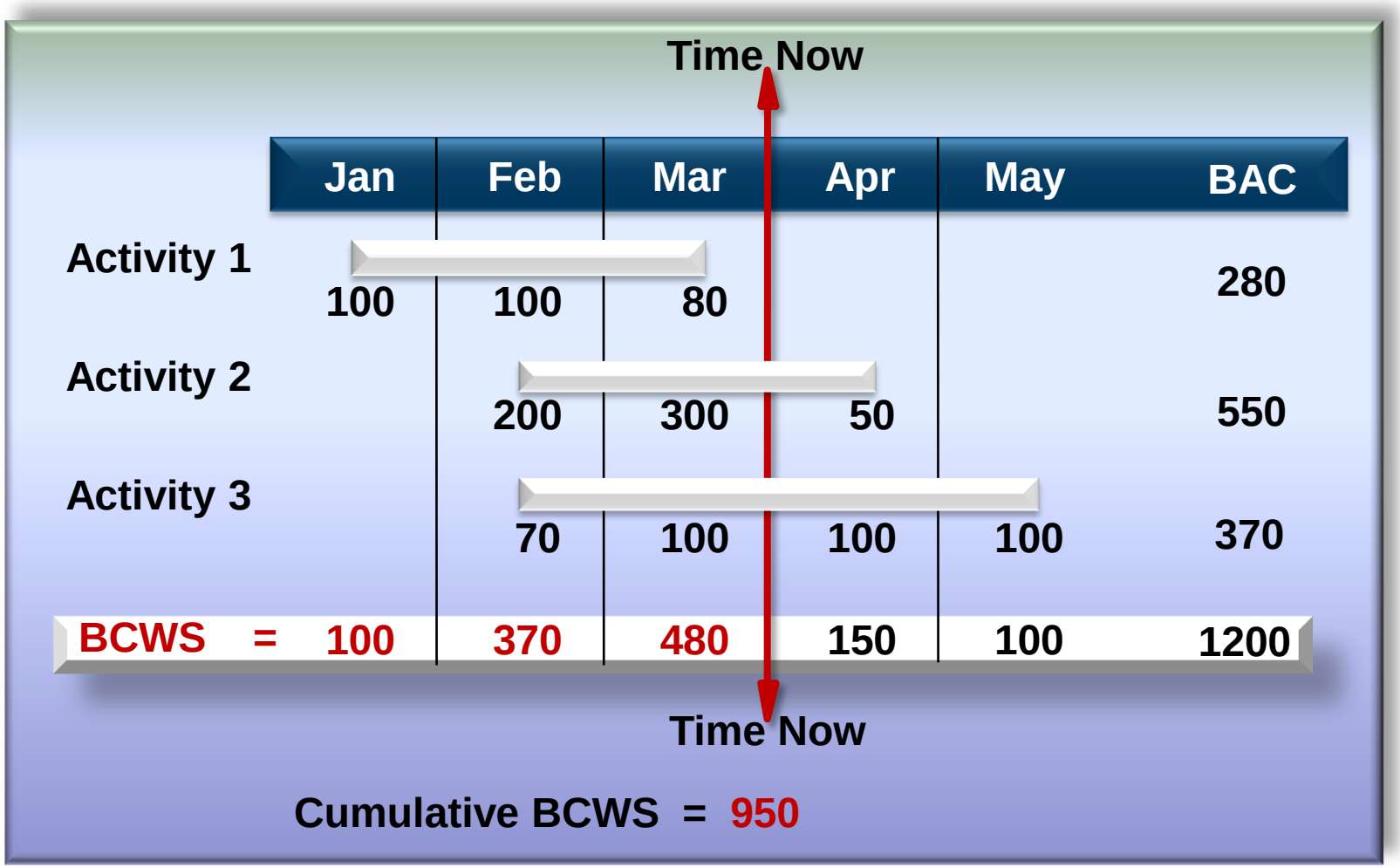
Assessing Accomplishments

Given:

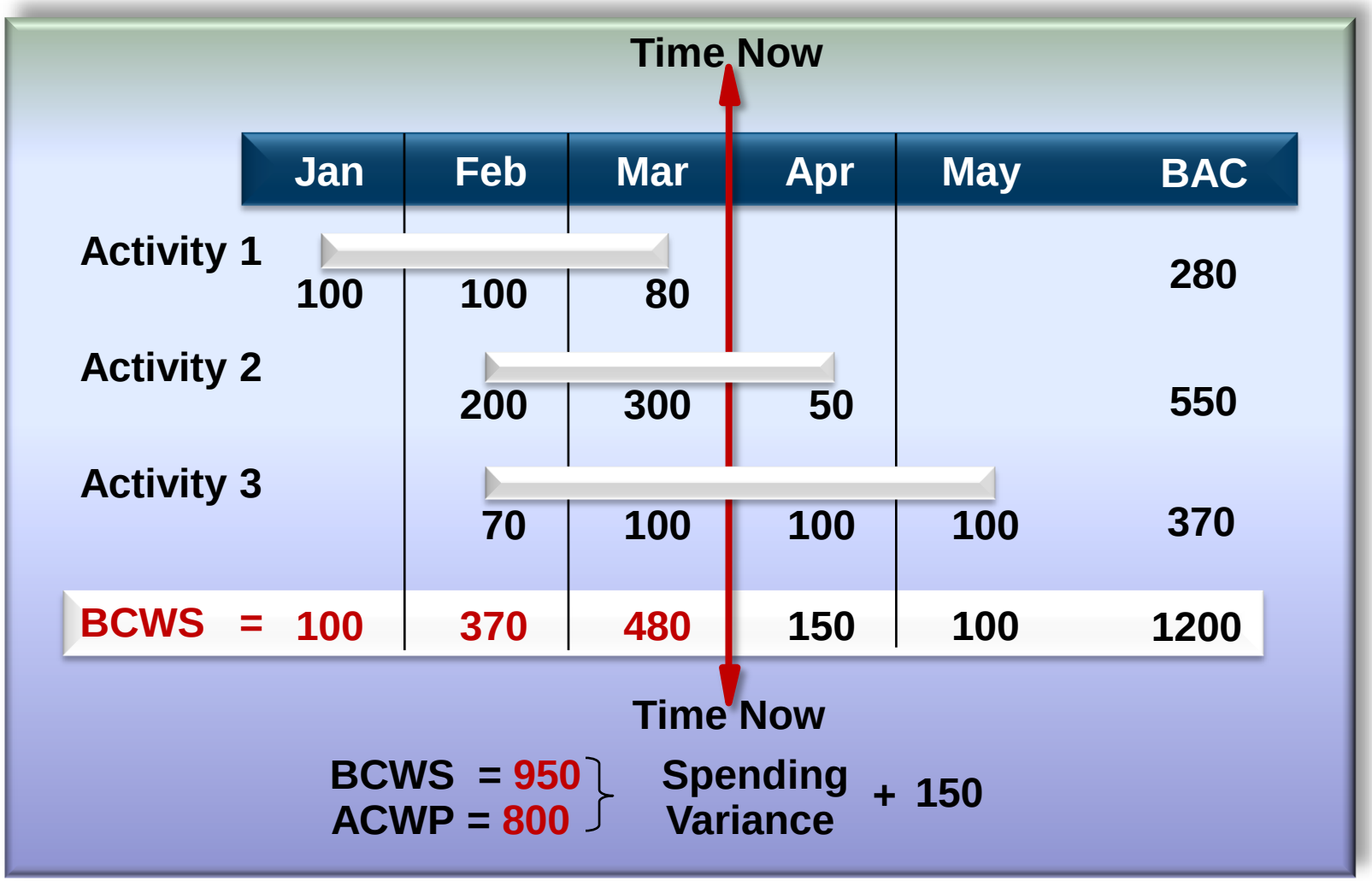
- Identical units to be produced: 100
- Units complete (with none in process): 40
- Budgeted/targeted hours for each unit: 10
- Hours expended to date: 500
- Non-recurring “setup” effort: None
- Point in 5-month project: End of Month 3

Question: What is our percent complete?

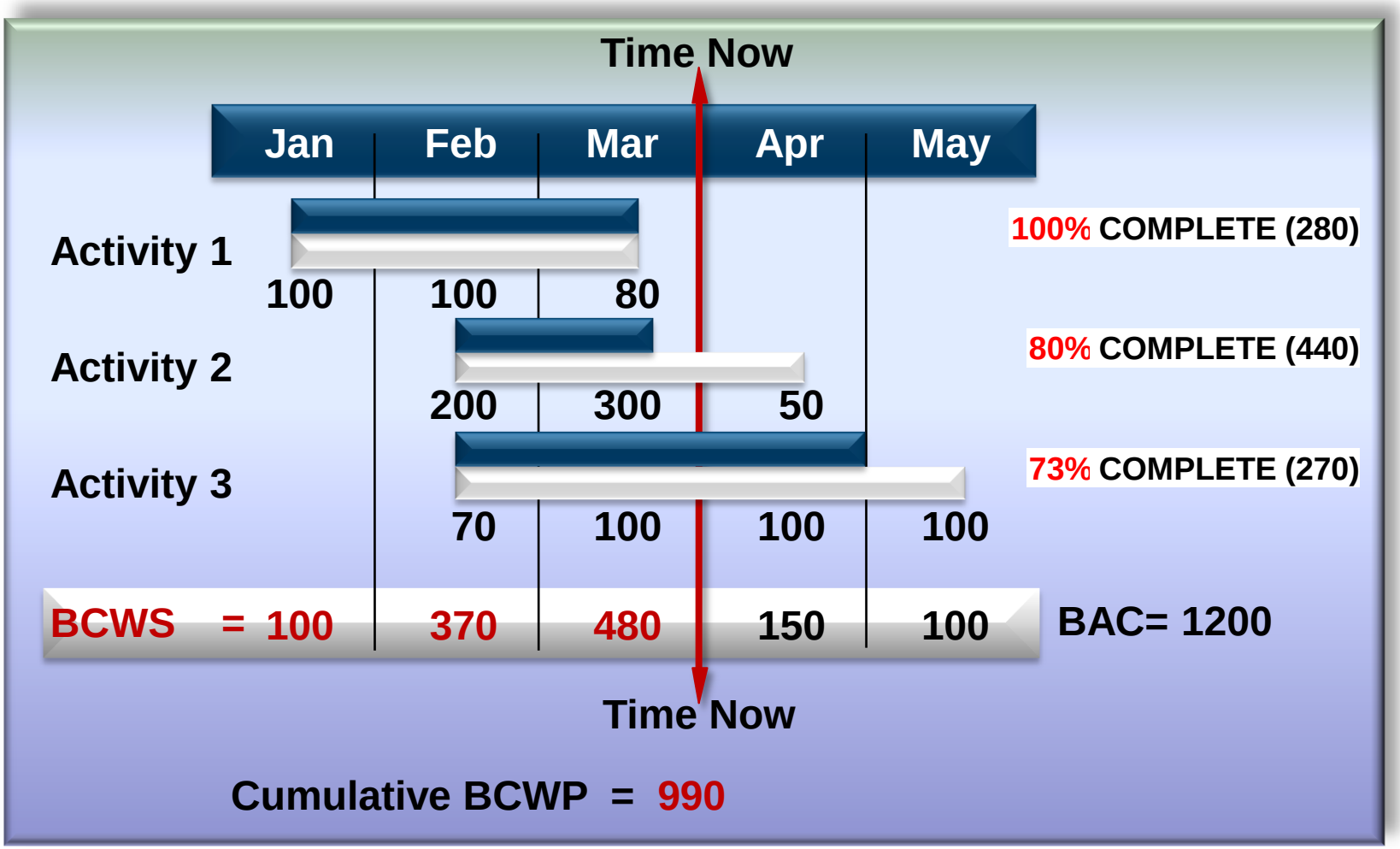
BCWS: The Time-Phased Budget Plan



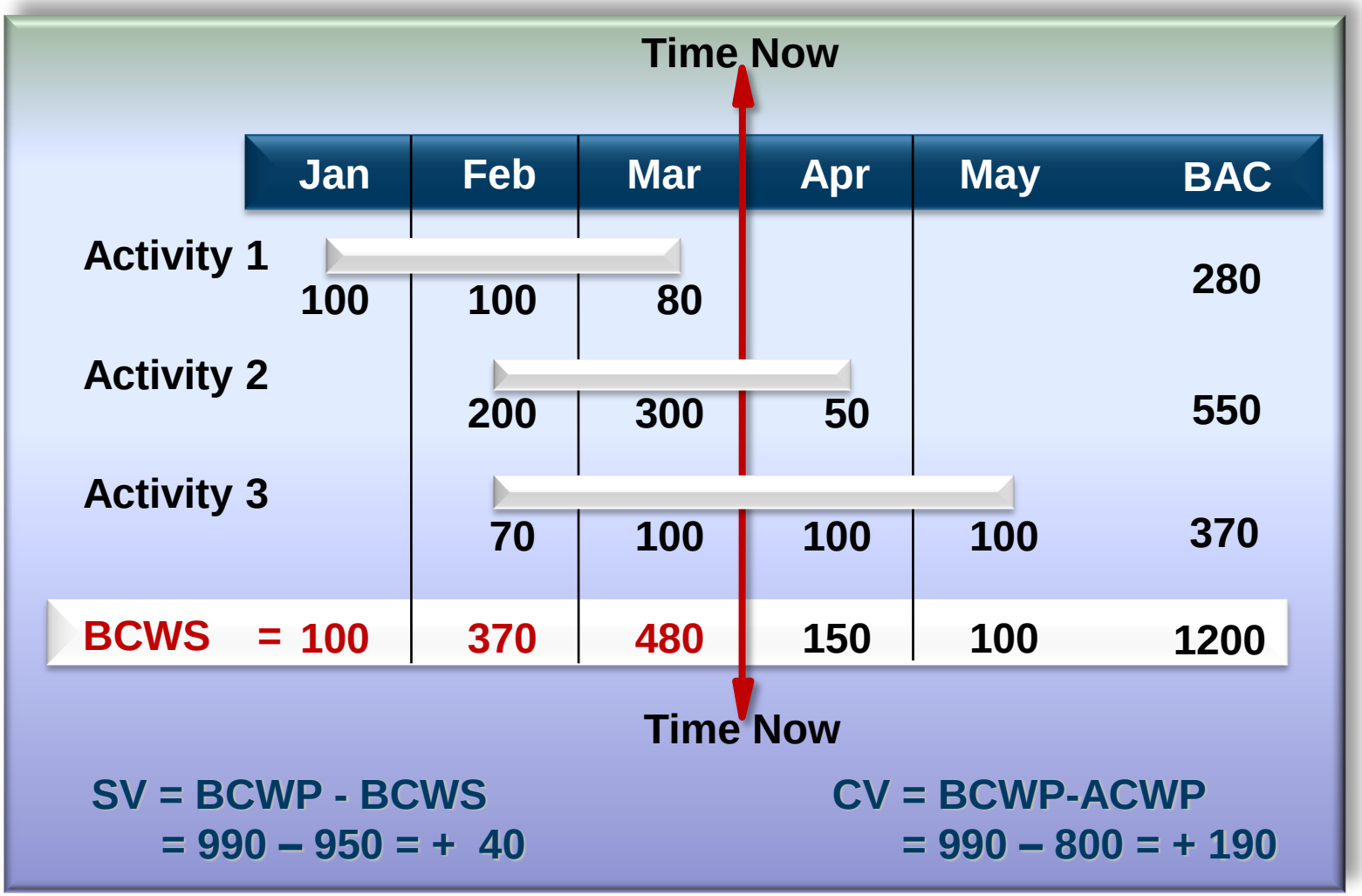
ACWP: What's Been Spent



BCWP:
The Budget for the Completed Work



Calculating Schedule and Cost Variances

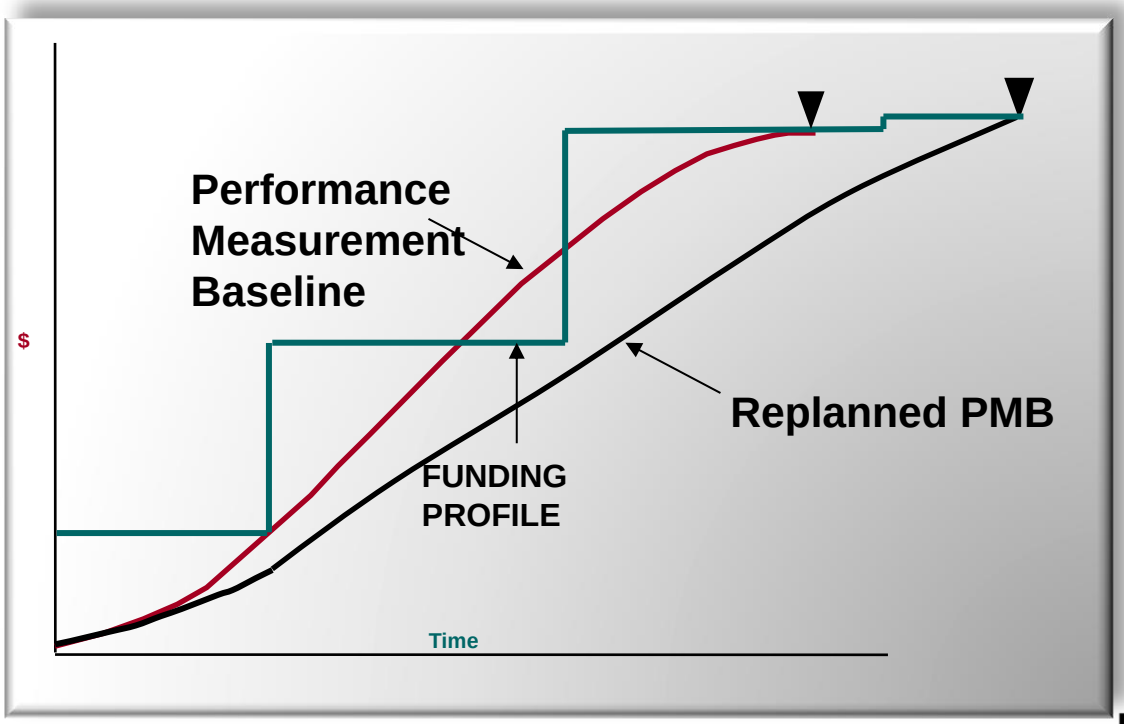


Key Data Comparisons

950	BCWS	Schedule Variance (SV)
990	BCWP	
800	ACWP	Cost Variance (CV)
210	BCWR	(BAC – EV)
1200	BAC	Variance At Completion (VAC)
?	EAC	

Budget vs. Funds

- **Budget**: Management-sanctioned estimate for total task phased over baseline schedule; basis for earned value performance measurement
- **Funds**: Current estimate of total dollar requirements, phased by distribution period



What is EVMS?

- It's not:
  - A reporting requirement
  - A panacea for project problems
  - Just the EV metric, or the ability to generate the data elements
  - A software system
- What it is:
  - A systematic PM process that results in an integrated plan against which performance is measured objectively
  - A systematic approach for calibrating the health of a project
  - A tool for establishing meaningful forecasts of cost and schedule positions at project completion

EVM doesn't solve problems.
If done right it will only point them out.

Surveillance Reviews

From:

- Re-certification Approach
- Every two years or at contract midpoint

To:

- Risk based, data driven
  - Risk Matrix
  - Portfolio focused
  - Data sources include contractor self- assessments, project peer reviews, Integrated PARS II

Why did they change?

- Common Goal:
  - *Maximize results* via continuous, real-time feedback and assistance; benefits all stakeholders
  - *Minimize surveillances costs* by reducing on-site reviews and disruption to the projects

Surveillance Reviews

Stage 1 Surveillance – Ongoing Monthly Analysis and Risk Assessment

- Uses PARS II Reports
- Other data sources:
  - Contractor's EVMS self-surveillance documentation
  - Assessments conducted relative to project performance and EVM system health
- Identify data disconnects, negative trends, and significant change that may point to systemic issues

Surveillance Reviews

Stage 2 Surveillance – Desk Top review

- Identifies the contractor's EVMS processes to be reviewed, the selected projects, and the anticipated timeframe.
- Uses a continuous, data-driven approach, the surveillance may be conducted over several months or during a single review.
- Most surveillances will be off-site reviews of individual projects.

Surveillance Reviews

Stage 3 Surveillance – On Site Review

- Interviews with CAMs, management, and other project staff
- Observation of demonstrations of tools and traces that could not be done remotely
- Physical verification of progress to assess reported work performed is accurately reflected
- A focused review, specifically to assess concerns raised in stages 1 and 2
- May result in Corrective Action Requests (CARs) that require formal responses by BNL- Corrective Action Plans (CAPs)

Surveillance Reviews

Stage 3 Surveillance – Scope of Review

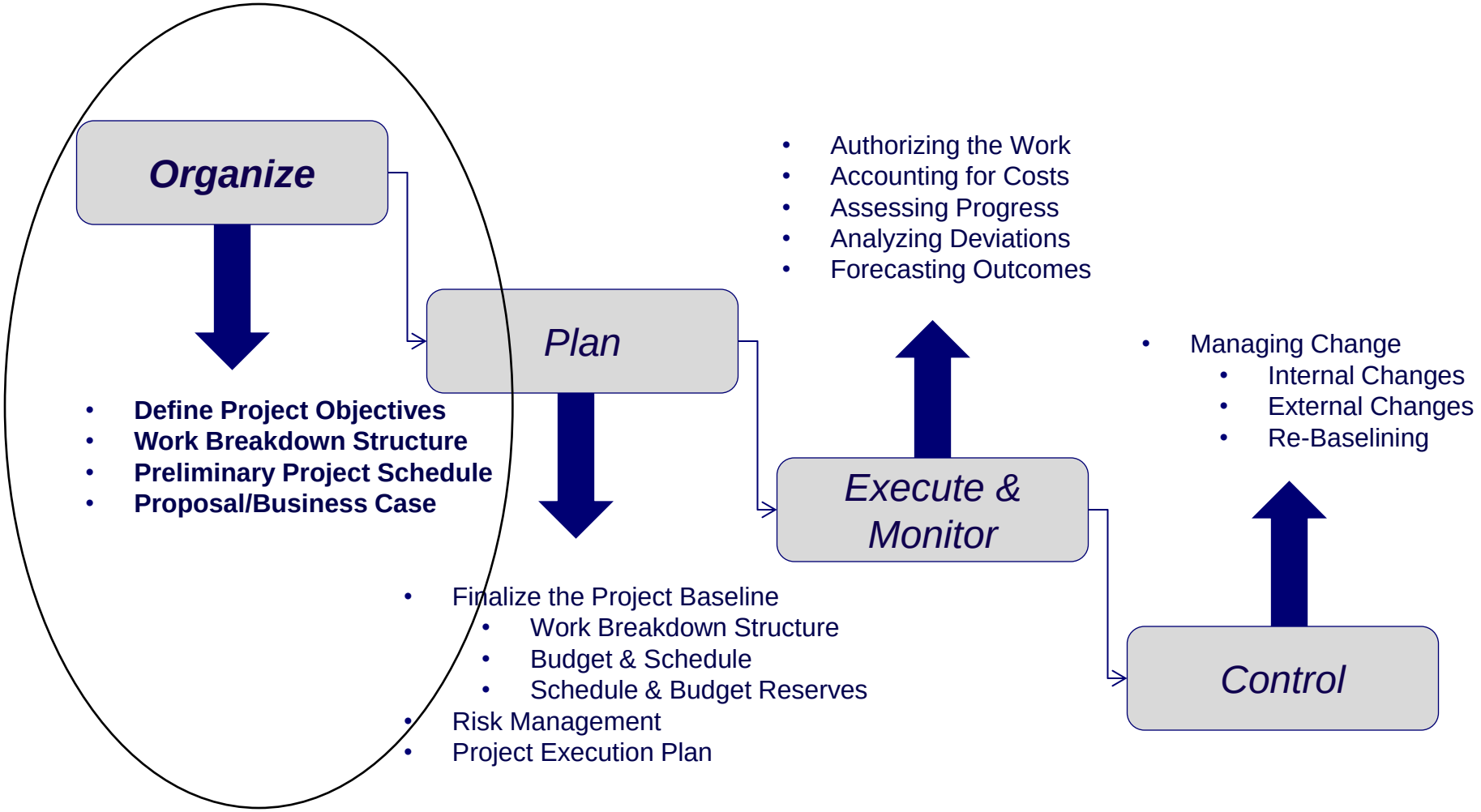
- Is the EV data accurate, timely and reliable?
- Is the EVMS being used to manage the project?
- Does the EV data represent all of the required scope?
- Does the EVMS comply with ANSI/EIA-748?

Surveillance Focus

CAM Interviews will focus on these process areas:

- Organizing
- Scheduling
- Work/budget planning and authorization
- Accounting
- Indirect cost management
- Managerial analysis & Forecasting
- Baseline Change Control
- Performance Measurement for Material items
- Subcontract Performance Measurement

EVMS Processes



Unsuccessful projects?

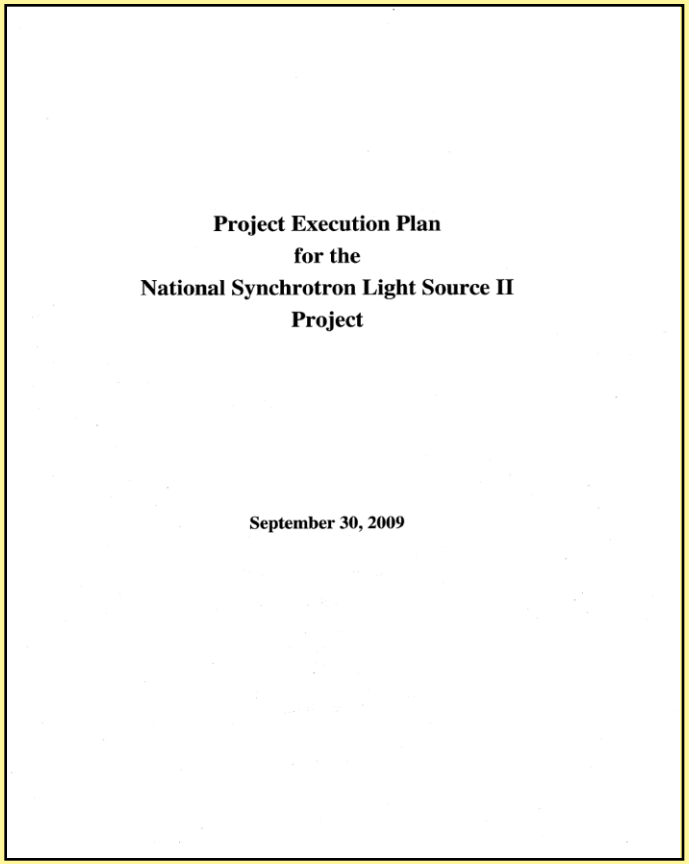
Why Do Project Fail?

- Unclear requirements
- Unrealistic timescales or budgets
- Scope creep
- Poor risk management
- Poor processes/documentation

Define Project Objectives

- Develop the Work Breakdown Structure
- Define WBS Elements
- Identify Control Accounts
- Develop the project execution model [CPM]
- Estimate resources

Project Execution Plan



Project Execution Plan
for the
National Synchrotron Light Source II
Project

September 30, 2009

- Identifies the organization, plans, and systems used to manage project
  - ✓ Identifies the mission need
  - ✓ Defines project scope, cost and schedule
  - ✓ From project planning to project completion to operations
- Complies with DOE 413.3B
- Complies with BSA/BNL's EVMS

Work Breakdown Structure (WBS) Defined

A product-oriented family of hardware, software, services, and other program/project elements which collectively represent the total scope of the project.

Originally developed by the DoD as a cost estimating tool, the WBS is a key ingredient to an integrated PM process and serves many purposes

Generic WBS Sample

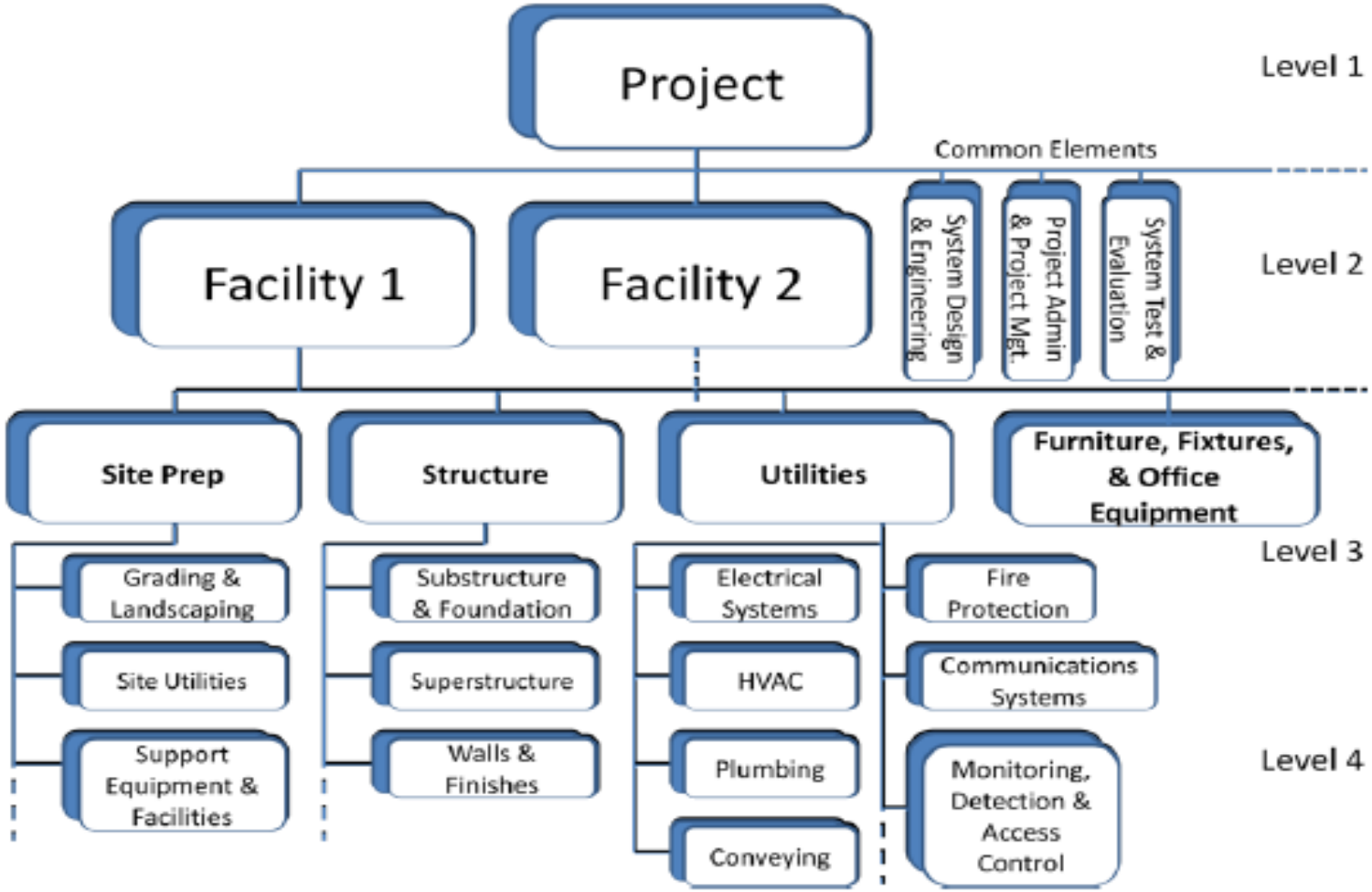


Figure II-1. Product-Oriented WBS Example

NSLS-II
NATIONAL SYNCHROTRON LIGHT SOURCE II

NSLS II

WBS List

16-Oc

WBS Code	WBS Name	Total Activities
1	NSLS-II Project	2823
1.01	Project Management	180
1.01.01	Project Management	32
1.01.01.01	Director	18
1.01.01.02	Deputy	8
1.01.01.03	Committees	6
1.01.02	Environmental, Safety & Health	40
1.01.02.01	ESH Management	33
1.01.02.02	Shielding Analysis	7
1.01.03	Project Support	70
1.01.03.01	Project Support Management	6
1.01.03.02	Business Operations	14
1.01.03.03	Project Controls	8
1.01.03.04	Office Management	7
1.01.03.05	Procurement	7
1.01.03.06	Information Technology	12
1.01.03.06.01	Enterprise IT Services	5
1.01.03.06.02	Business Systems Development	7
1.01.03.07	Human Resources	5
1.01.03.08	Facility	4
1.01.03.09	Space and Utilities	7
1.01.04	Quality Assurance	25
1.01.04.01	QA Management	6
1.01.04.02	Quality Engineering	6
1.01.04.03	Supplier Quality	6
1.01.04.04	Quality Assessment	6
1.01.04.05	Production Support	1
1.01.05	Configuration Management & Document Control	13
1.01.05.01	Configuration Management	7
1.01.05.02	Document and Records Management	6
1.02	R&D and Conceptual Design	127
1.02.01	Accelerator Systems R&D	75
1.02.01.01	Accelerator Systems & Project R&D Management	23

WBS Standards

An effective project WBS should have these attributes:

- Product (or deliverable) oriented
- Reflects ALL work scope associated with the project (even far-term effort not planned in detail)
- Clearly identifies every element as to content and distinguishes from all other elements
- Correlates every element to the statement of work
- Detailed enough to support effective management (i.e., extended to the control account level)
- Provides the necessary framework to identify the effort to the performing organization(s)

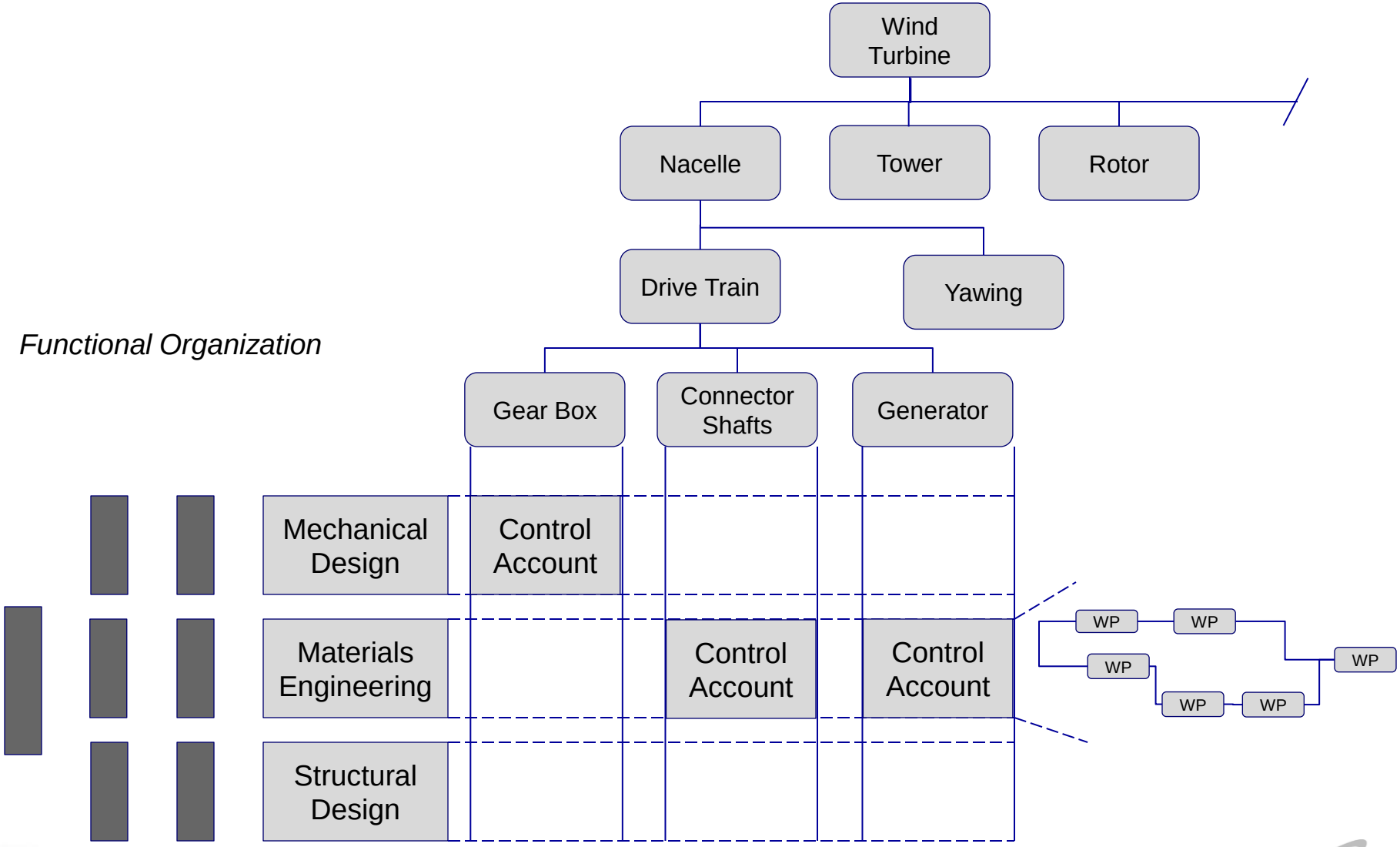
WBS Dictionary example

Tank/Silo Vessel
The Tank/Silo vessel is the main Tank/Silo container. This includes the metal, plastic, concrete or wood structure of the container, and shielding and insulation integrated into the container structure.

