Course Outline

- Participant Introductions
- SCRAM History, Context
- Overview of SCRAM Process
- Overview of the Root Cause Analysis of Schedule Slippage (RCASS) Model
- Overview of the SCRAM Process Reference/Assessment Model
- RCASS Categories and Processes (with exercises)
- Supporting Methods (SRA and Parametric Modelling)
- Wrap Up

Validating the Schedule

- An important part of every SCRAM Evaluation is an assessment of the schedule to ensure it is
  - Properly constructed
  - Aligns with the WBS
  - Can be used for project execution
  - Can be used for Schedule Risk Analysis

- This assessment is done by an experienced Project Controller / Scheduler but other SCRAM team members need to understand the basics of scheduling

- On the following slides, we will explore the process for developing a project schedule.

What is a Schedule?

- The planned completion of a project based on the logical arrangement of activities, milestones and resources

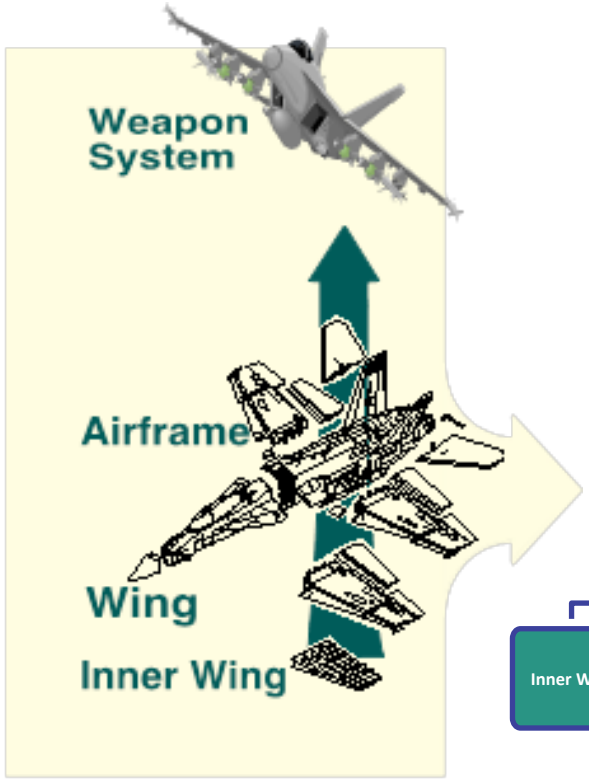
- To construct a valid schedule first you need
  - Work Breakdown Structure (WBS)
  - Organisational Breakdown Structure (OBS)
  - Responsibility Assignment Matrix (RAM)

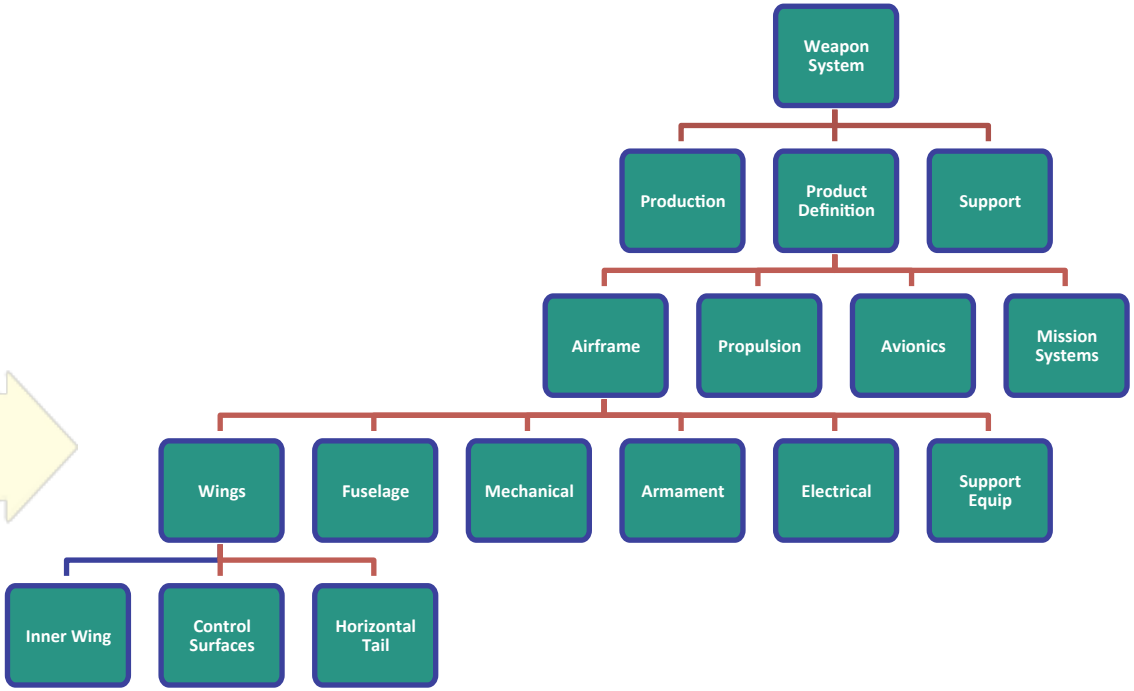
- Then:
  1. Develop and Sequence the list of project activities
  2. Determine the relationships between activities
  3. Estimate the duration for each activity
  4. Determine the project duration (start and completion dates)

Source: US Department of Energy

Work Breakdown Structure (WBS)

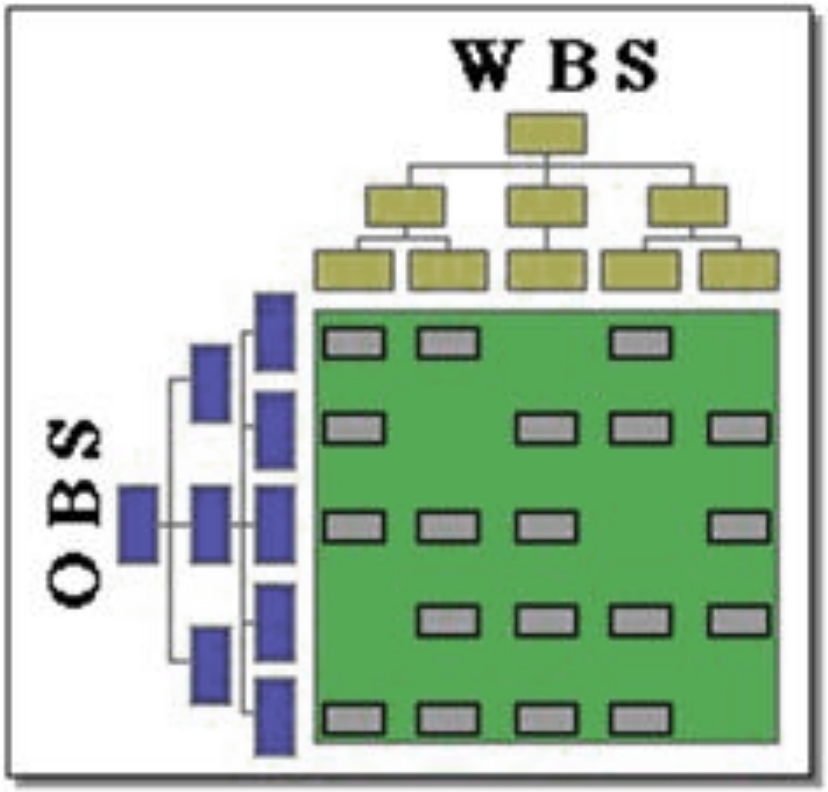
- The WBS structure should mirror the structure of the product being built
  - i.e. a Product Work Breakdown Structure





Organisational Breakdown Structure (OBS) & Responsibility Assignment Matrix (RAM)

- Organisational Breakdown Structure:
  - Shows the organisational relationships and used for assigning work responsibilities
- Responsibility Assignment Matrix:
  - Shows the lowest level of both the WBS and the OBS.
  - The integration identifies responsibility for project tasks.



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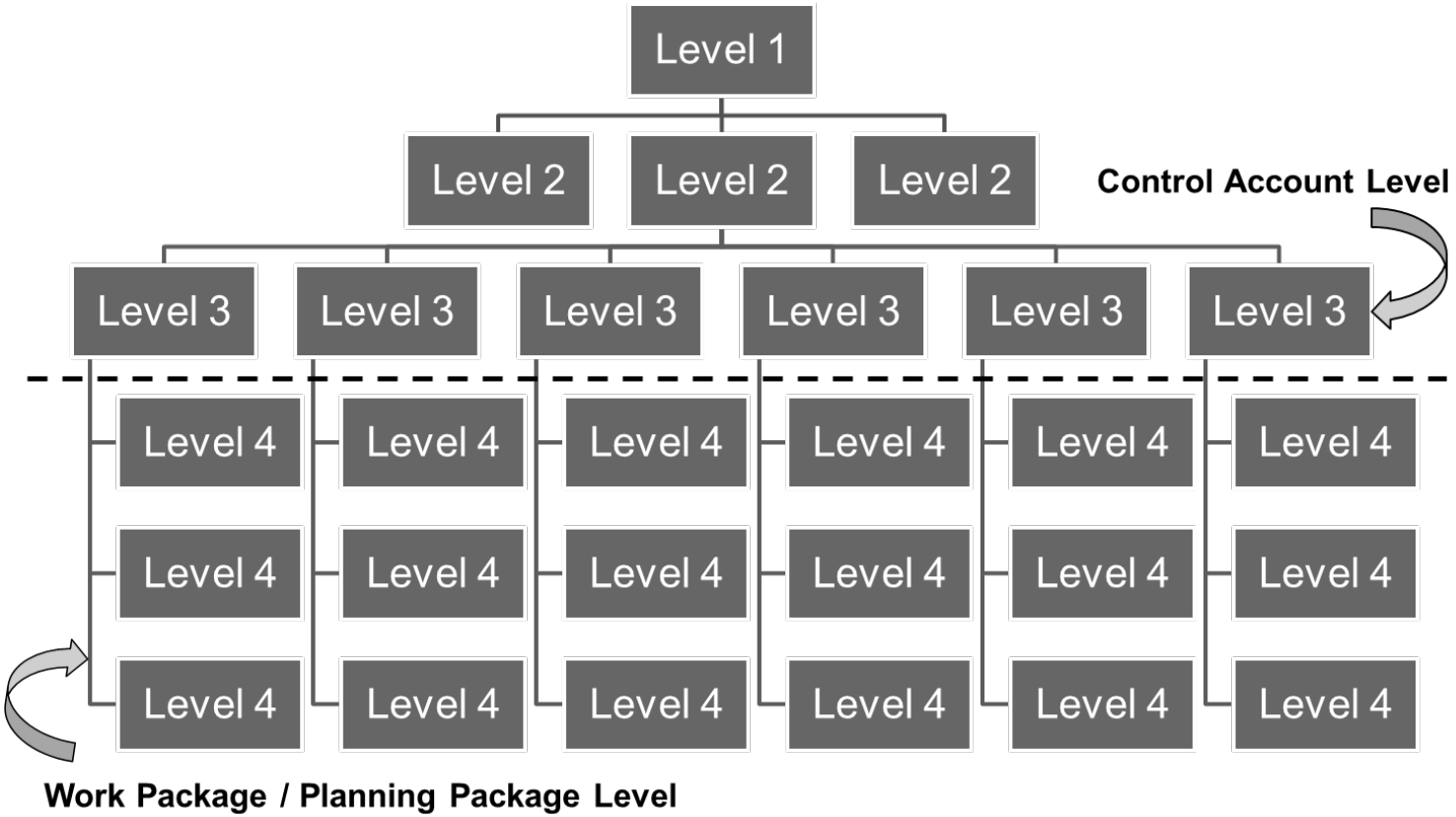
Source: US Department of Energy

Step 1:
Project Activities

- Develop and sequence the list of activities from the Work Package / Planning Package Level



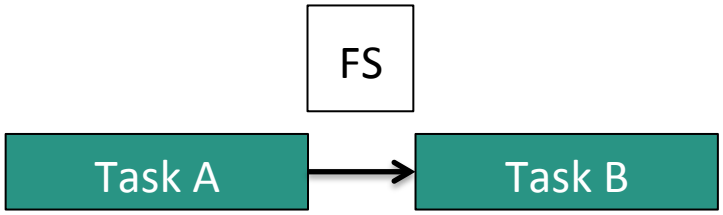
Step 2:
Relationships Between Project Activities

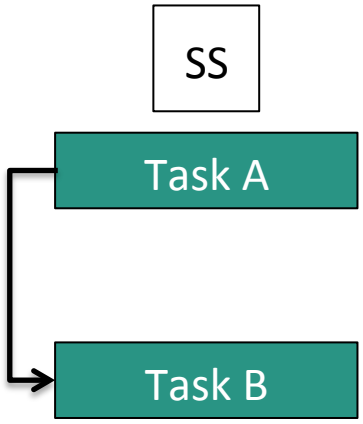
- By identifying the relationships between activities in scheduling, you identify the sequence plus dependencies between tasks.

