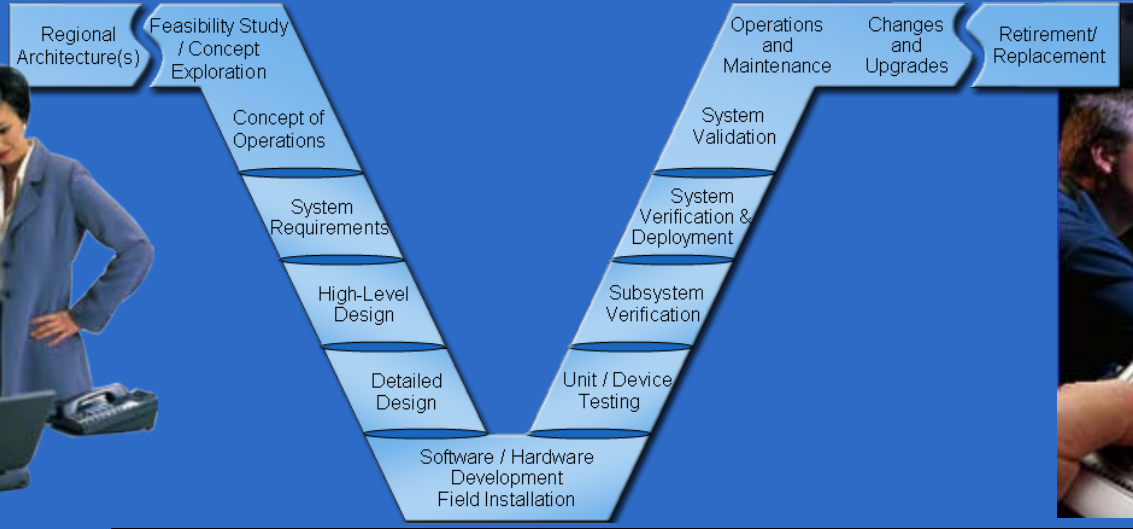


Session 4: Cross-Cutting Activities

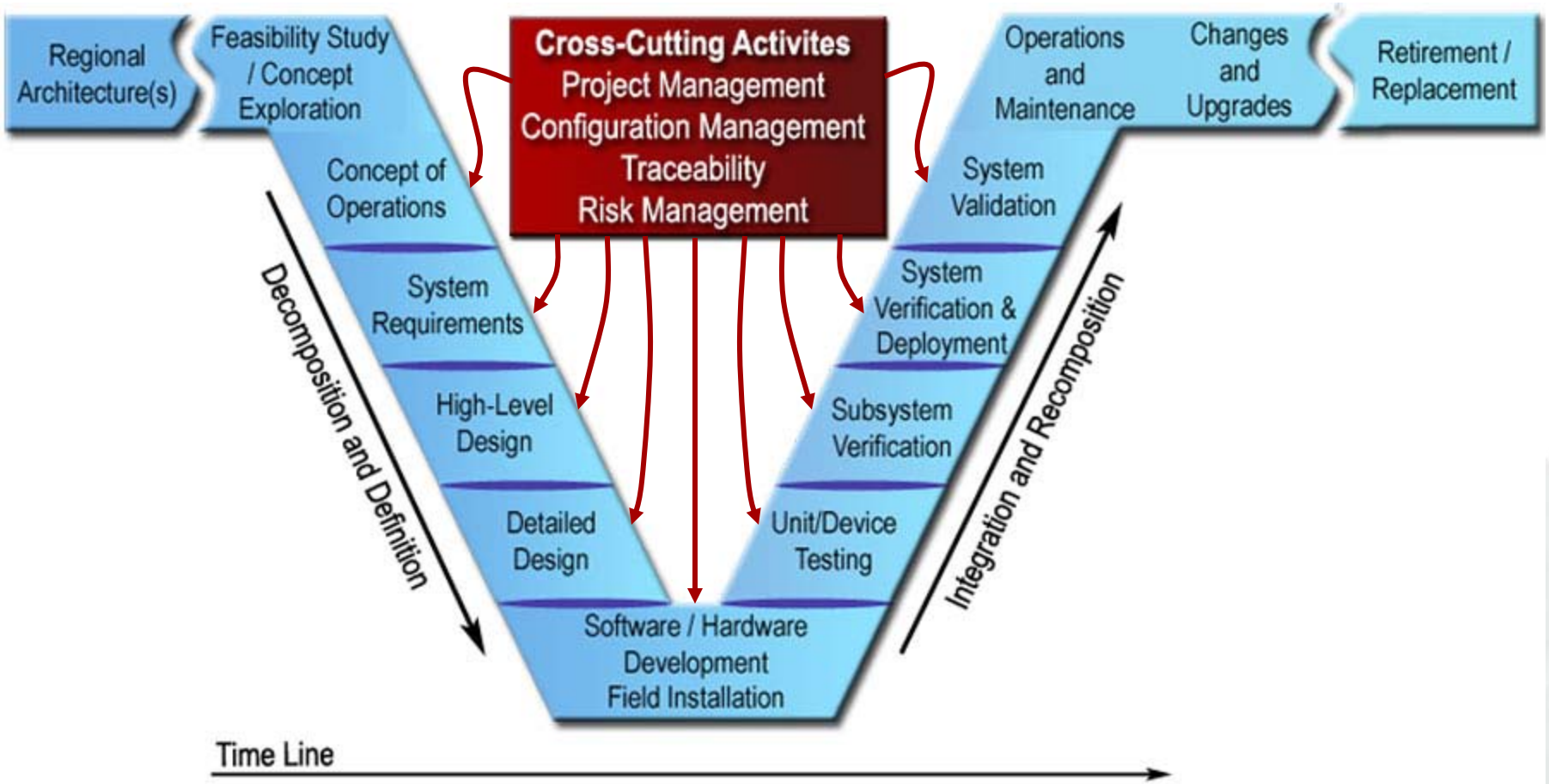
These materials developed under the RITA National ITS Architecture Program

U.S. Department of Transportation
Research and Innovative Technology Administration

Learning Outcomes

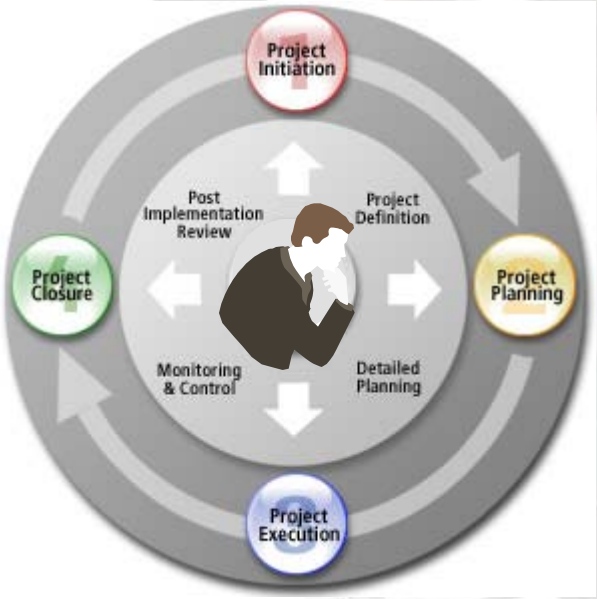
- List key project management activities
- State role of configuration management
- Explain why change control is important
- List elements of risk management

