Schedule Risk Assessment
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Defense Acquisition University

Foundational Learning Workflow Learning Performance Learning

Presented by:
Defense Acquisition University
Judd Fussell, PhD Judd.Fussell@dau.mil

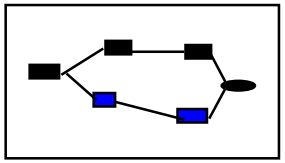
Overview

- Definition/Guidance
- The General SRA Process
- Getting Ready
- Monte Carlo Simulation Illustration
- SRA Outputs
- Other SRA Benefits
- Schedule Analysis Resources

What is an SRA?

- A Schedule Risk Assessment is a process which uses statistical techniques to identify technical, programmatic and schedule risk in a program and quantifies the impact of those risks on the program's schedule
- Required by the DIDs – DI-MGMT-81861 (IPMR) and DI-MGMT-81650 (IMS)
- SRA Benefits
  - Provides a means to identify and manage program risk / opportunities
  - Quantifies individual schedule risk
  - Forecasts completion costs and schedules when things not going according to plan

SRA Process

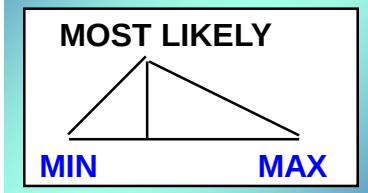


1. Develop a complete critical path network

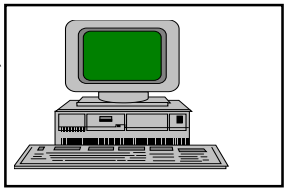
TECHNICAL RISKS:
- •EMC TESTING
- •S/W CODING
- •FLIGHT TEST

2. Identify reporting tasks and risk candidates

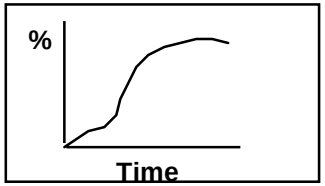
Contractor CAMs responsibility



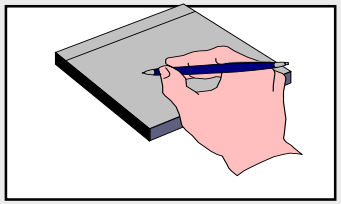
3. Enter risk parameters



4. Run Schedule Simulation & Quantify Impact of Risk on Schedule



5. Analyze Schedule Results & Integrate Into Cost Estimate



6. Document Results

As part of final process steps, the analyst prepares the report and presents a SRA position.

SA RISK ACTION PLAN

ISSUE -- ACTION -- DATE

7. Present to Program office and IPTs Develop Risk Mitigating Actions

Who Conducts the SRA?

- The contractor as required in the CDRL
  - And prior to IBR, OTB/OTS, Single Point Adjustments
- The government may conduct SRAs too
- We will focus primarily on the contractors assessment
  - But most of the following discussion applies to either case

Who Attends the Contractor's SRA?

- Government Participants
  - Program Manager
  - Program Office IPT Leads
  - Program Office Systems Engineering Lead
  - Program Office EV Analysts
  - Staff Scheduler
- Contractor Participants
  - Program Manager
  - IPT Leads
  - Project Schedulers / Project Control
  - CAMs
  - Key Sub-contractor representatives

Pre-Assessment Checklist/ CAM Questions

- To perform a proper SRA the following questions should be satisfied:
  - Does the schedule reflect the work to be done?
  - Are critical target dates identified?
  - Are they being used to plan the work?
  - Is work sequenced logically?
  - Are constraints, leads, and lags justified?
  - Are duration estimates meaningful?
  - Are resource estimates reasonable?
  - Are key resources available to support the plan?
  - Does the critical path make sense?
    - Does the scheduling software calculate it?
  - Are float times reasonable?
  - Does the schedule provide logical current status and forecasts of completion dates for all authorized work?

IPMR DI-MGMT-81861

- Three point estimates shall be developed for remaining durations of all tasks/activities consistent with the authorized work
  - Most Likely remaining duration
  - Minimum remaining duration
  - Maximum remaining duration
- These activities/tasks require individual estimates:
  - Tasks/activities identified in the primary, secondary, and tertiary driving paths (as specified in the CDRL or government direction)
  - High risk tasks/activities in the contractor's risk management plan
- Remaining tasks/activities: three point estimates may be individually or globally applied
- When required: per CDRL & prior to IBR, OTB/OTS, SPA