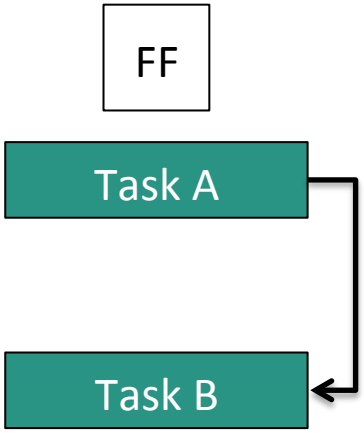
- There are 4 types of scheduling dependencies:
  - FS – Finish to Start
  - SS – Start to Start
  - FF – Finish to Finish
  - SF – Start to Finish (rarely, if ever used)

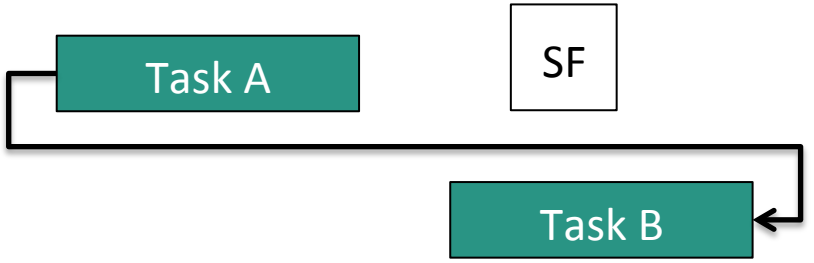
Source: US Department of Energy

Relationship Dependencies









Step 3:
Estimate Activity Duration

- Two duration estimating methods can help determine the activity duration
  - Critical Path Method (CPM)
    - a single point estimate of “Most Likely”
  - Project Evaluation Review Technique (PERT)
    - the average of three point estimates
      - Optimistic (O), Pessimistic (P) and Most Likely (M)
    - Specifically, (P + 4M + O) / 6

	Duration	Optimistic (O)	Pessimistic (P)	Most Likely (M)
CPM	M = 9	6	18	9
PERT	(P+4M+O)/6 = 10			

Source: US Department of Energy

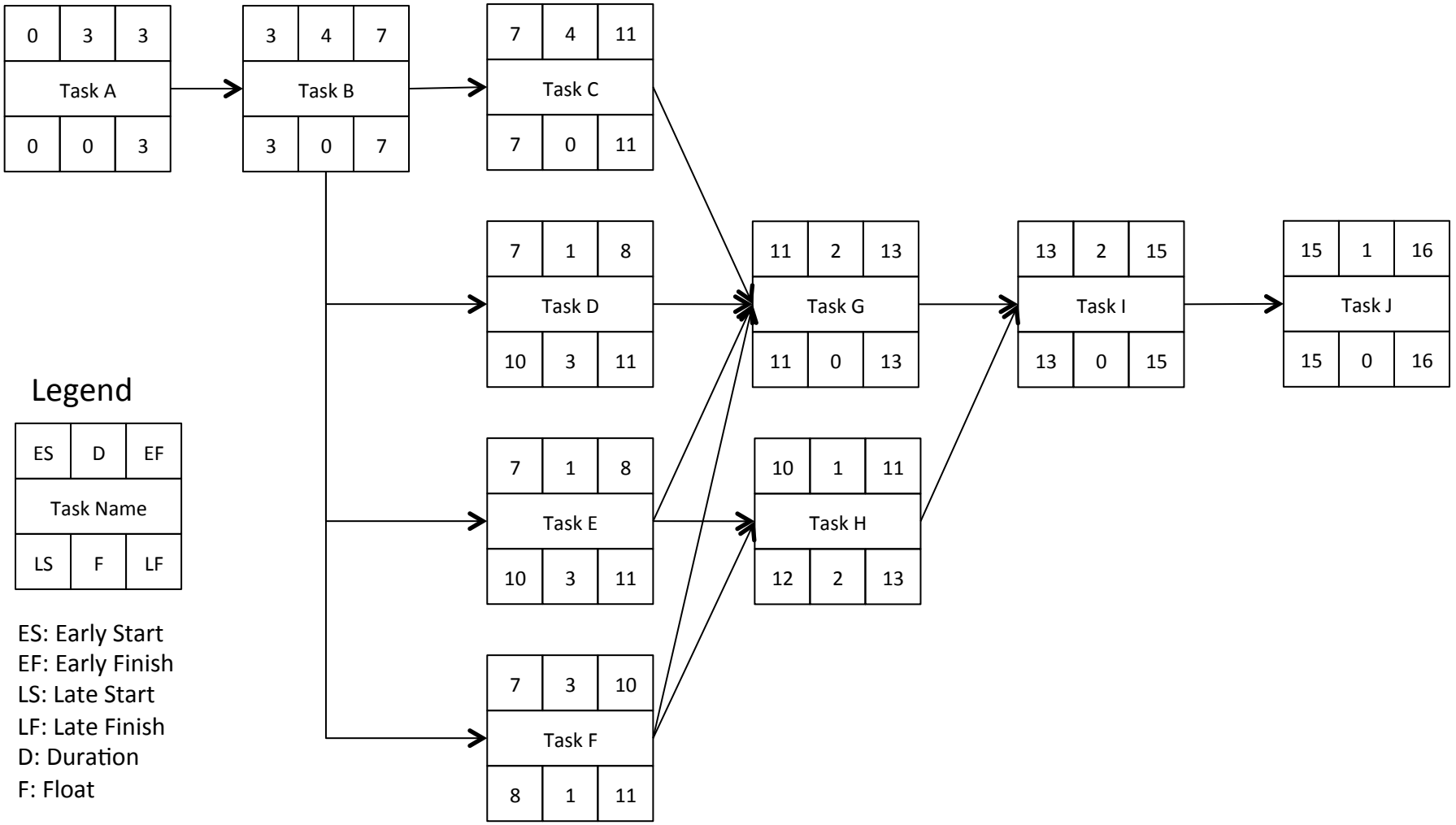
Step 4:
Determine The Project Duration

- Forward and Backward Pass
  - Forward Pass determines the early start (ES) and the early finish (EF) of each activity.
  - Backward Pass determines the late start (LS) and late finish (LF) of each activity.

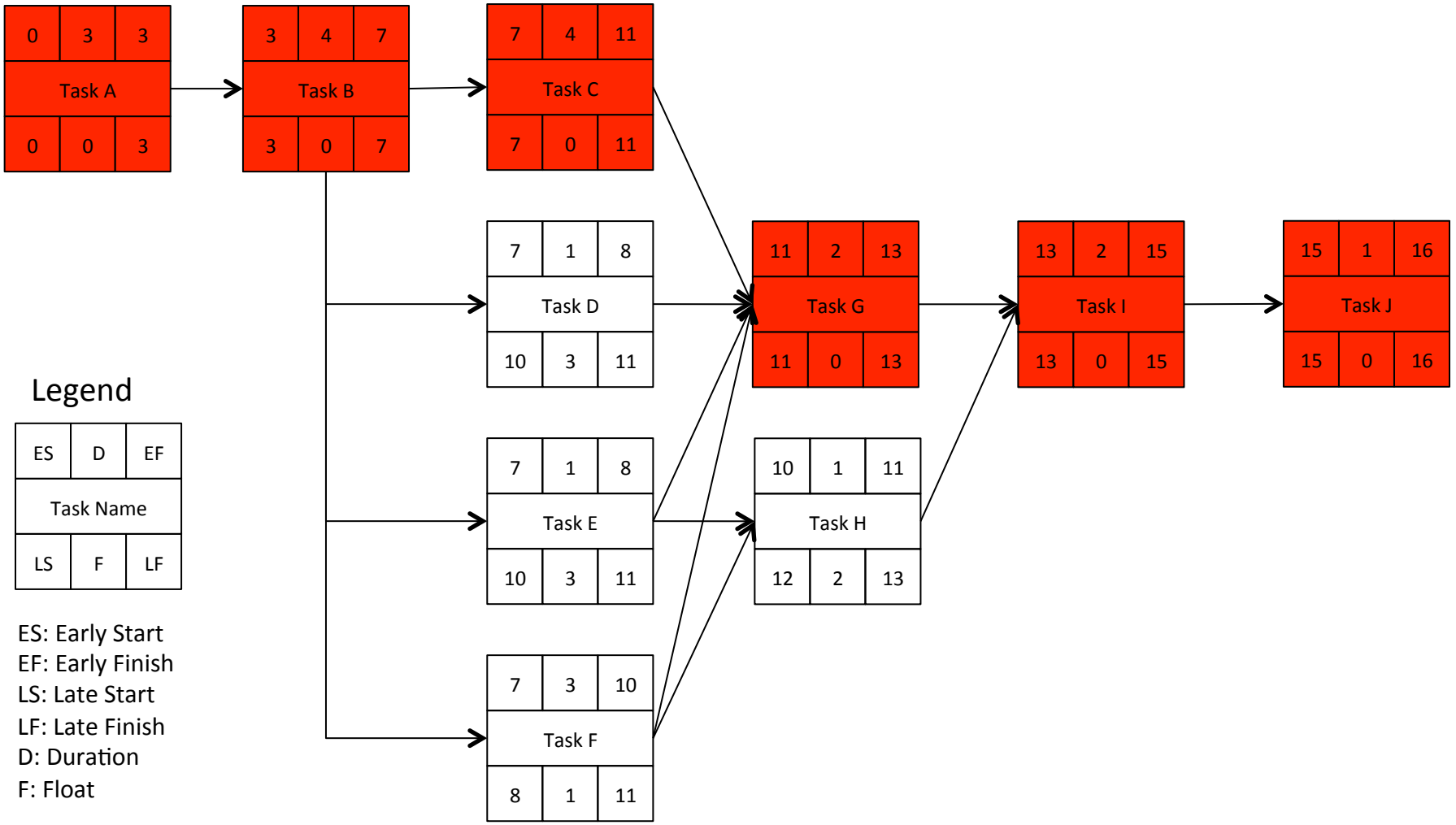
- This process calculates:
  - Total Project Duration
    - including the start and finish dates for each activity
  - Float
    - how much certain activities can slip without impacting the total project duration
  - The Critical Path calculated as:
    - Late Finish date (LF) - Early Finish date (EF)
      - If the difference is Zero, the activity is on the critical path.
      - If the difference is greater than Zero, the activity is **not** on the critical path and has **float**