Crosscutting Activities and The "V"



Project Management

1) Project Management
   a) Project Planning
   b) Project Monitoring and Control
2) Configuration Management
3) Traceability
4) Risk Management



Project Planning

- Project Plan defines
  - Scope of Work
    - Tasks
    - Deliverables
  - Resources and budget
  - Schedule
- Systems Engineering Management Plan
  - How SE will be applied on your project

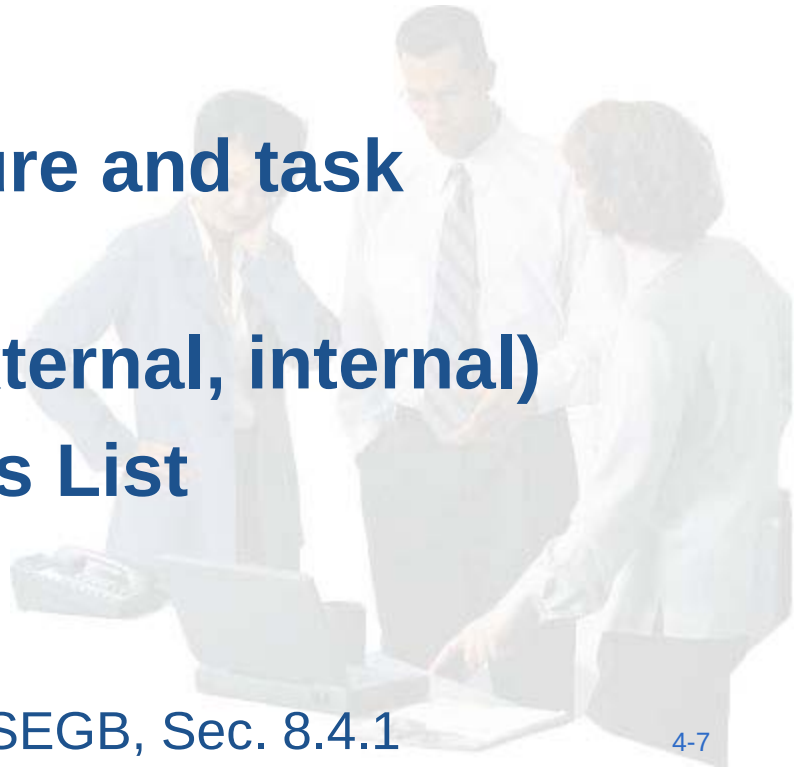
Project Plan for Small, Low-Risk Project Can Be a Simple Table

Task Name	Task Activities	Results / Decisions	Start Date	End Date	Budget	Task Staffing
1. Project Mgmt.	**a. Write PMP** **b. Prog. Rpts**	**a. PMP** **b. Prog. Rpt**	**Jan. 2008**	**Dec. 2008**	**$10,000**	**John is PM; does it all**
2.						
3.						
4.						
5.						
6.						
7.						

Project Plan for Large/Higher-Risk Project Should Be Comprehensive

Example Outline:

1. **Purpose of document**
2. **Scope of project**
3. **Project tasks**
4. **Work Breakdown Structure and task budgets**
5. **Schedule constraints (external, internal)**
6. **Deliverable Requirements List**
7. **Referenced documents**



Template and Checklist in CA SEGB, Sec. 8.4.1

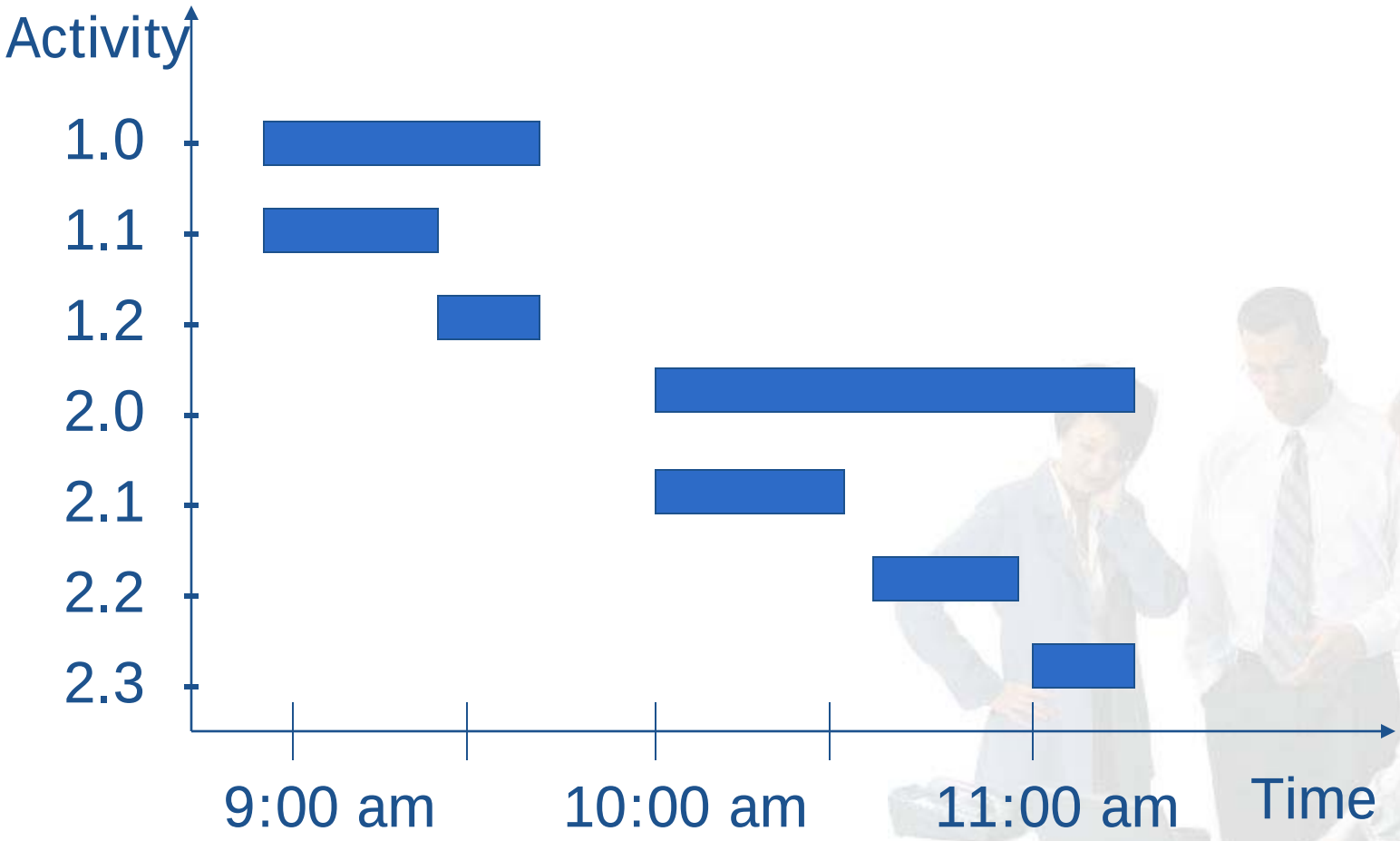
Project Planning - Work Breakdown Structure (WBS)