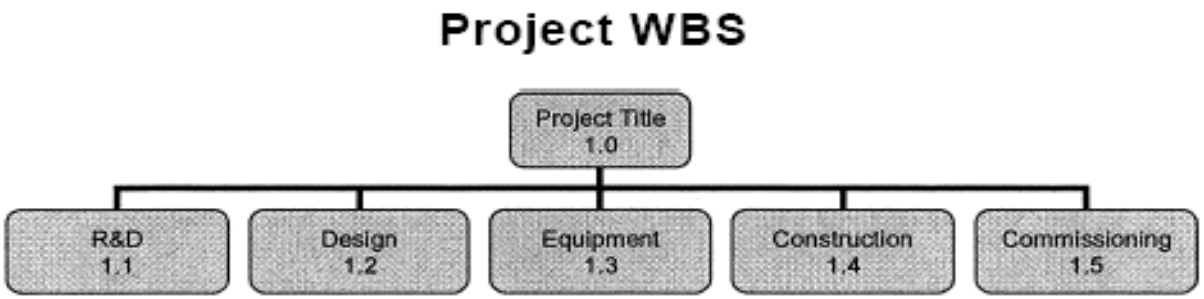
It includes the combination of labor that results in the design, development, construction, and/or operation of the Tank/Silo Vessel. This includes any Professional, Engineering, and Scientific Labor (e.g., engineers, analysts, programmers, scientists, and architects), Craft/Trades Labor (boilermakers, pipefitters, sheet metal workers, insulators, electricians, welders, etc.), General Labor, and Management and Administrative Labor.

This does not include support structure for the tank/silo superstructure, any piping or conveying systems for loading and unloading equipment, or insulation and shielding not integrated into the container structure (access and finishes).

Responsibility Assignment Matrix [RAM]



Sample BNL Project ram



OBS

Engineering Div.	CA D. Smith $1200K	CA L.Vance $2000K		CA B. Goldman $1875K	CA L.Vance $250K
Physics Div.	CA F. Czernas $3125K		CA B. Lazer $1000K		CA R. Nicks $230K
Fabrication Svcs			CA S. Parks $2300K		CA E. Goldman $75K
Design Dept.		CA M. Robbins 3000		CA H. Martin $350K	CA M. Robbins $300K

Control Accounts

Control Account Characteristics

- Control Accounts (CAs) represent natural decomposition of WBS designed to support responsibility assignment and accountability for cost, schedule, and technical performance
  - CAs assigned to only one responsible Control Account Manager (CAM)
  - CAM may rely on one or more organizations to execute CA work
  - Control Account is authorized via a formal Work Authorization Document that identifies scope, budget, schedule and responsibility
  - Detailed plans are established in Control Account Plan (CAP)

Dollarized RAM

WBS	Level	Description	CA #	OBS	CAM	% Complete	Budget
10109020271	6	PROJ AREA 12 WEST PIDs	12345	F & I	Johnson	60.5	$4,234,555
1010902027101	7	Project Management	12346	F & I	Wilder	36.3	$1,162,122
1010902027102	7	AREA 12 W PIDs	12347	Engineering	Eastwood	85.2	$836,448
1010902027103	7	AREA 12 W PIDs	12348	Engineering	Wilson	65.5	$2,179,585
101090202710301	8	05 AREA 12 W PIDs	12349	Engineering	Jackson	82.6	$509,508
1010902027103A1	8	06 Substation 6-1-3401 Zone 1	12350	Construction	Smith	100	$79,356
1010902027103A2	8	Substation 6-1-3402 Zone 1	12351	Construction	Coulter	56.7	$119,728
1010902027103B1	8	U12G Sub 12-2A-1/2 Replace OFC w/PMH7 Zone 1	12352	Construction	Hunter	48.6	$83,294
1010902027103B2	8	U12G Portal Yard Disconnect OFC/Abandon in Place Zone 1	12353	Construction	Sandman	8.5	$14,576

- The RAM is a valuable tool for both contractor and DOE:
  - Identifies each CA and the resources assigned
  - Identifies responsible CAM
  - Provides for assessing manageability of each CA

Control Account Manager (CAM)

- Who is a CAM?
  - Could be first line supervisor, scientist, cognizant engineer, second line manager (or even the PM on a small project)
  - Technically qualified to:
    - Manage Control Account effort
    - Understand EV information as management input
    - Make decisions regarding CA work execution
  - Assigned via a formal Work Authorization Document

Control Account Manager (CAM) (cont'd)

- CAM Responsibilities
  - Make significant contributions in development of project baseline plan [WPs, activities, resources etc.]
  - Manage execution of work according to authorized CA Plan
  - Monitor performance, communicate progress and forecasts
  - Analyze deviations from baseline plan and implement corrective action plans
  - Monitor and manage risks and opportunities
  - Identify and manage changes to scope and baseline plan

In other words, the CAM is

- ***Fully responsible for cost/schedule/technical performance***
- ***Key to the success of the contractor's EVMS!***

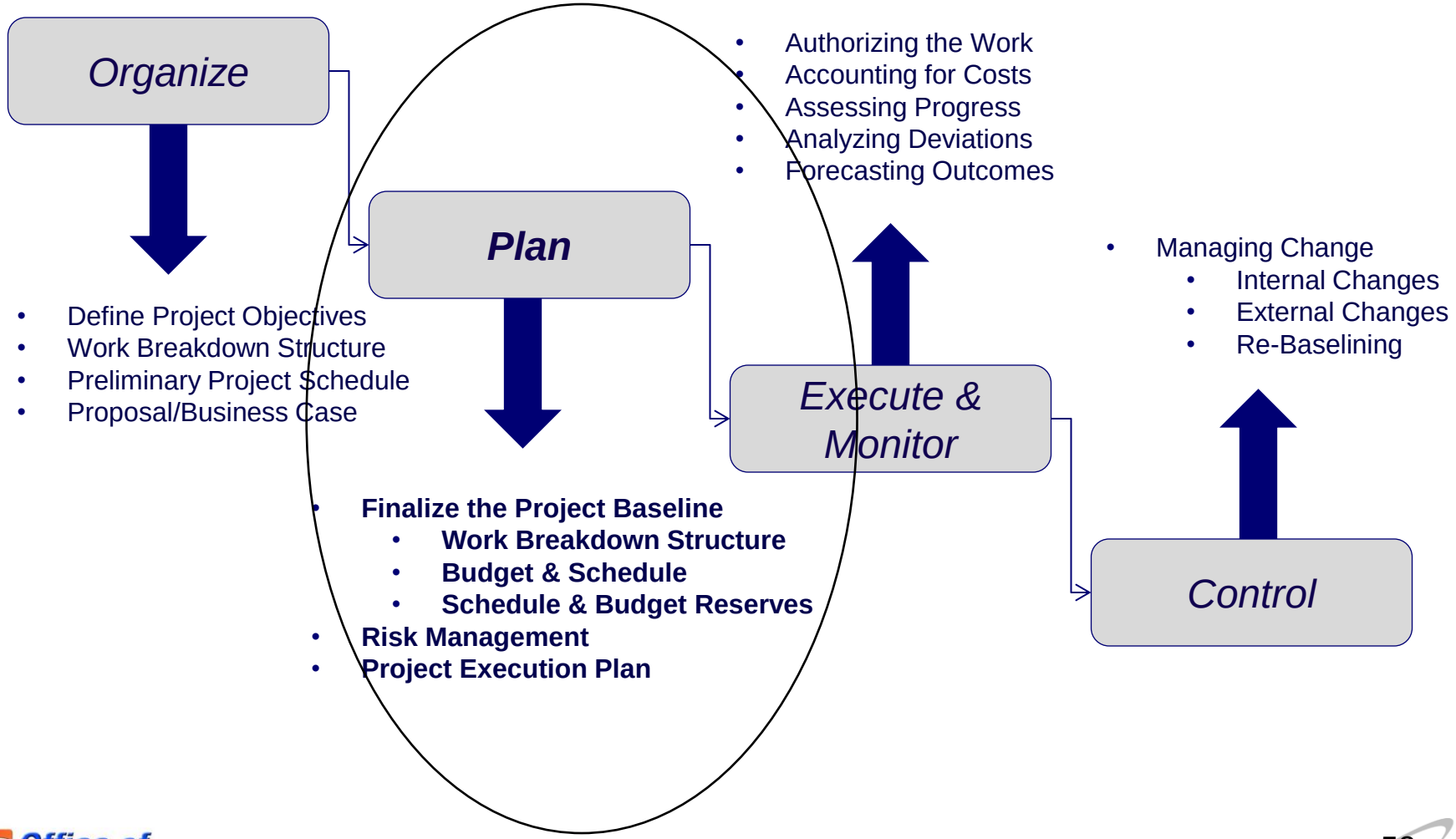
Help and Support for CAMs

- Project Controls Personnel
  - Facilitators of entire EVMS process
  - Are NOT the CAMs but support their planning, scheduling and reporting needs
  - Gate keepers for integrated schedule/budget baseline for project
  - Responsible to Project Manager for ensuring that EVMS provides valid, timely and accurate information

Help and Support for CAMs(cont'd)

- Project Controls Personnel Responsibilities:
  - Ensure that EVMS-compliant and management-approved processes are documented
  - Provide a robust EVMS training program to entire project team
  - Ensure that project team is using EVMS information correctly
  - Ensure that implementation of EVMS complies with approved company processes and procedures
  - Ensure that baseline and performance information is generated correctly
  - Ensure that only authorized and appropriate changes are made to baseline
  - Ensure that EVMS data is truly reflective of objectively-determined progress and forecasts

EVMS Processes



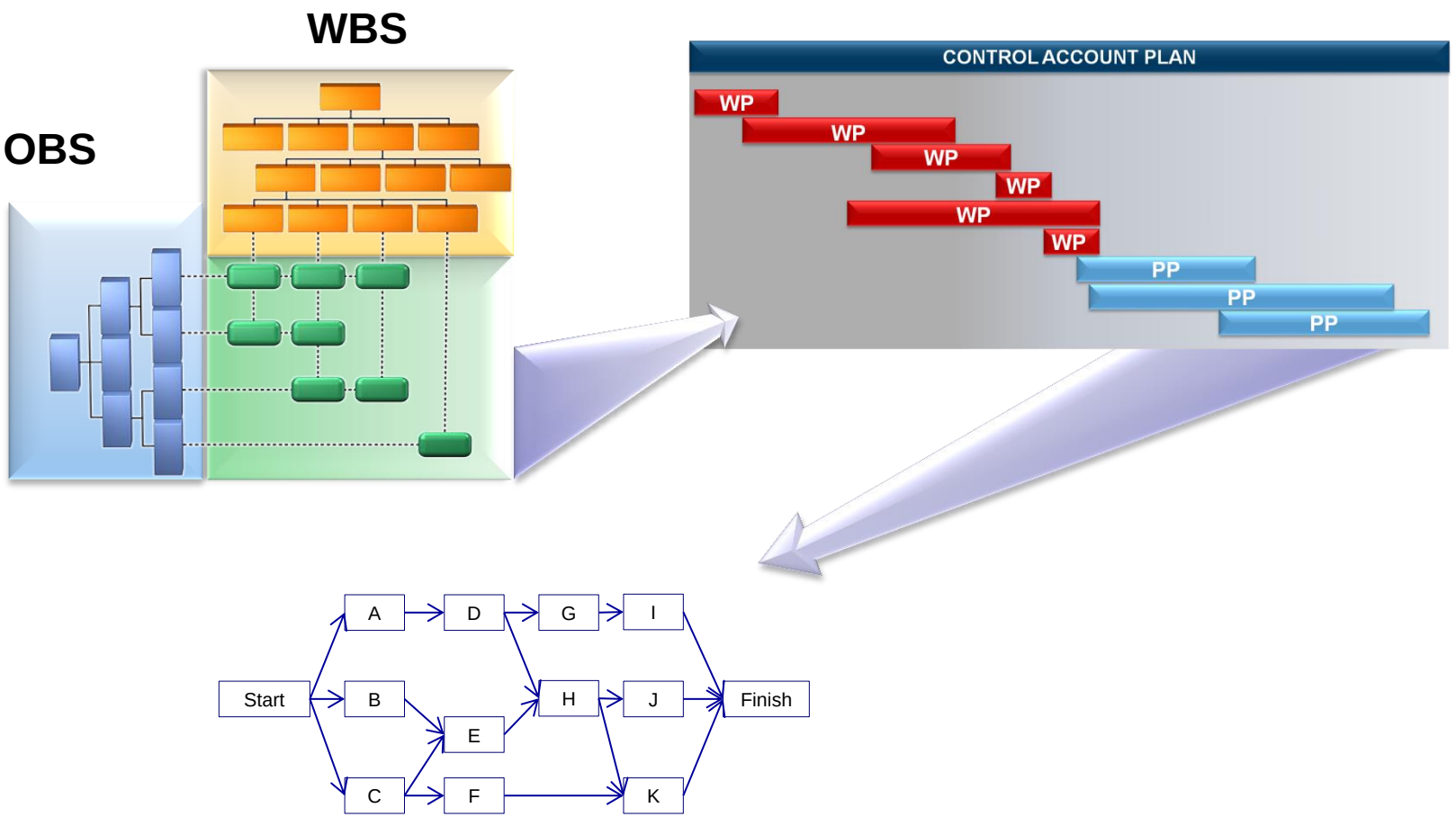
Baseline Concepts

- The project has a single integrated baseline which is Performance Measurement Baseline (PMB)
- The PMB represents resource plan for work phased to meet contract milestones
- The PMB and current work plan are normally different
- PMB is altered only through formal change control process

Performance Baseline

- A performance baseline deals with the approved TPC, CD-4 completion date, or performance and scope
- There is only one original PB and it is documented at CD-2 Approval. The PB represents DOE's commitment to Congress to deliver the project's defined scope by a particular date at a specific cost.
- It represents something different from the PMB

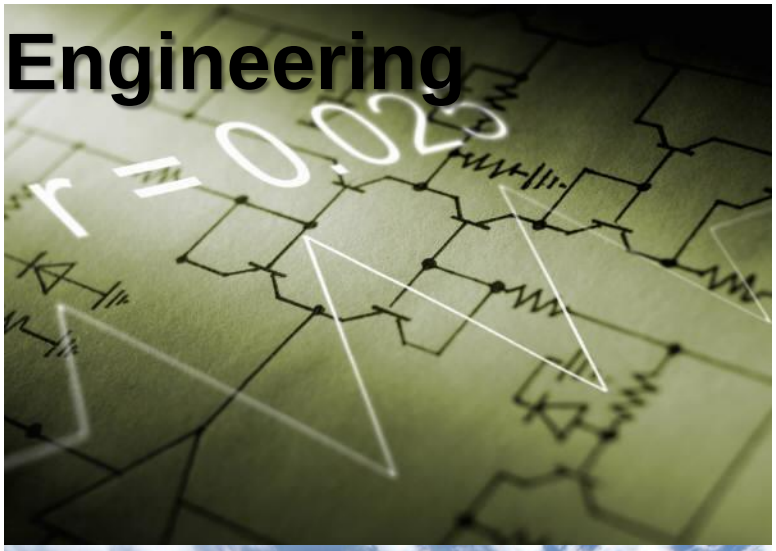
Control Account Planning and Scheduling



Work Package Description

- A work package is a natural subdivision of work within a control account
  - *It is a task or grouping of work items…*
- A work package has a scope of work, with time-phased resources, and has a method for assessment of accomplishments while work is in process (EV technique)
  - *It is comprised of one or more activities in detailed schedule…*

Typical Work Packages



- Design drawing package
- Develop quality plan
- Establish fire protection design basis
- Conduct design review
- Develop computer simulation

- Construct concrete wall
- Place concrete slab, Area 31
- Install 3" pipe, Area 2c
- Install stack liner
- Test instrumentation equipment

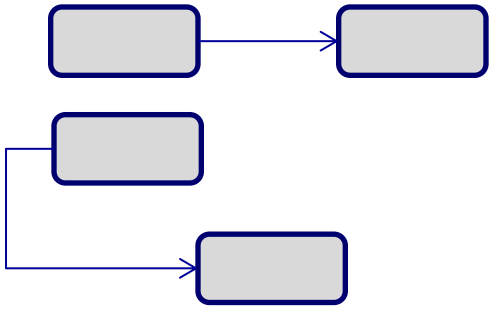
Schedule Development Process

1. Define scope and required activities
2. Establish sequence/relationships
3. Estimate activity durations
4. Estimate activity resources
5. Define calendars
6. Let scheduling software determine the project schedule
7. If necessary, makes changes to 1-5

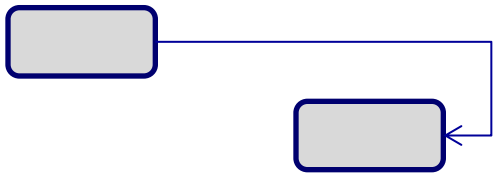
Types of PDM Relationships

Finish-to-Start

Start-to-Start



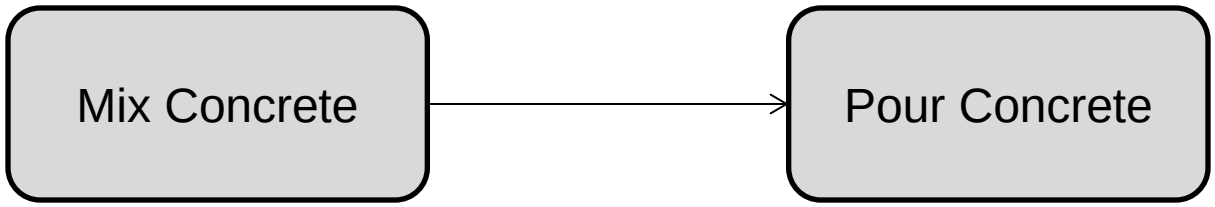
Finish-to-Finish



Start-to-Finish

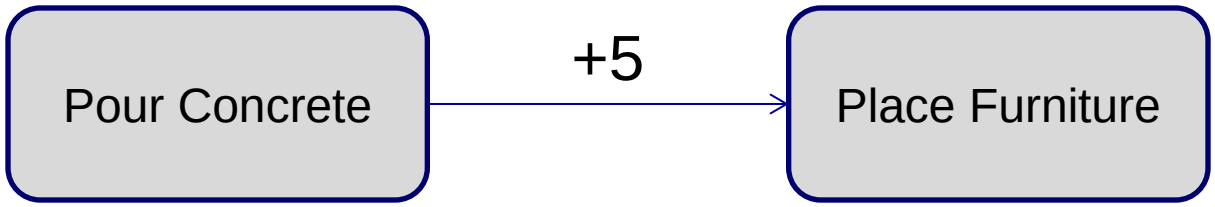
Leads / Lags

Finish-to-Start



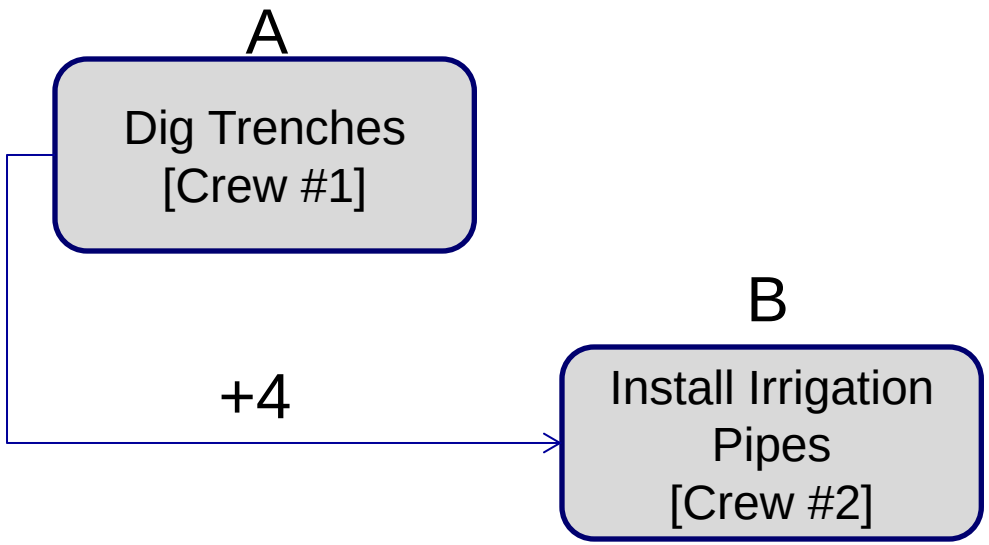
- Activity D can start as soon as A finishes
- Conventional (Default) Relationship

Lags



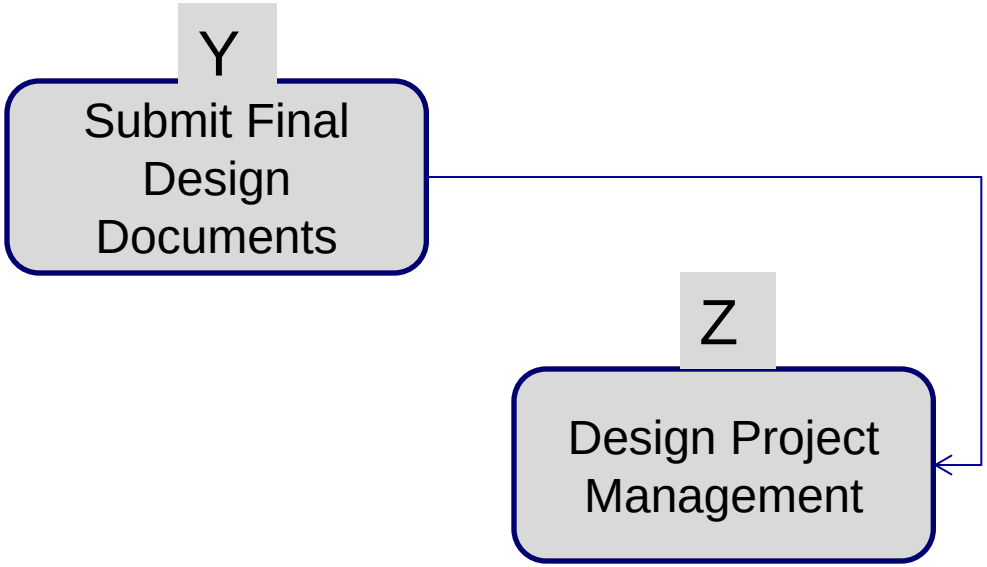
- Activity D can start 5 days after A finishes

Start-to-Start



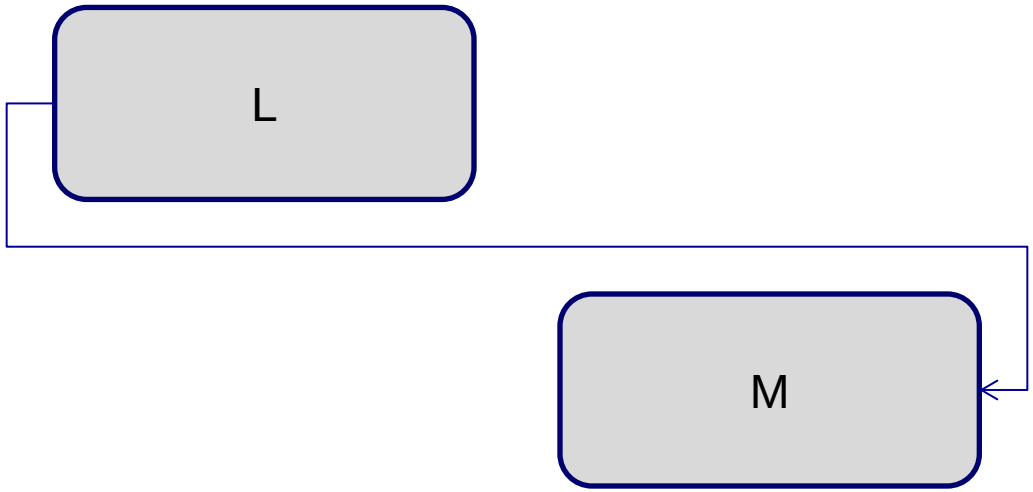
- Activity B can start after A starts

Finish-to-Finish



- Z cannot finish until Y finishes

Start-to-Finish



- The successor can't finish until the predecessor starts (huh?)
- Seldom used

Calculating The Network

1. Activity Durations
2. Forward Pass
3. Backward Pass

Estimate Task Durations

- Developed for each activity, preferably by activity “owner”
- Expert Judgement/History
- Shorter is generally better than longer [but realistic is most important!]
- Generally assumes normal conditions (manpower, equipment, calendar, etc.)
- Neither “success oriented” nor padded
- Document assumptions

CAM Schedule Responsibilities

- The CAM owns the schedule and has the responsibility of ensuring all activities and [realistic] durations are included in the P6 schedule and are completed as established.

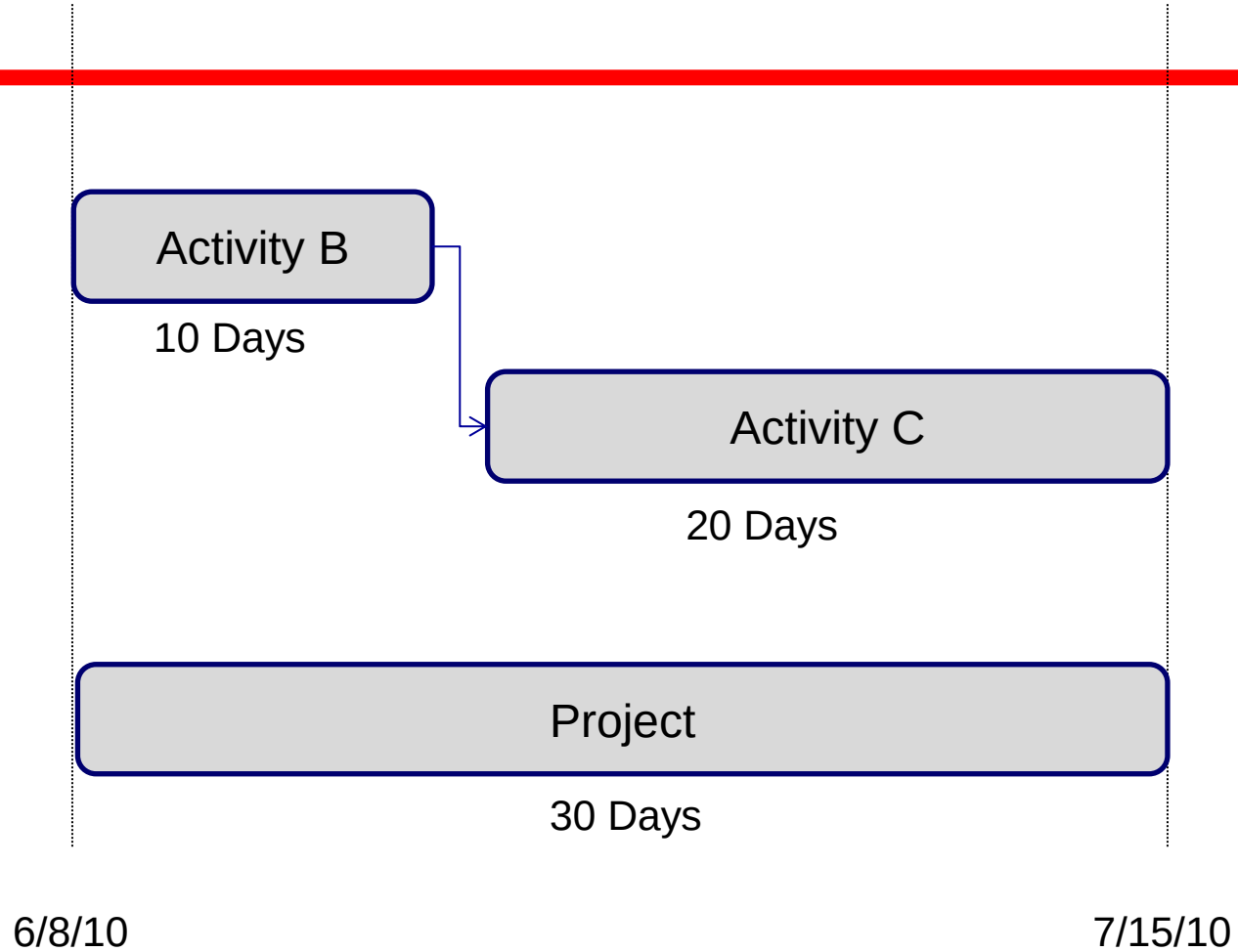
- CAMs must be aware of the timing for procurement activities and must incorporate them into the general project planning.

Program Evaluation Review Technique (PERT)

Activity Duration?

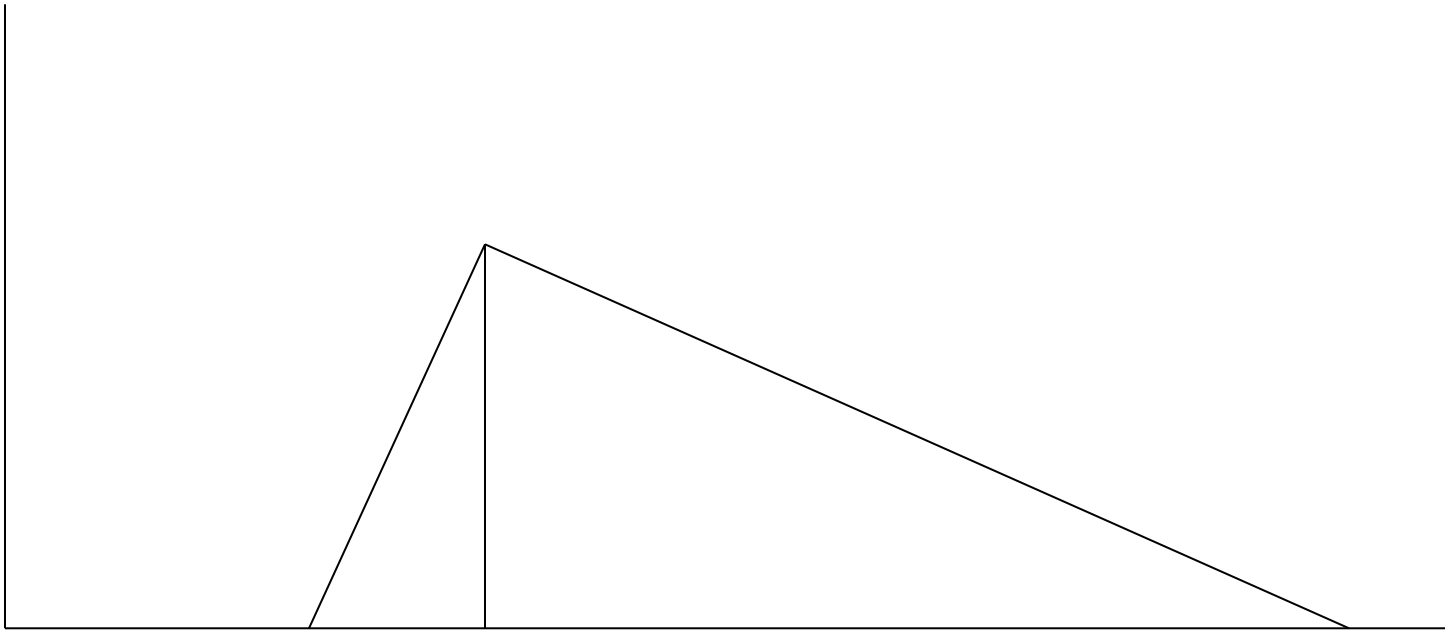
$$\text{Duration} = \frac{a + 4m + b}{6}$$

a - optimistic time estimate
b - pessimistic time estimate
m - most likely time estimate



The project duration is equal to the sum of durations for the longest path of activities/tasks through the network.

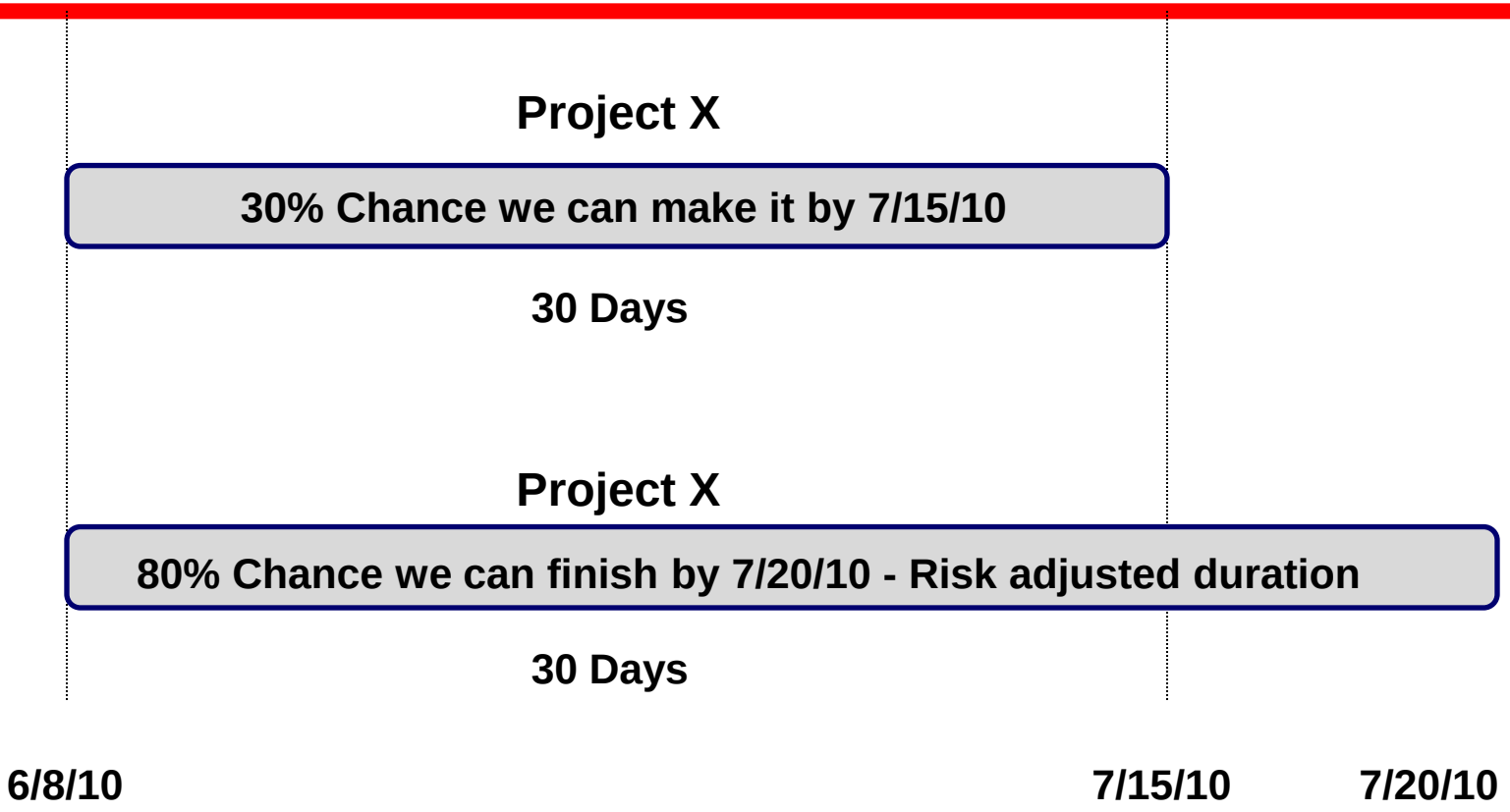
Activity C



Best Case: "We could finish in 10% less time if..."

Most Likely: "Typical" CPM Estimate

Worst Case: "But it might take as much as 30% longer if…"

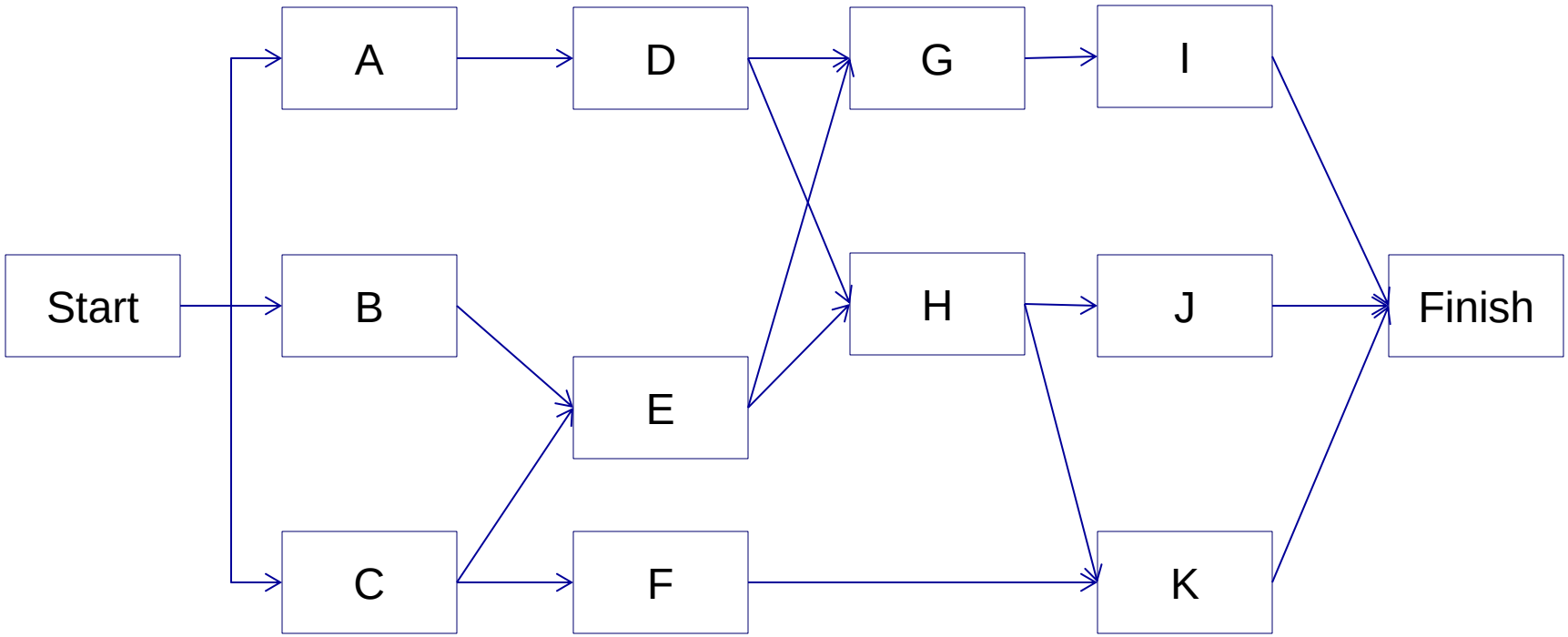


At what confidence level are you willing to make a commitment to your customer?