Source: US Department of Energy

Forward & Backward Passing

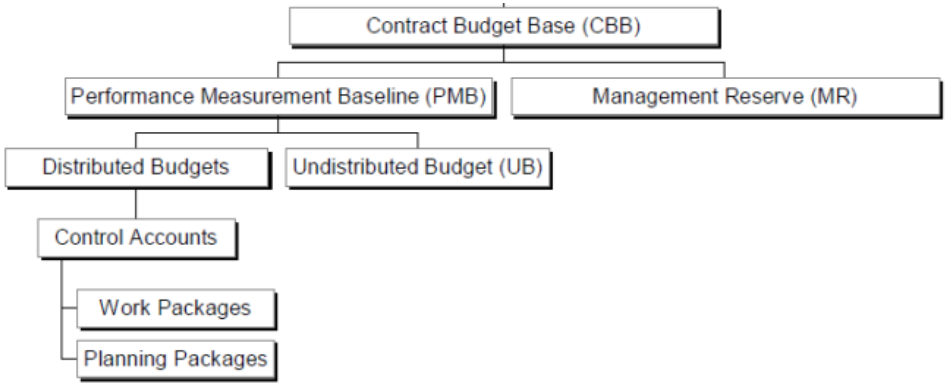


Critical Path



Setting the PMB

- The **Performance Measurement Baseline (PMB)** is a time-phased budget plan for accomplishing work, against which contract performance is measured
- A project PMB is established at an Earned Value Management Integrated Baseline Review (EVM IBR)
- Earned Value Management is used to measure and communicate the real physical progress of a project taking into account the work complete, the time taken and the costs incurred to complete that work.



Source: US Department of Energy

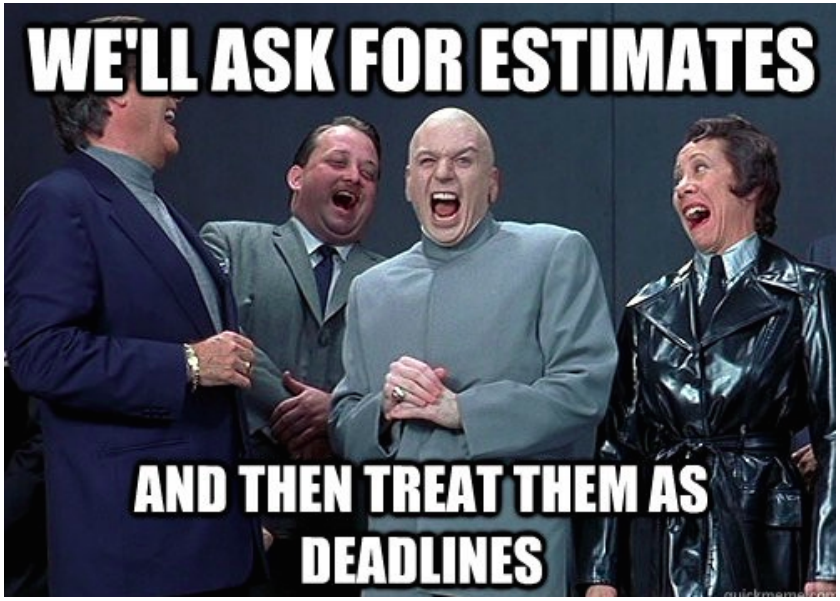
Two Methods of Quantifying Schedule Risk

- A Schedule Risk Analysis (SRA) provides a detailed view
  - Risks to schedule compliance are performed at the level of specific risks and specific tasks in the Project Schedule using a Monte Carlo simulation
- Parametric software modelling provides a high-level view
  - Forecast completion date can be determined based on product size (SLOC), historical data and achieved productivity
- The two techniques provide independent estimates of schedule compliance probability

Schedule Risk Analysis

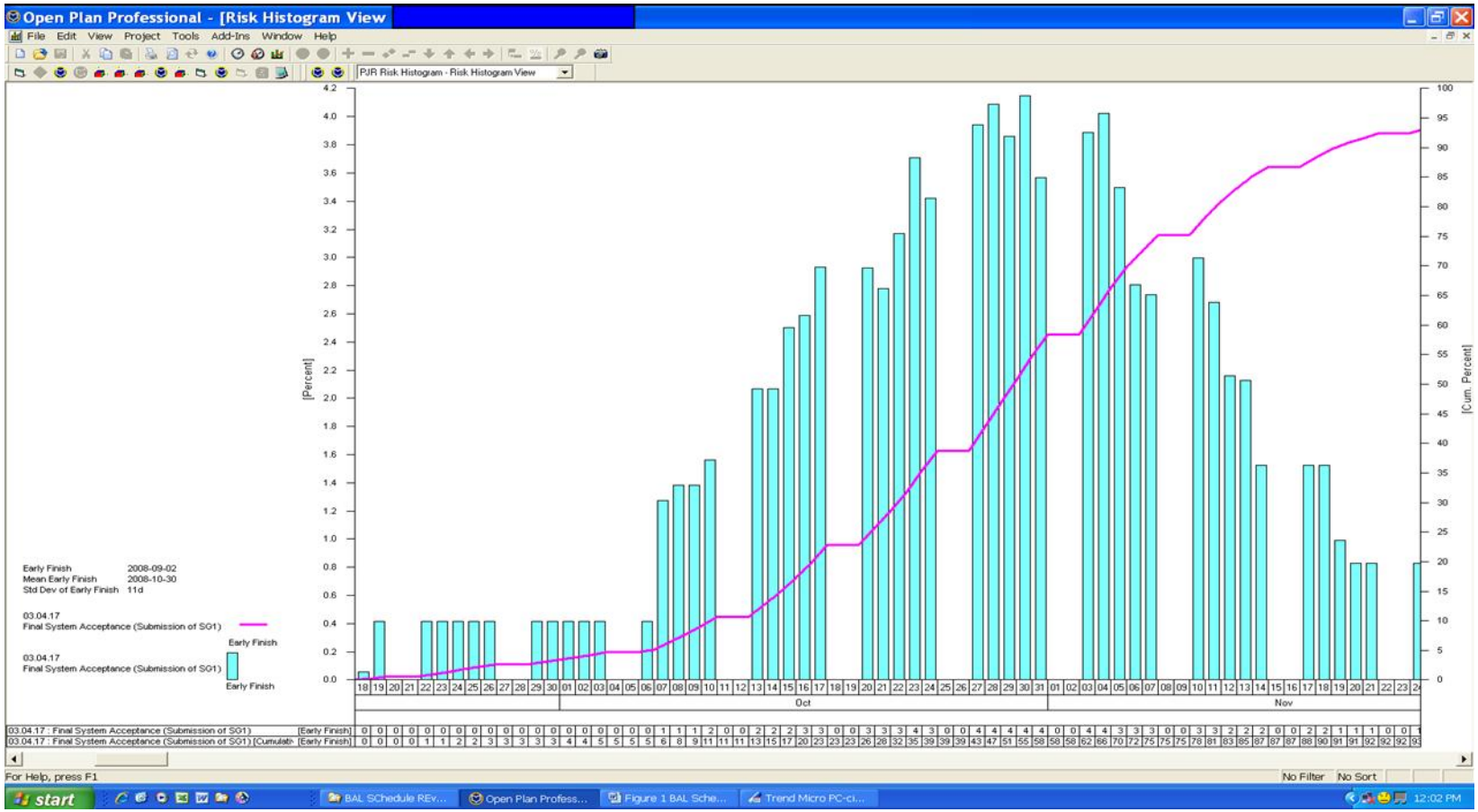
Why do complex development projects always take longer than anticipated?

Why are we always surprised when they do?



- We have discussed a number of risks and issues that can cause schedule delays
- Having identified the risks and issues, the question is how do we incorporate these risks into the schedule to quantify the overall risk to schedule compliance?
  - Answer is….
    - Use three point estimates and
    - Monte Carlo Simulation

Monte Carlo Simulation Results



How do we get to this?

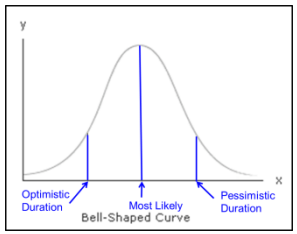
Three Point Estimates of Schedule Duration

- On complex projects, there is a degree of uncertainty associated with duration estimates for many tasks
- Actual task duration will fall within a range of durations surrounding the single best or most likely estimate (with some degree of confidence)

Monte Carlo Input - Normal Distribution

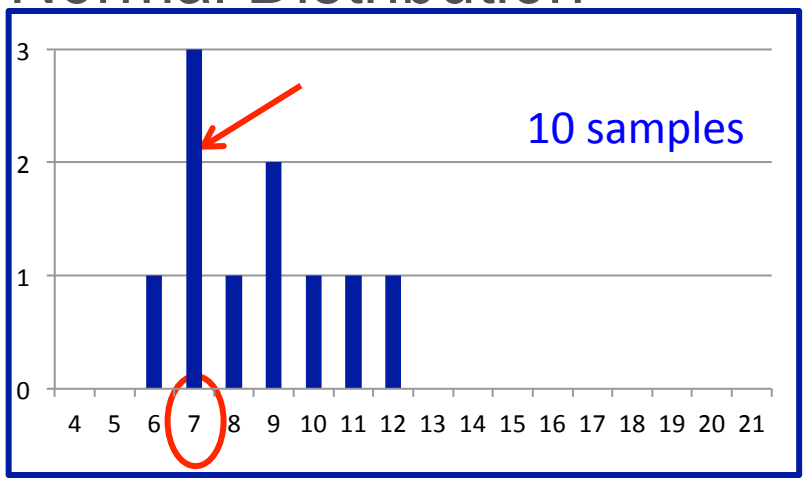
Simple Example:
Three Tasks, Numbers in Table represent estimated duration in Days

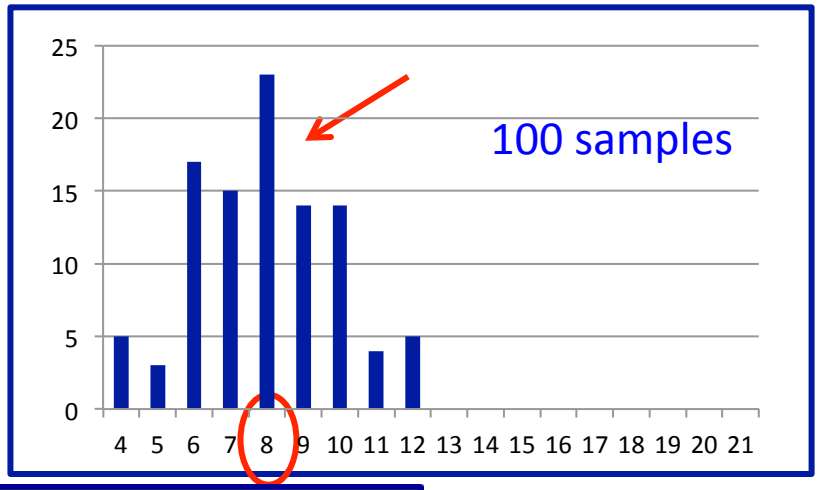
Probability	30%	40%	30%
Task 1	2	3	4
Task 2	1	3	5
Task 3	1	2	3

