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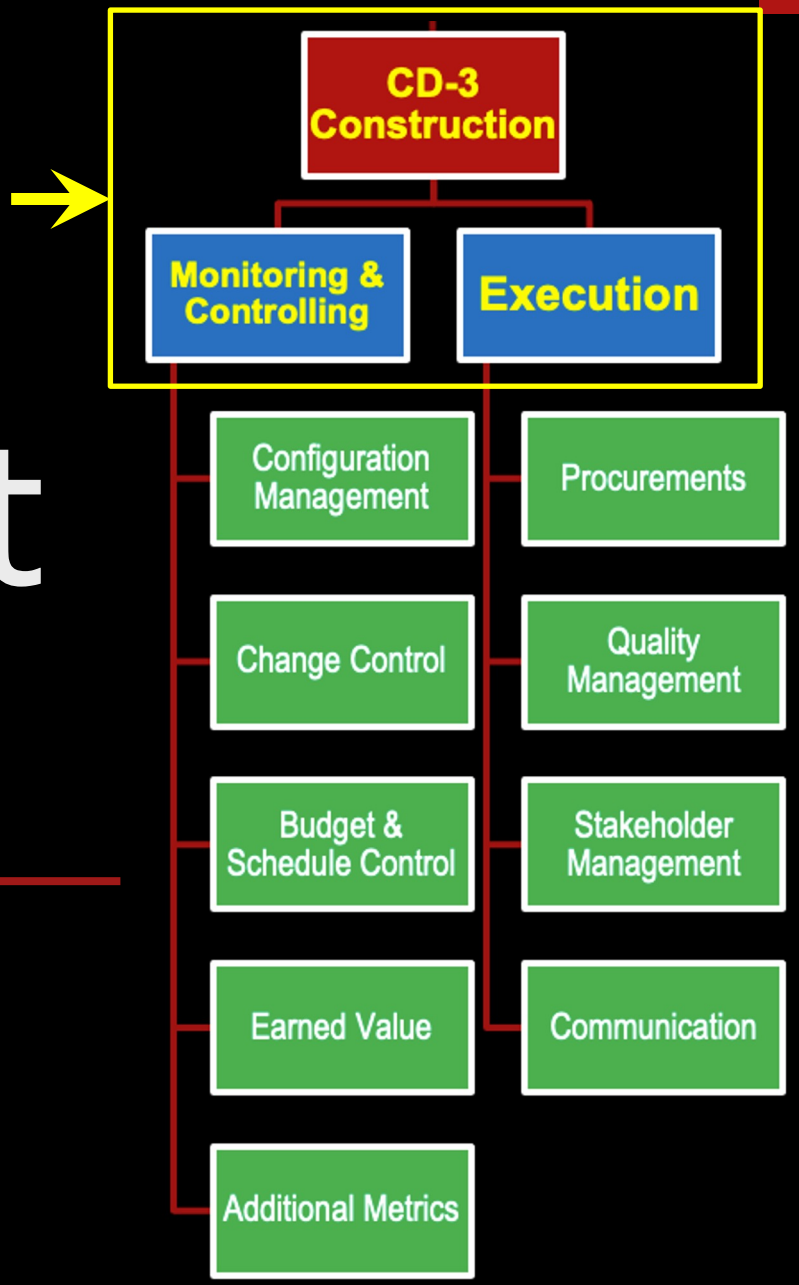
CD-3 Approve Start of Construction

Monitoring & Controlling / Execution



Where Should We Be?

- ☑ Charter integrated and in place
- ☑ Mission Need in place
- ☑ Alternative selected
- ☑ Conceptual and Preliminary designed completed, reviewed and approved
- ☑ Performance Baseline Approved
  - ☑ Work Breakdown structure established
  - ☑ Schedule network established
  - ☑ Baseline schedule established
  - ☑ Baseline budget established
  - ☑ Resource allocation/availability understood
  - ☑ Risk management in place assessment

So, everything's ready to go?

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CD-3 Everything should be running smoothly at this point

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- CD-3 Approve Start of Construction
  - Need to demonstrate that all project systems are functioning
    - Baseline Monitoring & Control
    - Configuration Management
    - Risk Management
    - Change Control
    - Production readiness
    - Communication
    - …
  - Less demanding than CD-2, it is however very important

No surprise here, but you're being watched…

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Office of Project Management
Oversight and Assessments

Project Dashboard - October 2022

POST CD-2 Active Projects

Program	Contractor	DOE Project Number	Project Name	Original Project Budget	Project Budget	Monthly Overall Assessment
NA	CNS	MIE-AMD-04	Calciner Project	$107,800,000	$107,800,000	Red
NE	BEA	16-E-200	Sample Preparation Laboratory (SPL)	$166,000,000	$166,000,000	Green
OE	Battelle	20-OE-100	Grid Storage Launchpad	$77,000,000	$77,000,000	Green
SC	BSA		NSLS-II Experimental Tools-II (NEXT-II)	$94,500,000	$94,500,000	Green
SC	UT-Battelle		Material Plasma Exposure eXperiment (MPEX)	$201,000,000	$201,000,000	Green
SC	UC-LBNL		Gamma-Ray Energy Tracking Array (GRETA)	$58,303,000	$58,303,000	Green
SC	FRA		Far Site Conventional Facilities – Excavation	$652,000,000	$652,000,000	Green
SC	FRA	11-SC-41	Muon to Electron Conversion Experiment (Mu2e)	$273,677,000	$273,677,000	Red
SC	Stanford University	13-SC-10	Linac Coherent Light Source-II (LCLS-II)	$1,045,000,000	$1,136,400,000	Green
SC	FRA	17-SC-71	Integrated Engineering Research Center (IERC)	$86,000,000	$86,000,000	Green
SC	BSA	17-SC-73	Core Facility Revitalization (CFR) Project	$74,850,000	$74,850,000	Green
SC	UChicago Argonne	18-SC-10	Advanced Photon Source Upgrade (APS-U)	$815,000,000	$815,000,000	Green
SC	UT-Battelle	18-SC-11	Spallation Neutron Source Proton Power Upgrade (PPU)	$271,567,000	$271,567,000	Green
SC	UC-LBNL	18-SC-12	Advanced Light Source Upgrade (ALS-U)	$590,000,000	$590,000,000	Green
SC	FRA	18-SC-42	Proton Improvement Plan-II (PIP-II)	$978,000,000	$978,000,000	Green
SC	BSA	19-SC-71	Science User Support Center (SUSC)	$86,200,000	$86,200,000	Green
SC	UChicago Argonne	19-SC-72	Electrical Capacity and Distribution Capability (ECDC)	$60,925,333	$60,925,333	Green
SC	UT-Battelle	19-SC-73	Translational Research Capability (TRC)	$95,000,000	$95,000,000	Green
SC	UC-LBNL	19-SC-74	Biological and Environmental Program Integration Center (BioEPIC)	$167,200,000	$167,200,000	Green
SC	BSA	20-SC-11	Nanoscale Science Research Centers Recapitalization (NSRC Recap)	$80,000,000	$80,000,000	Green
SC	FRA	MIE#61BL	HL-LHC Accelerator Upgrade (HL-LHC-AUP)	$242,720,000	$242,720,000	Yellow

DOE/SC CD-3 Requirements from Decision Matrix

Starting Execution / Construction

- Any changes to performance baseline and documents
- Project Execution Plan
- Long-lead procurements
- Project Management Plan
- Final Design
  - Final Design Review
  - Final Design Report
  - Sustainable Building
- Earned Value Management compliant & used
- Update Hazards Analysis Report (HAR)
- Construction Project Safety & Health Plan
- QAP updates
- CD-3 OPA Execution Readiness Review (IPR)
  - Independent Cost Estimate (ICE) / Review (ICR) if >$100 M*

Summary of Major Requirements

DECISION / REQUIREMENTS[1] / APPROVAL[2] \ TOTAL PROJECT COST (TPC)		$750M or more	Less than $750M to $400M	Less than $400M to $100M	Less than $100M to $50M*	Less than $50M* to $20M	Less than $20M to $10M** Delegation Allowed
CD-3--APPROVE START OF CONSTRUCTION		SC-1	SC-1	SC-2	SC-AD	SC-AD	SC-AD
PRIOR TO CD-3--FINAL DESIGN	Approve updated CD-2 Project Documentation (PEP, AS, PDS, etc) if major changes	Reviewed by SC-28 Approved by SC-1	Reviewed by SC-28 Approved by SC-1	Reviewed by SC-28 Approved by SC-2	Reviewed by SC-28 Approved by SC-AD	Reviewed by SC-28 Approved by SC-AD	Reviewed by SC-28 Approved by SC-AD
	Complete Final Design	Project	Project	Project	Project	Project	Project
	Incorporate High Performance & Sustainable Bldg. & Sustainable Env. Stewardship	Project	Project	Project	Project	Project	Project
	Conduct a Final Design Review	Team external to project	Team external to project	Team external to project	Team external to project	Team external to project	Team external to project
	Complete Final Design Report	Project	Project	Project	Project	Project	Project
	Employ a certified EVMS compliant with ANSI/EIA-748A, or as defined in the contract	Certified by SC-28	Certified by SC-28	Certified by SC-28	Certified by SC-28	Contractor	N/A
	Execution Readiness Review	ICE or ICR by PM if warranted or IPR by SC-28	ICE or ICR by PM if warranted or IPR by SC-28	ICE or ICR by PM if warranted or IPR by SC-28	SC-28	SC-28	SC-28
	Conduct a Technology Readiness Assessment, where significant CTE modification occurs	N/A	N/A	N/A	N/A	N/A	N/A
	Update the Hazard Analysis Report	Site Office or Lab	Site Office or Lab	Site Office or Lab	Site Office or Lab	Site Office or Lab	Site Office or Lab
	Prepare Construction Project Safety and Health Plan	Site Office or Lab	Site Office or Lab	Site Office or Lab	Site Office or Lab	Site Office or Lab	Site Office or Lab
	Update the Quality Assurance Program	Site Office or Lab	Site Office or Lab	Site Office or Lab	Site Office or Lab	Site Office or Lab	Site Office or Lab
	Finalize the Security Vulnerability Assessment Report, if necessary	Site Office or Lab	Site Office or Lab	Site Office or Lab	Site Office or Lab	Site Office or Lab	Site Office or Lab
	Nuclear Facility: *Hazard Cat. 1,2,3 Nuclear Facility--Update Safety Design Strategy (SDS)*	*SBAA & FPD, w/ CNS or CDNS concurrence, as appropriate*	*SBAA & FPD, w/ CNS or CDNS concurrence, as appropriate*	*SBAA & FPD, w/ CNS or CDNS concurrence, as appropriate*	*SBAA & FPD, w/ CNS or CDNS concurrence, as appropriate*	*SBAA & FPD, w/ CNS or CDNS concurrence, as appropriate*	*SBAA & FPD, w/ CNS or CDNS concurrence, as appropriate*
	Nuclear Facility: *Hazard Cat. 1,2,3 Nuclear Facility--Prepare a Preliminary Documented Safety Analysis[4] that updates the PSDR*	*SBA Authority via the SER*	*SBA Authority via the SER*	*SBA Authority via the SER*	*SBA Authority via the SER*	*SBA Authority via the SER*	*SBA Authority via the SER*
	Nuclear Facility: *Hazard Cat. 1,2,3 Nuclear Facility--Prepare a Safety Evaluation Report (SER)*	*SBAA w/ FPD concurrence*	*SBAA w/ FPD concurrence*	*SBAA w/ FPD concurrence*	*SBAA w/ FPD concurrence*	*SBAA w/ FPD concurrence*	*SBAA w/ FPD concurrence*
	Nuclear Facility: *Hazard Cat. 1,2,3 Nuclear Facility--Revise the Code of Record*	*Project*	*Project*	*Project*	*Project*	*Project*	*Project*
POST CD-3	Submit approved CD or equivalent documents to APM. If applicable, any PB BCP to APM	SC-28	SC-28	SC-28	SC-28	SC-28	SC-28
	Allow expenditure of TPC funds. Update budget document and OMB 300s if applicable.	SC-AD	SC-AD	SC-AD	SC-AD	SC-AD	SC-AD
	Update PARS II with monthly status	Prog. Mgr., FPD, and Contractor	Prog. Mgr., FPD, and Contractor	Prog. Mgr., FPD, and Contractor	Prog. Mgr., FPD, and Contractor	Prog. Mgr., FPD, and Contractor	Prog. Mgr. & FPD No Earned Value (EV)
	Continue with Monthly or Quarterly Project Reporting/Meeting	SC-AD Invite SC-1 and SC-28	SC-AD Invite SC-1 and SC-28	SC-AD Invite SC-2 and SC-28	SC-AD to invite SC-28	SC-AD to invite SC-28	SC-AD to invite SC-28
	Perform EVMS surveillance review	Bi-annually by SC-28 Annually by Contractor	Bi-annually by SC-28 Annually by Contractor	Bi-annually by SC-28 Annually by Contractor	Bi-annually by SC-28 Annually by Contractor	Annually by Contractor	N/A
	Submit Lessons Learned regarding up-front planning and design 90 days after CD-3	FPD	FPD	FPD	FPD	FPD	FPD
	SC-AD Request Annual Project Peer Review by PMSO	SC-28	SC-28	SC-28	SC-28	SC-28 Tailored	SC-28 Tailored

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CD-3 Approve Start of Construction Summary

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Long-Lead Procurements – CD-3a

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Don't push it

- Long-lead procurements / site-prep can be proposed
- A common and legitimate tailoring strategy
- May occur prior to, concurrent with, or after CD-2
  - May not occur prior to CD-1
  - Rarely occurs with CD-1
- Multiple CD-3x (CD-3a, CD-3b, …) is generally not acceptable
- Any advance procurements / work must be controlled to a baseline and must not impact TPC (range or otherwise)

Long-lead *dominos* does not work

A few points on Construction / Execution Approval

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- Emphasis is on implementation of systems previously established
- It is anticipated that bids are in hand
- Scope contingency and risks need to be fully addressed
  - Timing
  - Scope
  - Cost
  - Triggers
- The Construction Project Health & Safety Plan should be straightforward
  - Splitting of the *construction* from the *operational* hazards from the HAR
  - Majority of activities should be addressed by Laboratory ES&H framework
  - Complex project-specific risks are focus

CD-3 Reviewer Checklist – Summary

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DOE/SC-OPA Reviewer Checklist

✓**Project functioning:** For this stage of the project, are the number and skill mix of full and part-time members, organizational structure, division of roles/responsibilities, lines of communication and authority adequate?

✓Is the **project safety organization ready** for fabrication/construction?

✓Are the **QA processes appropriate** and being implemented properly?

✓Final Design—is the **final design sufficiently mature** for this stage of the project?

✓Design Review—was an **independent final design review** conducted?

✓Review **project performance** and understand the causes of good or poor performance.

✓Review **Baseline Change Proposals** to understand where project changes are.

✓If applicable, is the project **using the EVMS appropriately**?

✓Has the number of **critical activities** increased and why?

✓Is project **risk registry** updated regularly?

✓Is the project **cost and schedule estimates updated regularly**?

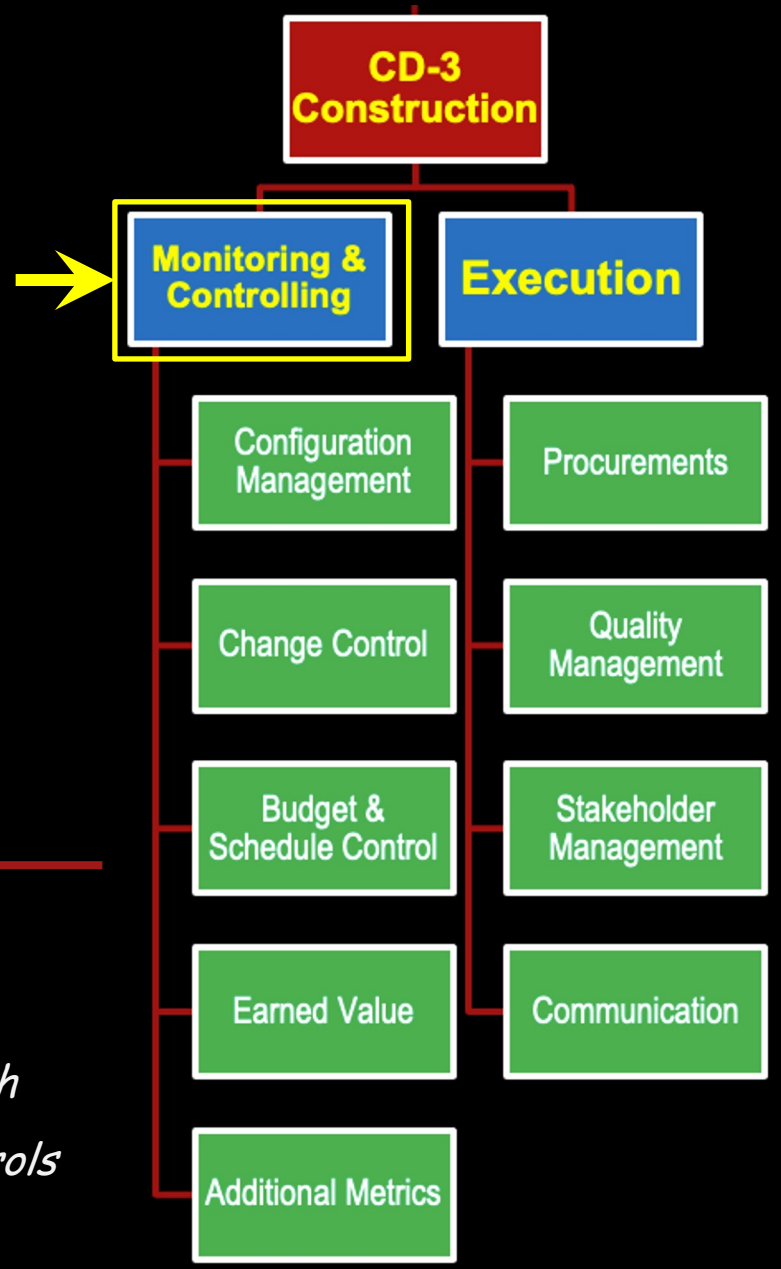
✓Are the **cost and schedule estimate adequate** for this stage of the project?

✓How recent is the **latest detailed estimate** and how are latest **EAC and ETC** estimated?

✓Are there **adequate resources** or labor available?

✓Has the project developed a more detailed and **prioritized list of scope enhancement or deletions including decision dates**?

Monitoring & Controlling Processes



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"I'm not a control freak, but would you mind straightening your napkin."

"As soon as the boss decides he wants his workers to do something, he has two problems: making them do it and monitoring what they do." — Robert Krulwich

"He who controls the present, controls the past. He who controls the past, controls the future." — George Orwell

PMI Monitoring / Controlling Process Group

- Monitor & control project work / Integrated change control
  - Scope verification
  - Schedule control
  - Cost control
  - Perform quality control
  - Manage project team
  - Performance reporting
  - Manage stakeholders
  - Risk monitoring and control
  - Contract administration

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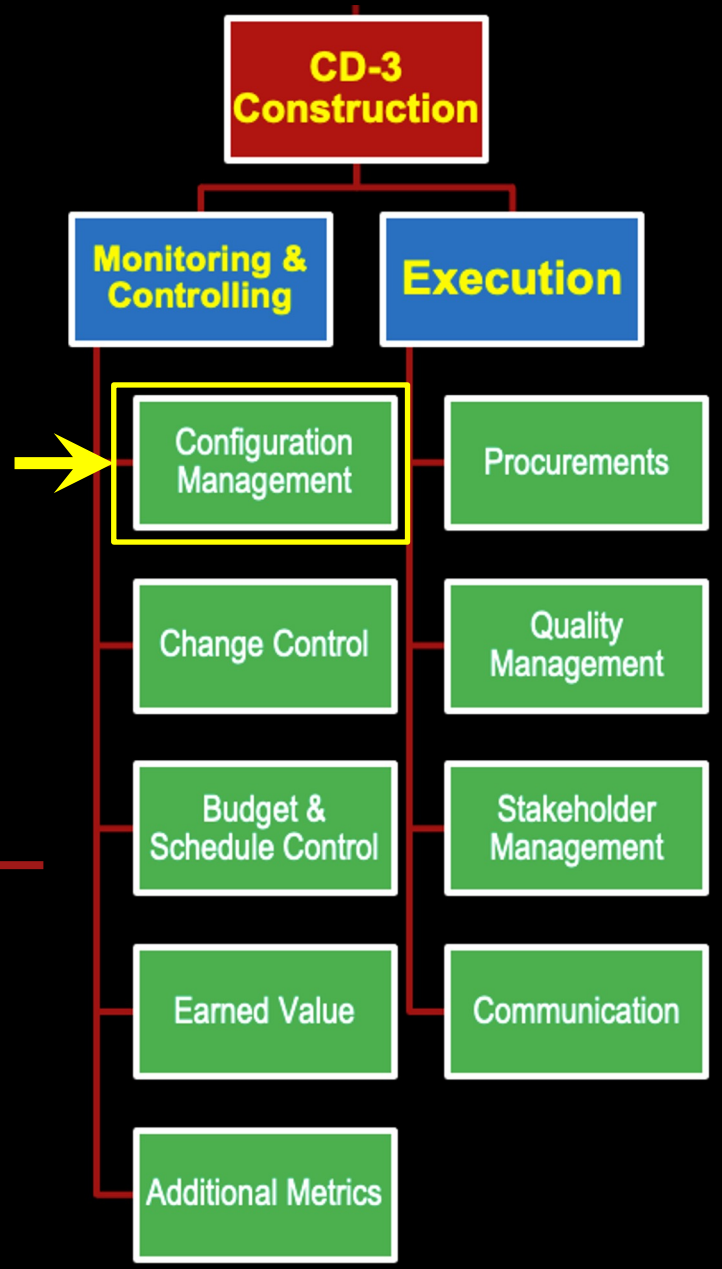
Configuration Management



Configuration Management

- To receive CD-3 Approval and be successful during the major construction and execution phase effective monitoring and control frameworks must be place
- Effective monitoring and controlling must be demonstrated across all of the dependent variables
  - Scope
  - Cost
  - Schedule
- Getting the entire team attuned to detect any change from the baseline plan is critical
- While good processes can help, they will not save a project from failure
  - Use and streamline processes for handling aspects that are *to plan*
  - Focus on managing *exceptions to plan*
- The project team must be sensitive to any potential configuration modification and escalate it before it becomes a *de facto* part of the project

I don't care what the decision is as long as it is a conscious decision

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Awareness – a team attuned to potential changes

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- Effective delegation of authority
- Demonstrated trust
- Focus on the *Gold Standard* of success = meets expectations / requirements
  - *Gold plating* is merely *gilding* and the opposite of added value
- Again, the effective management of the risk of unconscious changes is key during the execution phase
- Things will not go as planned — uncover deviations as quickly as possible to avoid major issues
- Everyone on the team must understand and have access to what completely constitutes the baseline

Project Repository — *"The Project Notebook"* Documented & Managed

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- A *Project Notebook* is an organized collection of all project information contained or referenced from a central location

> *"A Project Notebook is the single most important contributor to the successful organization and management of a project."*
> – Center for Project Management

- A *Project Notebook* is now never a physical notebook sitting on a shelf somewhere – it is an electronic repository and much more effective
- The Project Repository (*Project Notebook)* should have things such as:
  - Issues log, action items, workflow management, communication channels (chats/messages), etc.
- The project may be somewhat constrained in the choice of a Project Repository Platform based on its organizational assets, but it must have one in order to be effective

Benefits of a Project Repository / Notebook

Project

- Maintain central location for essential documents and project working papers
- Establish project PM and documentation mechanism
- Risks /Issues / Action Item tracking
- Workflow
- Use as a maintenance device
- Use as a training device

Organizational

- Establish common organization PM and documentation mechanism
- Establish framework for methodology
- Method for establishing common after action / lessons learned platform
- Basis for strengthening enterprise environmental factors
- Means for propagating organizational process assets
- Use as a training device

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Everything is in a Project Repository

- Project Request
- Project Charter
- Work Breakdown Structure
- Project Baseline
  - Scope
  - Schedule
  - Budget
- Basis of Estimate Documentation
- Issue logs
- Risk Registry
- Action Items
- Resource Requirements
- Applicable Standards
- Product Evaluation
- Mission Need
- Design Documentation
- Previous Reviews
- Recommendation Tracking
- EHS Documentation
- Project Execution Plan
- Project Management Plan
- Quality Assurance & Control
- Requirements
- Constraints
- Specifications
- Procurement
- Communications
- Integration plans
- Project Evolution
  - Scope
  - Schedule
  - Budget
- Change Control Log
- Actuals
  - Schedule
  - Cost
  - Resources
- Presentations
- Status Reports
- Product Acquisition
- Construction
- Testing
- Deployment
- …

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Just About Everybody Uses the Project Repository

- Project Manager
- Project Team
- Federal Project Director
- Functional Managers
- Maintenance/Support Personnel
- New Personnel
- Project Sponsors
- Project Stakeholders
- Subcontractors
- Collaborators
- Internal and External Reviewers

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Controlling the Three Dependent Variables

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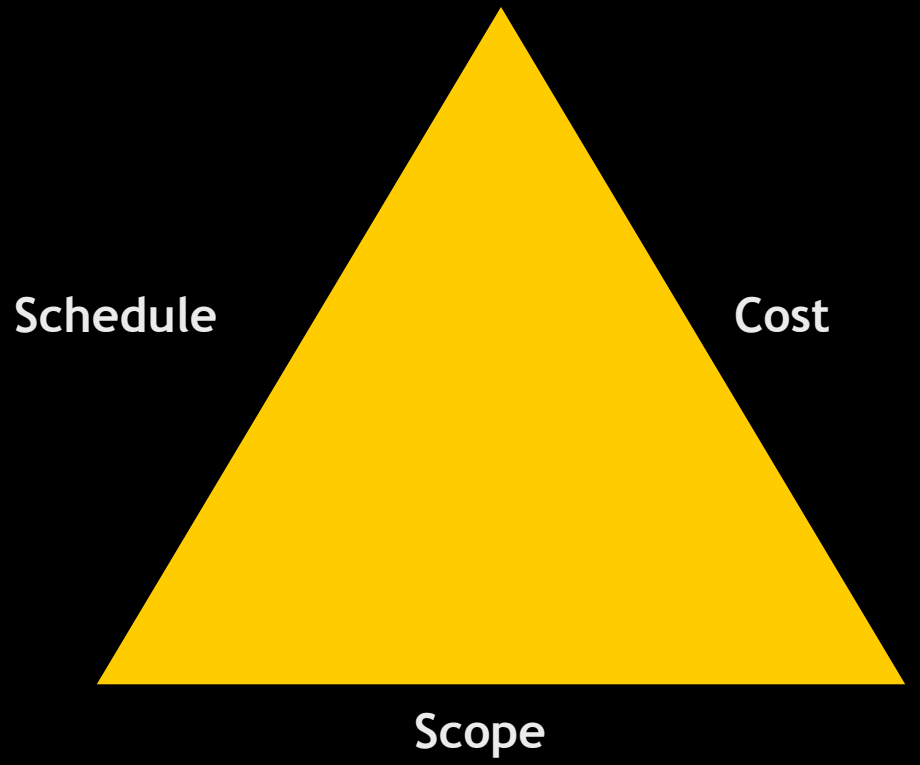

- External constraints place limits on values for all dependent variables.
- A successful project has monitors and controls on these variables

The Baseline Establishes the Limits of all Dependent Variables

- **Baseline Scope**
  - WBS, Statement of Work, Preliminary Design, Key Performance Parameters, etc.
- **Baseline Cost**
  - Estimate according to WBS
  - Cash Flow/Funding
  - Contingency
- **Baseline Schedule**
  - Milestones
  - Duration
  - Float
- Quality
- Risk & Uncertainty
- Stakeholder expectations
- Roles & Responsibilities

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Effective Control Requires Exercise of Leading and Lagging Indicators

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- Status reports are often imposed by management to attempt to get project managers to effectively **control** a project
- The production and publishing of status reports does not **control** the project
- Status reports, by and large, are tracking project **history** and if relied on exclusively, it's like driving by looking only through the rear-view mirrors.

Monitoring and Control Methods

- Meetings, reports and reviews
- Active risk and issue surveillance
- Rigorous change control
- Contingency, buffer, and milestone surveillance
- Communications and conflict resolution
- Use of outside experts
- Scheduling – Gantt charts, Pert chart, critical path network
- Cost accounting and cost schedule control system (CSCS), also referred to a project management control system (PMCS)

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Internal & External Reviews are Tools for Controlling / Managing

- Reviews are not a *necessary evil*
  - If approached properly highlight
    - Progress
    - Areas for improvement
    - Blind spots and oversights
    - Risks
- External reviews are a communication tool as well
- Internal reviews and advisory committees are forums for issue and risk examination
  - Design maturity and technical readiness
  - Process and management effectiveness
- Provide *plausible deniability* as a means for highlighting subsystem shortcomings

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Key Steps in Implementing a Project Management System

- Establish and use Integrated Planning and Control Systems as a focal point for implementation of the project
  - Know where you are going
  - How you are getting there
  - When you have arrived
- Be willing to re-examine and adapt …
  - Dealing with changing circumstances is key
- Long before the end of the project, plan for the end
  - Plans must be developed for:
    - Personnel
    - Other resources
    - Transfer of knowledge

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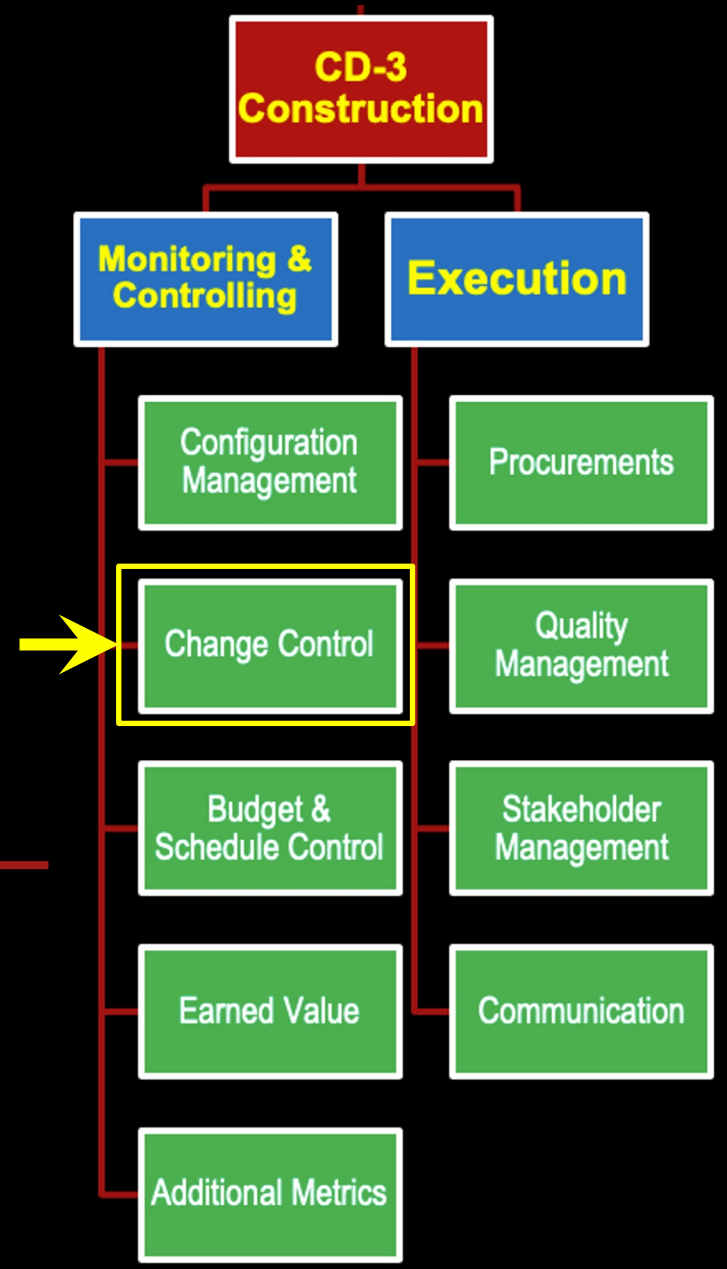
Change Control

Change is the only constant in life. — Heraclitus

They say that time changes things, but you actually have to change them yourself. — Andy Warhol

Change should be a friend. It should happen by plan, not by accident. — Philip Crosby



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Projects are subject to change

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- There has never been a project that hasn't been subject to change
  - Circumstances changes
  - Assumptions are no longer valid
  - Market conditions change
  - Unforeseen, but necessary, design/performance modifications
  - Risk events — threats and opportunities
- Change is inevitable, but must not be allowed to occur unconsciously
- Changes that result in a change in the project baseline must be understood before acceptance

Change control is necessary for all projects

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- All projects are subject to risk and uncertainty
- A project manager and team cannot lay out a project baseline with absolute certainty
- A project to be successful must adapt to changing circumstances
- Without appropriate change control rigor
  - Contingency will be squandered,
  - Schedule buffer will be consumed
  - Scope will creep
  - Quality will suffer

Control / Correction

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Why?