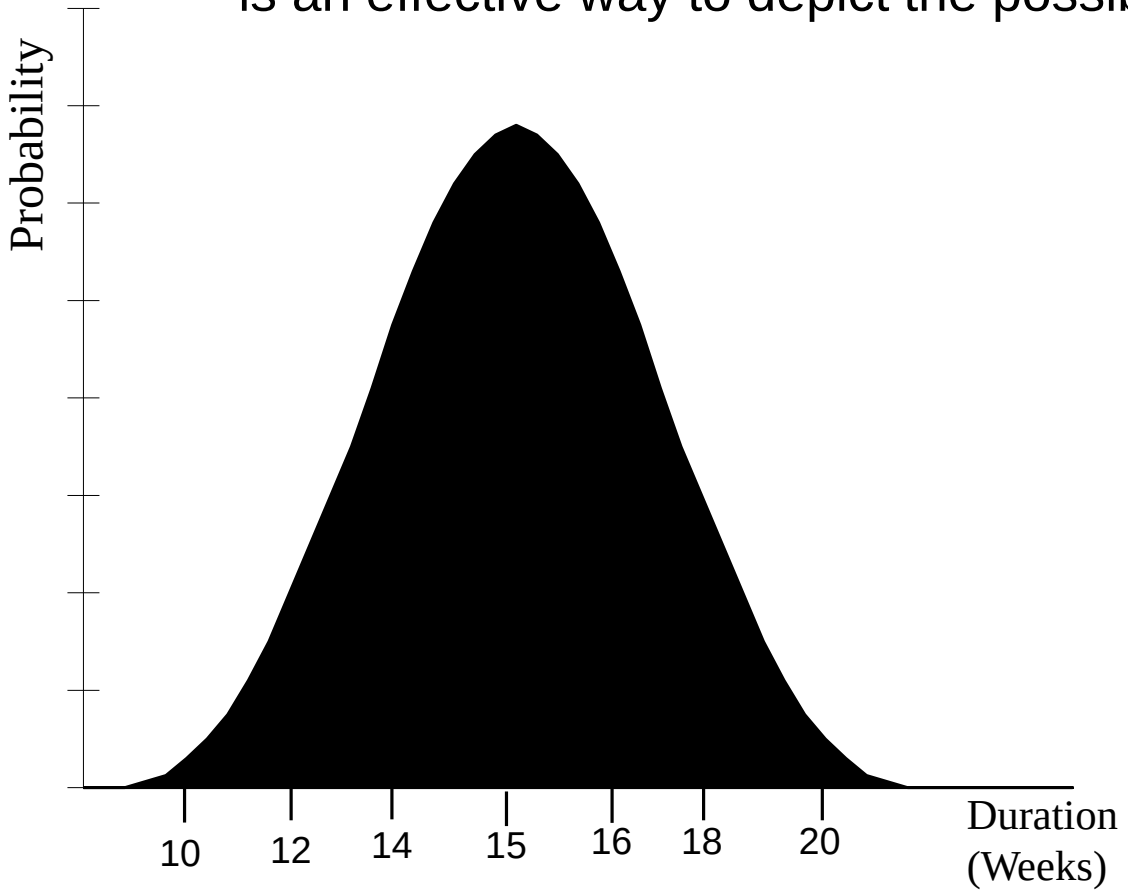
Driving path = Longest sequence of discrete tasks/activities from time now to selected interim contract milestone. Have least amount of float to milestone.

Risk Tool Entrance Criteria Goals

- Greater than 90% precedence logic
- Greater than 80% finish to start relationships
- No (or very few) constraints - most tasks must be able to start and finish “as soon as possible”
- Estimates completely independent of task interdependencies
- Identify reporting tasks
  - Risk candidates
  - Reporting tasks (or key events)
- Three point estimates are input based on remaining duration
- Review which tasks to apply global (group) edits
- Get SME input to define best distribution to represent the uncertainty

A Probability Density Function (PDF)

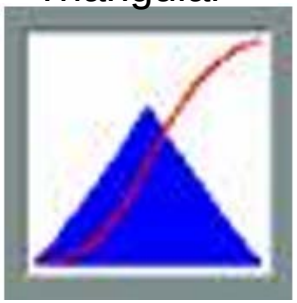
- A PDF characterizes the probability associated with all possible outcomes of a random variable
- If we view duration as a random variable, then a PDF is an effective way to depict the possible outcomes



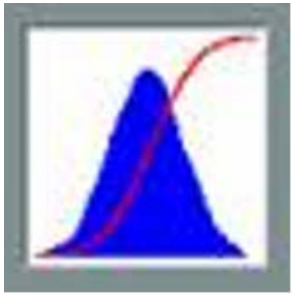
Using PDFs

- Identify a Probability Density Function (PDF) for the uncertain schedule durations
- Most commonly used:
  - **Triangular**
  - Normal
  - Uniform
  - Lognormal
  - Discrete

Triangular



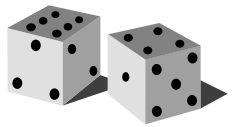
Normal



- Identify parameters (e.g., mean, SD, high, low, ML, discrete values)
  - Historical data
  - Expert opinion
  - Translate identified risks into possible parameter values
- Use Monte Carlo Simulation to aggregate all the individual schedule uncertainty into the total program schedule distribution