- Divides project into manageable pieces
- Requires focus on deliverables
  - Output needed for all WBS elements
- Schedule, budget and resources tied to WBS for planning and monitoring
- Well defined work packages

WBS Example – Grocery Shopping

WBS No.	Activity	Output(s)
1.0	Planning	Grocery List
1.1	Check food supply	
1.2	Prepare grocery list	
2.0	Purchase groceries	Groceries
2.1	Purchase fruit	
2.1.1	Select fruit	
2.1.2	Weigh & bag fruits	Fruit in cart
2.2	Purchase meat	Meat in cart
2.3	Check out	Register receipt

WBS is the Basis for Scheduling



Project Monitoring and Control Requires Metrics

- Progress can only be tracked if it can be measured.
- Many types of metrics
  - Miles of roadway paved
  - No. of detectors installed
  - No. of stakeholders contacted
  - No. of buses equipped
- Dollars/hours spent is not a measure of progress!

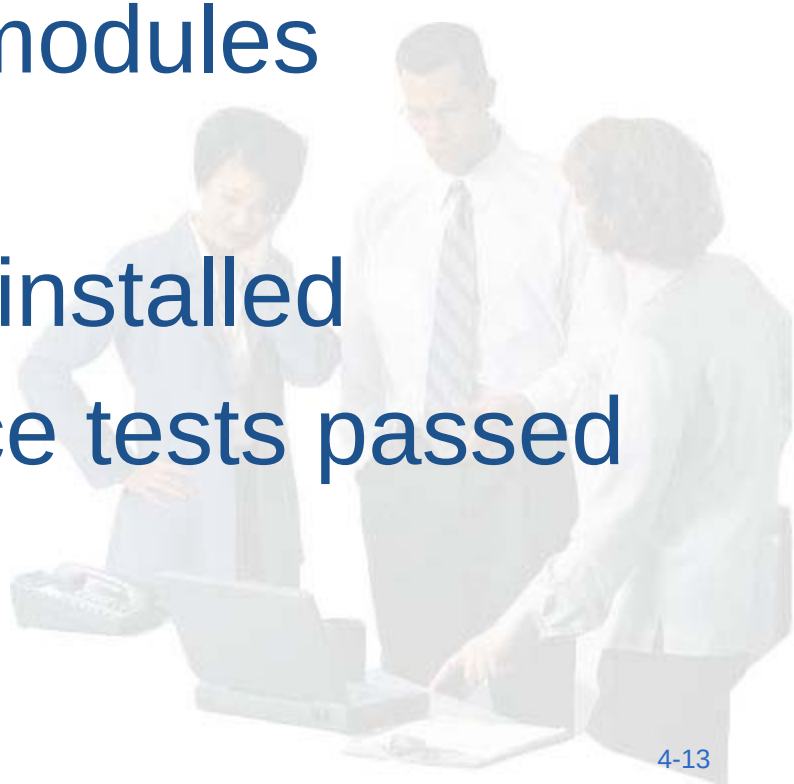
Two Types of Metrics

1. Metrics used to determine whether the system objectives are met. i.e. Changes in incident response times.

2. Metrics used to track design and development progress. i.e. Pages of documentation completed.

Examples of Development Metrics

- Number of requirements defined
- % of data elements entered in DB
- Number of software modules completed
- Number of field sites installed
- Number of acceptance tests passed



Characteristics of Good Metrics

- The metrics should not divert development resources. They should be:
  - Easy to obtain and/or measure
  - Limited in number
- Metrics should be a true representation of progress

Earned Value Analysis (EVA)

- Technique for quantifying project status
  - Are you on schedule and budget
  - How much time and money is needed for completion
- Assumes that you have:
  - Allocated resources to each task
  - Calculated costs for each task
  - Defined a metric for each task

Calculating Earned Value (EV)

EV = (Task Budget) x (Physical % Complete)

- Task defined by WBS
- Budget developed during project planning
- Physical % Complete based on metrics

Earned Value is the Starting Point

How much will it cost to finish this task?

$$\text{Cost at Completion} = \frac{\text{Actual Cost}}{\text{Physical \% Complete}}$$

Is the project on-budget?

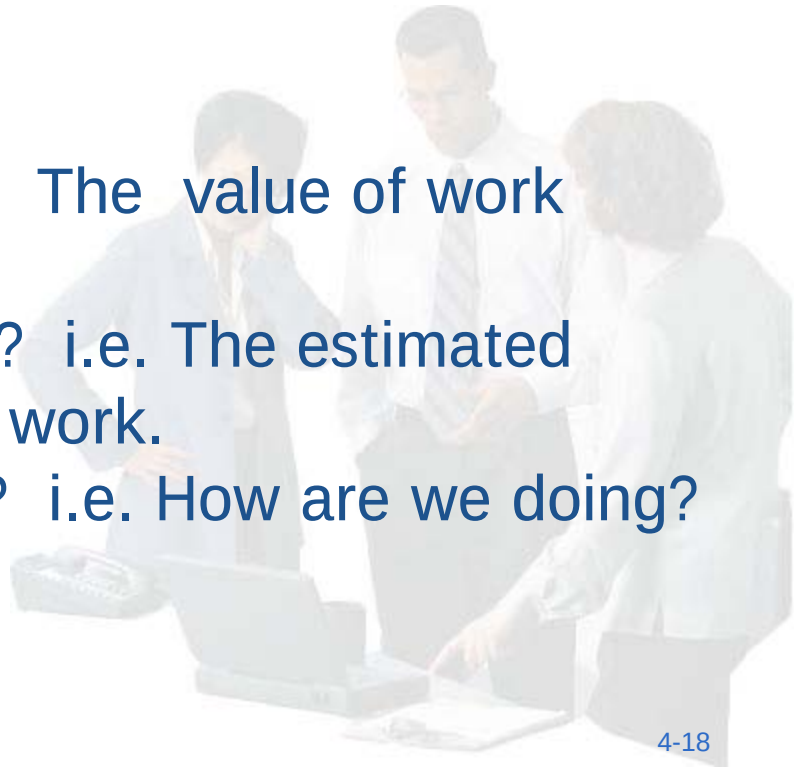
$$\text{Performance Ratio} = \frac{\text{Earned Value}}{\text{Actual Cost}}$$