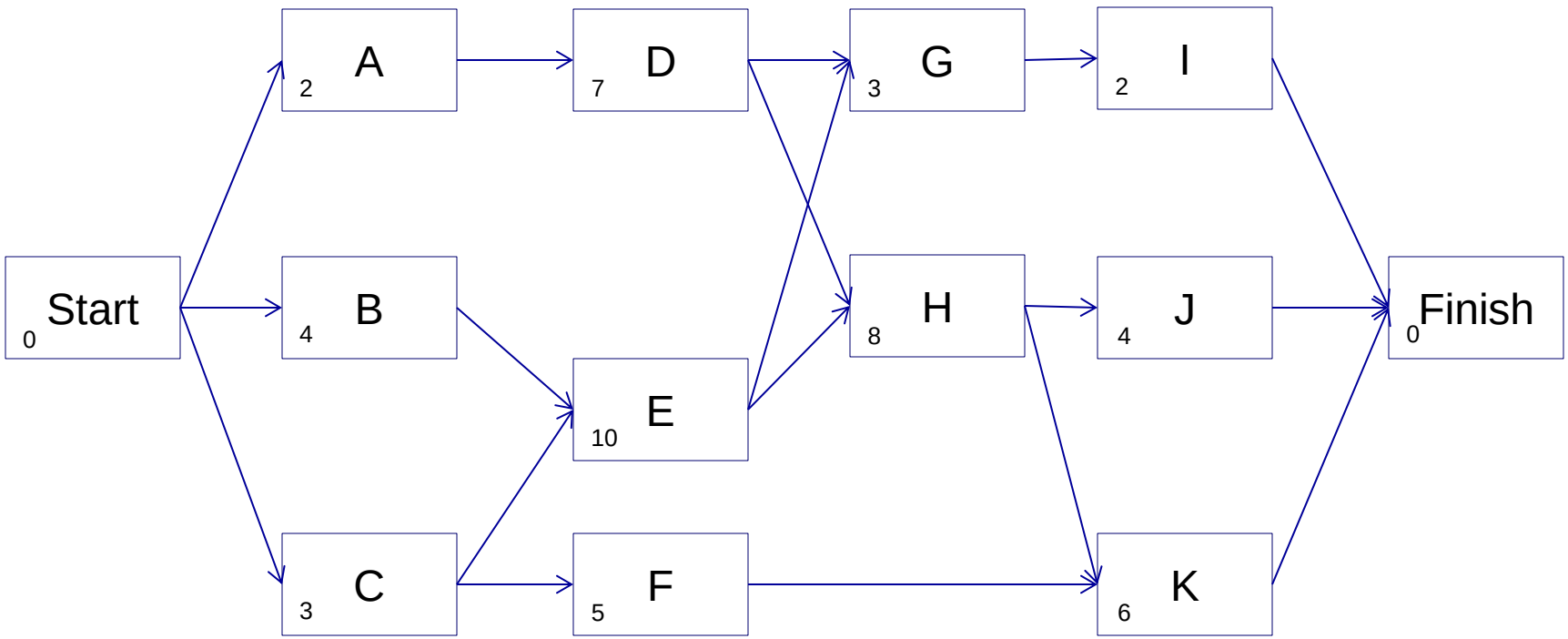
Activity Types

Fixed Duration	Duration estimate based on amount of calendar time necessary for task completion.
Effort Driven	Duration estimate based on amount of effort required to complete activity.
No Duration	Milestone: An important / critical event that must occur during project; start, completion of significant activity.

Project A Network



Network A: When can we finish?



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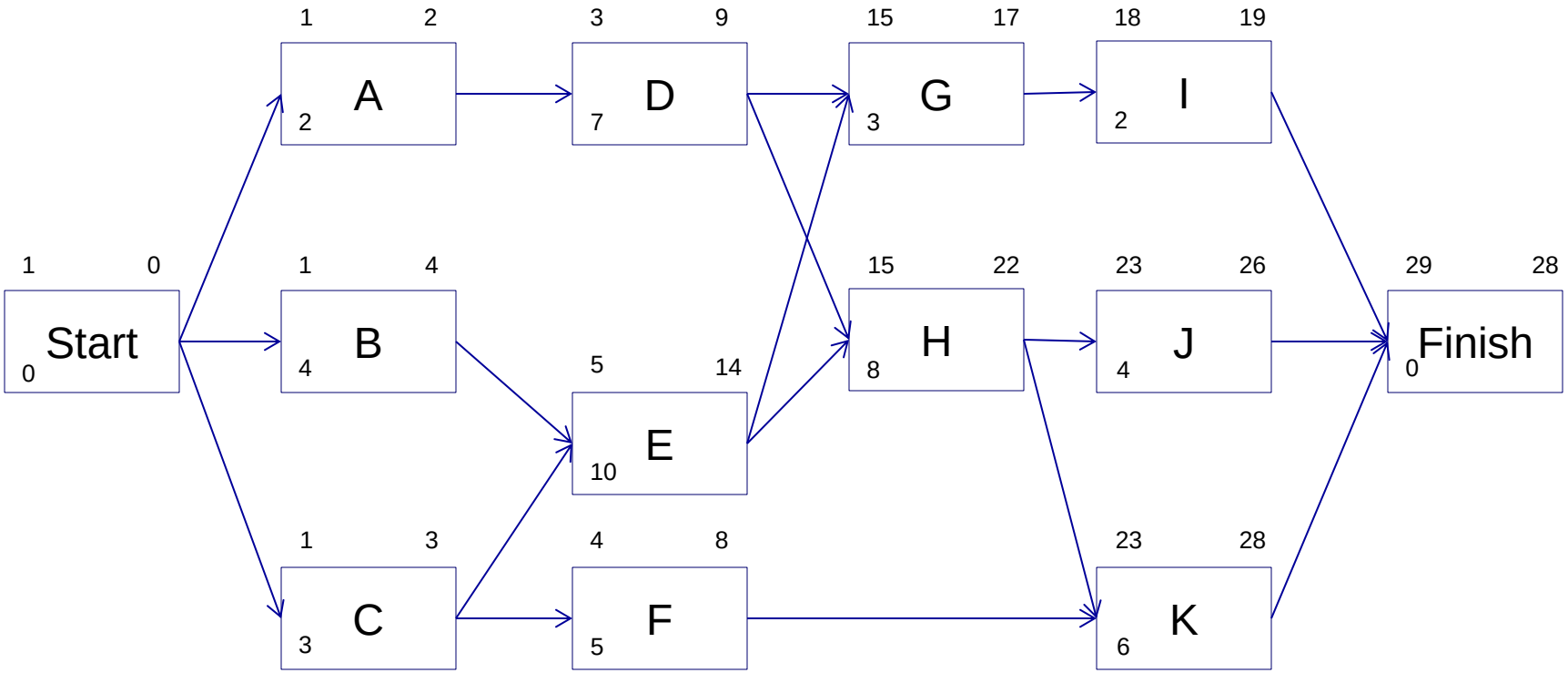
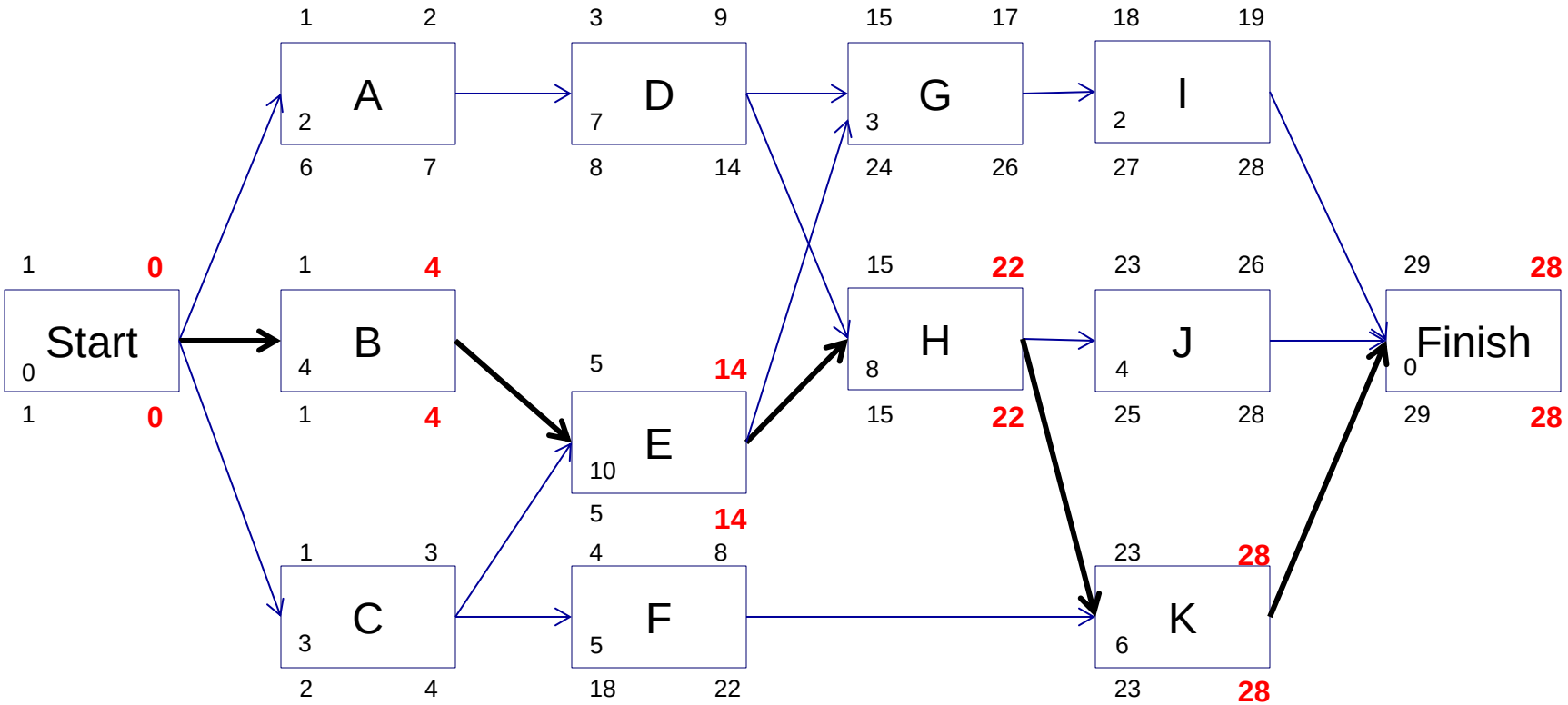
Network A Forward Pass

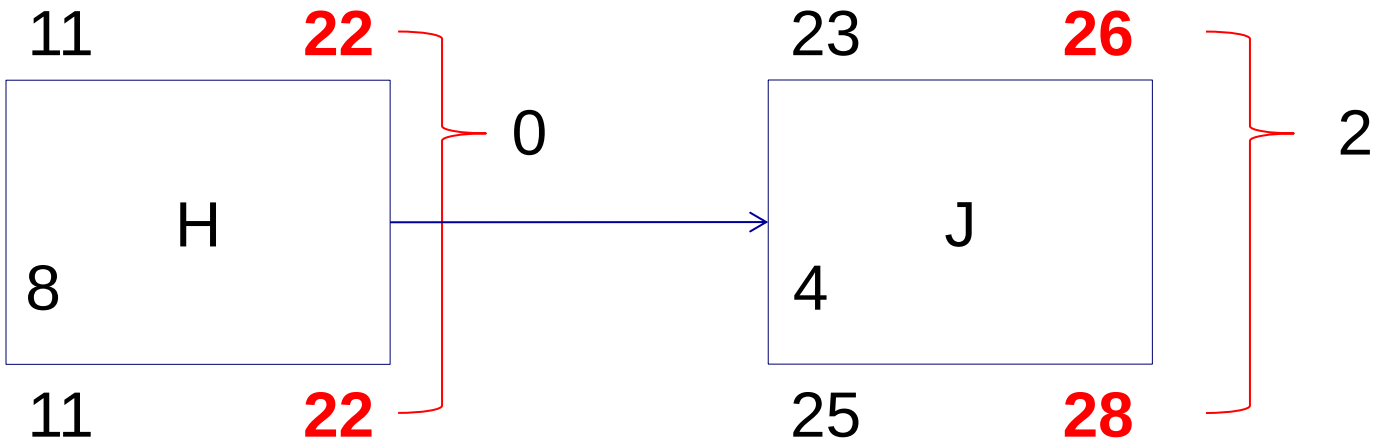


Backward Pass: When must we finish?



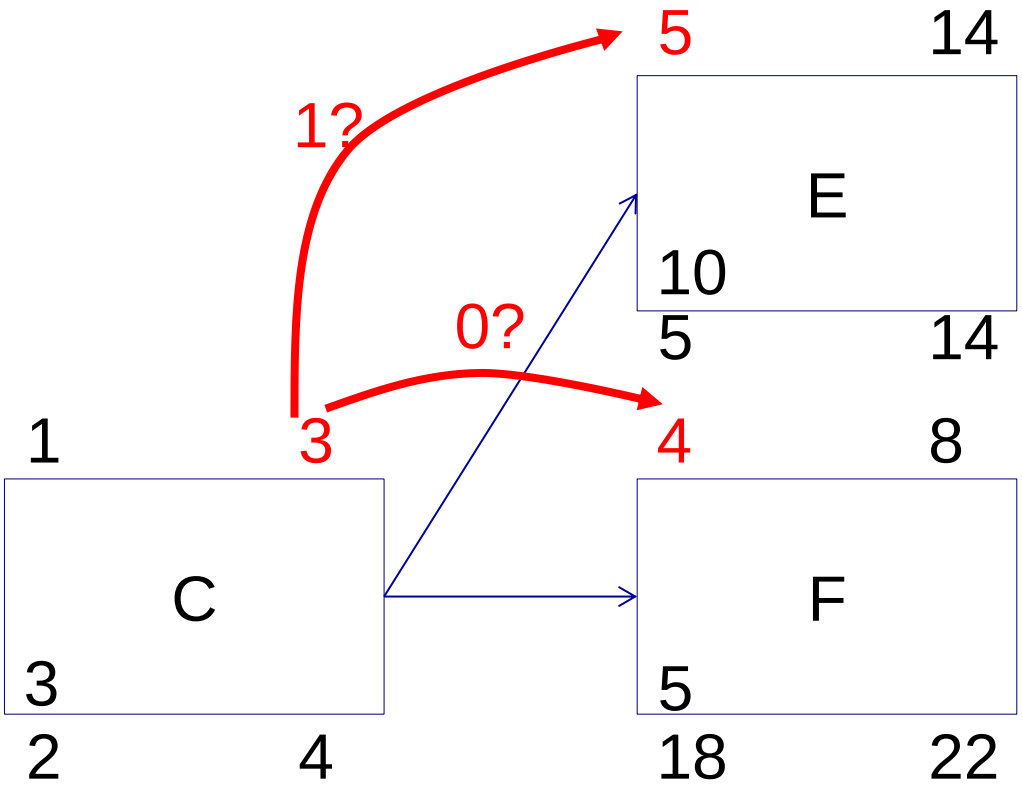
Total Float

"How much an activity can be delayed before it impacts the project finish date

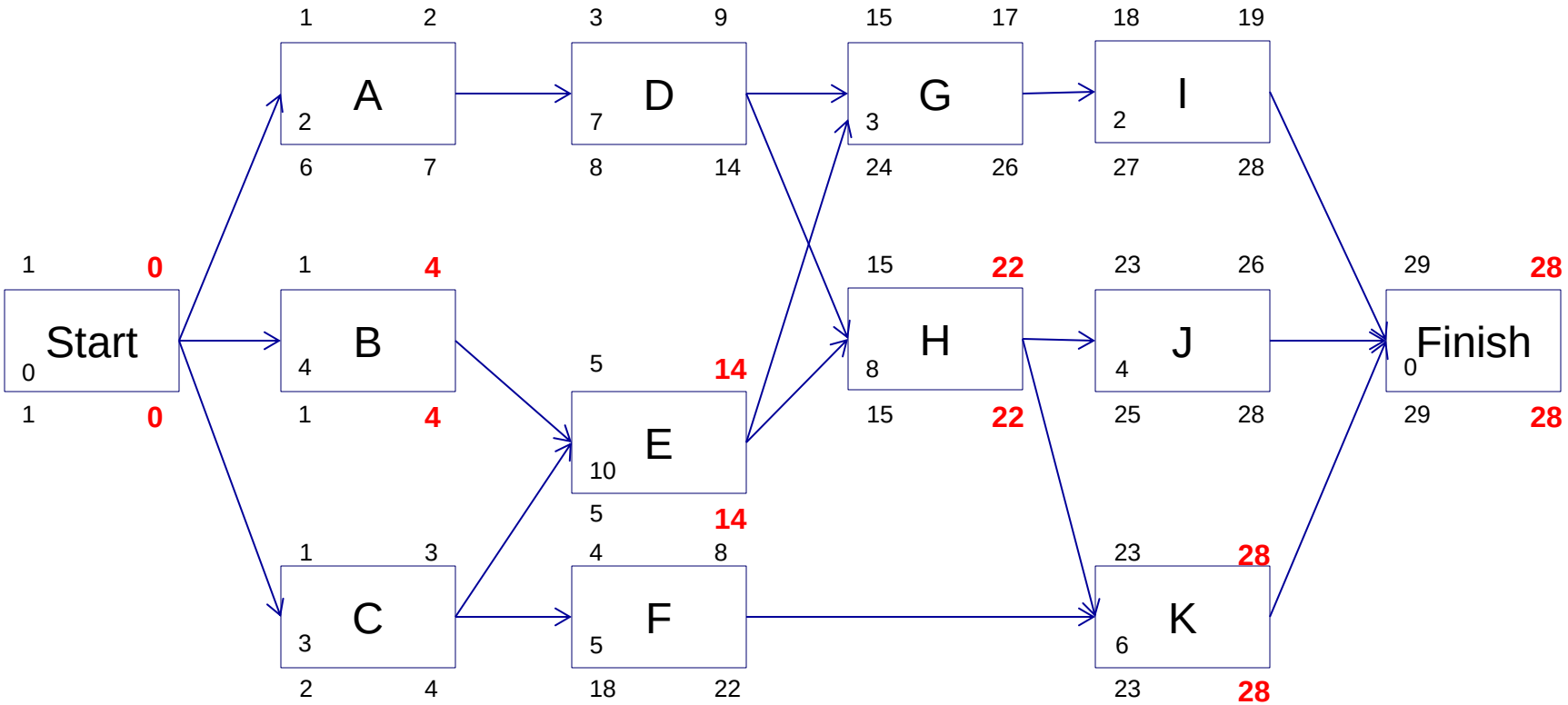


Free Float

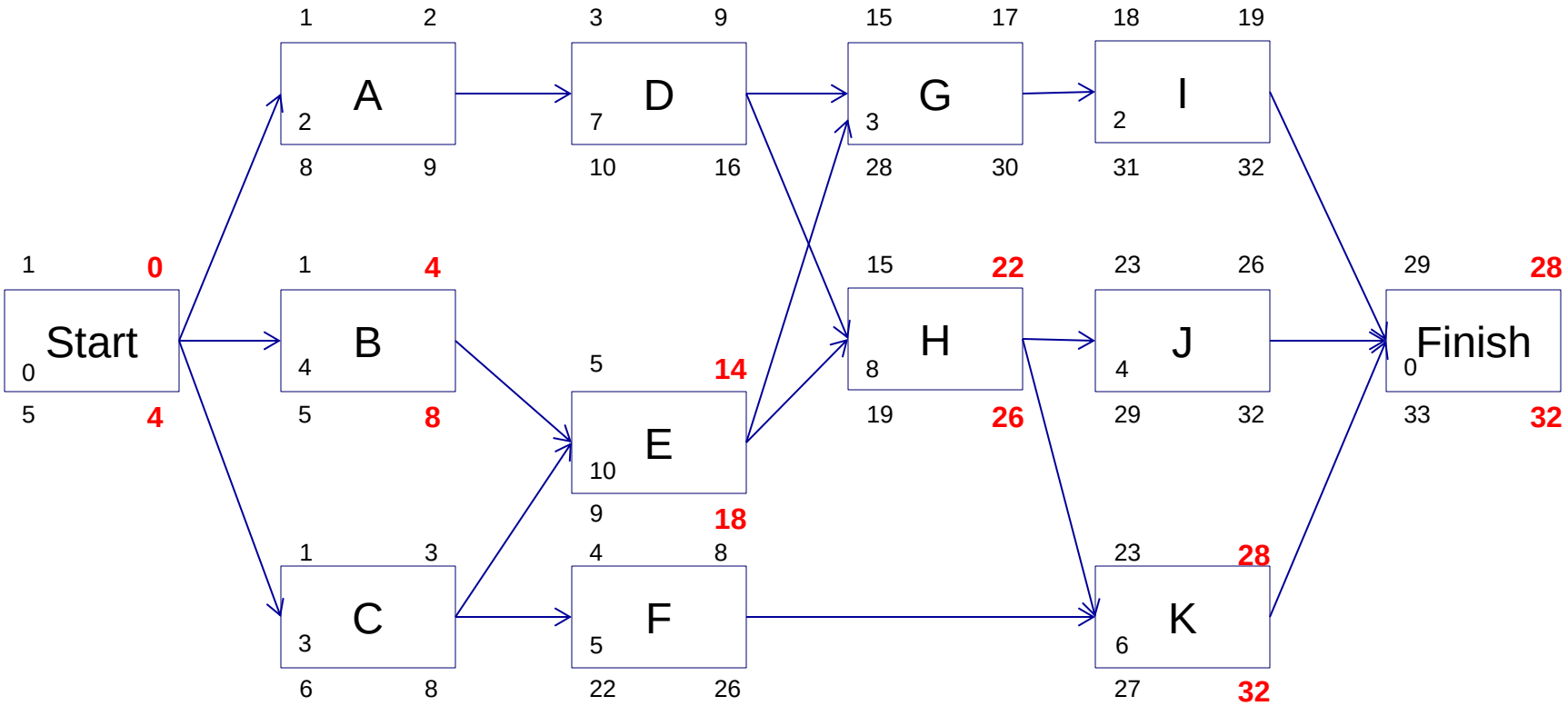
"How much an activity can be delayed before it impacts a direct successor activity"



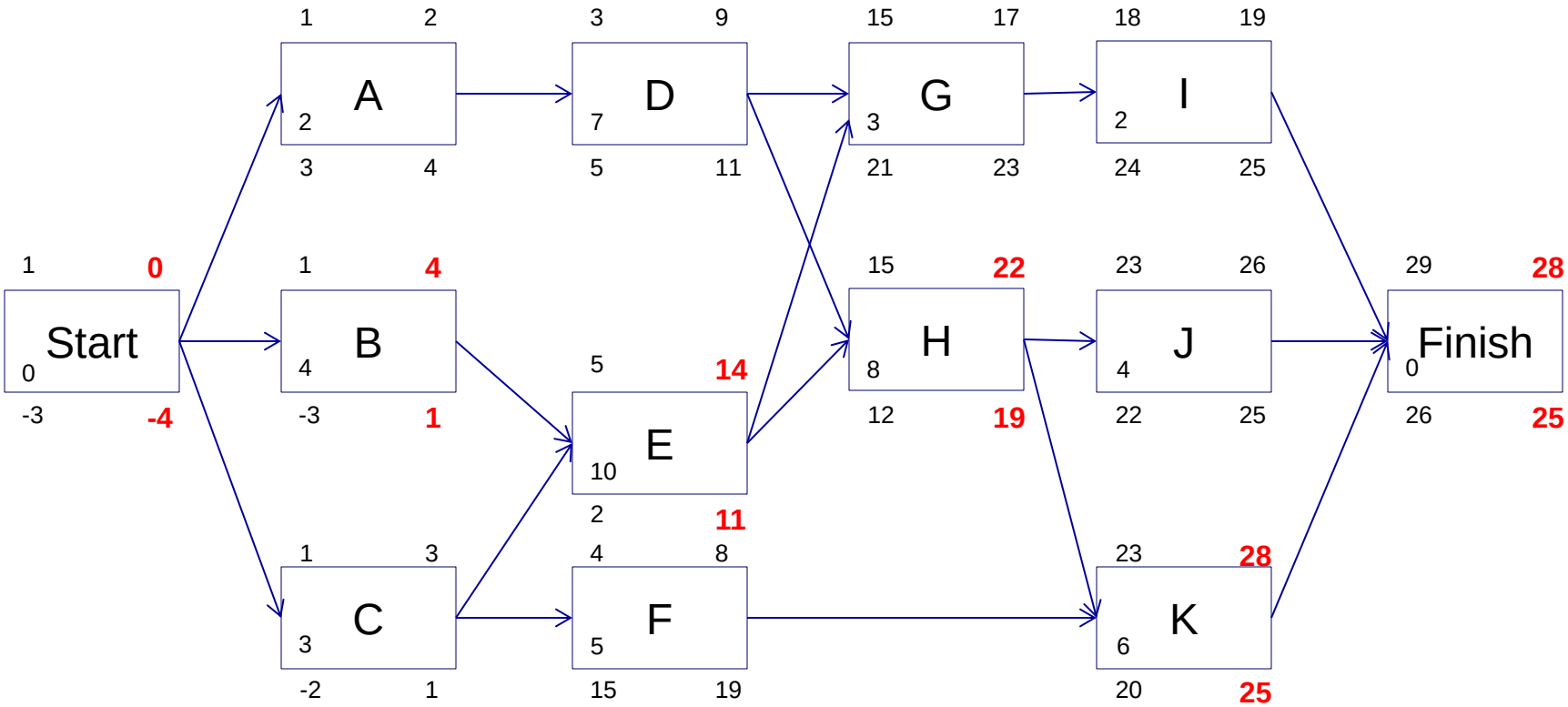
Calculating Float



Assumption #1: EF is earlier than LF



Assumption #1: LF is Before EF



So, when will we finish?

Questions

- How many hours in a shift?
- How many shifts per day?
- How many productive hours are in a shift
- Should we plan to work on weekends and/or holidays?
- Will anyone go on a vacation?
- What did the duration estimates assume?

Calendars

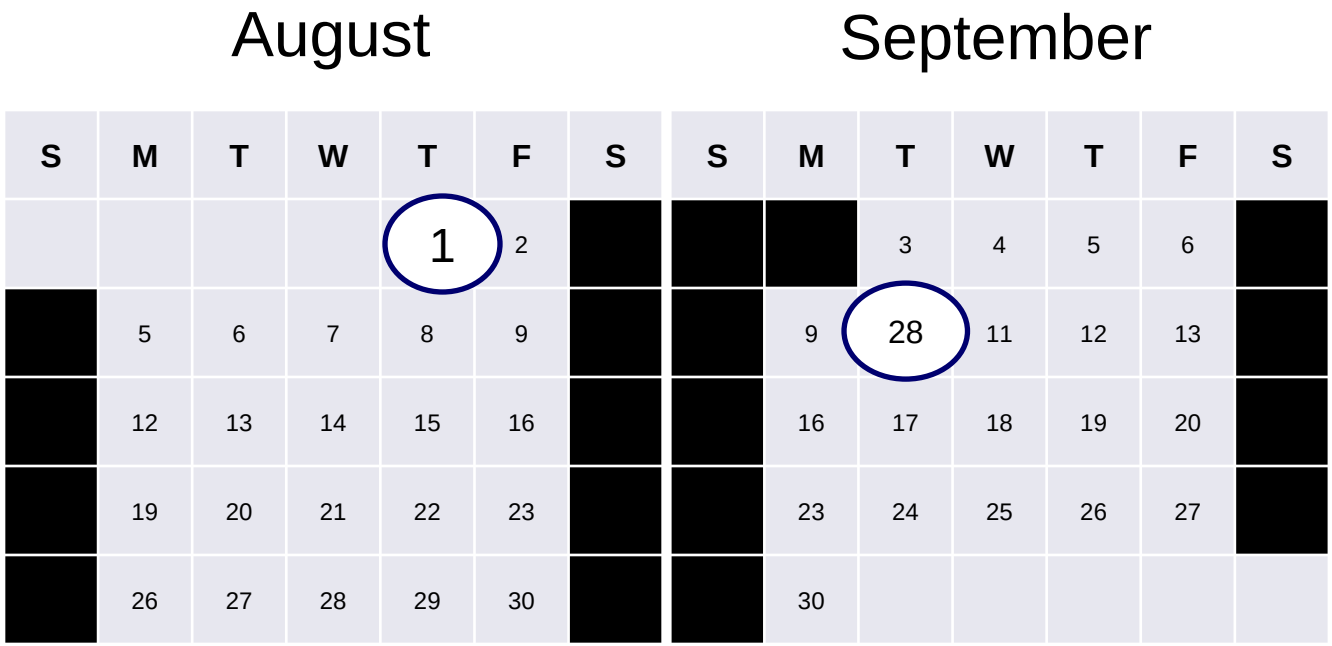
August

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

September

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

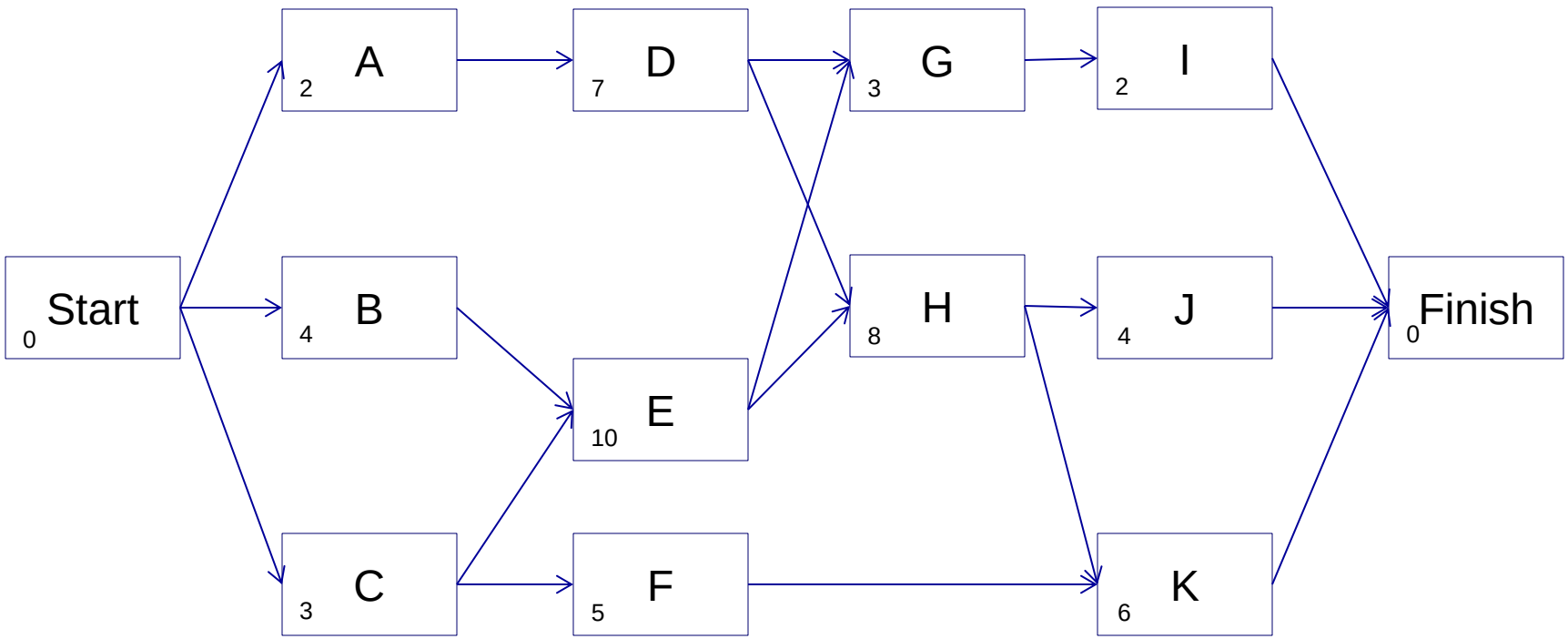
Calendars



Assigning Resources to the Schedule

- Labor
- Materials
- Equipment
- Facilities
- Rentals
- Subcontractors
- Other suppliers

Project A Network

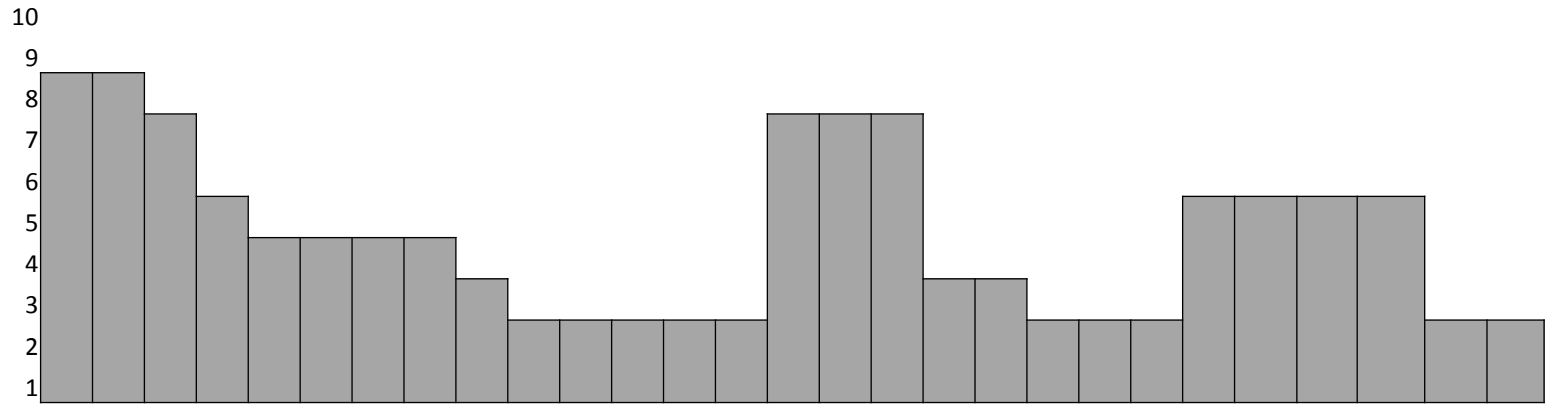


Duration – resource assumptions

Activity	Duration	Total Resources
A	2	4
B	4	12
C	3	9
D	7	7
E	10	20
F	5	5
G	3	15
H	8	16
I	2	2
J	4	12
k	6	12
	Total	114

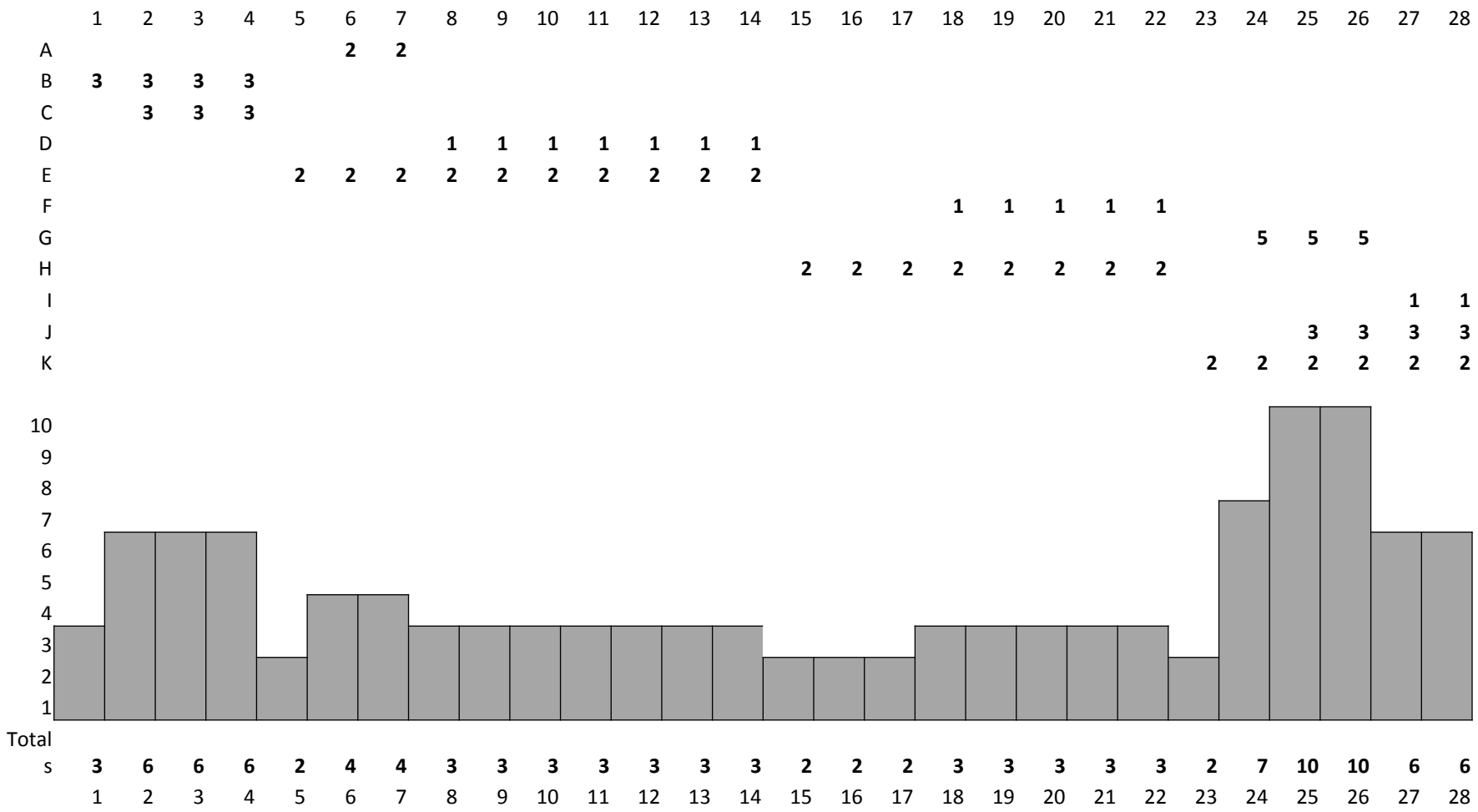
Resource profile: early dates

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
A	2	2					]																					
B	3	3	3	**3**																								
C	3	3	3	]																								
D			1	1	1	1	1	1	1					]														
E					2	2	2	2	2	2	2	2	2	**2**														
F				1	1	1	1	1													]							
G															5	5	5								]			
H															2	2	2	2	2	2	2	**2**						
I																		1	1								]	
J																							3	3	3	3	]	
K																							2	2	2	2	2	**2**

