



U.S. Army Research, Development and  
Engineering Command

2016 NDIA Armament Systems Forum TUTORIAL

# Lessons Learned from ARDEC Science and Technology (S&T) Project Management



***TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.***

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- Top Ten Lessons Learned
- Suggested Improvements
- Find Success as an S&T Project Manager

**There Needs  
to Be a Tie  
Between the  
Deliverables  
Your Project  
Produces and  
the Project  
Objectives**



# Suggestions



- Know What You Are Planning to Do Before You Start Doing It
  - What Are the Goals & Objectives of the Project?
  - What Are the Deliverables?
- Make Sure the Objectives Clearly State What the Project Will Achieve
- Make Sure Your Team and Your Stakeholders Know and Agree on the Objectives and Deliverables
  - “Shared Vision”
- Ask: What Does “Done” Look Like?

# Define Measures of Success



- Project Funds Spent on Time (As Defined by Monthly Goals)
- Project Achieves It's Objective Technical Performance Measures (TPMs)
  - Regardless of Time and Cost?
- Project is Completed on Schedule
  - Based on the Calendar?
  - Based on Transition Needs?
- Deliver a Technology That Meets All Expected Performance Requirements Within Cost and Schedule Constraints?
- What's the Measure of Success on Your Project?

# Lack of Shared Vision Effects



- Requirements Creep >>>> Scope Creep
- Scope Creep >>>> Longer Schedule
- Longer Schedule >>>> Higher Costs
- Longer Schedule >>>> Resource Instability
- Longer Schedule >>>> Arbitrary Calendar Deadlines
- Longer Schedule >>>> Missed Transition Opportunity



# A “Requirements Document” Rarely Exists Before an S&T Project Begins

ADDM 5000.02 TEMPLATE  
Systems Requirements Document

**SYSTEM REQUIREMENTS DOCUMENT**

**SYSTEM NAME and NOMENCLATURE (IF AVAILABLE)**

**Day Month Year (Ex: 01 January 2010)**  
**Status (Draft or Final)**

*Prepared for:*  
**Office or Customer**  
**Military Base, State**

*Prepared by:*  
**Company or Individual Name**  
**Street Address**  
**Mail Stop**  
**City, State (2 ltr abbreviation), Zip Code**

*Under: (Where applicable)*  
**Contract XXX (Where applicable)**  
**CDRL Item XXX (Where applicable)**

Authenticated by: \_\_\_\_\_//SIGNED//\_\_\_\_\_      Approved by: \_\_\_\_\_//SIGNED//\_\_\_\_\_

**First Name MI. Last Name**      **First Name MI. Last Name**  
**Chief or Lead Engineer**      **Program Manager**  
**Day Month Year**      **Day Month Year**

*(Ex: 01 January 2010)*      *(Ex: 01 January 2010)*

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ADDM: System Requirements Document (SRD), Version 1.2  
Based on MIL-HDBK-520 dated 19 Dec 2011

- Identify the “Stakeholders” (Source of Requirements)
  - Who Holds a Stake in the Project’s Success?
  - What Do They Want the Project to Achieve (Demonstrate)?
  - What Do They Want the Prototype and Process to Deliver?
- Leverage the Project Team’s Knowledge and Experience
  - How Do We Plan to Advance the Technological Capability Being Developed?
- Collect the “Voice of the Customer”
  - What Does It Need To Do?