Solve the following problem

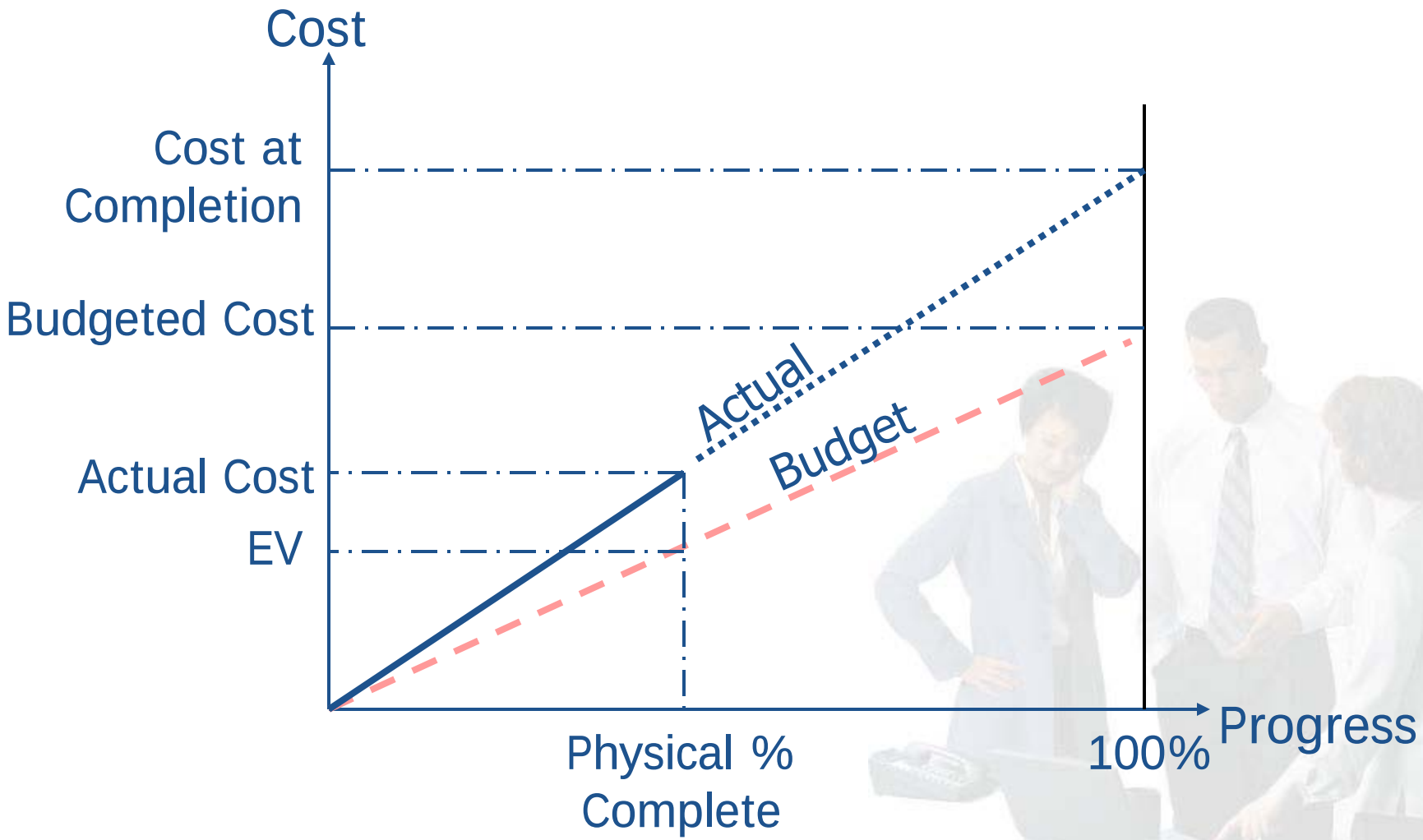
The Facts:
A requirements task has been budgeted to cost $100,000
150 of 500 anticipated requirements have been defined
Expenditures to date are $45,000

The Questions:

1) What is the earned value? i.e. The value of work performed so far.
2) What is the cost at completion? i.e. The estimated amount of money to finish the work.
3) What is the performance ratio? i.e. How are we doing?