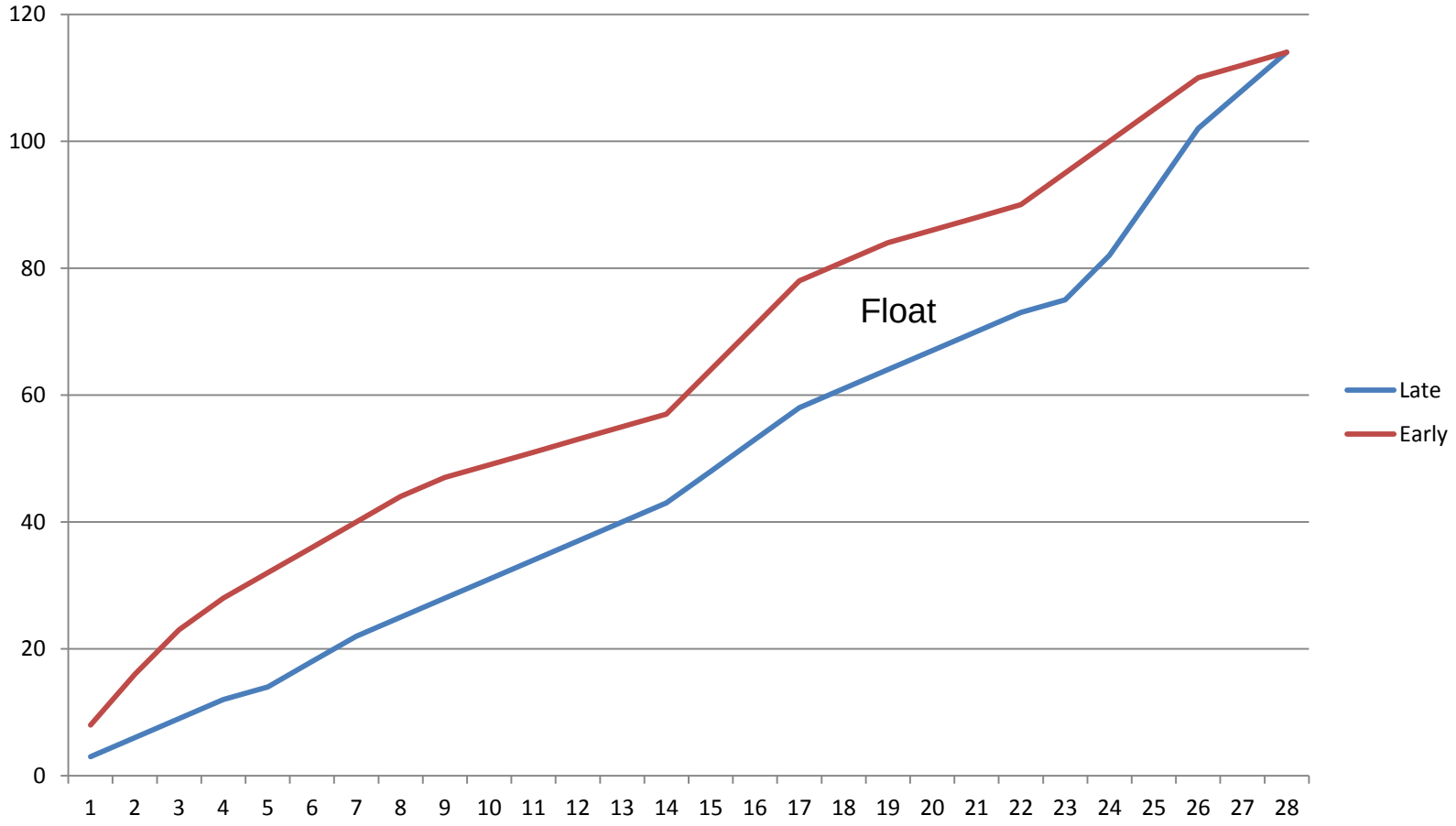


Totals	**8**	**8**	**7**	**5**	**4**	**4**	**4**	**4**	**3**	**2**	**2**	**2**	**2**	**2**	**7**	**7**	**7**	**3**	**3**	**2**	**2**	**2**	**5**	**5**	**5**	**5**	**2**	**2**
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28

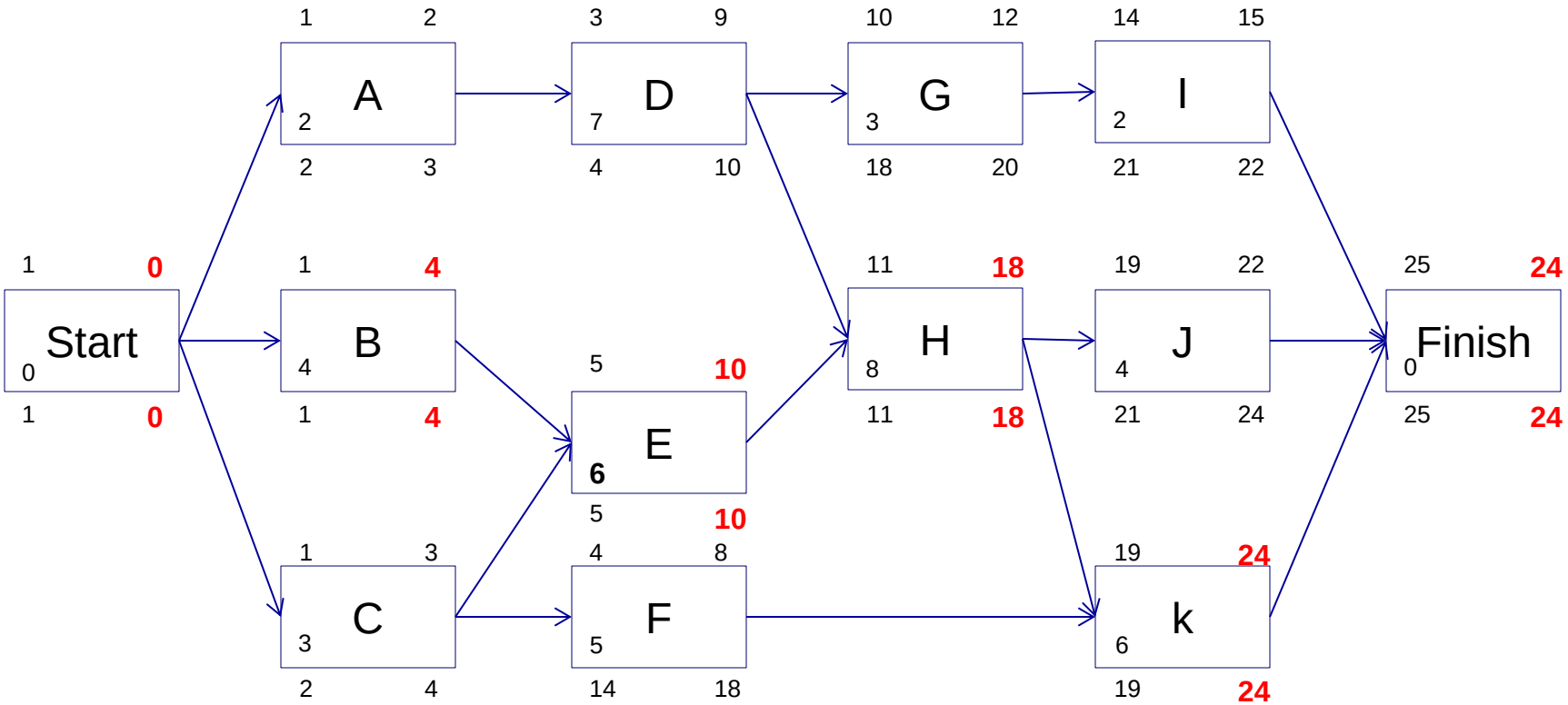
Resource profile: Late dates



Resource profiles



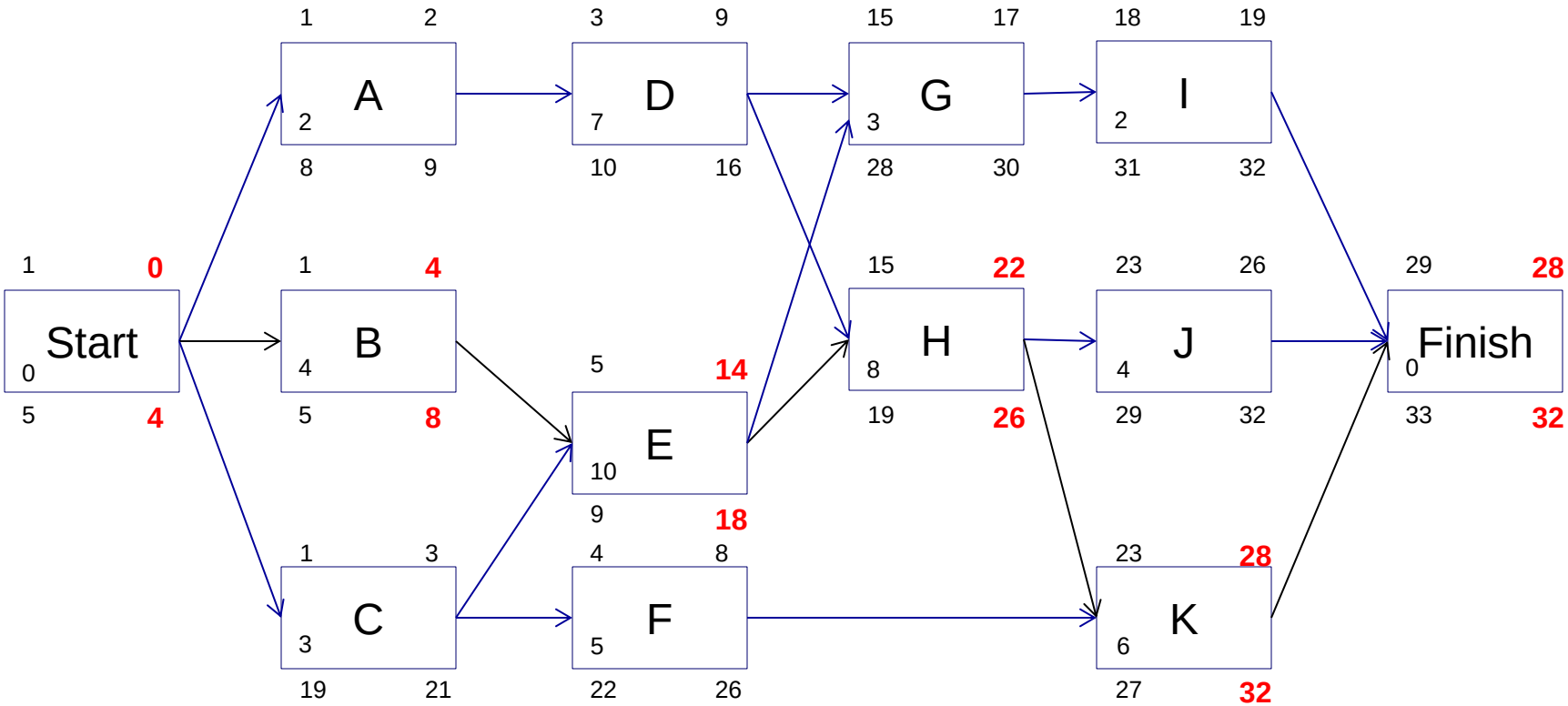
Assumption #1: EF = LF



Schedule Reserve

- Float, where EF < LF
- EF=LF, with buffer activity added
- Intermittent buffers at the end of major project phases

Assumption #1: EF < LF



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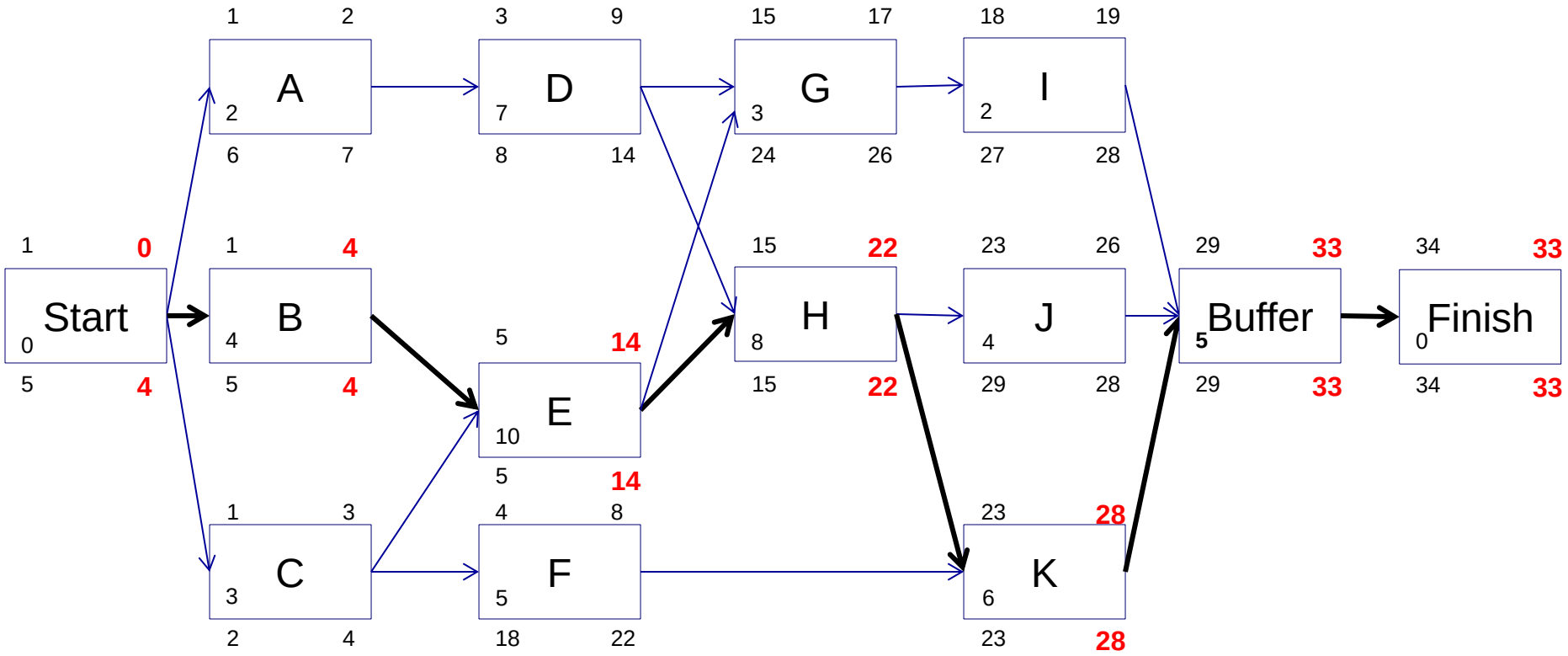
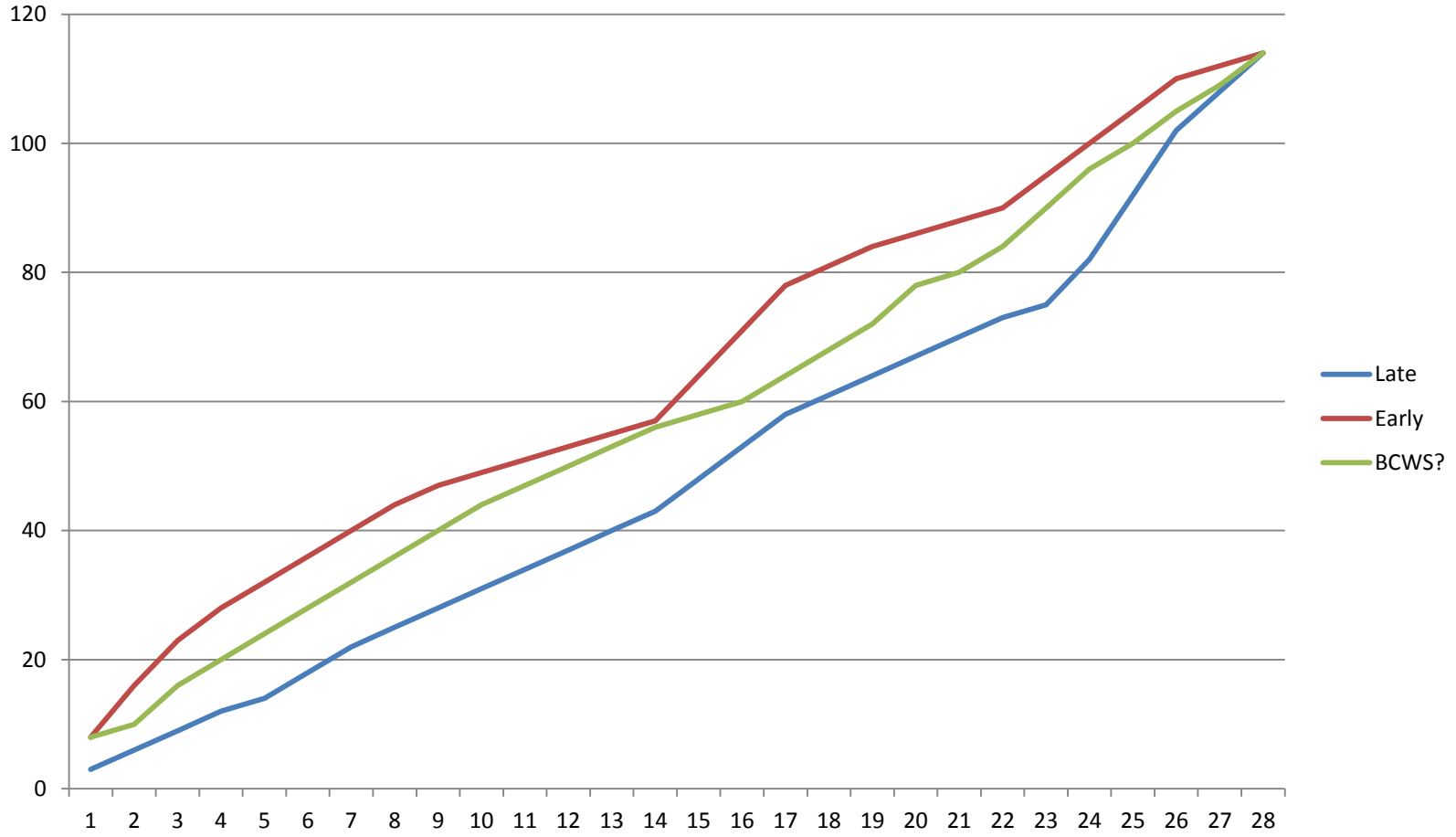
Reserve Buffer



You would be well advised to included some buffer before establishing/agree to a baseline finish date

BCWS: Integrated Baseline



Earned Value Metric

- COMPLETED TASKS
  +
  - Budget target
- IN-PROCESS TASKS
  - Estimate of budget for completed portion
  - **% Complete** x BAC
    - Important to use logical technique to ensure accuracy of result!

or…

The budget associated with completed work! (BCWP)

BNL EV Approach

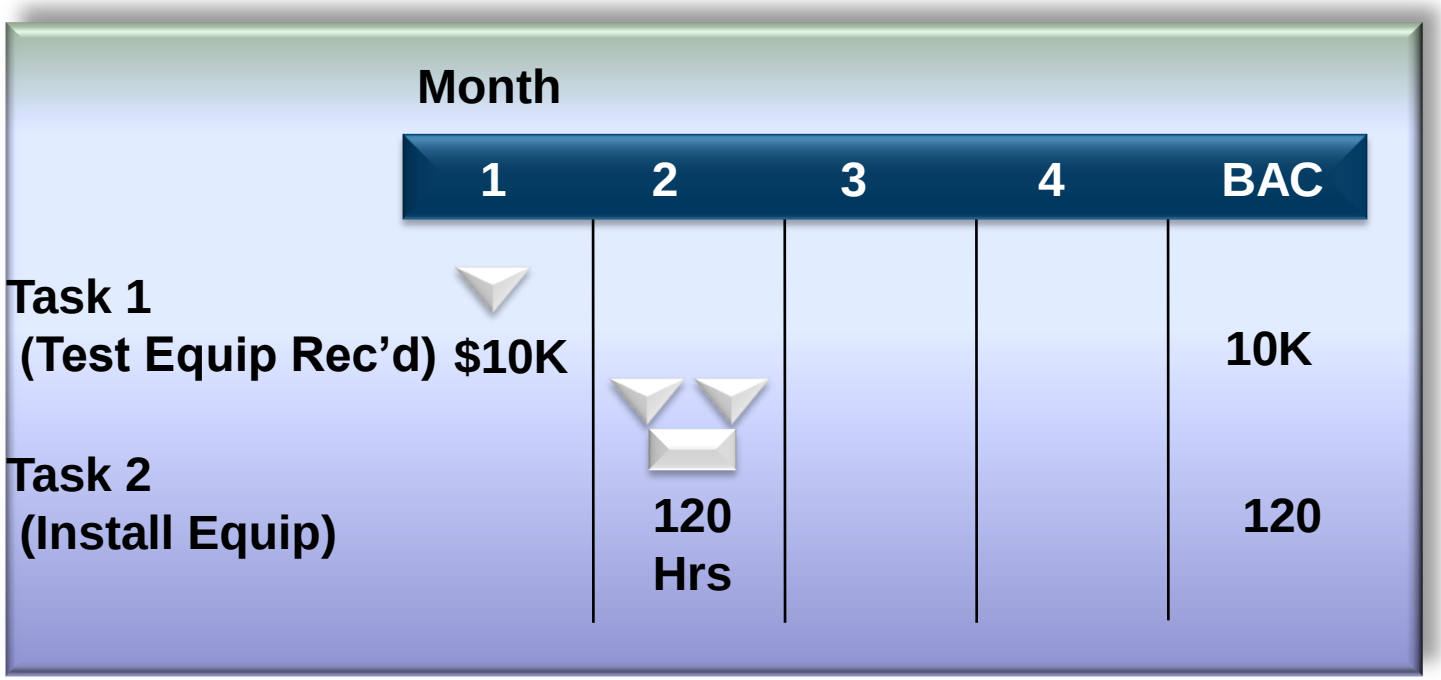
Product of Work	Duration of Work Effort	Duration of Work Effort
	Less than three Measurement Periods	>3 Measurement Periods
Tangible	Fixed Formula • 50/50 Percent • 0/100 Percent • % Complete	• Weighted Milestone • Percent Complete of Milestones
Intangible	• Apportioned Effort • Level of Effort	

BNL EV Measurement Methods

- **Tangible Outcomes [Discretely Measurable]**:
  - 0/100 – EV taken at completion
  - 50/50 – EV taken 50% when start, 50% when finished, e.g., spec writing
  - Predefined weighted milestones
  - Percent Complete with Steps – based on objective physical progress of the activity (duration > 3 months).
- **Level of Effort:** EV = the budget planned for the month, e.g., Project Management
- **Apportioned Effort:** Not used at BNL but provided for in ANSI-748
- **Material Purchases:** BCWP earned and ACWP accrued on receipt
- **Subcontracts** - Contractor schedule incorporated into project schedule once approved. EV based on milestones/contractor schedule status

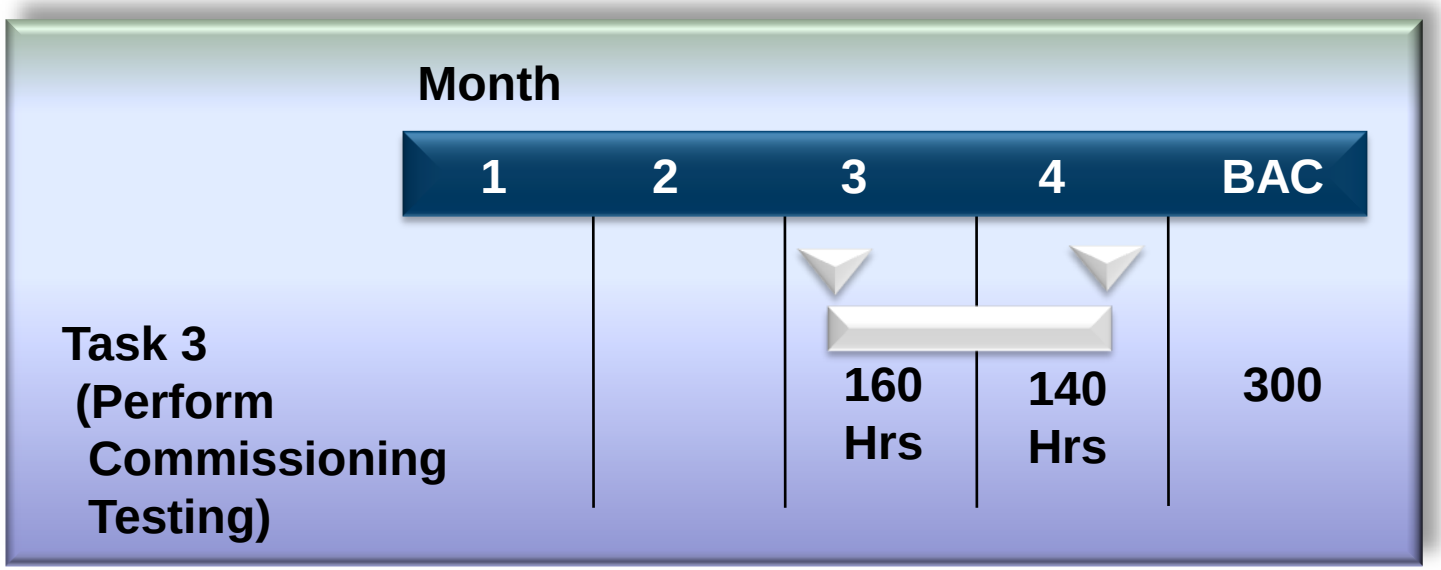
0-100

Used for Short Tasks
(within an Accounting Period)



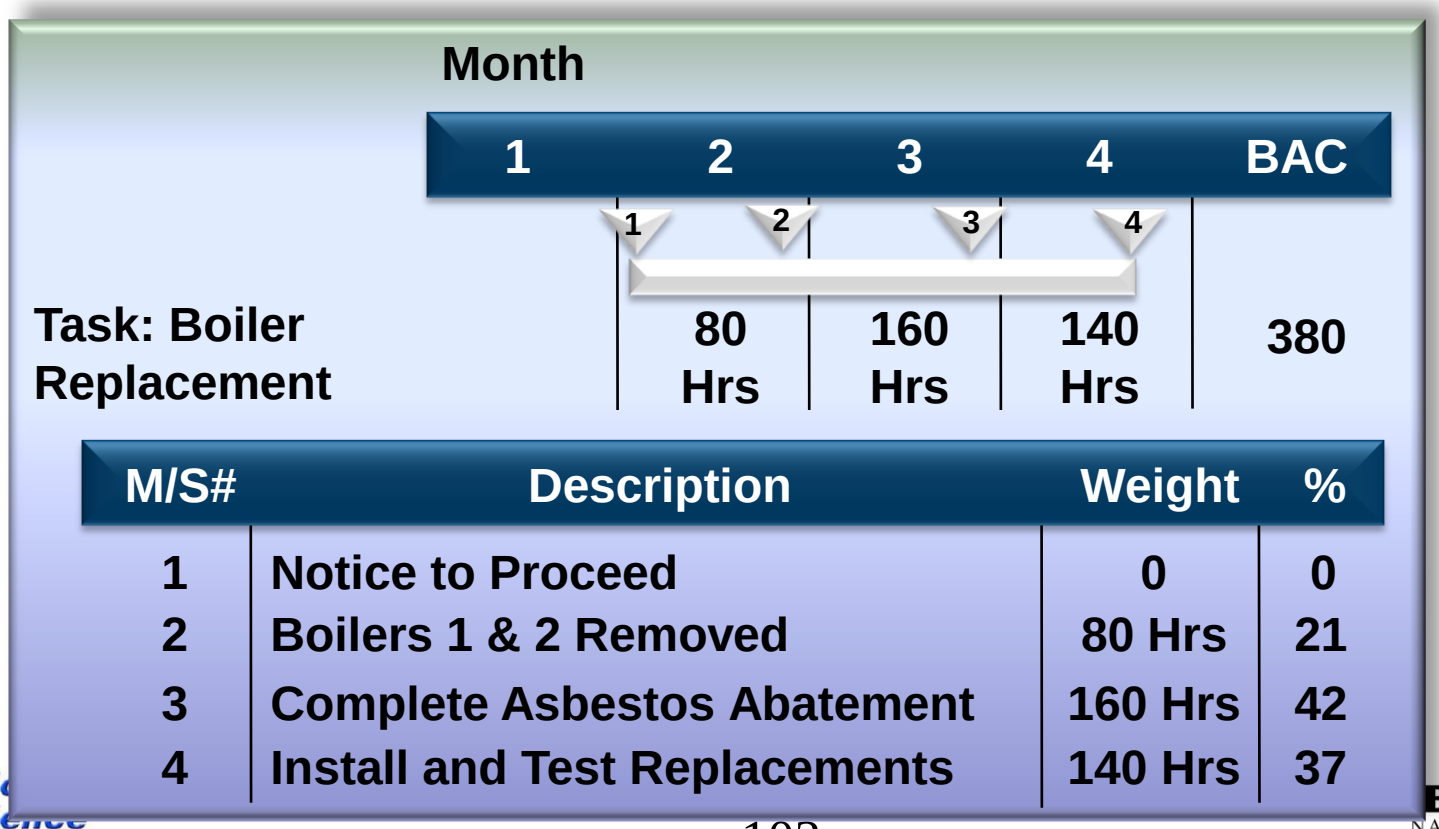
50-50

- Used for short tasks (usually less than 3 months)
- Ideally equal milestone resources



Milestones

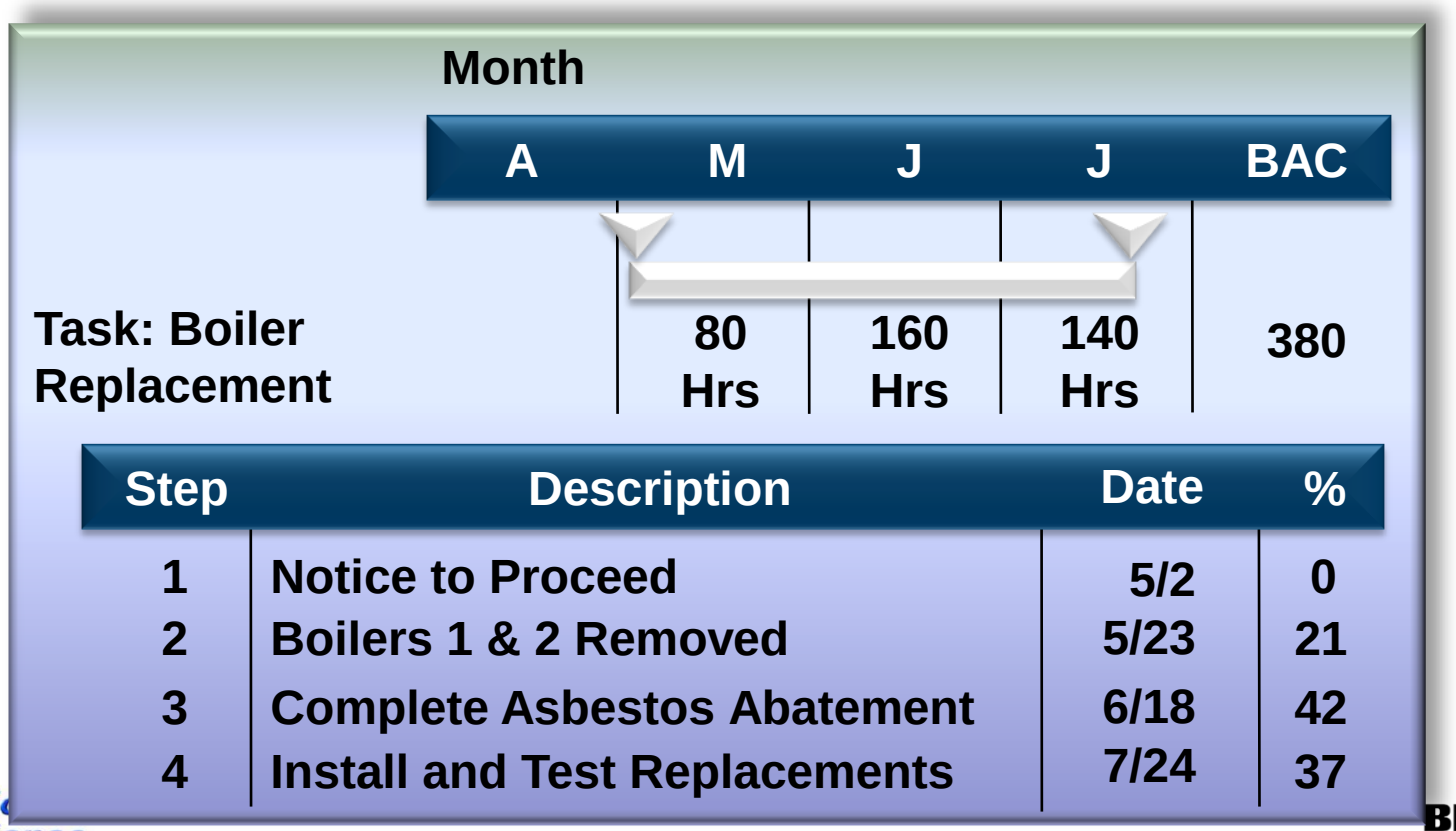
- Used for longer tasks
- Ideally should have milestone each month
- Milestones should be weighted based on resources



M/S#	Description	Weight	%
1	Notice to Proceed	0	0
2	Boilers 1 & 2 Removed	80 Hrs	21
3	Complete Asbestos Abatement	160 Hrs	42
4	Install and Test Replacements	140 Hrs	37

Percent Complete with Steps

- Used for longer tasks (task >3 months)
- Step and %'s captured in Primavera
- Steps should be weighted based on resources



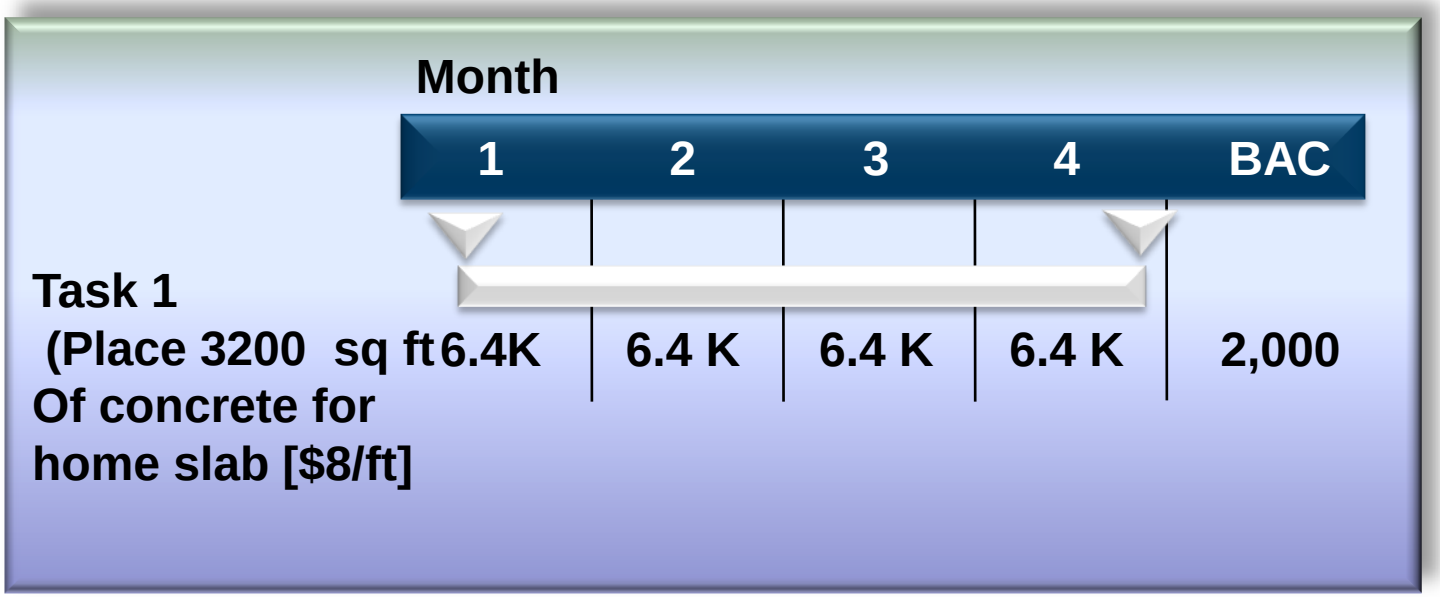
Step	Description	Date	%
1	Notice to Proceed	5/2	0
2	Boilers 1 & 2 Removed	5/23	21
3	Complete Asbestos Abatement	6/18	42
4	Install and Test Replacements	7/24	37

Large Subcontracts

- Schedule from subcontractor
  - Detailed schedule – short duration activities
  - Logic based incorporated into project schedule
  - Cost Loaded by activity
  - Contractor (Construction) required to use Primavera
  - Contractor owns schedule and submits monthly updates
  - Earned value based on physical % complete x activity resources
- Not FFP? Require S/C to implement EVMS