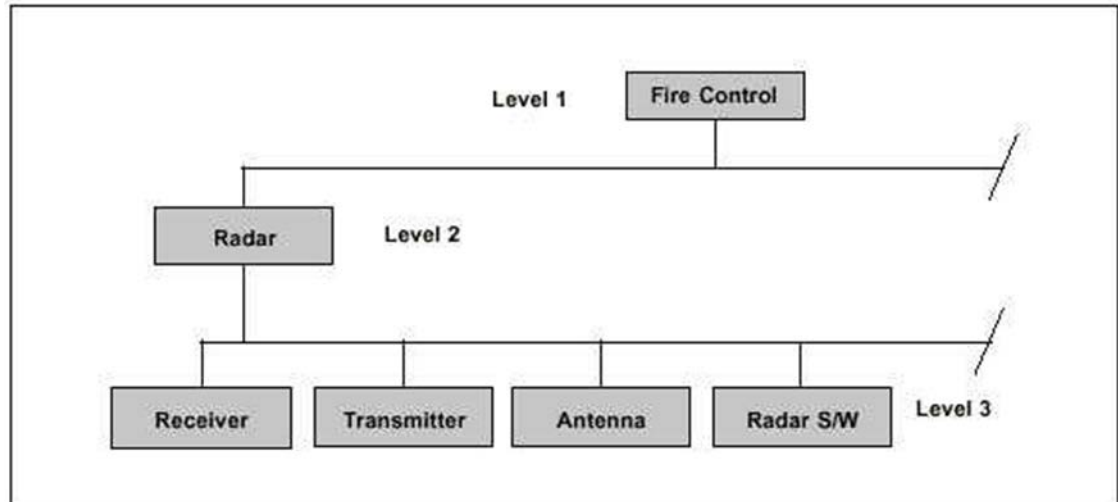
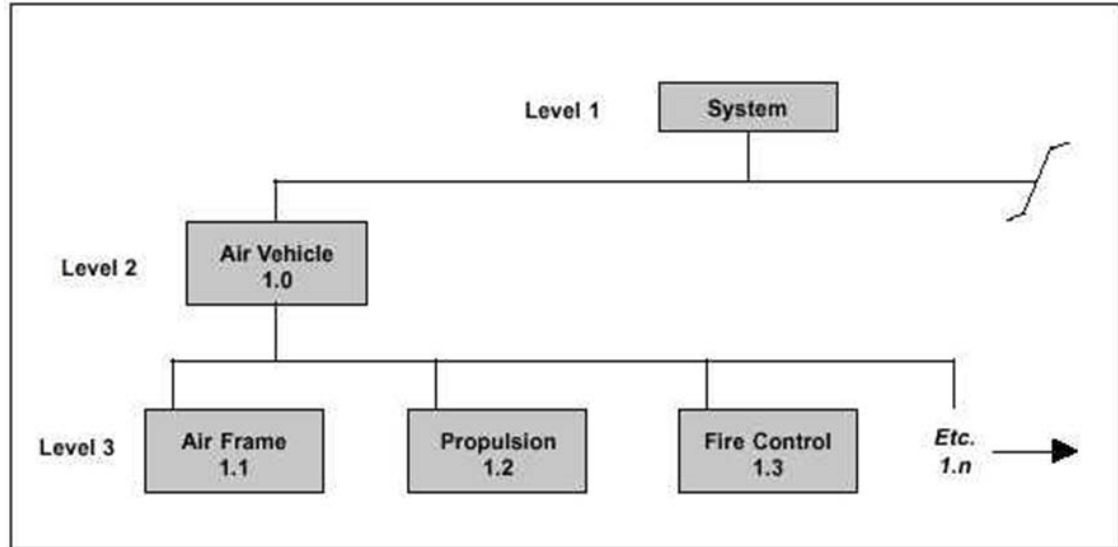


Vague or Evolving Requirements Lead to Scope Creep and Impacts to Budget and Schedule





## Few Engineers Know How to Create a Proper WBS



## Work Breakdown Structure

A Product-Oriented, Hierarchical Division of the Hardware, Software, Services, and Other Work Tasks That Organizes, Displays, and Defines the Products to be Developed and/or Produced and Relates the Elements of the Work to be Accomplished to Each Other and the End Product(s)

# Visualize The Project



- The WBS is the Project SCOPE
  - “100% Rule”: 100% of the Work Needed to Accomplish the Project Objective Must Be Included in the WBS
- Combines Products/Deliverables and Processes (e.g.,)

Product/Deliverable	Process
System	Project Management
Subsystem	System Engineering
Hardware	Integration
Component	Test & Evaluation
Report/Data	Training

- Decomposition of the Work Into Levels of Manageable Units
  - Lowest Level of WBS = Work Package Level (“80 Hour Rule”)
    - Where the **Cost & Duration** Can Be Estimated **Reliably**