Earned Value is an Extrapolation



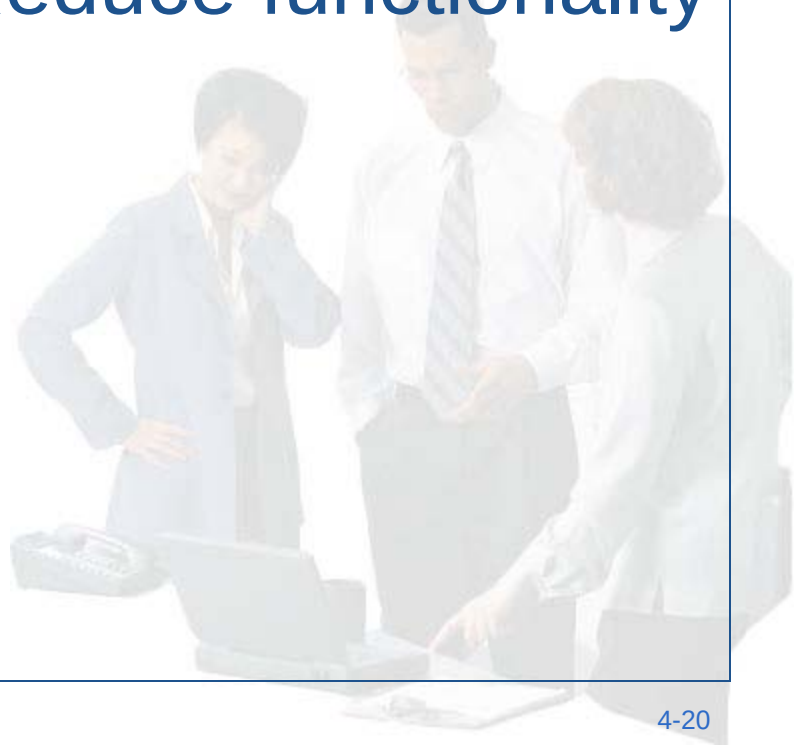
Corrective Action - Schedule

BAD

- Add staff
- Reduce schedule for later tasks
- Work overtime
- Abandon testing

GOOD

- Extend schedule
- Reduce functionality



Corrective Action - Budget

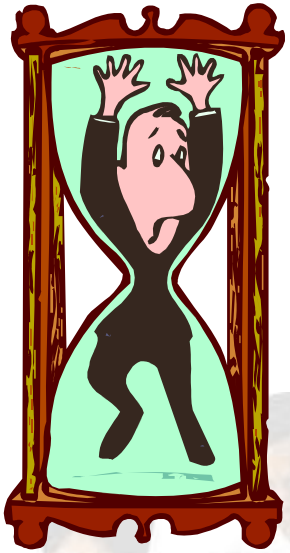
BAD

- Squeeze contractor
- Add lower cost labor
- Abandon project controls/testing

GOOD

- Extend schedule
- Reduce functionality

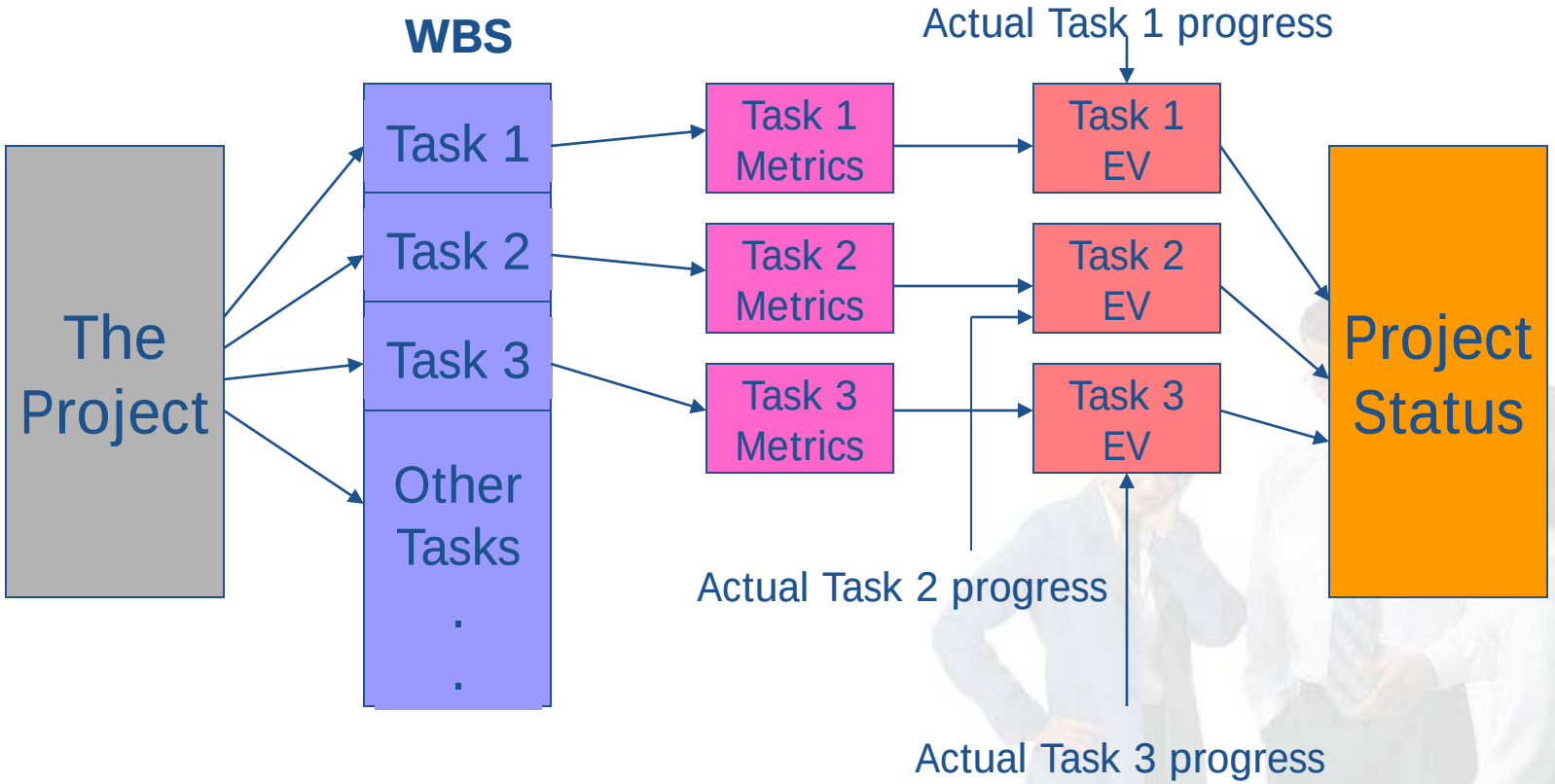
Brooks' Law



"Adding manpower to a late software (based) *project makes it later."*

— Brooks, 1975

Project Monitoring and Control - Tying It All Together



Project Reviews

- Keep all parties informed
- Provide visibility into the “true” progress of the project
- Control decision to proceed with next project phase.
- Validate that the product being produced is the one that is intended
- Recognize problems quickly

DON’T SHOOT THE MESSENGER!!!

Project Reviews

- Technical Reviews
  - Project planning
  - System requirements
  - Design
  - Readiness (system, documentation and test)
- Programmatic Reviews
  - Budget, Schedule, Resources

Configuration Management

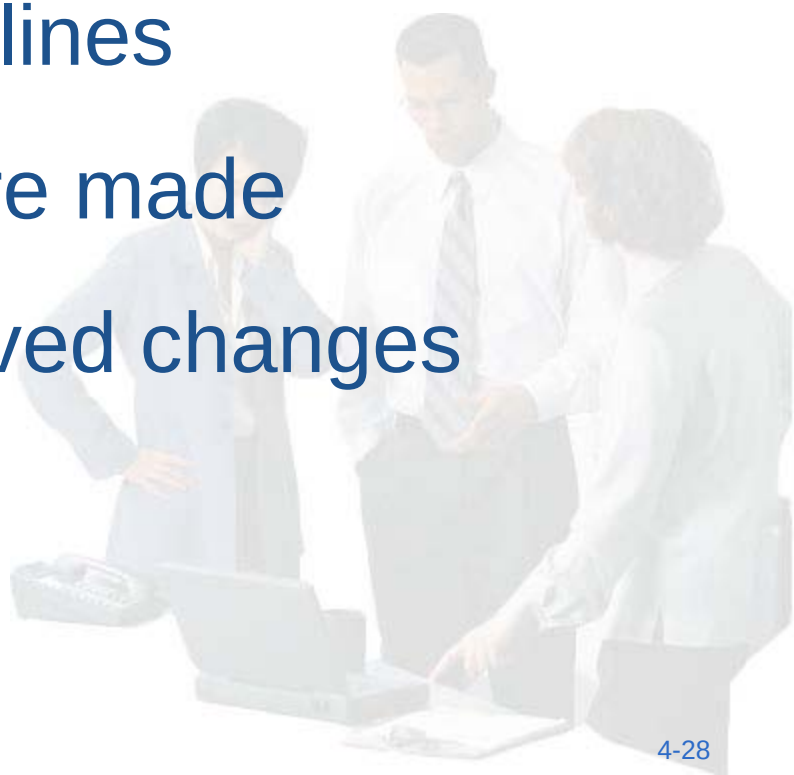
1) Project Management
2) Configuration Management
   a) Why CM?
   b) Configuration Identification
   c) Change Management
3) Traceability
4) Risk Management

Why Configuration Management?