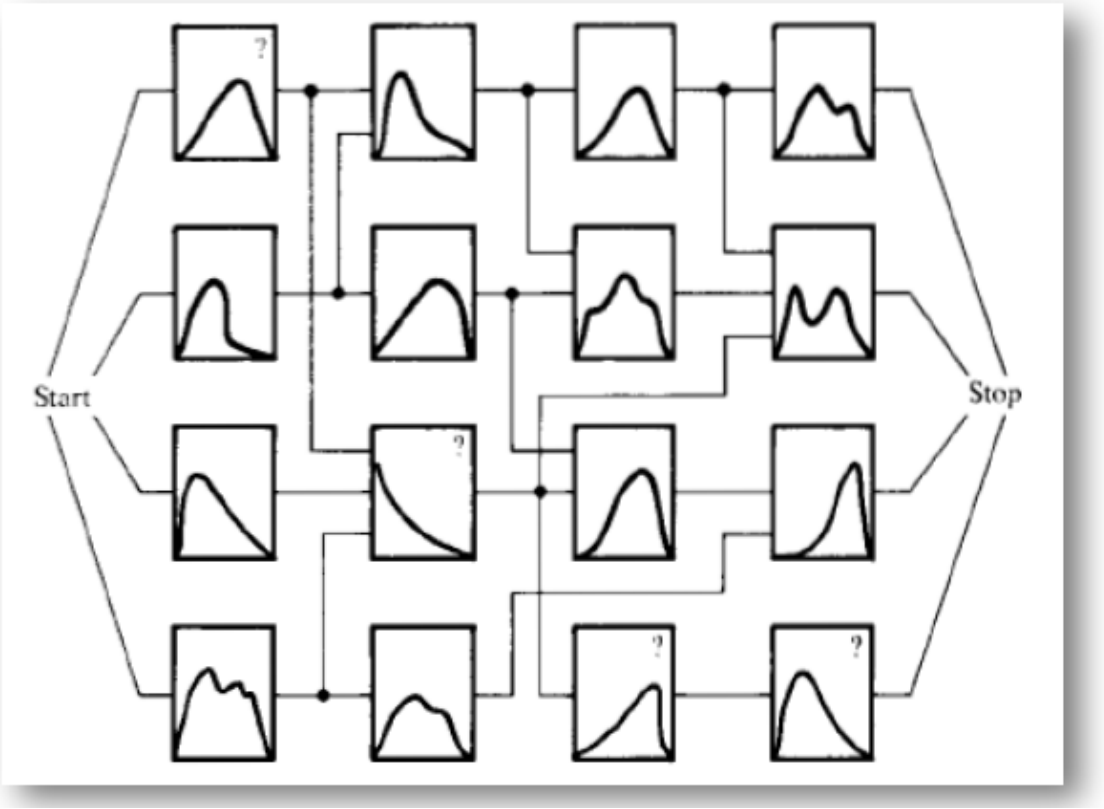
Monte Carlo Simulations

- During the simulation, the Risk software will pick one duration for each activity that is somewhere between the minimum and maximum estimate and according to its distribution
- The program will then plug the values into the schedule and see how they affect the schedule milestones/completion date
- The result is stored and the process is repeated until the selected number of iterations is complete