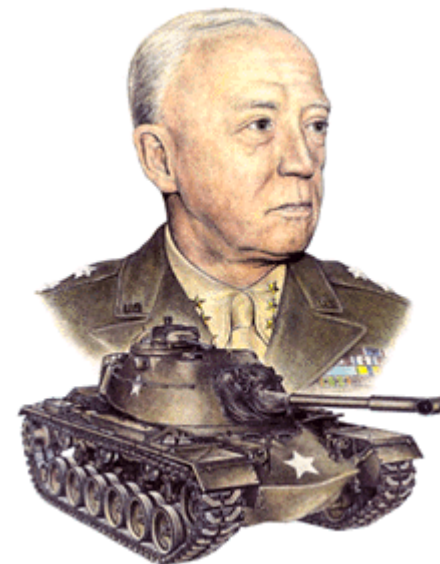
## Examples of What Not to Use as WBS Elements:

- Organizational Structure
- Project Phases
- Functional Efforts (e.g., “\_\_\_\_\_ Engineering”)
- Generic Terms
- Chronological List of Tasks

## Plans are nothing-Planning is everything

“In preparing for battle I have always found that *plans* are useless, but *planning* is indispensable.”

– Dwight D. Eisenhower



“If you don't know where you are going, you'll end up someplace else.”

– Yogi Berra



- Planning Should Encompass All of These Knowledge Areas:
  - Scope Management
  - Time Management
  - Cost Management
  - Risk Management
  - Quality Management
  - Communication Management
  - Procurement Management
  - Stakeholder Management
  - Integration Management
  - Human Resource Management

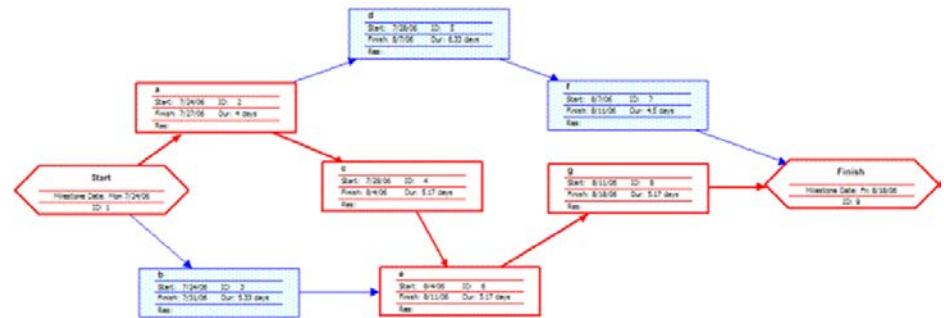


“Time  
Invested Up  
Front Will  
Save Time  
Later in  
Execution”



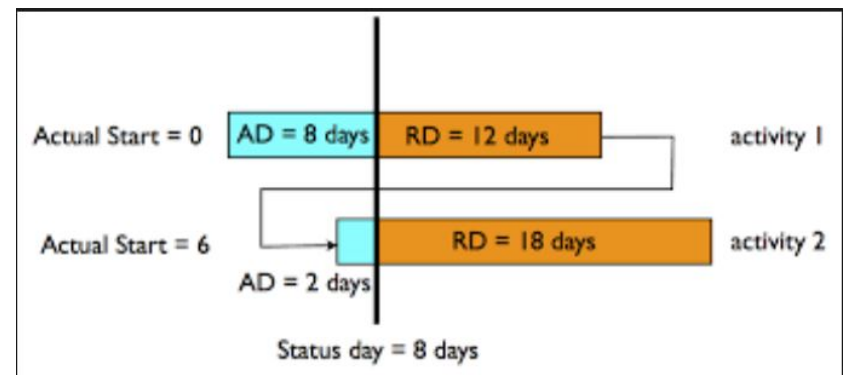
## The Project Manager Needs to Maintain the Project Schedule

- The PM Should Not Delegate Management of the Critical Path (a Prime PM Responsibility) to Somebody Else