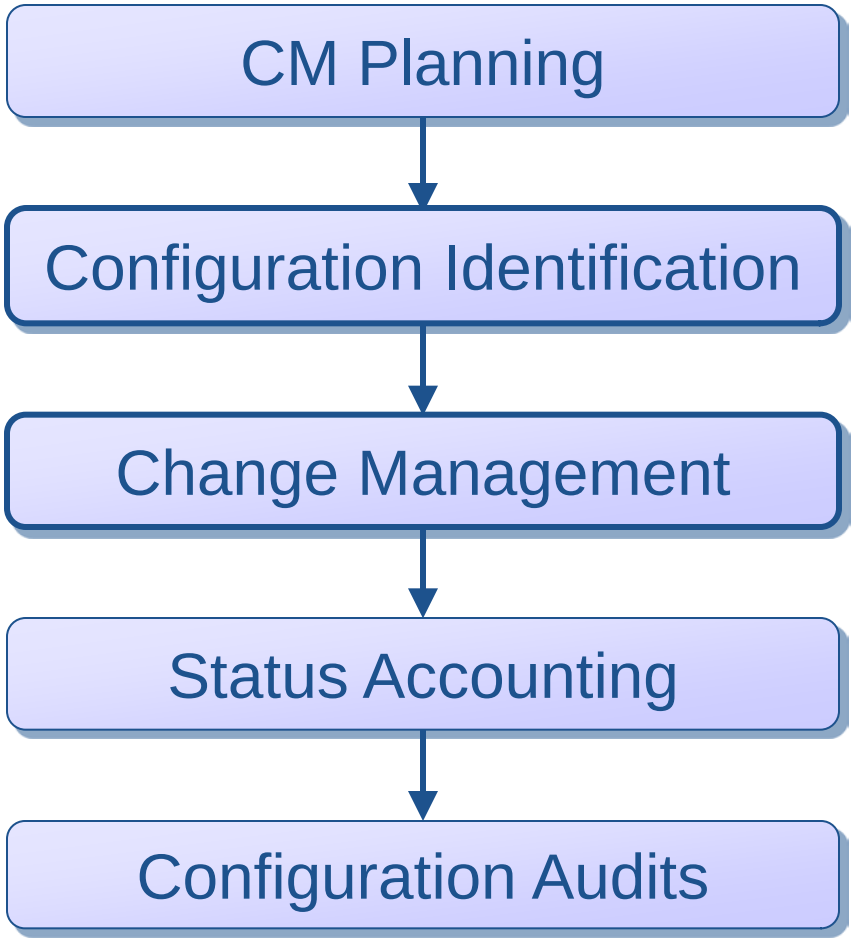
- Change is inevitable
- Even “small” changes, if not controlled, can have major effects
- Essential for an efficient development process
- Essential for maintenance

Configuration Management (CM)

- Controls design as system moves through its life cycle
- Establishes system baselines
- Controls how changes are made
- Communicates all approved changes



Configuration Management Activities



Configuration Identification: Hardware

- Hardware configuration can be tracked at the Part, Subassembly, Assembly, and Unit levels
- Pick the level of control best suited to your project

Traffic Signal Controller Example

- Part
- Subassembly
- Assembly
- Unit

- Processor chip
- Printed circuit board
- Traffic signal controller
- Controller cabinet

Configuration Identification: Software

- Source code for application programs
- Executable application code
- Test cases
- Third-party software
- Development environment
- Documentation

Change Management is Important

Reference: McConnell, "Rapid Development: Taming Wild Software Projects", 1996

Causes of Change Requests

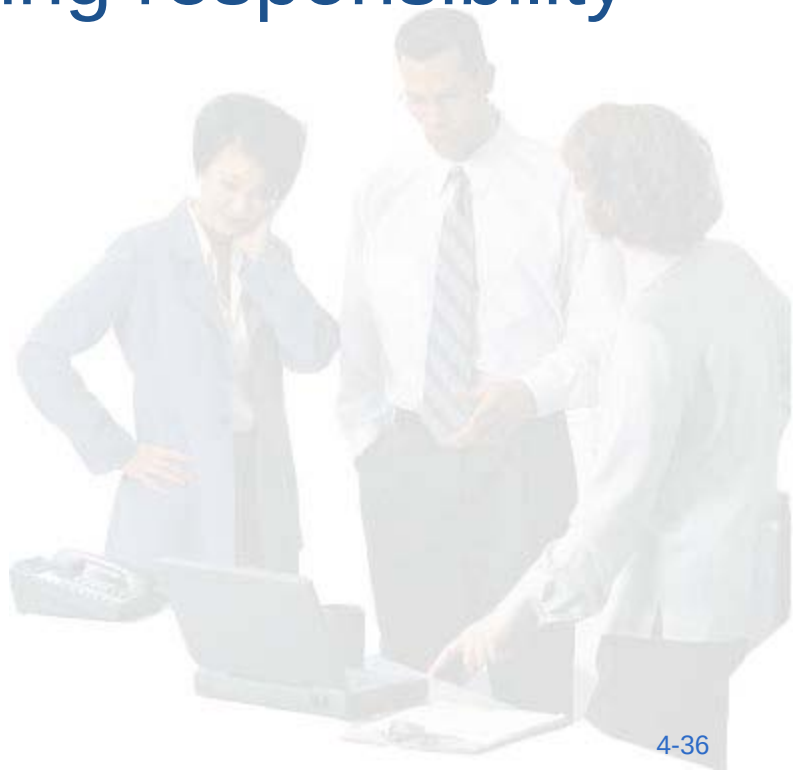
- Errors in system specifications
- External factors (e.g., legislation)
- Advances in technology
- Upgrades
- Additional capabilities requested by users
  - Justified
  - Unjustified
- “Improved” solutions proposed by technical team

Configuration Control Board (CCB)

- Reviews all proposed changes for impact on budget and schedule
- Prioritizes changes – identifies changes that can be postponed to future
- Limits “Scope Creep”

CCB Members

- Agency's and contractor's project managers
- At least one key user representative
- Senior manager with funding responsibility
- Configuration manager
- Quality control manager
- Systems engineer