To detect the early warning signs of potential project failure

Control / Correction

Why?

To detect the early warning signs of potential project failure

- Inadequate project planning, ambiguous milestones; failure to chart interdependencies between tasks and establish a critical path; estimates not based on actual history or experience
- Changing circumstances or risk triggers, funding profiles change, bidding environment differs, risks occur
- Poorly defined objectives – muddled objectives of a project, or not understanding the nature of scientific funding agency requirements, will likely cause a project to go off track. It is rare that a scientific project fails to deliver upon reaching the end of the project – it is generally terminated beforehand.
- Technology disconnects – A project that depends upon estimated performance gains from new technology entails significant risk and has the potential to derail. If technical developments are not carefully monitored and tracked considerable schedule and budget overruns are inevitable.

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Control / Correction

Why?

- Missing skills – Failure to initially assign and/or identify all required critical skills when doing resource allocation.
  - Even if this problem is later addressed by seeking help from outside consultants or by acquiring new skills through training, the schedule and budget may be irreparably impacted.

No project should be undertaken unless the required skills are identified and available as needed.

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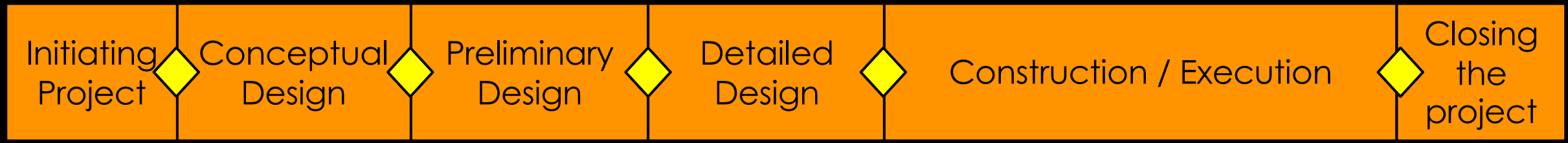
Why?

- Inappropriate complexity –
  - Work packages have multiple systems
    - Increased uncertainty and risk in estimates and control.
  - Work packages have multiple owners
    - Lack of accountability and responsibility

  - Solution: Break large work packages down into component work packages with clearly identified owners shorter timeframes – a key success factor.

Project Lifecycle – When to monitor/control change?



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- *Freeze date*: At a predefined phase, *freeze* project against all nonessential changes (freeze point must be agreed to by management)

The sooner the project can be frozen, the less that changes will adversely affect project schedule and cost

Control / Correction

- Change Control: A defined documented process which includes all stakeholders and the project plan to manage scope change. The process defines the forms and approvals that must be obtained prior to changing the project's scope and includes monitoring critical dates.

A rigorous change control process is a mandatory part of any project management process and is a primary element of scope management.

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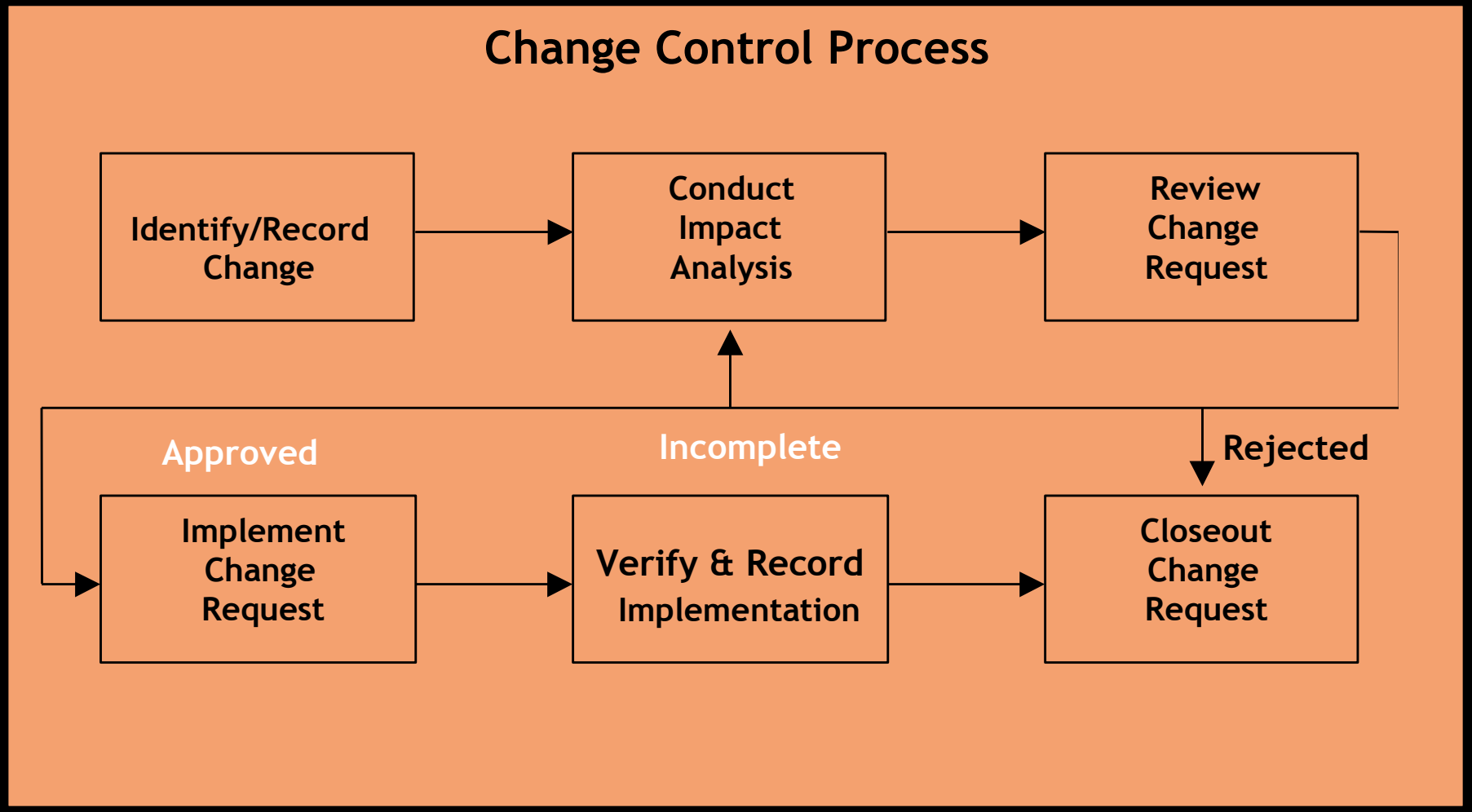

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How?

- Document
  - Each change must be documented on a change request form, including analysis of impact on cost, schedule, and technical baselines, as well as disposition of the change.
  - Decisions from the change control board must be recorded and disseminated.
  - A change log must be maintained showing status of all change requests.

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How?

- Establish a change control plan – A collection of documented procedures that defines how project performance will be monitored and evaluated including the steps by which the official project baseline may be changed.
- Establish thresholds – Determine the level of consideration and approval based upon the magnitude of the impact on technical performance, schedule or cost of a change.

Internal vs. External Control

- Internal vs. External Control
  - Internal
    - Exercised by contractor
  - External
    - Exercised by customer
      - Audit of books and records
      - Work inspection
      - Periodic reports of costs, schedule, and performance
      - Incentive contracts
      - Customer's own project manager

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Project Control Emphasis

- *Scope Change Control*
  - identify where changes have occurred
  - ensure the changes are necessary or beneficial
  - contain or delimit the changes wherever possible
  - the implementation of changes.

- *Quality Control*
  - manage work to achieve requirements and specifications
  - take preventive measures to eliminate errors and mistakes
  - identify and eliminate sources of errors and mistakes
  - includes technical performance measurement, TPM

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Project Control Emphasis

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- *Procurement Control*
  - Monitor quality, schedule, and cost of all procured items
  - Visit and inspect the facilities of subcontractors and suppliers
  - Track subcontractors' and suppliers' progress and expenses,
  - Prepare contingency for all major procured material, equipment, components, and services

Project Control Emphasis

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- *Schedule Control*

  Keep project on schedule and minimize schedule overruns

  - *Use Time Buffers (described next)*
  - *Fight Tendency to Multitask*
  - *Frequently Report Activity Status*
  - *Publicize Consequences of Delays and Benefits of Early Finish*

Change Control & Quality

- Documenting/ Communicating
  - Configuration management is any documented procedure used to apply technical and administrative direction and surveillance to:
    - Identify and document the functional and physical characteristics of an item or system
    - Control any changes to such characteristics
    - Record and report the change its implementation status
    - Audit the items and system to verify conformance to requirements
    - Lessons learned – the causes of variances, the reasoning behind corrective action chosen, and other types of lessons learned should be documented so that they become part of the historical database for both this project and other projects of the performing organization. The database is also the basis for knowledge management.

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Project Change Control Is Linked to Thresholds

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Thresholds for changes established in project plan (highest to lowest)

- Sponsor / Customer / Funding Agency
  - Oversight Groups / Line Organization Management
    - Project Director
      - Project Manager
        - System / Subsystem Manager
          - Work Package Manager

Change Control Matrix Examples

SNS Second Target Station (STS)

	Under Secretary for Science (S-4) (Level 0)	Associate Director of Science for Basic Energy Sciences (SC-22) (Level 1)	Federal Project Director (Level 2)	STS Project Director (Level 3)
Scope	Any change in scope that affects the ability to satisfy the mission need, meet a threshold KPP or achieve the baseline scope in section 2.1 and the PDS.	Any addition to or deletion of CD-2 baseline scope at WBS Level 2 as stated in the WBS dictionary that does not negatively impact the threshold KPPs. (Section 2.4); beamline TTOPs (Section 2.1) are also controlled at this level.	Any addition to or deletion of CD-2 baseline scope at WBS Level 3 as stated in the WBS dictionary that does not negatively impact the threshold KPPs. (Appendix B).	Major additions or deletions of scope to the WBS below Level 3 that does not negatively impact the threshold KPP. A PCR will be utilized for change control. (Appendix B)
Cost	Any increase in TPC of the project as stated in Table 2.	The cumulative use of contingency greater than 75% of the cost contingency established at CD-2. Once this level is reached, the AD may transfer any fraction of the remaining cost contingency to the FPD as needed. This may be repeated until the cost contingency is expended.	Any transfer of FPD controlled contingency to or from Management Reserve. Any specific cost contingency allocation up to 75% of the cost contingency established at CD-2. **	Any change to the Budget at Completion (BAC) that does not require the use of contingency. Any use of Management Reserve. *
Schedule	Any delay to the CD-4 project completion date as stated in Table 3.	The cumulative use of contingency greater than 75% of the schedule contingency established at CD-2. Once this level is reached, the AD may transfer any fraction of the remaining schedule contingency to the FPD as needed. This may be repeated until the schedule contingency is expended. Any delay to a Level 1 milestone > 3 months.	The cumulative use of contingency up to 75% of the schedule contingency established at CD-2.** Any specific schedule contingency allocation requested by the project within approval authority. A delay of 3 months or more to any Level 2 milestone as stated in Table 3A, the Level 1 authority will be notified.	Any distribution or use of contractor schedule MR to the PMB. Any delay to a Level 3 milestone > 3 months.
Funding	Any changes to the funding profile as stated in Section 2.5 that negatively impacts the Performance Baseline.			

UIM Project

	Deputy Director for Science	Acquisition Executive (AE)	Federal Project Director*	Contractor Project Manager
Scope	Any change in scope and/or performance that affects the ability to satisfy the mission need or is not in conformance with the current approved PEP Section 2.1 and Project Data Sheet (PDS).	Any addition to scope as described in PEP section 2.1 or Major changes in technology or approach to Level 2 WBS components as shown in Section 2.4	Major changes in technology or approach to Level 3 WBS components as shown in Table 6	Major changes to WBS below Level 3
Cost	Any increase in TPC, TEC, or OPC of the project as stated in Table 8	One time contingency* usage of $500k or larger or The larger cumulative change of—lesser than 50% or $2.5M of Level 2 WBS** as shown in Table 6.	The larger cumulative change of greater than 50% or $2M of Level 3 WBS** as shown in Table 6.	The larger cumulative change of greater than 50% or $1M to WBS Lower than level 3**.

	Deputy Director for Science	Acquisition Executive (AE)	Federal Project Director*	Contractor Project Manager
Schedule	Any delay in CD-4, project completion date as stated in Table 3.	Any changes to Level 1 milestone as shown in Table 3 (with the exception of CD-4). The cumulative change of lesser than 9 months of schedule contingency before CD-4 as shown in Table 3.	Any changes to Level 2 milestone shown in Table 4	Any changes to milestone below Level 2
Funding		Any changes to funding profile as shown in Section 2.5 that negatively impacts the Performance Baseline.		

* Any contingency usage will require the approval by the FPD or Federal personnel.
** After the cumulative threshold has been reached and the next higher change authority has been notified and has approved the changes, the cumulative cost thresholds will reset.

Thresholds Example: DESI Project Execution Plan

Table 12: Change Control (CC) Table

	Deputy Director for Science (CC Level 0 Change)	Project Management Executive (CC Level 1 Change)	Federal Project Director* (CC Level 2 Change)	DESI Project Director (CC Level 3 Change)
Scope	Any change in scope and/or performance that affects the ability to satisfy the mission need. The Deputy Sec'y of Energy must be notified of and approve a change from current approved Threshold KPPs in PEP Section 2.1	Any changes that negatively impact achieving the Objective Key Performance Parameters (KPPs) as defined in the PEP	Changes in scope affecting technical performance of WBS Level 2 components that do not affect the KPPs or Major changes in technology or approach to Level 2 WBS components	Changes to technical scope below the FPD thresholds
Cost*	Any increase in TPC, TEC, or OPC of the project as stated in Table 6	Cumulative allocation of $5M of contingency	Any cumulative change of ≥$1M in a WBS Level 2 cost shown in Table 6, or cumulative allocation of ≥$1M in contingency**	Any use of management reserve
Schedule	Any delay in CD-4, project completion date as stated in Table 7	Any delay to a Level 1 Milestone as shown in Table 7 (with the exception of CD-4). ≥6 month delay to a Level 2 Schedule Milestone shown in Table 8	≥3 month delay to a Level 2 Schedule Milestone date shown in Table 8	Any delay below the FPD threshold in a Level 2 Schedule Milestone date as shown in Table 8
Funding	Any changes to funding profile as shown in Table 10 that negatively impacts the Performance Baseline			

* Any contingency usage will require the approval by the FPD or Federal personnel. The FPD has the authority to allocate contingency to management reserve through the change control process.

** After the cumulative threshold has been reached and the next higher change authority has been notified and has approved the changes, the cumulative cost thresholds will reset.

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CHANGE CONTROL PLAN

Change Control Plan

- Change control is one of the key elements for keeping a project on track
- The Change Control Plan creates a process to ensure that each change to the project plan is evaluated for value and impact before being introduced
- The Change Control Plan is a mechanism for keeping a good plan from going bad

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Help Yourself

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- When developing the Change Control Plan, utilize the resources that are already at your disposal
- If the organization has an existing change control program, try and adapt this program to meet the requirements of the project
- An existing change control system allows the organization to leverage existing technology, simplifies integration of the project data into other databases and reduces the learning curve for project participants

Who

- The Change Control Plan should specifically identify who is authorized to request a change, as well as the formal process by which the request is submitted
- To avoid lost requests, the plan should identify who is responsible for tracking the change request from receipt to either implementation or rejection
- It also defines the process to ascertain the status of the request

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Approval

- The Change Control Plan must identify the specific individual or body that is authorized to approve requests
- If different levels of approval exist depending on the size of the change, then these thresholds should be identified
- All decision makers should be aware of the limitations on their authority

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Criteria

- The plan must identify the assessment criteria that will be used by the approval authority and the information that must be provided with the request in order for them to understand the full impact of the change
- The best way to address this need is by developing a comprehensive change request form that performs a rigorous examination of the change and its impact

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How

- The plan must define how an approved change will be integrated into the project plan
  - Scope statement changes
  - Project baseline updates
  - Work breakdown structure
  - Budget updates
  - Schedule update
  - Quality standard updates
  - Other
- What mechanisms are in place to ensure that it is accomplished
- The change control process does not end when a change is approved
- The plan must provide mechanisms for the change to be monitored throughout the implementation process

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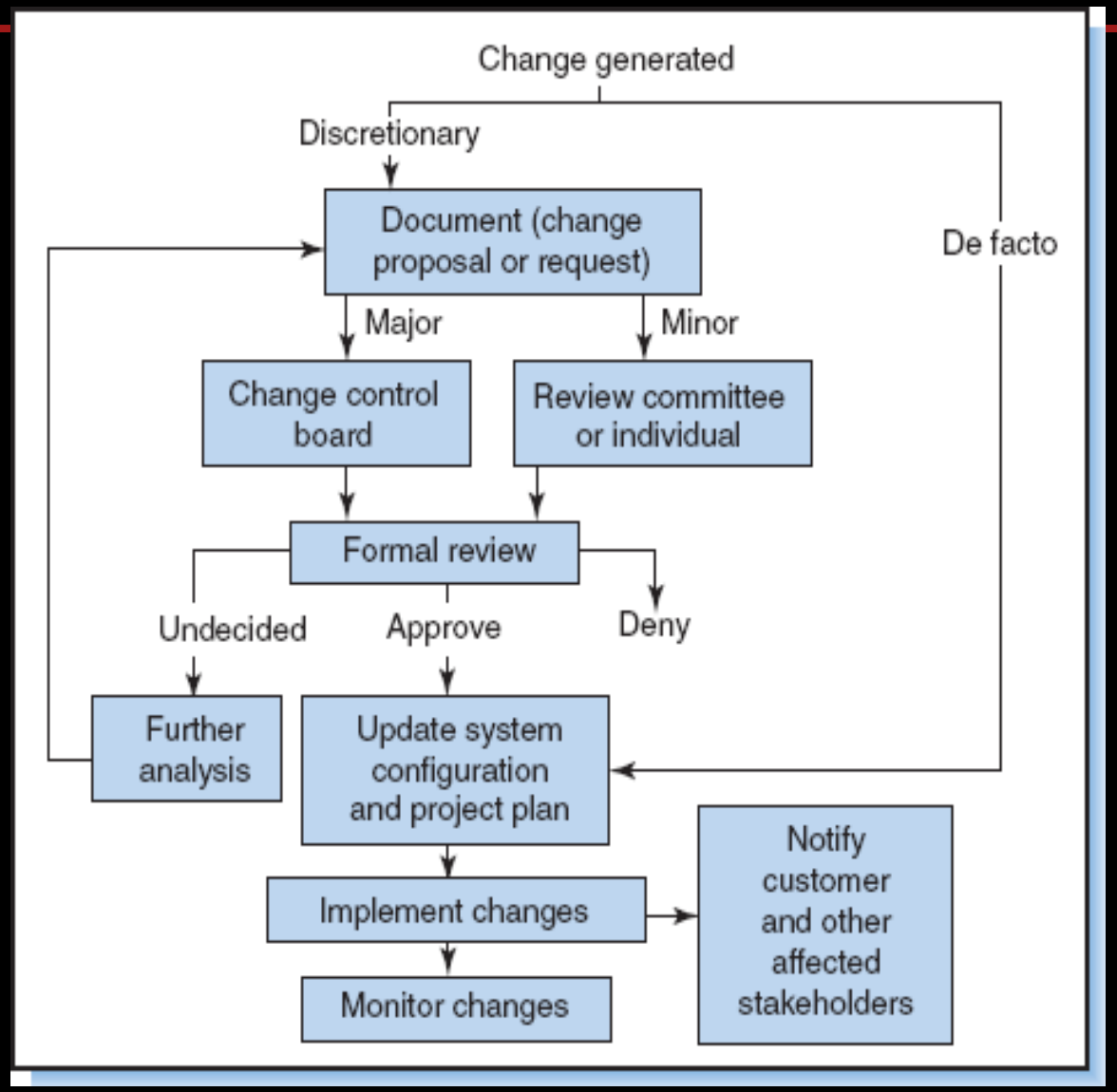
Example of Change Control proces



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Functions of Change Control

- Continuously identify changes as they occur
- Reveal consequences of changes
  (impacts on the other tasks, project costs, and duration)
- Analyze alternative courses of action and make acceptance or rejection decisions
- Minimize changes
- Communicate changes to all concerned
- Ensure changes are implemented
- Report summaries of all changes and their impact on the project

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Just do it

- Once the work is under way, no changes in the project plan or baseline should go unnoticed or unassessed
- Use the Change Control Plan to identify, verify and track all changes to the project
- Some change is unavoidable, but good planning should minimize the number of changes and ensure that most are confined to individual tasks, ideally having no effect on other work packages

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Why

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- Pay special attention to any change that extends beyond the boundary of a specific task, especially if it has implications for the baseline project cost, schedule or quality
- Use the Change Control Plan and the Change Request Template to rapidly detect, evaluate and incorporate changes that occur within the project
- This avoids surprises and ensures that the project scope remains stable

Metrics

"When performance is measured, performance improves. When performance is measured and reported back, the rate of improvement accelerates."

- Thomas S. Monson

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Metrics (2)

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Definitions:

- **Metrics** - Performance measurement techniques that help to assess the magnitude of any variations that does occur.
- **Variance** – Any deviation in schedule, technical performance, cost or quality from a specific plan.

You must have a project baseline in place for a measurement to be meaningful.

Metrics (3)

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Tools:

- **Technical Performance Measurements (TPMs)** – A deliverable's actual technical achievement compared to the project scope's stated technical achievement
- **Performance Reports** – Reports which document variation between stated and actual technical achievement

Performance reports should alert the team to issues or risks that could cause problems in the future.

Analysis

- Variance analysis looks at the stated goal versus the actual achievements for scope, schedule, and cost.
- Documented and charted results provide trend information for cost and schedule forecasts, as well as information regarding how well a project is managing scope.
- Analysis attempts to determine future outcomes based on data measured.

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Analysis (2)

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- An important part of variance analysis control is to decide if the identified variations requires corrective action.

- For example,
  - A major delay on a non-critical activity may have little effect on the overall project, but it could have compounding effects on resources
  - A much shorter delay on a critical or near-critical activity may require immediate action.

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Budget & Schedule Control

"It's clearly a budget. It's got a lot of numbers in it." — George W. Bush

"We didn't actually overspend our budget. The allocation simply fell short of our expenditure." — Keith Davis

"I still have checks so I must have money in the bank" — Cathy

Schedule and Budget

- Successful control of schedule and budget is based on frequent measurement and analysis
- The examination of contingency and schedule buffer consumption are key
  - Isolation of systematic issues
  - Ignoring random fluctuations
- If a reasonably accurate estimate doesn’t form the baseline then, control is essentially impossible
  - Revisions are likely as new information or developments emerge

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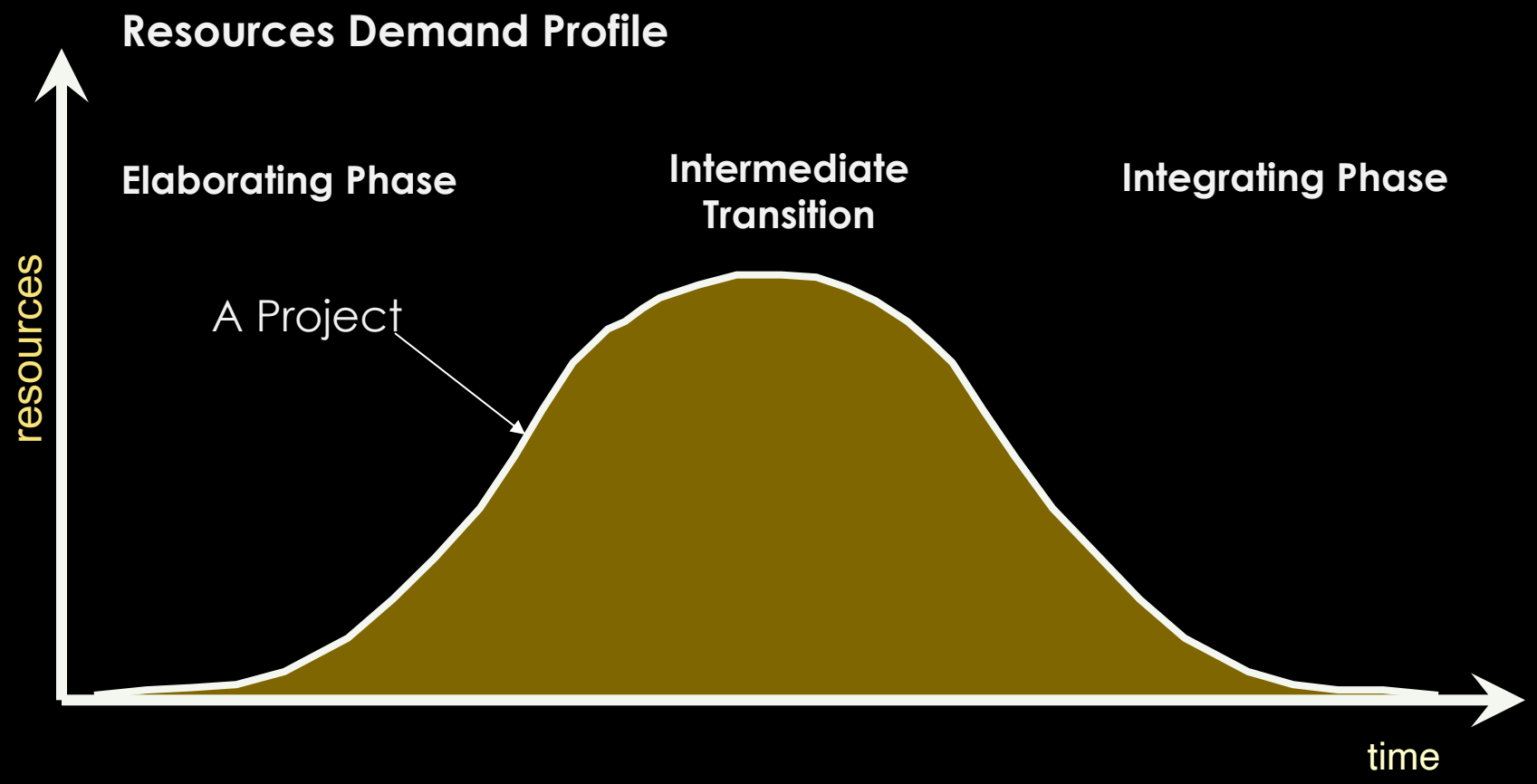
Project Resource Profile



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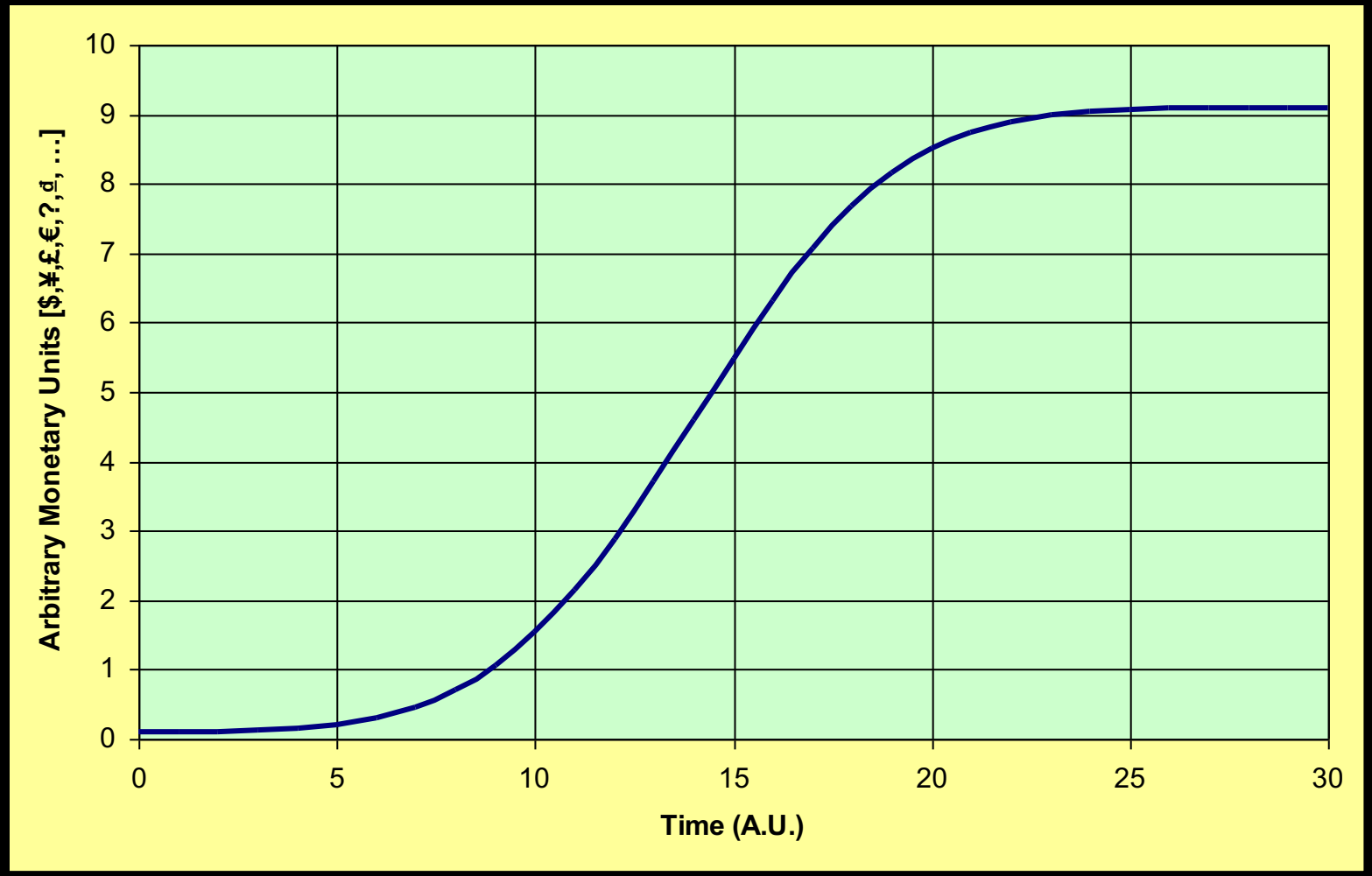
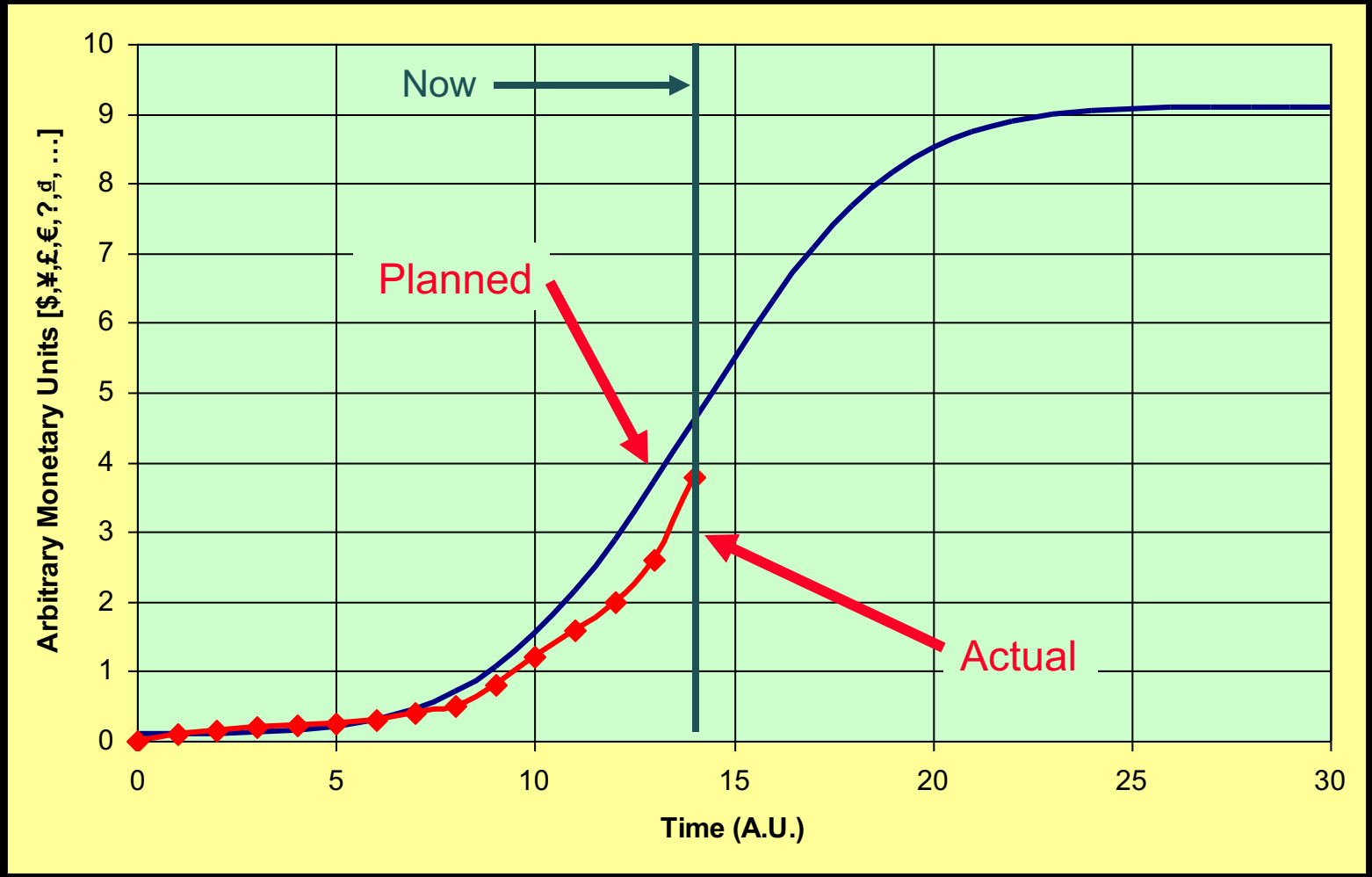
The Project *S-Curve:* The integral of the resources demand



- Based on the budget estimation and schedule a time-phased spending profile will result
- Frequently this is finances based, but it can be resources based as well.