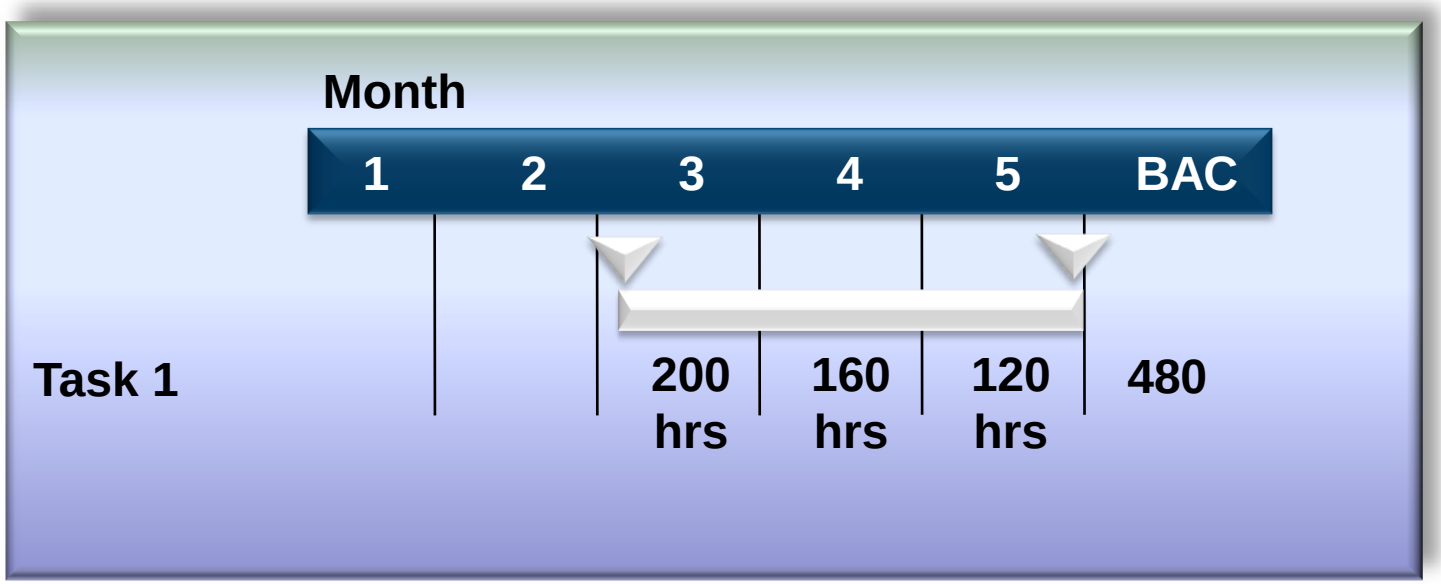
Subcontracts - Units complete

- Used for tasks where a physical count is appropriate
- Units are identical or similar
- Same budget value for each unit
- BCWS = Planned Qty x unit value
- BCWP = Actual Qty completed x unit value



Percent complete (Subjective – No Steps)

- 3 Months or less to minimize subjectivity
- Used when no interim milestones/steps are possible
- Based on an individual's assessment of percent complete of the total work to be performed
- Should be as objective as possible



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Apportioned effort

- Based on:
  - Parent/child Relationship
  - Historical Estimating Factor
  - Not used very often

For every 10 hours of production work, there is .5 hour of QC Inspection…

Example

Production WP

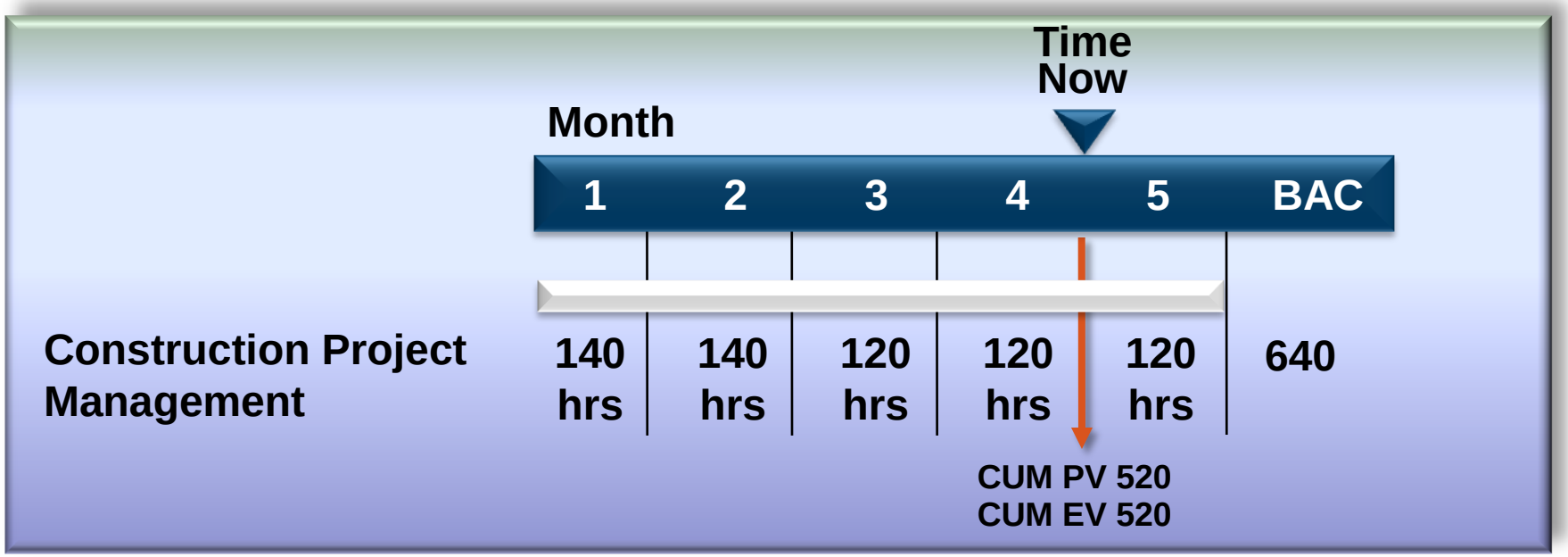
PV	**100**	**300**	**500**	**600**
EV	**140**	**400**		

Inspection WP

PV	**5**	**15**	**25**	**30**
EV	**7**	**20**		

Level of effort

- Support type effort; doesn't drive the schedule
- No product or accomplishment criterion
- Based on passage of time
- EV = PV (always)
- No schedule variance



Examples of LOE work

- Project Management Personnel
- Subcontract Management
- Security Guards
- Direct charge administrative staff

Effect of loe on metrics

CA 1 LOE	PV = 400	EV = 400
CA 2 Discrete	PV = 800	EV = 700
Total WBS	PV = 1200	EV = 1100

SV % with LOE = 8.3%
SV % without LOE = 12.5%

Understanding Earned Value

Exercise

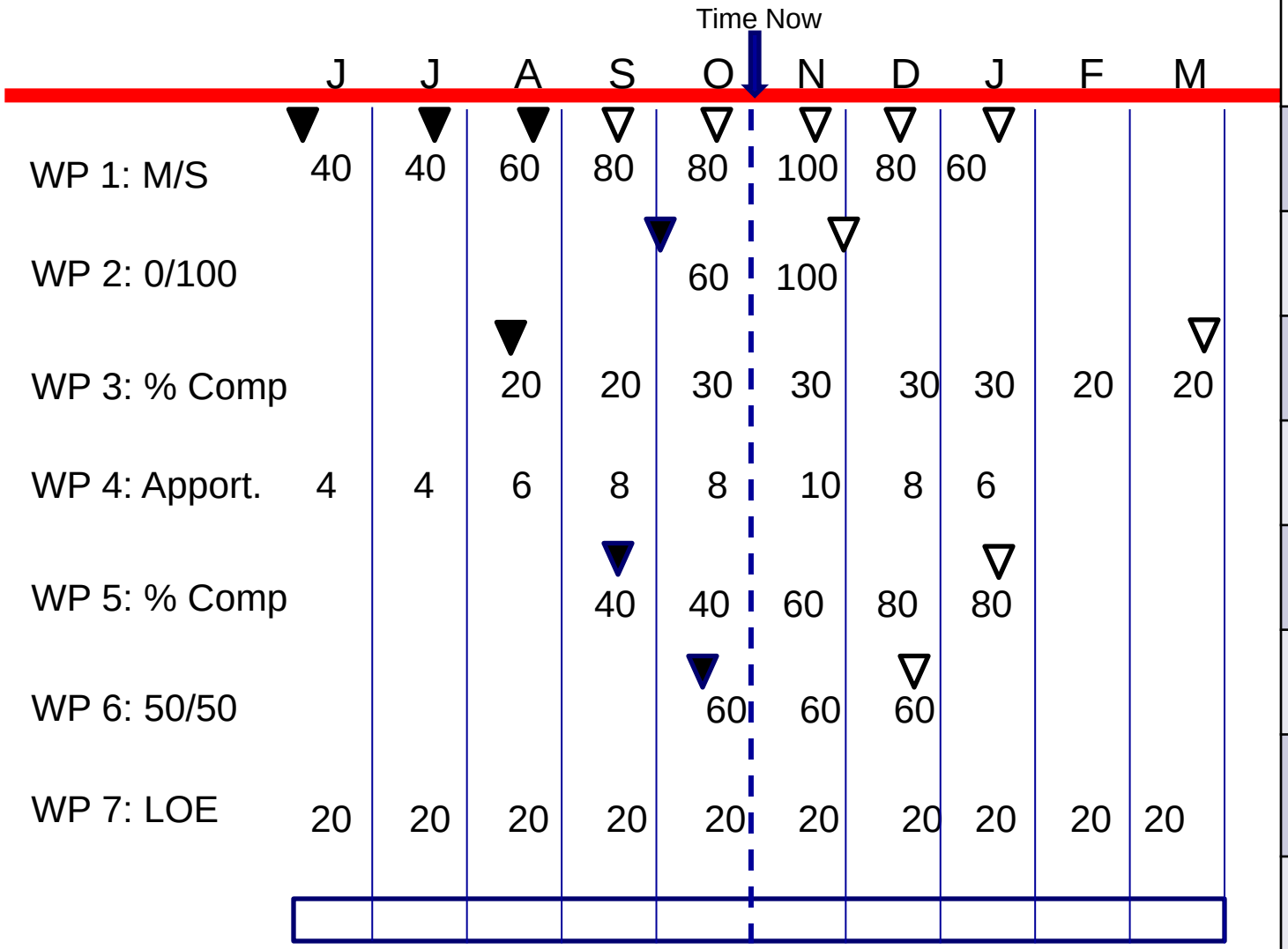
Given:

1. Time now is the end of October
2. WP 3 reported a total % complete last month 10% and this month is now 15% complete
3. WP 4 is apportioned against WP 1 @ 10%
4. WP 5 reported a total % complete last month of 10% and this month is now 20% complete
5. All of the filled in milestones (▼) were completed in the scheduled month,
6. Actual hours charged in October were 300 and cumulative-to-date are 650.

Questions:

1. What is the BAC for the Control Account?
2. What is the BCWP for the month of October for the Control Account?
3. What is the BCWP cumulative to date for the Control Account?
4. What are the current period and cumulative to date cost and schedule variances

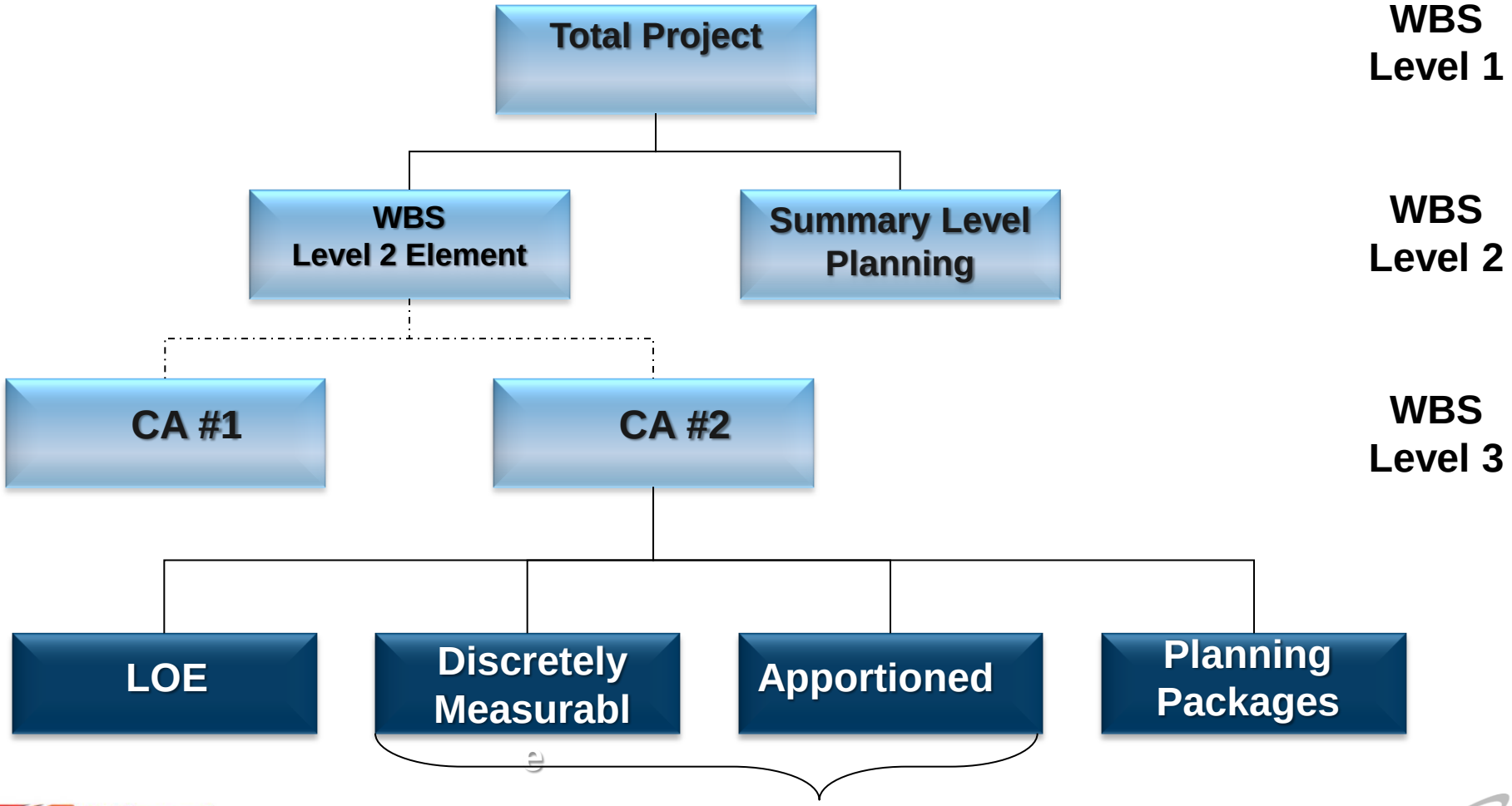
Control Account Plan



BAC	BCWP Oct.	BCWP Cum to Date

Month					
Cum					
	BCWS	BCWP	ACWP	SV	CV

Planning and Budgeting: Identify Work Packages, LOE, Apportioned Effort



Planning Package Concept

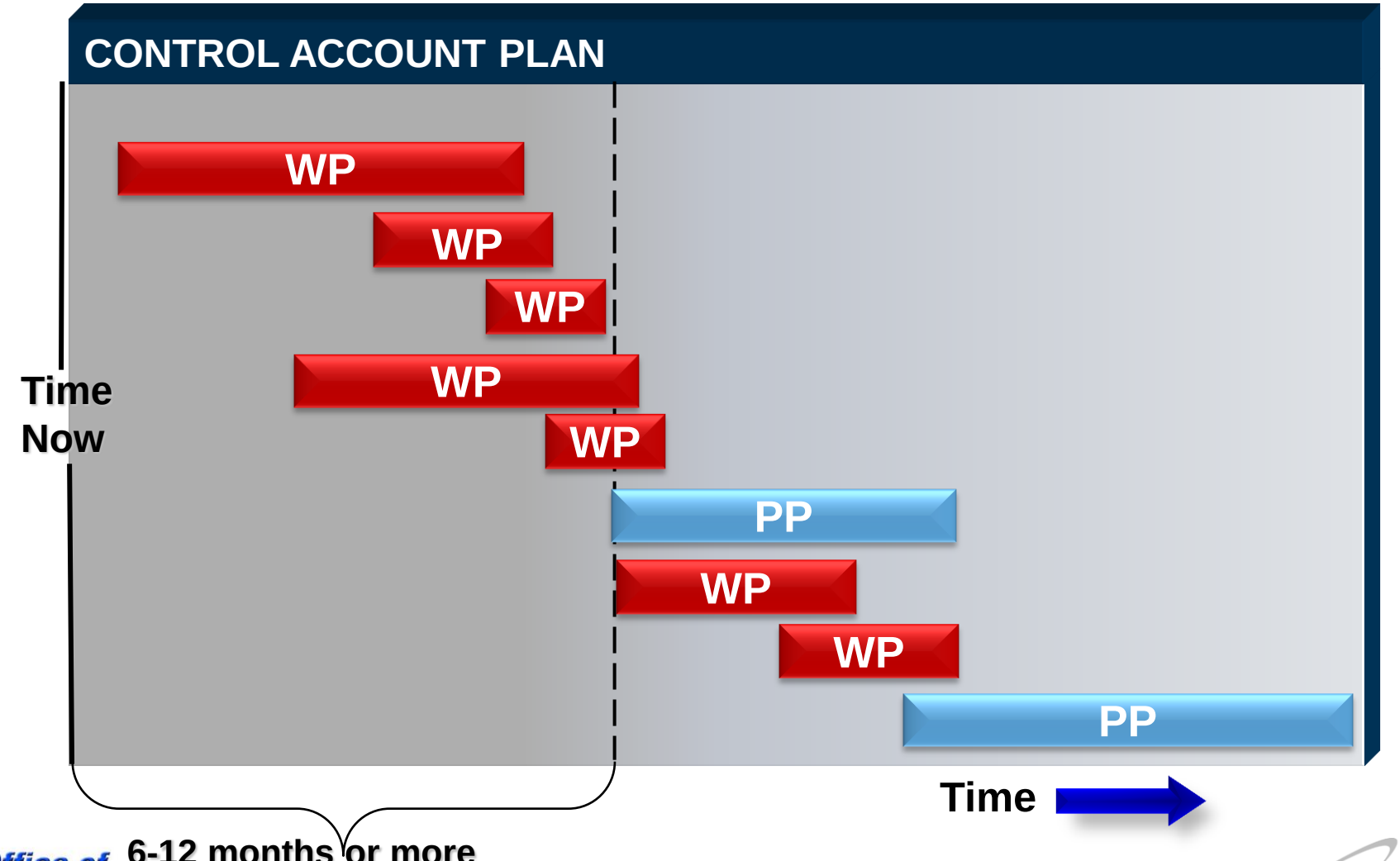
Planning Package: *A planning package represents future work that cannot be defined into specific work packages, or for which there is insufficient information to make detail planning practical.*

- Higher-level scope of work (less detail)
- Specific schedule with start and end dates
- Time-phased budget (at higher level of detail)
- Consistent with CA budget, schedule, and scope of work requirements
- Usually longer in duration than work packages
- For planning only, no performance measurement or actual cost collection
- Broken down into work packages over time

Rolling Wave Concept

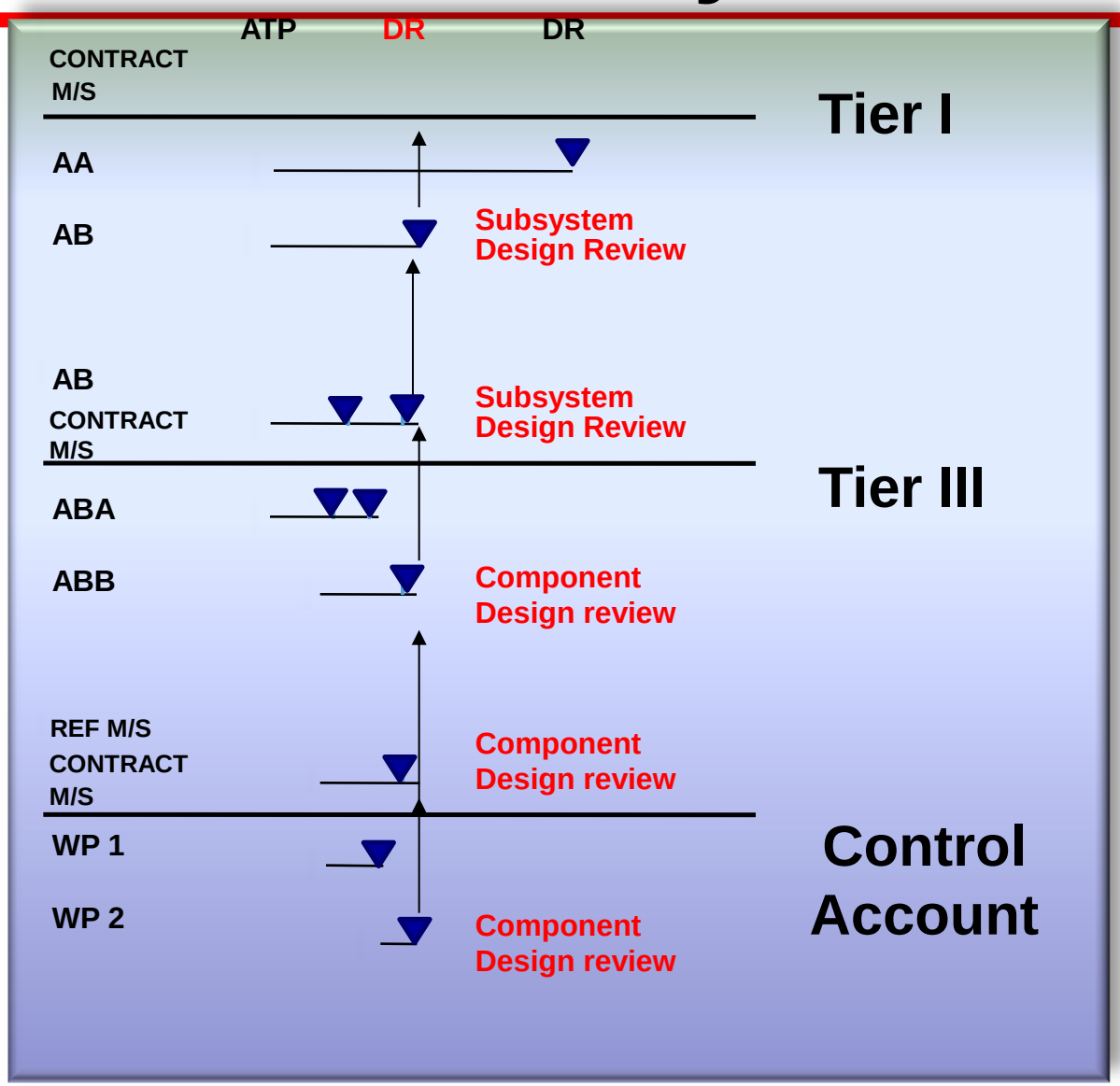
- All work is planned in the timeframe in which it is expected to be accomplished
- Work that cannot readily be planned in detailed work packages is planned in planning packages
- CA plans generally include the next 1-3 months of work detail, planned as work packages
- Planning packages are re-planned as work packages as soon as possible
  - Certainly before the work enters the current reporting period

Rolling Wave Planning



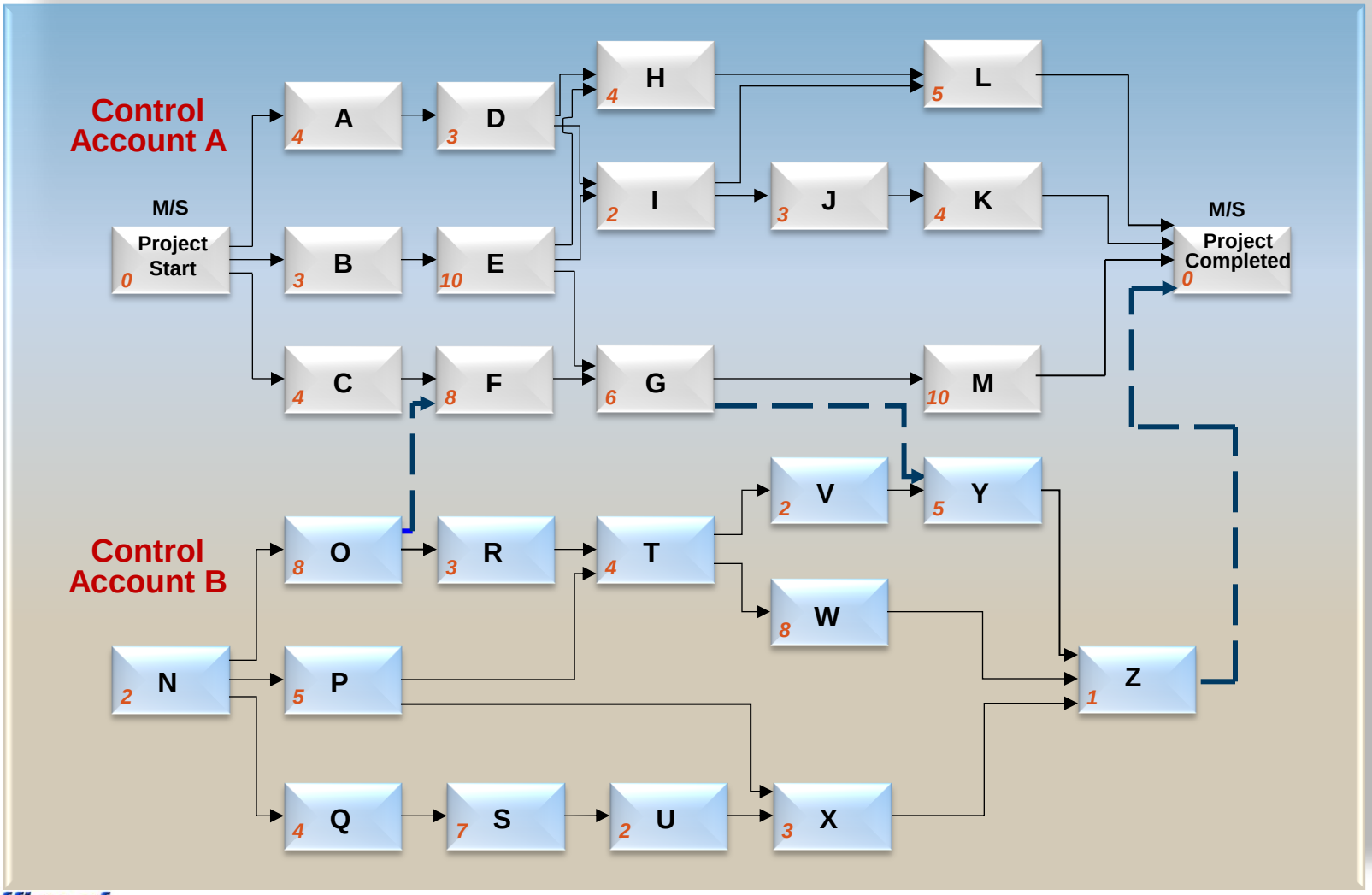
Vertical Traceability

Consistency Between Different Levels of Detail

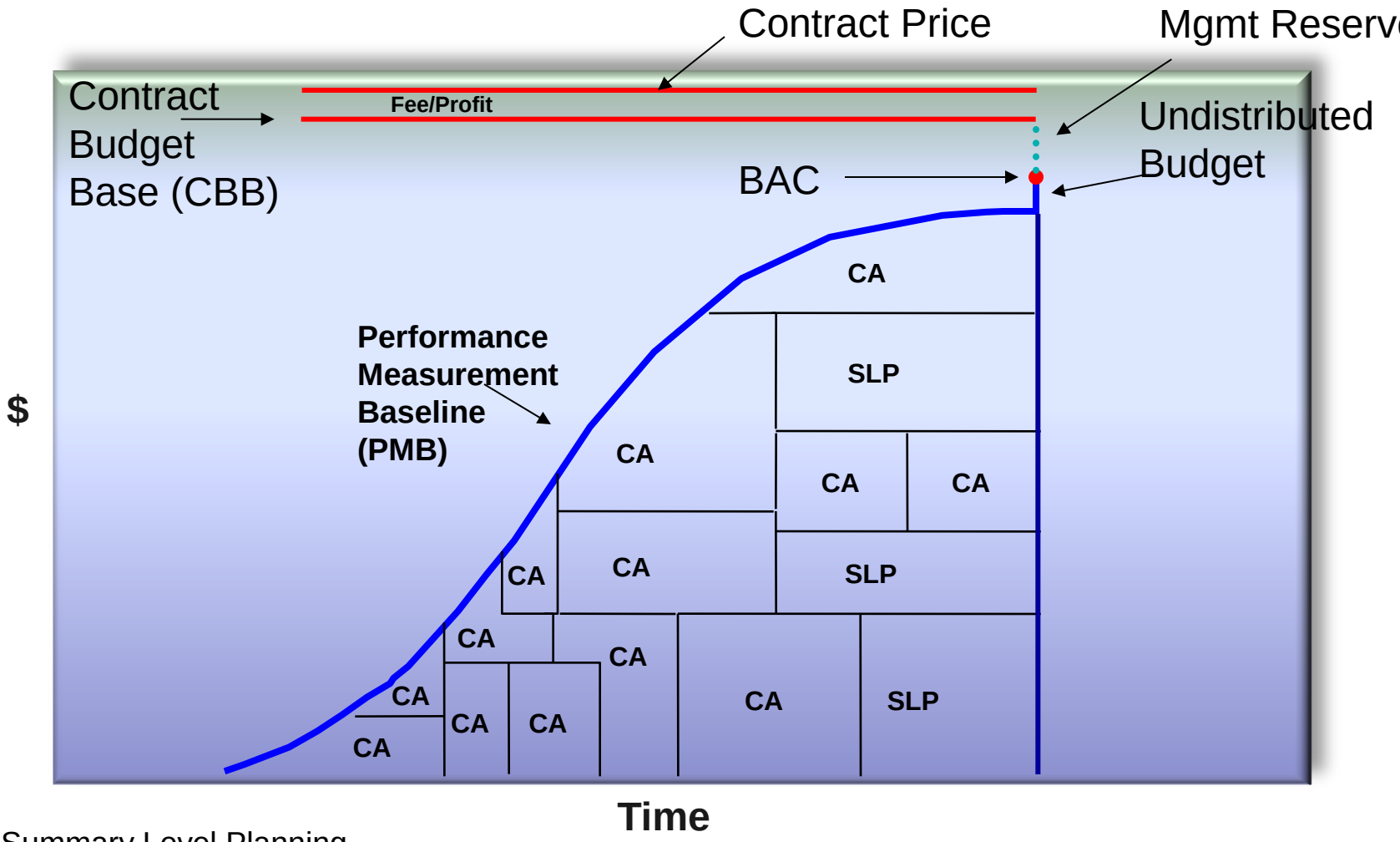


Horizontal Traceability

Consistency at the Same Level of Detail

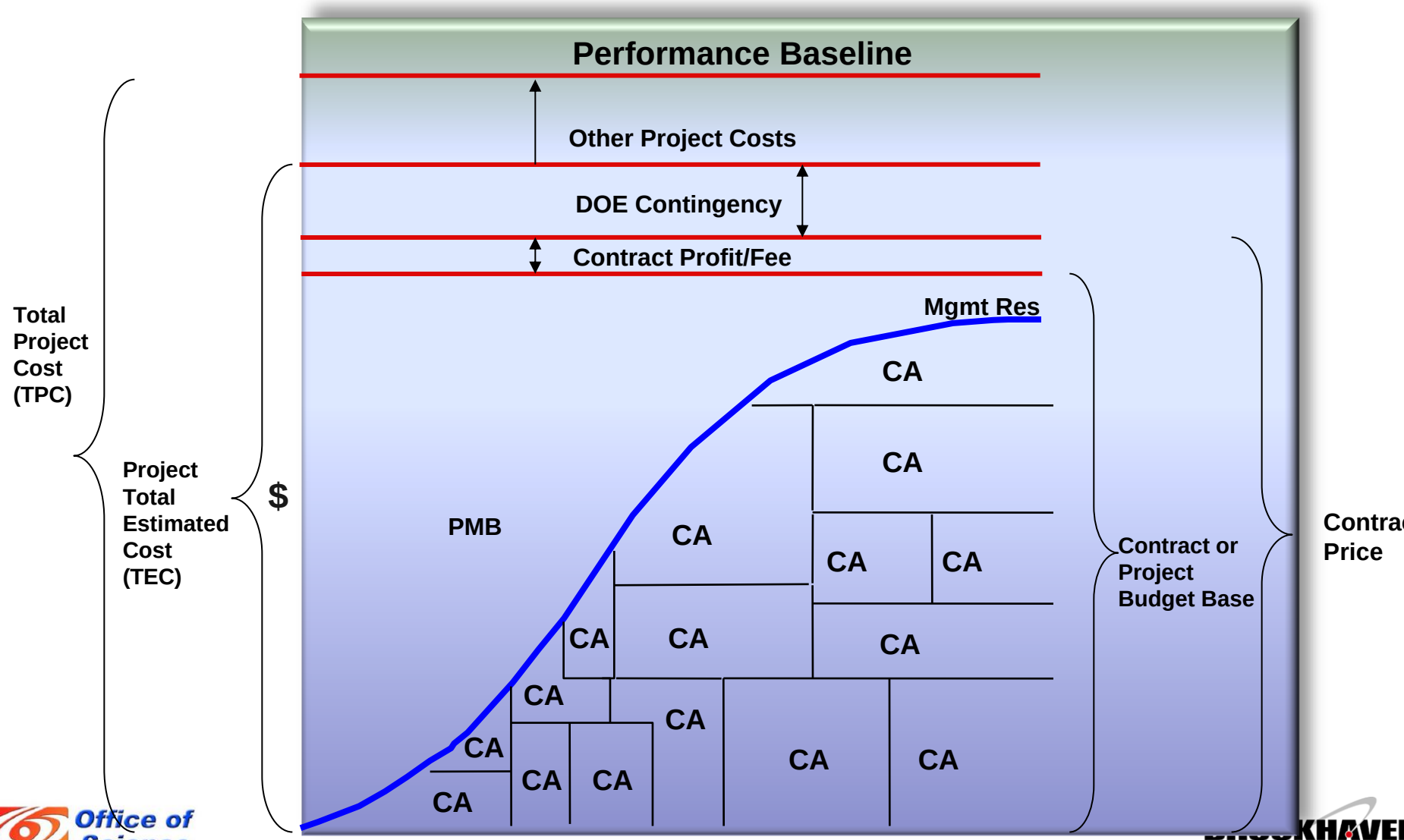


Budget Relationships in EVMS

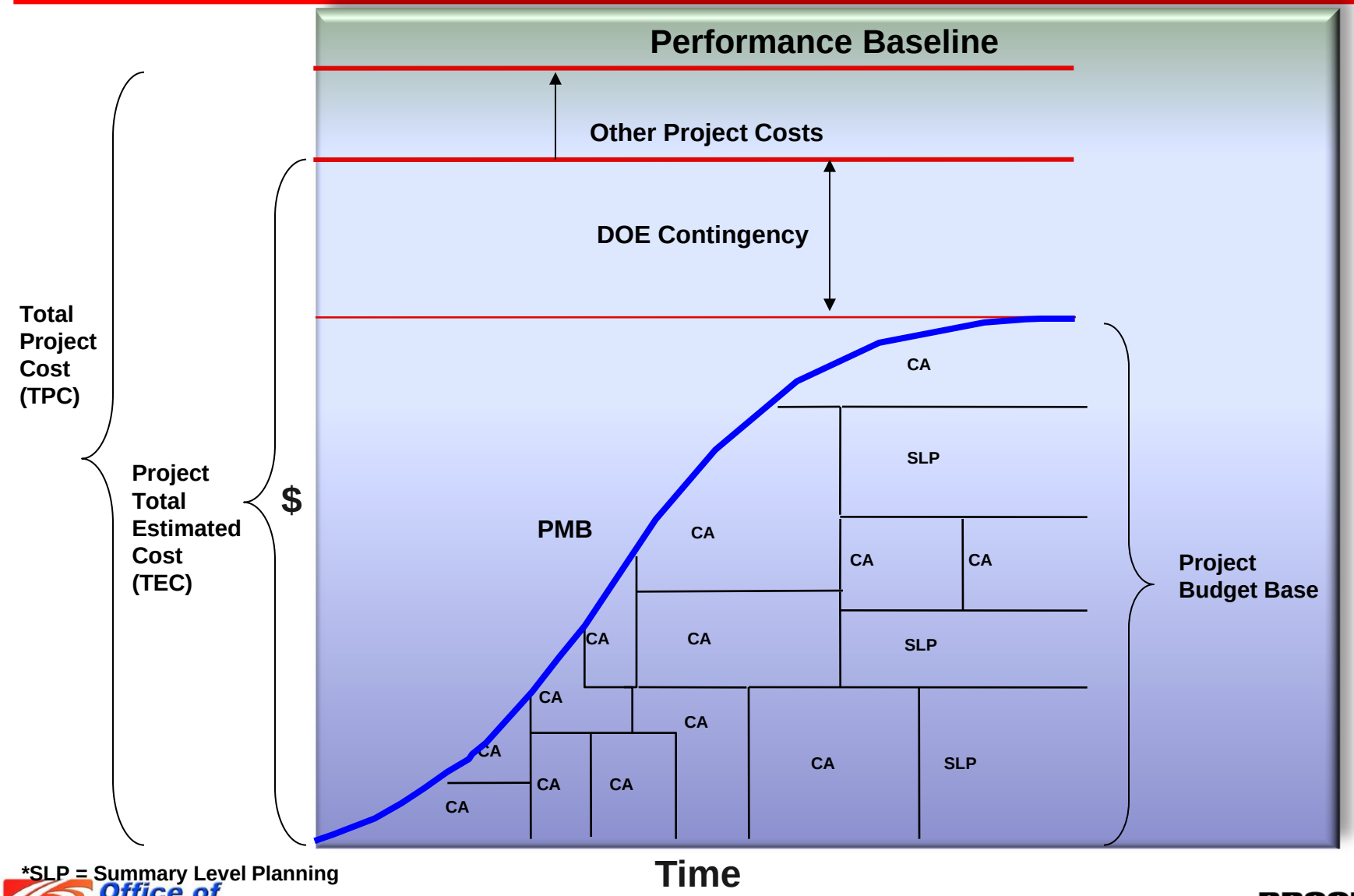


*SLP = Summary Level Planning

DOE Budget Relationships



DOE Budget Relationships – Operating Contract



*SLP = Summary Level Planning

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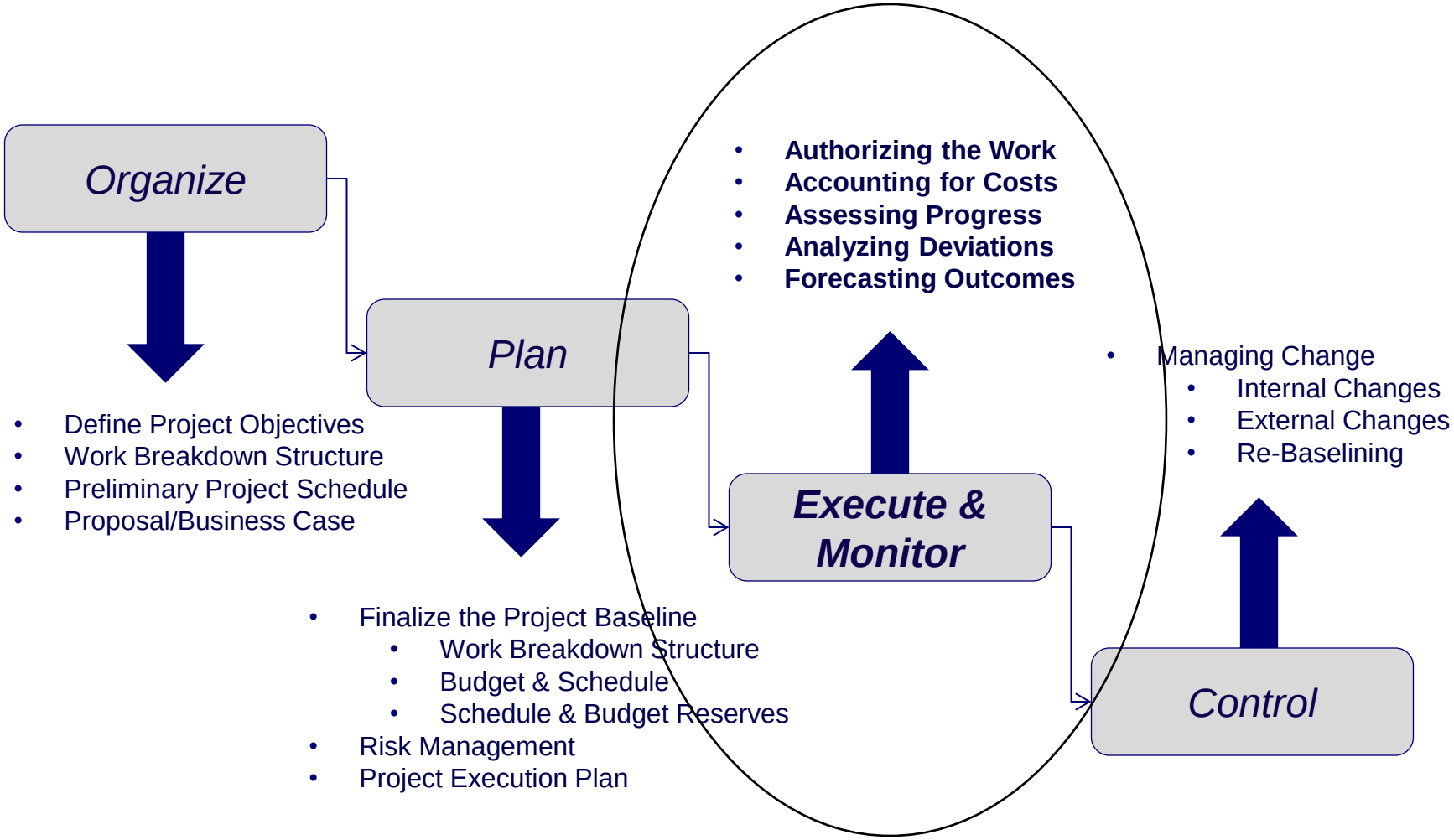
EVMS Processes