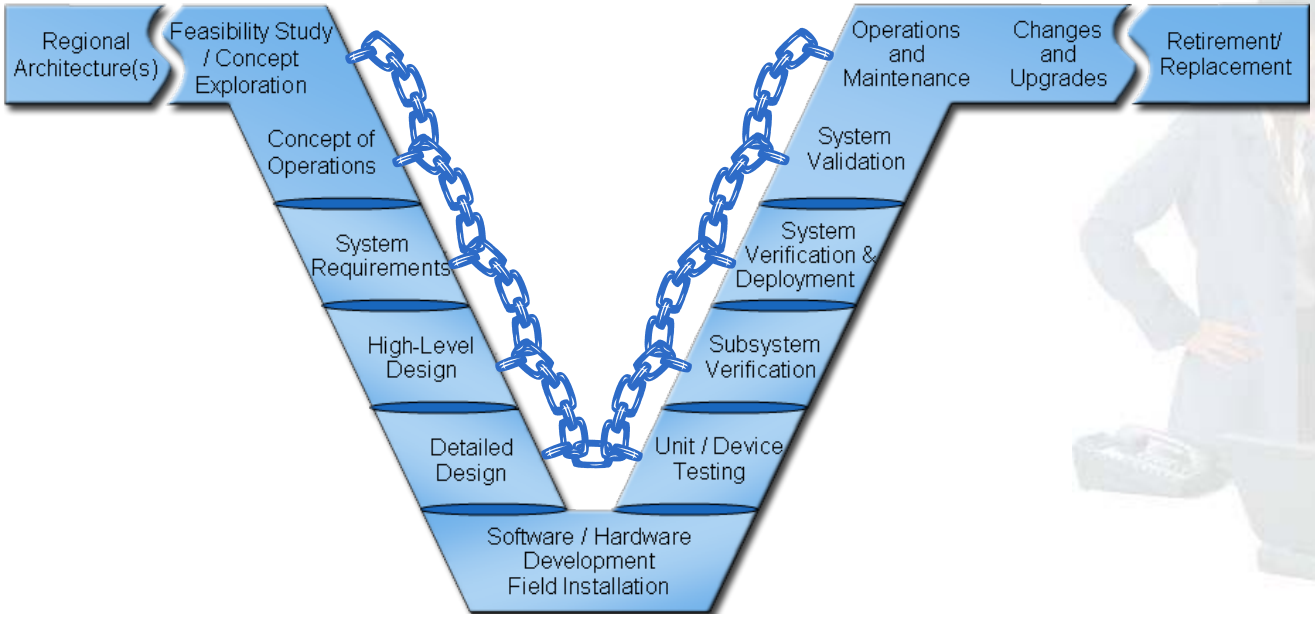


Change Control Process

1. Submit change request
2. Assess impact and prepare recommendation
3. Submit report to CCB
4. CCB deliberates and decides
5. Document approved changes
6. Update traceability matrices

Traceability

1) Project Management
2) Configuration Management
3) Traceability
4) Risk Management



Create Unique Project References…

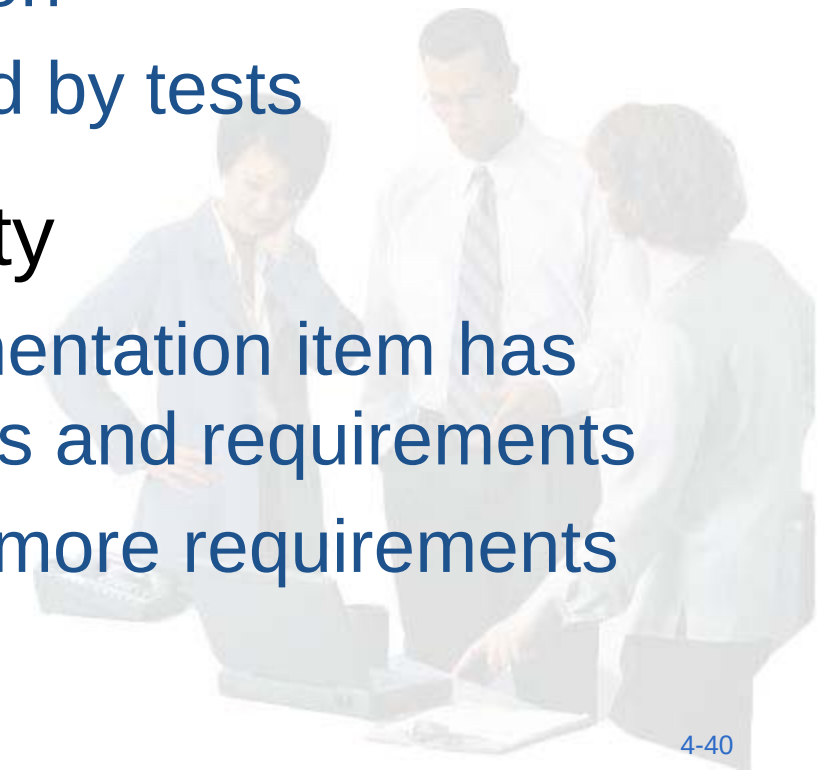
- It is important to have unique project references to:
  - User Needs and Scenarios
  - Requirements
  - Design elements
  - Software and Hardware items
  - Test Plans and Procedures

Unique references

1.1	The system shall generate …
1.2	The system shall provide …
2.1	The system shall collect…
2.2	The system shall store…

…in Order to Have Traceability

- Both forward traceability
  - Needs and requirements are satisfied by the design and implementation
  - Requirements are verified by tests
- And backward traceability
  - Every design and implementation item has corresponding user needs and requirements
  - Each test verifies one or more requirements



Traceability Example

Requirements:

2.0 The system shall have the ability to monitor traffic

2.1 The system shall measure traffic volumes

Specification:

3.83 System processing of volume data shall be performed by summing the actuations of each detector …

Implementation (software modules):

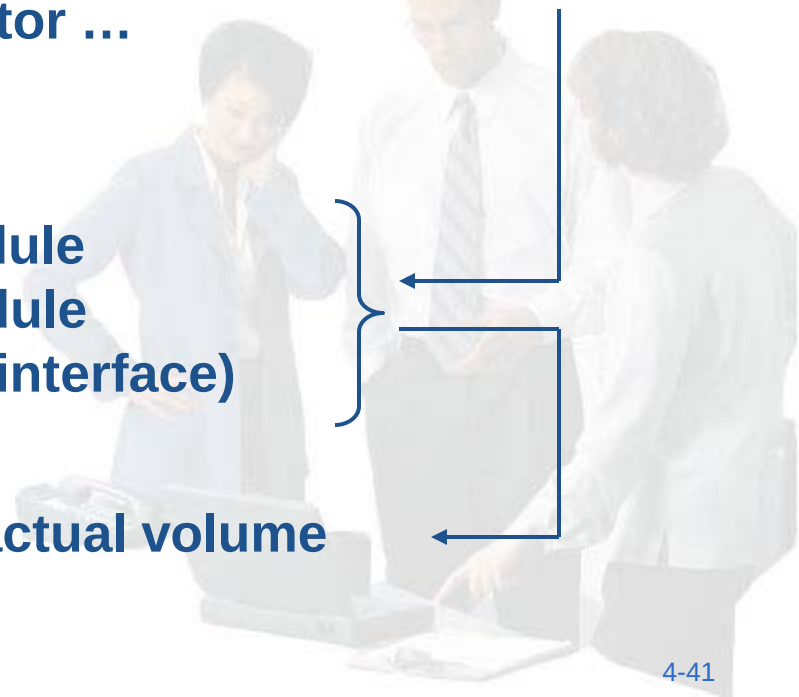
17.6.1 Detector data input module

18.3.4 Volume summation module

2.4.5 Volume storage (DBMS interface)

Test:

8.0 Compare calculated volume with actual volume



Traceability Matrix Illustration

Requirements	Specifications	Implementations	Verification (Acceptance Tests)
1.1	1.1, 2.6	2.0, 3.4, 5.1.1	1.0
1.2	1.2	6.8	4.0
2.1	3.83	17.6.1, 18.3.4, 2.4.5	8.0
2.2	4.9	12.2, 17.10	2.0
2.3	3.5	6.6	9.0

Risk Management

1) Project Management
2) Configuration Management
3) Traceability
4) Risk Management
   a) Sources of Risk
   b) Risk Planning
   c) Risk Control

Sources of Risks

- Technology
- People
- Physical environment
- Political environment
- Contract issues

Increased risk = Increased costs and delays

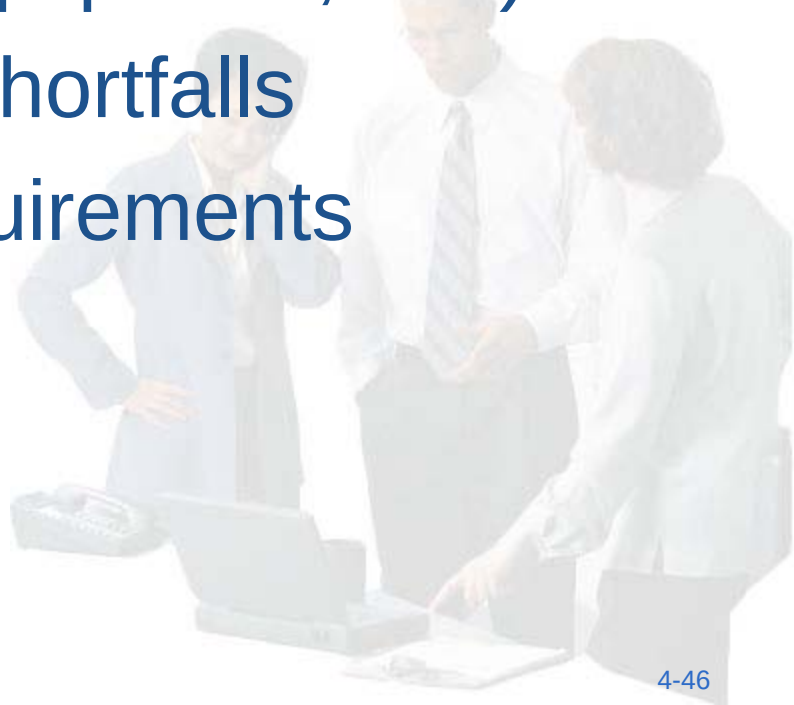
Top 10 Generic Risks

1. Personnel shortfalls
2. Unrealistic schedules and budgets
3. Functions not right
4. User interface not right
5. “Gold-plating”

Source: Kemerer

Top 10 Generic Risks, continued

6. Requirements changes (scope creep)
7. Component shortcomings
8. External dependencies (subcontractors, government-furnished equipment, etc.)
9. Real-time performance shortfalls
10. Unrealistic technical requirements



Source: Kemerer

Elements of Risk Management

- Risk Management
  - Risk Planning
    - Risk Identification
    - Risk Analysis
    - Risk Prioritization
  - Risk Control
    - Risk Monitoring
    - Risk Resolution

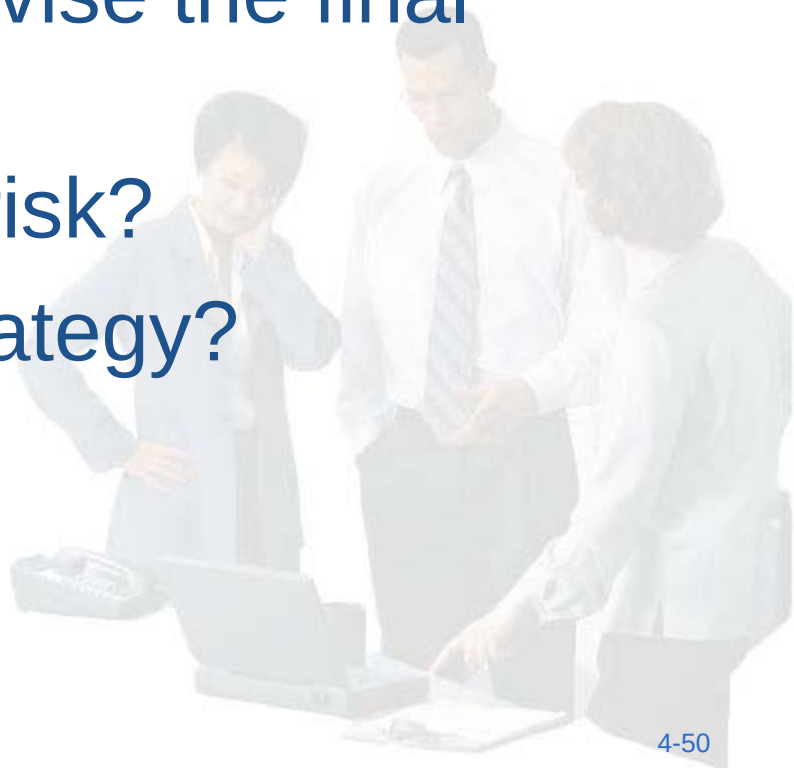
Sample Qualitative Risk Planning Process

Sample Risk Control Strategy

- Periodically check the Top 10 risks
  - Include health/status as agenda item on project progress meetings
- Take risk resolution actions if needed

Let's Practice – A Real Life Example

- Risk: Contractors worry that agencies will not review documentation. When final system does not meet expectations, contractor is required to revise the final product – at great cost!
- How would you avoid the risk?
- What is your mitigation strategy?



Risk Example – Some Answers

- Include submissions and review times in schedule
- Discuss impacts and schedule of review slippages at monthly review meetings.
- Agree that contractor will NEVER proceed on their own with work dependent on review
- Compensate contractor for missed reviews

Learning Outcomes

- List key project management activities
- State role of configuration management
- Explain why change control is important
- List elements of risk management