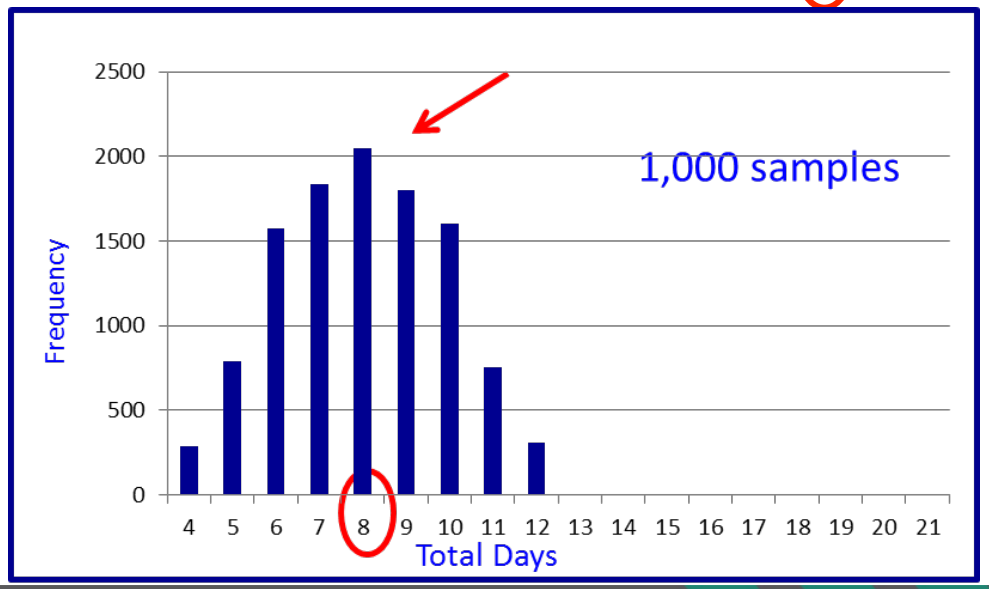


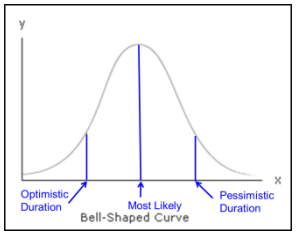
Note: Sum of the three most likely tasks is 3+3+2=8

Comparison of Monte Carlo Results
Normal Distribution



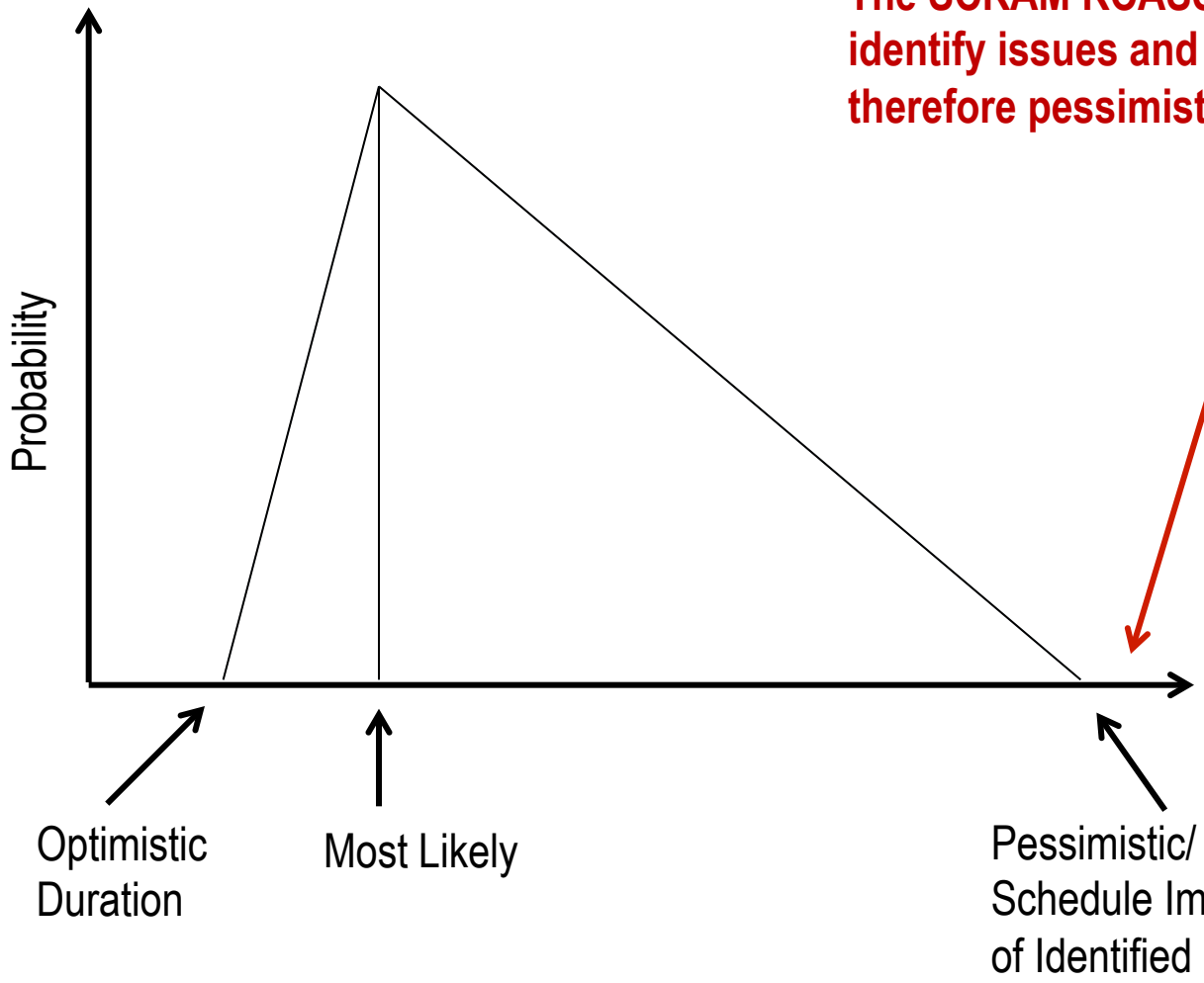






Triangular Distribution of Task Duration

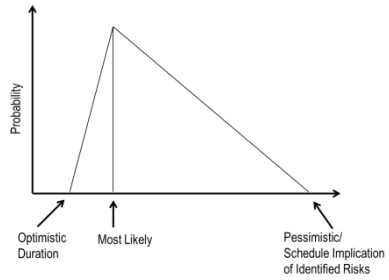
The SCRAM RCASS model helps us identify issues and risks and therefore pessimistic task duration



Monte Carlo Input – Skewed Distribution

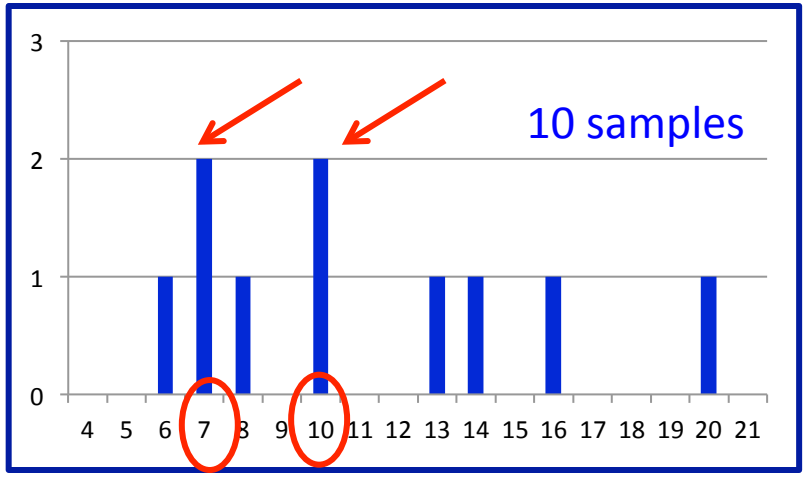
Simple Example:
Three Tasks, Numbers in Table represent estimated duration in Days

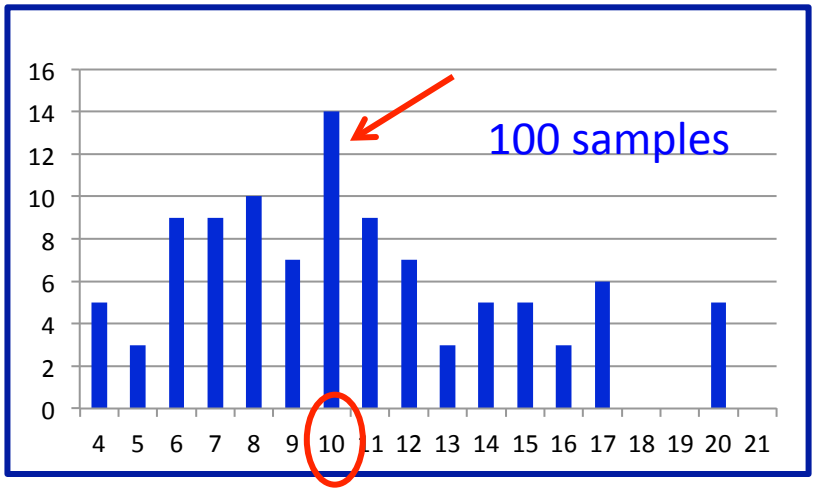
Probability	30%	40%	30%
Task 1	2	3	8
Task 2	1	3	6
Task 3	1	2	6

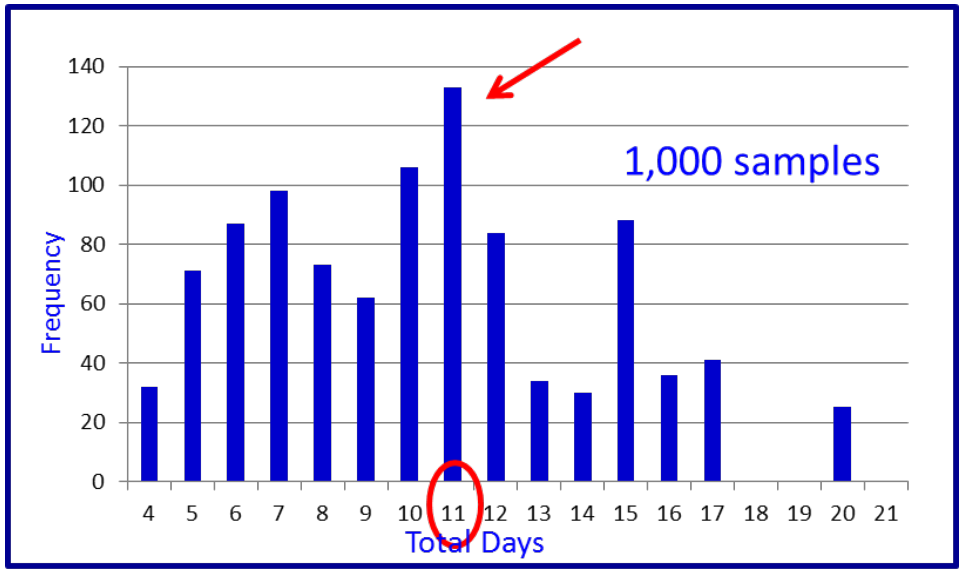


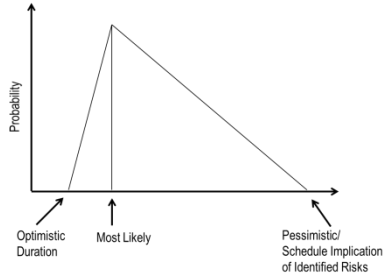
Note: Sum of the three most likely tasks is 3+3+2=8