The Project Proceeds …



- Question: Is this project doing well or not?

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The Project: Good, Bad, Ugly … ?

- *"We're spending less, that must be good!"*
- Spending information alone is not sufficient to tell how a project is doing
  - It may work for a small grant or research program;
  - It contains no information about deliverables or schedule compliance
- Analyzing the spending variance helps a little, but …

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Project Analysis – Spending

- Plotting the planned spending rate, the actual spending rate and the difference indicates the cost over-run or under-run
- Cost under-run indicates that the work being performed is costing less than foreseen
- Either (positive reasons ☺):

  The work has gone more smoothly than anticipated

  The work was done more efficiently than anticipated

  The estimate was generous

- Or (negative reasons ☹):

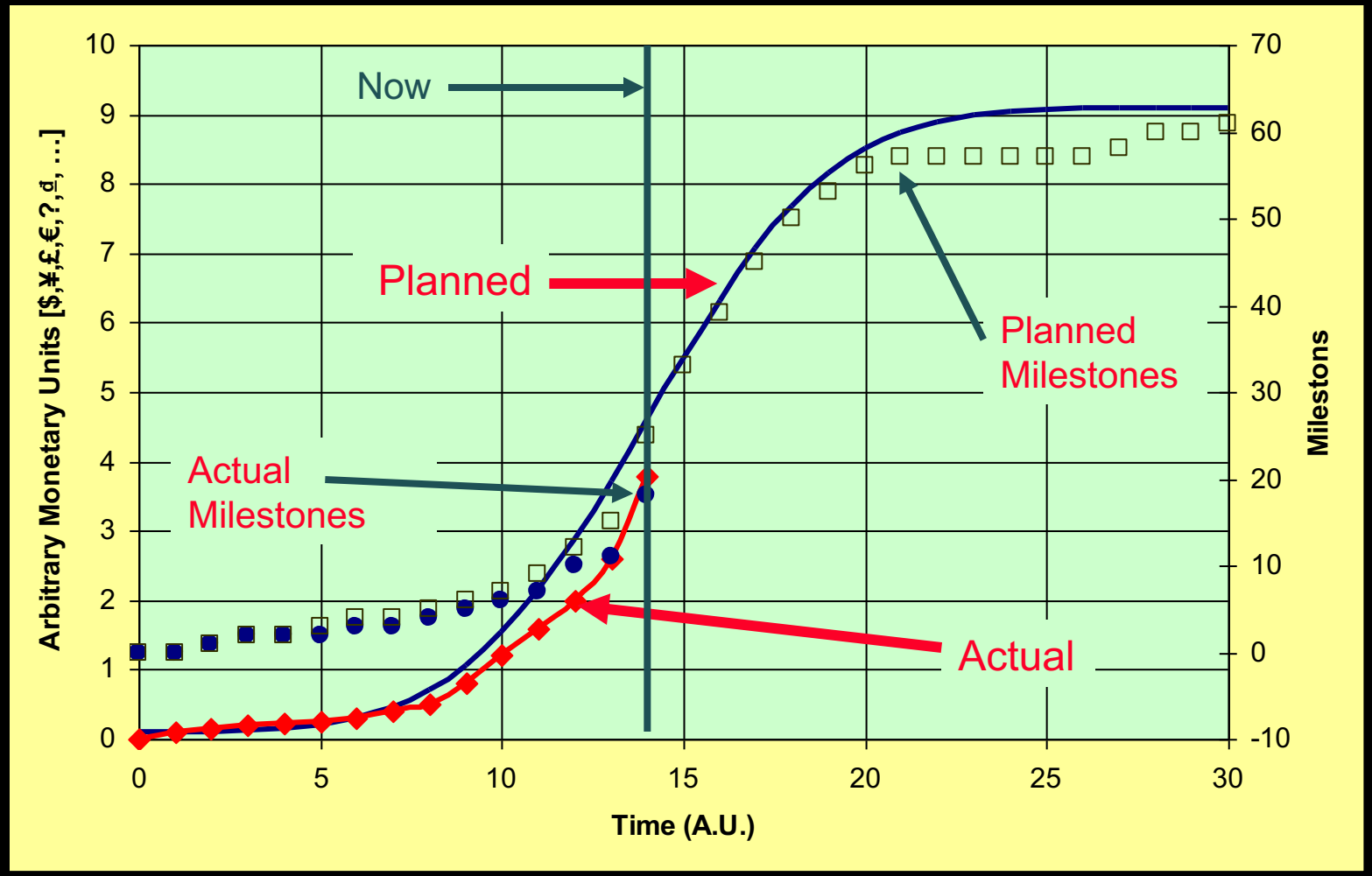
  Work is not being accomplished at the planned rate

  There are technical problems

  Work is not being performed with sufficient quality

- The spending comparison does not provide enough information to determine if things are going well, or badly

Add Some Deliverables Information



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Deliverable Information Helps

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- Actual milestones achieved against plan show that the project is not accomplishing its deliverables at the scheduled rate
- The actual costs are lower than scheduled
- On many projects, tracking deliverables and expenditures often is sufficient to determine the state of the project, but …
- Question: Is the project in budget trouble?
- Again, there is insufficient information to say …

The Concept of Value In the Project

Price is what you pay. Value is what you get.
- Warren Buffett

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- In projects, **value** represents what has been accomplished toward the deliverables of a project
- A project accumulates **value** as it executes work, tasks, and activities that contribute to the controlled project deliverables
- A project, therefore strives to **earn value**

Price: $0.25
(part of case bought at warehouse)

Price: $1.00
(bought from vending machine)

Price: $3.00
(bought at stadium concession)

EARNED VALUE MANAGEMENT (EVM) IS A SYSTEMATIC APPROACH TO THE INTEGRATION AND MEASUREMENT OF COST, SCHEDULE AND TECHNICAL (SCOPE) ACCOMPLISHMENTS ON A PROJECT OR TASK.

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Earned Value Management

I conceive that the great part of the miseries of mankind are brought upon them by false estimates they have made of the value of things.

- Benjamin Franklin

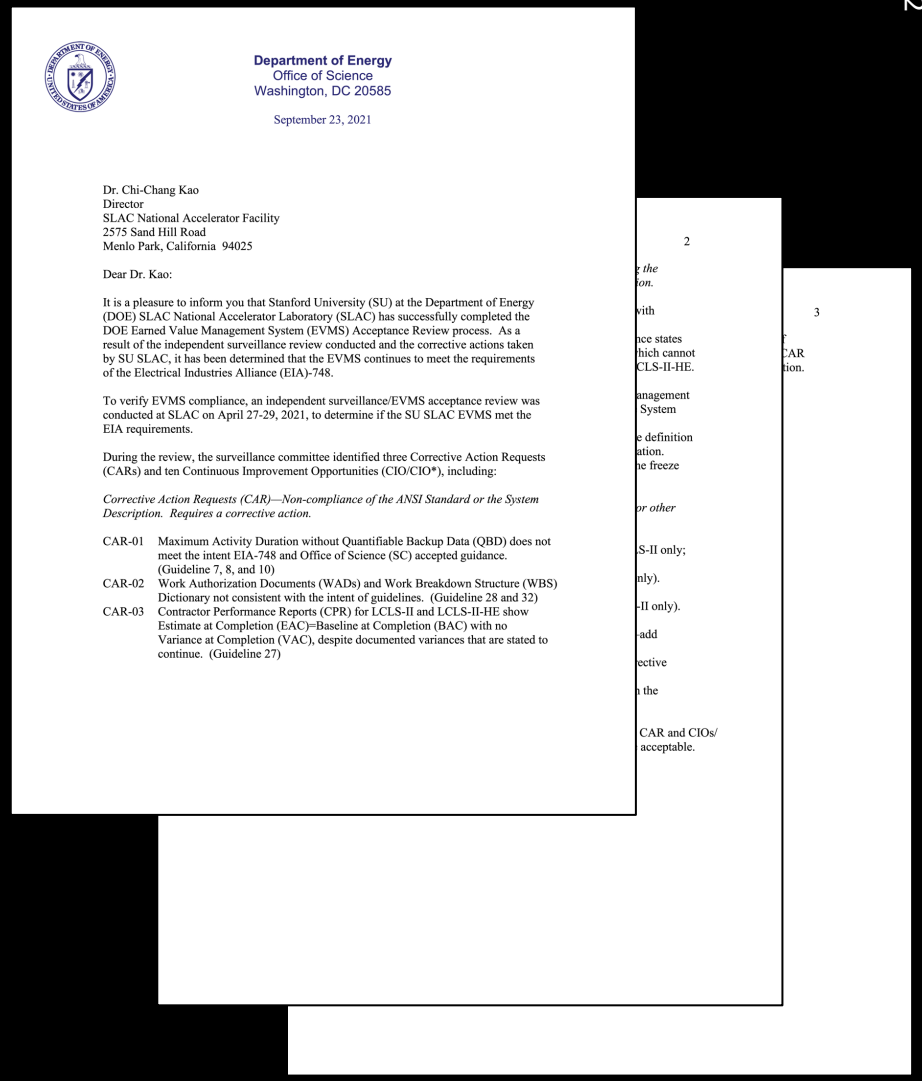
The aim of the system must be clear to everyone in the system. The aim must include plans for the future. The aim is a value judgment.

- Dr. W. Edwards Deming

Earned Value Management System

– It needs to be exercised and demonstrated

- Typically, ~3 months of trial data to show that systems and processes are in place
- Even though a baseline hasn't been established committees expect to see baseline change proposals (BCPs) against a trial baseline
- Need to show compliance with Laboratory certified systems



Department of Energy
Office of Science
Washington, DC 20585

September 23, 2021

Dr. Chi-Chang Kao
Director
SLAC National Accelerator Facility
2575 Sand Hill Road
Menlo Park, California 94025

Dear Dr. Kao:

It is a pleasure to inform you that Stanford University (SU) at the Department of Energy (DOE) SLAC National Accelerator Laboratory (SLAC) has successfully completed the DOE Earned Value Management System (EVMS) Acceptance Review process. As a result of the independent surveillance review conducted and the corrective actions taken by SU SLAC, it has been determined that the EVMS continues to meet the requirements of the Electrical Industries Alliance (EIA)-748.

To verify EVMS compliance, an independent surveillance/EVMS acceptance review was conducted at SLAC on April 27-29, 2021, to determine if the SU SLAC EVMS met the EIA requirements.

During the review, the surveillance committee identified three Corrective Action Requests (CARs) and ten Continuous Improvement Opportunities (CIO/CIO*), including:

Corrective Action Requests (CAR)—Non-compliance of the ANSI Standard or the System Description. Requires a corrective action.

CAR-01 Maximum Activity Duration without Quantifiable Backup Data (QBD) does not meet the intent EIA-748 and Office of Science (SC) accepted guidance. (Guideline 7, 8, and 10)
CAR-02 Work Authorization Documents (WADs) and Work Breakdown Structure (WBS) Dictionary not consistent with the intent of guidelines. (Guideline 28 and 32)
CAR-03 Contractor Performance Reports (CPR) for LCLS-II and LCLS-II-HE show Estimate at Completion (EAC)=Baseline at Completion (BAC) with no Variance at Completion (VAC), despite documented variances that are stated to continue. (Guideline 27)

But doesn't DOE O 413.3B says no EVM for fixed-price contracts?

Yes, it does, but …

- That's fixed-price between DOE and the Contractor.
- Not us (as contractor) and our subcontractors
- Need to establish mechanisms for performance
  - Schedule of values
  - Milestone payments
  - Subcontractor reporting
  - …

CONTRACTOR REQUIREMENTS DOCUMENT
DOE O 413.3B, PROGRAM AND PROJECT MANAGEMENT
FOR THE ACQUISITION OF CAPITAL ASSETS

This Contractor Requirements Document (CRD) sets forth requirements applicable to the contract to which this CRD is inserted. The Contractor is responsible for performing program and project management of Department-owned or -leased facilities as determined by the Federal Project Director and Contracting Officer, in conjunction with the Federally-assigned Integrated Project Team members. The Contractor shall: (1) comply with the requirements of this CRD to include subcontractor(s), and (2) flow down the appropriate requirements of the CRD to a subcontractor, when the total project cost to the prime contractor are greater than $50 million.

The Contractor's project management system shall satisfy the following requirements:

1. Except for firm fixed-price contracts, the Contractor shall:

   - Employ an Earned Value Management System (EVMS) prior to Critical Decision (CD)-2, or upon contract award, for projects greater than $50 million, unless granted an exemption from the PMSO. The system shall be compliant with EIA-748C (or as required by the contract) in accordance with contract clause FAR Subpart 52.234-4, EVMS.

The three data sources: PV, EV and AC

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Using earned value, we can compare:

- what was supposed to have been accomplished (PV / BCWS)
- what was actually accomplished (EV / BCWP)
- what was actually spent to perform the work (AC / ACWP)

These three data sources will be used to calculate EV metrics

Earned Value Concepts in Projects

The earned value must be evaluated as well as the cost

Earned Value (EV)	The value of work performed expressed in terms of the budget assigned to that work. Also referred to as the budgeted cost of work performed (BCWP).
Planned Value (PV)	The authorized budget assigned to the scheduled work to be accomplished. Also referred to as the budgeted cost of work scheduled (BCWS).
Actual Cost (AC)	Total costs actually incurred and recorded in accomplishing work performed during a given time period. Also referred to as actual cost of work performed (ACWP).
Budget at Completion (BAC)	The sum of all the budgets established for the work to be performed on the project. **The total planned value of the project.**

Planned Value – PV (PMI) / BCWS

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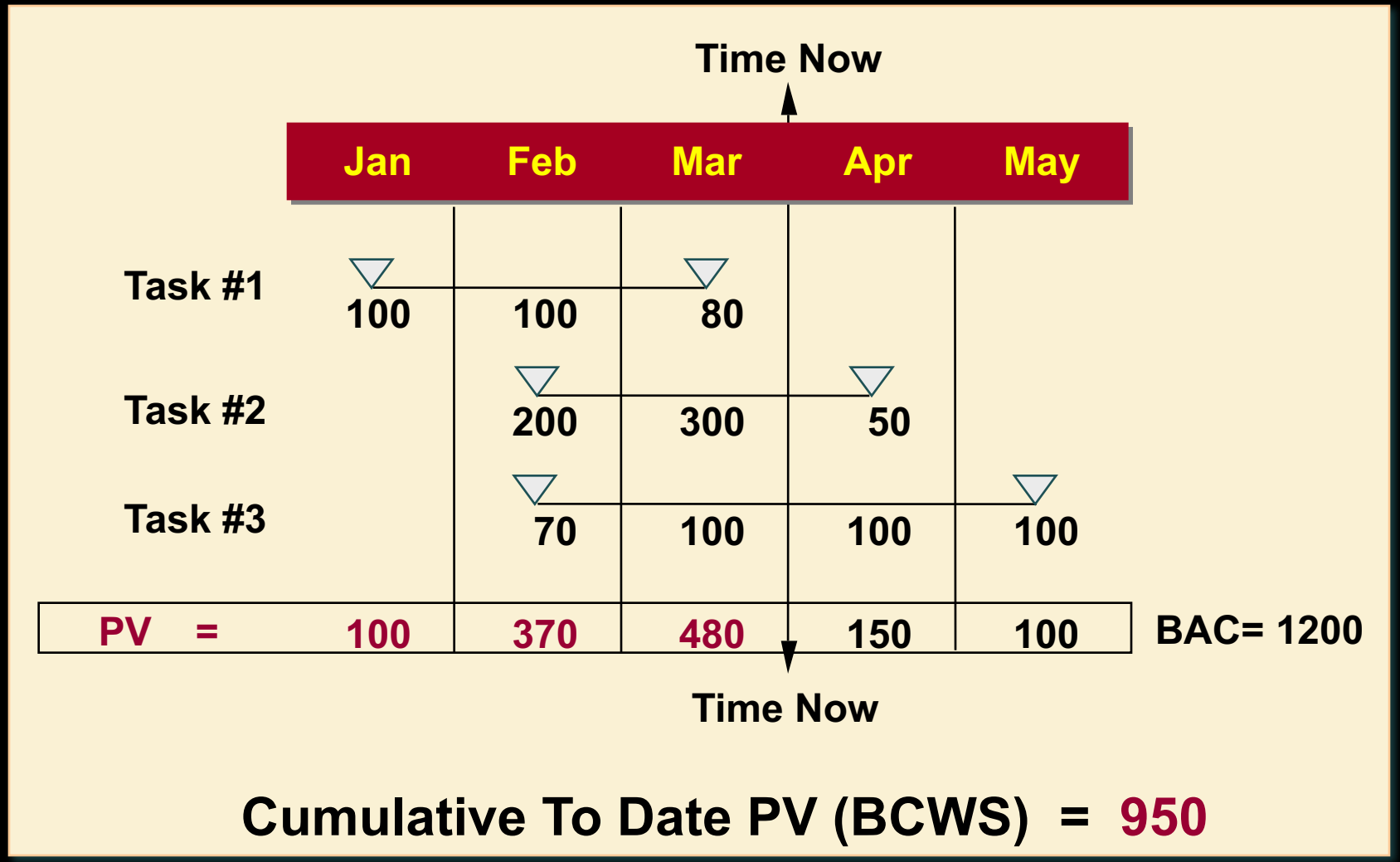
- What is it?
  - "The sum of the budgets for all work packages (or portions thereof), planning packages, etc., scheduled to be accomplished, plus the amount of level of effort and apportioned effort scheduled to be accomplished within a given time period."
  - Other things to know:
    - Answers the question: "How much work am I projecting to complete this period?" "What did I commit to performing?"
    - Comes from the baseline schedule
    - When baselined, does not change that much
    - Often output from the cost processor tool, ex. COBRA
- Previously referred to as Budgeted Cost of Work Scheduled (BCWS)

PV: What you planned to do in the Resource Loaded Schedule



Earned Value – EV (PMI) / BCWP

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- What is it?
  - "The sum of the calculated budget amounts for completed work packages and completed portions of open work packages, plus the applicable portion of the budgets for level of effort and apportioned effort."
  - Other things to know:
    - Answers the question: "How much physical work did I actually accomplish?" "Based on the work I did, how much did I earn this month?"
    - Based on the Earned Value Technique – % complete, 50/50, etc
    - Pulled from the forecast schedule into the cost processor tool where EV is then calculated.
    - If a budget exists, EV can be calculated
    - Summary calculation for EV: % complete X Budget At Completion (BAC)

- Previously called Budgeted Cost of Work Performed (BCWP)

The Determination of Earned Value

- There are several approaches to determine earned value
  - Discrete
  - Apportioned (uncommon)
  - Level of Effort ← **AVOID (THE WORST)**
- Within Discrete there are additional methods
  - Fixed formula
    - For example 50/50
      - 50% of value taken when work package started remainder at completion
  - Weighted milestone ← **THE BEST**
    - Work package has several intermediate milestones which are assigned value. As milestones are completed earned value accrues
  - *Expert* opinion
    - Internal – asking the work package manager to assess
    - External – asking 3rd party to assess (work package manager for instance)
    - Referred to at physical % complete. When utilizing this method it is best that performance measurement be based on objective evidence.

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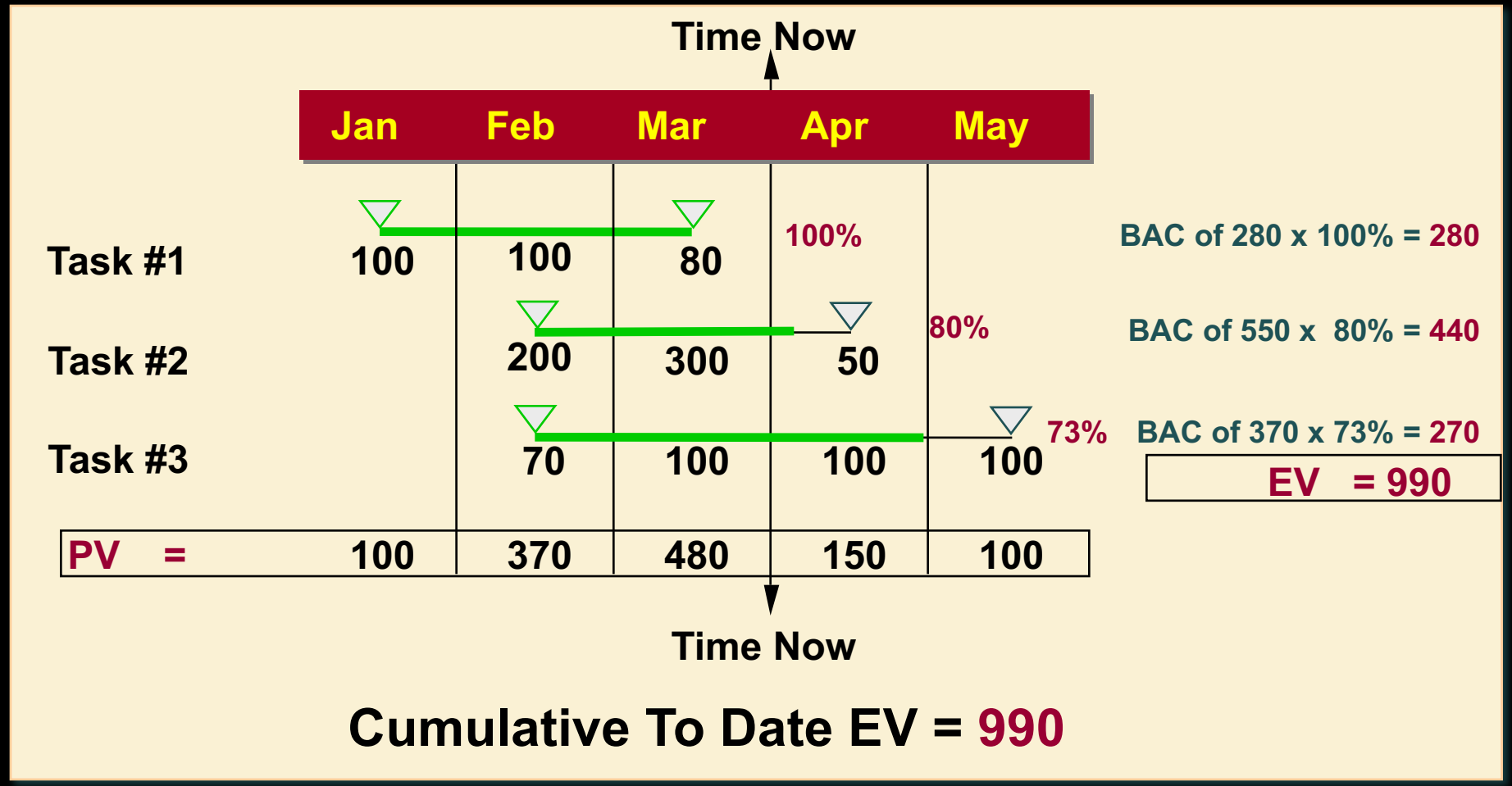
EV: Cost of the work performed calculated from % Complete



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Actual Cost – AC (PMI) / ACWP

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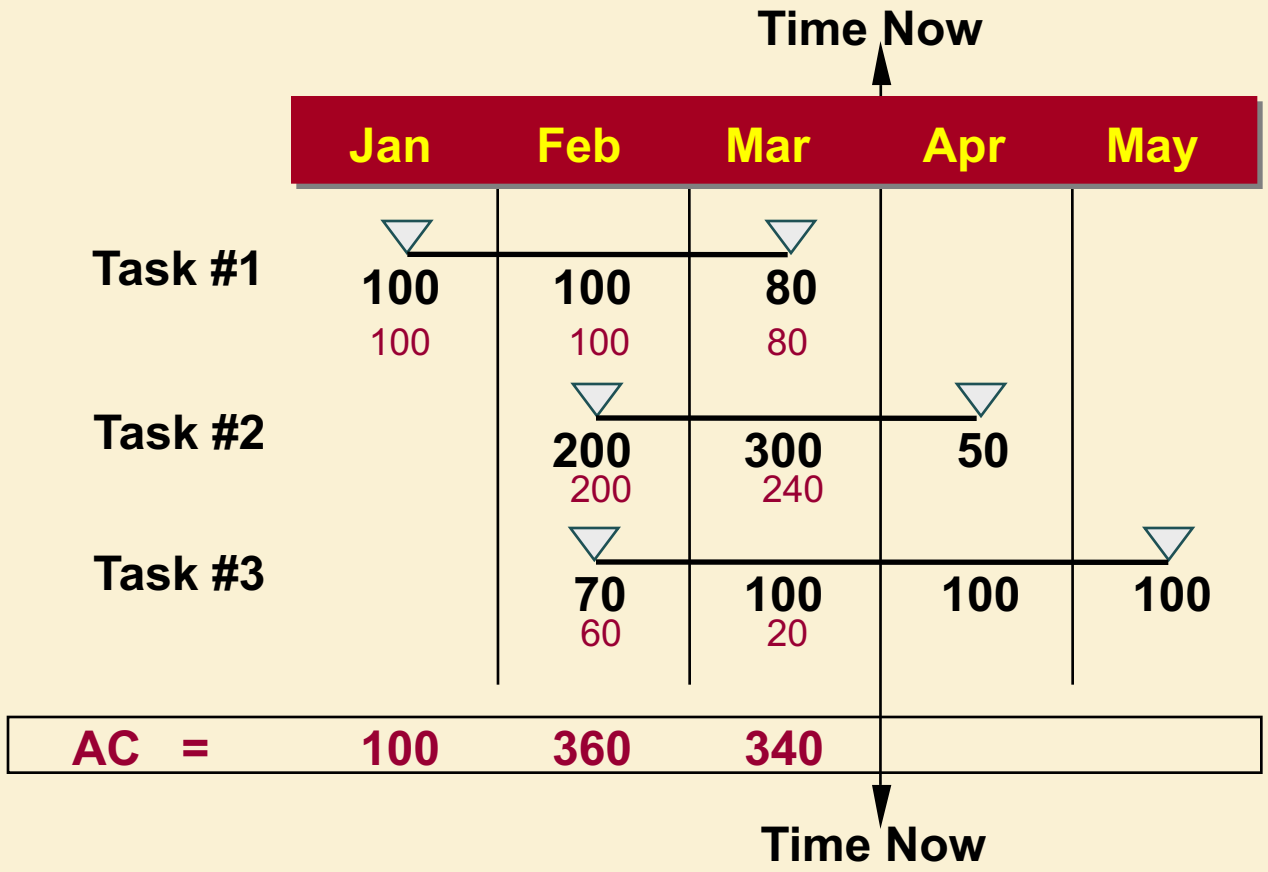
- What is it?
  - "The costs actually incurred and recorded in accomplishing the work performed within a project status time period."
  - Other things to know:
    - Answers the question: "How much did the physical work I actually accomplished cost me?"
    - Must match the accounting system
    - Includes:
      - Labor (Usually not accrued)
      - M&S invoiced and accrued (not invoiced yet – may or may not be in accounting system)
- Previously referred to as Actual Cost of Work Performed (ACWP)

AC: What was actually spent



Cumulative To Date AC = 800

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Earned Value Definitions – Variances

- Variances indicate the difference in Cost and Schedule for the same amount of work

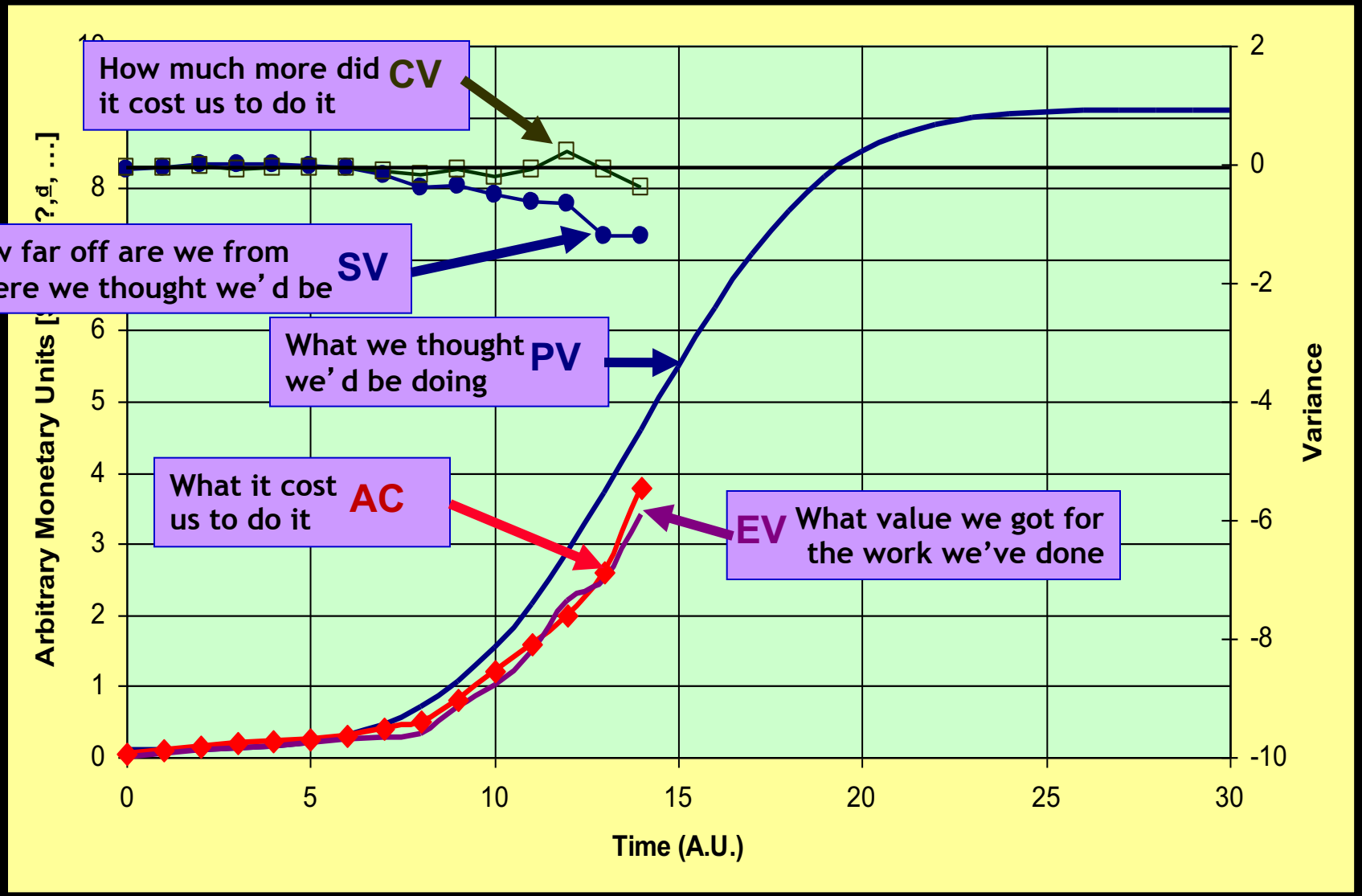
- They are a better indicator of problems than the mere differences in the spending rate or milestone achievement