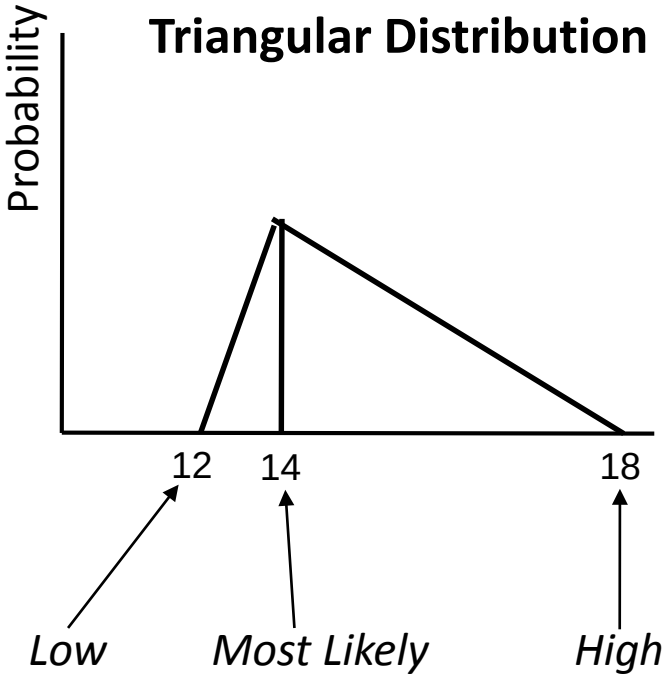
Getting from Start to Stop

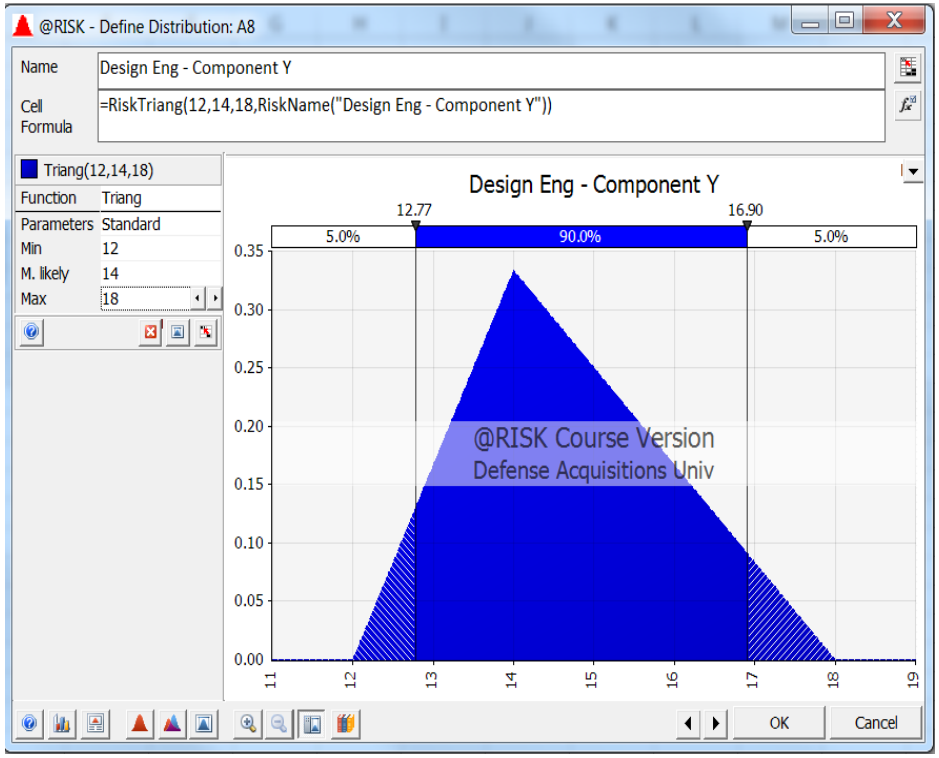
The IMS is a collection of probabilistic processes all coupled together



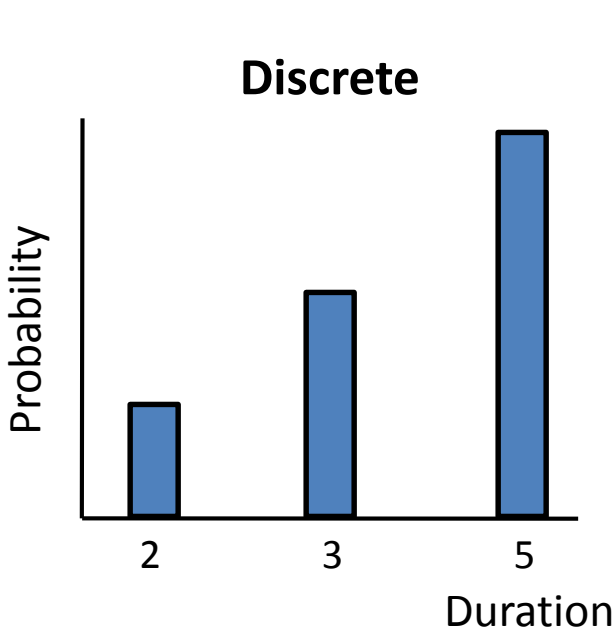
Example:
Design Engineering for Component Y

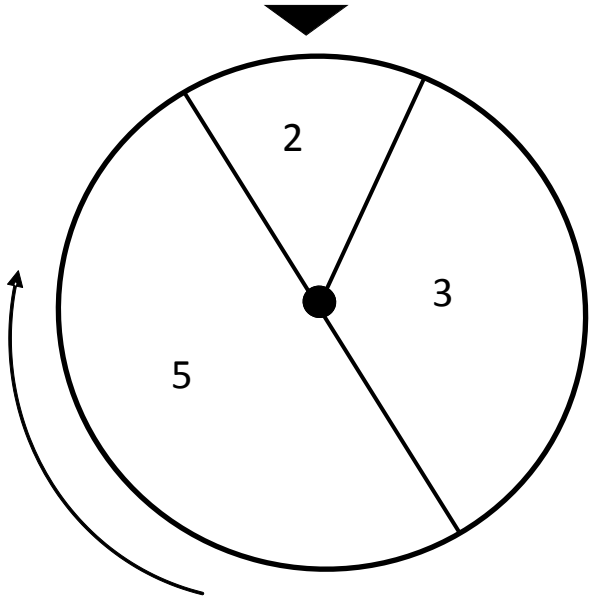
Design engineers estimated the design engineering for component Y could be accomplished in 14 weeks. However, further discussions with the engineers revealed the effort could be as low as 12 weeks or as high as 18 weeks depending on how much of the existing design needs to be modified.