Comparison of Monte Carlo Results
Skewed Distribution







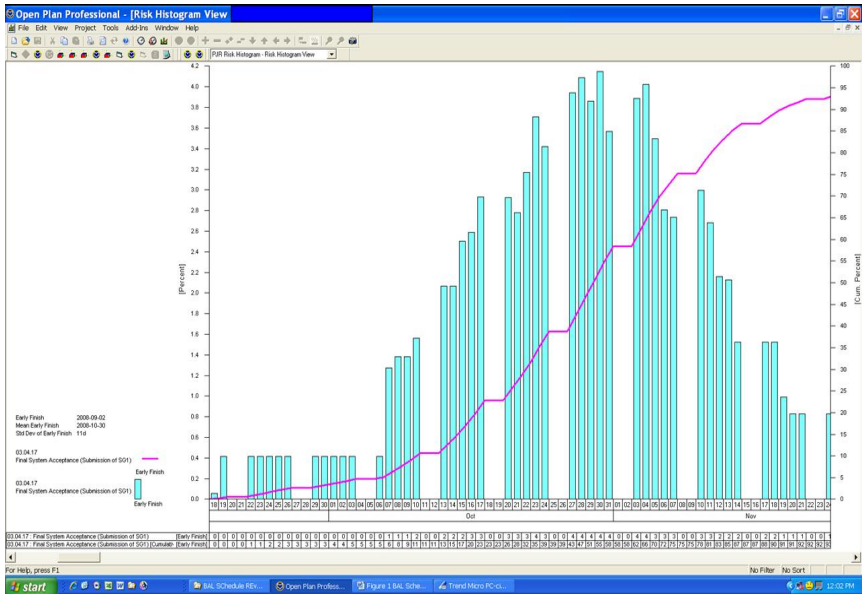


Schedule Risk Analysis/Monte Carlo

- Rate Tasks that are on the Critical or Near Critical Path
  - Assign three point estimates
    - Most Likely, Optimistic and Pessimistic
  - based on identified risks, issues, technical debt and any other sources of delays

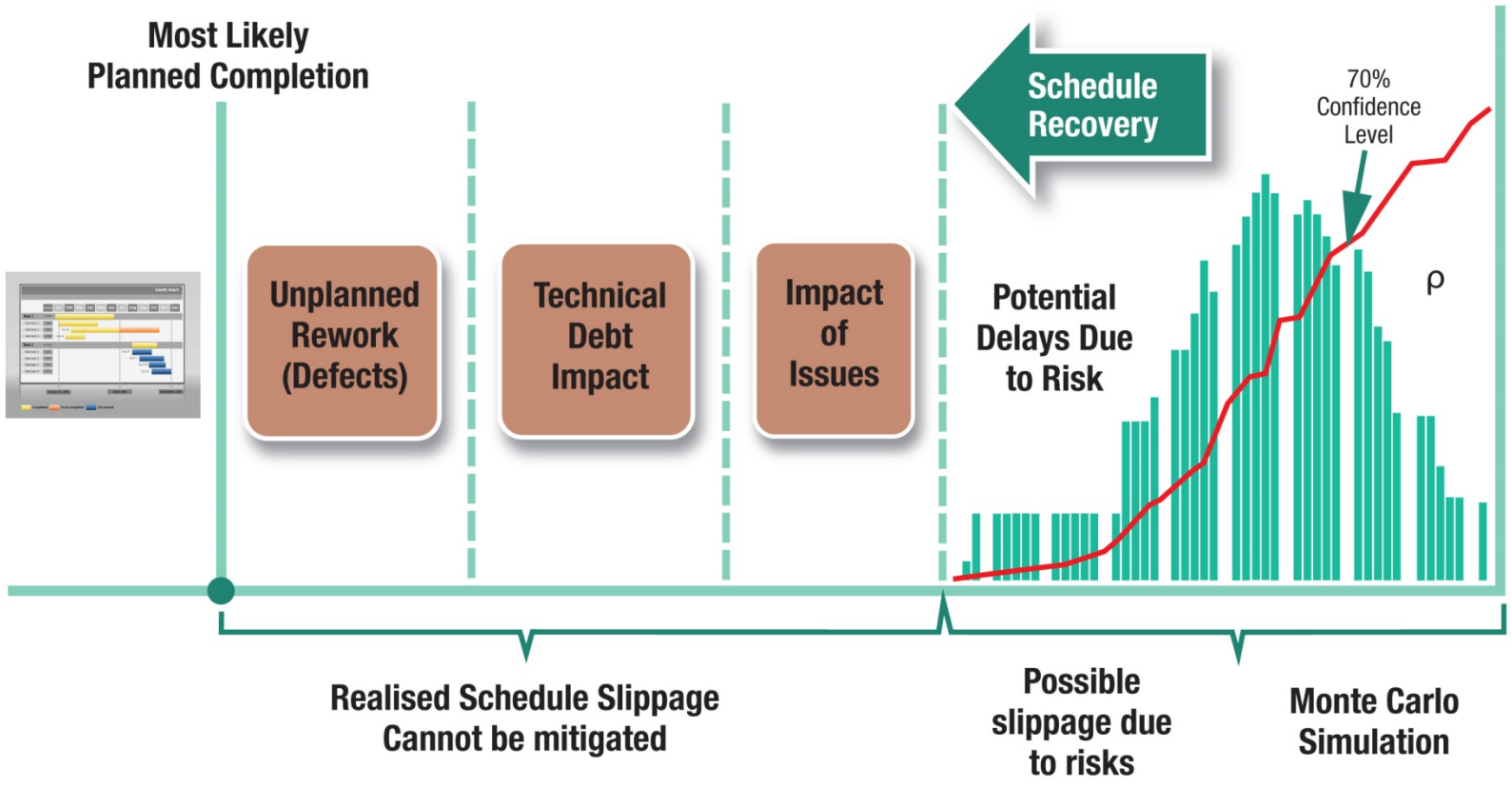
- Perform Monte Carlo Simulation
  - provides a picture of the potential impact of risk on schedule

- Projects must use the results of the SRA to develop remediation or mitigation plans to ensure that the risks don't become reality



SCRAM Identifies and Quantifies Schedule Slippage Root Causes and Risk

Causes of Project Slippage and Potential Risk Delays



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What is a Software Parametric Model?

- A software parametric model is a statistical tool with input parameters (e.g., estimated product size, complexity) to describe a software development
- Based on the inputs, the model estimates
  - duration/schedule
  - effort/staffing
  - expected defects
- Depending upon a program's life cycle phase, parametric analyses can be used to:
  - determine feasibility of a software development plan
  - forecast future milestone dates based on actual software development performance
  - forecast remaining software defects at specified release dates

SLIM-Control

We use a model, SLIM-Control, that forecasts future milestone dates based on actual progress to date

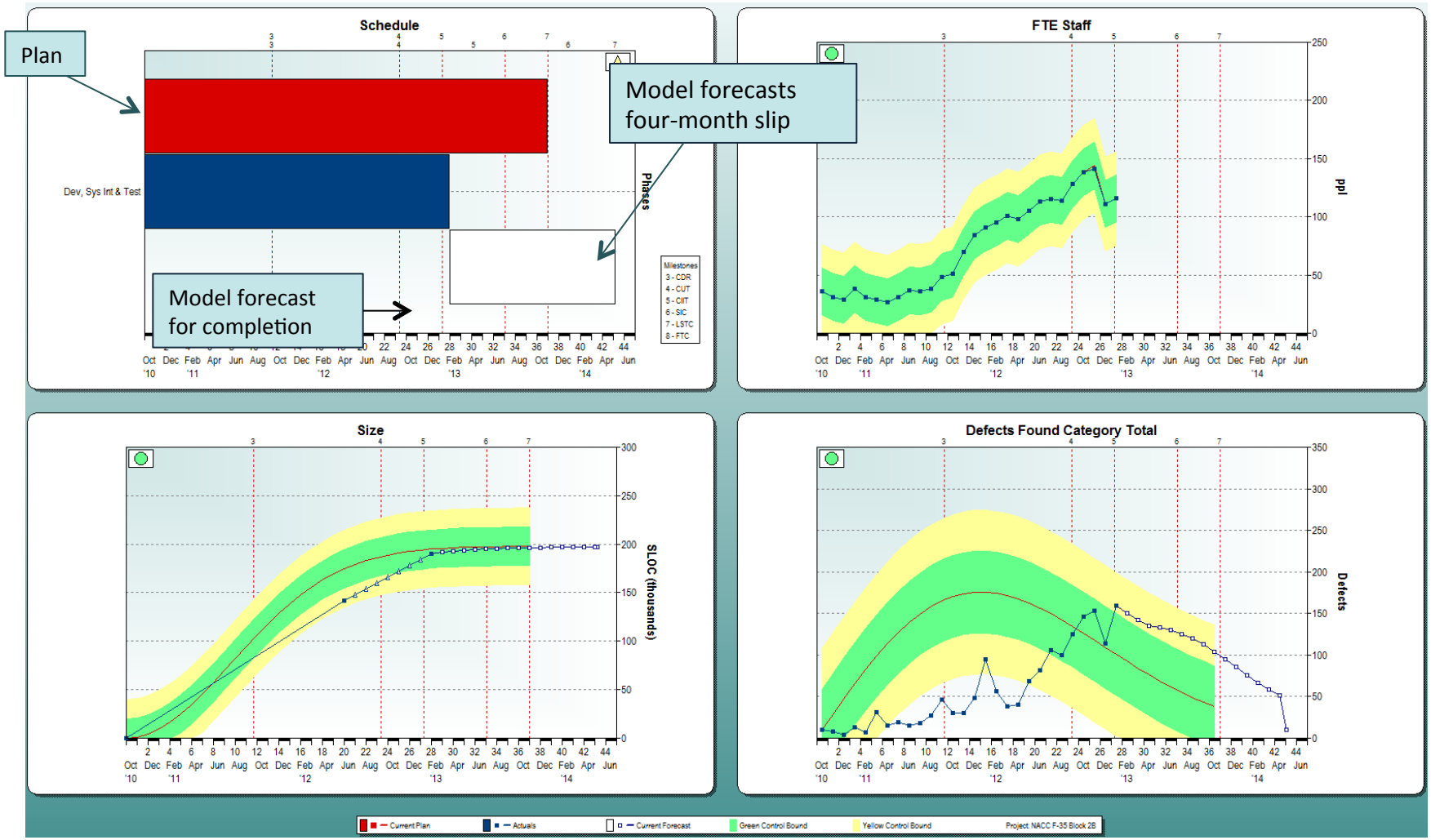
Inputs

- Planned
  - Total Size
    - SLOC, FPs, UCPs, SPs
  - Staffing
  - Milestones
  - Required Reliability
- Actuals (entered monthly)
  - Sizing Units completed
  - Staffing
  - Milestones completed
  - Defects discovered