Cost Variance (CV)	CV = EV – AC	The variance of cost from the budgeted value (CV>0 is Favorable - Underrun)
Schedule Variance (SV)	SV = EV – PV	The variance of value achieved against value scheduled (SV>0 is Favorable - Ahead of Schedule)

Earned Value Concepts in Projects

Cost Variance (CV) CV = EV - AC	The difference between the earned value (EV) and the actual cost (AC). Positive CV is good and negative is bad.
Schedule Variance (SV) SV = EV - PV	The difference between the earned value (EV) and the planned value (PV). Positive SV is good and negative SV is bad.
Estimate to Complete (ETC)	A forecast or estimate of the cost to complete the remaining work.
Estimate at Completion (EAC)	A revised estimate of the total cost of the project.
Cost Performance Index (CPI) = EV/AC	The ratio of EV to AC (EV/AC). A value of one is optimal. >1, underrun; <1, overrun
Schedule Performance Index (SPI) = EV/PV	The ratio of EV to PV (EV/PV). A value of one is optimal. >1, ahead of schedule ; <1, behind schedule

Earned Value Graphic Analysis



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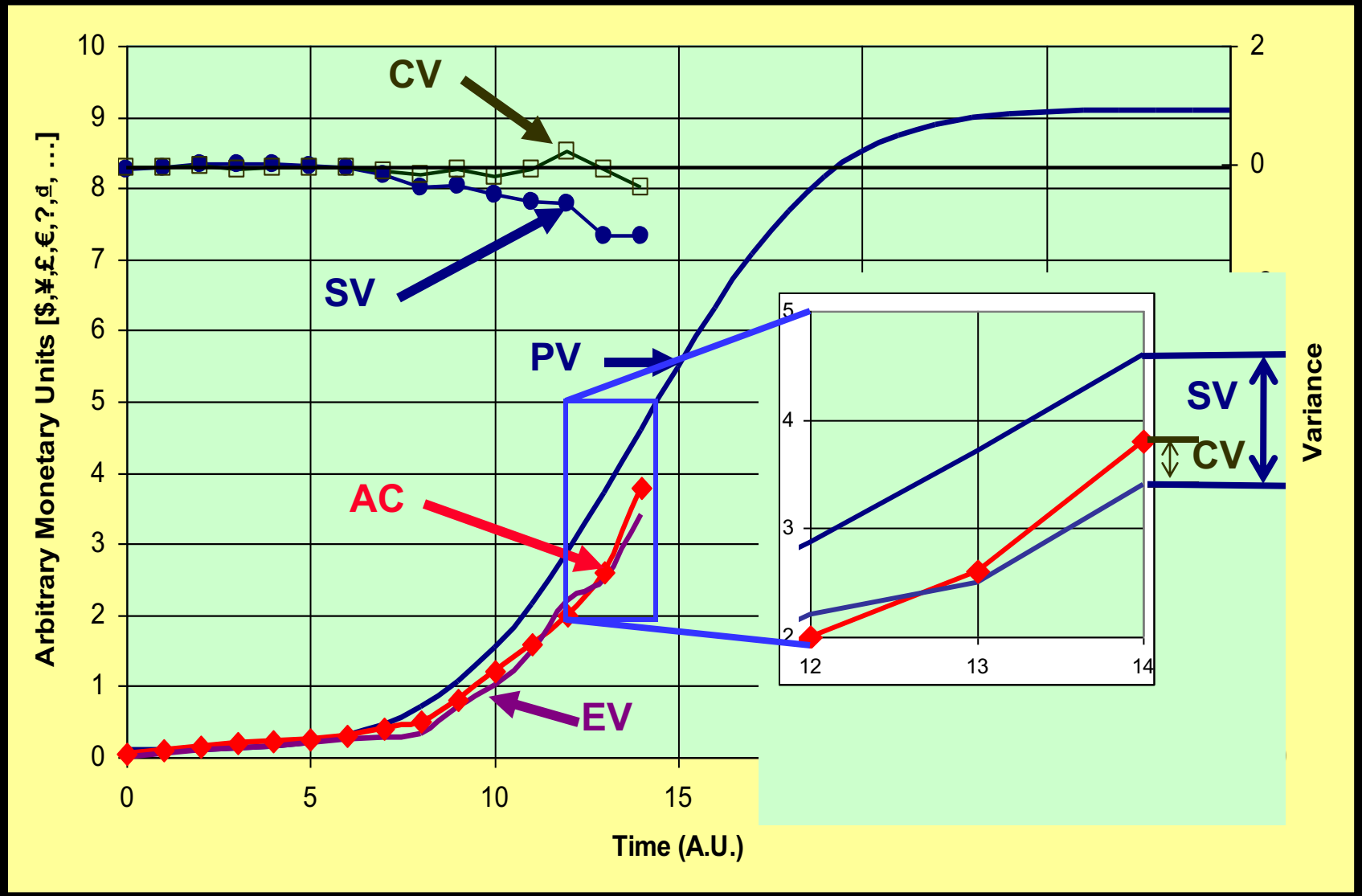
Earned Value Graphic Analysis



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Earned value on a project has its value in detailed analysis of a project

- Summary Earned Value data generally isn't that useful
  - Used as an indicator for overall ***health*** of the project
  - Too many inputs, variables causes, etc. to be an effective project tool
- In order to be an effective **project** management tool, the project must be subdivided into meaningful subprojects: **control accounts**
- The **control account manager** (CAM) is the **project manager** of the subproject / control account
- The CAM is responsible and accountable for the baseline of the control account:
  - **Scope**
  - **Schedule**
  - **Budget**

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Example Control Account: The paving subproject

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- Control Account Deliverable: 10 miles of paved road
- Control Account Baseline:
  - Scope: Paving 10 miles of road
  - Schedule: 10 days
  - Budget: $1,000,000

Paving Control Account: Baseline Plan

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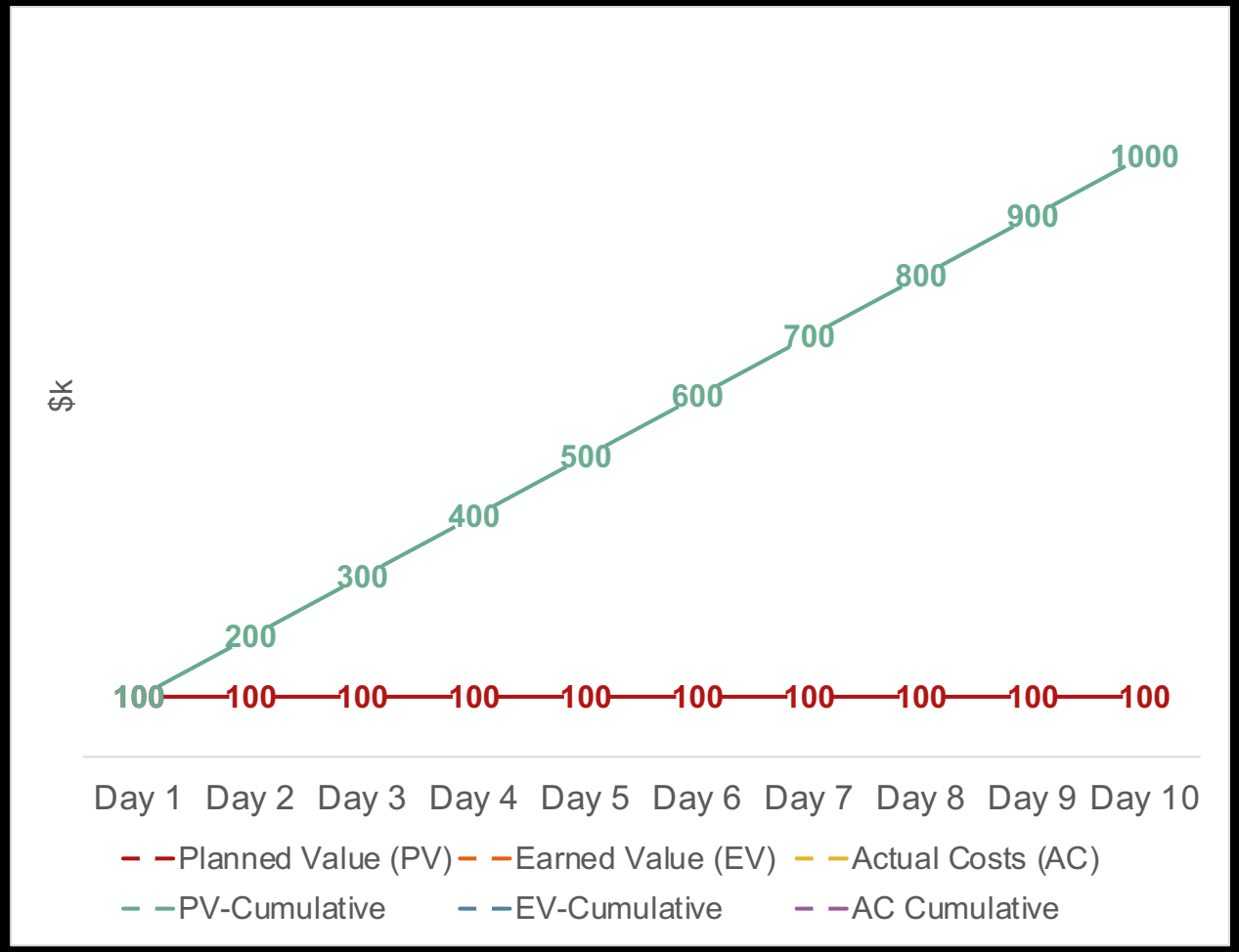
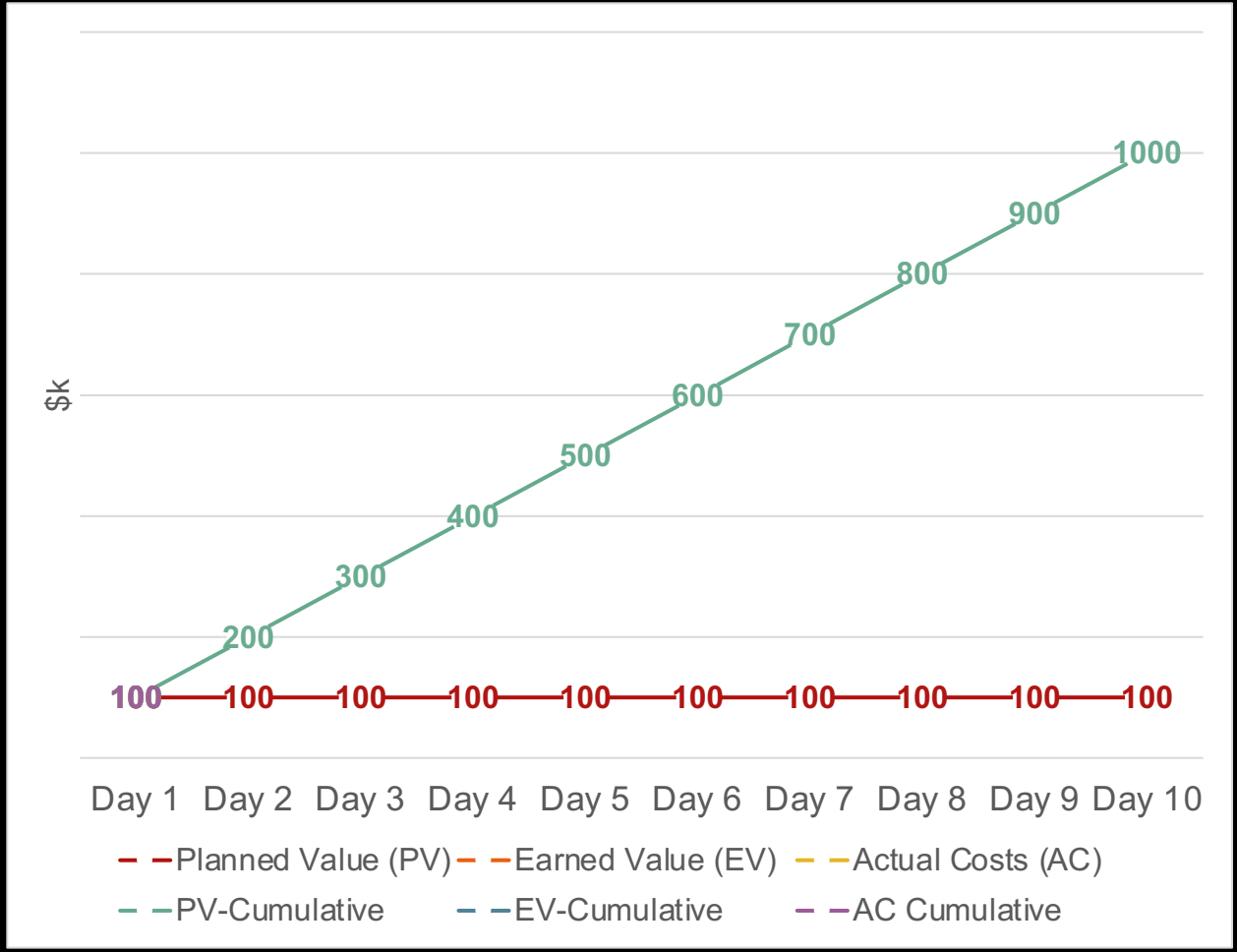


- **Plan is simple:**
- **1 mile / day**
- **Each mile = $100k**
- **Project completed in 10 Days**
- **BAC = $1000k**

Day 1: Everything goes according to plan



Performance Log Day 1:

- **EV=$100k** (1 mile paved)
- **AC=$100k** (Costs as expected)
- Incremental
  - No variances
    - PV = EV = AC = $100k
  - Indices
    - CPI = 1.0
    - SPI = 1.0
- Cumulative
  - No variances
    - PV = EV = AC = $100k
  - Indices
    - CPI = 1.0
    - SPI = 1.0
- Forecasts
  - EAC = BAC = $1000k
  - ETC = $900k

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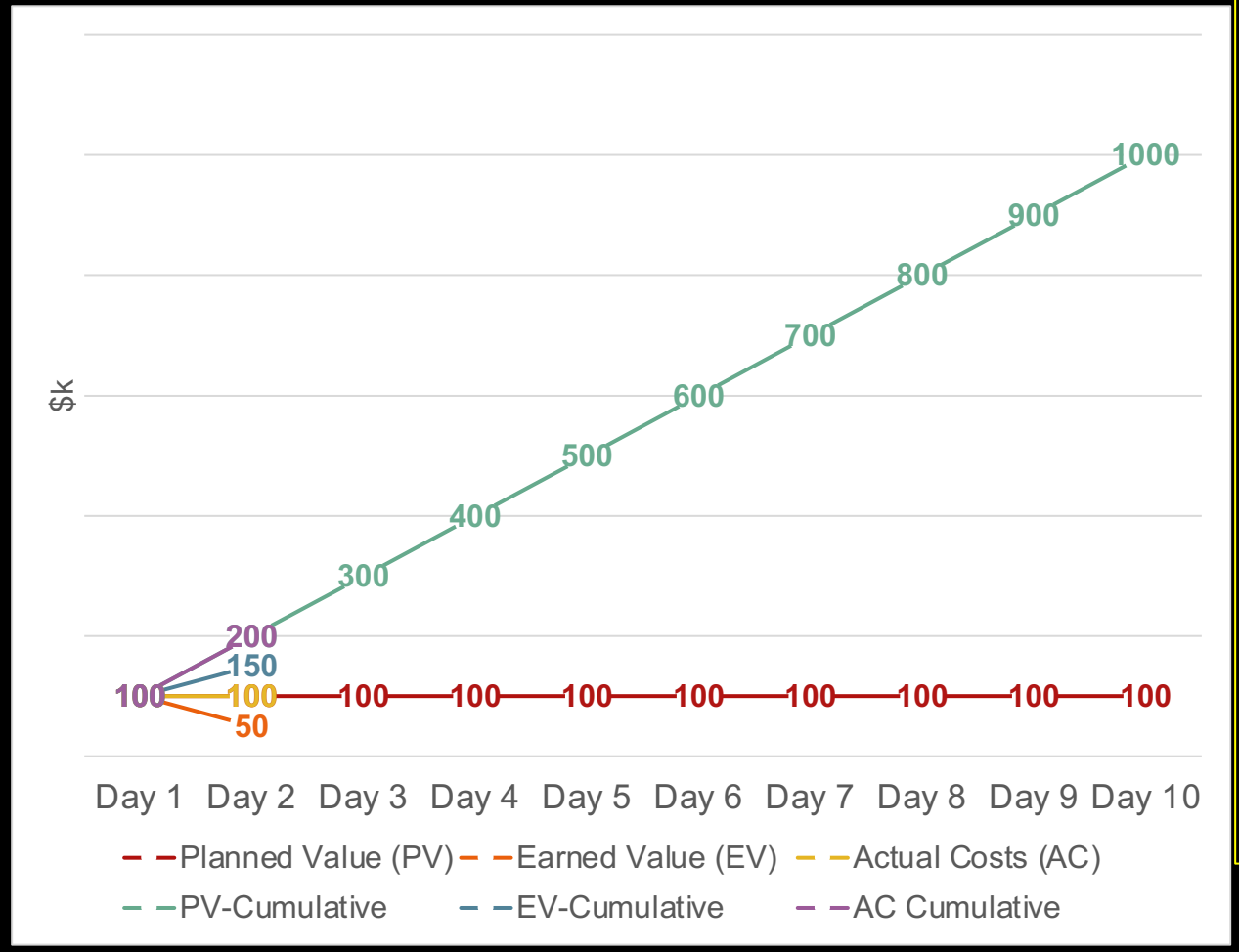
Day 2: Equipment breakdown halfway through the day



Performance Log Day 2:

- **EV=$50k** (0.5 mile paved)
- **AC=$100k** (Costs full day)
- Incremental
  - Variances
    - CV = **-$50k** = $50k - $100k
    - SV = **-$50k** = $50k - $100k
  - Indices
    - CPI = EV/AC = **0.50**
    - SPI = EV/PV = **0.50**
- Cumulative
  - Variances
    - CV = **-$50k** = $150k - $200k
    - SV = **-$50k** = $150k - $200k
  - Indices
    - CPI = EV/AC = **0.75**
    - SPI = EV/PV = **0.75**
- Forecasts
  - EAC_{opt} = $1050k = $200k + ($1000k - $150k)
  - EAC_{con} = $1333k = $1000k/0.75

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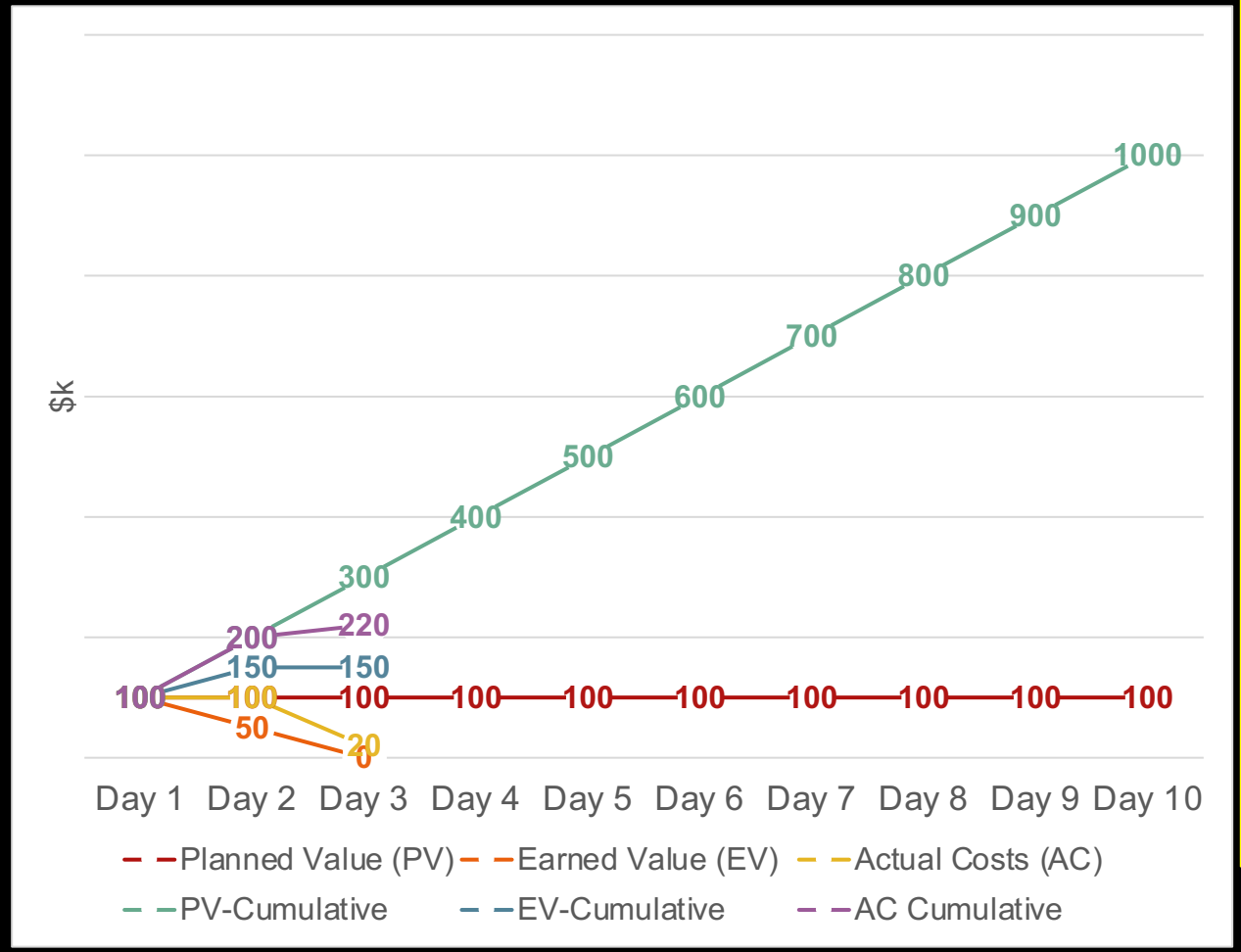
Day 3: Equipment getting fixed, but was able to keep crew off job



Performance Log Day 3:

- **EV=$0k** (0.0 mile paved)
- **AC=$20k** (repair and other costs)
- Incremental
  - Variances
    - CV = **-$20k** = $0k - $20k
    - SV = **-$100k** = $0k - $100k
  - Indices
    - CPI = EV/AC = **0.0**
    - SPI = EV/PV = **0.0**
- Cumulative
  - Variances
    - CV = **-$70k** = $150k - $220k
    - SV = **-$150k** = $150k - $300k
  - Indices
    - CPI = EV/AC = **0.68**
    - SPI = EV/PV = **0.50**
- Forecasts
  - EAC_{opt} = $1070k = $220k + ($1000k - $150k)
  - EAC_{con} = $1467k = $1000k/0.68

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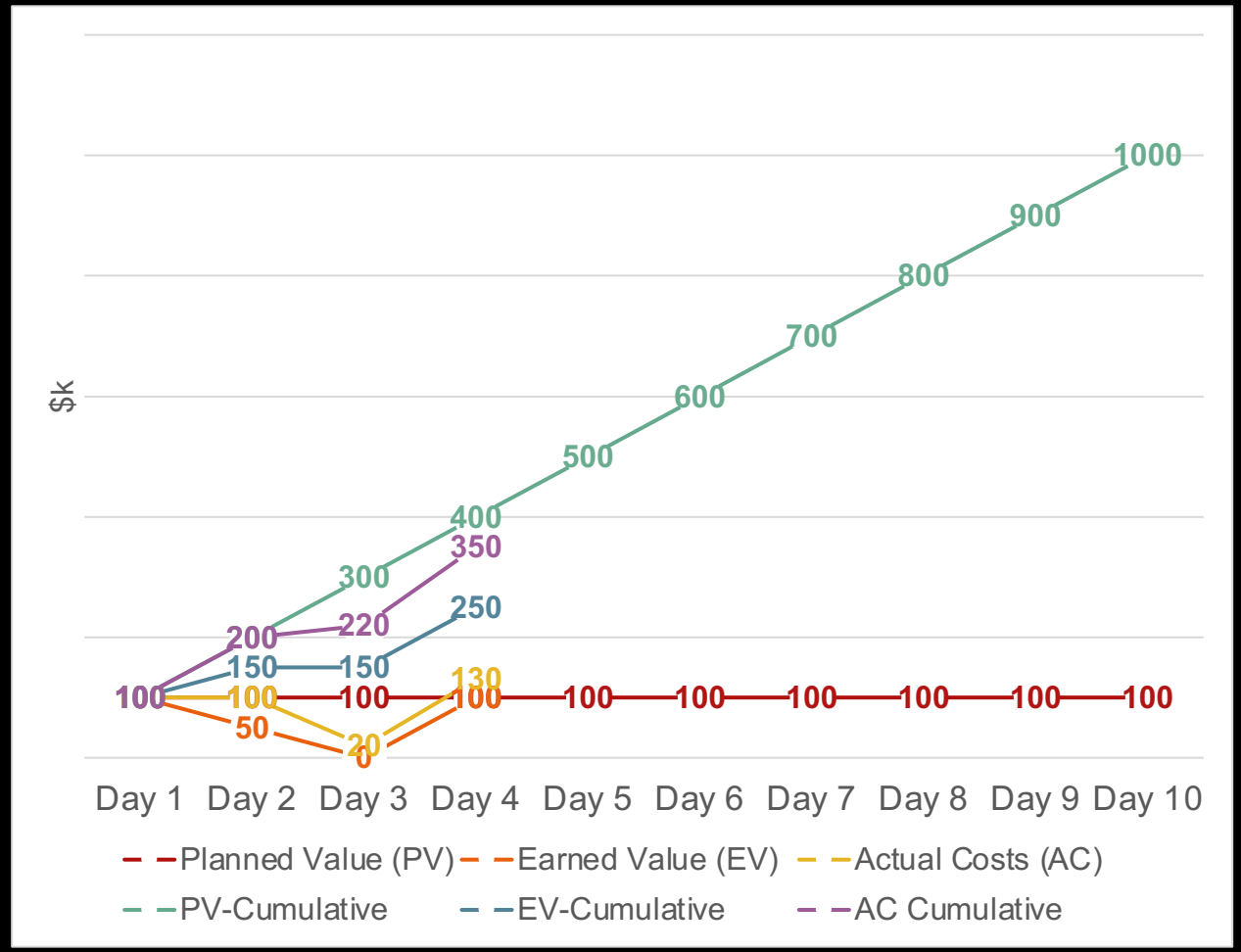
Day 4: Everything up and running, but lost one load of concrete



Performance Log Day 4:

- **EV=$100k** (1.0 mile paved)
- **AC=$130k** (costs incurred))
- Incremental
  - Variances
    - CV = **-$30k** = $100k - $130k
    - SV = **$0k** = $100k - $100k
  - Indices
    - CPI = EV/AC = **0.77**
    - SPI = EV/PV = **1.0**
- Cumulative
  - Variances
    - CV = **-$100k** = $250k - $350k
    - SV = **-$150k** = $250k - $400k
  - Indices
    - CPI = EV/AC = **0.71**
    - SPI = EV/PV = **0.63**
- Forecasts
  - EAC_{opt} = $1100k = $350k + ($1000k - $250k)
  - EAC_{con} = $1400k = $1000k/0.71

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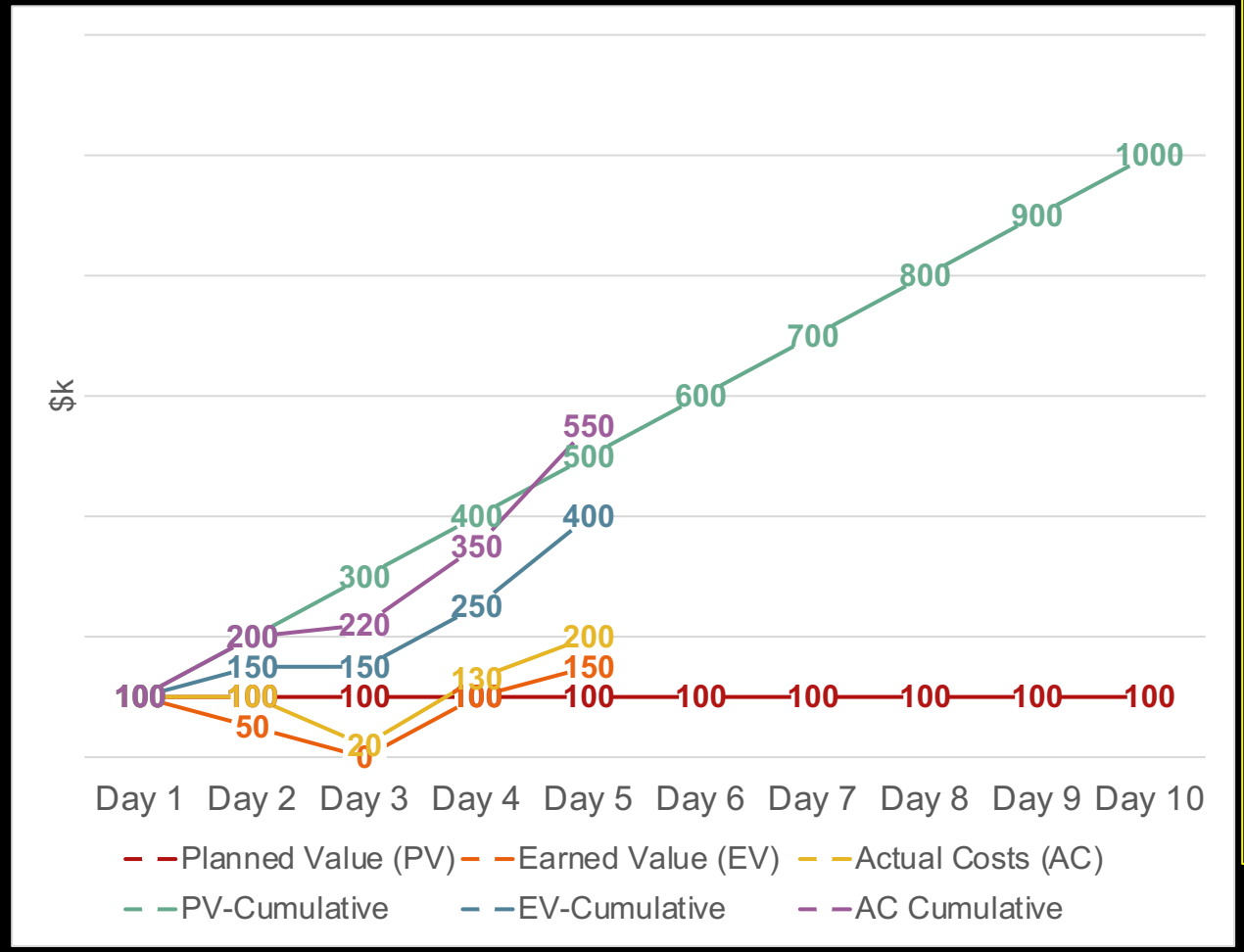
Day 5: Decide to work overtime to recover schedule slip