## Managing the Schedule is a Bigger Job Than You Think

- “Progress” Needs to Be Updated More Frequently Than Just Before a Review



# Scheduling Tips



- A Schedule Is Not Just an Image of a Gantt (Bar) Chart
  - It Identifies and Documents the Logical Relationships (Dependencies) Among the Project Tasks
- MS Project is One of the Project Manager's Modeling & Simulation Tools
  - Algorithms Calculate Results Based on User Inputs
  - Facilitates "What If" Scenarios
- "Dates" Are Not Inputs to Schedules
- Schedules Should Be Built Up By the Consensus of the Project Team, Not Passed Down to Them By the Project Manager



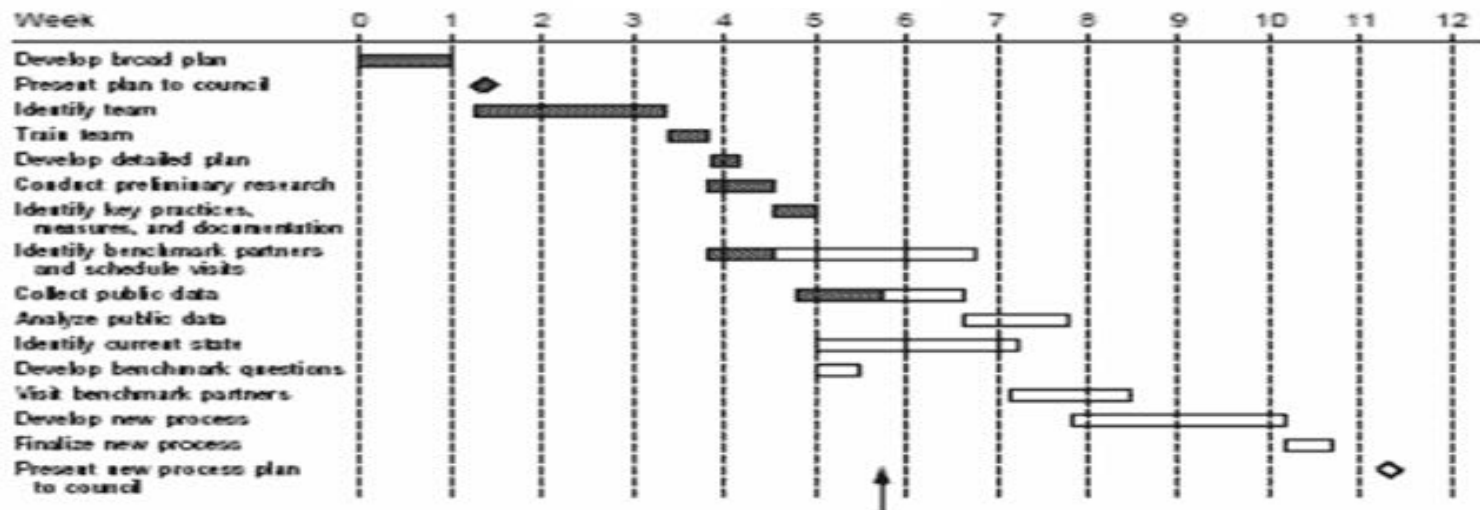


# Remember...

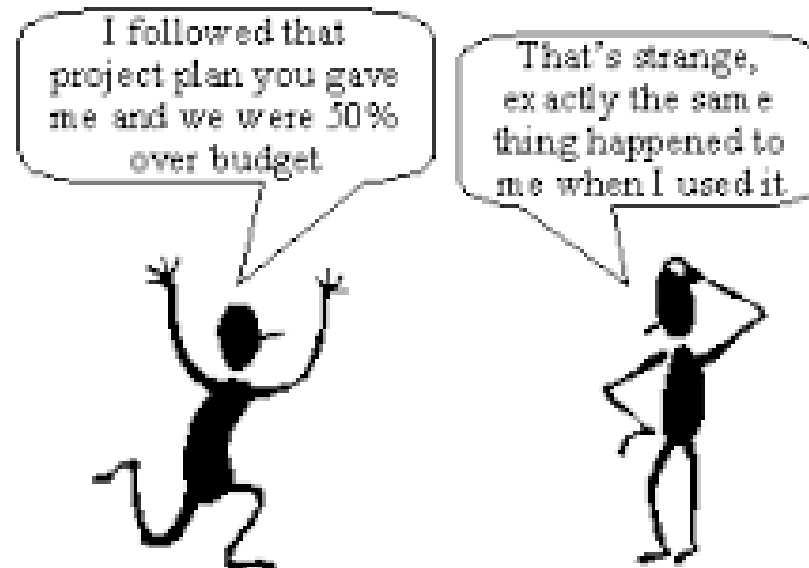


How Much You Completed Is Important, But Not As Important As How Much You Have Left To Do