Outputs

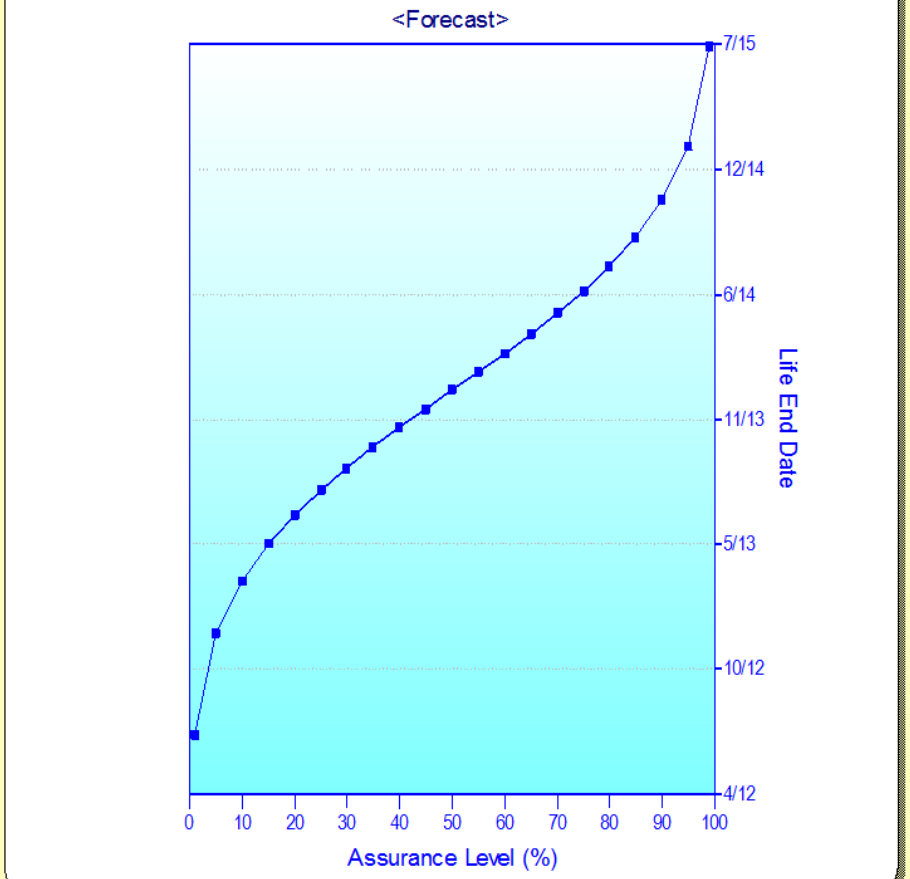
- Forecasted
  - Milestones (including end System Test)
  - Staffing required
  - Defects

Example Forecast



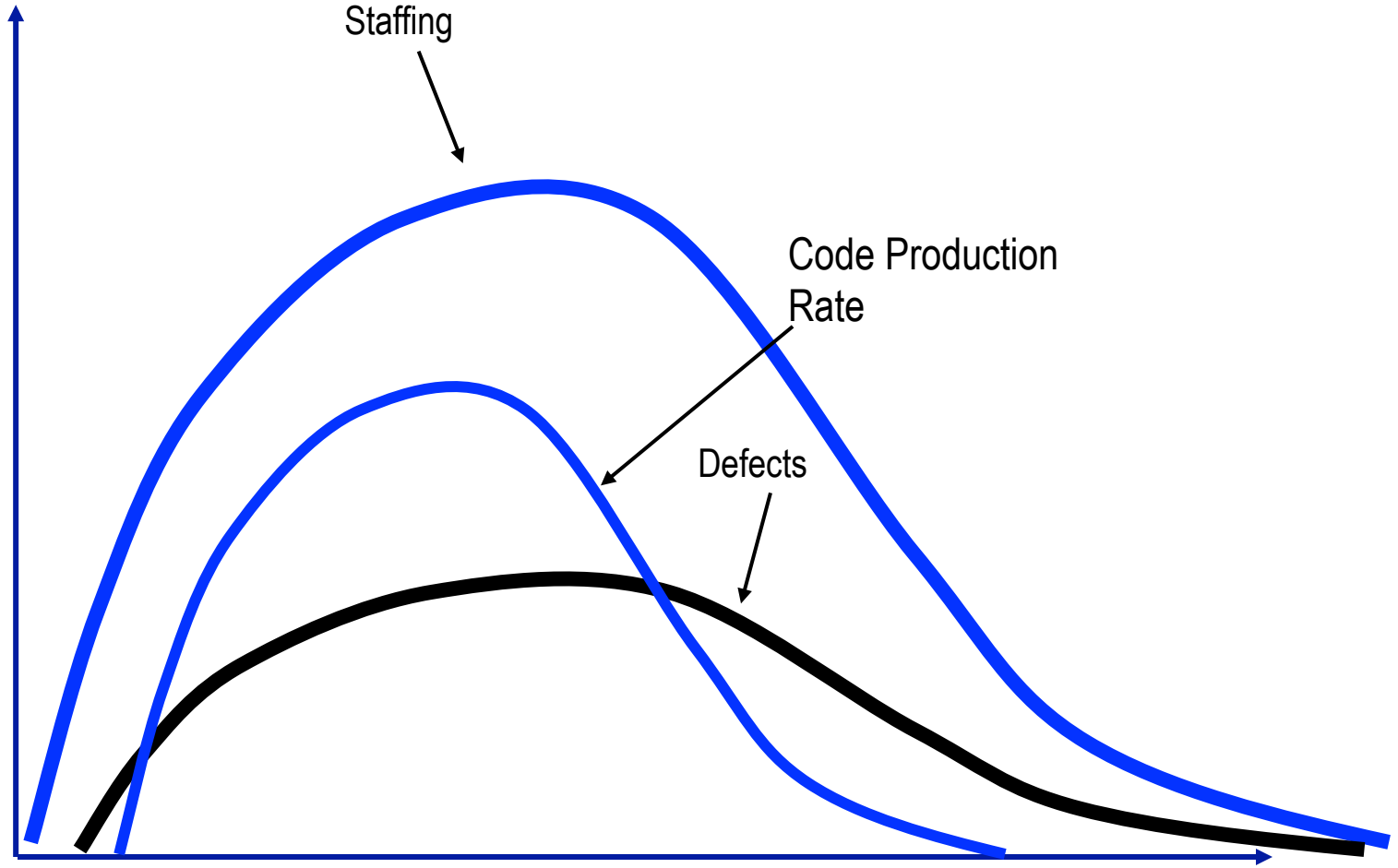
<Forecast>

Assurance Level (%)	Life End Date
1	7/5/2012
5	12/14/2012
10	3/9/2013
15	5/6/2013
20	6/21/2013
25	7/31/2013
30	9/5/2013
35	10/8/2013
40	11/9/2013
45	12/9/2013
50	1/8/2014
55	2/7/2014
60	3/7/2014
65	4/8/2014
70	5/11/2014
75	6/15/2014
80	7/25/2014
85	9/10/2014
90	11/7/2014
95	2/2/2015
99	7/12/2015



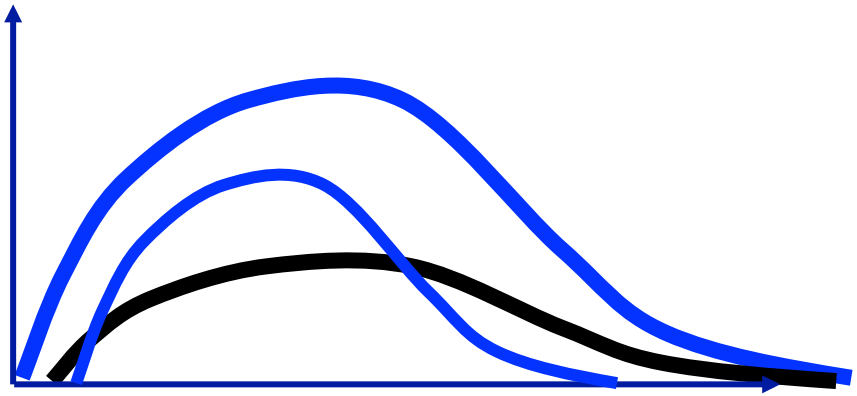
SLIM-Control

Model assumes that code production, defect discovery and staffing follow a Rayleigh curve.

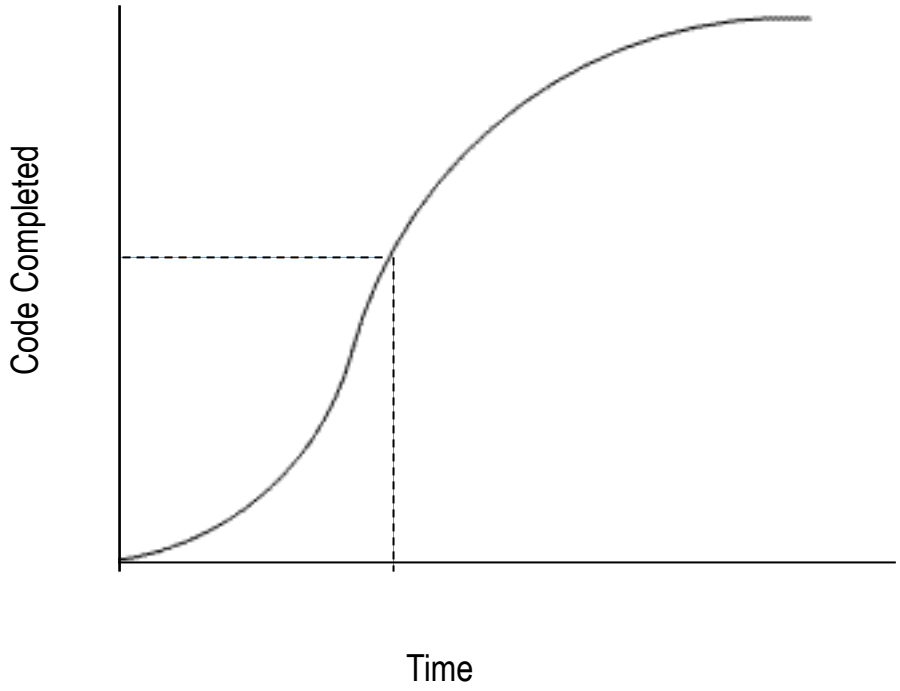


The Rayleigh Curve

- Applies to complex human intellectual activity (system development)
  - A small group of people begin to identify problems
  - As they solve the initial set of problems, more problems are encountered
  - The team expands when the problems can be assigned efficiently to new members
  - At some point, the number of new problems diminishes
  - The team diminishes in size
  - Some team members stay on to solve the more difficult problems creating a tail on the curve



Cumulative Rayleigh Curve is an S-Curve



When 50% of the code is completed, more than 50% of the required duration still remains