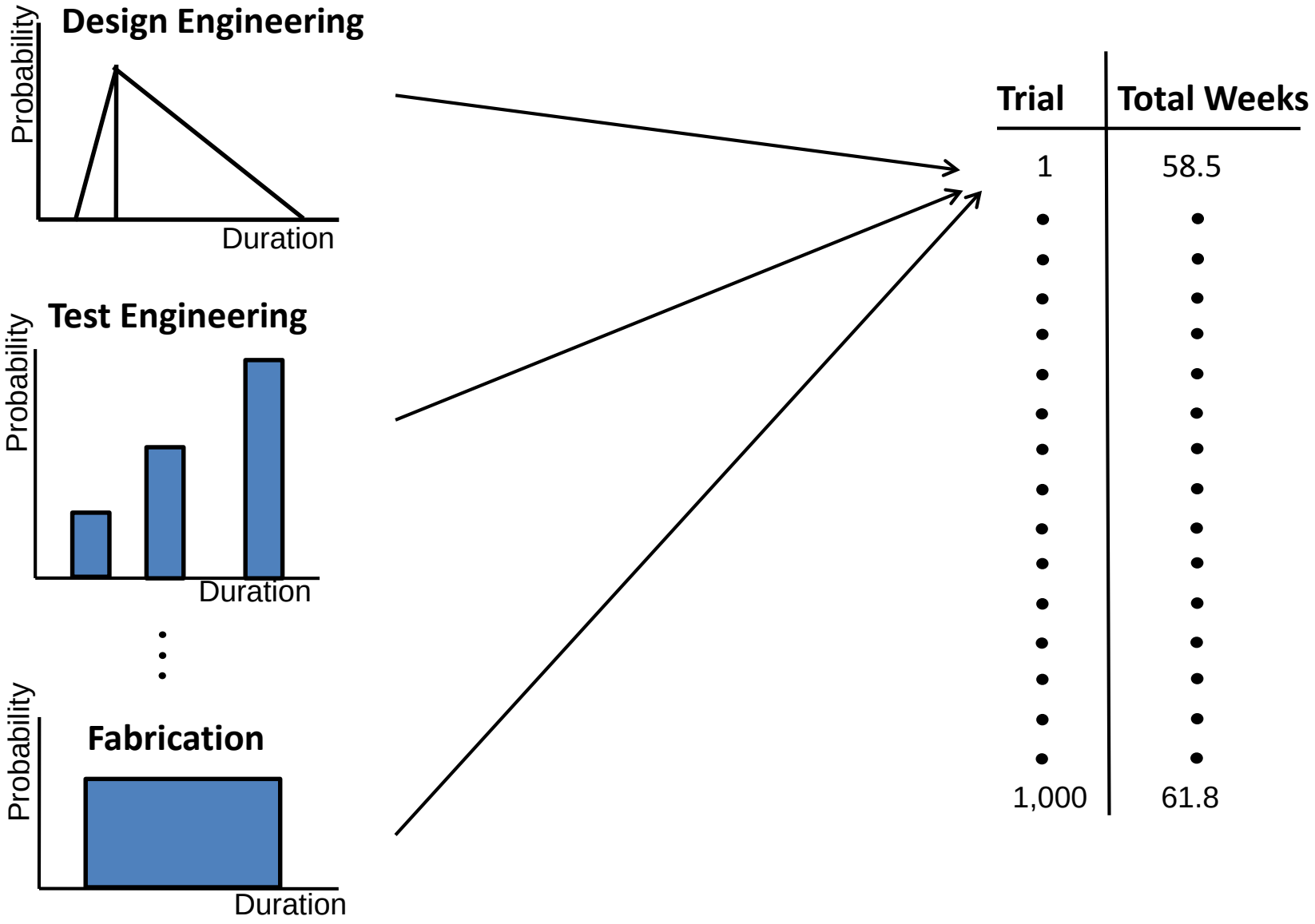


Random Sampling



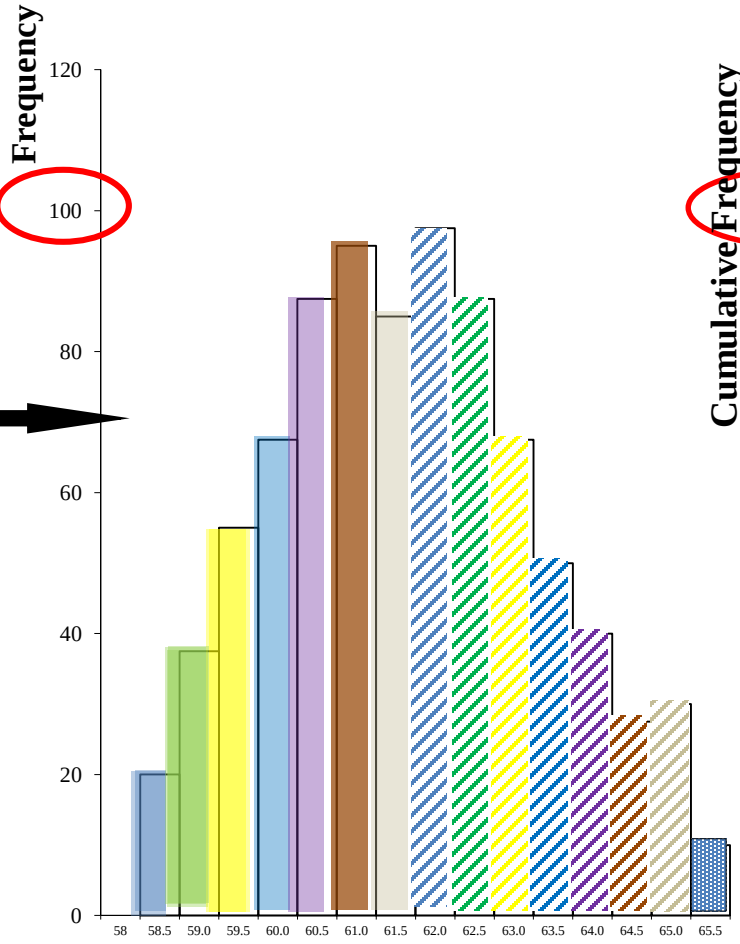


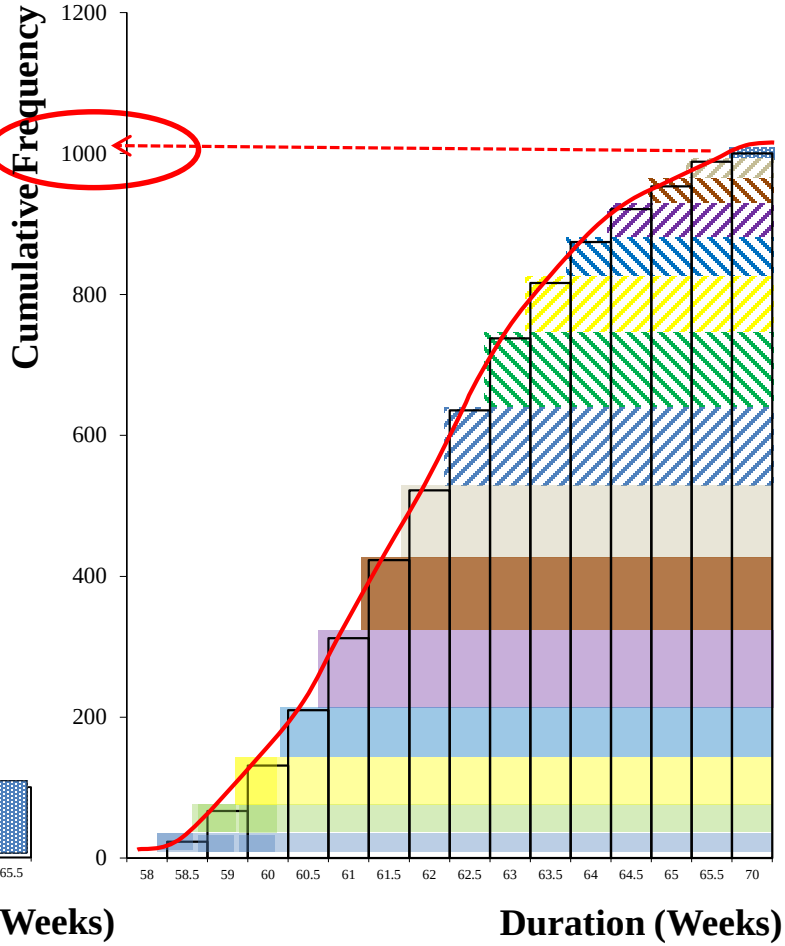
Iterations in Monte Carlo Simulation



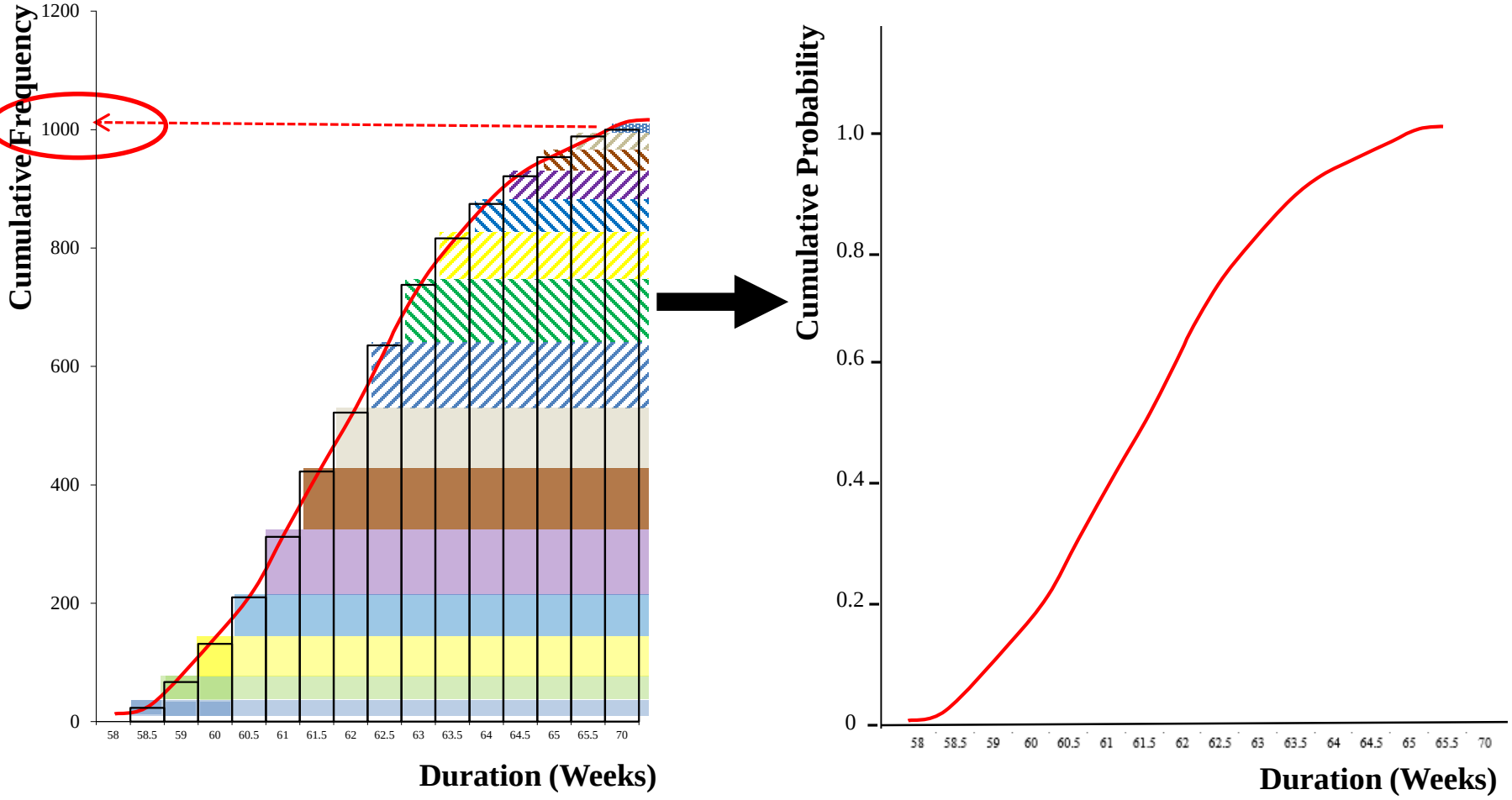
Simulation Results

Obs.	Total DUR (Weeks)
1	58.5
2	63.2
3	65.5
4	59.8
⋮	⋮
1000	61.2



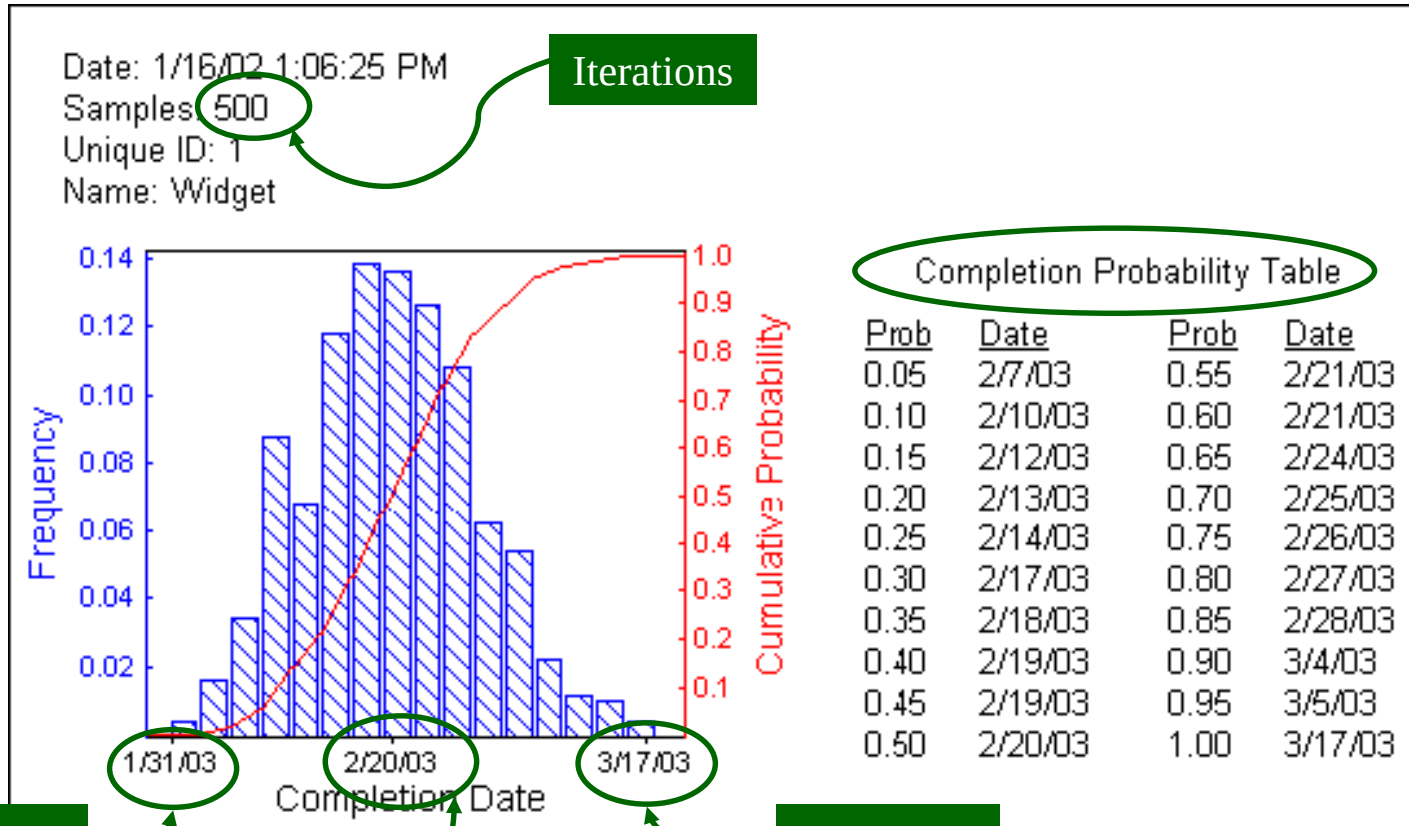