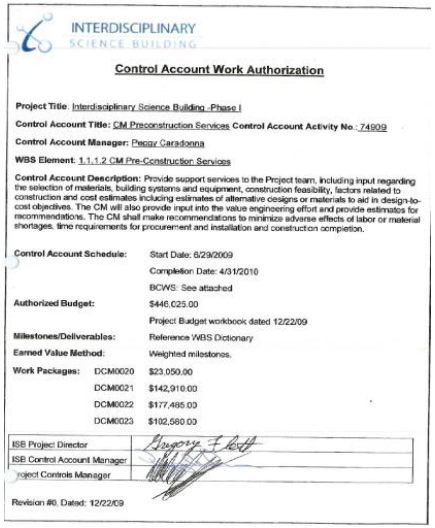
Work authorization

- Formal WA required in order to ensure that:
  - All/only effort required by the project is performed; and
  - A meaningful plan is in place for all work

Work authorization

Approved Project Execution Plan

Approved CA WAD



INTERDISCIPLINARY SCIENCE BUILDING

Control Account Work Authorization

Project Title: Interdisciplinary Science Building -Phase I

Control Account Title: CM Preconstruction Services **Control Account Activity No.:** 74909

Control Account Manager: Peggy Caradonna

WBS Element: 1.1.1.2 CM Pre-Construction Services

Control Account Description: Provide support services to the Project team, including input regarding the selection of materials, building systems and equipment, construction feasibility, factors related to construction and cost estimates including estimates of alternative designs or materials to aid in design-to-cost objectives. The CM will also provide input into the value engineering effort and provide estimates for recommendations. The CM shall make recommendations to minimize adverse effects of labor or material shortages, time requirements for procurement and installation and construction completion.

Control Account Schedule:		Start Date: 6/29/2009
		Completion Date: 4/31/2010
		BCWS: See attached
Authorized Budget:		$446,025.00
		Project Budget workbook dated 12/22/09
Milestones/Deliverables:		Reference WBS Dictionary
Earned Value Method:		Weighted milestones.
Work Packages:	DCM0020	$23,050.00
	DCM0021	$142,910.00
	DCM0022	$177,485.00
	DCM0023	$102,580.00

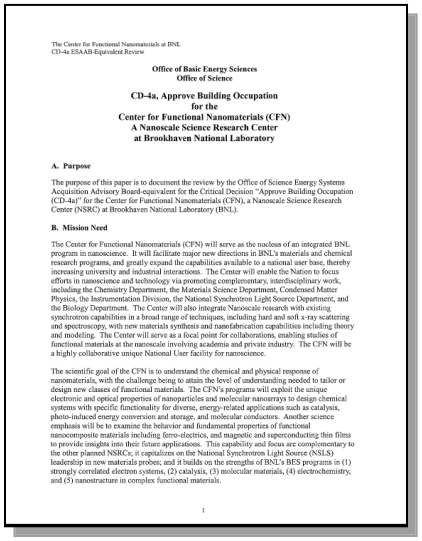
ISB Project Director

ISB Control Account Manager

Project Controls Manager

Revision #0, Dated: 12/22/09

Subcontract/PO



The Center for Functional Nanomaterials at BNL
CD-4a ESAAB-Equivalent Review

Office of Basic Energy Sciences
Office of Science

CD-4a, Approve Building Occupation
for the
Center for Functional Nanomaterials (CFN)
A Nanoscale Science Research Center
at Brookhaven National Laboratory

A. Purpose

The purpose of this paper is to document the review by the Office of Science Energy Systems Acquisition Advisory Board-equivalent for the Critical Decision "Approve Building Occupation (CD-4a)" for the Center for Functional Nanomaterials (CFN), a Nanoscale Science Research Center (NSRC) at Brookhaven National Laboratory (BNL).

B. Mission Need

The Center for Functional Nanomaterials (CFN) will serve as the nucleus of an integrated BNL program in nanoscience. It will facilitate major new directions in BNL's materials and chemical research programs, and greatly expand the capabilities available to a national user base, thereby increasing university and industrial interactions. The Center will enable the Nation to focus efforts in nanoscience and technology via promoting complementary, interdisciplinary work, including the Chemistry Department, the Materials Science Department, Condensed Matter Physics, the Instrumentation Division, the National Synchrotron Light Source Department, and the Biology Department. The Center will also integrate Nanoscale research with existing synchrotron capabilities in a broad range of techniques, including hard and soft x-ray scattering and spectroscopy, with new materials synthesis and nanofabrication capabilities including theory and modeling. The Center will serve as a focal point for collaborations, enabling studies of functional materials at the nanoscale involving academia and private industry. The CFN will be a highly collaborative unique National User facility for nanoscience.

The scientific goal of the CFN is to understand the chemical and physical response of nanomaterials, with the challenge being to attain the level of understanding needed to tailor or design new classes of functional materials. The CFN's programs will exploit the unique electronic and optical properties of nanoparticles and molecular nanoarrays to design chemical systems with specific functionality for diverse, energy-related applications such as catalysis, photo-induced energy conversion and storage, and molecular conductors. Another science emphasis will be to examine the behavior and fundamental properties of functional nanocomposite materials including ferro-electrics, and magnetic and superconducting thin films to provide insights into their future applications. This capability and focus are complementary to the other planned NSRCs; it capitalizes on the National Synchrotron Light Source (NSLS) leadership in new materials probes; and it builds on the strengths of BNL's BES programs in (1) strongly correlated electron systems, (2) catalysis, (3) molecular materials, (4) electrochemistry, and (5) nanostructure in complex functional materials.

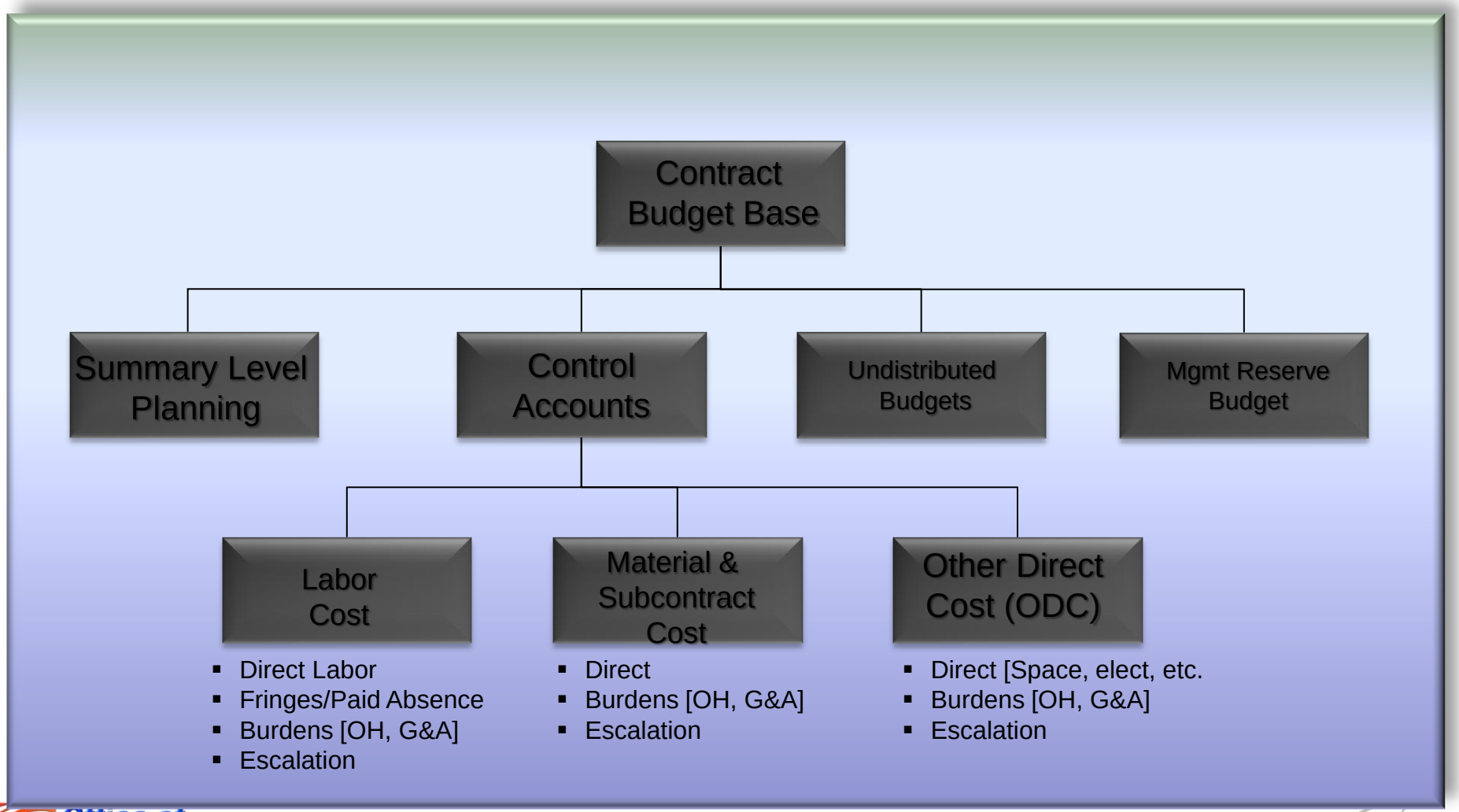
1

- Identifies the organization, plans, and systems used to manage project
  - ✓ Identifies the mission need
  - ✓ Defines project scope, cost and schedule
  - ✓ From project planning to project completion to operations
- Complies with DOE 413.3B
- Complies with BSA/BNL's EVMS

- ✓ Agreement between CAM and Project Director
- ✓ Documents delegation of work to CAM
- ✓ Scope, schedule and budget authorized
- ✓ Changes made through formal Change Control
- ✓ Allocates incremental funding

- ✓ Agreement between BNL and subcontractors, suppliers, vendors
- ✓ Documents Scope, schedule and dollars authorized
- ✓ Changes made through formal Change Control

Cost Components



Application of Rates

	Labor Hours	Direct $	Fully Loaded
$BCWS_{CUM}$	100	$5.0 K	$10.0 K
$BCWP_{CUM}$	80	$4.0 K	$8.0 K
$ACWP_{CUM}$	90	$4.7 K	$9.8 K

BCWS/P Rates = $50/Hr (Labor), 100% OH
ACWP Rates = $52/Hr (Labor), 110% OH

Material Performance Measurement

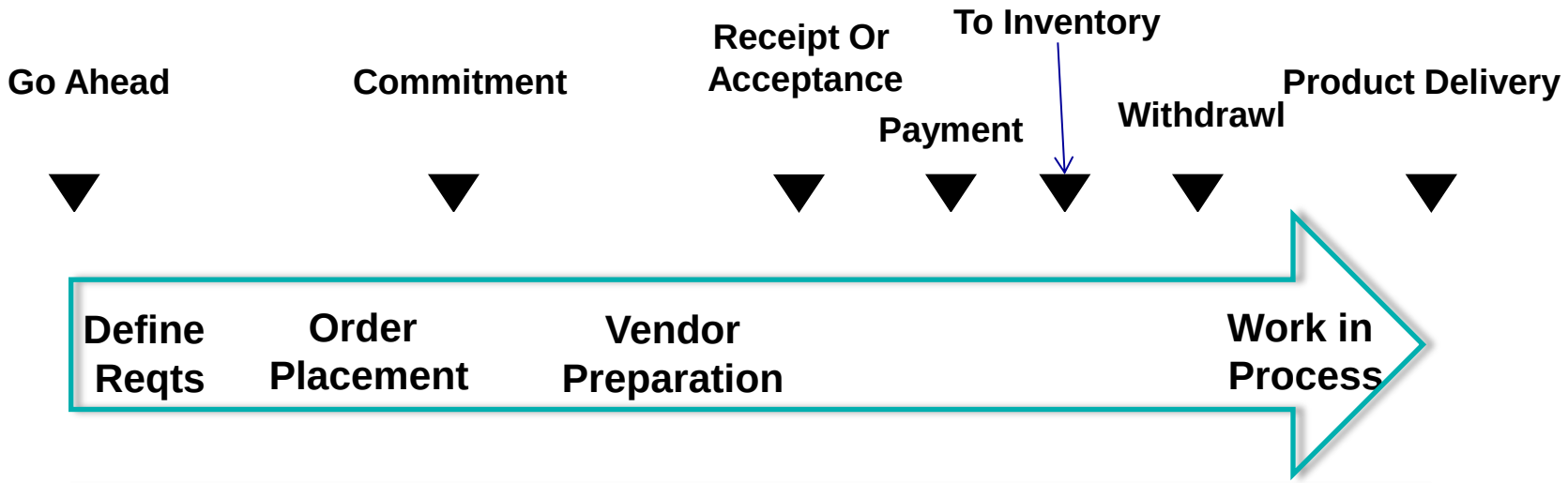
Four Key Assumptions:

- ***Adequate purchasing capability***
- ***Adequate inventory management***
- ***Accounting for commitments***
- ***Accounting for booked material costs***

Thus…

- True purpose is **not** materials/inventory management but visibility into program progress.
- Therefore, material considered a resource to be expended toward accomplishing project work.

Planning Material BCWS



- When should BCWP be taken?
- Answer drives BCWS timing

EV for Material Items: Accruals are Essential!

	J	F	M
BCWS	$10K		
BCWP	$10K		
ACWP	$ 0K	$10K	

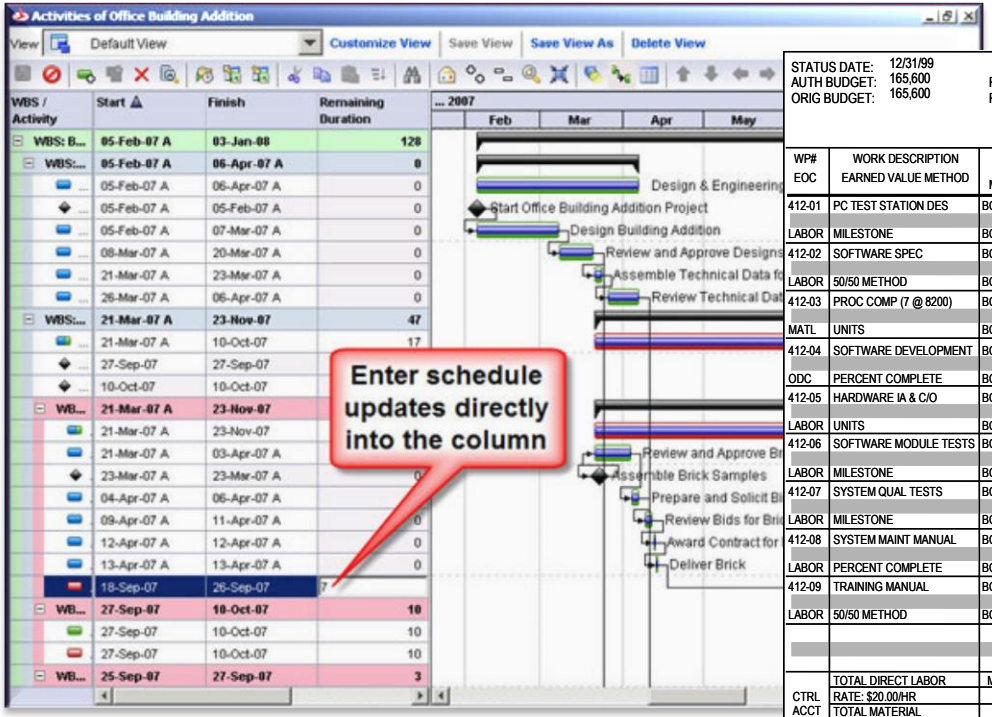
CV= +$10k

CV= -$10k

- **At BNL**:
  - Material purchases accrued automatically
  - Subcontracts and outside services require CAM involvement!

Measure Progress By

- Update integrated project schedule
- Record earned value



CONTROL ACCOUNT PLAN — PAGE: 1 OF 1

STATUS DATE: 12/31/99 | REV LEVEL: INIT. | CTRL ACCT TITLE: PC TEST STATION | WBS: 4.1.2
AUTH BUDGET: 165,600 | REV DATE: 4/1/99 | CTRL ACCT MGR: WILL SPENDUM | DEPT: 43
ORIG BUDGET: 165,600

TIME-PHASED CONTROL ACCOUNT PLAN

WP# / EOC	WORK DESCRIPTION / EARNED VALUE METHOD	MHRS	1999 JUN	JUL	AUG	SEP	OCT	NOV	DEC	2000 JAN	FEB	MAR	APR	MAY	PAGE TOTAL
412-01	PC TEST STATION DES	BCWS	160 a	160 b	160 c	160 d									640
LABOR	MILESTONE	BCWP													
412-02	SOFTWARE SPEC	BCWS		160 e	160 f										320
LABOR	50/50 METHOD	BCWP													
412-03	PROC COMP (7 @ 8200)	BCWS					8200 (1)	24600 (3)	24600 (3)						57400
MATL	UNITS	BCWP													
412-04	SOFTWARE DEVELOPMENT	BCWS				9680	9680	9680							29040
ODC	PERCENT COMPLETE	BCWP													
412-05	HARDWARE IA & C/O	BCWS					40 (1)	120 (3)	120 (3)						280
LABOR	UNITS	BCWP													
412-06	SOFTWARE MODULE TESTS	BCWS								320 g	320 h	320 i			960
LABOR	MILESTONE	BCWP													
412-07	SYSTEM QUAL TESTS	BCWS										320 j	320 k	320 l	960
LABOR	MILESTONE	BCWP													
412-08	SYSTEM MAINT MANUAL	BCWS								160	160	160			480
LABOR	PERCENT COMPLETE	BCWP													
412-09	TRAINING MANUAL	BCWS											160	160	320
LABOR	50/50 METHOD	BCWP													
CTRL ACCT PLAN DATA	TOTAL DIRECT LABOR	MHRS	160	320	320	160	40	120	120	480	480	800	480	480	3960
	RATE: $20.00/HR	K$	3.2	6.4	6.4	3.2	0.8	2.4	2.4	9.6	9.6	16.0	9.6	9.6	79.2
	TOTAL MATERIAL	K$	0.0	0.0	0.0	0.0	8.2	24.6	24.6	0.0	0.0	0.0	0.0	0.0	57.4
	TOTAL OTHER COSTS	K$	0.0	0.0	0.0	9.7	9.7	9.7	0.0	0.0	0.0	0.0	0.0	0.0	29.0
	CTRL ACCT MO. TOTAL	K$	3.2	6.4	6.4	12.9	18.7	36.7	27.0	9.6	9.6	16.0	9.6	9.6	165.6
	CTRL ACCT CUM TOTAL	K$	3.2	9.6	16.0	28.9	47.6	84.2	111.2	120.8	130.4	146.4	156.0	165.6	

SCHEDULE MILESTONE LEGEND

a - TEST STA. LAYOUT DWGS
b - FACILITY INTERFACE DWGS
c - ELECTRICAL SCHEMATICS
d - RELEASE DRAWING PKG
e - SOFTWARE REQS OUTLINE
f - RELEASE SPECIFICATION
g - COMPL MODULE 1 TESTS
h - COMPL MODULE 2 TESTS
i - COMPL MODULE 3 TESTS
j - FUNCT'L TEST COMPLETE
K - SYSTEM RELIABILITY CMPLT
l - MAINTENANCE DEMO CMPLT

MILESTONE FORMATS
△ SCHEDULED EVENT
▲ COMPLETED EVENT
◇ FORECAST CHANGE
◬ CONTROL MILESTONE

AUTHORIZING SIGNATURES
CAM:
FM:
PP&C:
PM:

Monthly Status Meetings

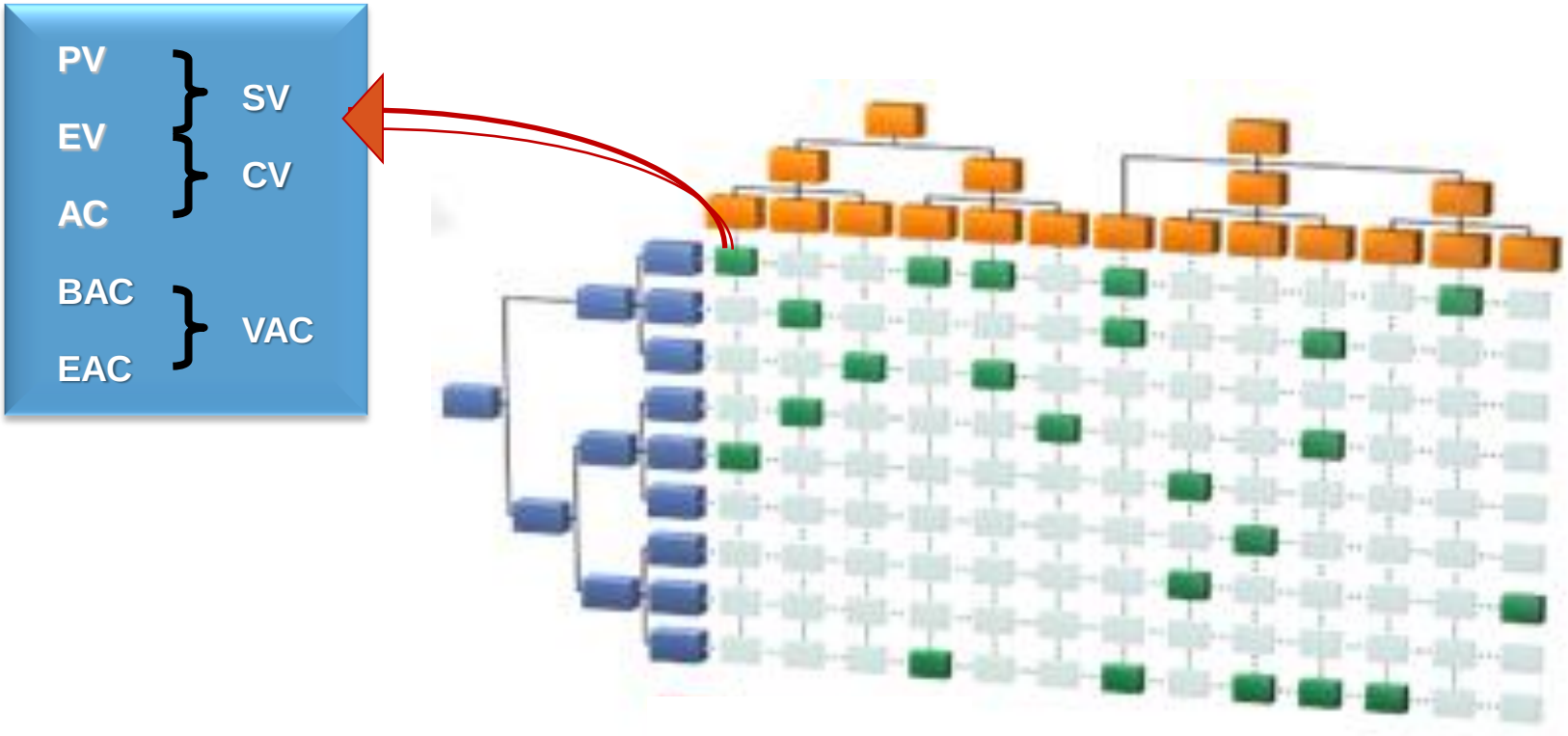
- Monthly Status Meetings to:
  - Discuss Schedule Status
  - Current and upcoming Procurement Status
  - Discuss Estimates at Completion
- Attendees:
  - CAM
  - Project Controls
  - Procurement
  - Budget Office

STANDING MONTHLY SCHEDULE UPDATE MEETINGS ***Building 830NM – Conference Room 1***		
2011 DATE	TIME/EACH MONTH	NAME
December 1	9:00 – 9:30 a.m.	Toshi Tanabe
	9:30 – 10:00 a.m.	Scott Buda
	10:00 – 10:30 a.m.	Bob Dalesio
	11:30 – 12:00 p.m.	Om Singh
	1:00 – 1:30 p.m.	Timur Shaftan
	1:30 – 2:00 p.m.	Sushil Sharma/Lewis Doom
	2:30 – 3:00 p.m.	Dick Hseuh
	3:00 – 3:30 p.m.	Jim Rose

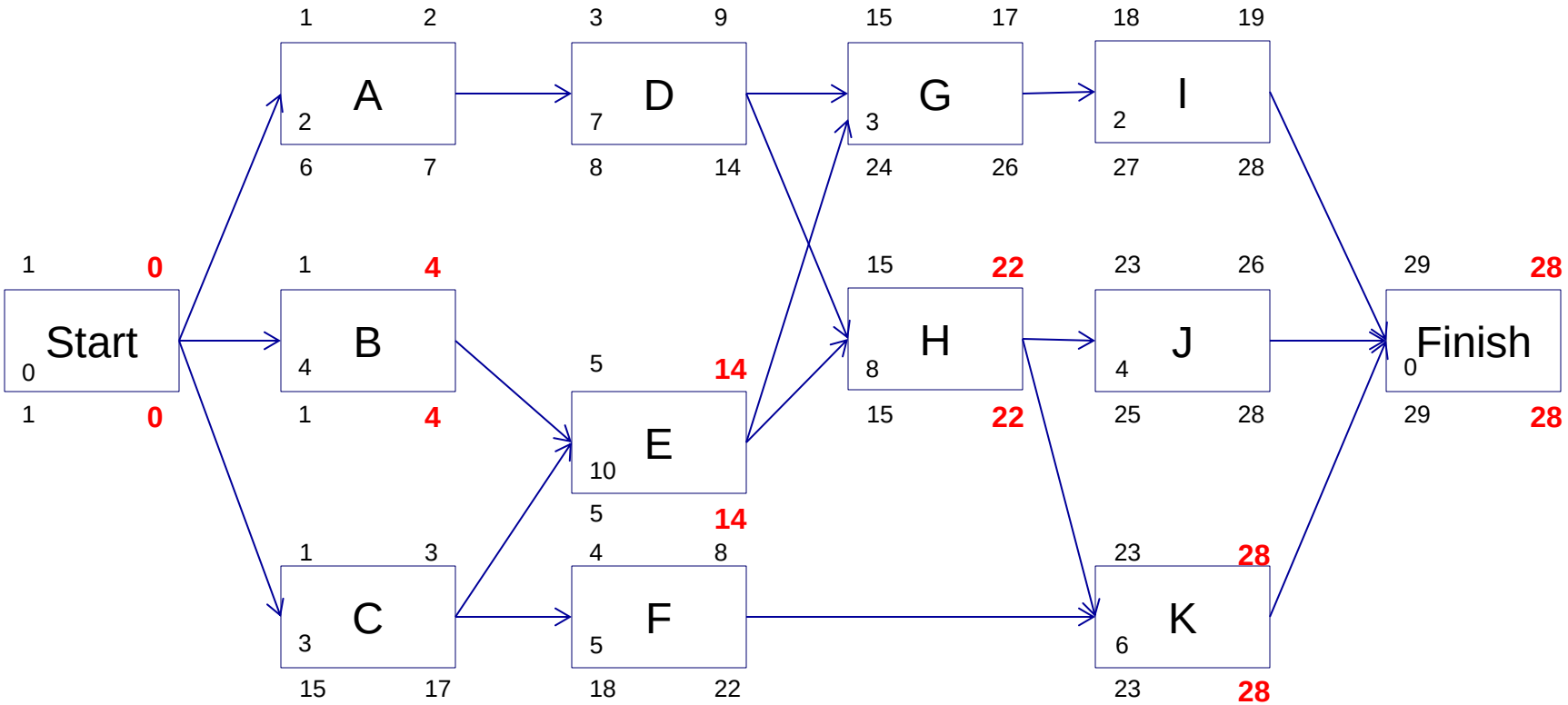
Scheduling Status Questions

- When did activity/WP start?
- If scheduled start date has passed, when will it start?
- What is task's physical % complete based on assigned EV technique?
- When did activity finish?
- When will activity finish?
- What resources will be required to finish?