Performance Log Day 5:

- **EV=$150k** (1.5 mile paved)
- **AC=$200k** (costs incurred)
- Incremental
  - Variances
    - CV = **-$50k** = $150k - $200k
    - SV = **$50k** = $150k - $100k
  - Indices
    - CPI = EV/AC = **0.75**
    - SPI = EV/PV = **1.5**
- Cumulative
  - Variances
    - CV = **-$150k** = $400k - $550k
    - SV = **-$100k** = $400k - $500k
  - Indices
    - CPI = EV/AC = **0.73**
    - SPI = EV/PV = **0.80**
- Forecasts
  - EAC_{opt} = $1150k = $550k + ($1000k - $400k)
  - EAC_{con} = $1375k = $1000k/0.73

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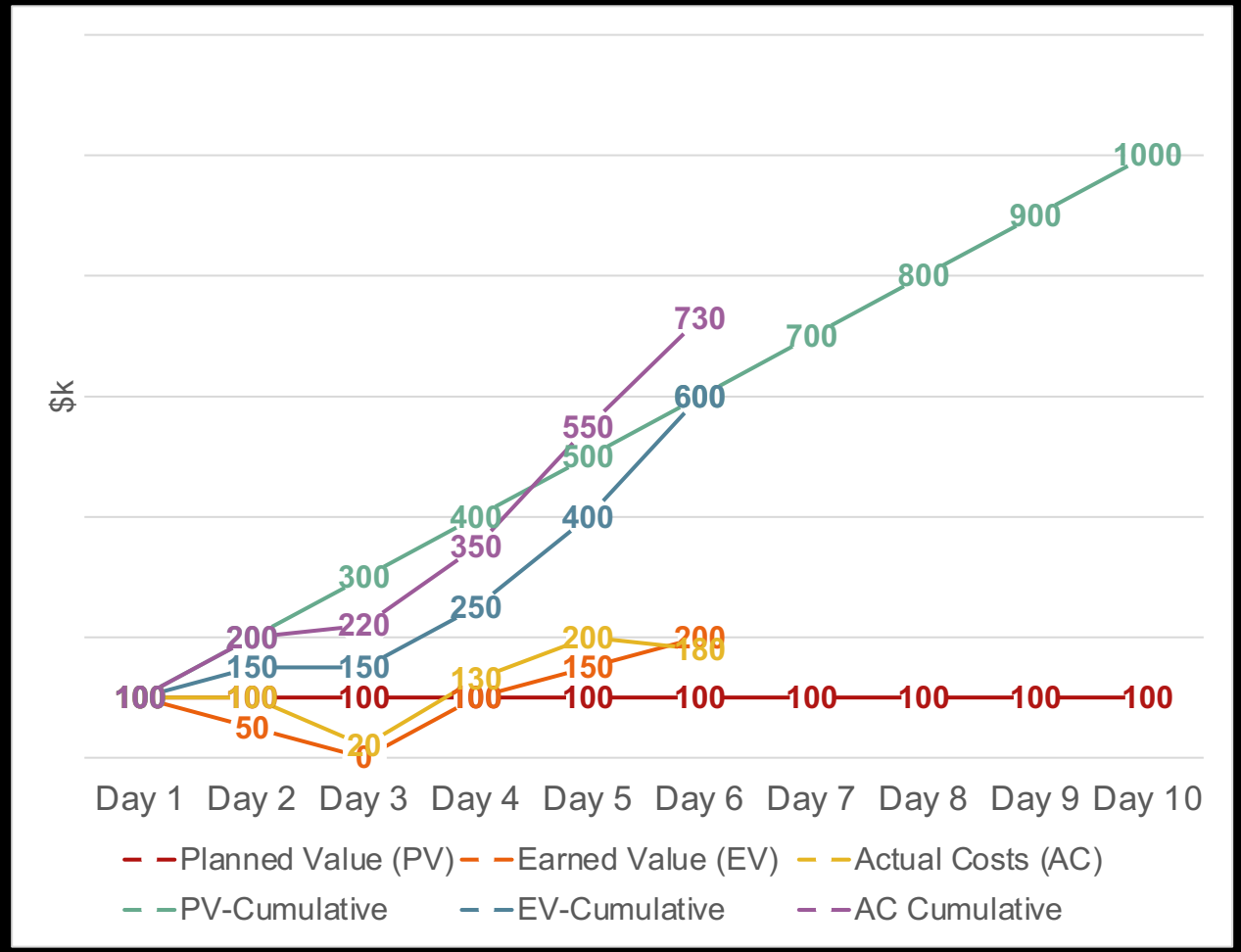
Day 6: Arrange to have 2nd crew show up; work two shifts



Performance Log Day 6:

- **EV=$200k** (2.0 miles paved)
- **AC=$180k** (costs incurred)
- Incremental
  - Variances
    - CV = $20k = $200k - $180k
    - SV = $100k = $200k - $100k
  - Indices
    - CPI = EV/AC = 1.11
    - SPI = EV/PV = 2.00
- Cumulative
  - Variances
    - CV = -$130k = $600k - $730k
    - SV = $0k = $600k - $600k
  - Indices
    - CPI = EV/AC = 0.82
    - SPI = EV/PV = 1.00
- Forecasts
  - EAC_{opt} = $1130k = $730k + ($1000k - $600k)
  - EAC_{con} = $1217k = $1000k/0.82

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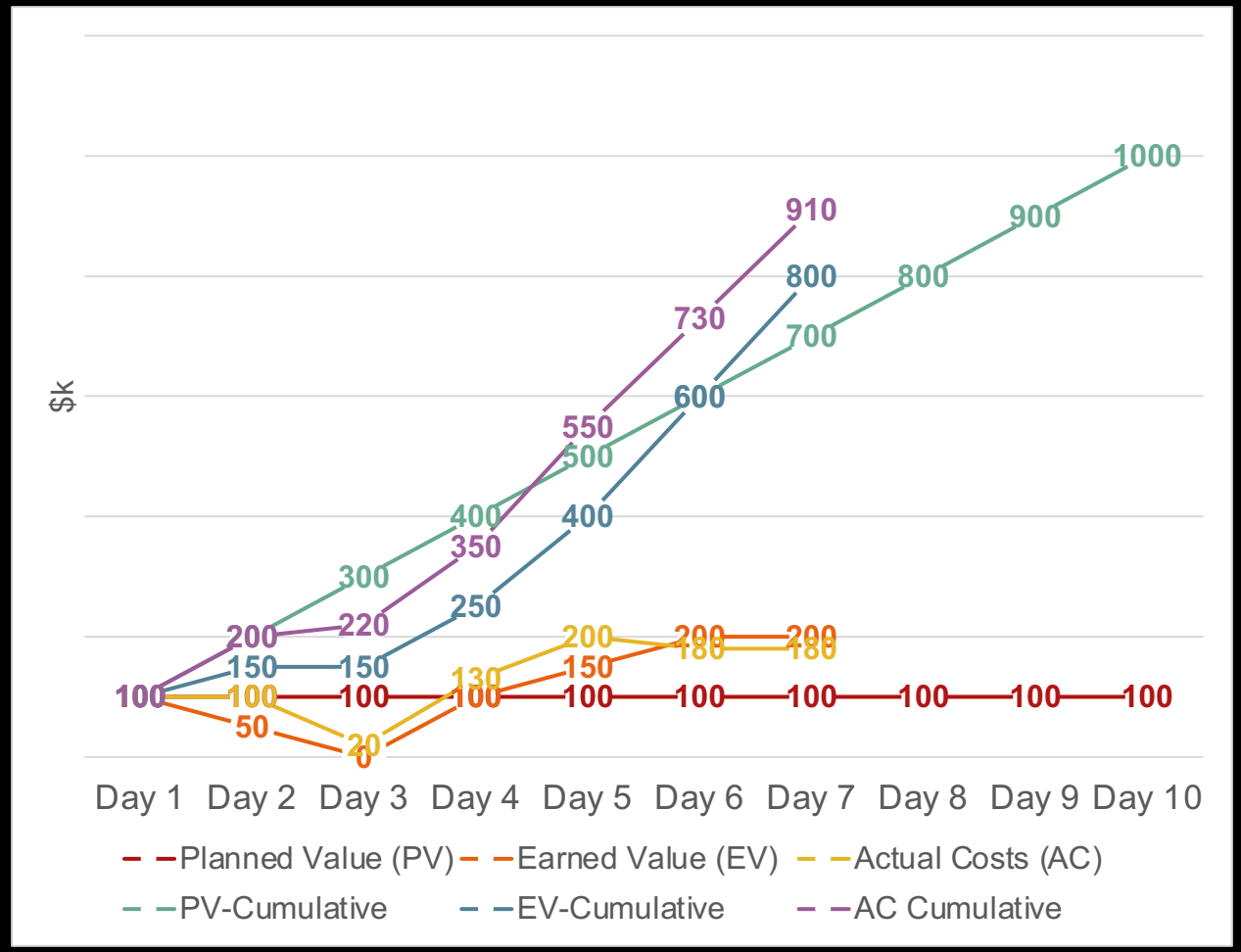
Day 7: Two shifts run smoothly; nothing goes amiss



Performance Log Day 7:

- **EV=$200k** (2.0 miles paved)
- **AC=$180k** (costs incurred)
- Incremental
  - Variances
    - CV = $20k = $200k - $180k
    - SV = $100k = $200k - $100k
  - Indices
    - CPI = EV/AC = 1.11
    - SPI = EV/PV = 2.00
- Cumulative
  - Variances
    - CV = -$110k = $800k - $910k
    - SV = $100k = $800k - $700k
  - Indices
    - CPI = EV/AC = 0.88
    - SPI = EV/PV = 1.14
- Forecasts
  - EAC_{opt} = $1110k = $910k + ($1000k - $800k)
  - EAC_{con} = $1138k = $1000k/0.88

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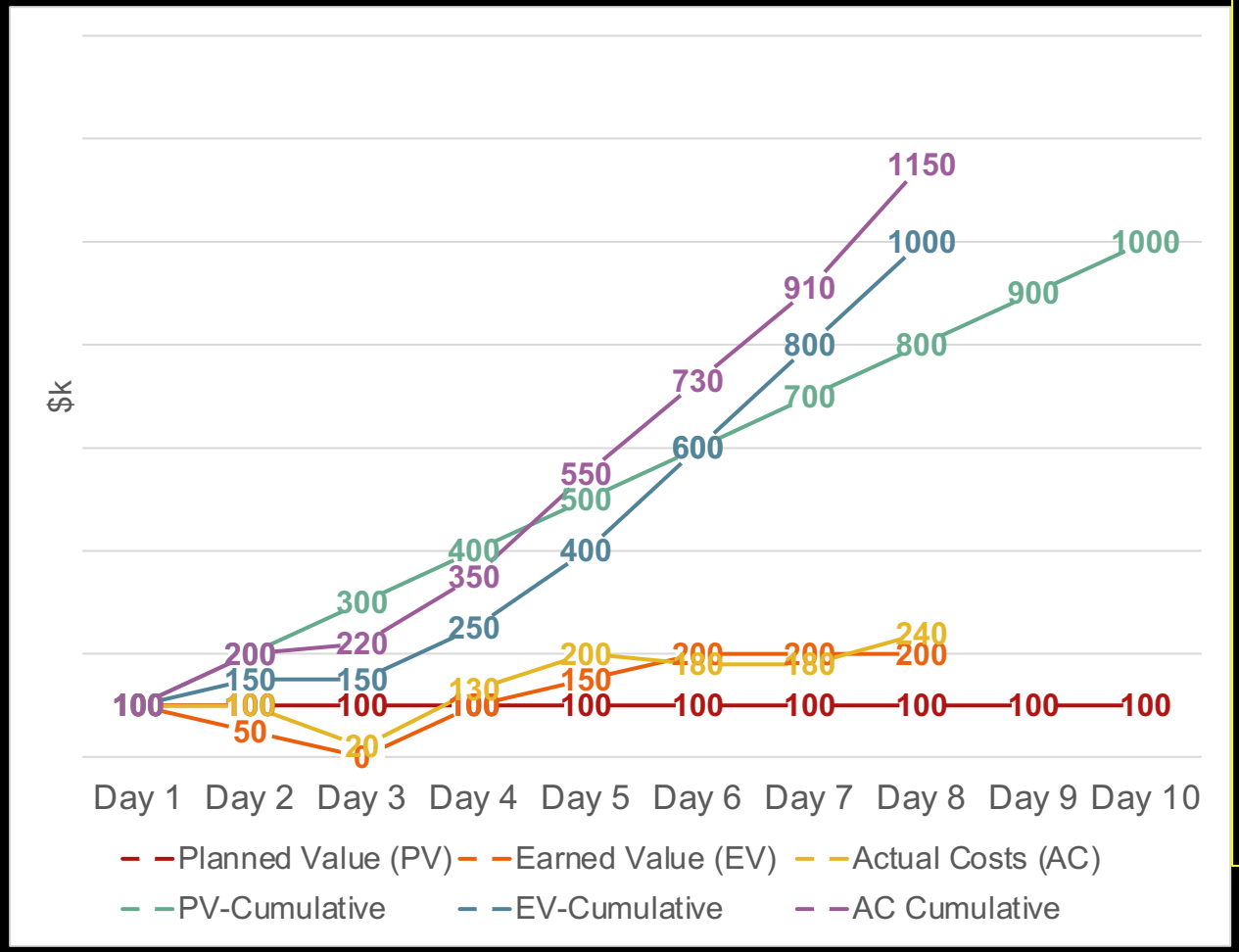
Day 8: Two shifts but need a 2nd cement source – pay premium



Performance Log Day 8:

- **EV=$200k** (2.0 miles paved)
- **AC=$240k** (costs incurred)
- Incremental
  - Variances
    - CV = **-$40k** = $200k - $240k
    - SV = **$100k** = $200k - $100k
  - Indices
    - CPI = EV/AC = **0.83**
    - SPI = EV/PV = **2.00**
- Cumulative
  - Variances
    - CV = **-$150k** = $1000k - $1150k
    - SV = **$200k** = $1000k - $800k
  - Indices
    - CPI = EV/AC = **0.87**
    - SPI = EV/PV = **1.25**
- Forecasts
  - EAC_{opt} = $1150k = $1150k + ($1000k - $1000k)
  - EAC_{con} = $1150k = $1000k/0.87

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Just a few details

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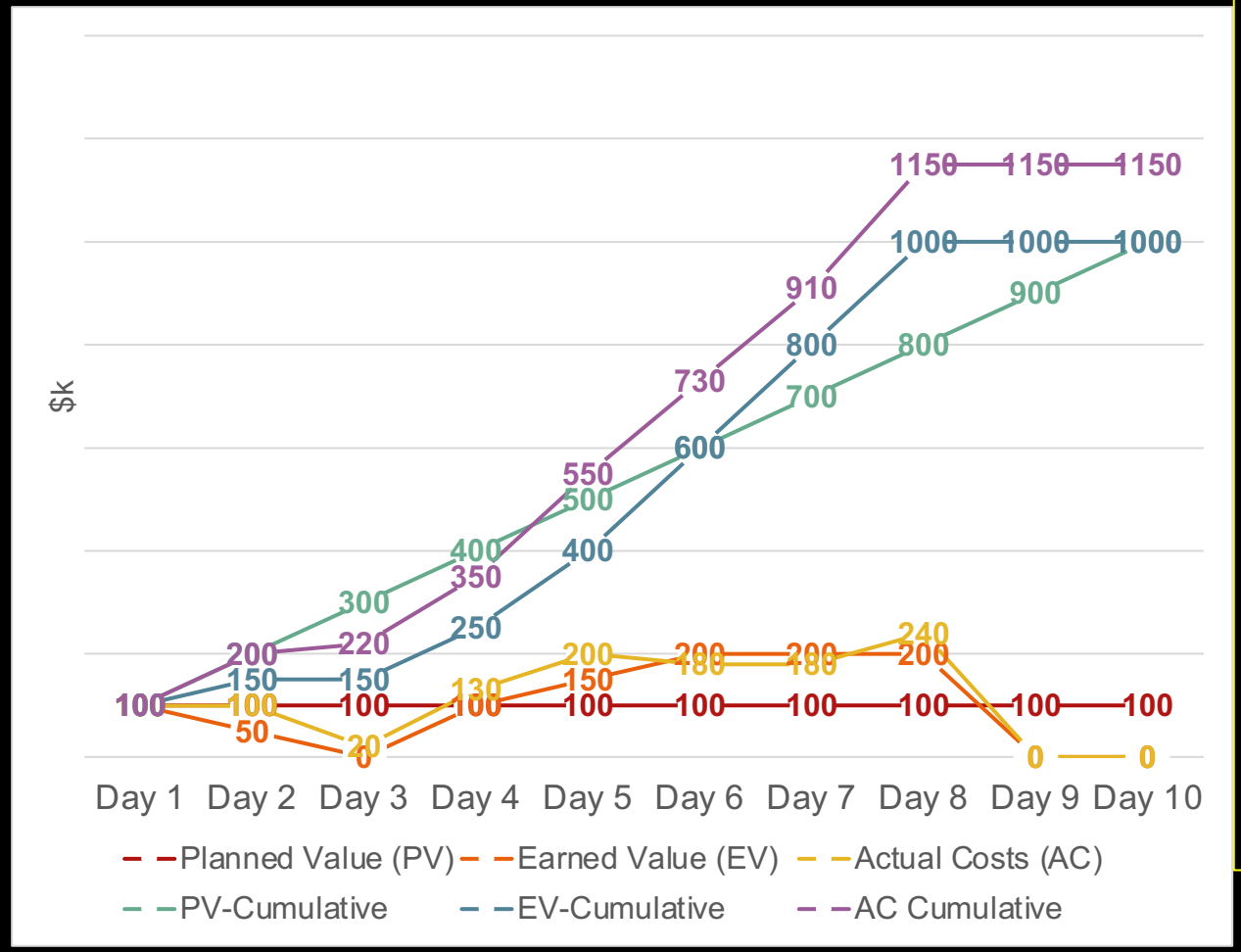
- A control account almost **always** has multiple activities going on in parallel
- The PV, EV, and AC is then obtained by summing over the concurrent activities
- Note that SV, which represents schedule, is stated in units of money

Day 9 and 10: work complete, but project office didn't close account



Performance Log Day 10:

- **EV=$0K** (0.0 miles paved)
- **AC=$0k** (cost incurred)
- Incremental
  - Variances
    - CV = $0k = $0k - $0k
    - SV = $0k = $0k - $0k
  - Indices
    - CPI = EV/AC = undefined
    - SPI = EV/PV = 0.00
- Cumulative
  - Variances
    - CV = -$150k = $1000k - $1150k
    - SV = $0k = $1000k - $1000k
  - Indices
    - CPI = EV/AC = 0.87
    - SPI = EV/PV = 1.00
- Forecasts
  - EAC_{opt} = $1150k = $1150k + ($1000k - $1000k)
  - EAC_{con} = $1150k = $1000k/0.87

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Numerical Example: Scenario #1

- Plan:
  - 2 people work 40 hrs each @ $30/hr for 1 week
  - 1 person works 30 hrs @ $50/hr during 1 week
  - PV = 40 hr x $30/hr x 2 + 30 x $50/hr = $3900
- Earned Value:
  - 1 person works 40 hours and gets 100% complete
  - 1 person works 40 hours but only gets 80% complete
  - 1 person works 30 hours and gets 100% complete
- EV = (40 x $30) + (0.8 x 40 x $30) + (30 x $50) = $3660
- Actual Cost = AC = (2 x 40 x $30) + (30 x $50) = $3900
- SV = $3660 - $3900 = -$240 (behind schedule) [SPI = 0.94]
- CV = $3660 - $3900 = -$240 (over budget) [CPI = 0.94]

- Note: Some might conclude that because SV = CV that the CV is only the result of the schedule variance – WRONG. It is a true cost **and** schedule variance because of an inefficiency (only 80% of the work done with 100% of the effort)

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Numerical Examples: Scenarios #2 & #3

- Plan: Same as #1 for both #2 and #3 PV = $3900
- Earned Value #2:
  - 1 person works 40 hours and gets 100% complete
  - 1 person works 32 hours but only gets 80% complete
  - 1 person works 30 hours and gets 100% complete
- EV = (40 x $30) + (0.8 x 40 x $30) + (30 x $50) = $3660
- Actual Cost #2: AC = (40 x $30) + (32 x $30) + (30 x $50) = $3660
- SV = $3660 - $3900 = -$240 (behind schedule) [SPI = 0.94]
- CV = $3660 - $3660 = $0 (on budget) [CPI = 1.00]

- Earned Value #3:
  - 1 person works 40 hours and gets 100% complete
  - 1 person works 40 hours and gets 100% complete
  - 1 person works 34.8 hours and gets 100% complete
- EV = (40 x $30) + (40 x $30) + (30 x $50) = $3900
- Actual Cost #3: AC = (40 x $30) + (40 x $30) + (34.8 x $50) = $4140
- SV = $3900 - $3900 = $0 (on schedule)[SPI = 1.00]
- CV = $3900 - $4140 = -$240 (over cost) [CPI = 0.94]

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Example of a Monthly Cost Performance Report

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Current and Cumulative Schedule and Cost Variances

CA	WBS	DESCRIPTION	% CMP	CURRENT PERIOD BCWS	BCWP	ACWP	SV	CV	CUMULATIVE TO DATE BCWS	BCWP	ACWP	SV	CV	SPI	CPI	BAC	EAC	VAC
	1	Daya Bay Project (Total Proj	23	1,096.2	597.6	312.1	(498.5)	285.5	7,202.4	6,187.8	5,949.7	(1,014.6)	238.1	0.86	1.04	26,990.2	-	26,990.2
CA	1.01	Antineutrino Detector	21	548.5	152.5	93.2	(396.0)	59.3	2,511.1	1,753.4	1,695.5	(757.7)	57.9	0.70	1.03	8,384.8	-	8,384.8
	1.01.02	Acrylic Vessels	100	-	-	3.4	-	(3.4)	320.4	320.4	444.2	-	(123.8)	1.00	0.72	320.4	-	320.4
	1.01.03	Gd-LS Production	37	74.7	23.4	29.1	(51.3)	(5.7)	483.5	405.1	361.5	(78.4)	43.6	0.84	1.12	1,106.2	-	1,106.2
	1.01.04	PMT AD Mechanical Systems	21	386.7	55.3	30.7	(331.3)	24.6	665.2	328.6	432.0	(336.7)	(103.5)	0.49	0.76	1,537.5	-	1,537.5
	1.01.05	System for Measuring Physic	77	-	-	-	-	-	340.6	261.6	227.1	(79.0)	34.5	0.77	1.15	340.6	-	340.6
	1.01.07	Materials Compatibility and L	63	2.5	10.1	12.6	7.6	(2.4)	129.8	97.9	75.4	(31.8)	22.5	0.76	1.30	155.1	-	155.1
	1.01.08	Other AD Systems	31	38.7	31.2	-	(7.6)	31.2	254.4	116.8	0.2	(137.6)	116.6	0.46	572.39	378.8	-	378.8
	1.01.09	AD Integration	16	30.5	18.8	-	(11.7)	18.8	55.2	19.4	-	(35.7)	19.4	0.35	-	122.2	-	122.2
	1.01.10	AD Assembly&Installation	0	1.7	-	0.4	(1.7)	(0.4)	37.2	-	3.8	(37.2)	(3.8)	-	-	457.5	-	457.5
	1.01.11	Subsystem Management	34	13.6	13.6	17.1	-	(3.4)	139.9	139.9	66.3	-	73.6	1.00	2.11	409.3	-	409.3
	1.01.12	UWM Milestone Payments w/	2	-	-	-	-	-	85.0	63.7	85.0	(21.2)	(21.2)	0.75	0.75	3,557.1	-	3,557.1
CA	1.02	Muon System	21	177.3	19.3	21.3	(158.0)	(2.0)	718.7	506.7	470.8	(212.1)	35.9	0.71	1.08	2,467.8	-	2,467.8
	1.02.01	Resistive Plate Chambers	18	81.5	8.2	-	(73.3)	8.2	135.5	65.9	27.1	(69.6)	38.8	0.49	2.43	363.9	-	363.9
	1.02.02	PMT Supports	29	1.2	1.1	14.7	(0.1)	(13.5)	149.5	148.4	233.2	(1.0)	(84.8)	0.99	0.64	517.9	-	517.9
	1.02.03	Oxygen Difficiency Hazard Sys	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.02.04	Pool Liner	5	-	-	0.1	-	(0.1)	8.3	7.5	2.7	(0.8)	4.8	0.90	2.77	148.4	-	148.4
	1.02.05	Water System	0	-	-	0.1	-	(0.1)	-	-	18.6	-	(18.6)	-	-	510.0	-	510.0
	1.02.06	Subsystem Management	34	8.4	8.4	-	-	8.4	91.2	91.2	52.1	-	39.1	1.00	1.75	269.5	-	269.5
	1.02.07	Muon PMT calibration system	35	0.9	-	-	(0.9)	-	42.9	15.0	3.9	(27.9)	11.1	0.35	3.82	43.3	-	43.3
	1.02.08	Reflectors for AD's	14	2.0	-	-	(2.0)	-	34.2	4.8	-	(29.5)	4.8	0.14	######	34.2	-	34.2
	1.02.09	Pool cover	18	83.4	1.6	6.4	(81.8)	(4.9)	105.8	18.6	14.1	(87.2)	4.5	0.18	1.32	106.3	-	106.3
	1.02.10	Princeton Milestone Payment	13	-	-	-	-	-	45.0	45.0	45.0	-	-	1.00	1.00	359.9	-	359.9
	1.02.11	BNL Subcontract Generation	75	-	0.1	-	0.1	0.1	8.0	12.0	-	4.0	12.0	1.50	-	16.0	-	16.0
	1.02.12	FY07 BNL Actuals	100	-	-	-	-	-	98.3	98.3	74.0	-	24.3	1.00	1.33	98.3	-	98.3

Possible causes of variances

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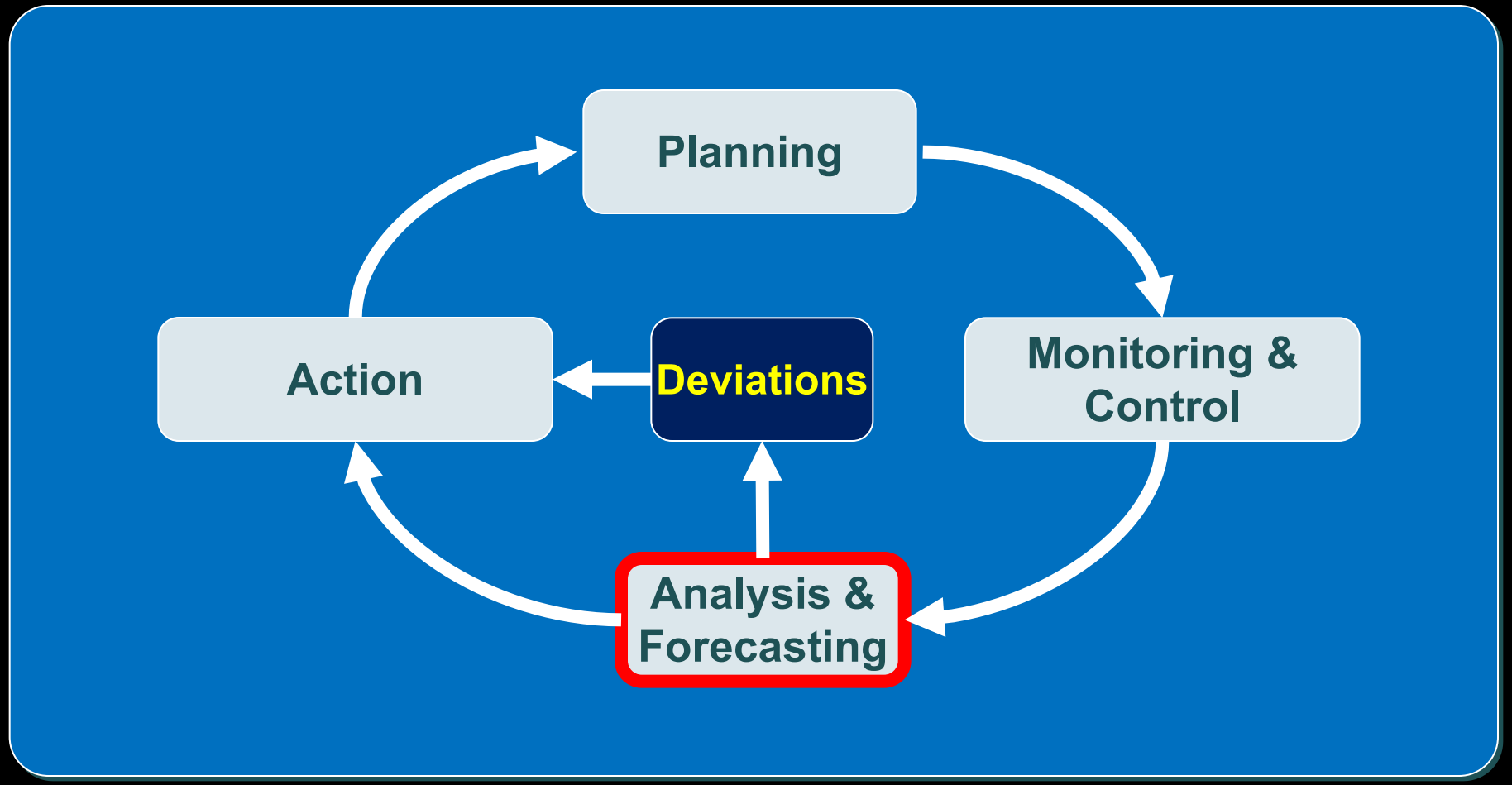
Unfavorable	▪ Lack of resources due to… ▪ Late vendor deliveries because… ▪ Rework required due to… ▪ Work more complex than expected because… ▪ Unclear requirements in the areas of…	▪ Work is more complex than anticipated because… ▪ Extensive Design Review comments have resulted in… ▪ Material price 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… ▪ Got critical resources ahead of plan… ▪ 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…

Analysis & Forecasting Cycle



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Cost and Schedule Analysis and Forecasting

- The use of cost and schedule indices data and metrics is a prime way for **the project manager** to monitor progress and analyze the future

- Key indices and metric data include:
  - Cost Performance Index and Schedule Performance Index
  - Trend Data
  - Total Cost Performance Index

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Example of a Monthly Cost Performance Report

SPI = EV/PV => 6,188 / 7,202 = 0.86
Meaning: "For every dollar, I got $0.86 worth of work completed." Somewhat Inefficient
CPI = EV/AC => 6,188 / 5,950 = 1.04
Meaning: "For every dollar I spent, I got $1.04 worth of work completed." Efficient