➤ That's What Drives Your Final Project Completion Date and Total Cost



# Engineers May Be Good at Solving Problems, But They Are Not As Good at Estimating How Long It Will Take or How Much It Will Cost



# Recognize Pitfalls



- People are Generally Optimistic and Often Underestimate How Long Tasks Will Take
- Assuming That Resources Will Be Productive for 100% of Their Time
- Resources Working on Multiple Projects Take Longer to Complete Tasks Because of Time Lost Switching Between Them
- Estimating Involves Risk--Visibility Improves the Closer You Get to the Task; Example:
  - Resource Availability: Who's Available at That Point in Time?

# Suggestions



- Do Not Estimate What You Do Not Understand
  - Make Use of Other People's Experiences When Creating Your Estimates (Team-based Planning)
  - Get an Expert Viewpoint (for Accuracy and Credibility)
- Break the Work Down
  - Into 3 Categories: Labor, Non-Labor, Outsourced (**GOOD**)
  - Into “Visible” Smaller Pieces (**BETTER**)
  - Estimate Each Task in the WBS to Arrive at a Total, Rather Than Trying to Estimate the Project as a Whole (**BEST**)
- Include Management Time and Cost in Any Estimate
- Always Build in Contingency or Management Reserve for Problem Solving, Meetings and Other Unexpected Events
- Always Document Assumptions

# Use the PERT\* Formula




- Use Three Point Estimates for Time or Cost:

$$\text{(Estimated Value) } V_e = (O + 4M + P) / 6$$

O Is the Optimistic Value

M Is the Most Likely Value

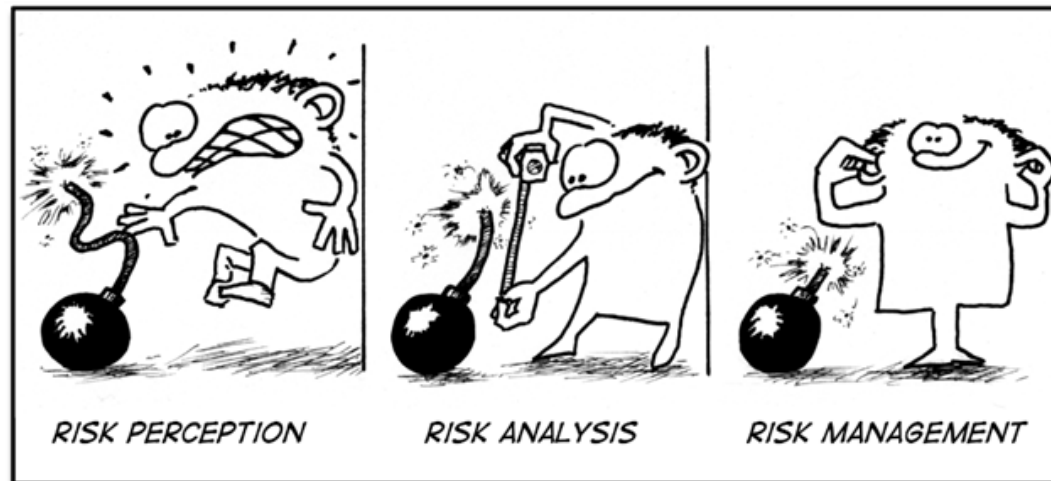
P Is the Pessimistic Value

- For P  Consider the Main Cost/Schedule Risks That Could Impact the Project Task and Allot Budget/Time to Deal With Those Risks.