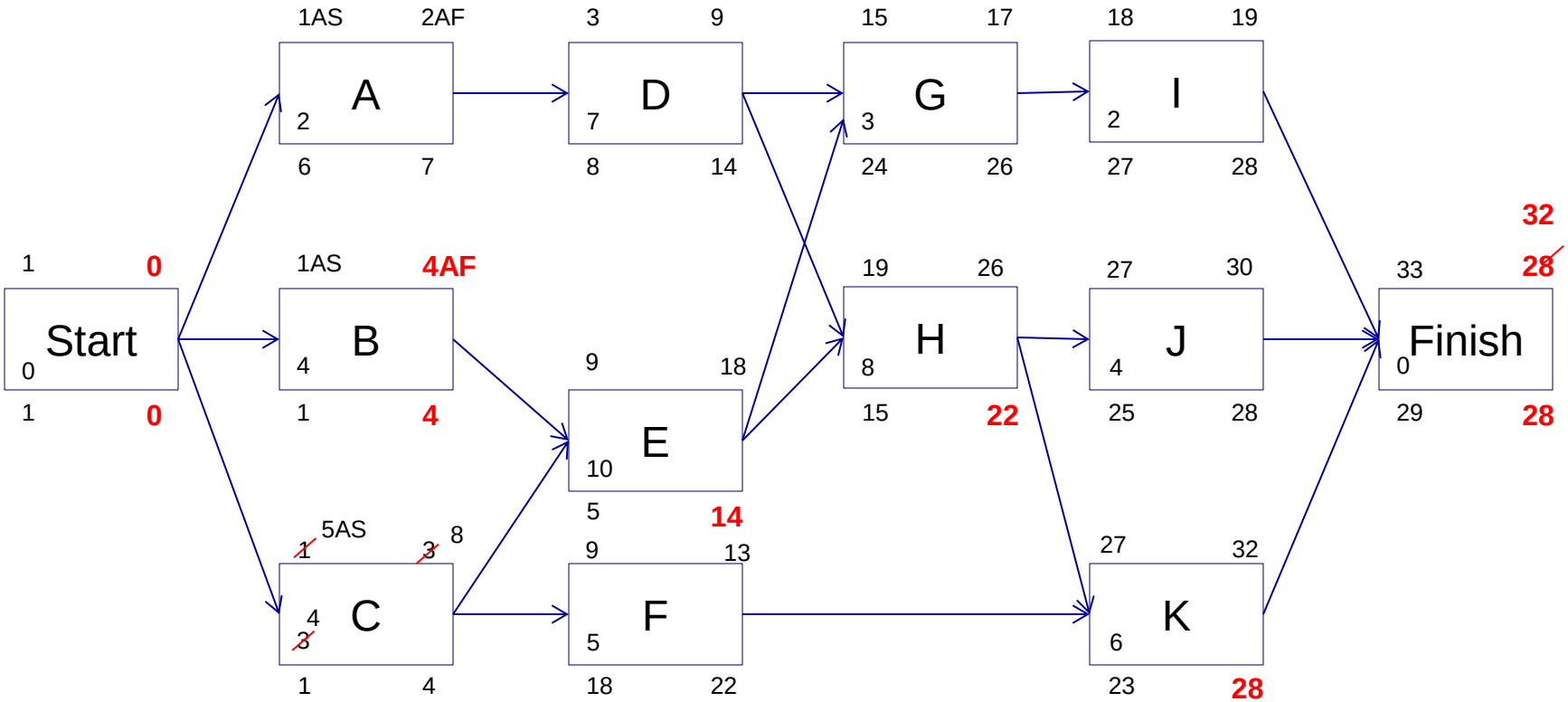
Data Accumulation



Progress Updates



Progress Updates



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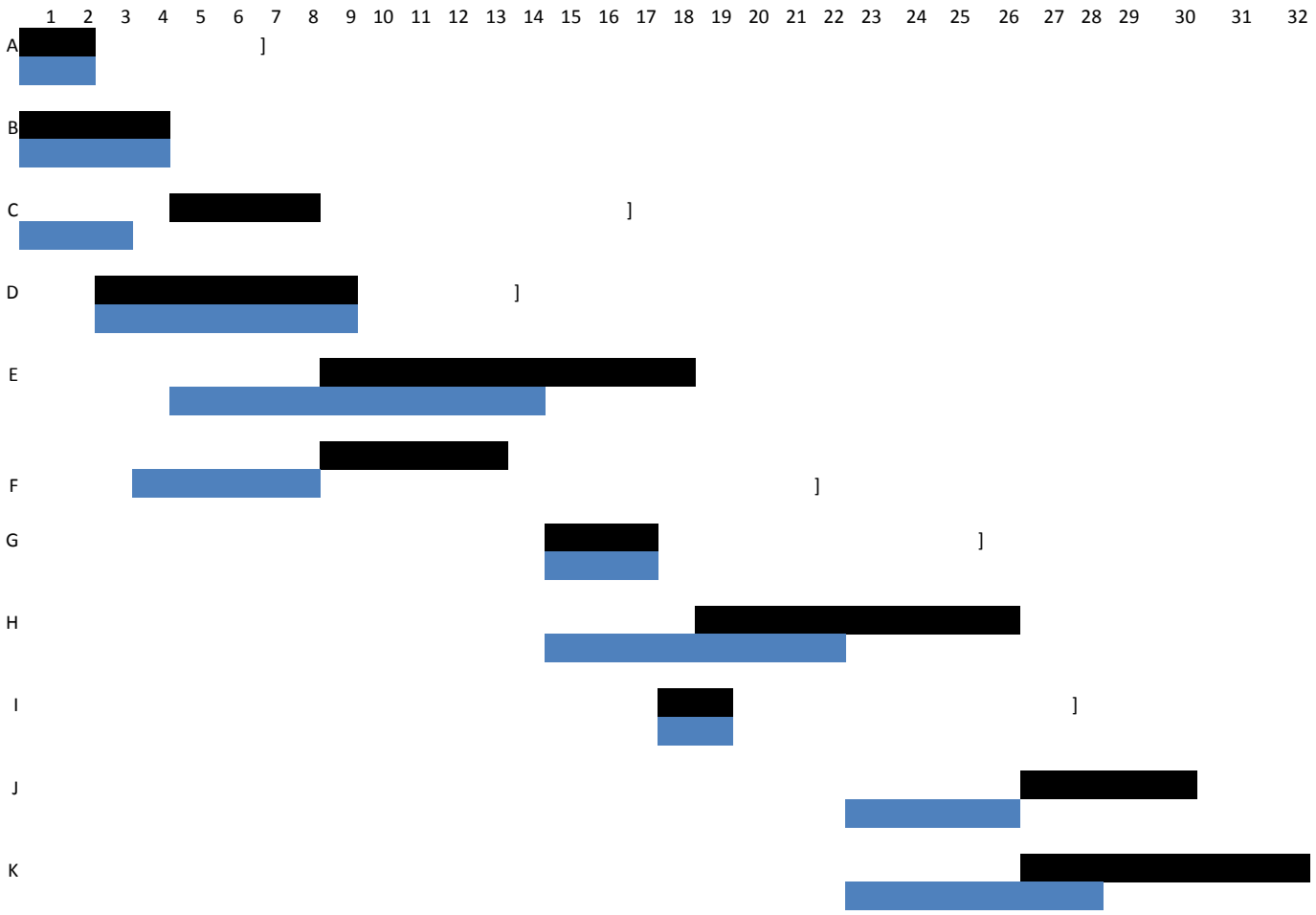
Baseline Vs. Current schedule



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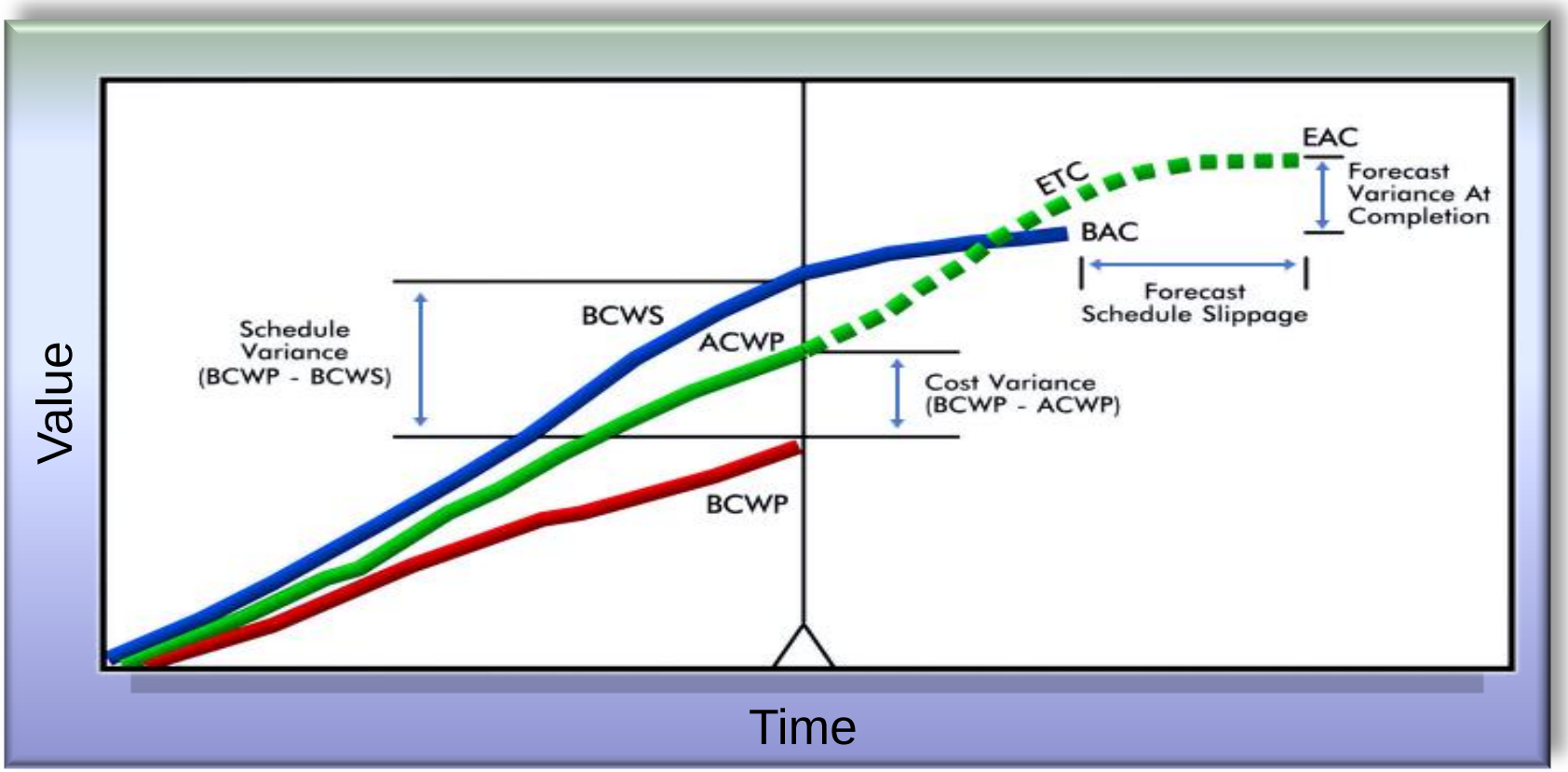
Variance Analysis



Monthly Reports posted to IPD

IPD - Windows Internet Explorer

http://ipd.ls.bnl.gov/overview/reports.aspx

Light Sources DIRECTORATE — INTEGRATED PROJECT DATA — BROOKHAVEN NATIONAL LABORATORY

- Home
- Project Overview
- Project Overview Home
- Cobra Reports
- WBS
- WBS Dictionary
- OBS
- RAM

Project Overview

Title:	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Monthly Status Report							
Cost Performance Report							
Time Phased Plan By Control Account							
EVMS Project Level Status							
EVMS 1.1 Status - Project Management							
EVMS 1.2 Status - R&D							
EVMS 1.3 Status - Accelerator							
EVMS 1.4 Status - Experimental							
EVMS 1.5 Status - Conventional							
EVMS 1.6 Status - PreOp							
Summary Schedule							
Milestone Schedule							
Schedule Detail							
Critical Path							
Near Critical Path							
WBS Summary Level 3							
90 Day Look-ahead Schedule - Accelerator Systems							
90 Day Look-ahead Schedule - Experimental Systems							
90 Day Look-ahead Schedule - Conventional							
WBS Dictionary							
Summary Cartoon Schedule							
Significant Procurements Schedule							
Significant Procurements - APP Org							
Ring-building Contractor Schedule							
LOB Contractor Schedule							

National Synchrotron Light Source II

Project Progress Report

January 2013 Activity

Noontime sun spotlights the NSLS-II facility; January 31, 2013.

report due date:
February 20, 2013

Steve Dierker
NSLS-II Project Director

Brookhaven National Laboratory
Upton, New York 11973

BROOKHAVEN NATIONAL LABORATORY

Office of Science
U.S. DEPARTMENT OF ENERGY

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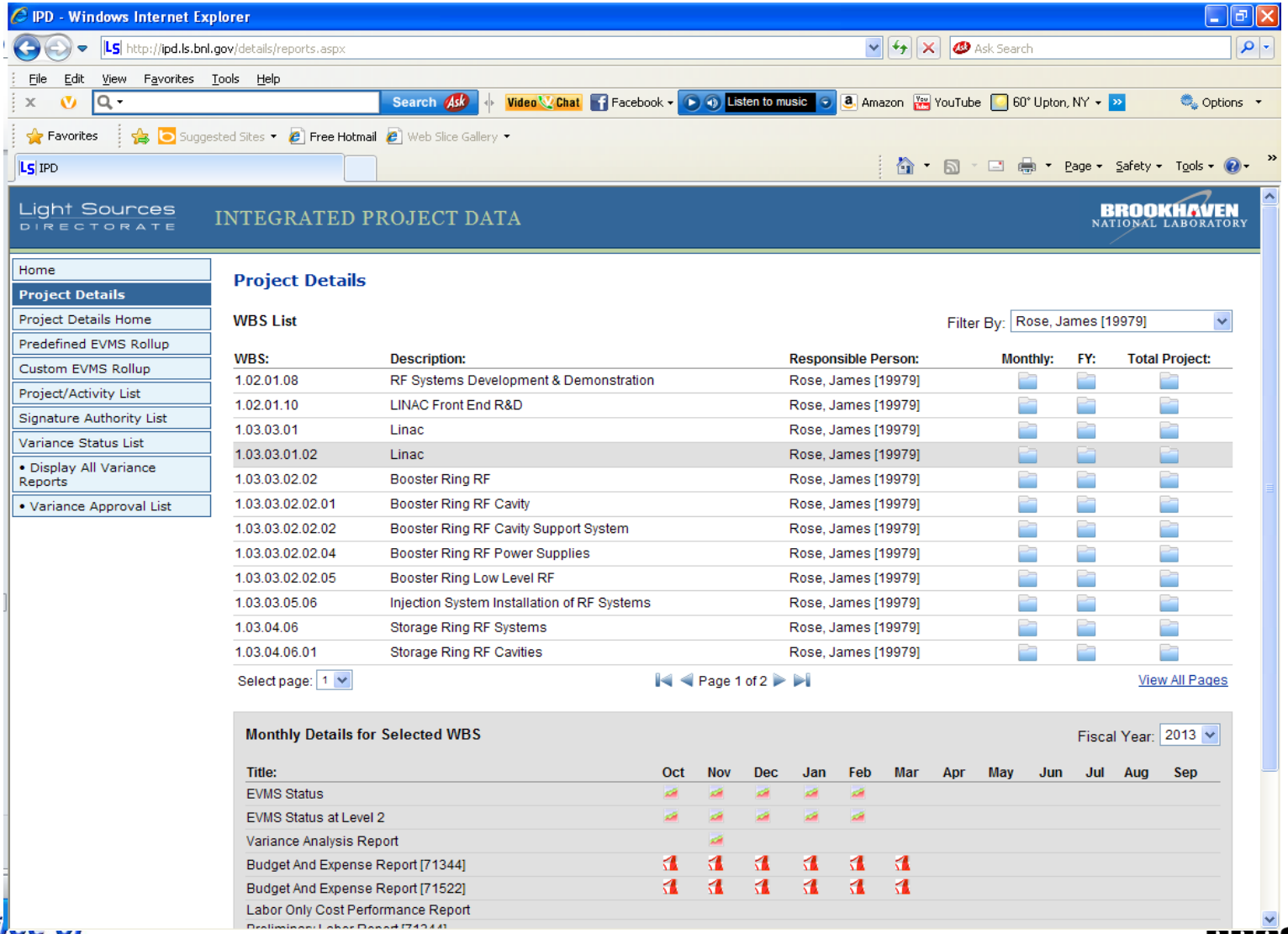
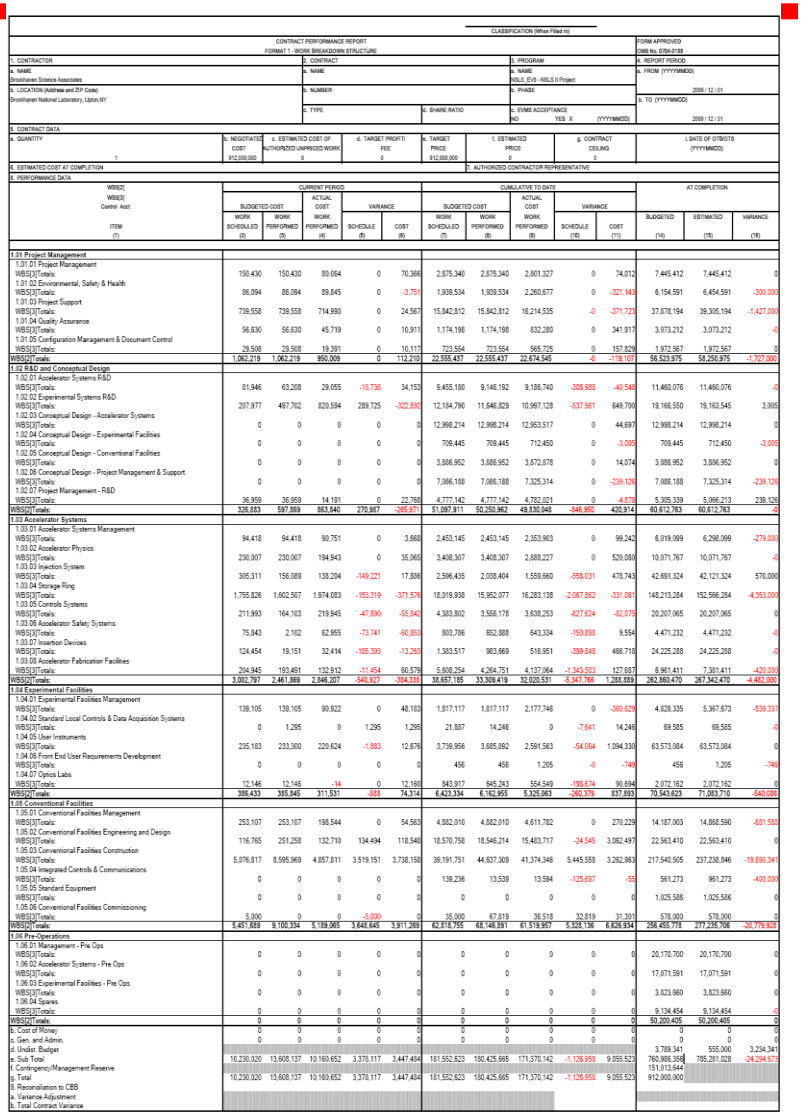
BROOKHAVEN NATIONAL LABORATORY
BROOKHAVEN SCIENCE

Monthly Reports by Control Account

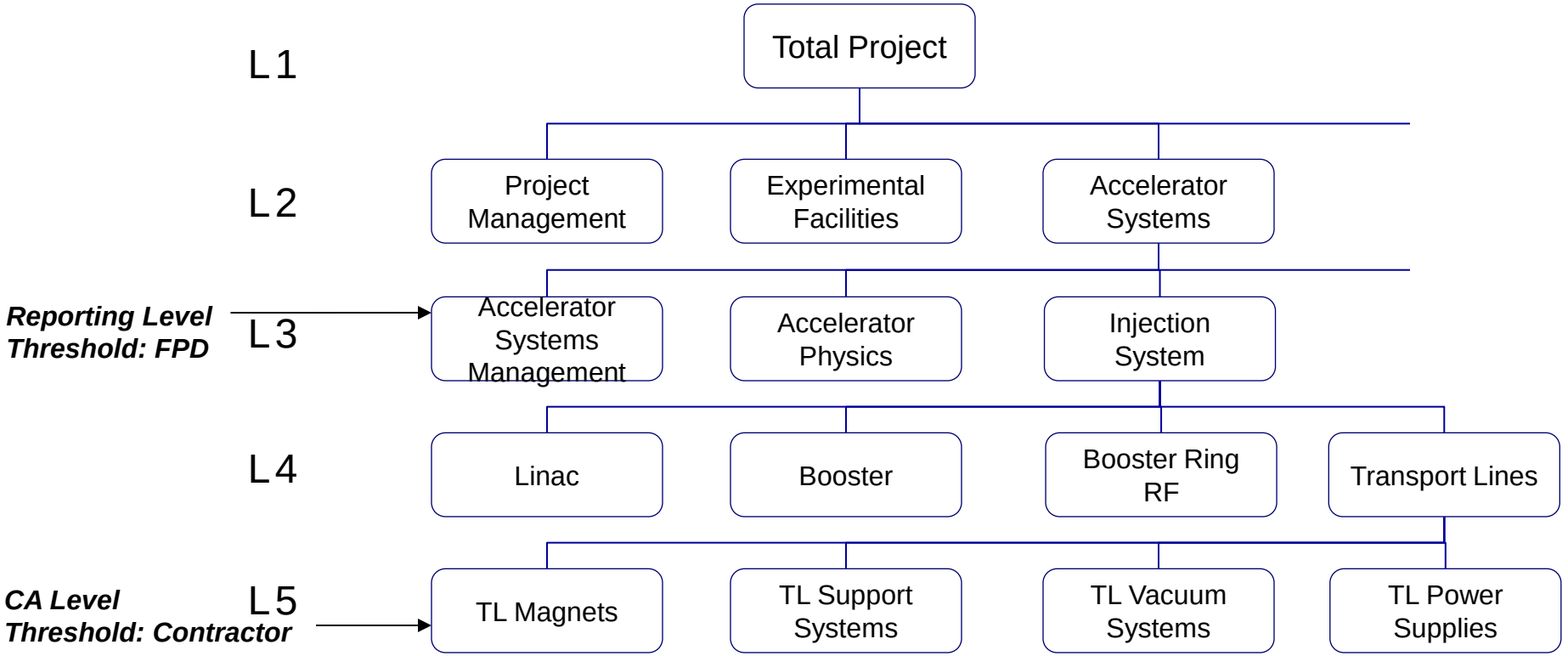


EVMS Cost Performance Reports

- ✓ Generated monthly for project, BNL, and DOE management
- ✓ Project and cost account level
- ✓ Based on PMB from Cobra/Excel



Variance Analysis: Reporting Levels



Significant Variance As a Reporting and Control Tool

- Defined by FPD at WBS reporting level
  - % Variance
  - $ Variance
  - Critical Path Element
  - Risk/Complexity
  - Cost & Schedule Drivers
- BNL PM defines “significant” internally so as to be supportive of reporting level needs
- In theory, if BNL takes effective corrective actions at CA level, no reportable variances will be identified at reporting level

Calculating Variances as a Percentage

Schedule Variance

$$\frac{SV}{PV} \times 100 = \%\ SV$$

$$\frac{(\$90K)\ SV}{\$300K\ PV} \times 100 = (\ 30.0\%\ )$$

Cost Variance

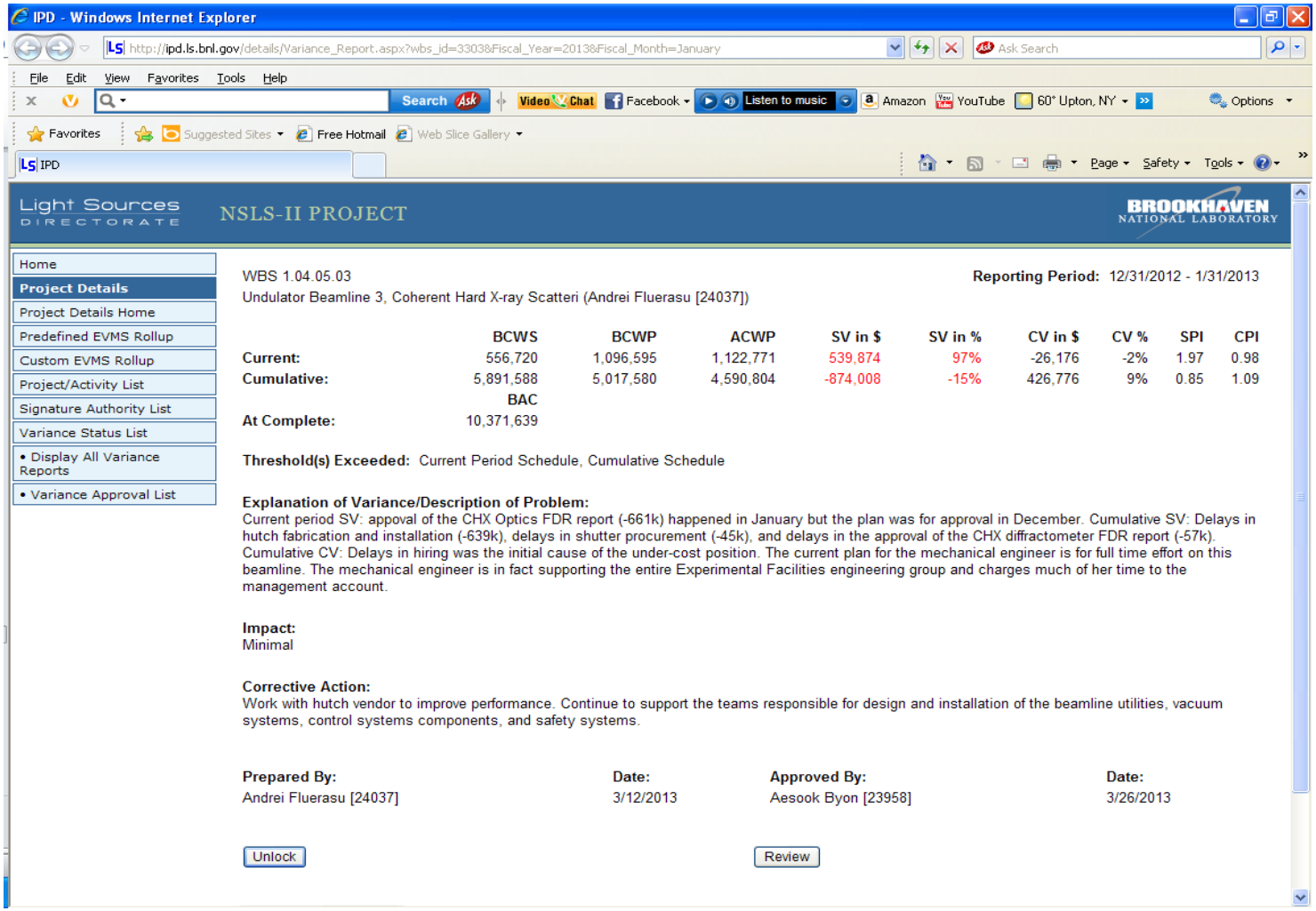
$$\frac{\text{Cost Variance}}{EV} \times 100 = \%\ CV$$

$$\frac{(\$\ 11.9)\ CV}{\$\ 42.0\ EV} \times 100 = (\ 28.3\%\ )$$

Variance Analysis

- Should identify problems, causes, impacts, corrective actions and effects on EAC
- Should be closely linked to risk analysis to focus on schedule, technical, and cost drivers
- Documented on a Variance Analysis Report (VAR) developed by CAM
- Summarized in monthly submission to customer (sometimes referred to as “Format 5”)

BNL Variance Analysis Report



- **Thresholds defined in PEP**

Variance Analysis (cont'd)

- Should discuss CV and SV separately
- Should discuss Current period and Cumulative period separately
- Should clearly discuss the root cause(s) of each variance
- Should emphasize problems in Control Accounts
- Should quantify variances
- Should be specific, not general

Example Root Causes of Variances

	Schedule Variance	Cost Variance
Unfavorable	■ Lack of resources due to… ■ Late vendor deliveries because… ■ Rework required due to… ■ Work more complex than expected because… ■ Unclear requirements in the areas of…	■ Work is more complex than anticipated because… ■ Extensive Design Review comments have resulted in… ■ Material price escalation due to… ■ The estimate was understated because….
Favorable	■ Increased efficiency due to… ■ Work less complex than anticipated in the areas of… ■ Fewer revisions and rework because… ■ Subcontractor ahead of schedule because…	■ Efficiencies being realized because… ■ We used less expensive resources to accomplish the work and… ■ We negotiated a lower price with the supplier due to… ■ The new CAD system reduced the time required..

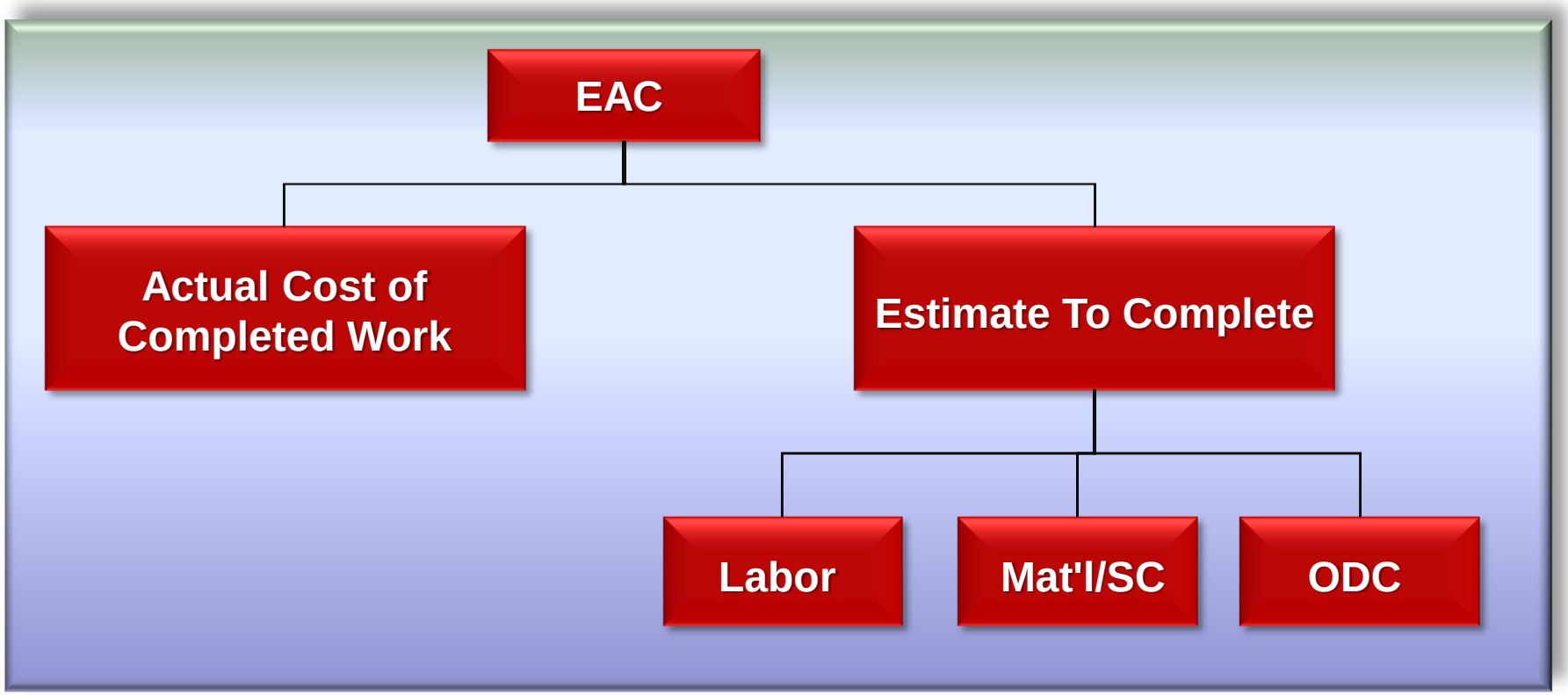
Root Cause Analysis?

- Spent more than I planned
- Someone charged extra hours
- I didn't earn enough EV
- System variance
- See last month's report

Corrective Actions Plan Questions

- What actions are/can/should be taken?
- Are any scarce resources needed?
- Who's responsible?
- What are the get well dates?
- What are the cost trade-offs?
- Which is more important: cost or schedule?

Developing the Estimate At Completion



EACs Updates

- Comprehensive annual update
- Monthly CAM review
- Whenever a “significant” variance occurs
- Project manager / customer request

Who's Responsible For EACs?

- Primary:
  - Project Manager
  - Control Account Managers
- Support:
  - Functional managers
  - Project control/business management
  - Subcontract management
  - Finance/accounting

EAC Issues to Consider

- Outstanding commitments?
- Accruals?
- Future resources/rates?
- Scope issues?
- Future risks?

EVM Data Analysis

Beginning of Project Data

- Scope: 200 drawings
- Schedule: 10 months
- Budget: 30 hours per drawing
- BAC: $300K (6000 hrs x $50/hr)
- Plan: 20 drawings per month

Contractor Reported Status Information for Month 5

- 100 Drawings Planned
- 70 Drawings Completed
- 2450 Hours Charged
- $52/Hour Average Cost

	BCWS	BCWP	ACWP	SV	CV	BAC	EAC	VAC
Hours	3000	2100	2450	(900)	(350)	6000	6000	0
Dollars	150.0	105.0	127.4	(45.0)	(22.4)	300.0	300.0	0

Calculating Percent SV

$$\frac{\text{SV Hours}}{\text{BCWS Hours}} \times 100 = \%\ \text{SV}$$

$$\frac{(900)\ \text{Hours SV}}{3000\ \text{Hours BCWS}} \times 100 = (\ 30.0\%\ )$$

Schedule Performance Index

$$\frac{\text{Work Completed}}{\text{Work Planned}} \text{ or } \frac{\text{BCWP}}{\text{BCWS}} = \text{SPI}$$

$$\frac{\text{2100 Hours BCWP}}{\text{3000 Hours BCWS}} = .70 \text{ SPI}$$

70% Efficiency to Schedule

Cost Variance as a Percentage

$$\frac{\$ \text{ Cost Variance}}{\$ \text{ BCWP}} \times 100 = \% \text{ CV}$$

$$\frac{(\$ 22.4) \text{ CV}}{\$ 105.0 \text{ BCWP}} \times 100 = (21.3\%)$$

Cost Performance Index

$$\frac{\text{Work Completed}}{\text{Actual Cost}} \text{ or } \frac{\$ \text{ BCWP}}{\$ \text{ ACWP}} = \text{CPI}$$

$$\frac{\$105.0 \text{ K BCWP}}{\$127.4 \text{ K ACWP}} = .82 \text{ CPI}$$

82% Cost Efficiency

To-Complete Performance Index: Performance Required to Achieve EAC ($TCPI_{EAC}$)

$$TCPI_{EAC} = \frac{\text{Remaining Work}}{\text{ETC}}$$

$$= \frac{\text{BAC - BCWP}}{\text{EAC - ACWP}}$$

$$= \frac{\$300.0 - \$105.0}{\$350.0^{*} - \$127.4} = .88$$

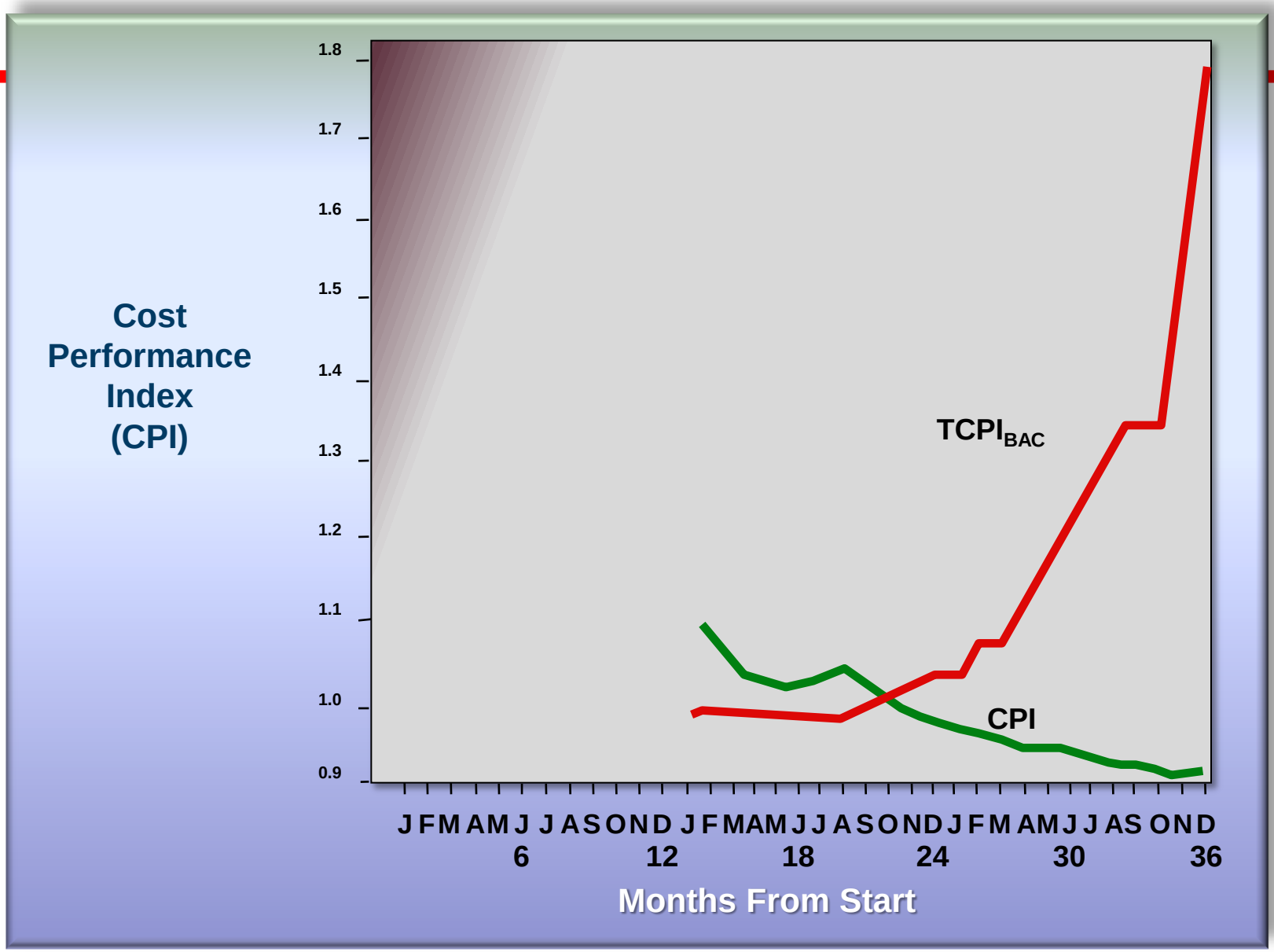
**CAM re-estimate of EAC*

$TCPI_{BAC}$ To Not Exceed the BAC

$$TCPI_{BAC} = \frac{\text{Remaining Work}}{\text{Unspent Budget}}$$

$$= \frac{BAC - BCWP}{BAC - ACWP}$$

$$= \frac{\$300.0 - \$105.0}{\$300.0 - \$127.4} = 1.13$$


Cost Performance Index (CPI)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
TCPI$_{BAC}$
CPI
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
6
12
18
24
30
36
Months From Start