Schedule and Cost Performance Indexes

				CURRENT PERIOD					CUMULATIVE TO DATE									
CA	WBS	DESCRIPTION	% CMP	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	CV	SPI	CPI	BAC	EAC	VAC
	1	Daya Bay Project (Total Proje	23	1,096.2	597.6	312.1	(498.5)	285.5	7,202.4	6,187.8	5,949.7	(1,014.6)	238.1	0.86	1.04	26,990.2	-	26,990.2
CA	1.01	Antineutrino Detector	21	548.5	152.5	93.2	(396.0)	59.3	2,511.1	1,753.4	1,695.5	(757.7)	57.9	0.70	1.03	8,384.8	-	8,384.8
	1.01.02	Acrylic Vessels	100	-	-	3.4	-	(3.4)	320.4	320.4	444.2	-	(123.8	1.00	0.72	320.4	-	320.4
	1.01.03	Gd-LS Production	37	74.7	23.4	29.1	(51.3)	(5.7)	483.5	405.1	361.5	(78.4)	43.6	0.84	1.12	1,106.2	-	1,106.2
	1.01.04	PMT AD Mechanical Systems	21	386.7	55.3	30.7	(331.3)	24.6	665.2	328.6	432.0	(336.7)	(103.5	0.49	0.76	1,537.5	-	1,537.5
	1.01.05	System for Measuring Physic	77	-	-	-	-	-	340.6	261.6	227.1	(79.0)	34.5	0.77	1.15	340.6	-	340.6
	1.01.07	Materials Compatibility and L	63	2.5	10.1	12.6	7.6	(2.4)	129.8	97.9	75.4	(31.8)	22.5	0.76	1.30	155.1	-	155.1
	1.01.08	Other AD Systems	31	38.7	31.2	-	(7.6)	31.2	254.4	116.8	0.2	(137.6)	116.6	0.46	572.39	378.8	-	378.8
	1.01.09	AD Integration	16	30.5	18.8	-	(11.7)	18.8	55.2	19.4	-	(35.7)	19.4	0.35	-	122.2	-	122.2
	1.01.10	AD Assembly&Installation	0	1.7	-	0.4	(1.7)	(0.4)	37.2	-	3.8	(37.2)	(3.8	-	-	457.5	-	457.5
	1.01.11	Subsystem Management	34	13.6	13.6	17.1	-	(3.4)	139.9	139.9	66.3	-	73.6	1.00	2.11	409.3	-	409.3
	1.01.12	UWM Milestone Payments w/	2	-	-	-	-	-	85.0	63.7	85.0	(21.2)	(21.2	0.75	0.75	3,557.1	-	3,557.1
CA	1.02	Muon System	21	177.3	19.3	21.3	(158.0)	(2.0)	718.7	506.7	470.8	(212.1)	35.9	0.71	1.08	2,467.8	-	2,467.8
	1.02.01	Resistive Plate Chambers	18	81.5	8.2	-	(73.3)	8.2	135.5	65.9	27.1	(69.6)	38.8	0.49	2.43	363.9	-	363.9
	1.02.02	PMT Supports	29	1.2	1.1	14.7	(0.1)	(13.5)	149.5	148.4	233.2	(1.0)	(84.8	0.99	0.64	517.9	-	517.9
	1.02.03	Oxygen Difficiency Hazard Sys	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.02.04	Pool Liner	5	-	-	0.1	-	(0.1)	8.3	7.5	2.7	(0.8)	4.8	0.90	2.77	148.4	-	148.4
	1.02.05	Water System	0	-	-	0.1	-	(0.1)	-	-	18.6	-	(18.6	-	-	510.0	-	510.0
	1.02.06	Subsystem Management	34	8.4	8.4	-	-	8.4	91.2	91.2	52.1	-	39.1	1.00	1.75	269.5	-	269.5
	1.02.07	Muon PMT calibration system	35	0.9	-	-	(0.9)	-	42.9	15.0	3.9	(27.9)	11.1	0.35	3.82	43.3	-	43.3
	1.02.08	Reflectors for AD's	14	2.0	-	-	(2.0)	-	34.2	4.8	-	(29.5)	4.8	0.14	######	34.2	-	34.2
	1.02.09	Pool cover	18	83.4	1.6	6.4	(81.8)	(4.9)	105.8	18.6	14.1	(87.2)	4.5	0.18	1.32	106.3	-	106.3
	1.02.10	Princeton Milestone Payment	13	-	-	-	-	-	45.0	45.0	45.0	-	-	1.00	1.00	359.9	-	359.9
	1.02.11	BNL Subcontract Generation	75	-	0.1	-	0.1	0.1	8.0	12.0	-	4.0	12.0	1.50	-	16.0	-	16.0
	1.02.12	FY07 BNL Actuals	100	-	-	-	-	-	98.3	98.3	74.0	-	24.3	1.00	1.33	98.3	-	98.3

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OPA SPI/CPI Assessment

- Indicates performance is on target
- Indicates performance is marginal
- Indicates performance is substandard

Any cumulative SPI or CPI less than 0.90 or greater than 1.15 at the Control Account level will trigger a variance analysis report

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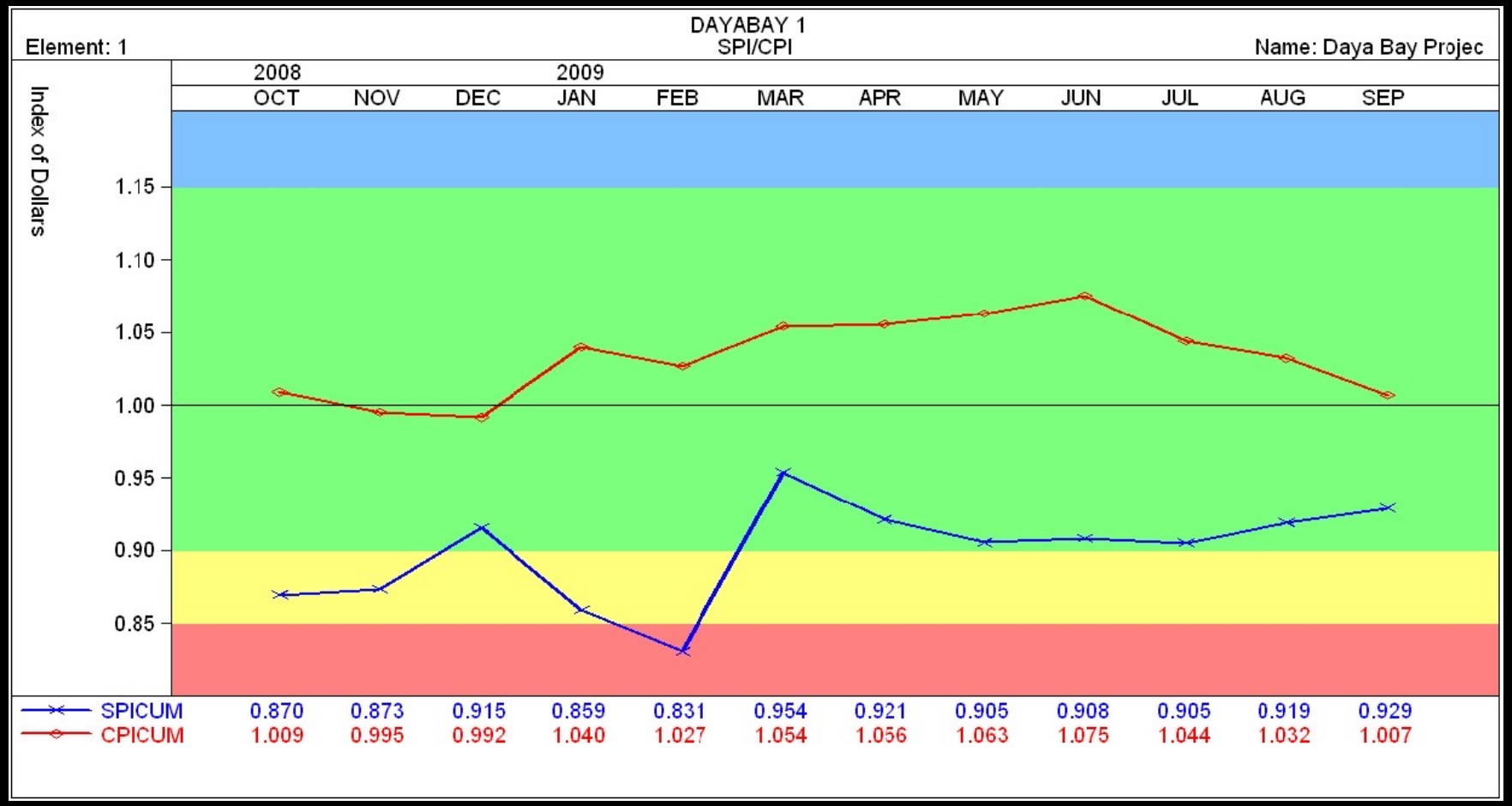
CPI/SPI Trend Chart



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Variance Analysis

- Variance analysis is a key component of the EVM process. It is used to analyze project cost and schedule performance.
- Variances come in 3 main categories:
  - Cost Variance (Earned Value – Actual Costs)
  - Schedule Variance (Earned Value – Planned Value)
  - Variance at Completion (Budget at Completion – Estimate at Completion)
- OPA or predetermined thresholds are established for the project to identify when formal variance write-ups are required
- Variance analysis should be viewed as an opportunity to review and uncover potential issues and hopefully, mitigate those issues before they negatively impact the project.

Variance Analysis (Cont.)

- **What? Why?**
  - **Schedule Variances (SV and SPI)**
    - **What?** Review the schedule and identify the actual activity(s) that is driving the SV/SPI
    - **Why?** Why is the activity(s) behind? Be specific.
    - **How?** Will SV/SPI impact overall project? If so, how?
  - **Cost Variances (CV and CPI)**
    - **What?** Review the actual costs for both the period and cumulative. What has caused the cost variance? Positive: possible accruals missing; Negative: overrun
    - **Who?** Review actuals, as well as vendor invoices and what hasn't be invoiced (accruals)
    - **How?** Will CV/CPI impact overall project? If so, how?
  - **Address schedule and cost variances separately.**

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Variance Analysis (Cont.)

CA WBS: 1.1 CA Description: Antineutrino Detectors

CAM: Karsten Heeger Cum SPI: 0.733 Cum. CPI: 0.993

Performance as of 2007-11	CURRENT PERIOD					CUMULATIVE TO DATE							AT COMPLETION		
	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	CV	SPI	CPI	BAC	EAC	VAC
Control Account Variance Summary	13.5	6.1	14.3	(7.4)	(8.2)	154.4	113.2	114.1	(41.2)	(0.9)	0.733	0.993	489.1	600.0	(110.9)

Cause

What caused the variance?

Corrective Action

What are you going to do to correct the variance?
When will the variance be corrected?

Impact on Subsystem/Project

What is the impact on the subsystem, other subsystems or the Project?

Signatures

Project Manager Date Control Account Manager Date

Note: Variance Thresholds are on any cumulative SPI or CPI less than 0.9 or greater than 1.15

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Comments on Earned Value

- While the concept and math is simple, a lot of people get mixed up
- Negative variance is **always** bad
- CV and SV are independent of each other
- The SPI will **always**→ 1 when the project is completed
- Analysis at the top level is not sufficient to understand detailed areas of concern
- Because of the nature of project efforts, it is relatively rare to have **only** a schedule variance (standing army aspects, etc.)
- Level of Effort should be used **only** for those tasks that in essence do not contribute directly to the deliverables of the project

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It’s important not to simply rely on calculated Estimate at Completion (EAC)

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- Remember, the value of EVM is not just reporting history but anticipating the future
- If a CAM / project manager understands that something may / will impact the outcome, it is important to reflect that in the EAC.
  - If currently on track, but the CAM/PM knows something is coming (e.g. bids are coming high, future work will be delayed and cost more, …)
  - Include that in the EAC before it goes through formal change control (once it's gone through formal change control it will be reflected in the BAC as applicable)
- The EAC must reflect the full knowledge of the CAM/PM

Earned Value Definitions: Estimate At Completion

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The **Estimate** of the amount of money that will be spent
At the **Completion** of the work = **EAC**

- EAC = ETC + AC
  - Bottom Up ETC
- EAC = (BAC-EV) + AC; ETC = BAC - EV
  - Calculated ETC
- The Variance at Completion (VAC) is obtained by subtracting the Budget at Completion (BAC) from the Estimate at Completion (EAC)

The VAC gives the total expected under-run/over-run

Earned Value Definitions: Estimate To Complete

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The estimate of the cost of the work to complete the Control Account = **ETC**

- This Estimate must be done regularly in order to determine the realistic expected cost of the work at completion
- This Estimate must be done by **RE–ASSESSING** the Control Account for the work that **REMAINS** to be performed – typically called a bottom-up ETC

This estimate is not done by subtracting the AC from the BAC

Projection of Project – EAC Estimate at Completion

- The optimistic case projection assumes the original rate can be achieved. All work packages not yet opened will be completed at the planned cost. Or revised cost based upon history of completed work packages
  - **EAC = AC + (BAC – EV)**
  - Need a reality check – is this a realistic option?
  - Assumes that all of the problems are
    - Identified
    - Resolved
    - All technical risks are under control
- The conservative case projection assumes the most recent rate will be continued.
  - **EAC = BAC/CPI**
  - Schedule may be improved by
    - Additional labor being applied
    - Overtime for those already working on project
  - Both cost extra money
    - Cost overrun would be even greater

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Projection of Project – To Complete Performance Index (TCPI)

- The BAC projection: the efficiency that must be maintained in order to complete on plan
  - $TCPI_{BAC}$ = Remaining Work/Unspent Budget
    - (BAC – EV) / (BAC – AC)
    - =($300-$105) / ($300-127.4) = 1.13
- The EAC projection: the efficiency that must be maintained in order to complete with the current estimate at completion
  - $TCPI_{EAC}$ = Remaining Work/ETC
    - (BAC – EV) / (EAC – AC)
    - = ($300-$105) / ($350-127.4) = .88
- TCPI>1.0 is a forecast of favorable cost performance in the future. *"In the future, for every dollar I spend, I must earn "$X" in order to achieve EAC or BAC (depends on calculation used)*

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Codification of Earned Value

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- An Earned Value Management System (EVMS)
  - Is a management of a project based on earned value
  - Is centered and based on external standards
    - EIA-748-C = industry and government
    - NDIA Intent Guide
    - PMI Practice Standard for Earned Value Management
- A complete EVMS includes many elements of strong project management practice in addition to earned value analysis

Principles of EVMS*

- Plan all work scope for the project 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. Control changes to the baseline.
- Use actual costs incurred and recorded in accomplishing the work performed.
- 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.
- Use EVMS information in the institution's management processes.

*Based on EIA 748-C 2013

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EVMS Guidelines (1)*

- Organization
  - Define the authorized work elements
    [WBS detailed enough to monitor progress]
  - Organizational elements responsible for planning, control and execution
    - Internal
    - External (subcontractors)
  - Integrated planning, budgeting, and work authorization process
  - Entity for control of overhead identified
  - Complementary organization and WBS structure
    [Responsibility Assignment Matrix – RAM]

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*Based on EIA 748-C 2013

EVMS Guidelines (2)*

- Planning Scheduling, and Budgeting
  - Sequence and interdependences identified
  - Milestones, deliverables, technical performance goals defined so as to provide tangible evidence of intermediate progress
  - Time-phased budget baseline established and maintained
  - Budgets established for proper level of cost control
  - Discrete work package budgets as practical; planning packages beyond
  - Actuals and Budget roll ups permit direct comparison
  - Use of level-of-effort (LOE) only where appropriate
  - Indirect costs properly reflected in budgets
  - Management reserve, contingency, undistributed budgets clearly identified
  - TPC = OPC + TEC = All budgeted costs + reserves

*Based on EIA 748-C 2013

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EVMS Guidelines (3)*

- Accounting Considerations
  - Record actual costs consistent with budgets within formal system in general books of account
  - One-to-one correspondence between WBS and control accounts at monitoring levels
  - One-to-one correspondence between organizational units and cost accounts
  - All indirect costs recorded
  - Unit, equivalent unit, or lot costs recorded as needed
  - EVMS accounting system
    - Accurate cost accumulation and assignment with respect to budgets
    - Cost performance measurement used suitable for category of material: no earlier than progress payments or receipt of material
    - Full accountability of materials purchased including residual inventory

*Based on EIA 748-C 2013

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EVMS Guidelines (4)*

- Analysis and Management Reports
  - At least monthly reports with actuals
    - Comparison with planned budget and amount of budget earned for work performed (schedule variance)
    - Comparison of amount of budget earned and actual costs (cost variance)
  - Monthly variance analysis and justifications
  - Identified indirect costs and variance justification
  - Summarize as required for management and customer requirements
  - Implement managerial actions as a result of EV information
  - Develop revised estimate at completion (EAC) and justify and document identified variances

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*Based on EIA 748-C 2013

EVMS Guidelines (5)*

- Revisions and Data Maintenance
  - Incorporate authorized changes in timely manner
  - Reconcile current and prior budgets involved in changes
  - Restrict retroactive changes to
    - Correction of errors
    - Routine accounting adjustments
    - Managerial or customer directed
    - Improvements to baseline integrity
    - Improve accuracy of performance management data
  - Budget revised allowed only as approved in change control
  - Baseline changes documented

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*Based on EIA 748-C 2013

Summary

- Earned Value Management is all about
  - Planning carefully to anticipate what is needed for the project
  - Understanding and measuring performance
  - Analyzing performance and variances to identify problems and frame corrective actions
  - Forecasting possible future performance or risks to take preventative or mitigating measures
- It is important the control account managers **own** the baseline of their control accounts:
  - Scope
  - Cost
  - Schedule

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Consider additional metrics if they will help you understand where your project is heading

- Additional metrics should be actively sought out by the project to ensure that it becomes aware of emerging risks/issues
- For Example
  - Task / Milestone completion metrics
    - Baseline Execution Index
    - Current Execution Index
  - Critical / near-critical path metrics
    - Critical Path Length Index
    - Total Float Consumption Index
  - Time based schedule variances and analysis
    - Time-based Schedule Performance Index
    - Earned Schedule
  - Contingency consumption
  - Quality assurance and control metrics
  - Process / approval metrics
  - EH&S metrics

It is important to understand as early as possible in a project what metrics your stakeholders expect

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Procurement Management

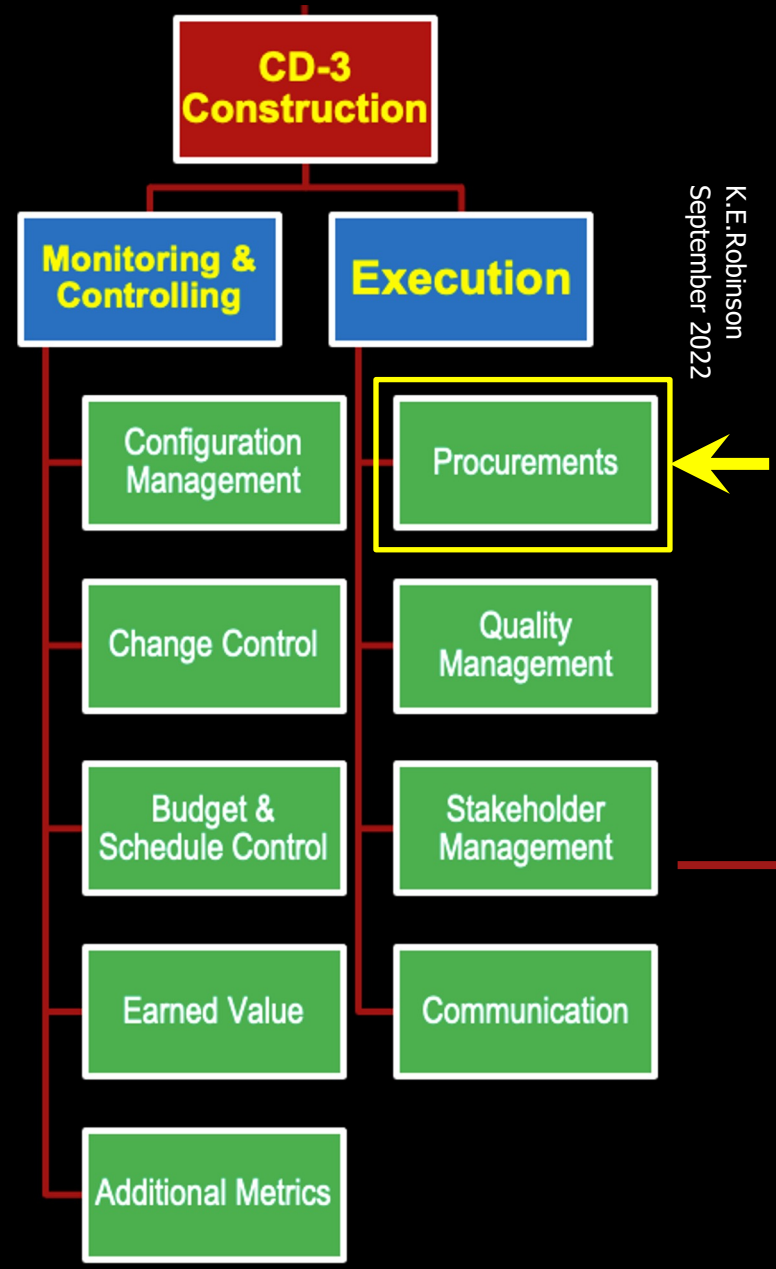
– General Concepts

Rule #4:
Whoever you deal with, deal fairly. Space is not a big playing field. You may be surprised how often you have to work with the same people. Better they respect you than carry a grudge.

Rule #50:
Being friendly with a contractor is fine—being a friend of a contractor is dangerous to your objectivity.

Rule #53:
Contractors respond well to the customer that pays attention to what they are doing, but not too well to the customer that continually second-guesses their activity. The basic rule is a customer is always right, but the cost will escalate if a customer always has things done his way instead of how the contractor planned on doing it. The ground rule is: never change a contractor's plans unless they are flawed or too costly (i.e., The old saying that better is the enemy of good).

- Jerry Madden, 100 Rules For NASA Project Managers



The processes* surrounding procurements seem straightforward ...

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1. Plan Procurement Management

- Plan
- Strategy
- Make-or-Buy
- Source selection
- Developing contracts

2. Conduct Procurements

- Selected vendors
- Contracts

3. Control Procurements

- Monitoring progress
- Claims administration
- Acceptance
- Closure

Points to understand and follow for project procurements:

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A. To know your project, know your procurements
B. Learn and understand your organizational constructs and constraints
   *Don't tinker with procurement systems**
C. Manage the critical path* — *The early bird catches the …*
D. Project procurements are a team sport – *Question the matrix**
E. Requirements, requirements, requirements – you get what you ask for
F. Risk mythology – Fixed-price contracts rarely are …
G. Information technology timing and selection – *The Blackberry seemed like the right choice …*
H. Supplier interaction and oversight – *How can they miss you if you won't go away…*
I. Problems won't simply go away, but suppliers can

**Adapted from The Wiley Guide to Project Technology, Supply Chain & Procurement Management*, Chapter Eleven: Procurement—Process Overview and Emerging Project Management Techniques, Mark E. Nissen, eds: Peter W. G. Morris and Jeffrey K. Pinto, John Wiley & Sons © 2007

A. To know your project, know your procurements (1)

Procurements Form an essential integral part of all DOE projects

- Current DOE projects (conventional and scientific hardware) **never** build everything themselves
- Most projects have at least one or more critical procurements that can jeopardize success of the total project
- Projects often need to seek long-lead procurement authorization **before** the bulk of construction phase begins
- Procurements can form part of risk mitigation strategies, or
  - They can also create greater risks if not managed properly

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A. To know your project, know your procurements (2)

- Look and understand what procurements you will face early and often throughout the development of your project
  - Initiation
    - Are there particularly challenging or risky procurements?
  - Early planning / conceptual design
    - What systems, subsystems, components, are longest lead and why?
    - What risks (volatility, availability, sourcing, …) that critical procurements face?
  - Detailed planning / Design
    - When is each procurement element needed?
    - Getting to a contract takes longer than you think it should?
    - Procurements more often than not are on the critical path

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B. Learn and understand your organizational constructs and constraints

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- Procurements are external contracts
- Project managers *never* place or administer contracts
- Organizations have been doing procurements for a long time
- Learn your organization's procurement system early
- Don't bother trying to tinker or change with your organizations' system

C. Manage the critical path — *The early bird catches…* — Plan, plan, plan (1)

Focus on Procurement Planning — *The most critical part*

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- Development of procurement SOW and specifications
- Laying out major milestones and timing/schedule
- Performing make or buy analysis
- Determining if long lead procurement is necessary
- Determining whether qualified vendors exist
- Identifying the source selection criteria
- Preparing a listing of procurement risks
- Development of procurement (acquisition) plan
- Obtaining authorization and approval to proceed
- Look for *throttle points* where schedule is lost

C. Manage the critical path — *The early bird catches…* — Plan, plan, plan (2)

Make or Buy?

- In a laboratory, university, or private setting, buying is generally better, but …
  - There is a different set of requirements on the project for oversight
  - Suppliers/subcontractors have profit motives that must be understood
  - Suppliers/subcontractors will do exactly what you tell them to do and rarely more without additional charges
- If there is a specific justification for control or great uncertainty and/or development then making something within the project may be justified

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C. [BACKUP] Plan: Consequences of Poor Planning

- Common failures of poor planning include:
  - Late delivery
  - Missed milestones & funding commitments
  - Degraded quality or performance
  - Higher prices
  - Increased claims from vendors
  - Negative impact on vendor relationships
  - Reduced participation of small business firms

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C. Manage the critical path — *The early bird catches…* — When "*must*" we Award a Contract

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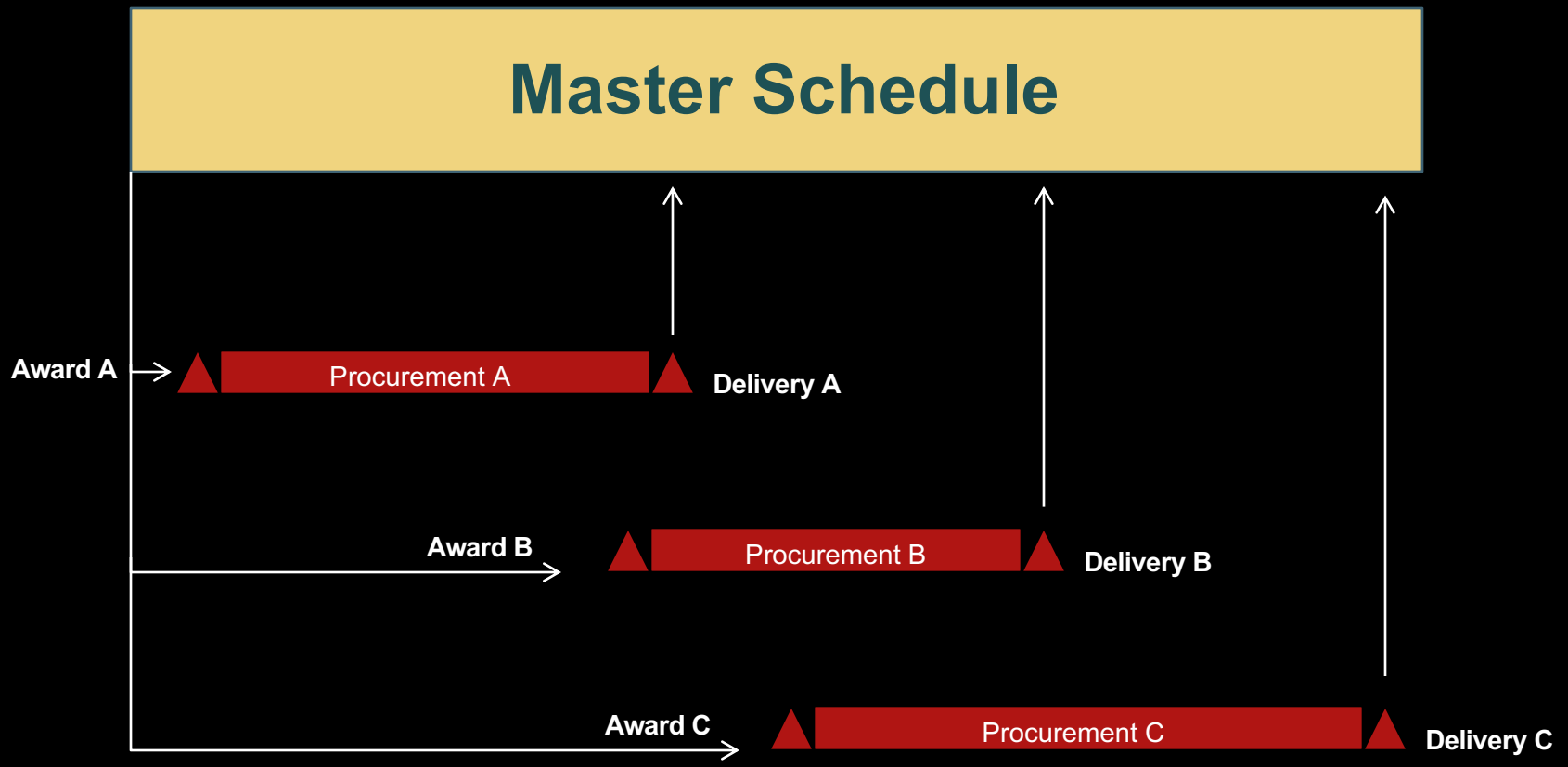
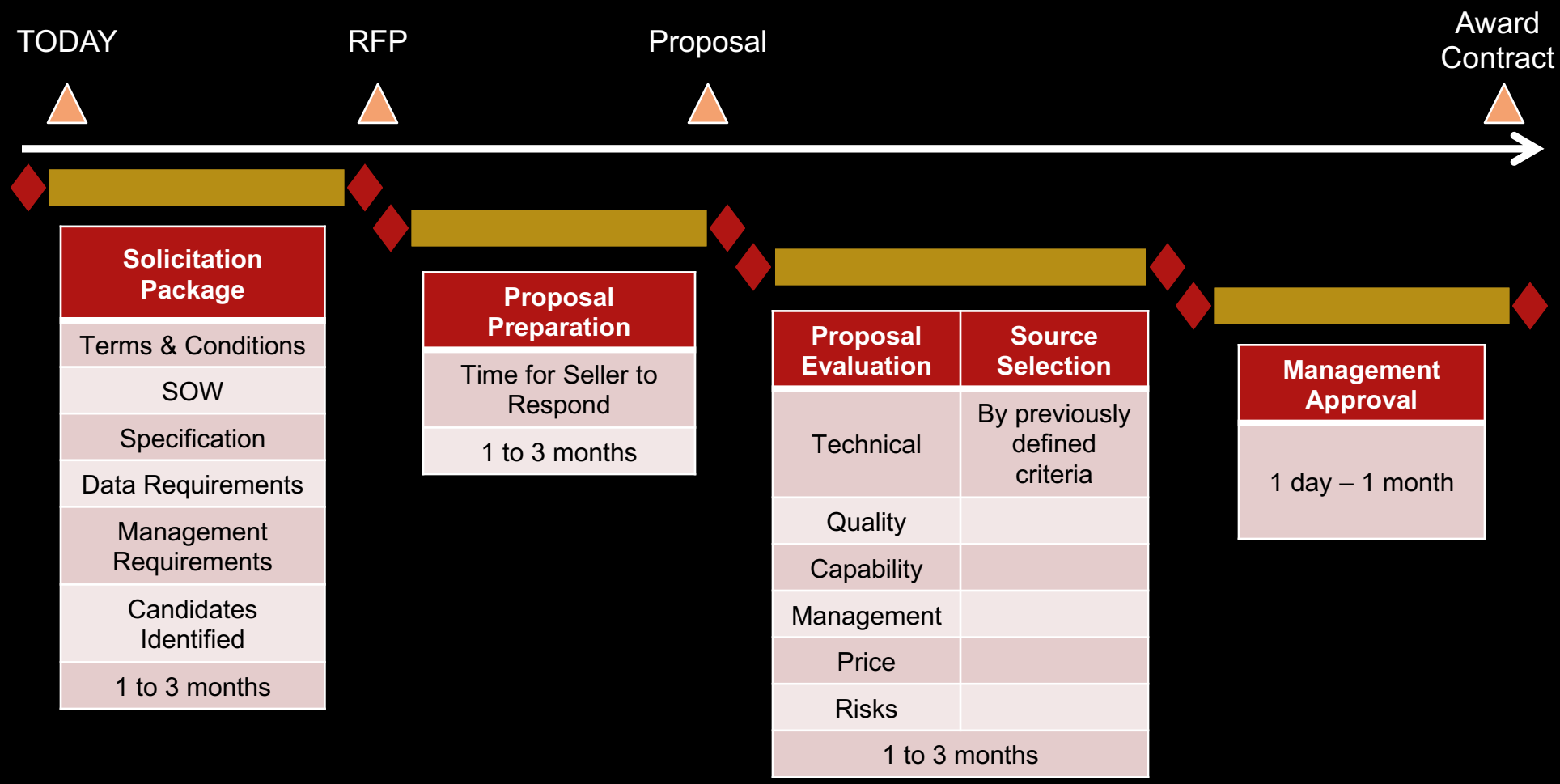