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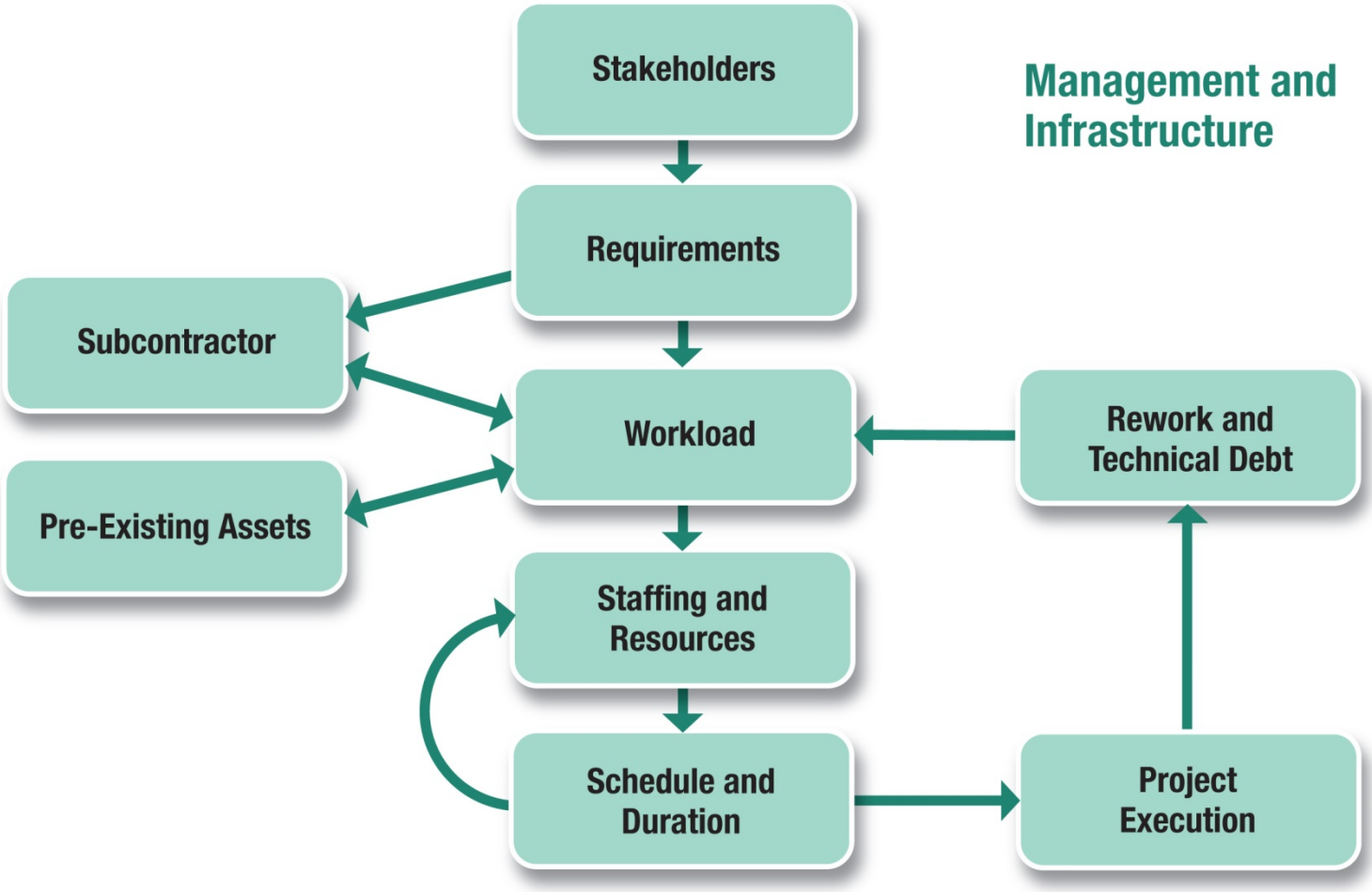
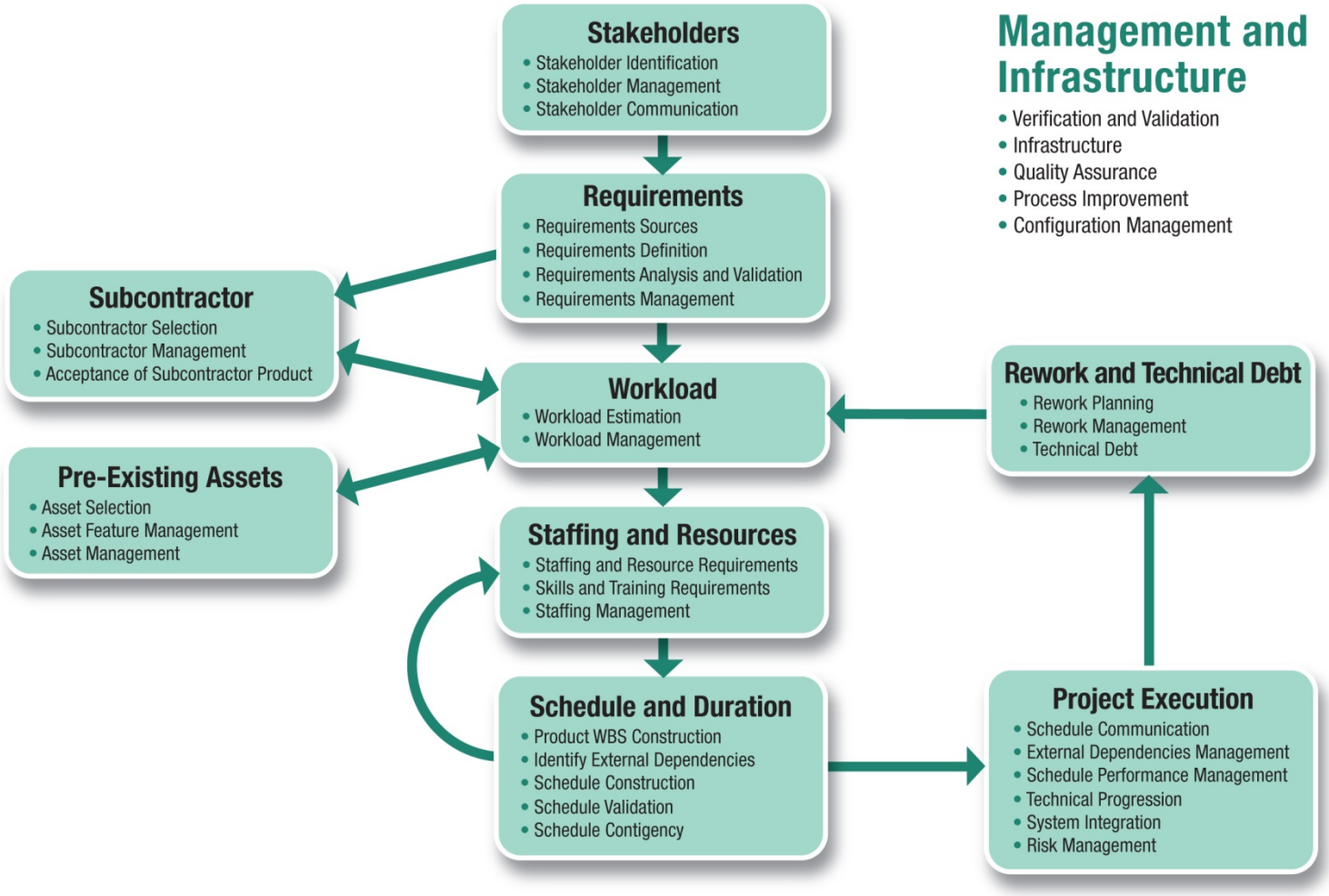
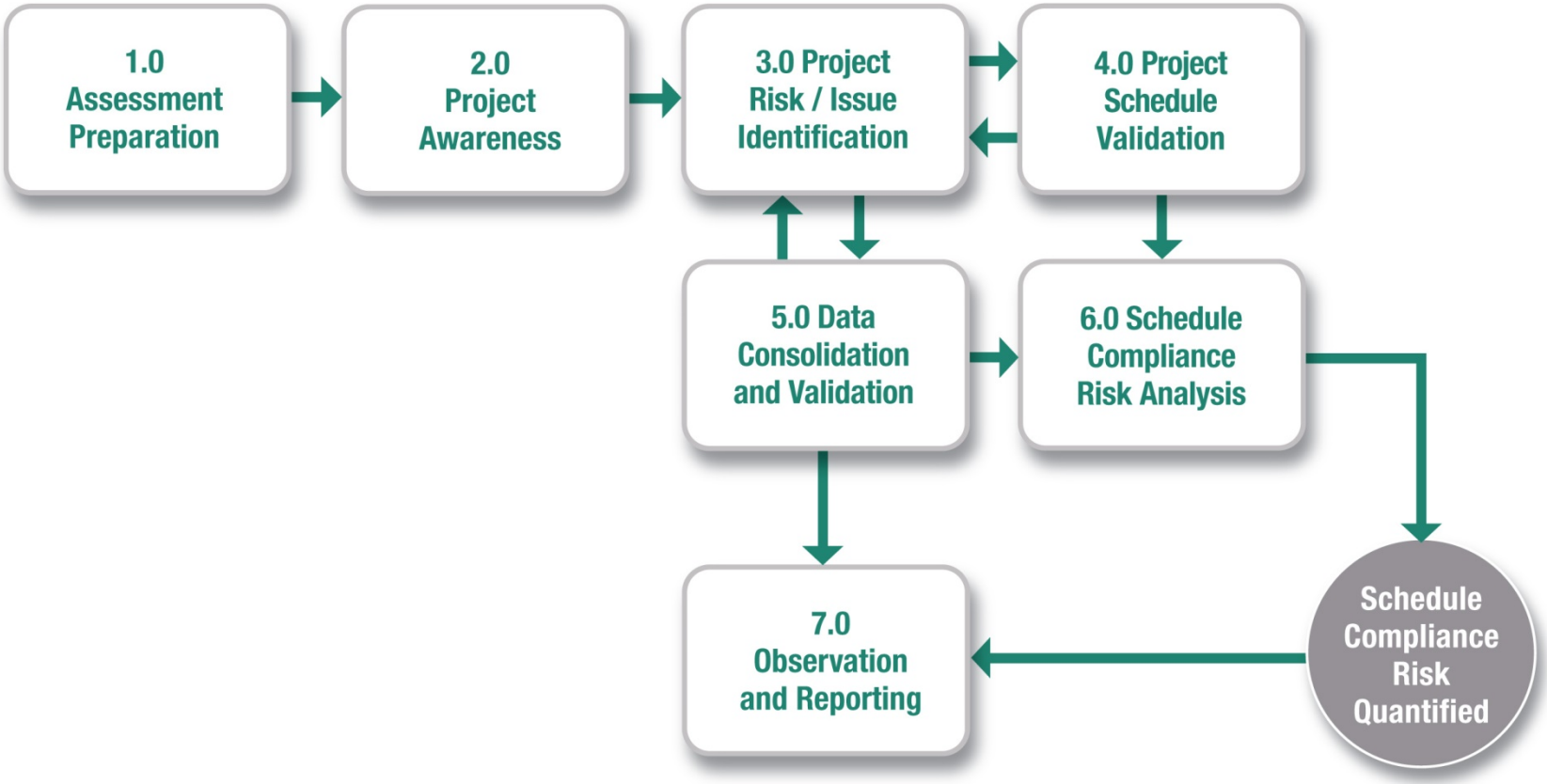
Root Cause Analysis of Schedule Slippage (RCASS) Model