Index Comparisons

- CPI_{CUM} = 82%
- $TCPI_{BAC}$ = 113%
- $TCPI_{EAC}$ = 88%

Schedule Conversions: Ahead/behind

$$\text{Months A/B} = \frac{\text{Schedule Variance}}{\text{Average Monthly BCWS}}$$

$$= \frac{\$45.0}{\$30.0} = 1.5 \text{ Months Behind}$$

Ahead/behind At-Completion Projection

Projected Months A/B At-Completion

$$= \frac{BAC - (BAC/SPI)}{\text{Average Monthly BCWS}}$$

$$= \frac{\$300.0 - (\$300.0/.7)}{\$30.0}$$

= 4.28 Months Behind At-Completion

Assessing Realism of Reported EAC

IEAC* = AC + Calculated ETC

= AC + $\frac{\text{BAC - EV}}{\text{Performance Factor}}$

*Independent EAC

IEAC* Based on Performance to Date

$$IEAC = AC + \frac{BAC - BCWP}{CPI\ Cumulative} = \frac{BAC}{CPI}$$

$$= \$127.4K + \frac{\$300.0K - \$105.0K}{.82}$$

$$= \$365.2K$$

*Independent Estimate at Completion

IEAC Based on Recent Performance

$$IEAC = ACWP + \frac{BAC - BCWP}{\text{3 Month Moving Avg}}$$

$$= \$127.4K + \frac{\$300.0K - \$105.0K}{.85}$$

$$= \$356.8K$$

	BCWP	ACWP
Now	xxx	yyy
Now -1	xxx	yyy
Now -2	*xxx*	*yyy*
	∑P	*/ ∑A*

IEAC Based on Combination of Cost and Schedule Performance – One Option

$$IEAC = ACWP + \frac{BAC - BCWP}{(.2)SPI + (.8)CPI}$$

$$= \$127.4K + \frac{\$300.0K - \$105.0K}{.80}$$

$$= \$371.2K$$

IEAC Based on Combination of Cost and Schedule Performance – Most Frequently Used Option

$$IEAC = ACWP + \frac{BAC - BCWP}{SPI \times CPI}$$

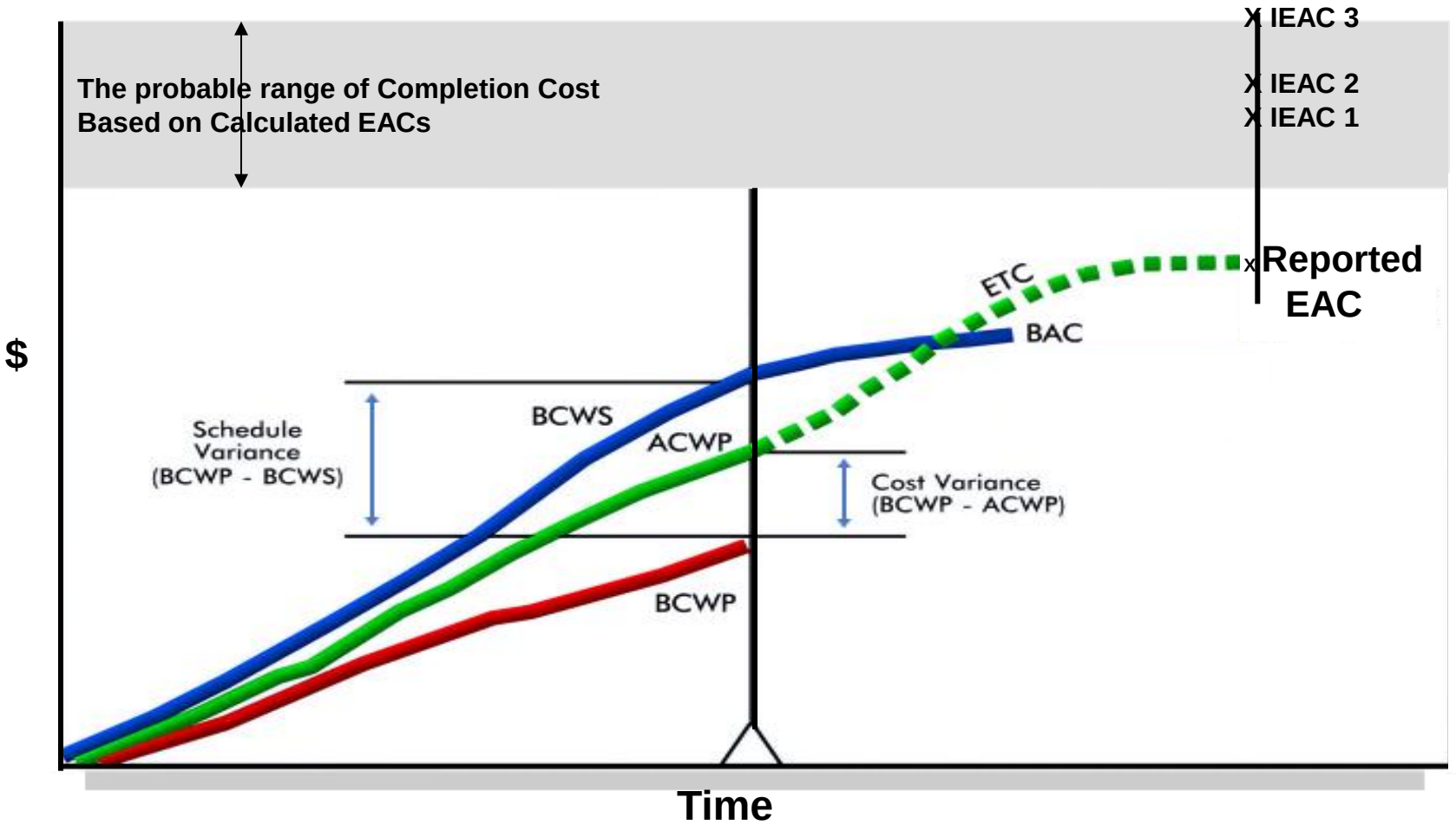
$$= \$127.4K + \frac{\$300.0K - \$105.0K}{.574}$$

$$= \$467.1K$$

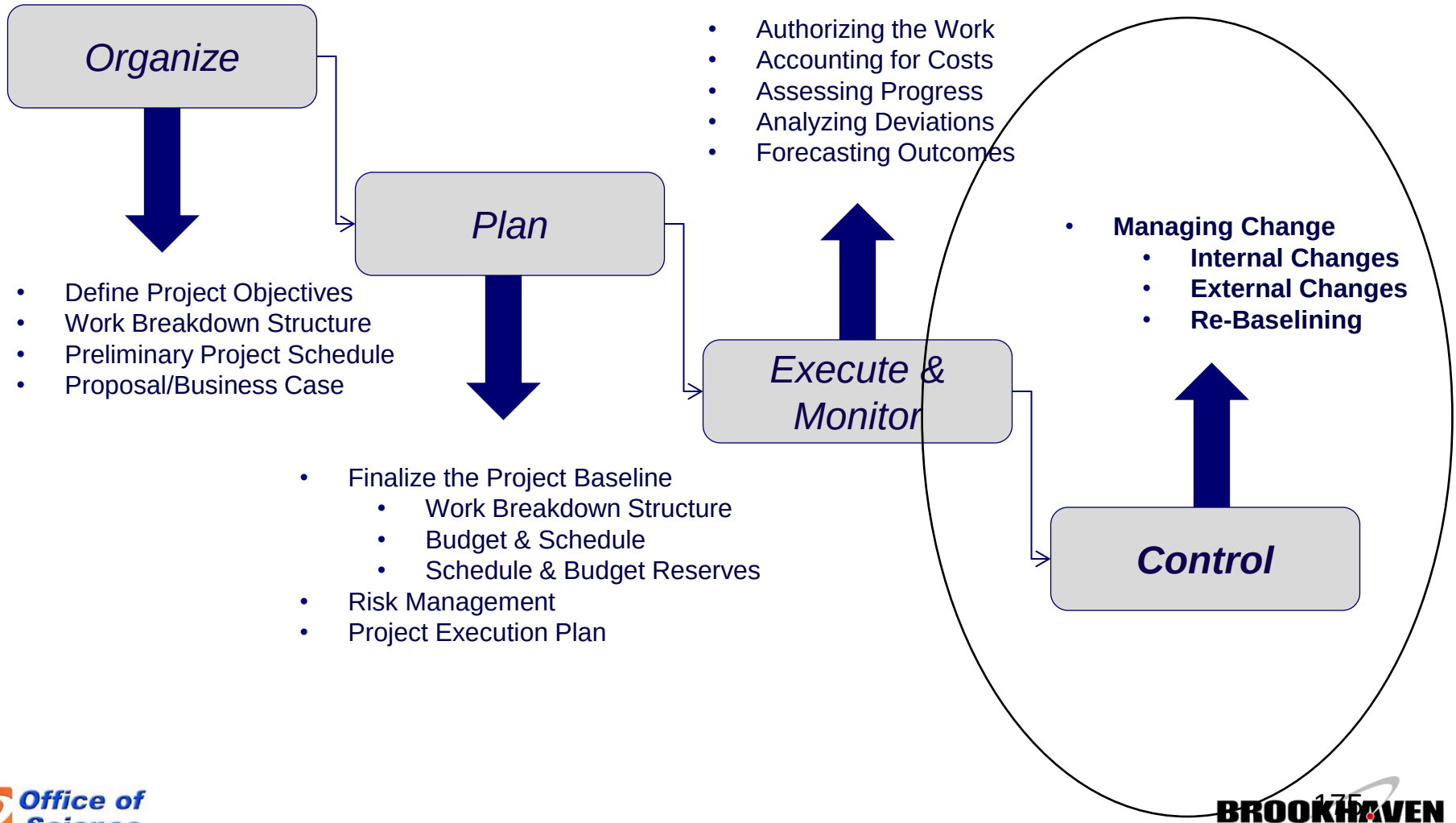
IEAC Formulas Used by PARS II

1. IEAC1=ACWP$_{cum}$+(BCWR/CPI$_{cum}$)
2. IEAC2=ACWP$_{cum}$+(BCWR/CPI$_{cum}$ X SPI$_{cum}$)
3. IEAC3=ACWP$_{cum}$+(BCWR/CPI$_{3\text{-mo avg}}$)
4. IEAC4=ACWP$_{cum}$+(BCWR/SPI$_{cum}$)
5. IEAC5=ACWP$_{cum}$+(BCWR/(0.8CPI$_{cum}$ x 0.2SPI$_{cum}$)
6. Note: Weights assigned to CPI and SPI for IEAC5 calculation cannot be changed by user.

EAC Comparisons



EVMS Processes



Change Control Objectives

- Maintain the integrated technical, schedule, and budget baseline, ensuring that it reflects all authorized work.
- To incorporate authorized changes to the PMB in a timely and traceable manner
- To allow only authorized changes and revisions
- Document changes to maintain the PMB's integrity

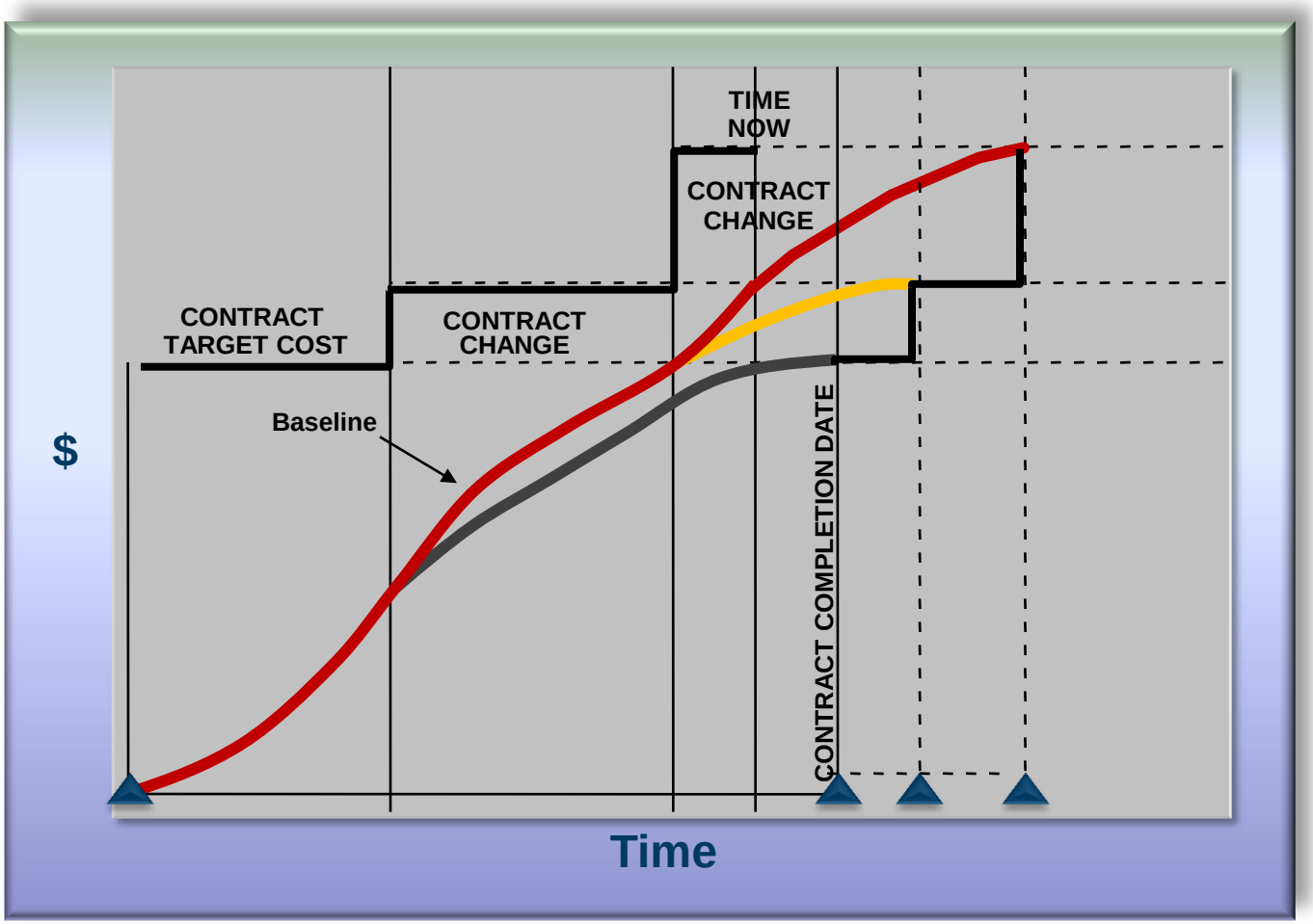
PMB Baseline Management

- Crucial for properly documenting, approving and implementing changes to PMB
- For determining if the project is in danger of exceeding the Contract Budget Baseline or the Program Baseline
- Contract changes are required for implementation of changes to the Contract Budget Base [CBB]

Change Control Challenges

- It is important that the change control process to provide traceability (visibility) to what is being changed (scope, budget, schedule), what prompted the change, and budget sources
- Changes not processed to solely to correct variances
- Baseline changes cannot change history!

Baseline Traceability



Project Baseline Log

Entry Description	Distributed Budget		Undistributed Budget		Management Reserve		Contract Budget Base	
	▲	Total	▲	Total	▲	Total	▲	Total
1. Initial Baseline	+250.5	+250.5	+10.0	+10.0	+20.0	+20.0	+280.5	280.5
2. MR to WBSE 1.2.4	+2.6	253.1		10.0	-2.6	17.4		280.5
3. Approved CR #21	+3.4	256.5		10.0	+.3	17.7	+3.7	284.2

BNL PCR

National Synchrotron Light Source II Project Change Request (PCR)

PCR_yy_####

Instructions: 1. Provide detailed attachments as appropriate and check the box to indicate a document is attached.

Section A

Origination (dd/Month/yy) (type in expandable field) PCR title:

WBS No(s)

Type of change (Check all that apply; give details in Section B.) Directed change? Y ☐ Brief reason for change:

Technical ☐ Schedule ☐ Level of change (Level affects signatures needed in Concurrence... section.)

Cost ☐ Administrative ☐ 4 ☐ 3 ☐ 2 ☐ 1B ☐ 1A ☐ 0 ☐

Use of management reserve? Y ☐ N ☐ Project Levels ——————DOE Levels ——————

Use of contingency funds? Y ☐ N ☐ If this PCR requires a phased implementation, check here. ☐

Section B

Summary of change: Attachments? Y ☐

Technical change Description (include interfaces with other elements) Attachments? Y ☐

Detailed cost estimate with basis for estimate Description with basis Total change in $K Attachments? Y ☐

Cost baseline impact Orig. cost, $K Est. revised, $K Est. change, $K **Final budgeted cost, $K**

Description Attachments? Y ☐ EAC or Risk ID #

Schedule impact Attachments? Y ☐

Administrative impact Labor costs ☐ Material costs ☐ Changes WBS dictionary? Y ☐ N ☐ if Y, highest WBS level affected: 4 ☐ 3 ☐ 2 ☐

Major(>$100K) procurement ☐ Description Documentation update required? Y ☐ N ☐ Attachments? Y ☐

Section C (use only if management reserve funds are involved, or for DOE-level changes: Levels 2, 1B, 1A, and 0)

BNL PCR

Funding source and impacts on funding and contracts	Contingency ($K)	Mgmt. Res.($K)
Before:	$	$
This requisition:	$	$
New net:	$	$

Funding spread (BA) by FY	FY09	FY10	FY11	FY12	FY13	FY14	TOTAL

Cost Baseline in $K	FY09	FY10	FY11	FY12	FY13	FY14	TOTAL
Baseline Proposed Change (BCWS)							
Management Reserve / Contingency							

Total Project Cost (TPC) in $K	Baseline DOE PCR	Change	Proposed Baseline PCR
WBS 1.1 Project Management			
WBS 1.3 Accelerator Systems			
WBS 1.4 Experimental Facilities			
WBS 1.5 Conventional Facilities			
Management Reserve			
Total Estimated Cost (TEC) Contingency			
Total Estimated Cost			
WBS 1.2 R&D and Conceptual Design			
WBS 1.8 Pre-Operations			
Other Project Costs (OPC) Contingency			
Total OPC			
Total Project Costs (TPC)			

Examples of Allowable Changes

- Use MR to revise CA budgets for new work within the scope of the contract
- Re-plan future WPs and future portion of open WPs within CA constraints
- Transfer work and associated budget between CAs
- Re-plan [re-baseline?] per customer agreements

Examples of Unallowable Changes

- Retroactively change budgets or costs for accomplished work
- Budget is not transferred with work
- Re-open closed work packages
- Make undocumented or untraceable changes to project baseline

Re-planning vs. Re-baselining*

- Re-planning can lead to minor changes in baseline phasing, but is not a form of re-baselining
  - Relates to routine re-planning actions associated with:
    - Rolling wave process
    - "Typical" MR transactions
    - Shifts of work and planning packages that don't affect any higher level milestones or control account constraints
- Re-baselining relates to broad (i.e., many control accounts), significant:
  - Increases/decreases to future work and budgets
  - Shifts in phasing of work and, possibly
  - Shifts in timing of contractual milestones

**These are unofficial definitions since there are no formally documented definitions for these terms*

Re-baselining is done when?

- Major changes to technical approach
- Changes in funding [does not necessarily result in “single point adjustments” to existing variances]
- Significant rate changes

EV Report Analysis

Exercise

Earned Value Report Analysis

Questions:

1. What are the cumulative cost and schedule variances in dollars and percent?
2. What variance, if any, is the contractor forecasting to the PMB? To the contract target cost?
3. Calculate the SPI and CPI.
4. What is the project percent completion?
5. At what level of efficiency must the contractor perform the balance of work in order to meet the reported EAC?
6. Calculate an independent EAC using whatever performance factor you consider appropriate.
7. Can you forecast projected months ahead/behind at completion?

EARNED VALUE REPORT

DOLLARS IN: Thousands

1. CONTRACTOR	2. CONTRACT		3. PROGRAM	4. REPORT PERIOD
a. NAME Waste Processing, LLC	a. NAME Waste Processing Plant		a. NAME Waste Processing Plant	a. FROM *(CCYYMMDD)* 20021201
b. LOCATION *(Address and ZIP code)* Sunnyside, CA	b. NUMBER A00019-84-C-0157			b. TO *(CCYYMMDD)* 20021231
	c. TYPE CPIF	d. SHARE RATIO 15/85 85/15	b. PHASE *(X one)* [ ] RDT&E [ ] PRODUCTION	

5. AUTHORIZED CONTRACTOR REPRESENTATIVE

a. NAME *(Last, First, Middle Initial)*	b. TITLE	c. SIGNATURE	d. DATE *(CCYYMMDD)*
	Prog Mgr		20030108

6. CONTRACT DATA

a. ORIGINAL CONTRACT TARGET COST	b. NEGOTIATED CONTRACT CHANGES	c. CURRENT TARGET COST *(a. + b.)*	d. ESTIMATED COST OF AUTHORIZED UNPRICED WORK
$228,900	$63,520	$292,420	$0
e. CONTRACT BUDGET BASE *(c. + d.)*	**f. MANAGEMENT ESTIMATE AT COMPLETION**	**g. VARIANCE AT COMPLETION** *(e. - f.)*	**h. OVER TARGET BASELINE DATE** *(CCYYMMDD)*
$292,420			

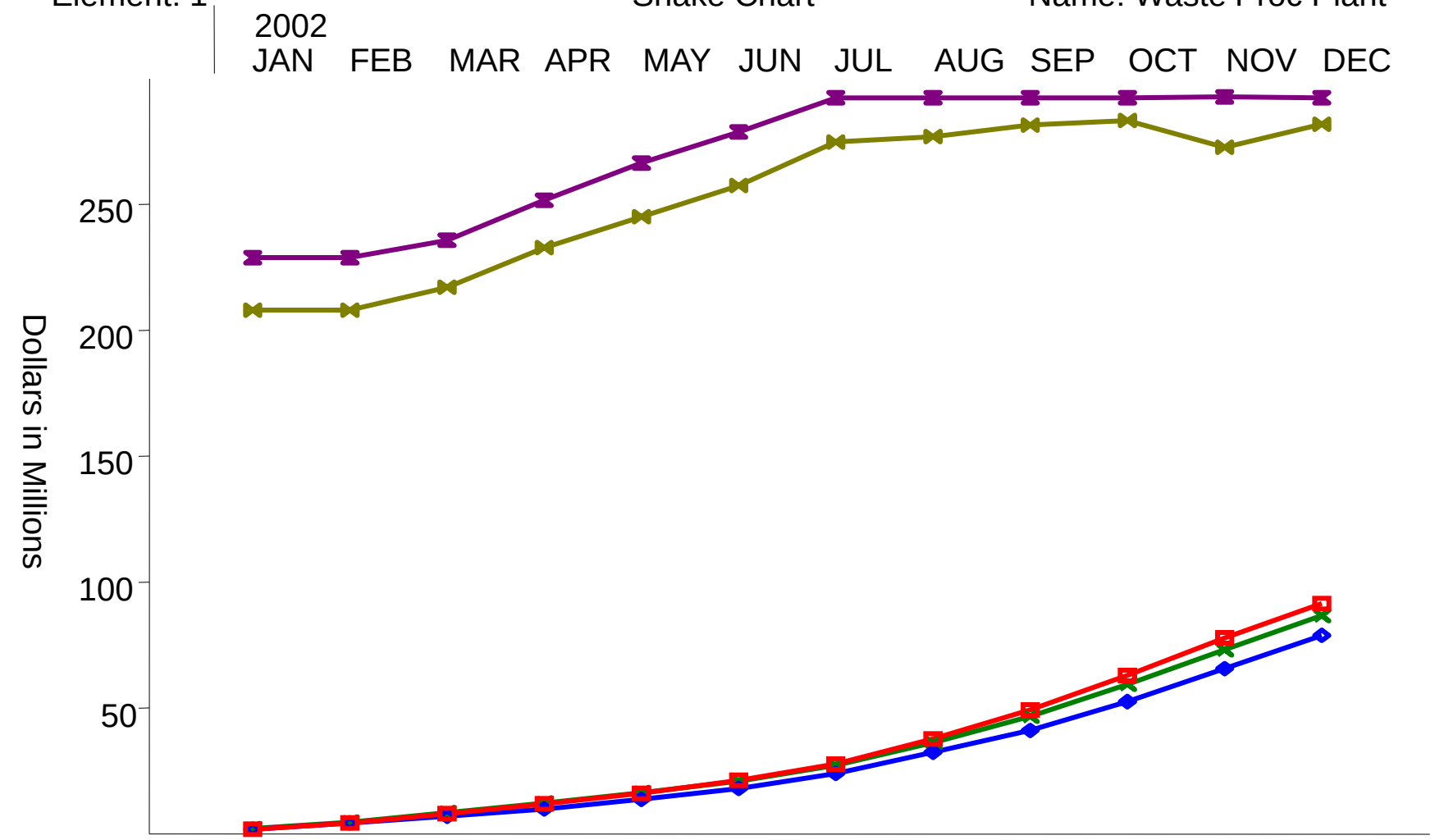
7. PERFORMANCE DATA

ITEM		CUMULATIVE TO DATE					AT COMPLETION		
		BUDGETED COST		ACTUAL COST	VARIANCE				
		WORK SCHEDULED	WORK PERFORMED	WORK PERFORMED	SCHEDULE	COST	BUDGETED	ESTIMATED	VARIANCE
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
a. WORK BREAKDOWN STRUCTURE ELEMENT									
1.0 Waste Processing Plant	2	29,775	25,348	32,235	-4,427	-6,887	76,234	76,584	-350
2.0 Laboratory	2	24,772	23,506	26,008	-1,266	-2,502	82,494	83,255	-761
3.0 RX-1 Equipment	2	6,399	6,185	6,496	-214	-311	23,026	23,239	-213
4.0 Training	2	274	271	285	-3	-14	1,930	1,930	0
5.0 Support Equipment	2	119	115	114	-4	1	2,386	2,386	0
6.0 System Test	2	6,487	5,655	6,975	-832	-1,320	26,681	26,995	-314
7.0 Project Management	2	7,570	7,380	7,470	-190	-90	18,836	18,836	0
8.0 Data	2	886	911	911	25	0	8,362	8,062	300
9.0 Spares	2	0	0	0	0	0	6,699	6,699	0
[OH] - OVERHEAD	2	0	0	0	0	0	0	0	0
b. COST OF MONEY	2	0	0	0	0	0	0	0	0
c. GENERAL & ADMINISTRATIVE	2	10,451	9,504	11,028	-947	-1,524	33,790	33,974	-184
d. UNDISTRIBUTED BUDGET	2						0	0	0
e. SUBTOTAL *(Performance Measurement Baseline)*		86,733	78,875	91,522	-7,858	-12,647	280,438	281,960	-1,522
f. MANAGEMENT RESERVE	2						11,982		
g. TOTAL		86,733	78,875	91,522	-7,858	-12,647	292,420		

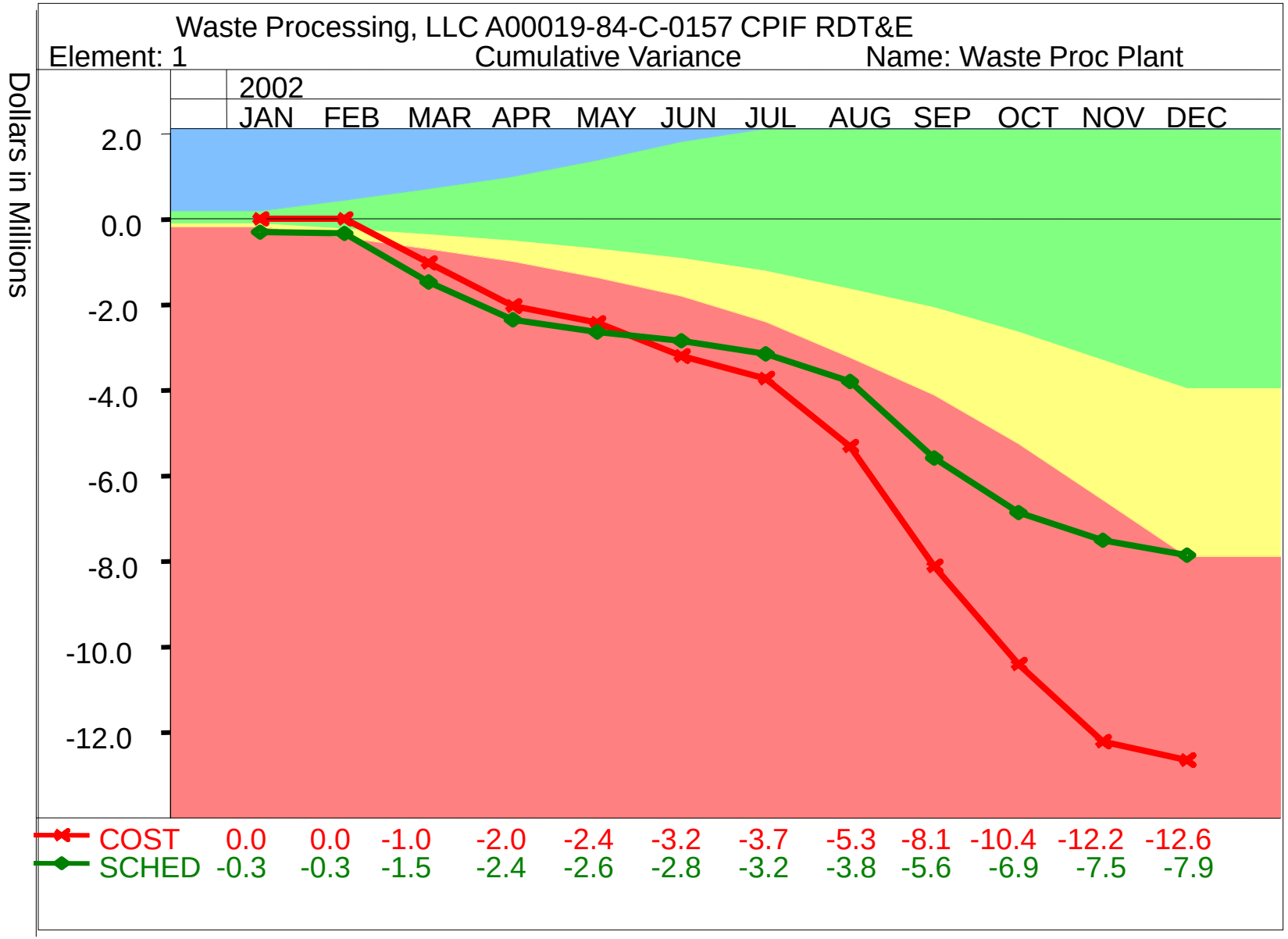
CLASSIFICATION *(When filled in)*

Waste Processing, LLC A00019-84-C-0157 CPIF RDT&E

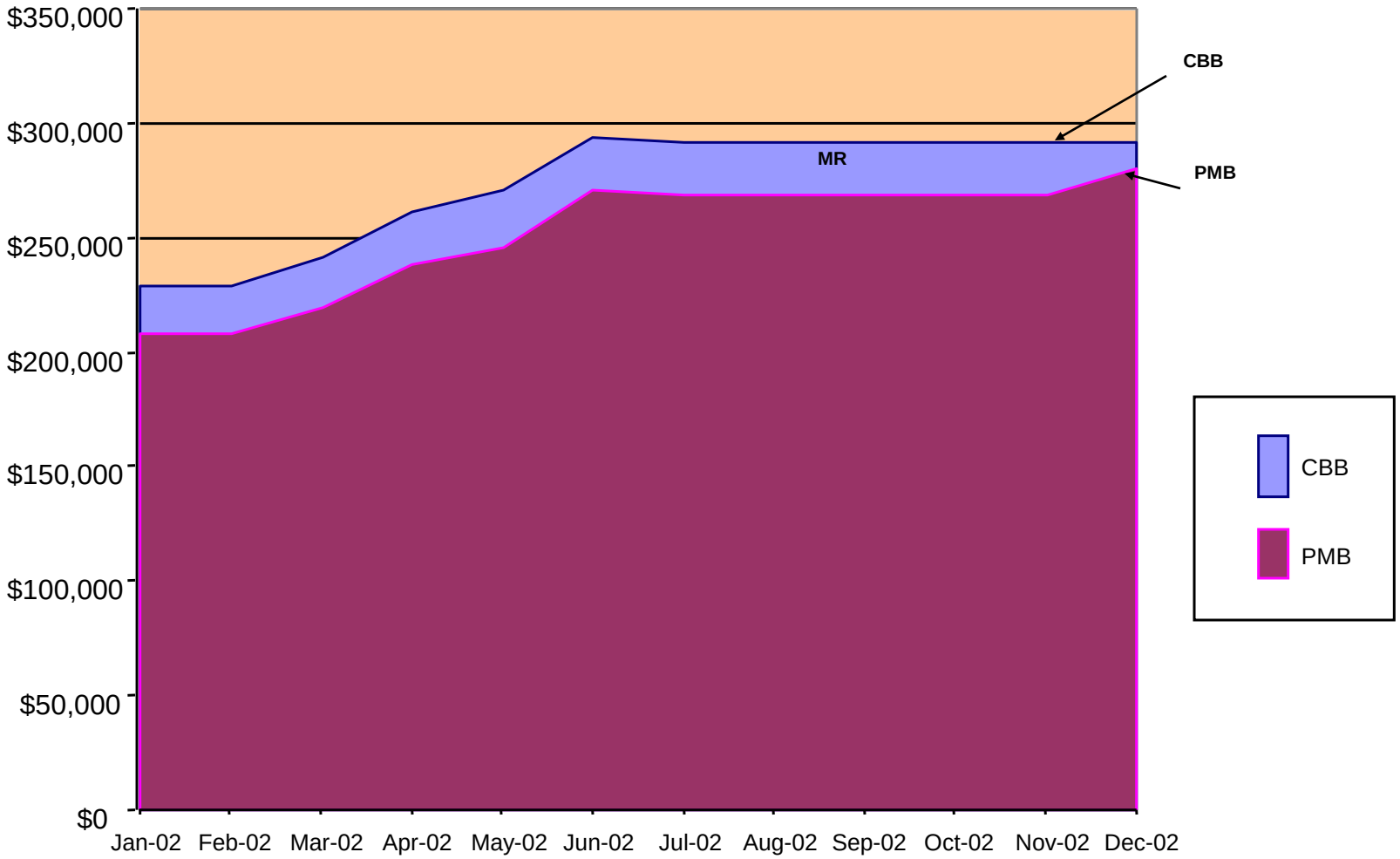
Element: 1 Snake Chart Name: Waste Proc Plant



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
BCWS	2.2	4.7	8.5	12.3	16.4	20.9	27.2	36.2	46.7	59.4	73.2	86.7
BCWP	1.8	4.3	7.0	9.9	13.7	18.1	24.0	32.4	41.1	52.6	65.7	78.9
ACWP	1.8	4.3	8.1	12.0	16.2	21.3	27.8	37.7	49.3	63.0	77.9	91.5
BAC	228.9	228.9	235.8	251.7	266.5	278.8	292.4	292.4	292.4	292.4	292.8	292.4
EAC	208.1	208.1	217.1	232.9	245.2	257.5	274.9	277.0	281.6	283.4	272.7	282.0


Waste Processing, LLC A00019-84-C-0157 CPIF RDT&E
Element: 1
Cumulative Variance
Name: Waste Proc Plant
Dollars in Millions
2002
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
2.0
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
COST 0.0 0.0 -1.0 -2.0 -2.4 -3.2 -3.7 -5.3 -8.1 -10.4 -12.2 -12.6
SCHED -0.3 -0.3 -1.5 -2.4 -2.6 -2.8 -3.2 -3.8 -5.6 -6.9 -7.5 -7.9

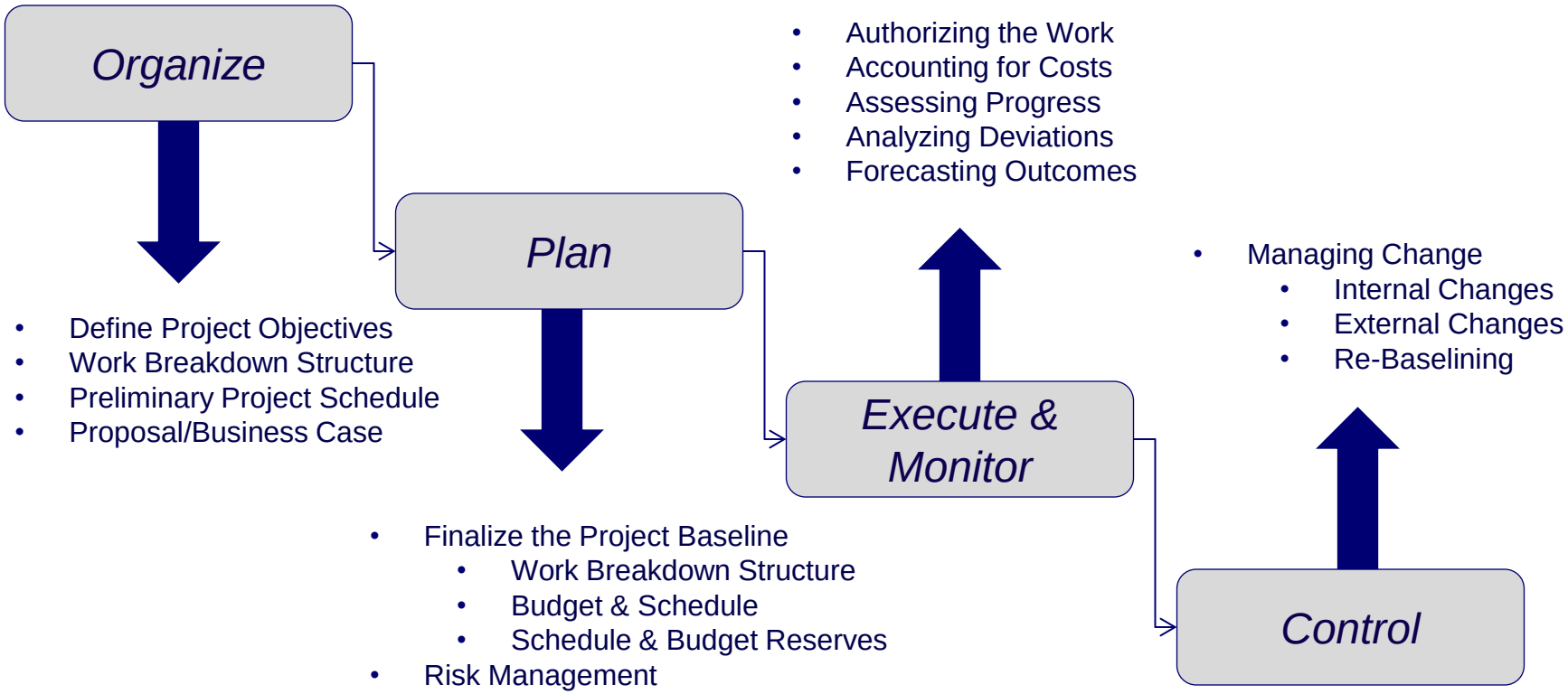
CBB vs. PMB Over Time



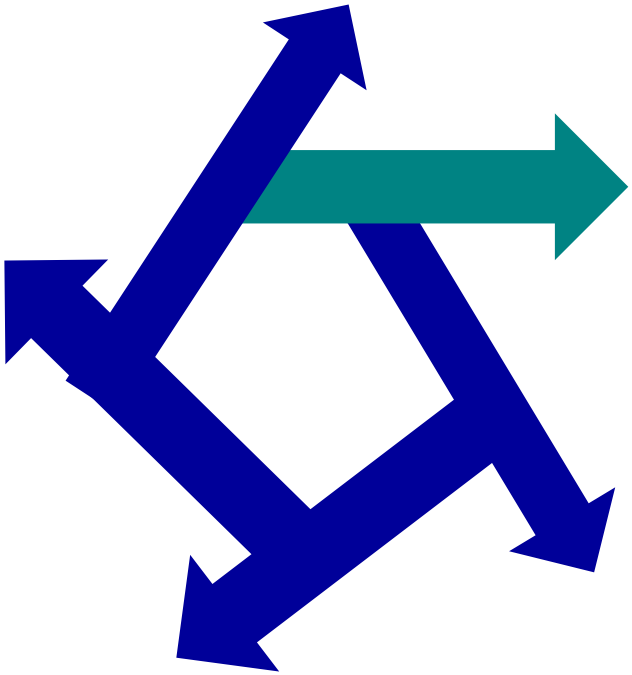
Monthly Data

	JAN 02	FEB 02	MAR 02	APR 02	MAY 02	JUN 02	JUL 02	AUG 02	SEP 02	OCT 02	NOV 02	DEC 02
BCWS	$2,153	$4,687	$8,507	$12,287	$16,381	$20,909	$27,200	$36,228	$46,735	$59,420	$73,182	$86,733
BCWP	$1,845	$4,347	$7,032	$9,929	$13,735	$18,060	$24,045	$32,428	$41,147	$52,558	$65,671	$78,875
ACWP	$1,845	$4,347	$8,060	$11,964	$16,161	$21,263	$27,778	$37,748	$49,268	$62,969	$77,888	$91,522
CBB	$228,900	$228,900	$241,992	$262,151	$271,323	$294,393	$292,420	$292,420	$292,420	$292,420	$292,420	$292,420
PMB	$208,071	$208,071	$219,992	$238,319	$246,657	$271,042	$269,068	$269,068	$269,068	$269,068	$269,068	$280,438
EAC	$208,071	$208,071	$223,326	$243,323	$249,990	$273,102	$274,883	$276,983	$281,600	$283,388	$283,438	$281,960

EVMS Processes



More Questions?



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