Schedule backward from Delivery to Award

Project Procurement Management, Q.W. Fleming

C. Manage the critical path — *The early bird catches…* — When *"can"* we Award a contract



Schedule forward from Today to Award date

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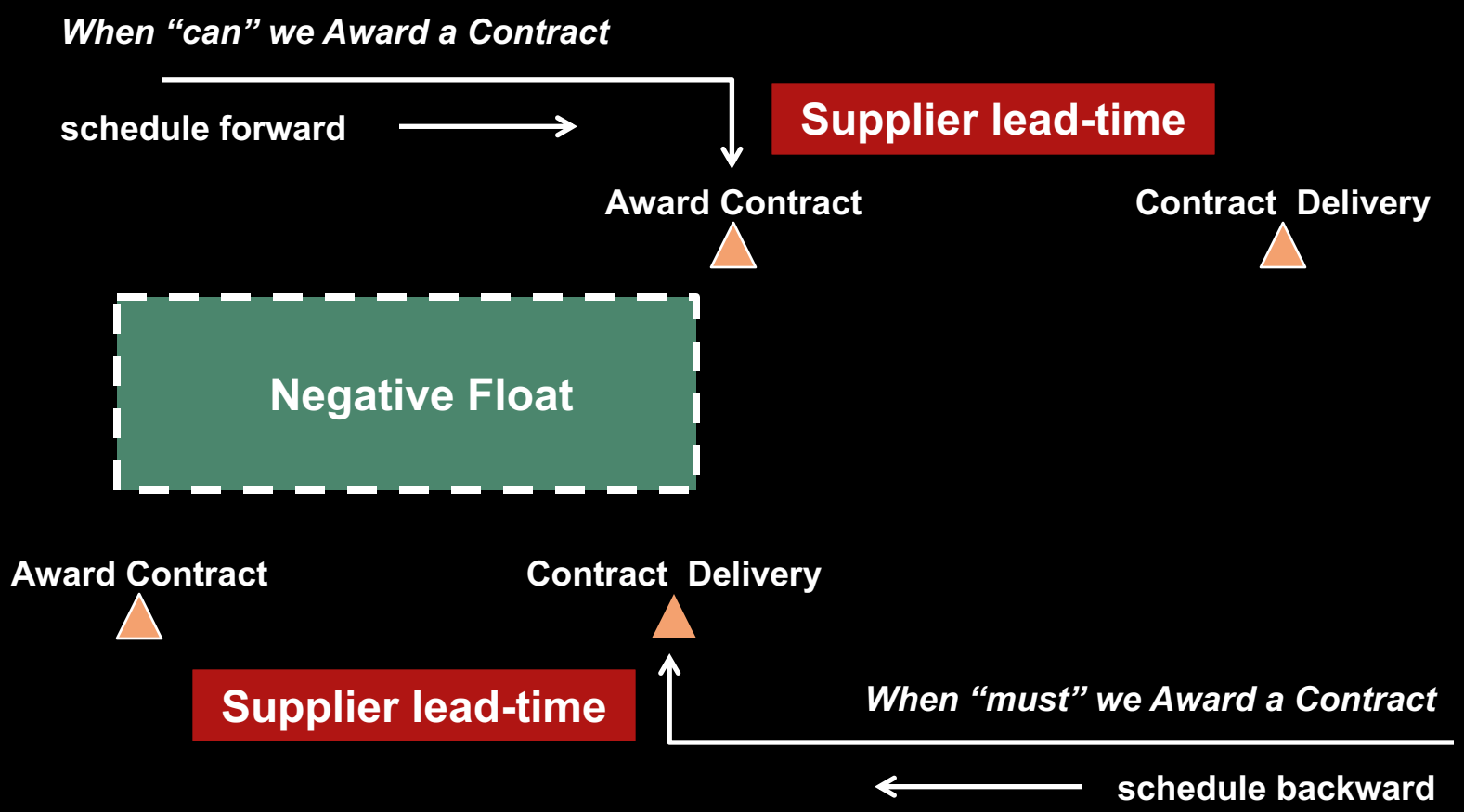
C. Manage the critical path
— The difference…sometimes negative



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D. Project procurements are a team sport – — The Subcontracting Officer (SO)

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In an Organization the Subcontracting Officer is the **only** authority to make contractual commitments with regard to price, quantity, quality, or delivery

- Leads solicitation process and vendor negotiations through contract award
- Administers all contract related business matters
  - Directs and negotiates changes with the subcontractor
  - Executes necessary directives and notifications to mitigate and/or correct contractor performance issues
  - Communicates acceptance
  - Enforces contract warranty and termination provisions

D. Project procurements are a team sport – — The Subcontracting Officer Technical Representative (SOTR)

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- You or one of your team will be the SOTR on procurements on your project
- The chief role is to provide technical oversight of assigned contract actions
  - Provide contractor direction within specific limits of authority
  - Main point of reference to ensure technical understanding, performance, and quality
- The SOTR also serves as the SO's technical expert during the solicitation and contract admin phases

D. Project procurements are a team sport – — The Subcontracting Officer Technical Representative (SOTR)(2)

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- Support Subcontracting Officer in processing the solicitation to award
  - Participate in pre-award conferences/site visits
  - Provide SO responses to comments and questions
  - Provide input for amendments to RFP
  - Lead the Technical Evaluation Team (TET)
    - Develop Technical Criteria and evaluate offers
    - Conduct "discussions" as necessary, and make recommendation of award
  - Protect "Sensitive" source selection information from release to parties outside the Technical Evaluation Team

D. Project procurements are a team sport – Questioning the Matrix

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Project managers tend to want captured procurement resources

Captured Procurement Resources

- Works well for specialized one-off procurements
- Requires PM direct management of procurement resources
- Projects prefer this model for the specialized skills

Service Bureau Resource Model

- Works well for standard commodity procurements
- Potential loss of continuity of Procurement personnel on long-term projects
- Organizations tend to this model from an efficiency standpoint

E. Requirements & specifications – you get what you ask for (1) – Creating the Statement of Work (SOW)

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- SOW becomes the basis for the contract document
  - Provides description or scope of work to be performed
    - Lists applicable documents, technical requirements, specifications, quality requirements, handling packaging and delivery,
    - Identifies required contractor training
    - Identifies applicable code, technical (quality control) inspection, or testing requirements
  - Must be sufficiently detailed to be competitively priced
    - Include standards to measure progress and results

E. Requirements & specifications – you get what you ask for (2) – Basic Types of Specifications Used

The type of specification affects risk of performance

- **Design Specifications** (*Build to Print*):
  - Detail what is to be done in terms of physical characteristics
  - The risk of performance is on the buyer
- **Performance Specifications** *(Build to Performance)*:
  - Specify measurable capabilities the end product must achieve in terms of operational characteristics
  - The risk of performance is on the contractor
- **Functional Specifications** *(Build to capability)*:
  - Seller describes the end use of the item to stimulate competition among commercial items, at a lower overall cost
  - A subset of performance specification, risk of performance is on the contractor

Avoid telling a seller **how** to do something, unless ...

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E. Requirements & specifications – you get what you ask for (3) – Inspection and Acceptance Requirements

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A standard inspection clause:

- Gives project the right to make inspections and tests while work is in progress
- Requires contractor to keep complete (and make available to project) records of its inspection work
- Provides that acceptance shall be conclusive, except for latent defects, fraud, gross mistakes amounting to fraud, or as otherwise provided in the contract
  - If not conclusive - the contractor is required to correct or replace the defective or nonconforming work

Get to the "*chicken tests*" as quickly as possible

F. Risk mythology – Fixed-price contracts rarely are … – Selecting the Appropriate Contract Type (1)

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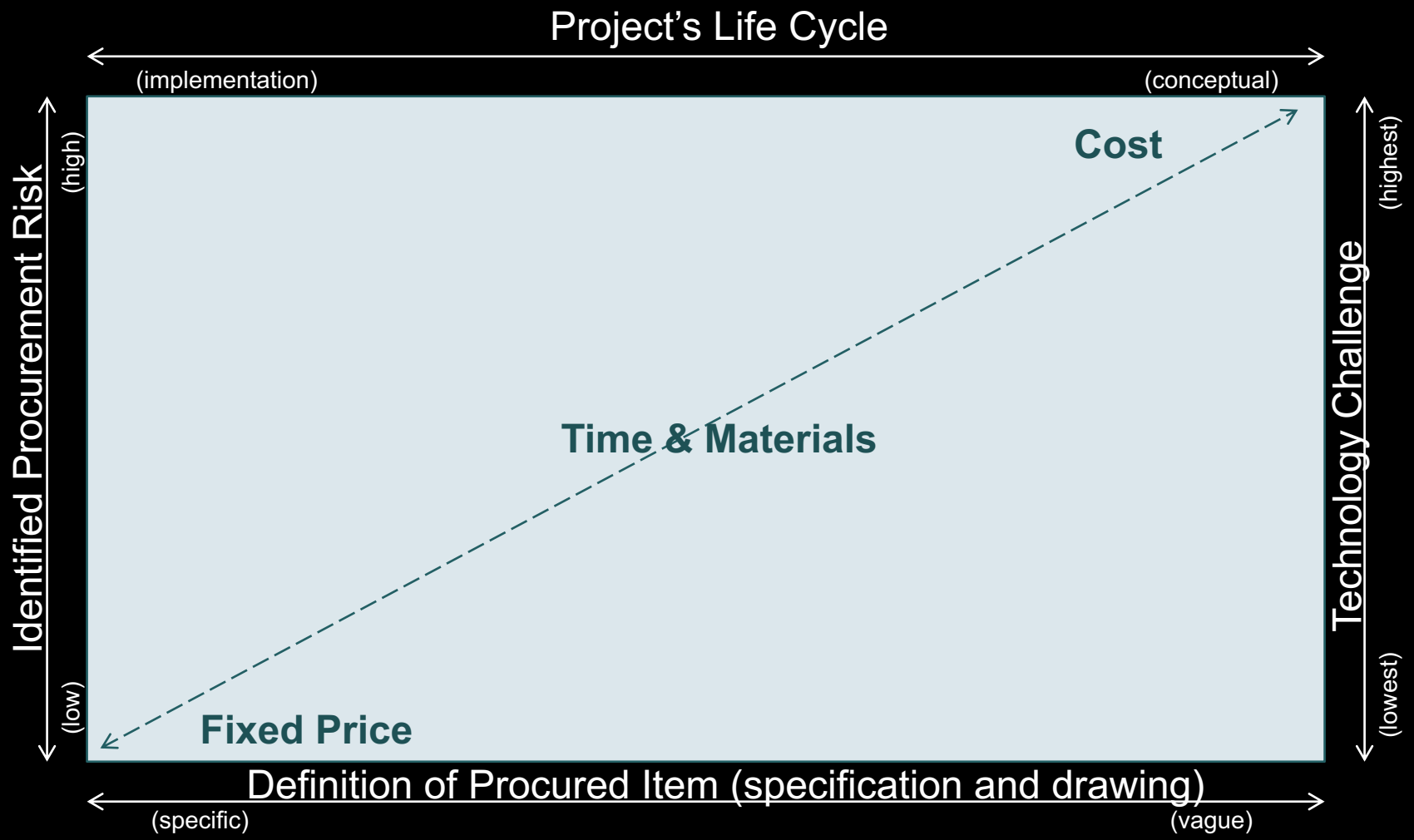
- **Fixed Price (FP) Contracts**
  - Provide for a firm price
  - Use when requirements can be clearly defined
  - Places maximum risk on the subcontractor to perform
- **Cost Reimbursement Contracts**
  - Provide for payment of allowable incurred costs
  - Outcome is "Best efforts"- NO performance guarantee
  - Requires continuous oversight of seller performance by project team
- **Time-and-materials** use burdened labor rates and actual material cost as basis of billing

F. Risk mythology – Fixed-price contracts rarely are … – Selecting the Appropriate Contract Type (2)



Fixed Price contracts **must** have the most informed/sure knowledge of specifications or they will not reduce project risk

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Project Procurement Management, Q.W. Fleming

G. Information technology timing and selection – *The Blackberry seemed like the right choice …*

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- Successful procurements are all about information exchange
  - Specs, qualifications, deliverables, progress, quality, schedules, …
- Use the contracting officer to get as much information as possible from potential suppliers to ensure the **best value supplier**
- Set up and facilitate open exchange with suppliers
- Balance information technology basis with suppliers
  - Control
  - Legal
  - Open

H. Supplier Interaction and Oversight (1)

- Again, successful procurements are all about enough information exchange and interaction
- Ensure maximum information exchange without compromising the suppliers or the procurement
  - Before bids or quotations, during negotiations, during execution, during closeouts
- Pick the proper contractual information instrument for the needs of the procurement
  - Request for Information
  - Request for Quotation
  - Request for Proposal

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H. Supplier Interaction and Oversight (2)

- Remember your suppliers are on a schedule
  - For them *time is money*
  - Be responsive
  - Be Prompt
- Understand your suppliers schedule and critical points and **be there** when there are things that could add risk to your project procurement
- Without caution compromises between flexibility and project risk can occur

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H. Supplier Interaction and Oversight
— Conduct Procurements: Selection Strategies

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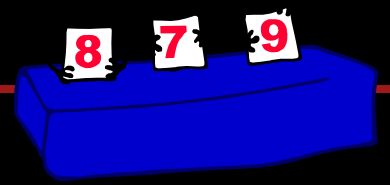
- Three basic approaches to selecting a contractor
  1. Lowest price (shortest time to process)
  2. Technical acceptability (minimum standards) & low price
  3. Best Value uses tradeoffs of tech. factors and price
- We must satisfy four basic questions before award:
  1. Is the offer "Responsive" to the solicitation?
  2. Is the contractor "Responsible" to complete the work?
  3. Is the final price "Fair and Reasonable"?
  4. Is the award decision consistent with the solicitation?

H. Supplier Interaction and Oversight — Best Value Allows the Most Flexibility



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A best value selection evaluates and scores the differences of competing proposals

- Price is always considered separately in the evaluation but not scored with the technical proposals
- May award on the initial offers received but If "discussions" are conducted must get "Best & Final Offer" (BAFO)
  - Technical evaluation and price must support award decision
- If requested by the unsuccessful offeror(s), we provide an individual post-award debriefing led by the SO
  - Purpose is to assist vendors to bid future work for project
  - Only weaknesses of the unsuccessful offeror are debriefed

H. Supplier Interaction and Oversight — Administer Procurements: Avoid Costly Delays and Claims

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Proactive oversight is the first line of defense

- Ensure contractor submittals are thoroughly reviewed and corrected in a timely manner
  - You may have liability for contractor errors that were not detected in the review
- Fully enforce contract requirements
  - Your silence may create acceptance of non-conforming or defective work
- Provide required information and approvals in accordance with the contract requirements

I. Problems won't simply go away, but suppliers can — Close Procurements

- Final acceptance of deliverables: verification that all the work performed, and the deliverables produced are acceptable
- Close of procurement documentation
  - Documented verification of accepted deliverables
  - Debrief seller on overall performance
  - Archive all necessary project documentation
  - Document lessons learned
  - Identify best practices

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I. Problems won't simply go away, but suppliers can — Close Procurements and Payments

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- Follow up with supplier
  - What went well…
  - What didn't do so well...
  - How could future work together be improved...
- Small businesses thrive or dwindle on cash flow
  - If a supplier serves the project well …
    … ensure that they are paid in a timely basis
  - Laboratories and universities don't necessarily optimize on this

Summary:
— Remember why a project has procurements

- Suppliers and subcontractors are engaged
  - Provide something not otherwise available to the project
  - Provide something
    - Faster
    - Better
    - Cheaper
  - Assume risk from a project
- It is important to understand the reasons a procurement is being made to avoid losing the value of the procurement

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Summary:
— Your approach is critical to success

- The best suppliers take an interest in the value of their contribution to the project
- Cultivate a positive work relationship with the contractor
  - Convey realistic expectations - the contractor is only accountable for what's in the contract
  - Ensure technical oversight does not interfere with contractor's ability to perform required work
  - Maintain open communications with all parties
  - Seek "win-win" outcomes
  - Demonstrate integrity in all work relationships

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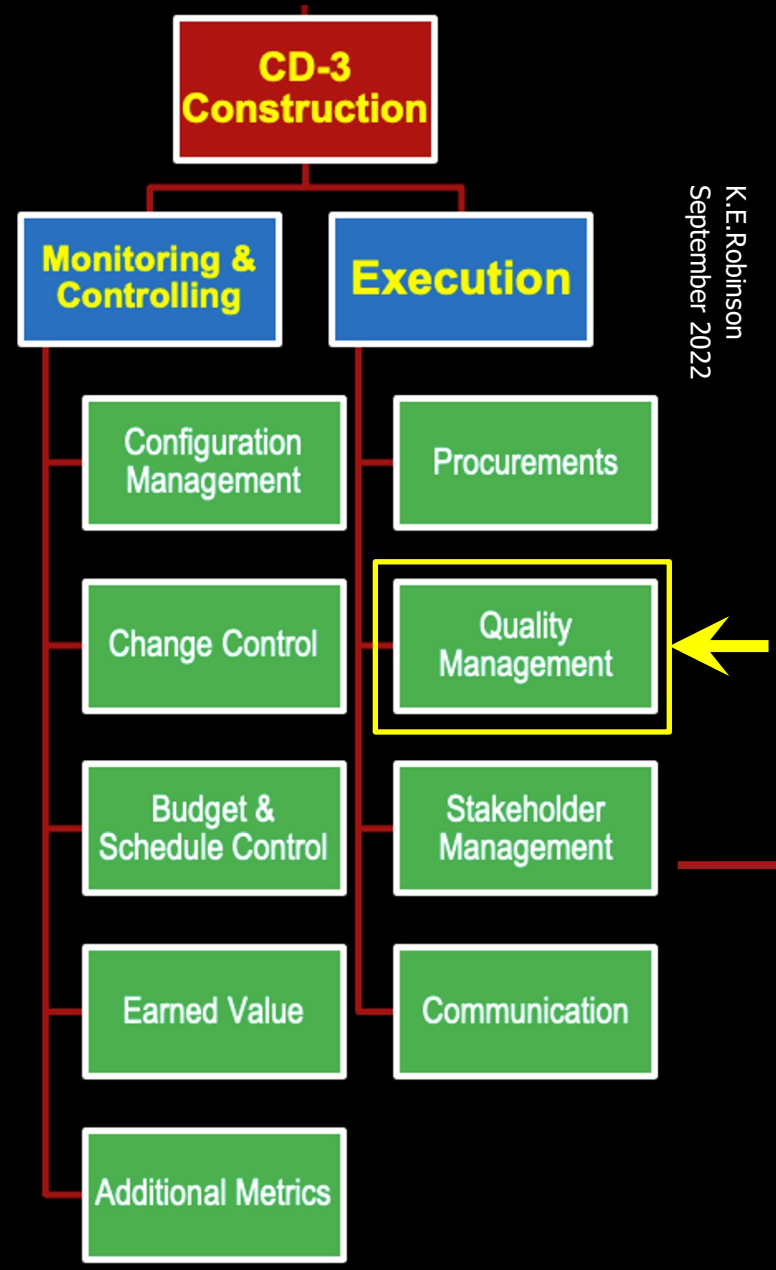
Quality Management



Quality Is a Necessary Consideration in All Projects

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- At the beginning of a project one must **plan** on how quality of the project deliverables will be ensured
- During the project execution one must **assure** that project meets requirements
- During project control, integration, and closeout one must **control** project results

OK, all fine and good, but what do you mean by quality on a project?

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- Fitness of purpose
  - Performance
  - Safety
  - Reliability
  - Ease of handling
  - Logistical support
  - Environmental safety
  - Equipment protection
  - …
- Absence of defects (does NOT mean *zero defects*)
- Value for money
- Key stakeholders (customer) satisfaction

For projects: Good enough quality is the determining factor*

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- Creating systems ”of the very best quality” is a very, very expensive proposition; clients may not even notice the difference between *best possible quality* and *adequate (pretty good) quality.***
- Quality must be balanced with the cost and schedule of the project
- Quality must not be confused with *grade*

- The Concept of Quality on a project implies everyone:
  - Knows what is expected of her / him
  - Is able & willing to meet those expectations
  - Knows the extent to which he /she meets the expectations
  - Has the ability & authority to take required corrective actions

- Good quality implies cost-effectiveness and fitness for a specific intended purpose

Consider quality throughout the entire project

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- Before even CD-0
  - All DOE laboratories as part of their M&O contracts must have a Quality Assurance program in place
  - Know what your lab's QA program is and what you can leverage and use on your project
- CD-0 / Mission Need
  - While framing the mission need understand if there are any major challenges with respect to quality assurance that will require significant resources/effort
- CD-1 / Conceptual Design
  - Plan out before the design starts how you will ensure quality in design development
    - Requirements, constraints, assumptions, highly developmental or unknown, modeling, R&D, trades, etc.
  - Develop the design to the appropriate degree of rigor/standards
- CD-2 / Performance Baseline
  - Clearly understand and detail out any areas where special attention to quality assurance and control will be necessary
  - Properly estimate and account for the correct level of quality assurance & control
- CD-3 / Execution
  - Ensure that all quality assurances and controls are in place before they're needed in production
  - Monitor and control carefully any emergent quality related risks and correct them prior to them becoming issues
- CD-4 / Closeout
  - Performance verifications and KPP fulfilment

Quality Management Processes

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- Quality Planning – identifies which quality standards are relevant to a project and how they will be satisfied
- Quality Assurance – applies planned, systematic quality activities to ensure that the project employs the processes needed to meet requirements
- Quality Control – monitors specific project results to determine compliance and eliminates causes of unsatisfactory performance

Quality Assurance During Phases: Design Phase

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- Assuring quality during the design phase is the least expensive time
- Must have multiple pronged approach to ensure quality
  - Design reviews
  - Requirements verification
  - Detailed design verification / checking
  - Specifications review and generation
  - Material specifications
  - Manufacturability
  - Ability to be assembled / integrated
- Don’t over specify in hopes that what you actually need will be achieved

Quality Assurance During Phases: Construction / Execution Phase

- Need to add quality assurance steps throughout the construction / execution phase
- Determine suitability as early as possible
  - Prototyping
  - Raw Materials & Supplies
  - Subassembly
- Do inspections on materials rather than assemblies / structures
- Attempt to detect quality shortcomings as early in a *fabrication string* as possible to minimize cost in time and schedule
- Understand when material certifications will be required
- Understand and plan on how deviations will be considered before it is needed

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Quality issues will come up during project execution

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- Actively plan and understand the quality assurance and controls needed and deploy appropriately
- Plan on the "**Chicken Tests**" (that is Go/No-Go) as early and soon as possible
  - Remember the costs of rework/change increase exponentially as the project progresses
- Don't just default to "boilerplate" QA/QC clauses
  - Understand what is important; the critical characteristics; and the firmness of requirements
- When selecting subcontractors, vendors, collaborators ensure that they can produce what the project needs and the quality required
- Material Disposition Board / Discrepancy handling procedures should be determined before the fact
  - **THESE DO NOT WORK:**
    - "Make it as good as you can."
    - "We'll pretend to give you tolerances, and you pretend to meet them."
    - "We'll take care of it during installation and commissioning."

Quality / Risk / Scope / Requirements all focus on achieving desired outcomes

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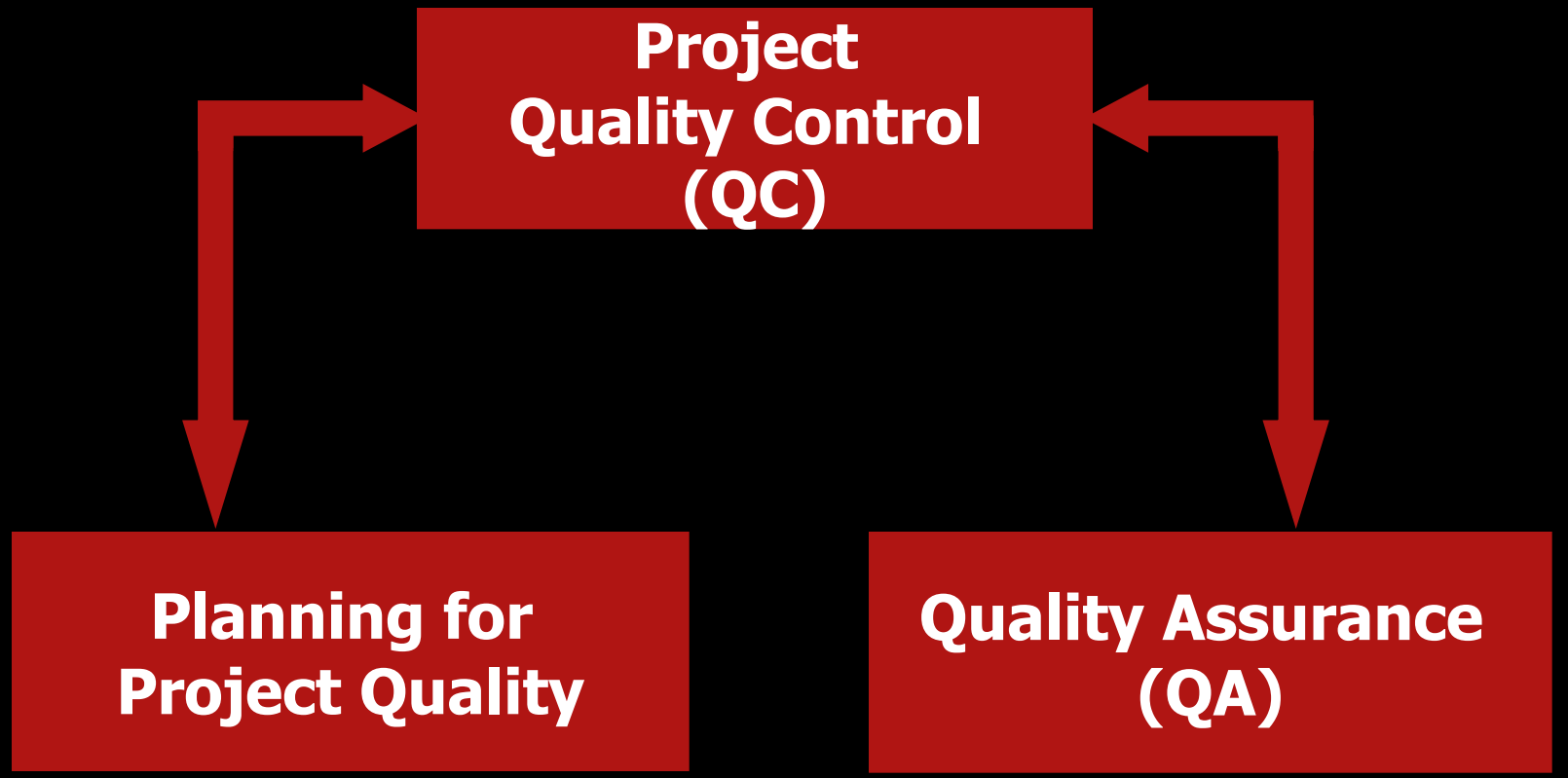
- Quality management is inextricably linked to
  - Risk management
  - Scope management
  - Requirements management

- Quality has a compounding effect on cost and schedule
  - The earlier that the proper quality can be assured the less cost and schedule risk will be present for the project
  - The later in the project's development that quality is ensured (by controls and/or inspections), the more costly it will be

Project Quality Management Process*



The term "Quality Assurance" is sometimes used to describe all three the above

From Nicholas and Steyn, Project Management for Engineering, Business & Technology, 6th Edition

Quality Planning

Inputs	Tools & Techniques	Outputs
■ Project environment ■ Agency / institution process assets or requirements ■ Project Scope ■ Project Management Plan	■ Cost-benefit analysis ■ Benchmarking ■ Design of experiments ■ Cost of quality (COQ) ■ Other quality planning tools	■ Quality management Plan ■ Quality metrics ■ Quality checklists ■ Process improvement plan ■ Quality baseline ■ Updates to project management plan

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Performing Quality Assurance

Inputs	Tools & Techniques	Outputs
■ Quality assurance plan ■ Quality metrics ■ Process improvement plan ■ Work performance information ■ Quality control measures ■ Implemented changes requests ■ Implemented corrective actions ■ Implemented defect repair ■ Implemented preventative actions	■ Quality planning tools and techniques ■ Quality audits ■ Process analysis ■ Quality control tools and techniques	■ Requested changes ■ Recommended corrective actions ■ Updates to institutional processes ■ Updates to the project management plan

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Performing Quality Control

Inputs	Tools & Techniques	Outputs
■ Quality management plan ■ Quality metrics ■ Quality checklists ■ Institutional/agency process assets or requirements ■ Work performance information ■ Approved change requests ■ Deliverables	■ Cause & effect diagram ■ Control charts ■ Flowcharting ■ Histogram ■ Pareto chart ■ Run chart ■ Scatter diagram ■ Statistical sampling ■ Inspection ■ Defect repair review	■ Validated deliverables ■ Quality control measurement ■ Validated defect repair ■ Updates to quality baseline ■ Recommended corrective actions ■ Recommended preventative actions ■ Requested changes ■Recommended defect repair ■ Updates to institutional process updates ■ Updates to project management plan

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Summary

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- Project schedules, budgets, and quality management address thethree dimensions of project goals:
  - Finish on time
  - On budget
  - Satisfy requirements.
- Project quality accounts for an end-item's
  - Compliance to specifications
  - Fitness for the purpose
  - Customer expectations.
- Project quality does not imply
  - Highest grade
  - Most product features
  - Zero defects
- Quality management includes three processes
  - quality planning,
  - quality assurance, and
  - quality control.