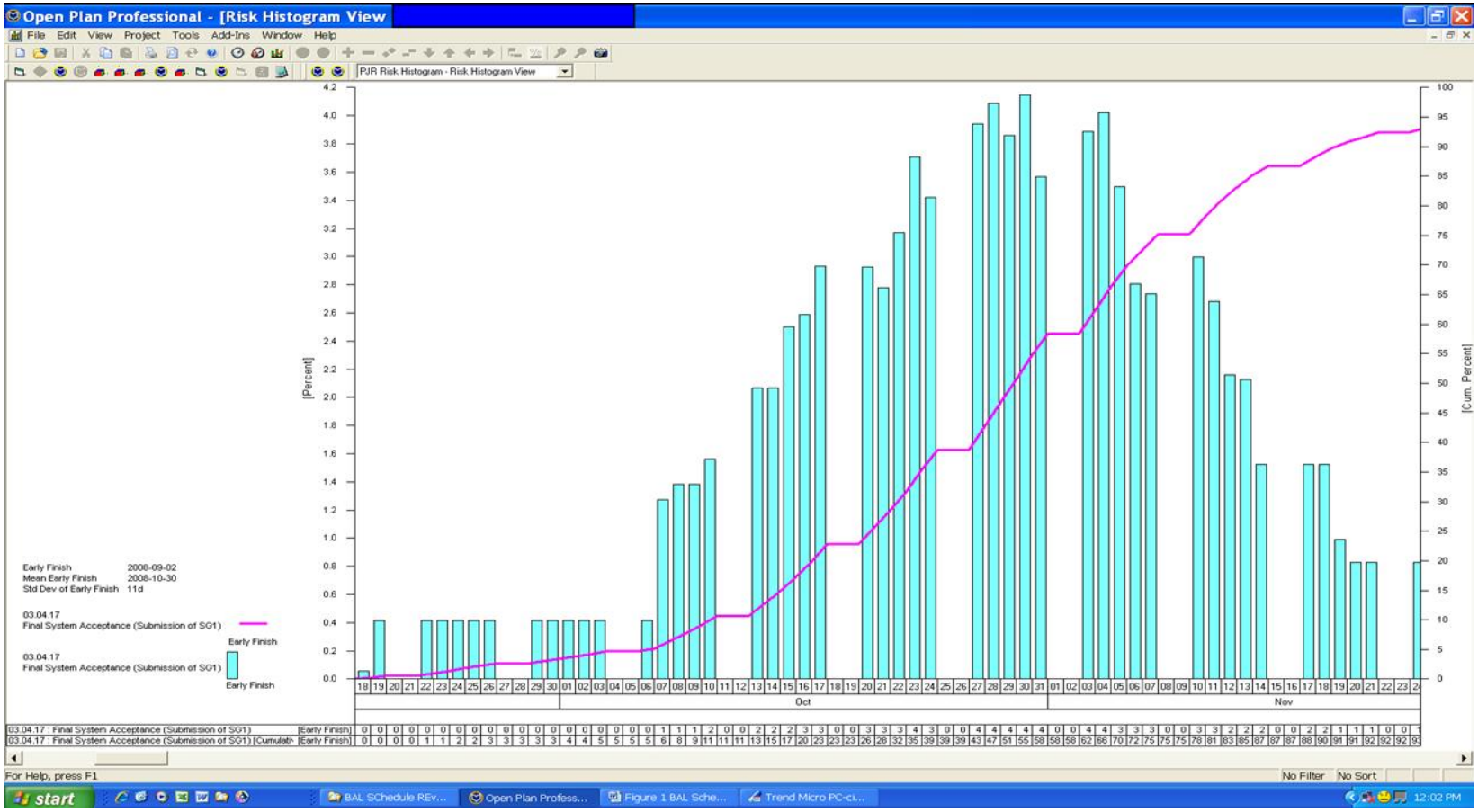
SCRAM PR/AM Processes



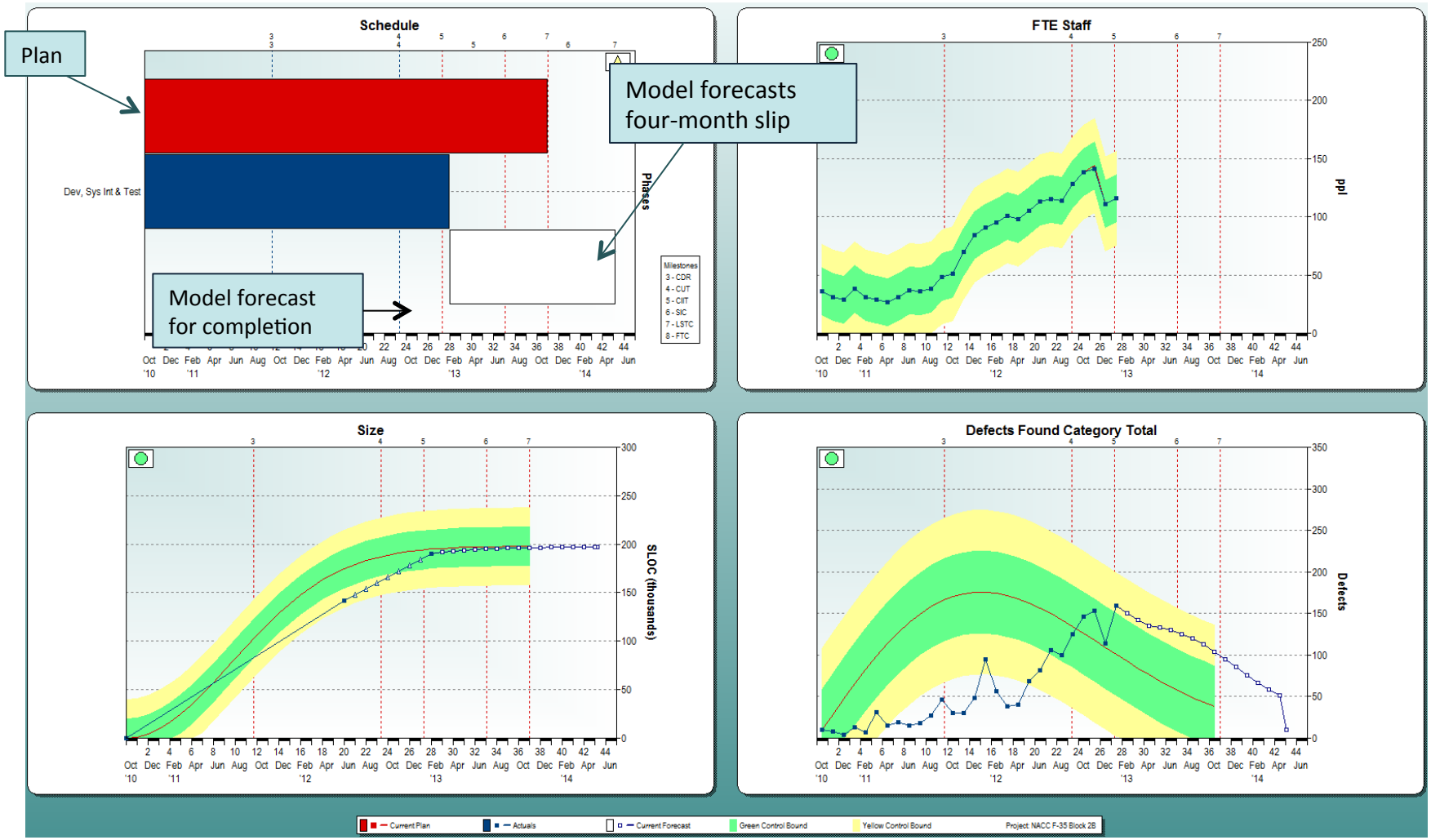
SCRAM Assessment Process



Monte Carlo Simulation



Example Forecast

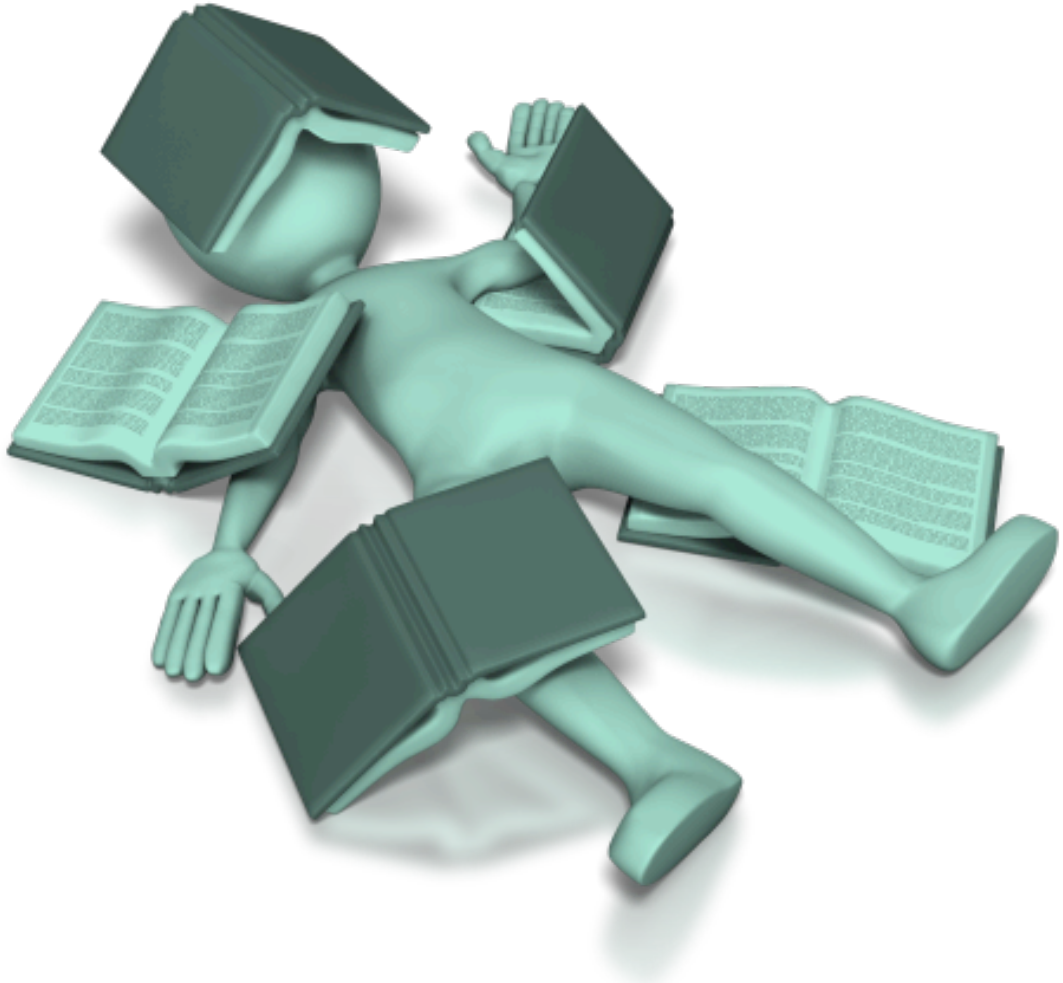


Future SCRAM Development

- SCRAM continues to be refined and developed based on our growing knowledge and expertise

- DMO future plans include:
  - SCRAM combined with EVM-IBR
  - Expansion to include Manufacturing and Production
  - Technical Implementation Risk Assessment (TIRA)
  - Periodic updates and refinements to the PR/AM
  - SCRAM Project Estimate

Thank you for your attention



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