\*PERT-Project Evaluation and Review Technique



# Risk Identification Is the Most Critical Step in Risk Management, But It Is Usually Poorly Done



Acknowledge the Reality of Risk



- Very Few S&T Projects Practice Robust Risk Management
- The Greatest Risks Are Often Overlooked
- Often a Single Risk Driver (Source of the Risk) Will Impact Many Facets of the Project
- Know the Difference Between a Risk and an Issue:
  - Risk: Uncertainty That Matters
    - Proactive (It Might Occur)
  - Issue: Certainty That Matters
    - Reactive (It Has Occurred)

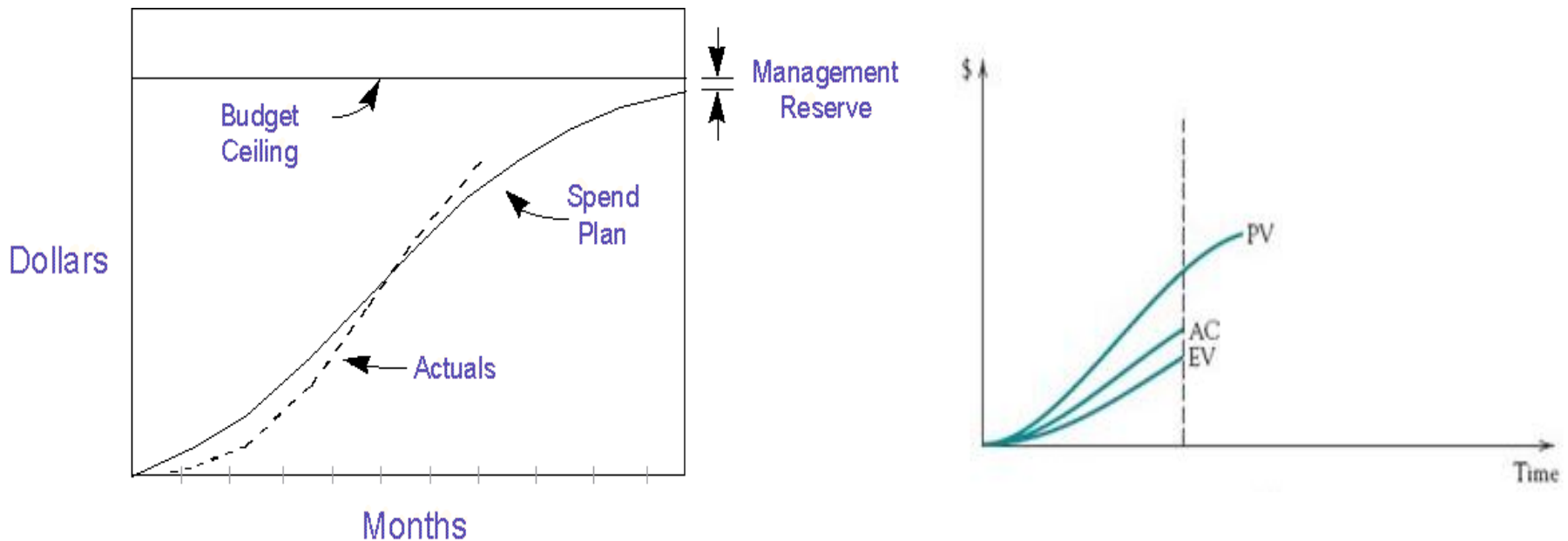


- Follow a Defined Risk Management Process
- Use Regularly Scheduled Team Meetings to Review and Update Risks
  - Share the Work
  - Foster Group Participation
- Identify the Person who Experiences the Risk as the Risk Owner
  - Delegate Risk Responsibility, Authority, and Accountability to Them
- Create and Maintain a Risk Register
- Prioritize Risks
- Keep the Project Stakeholders Informed of the Highest Risks
  - Want to Create “Shared Ownership”
- Don’t Forget about “Positive” Risk (Opportunity)





# Inadequate Focus on Cost Variance – Causes and Corrective Actions



# Common Causes of Variance



- Team Members Are Not Properly Charging the Project
- Some Activities Cost More Than Estimated
  - This Could Be Due To Working Unscheduled Overtime or Applying More Resources or Time Than Estimated
- You May have Underestimated Labor or Non-Labor Costs
- Activities or Project Expenses Were Missed When the Original Estimates Were Created.
- You May Be Working on Activities That Are Outside the Approved Project Scope or Requirements.
  - Stop New Work Until the Added Scope is Approved and Funded