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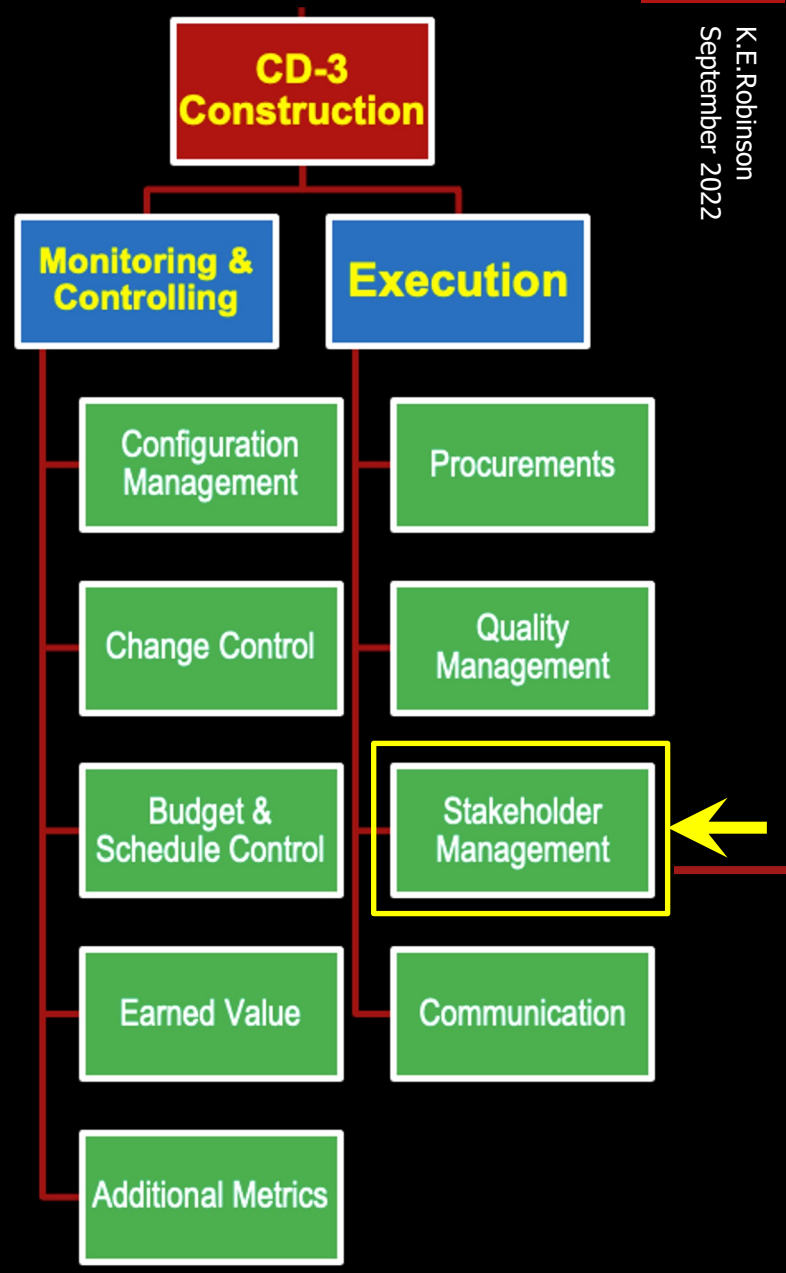
Stakeholder Management



President Whitmore: "What do you want us to do?"
Captured alien: "Die. Die."
— "Independence Day"

"You can't please everyone, and you can't make everyone like you."
— Katie Couric

You don't tug on Superman's cape
You don't spit into the wind
You don't pull the mask off that old Lone Ranger
And you don't mess around with Jim
— Jim Croce, "You don't mess around with Jim"

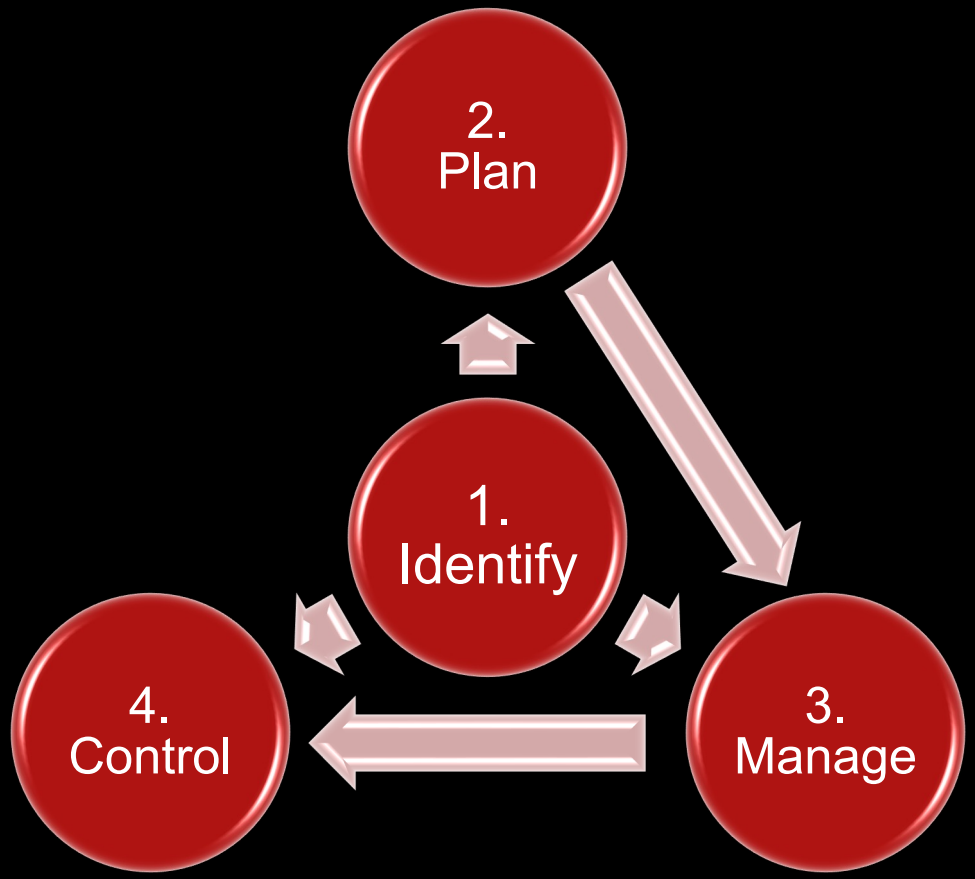
Just to reiterate – Stakeholders must be considered

Stakeholders: Individuals and organizations involved in or affected by the project activities

Medieval project manager Joan of Arc discovers too late that her project goals are not in alignment with the English stakeholders' priorities

DOE is a critical key stakeholder, but not the only stakeholder that must be attended to

The approach to stakeholders is comparable to other knowledge area approaches



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Every project has stakeholders

- Stakeholders:
  - Impacted by project ☺ or ☹
  - Or can impact project ☺ or ☹
- Influence on project outcomes?
  - Limited
  - Significant
- Project managers must
  - Correctly identify stakeholders
  - Ensure appropriate interactions

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Identifying stakeholders – don't forget to look for blind spots

- It's part of risk mitigation – a knowledge-based risk
- Look in the usual places and unusual places
  - Project charter
  - Procurement documents
  - Enterprise environmental factors
- Create a list / register (it need not be formal)
- Analyze stakeholders
  - Potential project to impact
  - Potential for them to impact project

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Planning stakeholder engagement/management – don't go in blind

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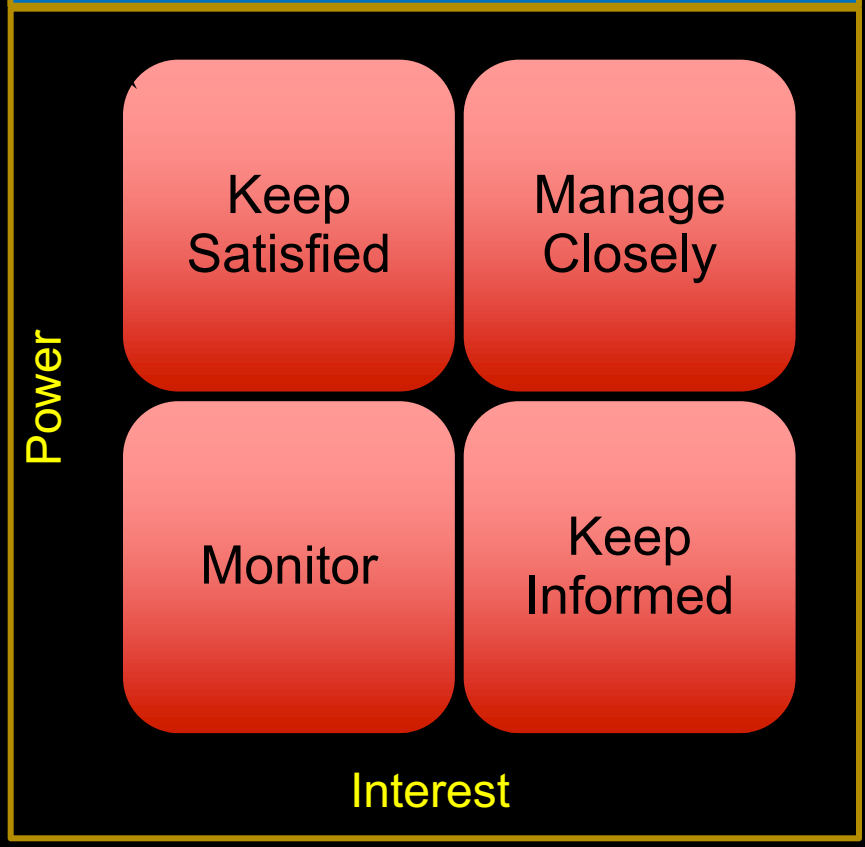
- Seek Expert judgment
  - Senior management / key stakeholders
  - Team members
  - Others within the organization
  - Others who have done something similar
  - Subject matter experts / consultants / industry groups
  - Associations, regulatory bodies, NGOs

Assess your stakeholders –

Engagement Level

- Unaware
- Resistant
- Neutral
- Supportive
- Leading

Stakeholder Power/Interest Grid



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Managing stakeholder engagement: When, where, what

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- Various project stages
  - Obtain / confirm commitment
- Managing expectation to ensure project goals
  - Communication / Negotiations
- Risk and Issues management
  - Identifying risks / issues as they arise
  - Actively mitigating risks / addressing risks

The 12 Commandments of Stakeholder Management*

1. Thou shall not hide bad news.
2. Thou shall not make false promises or fail to meet deadlines.
3. Thou shall address requests promptly.
4. Thou shall not transmit documents without cover information.
5. Thou shall remember the details will kill you.
6. Thou shall never assume anything.
7. Thou shall recognize your written work mirrors you.
8. Thou shall not practice law.
9. Thou shall show deference to the stakeholder.
10. Thou shall not mingle your interests with those of the stakeholder.
11. Thou shall not interfere with the competition.
12. Thou shall respect confidences absolutely.

* Adapted from 12 Commandments of Customer Service. Source Unknown

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Client-Stakeholder Satisfaction — Key Attributes

- Clear identification
- Open Communication
- Continued Involvement
- Requirements
- Clarity of deliverables
- Understanding who is the client, customer, user, stakeholder

Case Studies:

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- Who were the stakeholders?
- What was done with each of the stakeholders?
- Was the ultimate outcomes related to stakeholders?
- Was the project team in a position to effectively manage all stakeholders?

Stakeholder Summary/Checklist

- Have you identified all of the stakeholders of the project?
- Have you correctly assessed stakeholder
  - Interest?
  - Impact?
  - Power?
  - Engagement?
- Do you actively plan managing stakeholders?
- Are you monitoring and correct your approach with stakeholders as the project evolves?
- Are you focusing on effective multiple communication links and feedback?
- Are you addressing stakeholders risks and issues as soon as feasible?

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Exercise:

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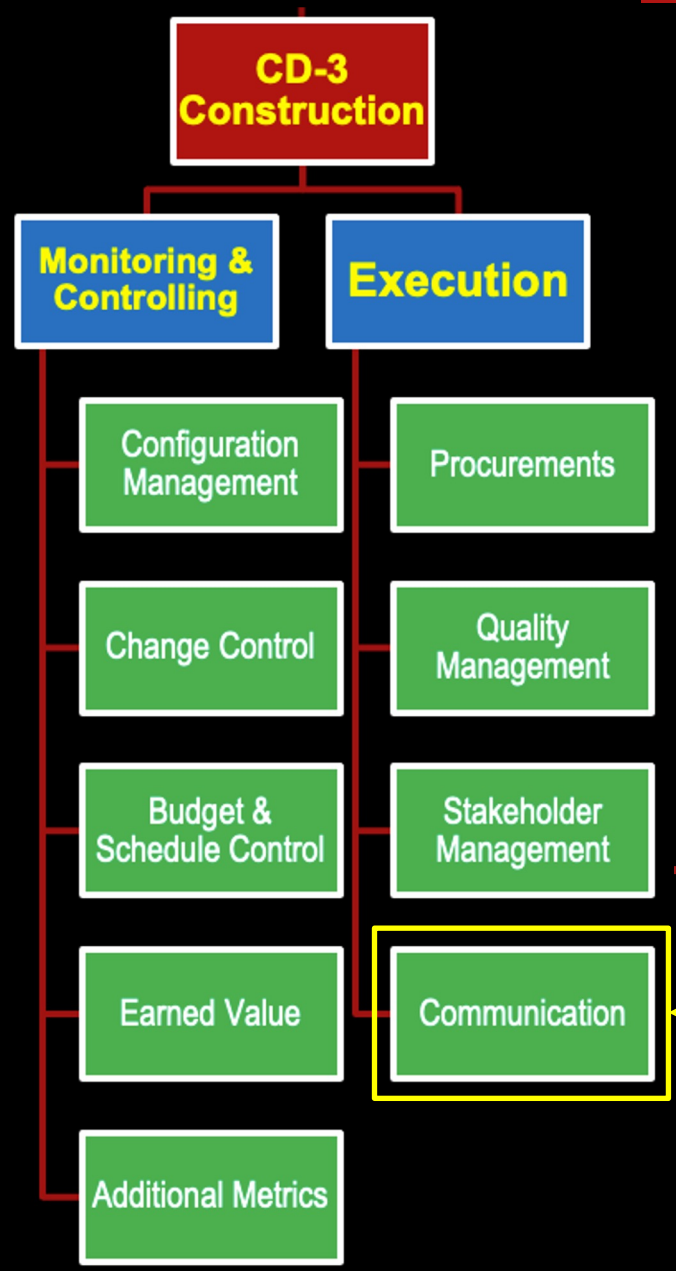
- Identify stakeholders in both your projects
  - Development Project
  - Site Visit /Personal Time / Case Study
- Identify management or other mitigation strategies for stakeholders

Communication Management



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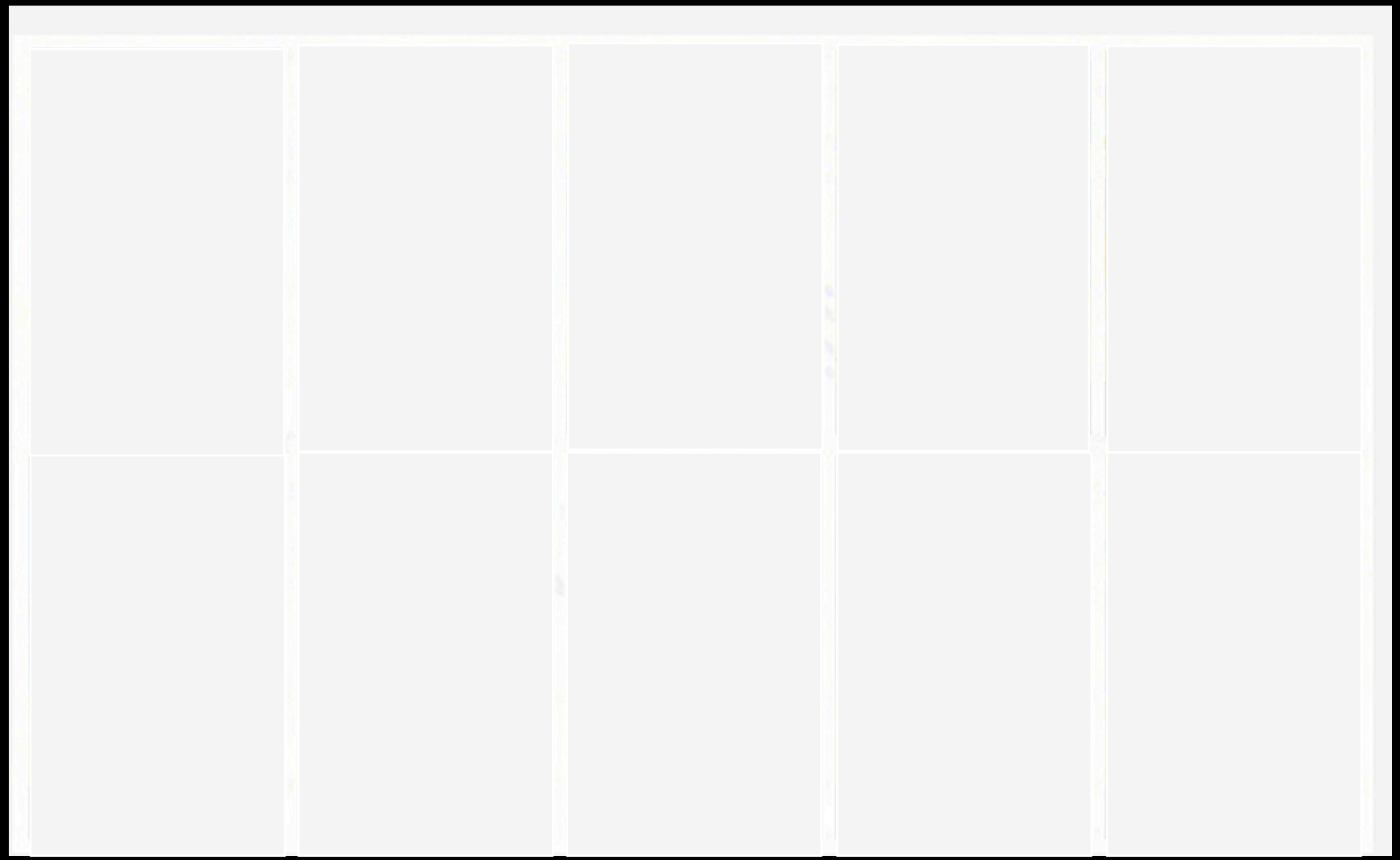
The problem with communication ... is the illusion that it has been accomplished. - George Bernard Shaw

The more elaborate our means of communication, the less we communicate. - Joseph Priestley

You can get far in North America with laconic grunts. "Huh," "hun," and "hi!" In their various modulations, together with "sure," "guess so," "that so?" And "nuts!" Will meet almost any contingency. - Ian Fleming

Successful Communication Management and *– A Dream?*



Communication – The *Only* Tool

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- In project management, effective communication is not optional. It is essential for project success.
- As a project manager, you will likely spend 90% of your time communicating.
- Every project requires communication
  - Multiple levels
  - Multiple messages
  - Multiple audiences
  - Multiple media
  - Multiple means
  - Multiple feedback loops

Communication Management Processes

- Communications planning: Matching information and communication to project stakeholders
- Information distribution: making information available to project stakeholders in a timely fashion
- Performance reporting: collecting and distributing the project performance
- Stakeholder management: effective communication to satisfy requirements and resolve issues of project stakeholders

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Communications Planning

Inputs	Tools & Techniques	Outputs

▪ Project environment
▪ Agency / institution process assets or requirements
▪ Project Scope
▪ Project Management Plan
  ▪ Constraints
  ▪ Assumptions
	▪ Communication requirements analysis
	▪ Communications technology
		• Communication Management Plan

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Communication

Develop a Communication Plan – Decide upon the project meeting types, when they will be held and their frequency. Agree on who will be invited and how reports and minutes will be disseminated. Document the plan.

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Examples:

- Team meetings – attendees include project management and team members, typically held weekly.
- Status reports – attendees include the sponsor, project management and selected team members, typically monthly.
- Sponsor meetings – Held at sponsor's discretion, can be critical review type meeting, or for a major project milestone. Attendees include sponsors, project management, project leads, and responsible engineers.

Communication Plan Aspects

- Audience – *Who needs to know?*
- Message – *What do they need to know?*
- Intent – *Why do they need to know?*
- Media – *How are they going to know?*
- Timeframe – *When are they going to know?*
- Responsibilities – *Who is delivering the message?*
- *GOALS:*
  - *No surprises*
  - *Up and down the chain*
  - *Feedback (Quality Assurance)*
  - *Repetition, reinforcement, regularity*

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Communication Requirements Analysis

- Communication channels grow geometrically with number of stakeholders
- What are sources for communication requirements?
- What information is needed for each type of stakeholder?
  - Project team
  - Institution management
  - Funding agency and program sponsors
  - Scientific community
  - General public
- What is the urgency of needed information?

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Communications Technology

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- How are you going to communicate?
  - Considerations:
    - Urgency
    - Availability
    - Project team familiarity
    - Project length
    - Project ecosystem
  - Meetings and e-mails are inevitable, but beware! They can be very ineffective.

Communication

Communication Plan Example

Communication Item	Description	Purpose	Frequency	Media	Audience	Responsibility	Distribution	Start Date	Estimated Quantity and Cost
Budget Review Meeting Minutes	Review financial and budget information	Conduct variance analysis of budget and actual financial results	Monthly: 3rd Wednesday	Budget status reports distributed prior to meeting	Project executive; team leaders	Project manager	Project executive; team leaders	4/1/99	None – electronic distribution
Project Status Meeting Minutes	Attendees, agenda, areas/presentations, persons responsible for presentations, action items, next meeting	Informational —For project monthly held meetings	Monthly	Office Vision, formal review of meetings from previous meeting	Project executive, customers	Project executive	Project executive; team leaders	3/1/99	Staff time for preparation. Plotter paper/ ink. No external distribution.
Issues Documentation	Issues ID , creation date, description, person responsible, status, status date	Informational —To track all issues related with the project	Weekly (as required) during project meetings	Paper and electronic entry to status system	Project team members	Project manager	Project team	6/9/99	None – electronic distribution
Action Items Documentation	Action ID, creation date, description, person responsible, status, status date	Informational —For all actions items tracked by project	Weekly (as required) during project meetings	E-mail and calendaring system	Project team members	Project manager	Project team members	6/9/99	None – electronic distribution
Project Informational Presentations	Presentations	Informational —All information related to the project	As required	Formal presentations	Individuals interested in information related to project	Project leader		6/9/99	Staff time for preparation. Plotter paper/ ink. Costs for media for external distribution.

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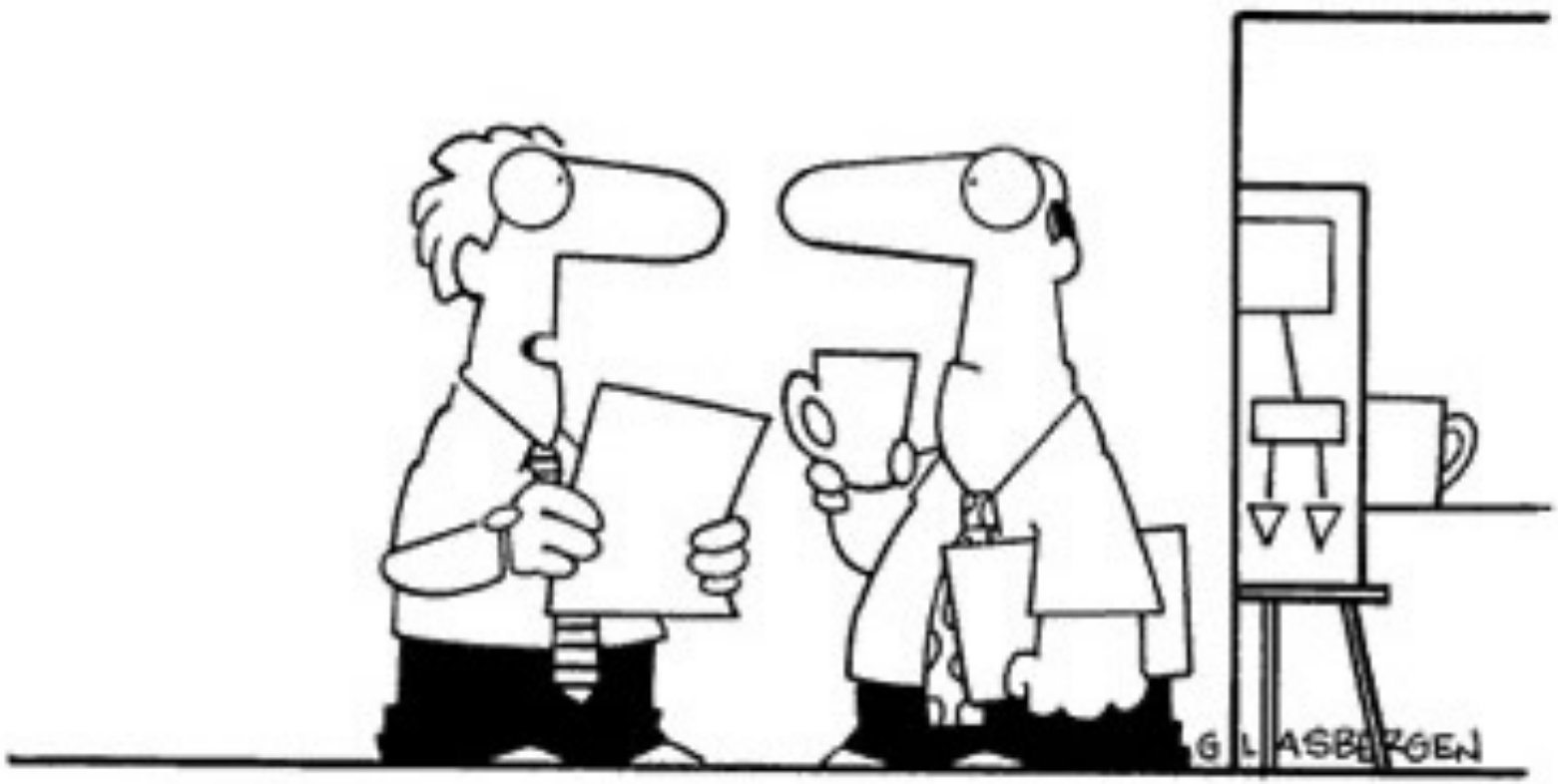

"Scientists say that coffee and donuts release chemicals into the brain that create the illusion that meetings are a productive way to get things done."

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Meetings Should Not merely be an Alternative to Productive Work

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- Meetings are often viewed as the least productive parts of one's job
  - If a meeting isn't directly related to project success outcomes why is it being held?

- Time is money – and specifically it is your project money
- Have a goal/objective for every meeting
- The degree of control of a meeting must be carefully tailored
  - Meetings which are *pronouncement* meetings will lose project supporters very quickly
  - Meetings which do not drive towards the objective won't gain project support
- Meetings should focus on things not people

Conducting Effective Project Meetings

- Learn as much as you can about group processes and the psychology of small groups.
- **Question the need** for the meeting – explore other alternatives.
- Have a **specific objective** for each meeting.
- Have a **detailed agenda** with specific time, place, and assigned responsibility for each item.
- Distribute agenda and other relevant **materials in advance**.
- Keep **participants to a minimum** – attendance by invitation only.
- **Participants must have authority** to make commitments.
- Start and end the meeting **on time**
- Conduct **one piece of business at a time**, stay with the agenda, and do not allow petty interruptions
- Allow **each member to contribute** in their way; support, counter, or challenge viewpoint differences as being helpful or not
- **Get closure** (decision) on each item; test for commitment
- **Document meeting** through minutes, issues log tracking and 'decisions made' documentation. Either perform this function or assign a team member to perform this function.
- **Share your documents**.

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Standard Project Update meetings should be banned

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- Only 3 types of meetings should be held*:
  - Brainstorming (creating new ideas, approaches)
  - Connecting people and ideas (creating *aha's* and alignment)
  - Making decisions / Planning next steps

- *Information Sharing* meetings shouldn't be held. Use the project repository / work platform
  - Insist on getting updates on the platform and ensure that any discrepancy or variance from the plan is highlighted.
  - Use the project meeting to address discrepancy or variance from the plan (falls in line with the 3 types of acceptable meetings)

*The Simplicity Survival Handbook, W.D. Jensen, 2003

Meetings, Reports and Reviews

- Weekly or bi-weekly meeting
  - Project office
  - Technical system (each system separately)
  - Design discussion
- Monthly meeting
  - Project management
  - Department office
  - Project monthly report (usually to funding agency representative)
- Quarterly
  - Project quarterly report (usually to funding agency representative)
- 6 month
  - Semi-annual review (usually by funding agency representative)

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Conducting Effective Project Meetings – Virtual/Global Teams

- Picture org charts
- F2F (face-to-face) when possible
- Audio/video conferencing
- 1-1 teleconferences with key team members
- Email "thank you cards," cc their manager
- Rotate meetings times – meeting times should not always be at the convenience of the senior manager
- Document repositories – easy access to project information
- 'Decisions Made' document – meeting minutes, issues logs
- Regular project team meetings
- Get a high level manager on the other end to sponsor the project

**Pat Harper, USF, PMGT 634

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Never let a good pandemic go to waste, or at this point *everyone* has done myriad virtual meetings

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- Virtual meetings have emphasized to us
  - What makes a good vs. a bad meeting
  - What makes a good vs. a bad virtual meeting

E-mails: The Curse of the Computer

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- Pragmatism rules – The goal is a successful project. There isn't time, or excess resources to allow your ego to get in the way of the project.
- Only you can prevent forest fires – Never reply or be incited to reply in haste when emotionally charged e-mails come your way
- E-mail is a public record – Never assume that an e-mail is confidential

E-mails: Brevity & Focus are Key

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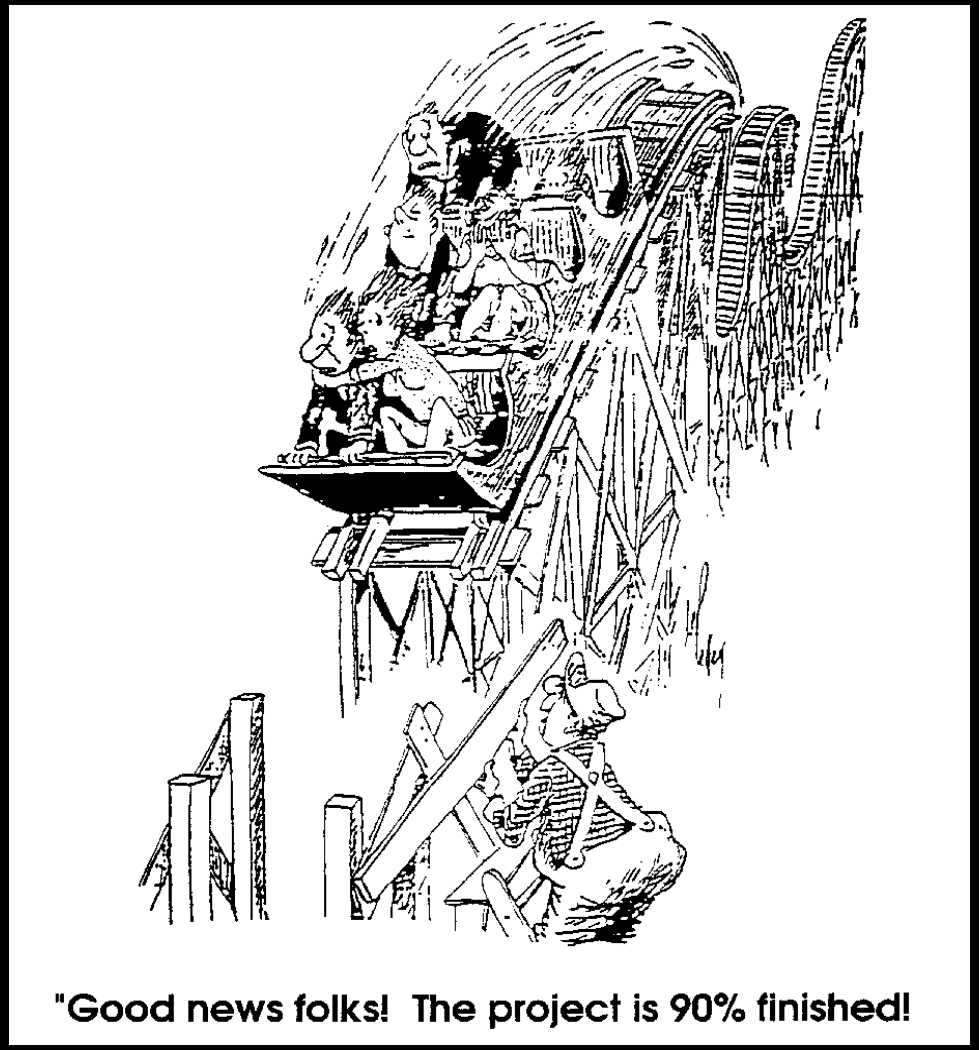
If you are not careful, your e-mails will either be deleted or ignored

- Make the subject line mean something
- Clearly state in the first 1-2 sentences what you need from the person and the connection to them
- Provide background information after the request is made and clearly separated
- Limit an e-mail to a single topic or request

Effective Progress Tracking



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Performance Reporting

Inputs	Tools & Techniques	Outputs
▪ Work performance information ▪ Performance measurements ▪ Forecasted completion ▪ Quality control measurements ▪ Project baseline measurement ▪ Approved change requests ▪ Deliverables	▪ Information presentation tools ▪ Performance information and gathering ▪ Status review meetings ▪ Time reporting systems ▪ Cost reporting systems	▪ Performance reports ▪ Forecasts ▪ Requested changes ▪ Recommended corrective actions ▪ Lessons learned

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Why Performance & Status Reporting?

- DOE and Lab management have been *burned* too many times to assume that everything is going well
  - Performance reporting is often an attempt to get projects to properly manage themselves
  - It is important to understand and communicate succinctly
    - Where the project is with respect to Cost, Schedule, and Scope
    - What are the emerging or changing risks / issues

- Worst reason: *"Because we have to."*
- Somewhat better: *"To keep <u>them</u> off our backs."*
- Better still: *"To show <u>them</u> how we've done."*
- Much Better: *"To engage upper management and the program sponsors in addressing project issues and threats as is appropriate."*

Rule #100: Never make excuses; instead, present plans of actions to be taken.
– Jerry Madden, *100 Rules for NASA Project Managers*

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Effective Monitoring & Status Reporting

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“Management by exception”
is an issue-centric style of monitoring

- Early bad news is far more preferable than delayed bad news
- Make exception reports part of ongoing status reporting
- Upper management must ensure that information is passed up the chain of command without fear of reprisals

Project Reports and Status

- Forward looking emphasis with performance history
  - Issues Log
  - Action Items
  - Risk Registry
  - Technical Performance Measures
  - Pending Milestones / Deliverables
  - Variance analysis and corrective actions
  - Significant Events
  - Schedule
  - Budget / Contingency forecasts and calls

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Communication Summary

- Effective project communication does not just happen – it is planned.
- It is important to understand the needs of all stakeholders in considering what and how to communicate needed information.
- Technology is wonderful, but can actually detract from effective communication if not carefully handled.
- Effective performance reporting is a tool for use in addressing project issues and risks.

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Exercise: Status Report

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- Develop what a status report to your management and sponsor should contain for your site visit project