# Suggestions



- Do Not Manage the Project to the Total Budget Available
  - Manage to Your Detailed Spend Plan
  - Identify and Fix the Reasons for any Variance
- Re-Estimate Remaining Work at Each Milestone
  - Develop and Execute a Plan to Get Back on Budget
  - Manage Expectations; But,
  - If You Need More Money—Ask for It! (or De-Scope)
- Financial Management is Not “Somebody Else’s Job”
- Spend Your Money, It’s Easy for Others to Track
  - If You Don’t Spend Your Money, You Risk Losing It



# Improve Your Communications...



**... and  
Make them  
More  
Effective**



- Who Has Attended Presentations Where the Speaker:
  - Provides Too Much Detailed Technical Information in a Program Review of Performance/Cost/Schedule?
  - Rambles On and Is Unfocused?
  - Is Unsure of the Material?
  - Lacks Confidence in Presenting?
  - Appears That They Haven't Done their Homework?
  - Avoids Negative Risks/Issues?
  - Acts Arrogant or Defensive to the Audience?
  - Doesn't Ask the Decision-Maker(s) for Help?

# Oral Presentations

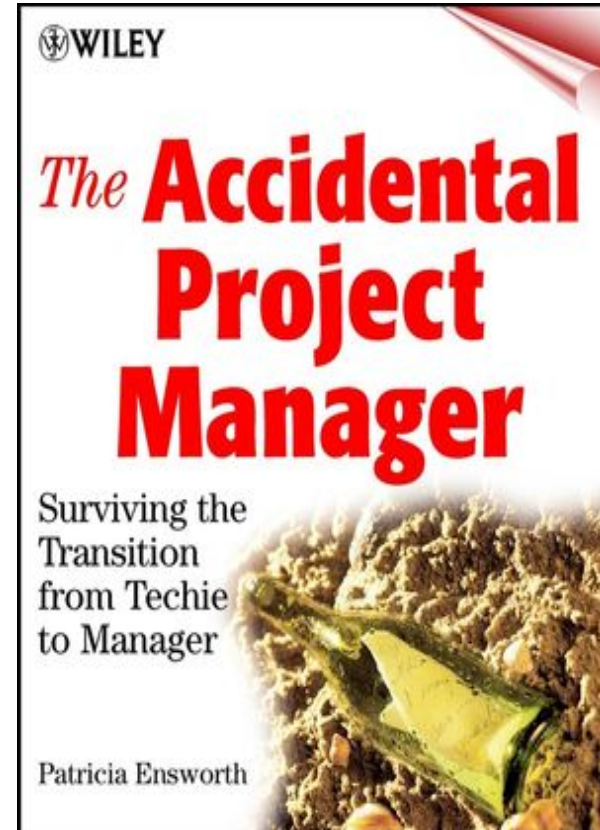


- Know the Stakeholder Needs of the Presentation
  - Stick to the Theme at the Requisite Level
- Know Your Topic (Credibility)
- In 3 Simple Steps:
  - Tell Them What You Are Going to Tell Them (BLUF)
  - Tell Them
  - Tell Them What You Told Them (Summary)
- “Less is More”
- Slides Should Support, Not Replace, You
- Face the Audience, Not the Screen





# Good Engineers Don't Always Make Good Project Managers



# Observations



- Project Management Takes More Time Than You Think
- Project Management Duties Become Lower Priority to Project Engineering Duties in S&T
- Note the Opposing Skills and Points of View:

Engineers	Project Managers
Wait for Decisions to be Made	Make Decisions (Lead)
Independent Thinkers	Depend on Other's Thoughts
See "the Trees"	See "the Forest"
Solve Problems	Avoid Problems
Trust Themselves	Trust Team Members
Crave Recognition	Eager to Reward Others
Performance/Cost/Schedule	Cost/Schedule/Performance





- Lead their Project Team
- Understand the “Big-Picture” As Well As the Details
- Make Fact-Based Decisions Quickly
- Communicate Frequently with Stakeholders and Their Project Team to Manage Expectations
- Pro-Actively Manage Risks
- Document Agreements and Assumptions to Avoid Future Conflict and Rework



# Questions?