Cum Frequency Diagram to a Cum Density Function (CDF)



Risk Histogram

This example is from MS Project, Risk + add-in tool



Task Criticality Analysis

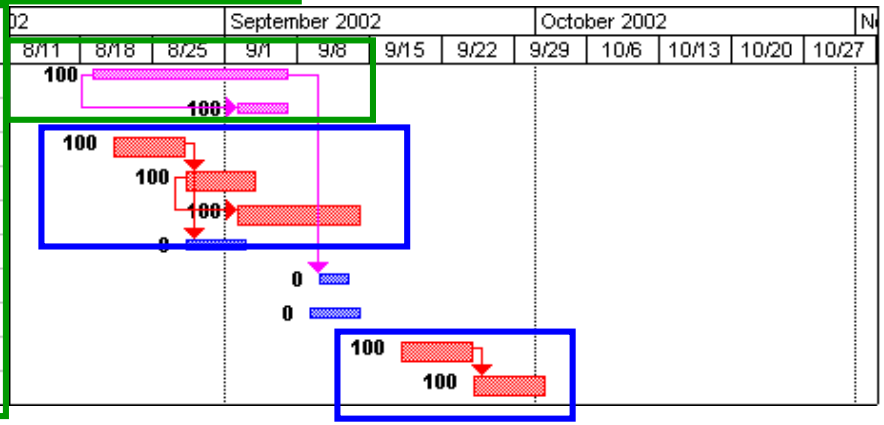
- A measure of the frequency that an activity in the project schedule is critical (Total Float = 0) in a simulation
- If a task is critical in 500 of the 1,000 iterations of the simulation, it has a Criticality Index of 0.5
- The higher the criticality index, the more certain it is that the task will be critical in the project

Criticality index, risk critical tasks

Previously (and remaining) critical

Risk critical tasks

ID	Task Name	Total Slack	Critical	% Critical	Risk Critical
67	Build remaining garage wall:	7 days	No	100	Yes
68	Garage finish work	7 days	No	100	Yes
71	Install wall, ceiling insulation	0 days	Yes	100	No
72	Measure, prepare, cut dryw	0 days	Yes	100	No
73	Hang drywall, inside, outsid	0 days	Yes	100	No
75	Finish (paint) ceiling pipes, s	6 days	No	0	No
82	Prepare soil, rototilling, etc.	31 days	No	0	No
83	Receive plants, trees, shrub	20 days	No	0	No
77	Install floor boards, moulding	0 days	Yes	100	No
78	Misc. interior finish work	0 days	Yes	100	No

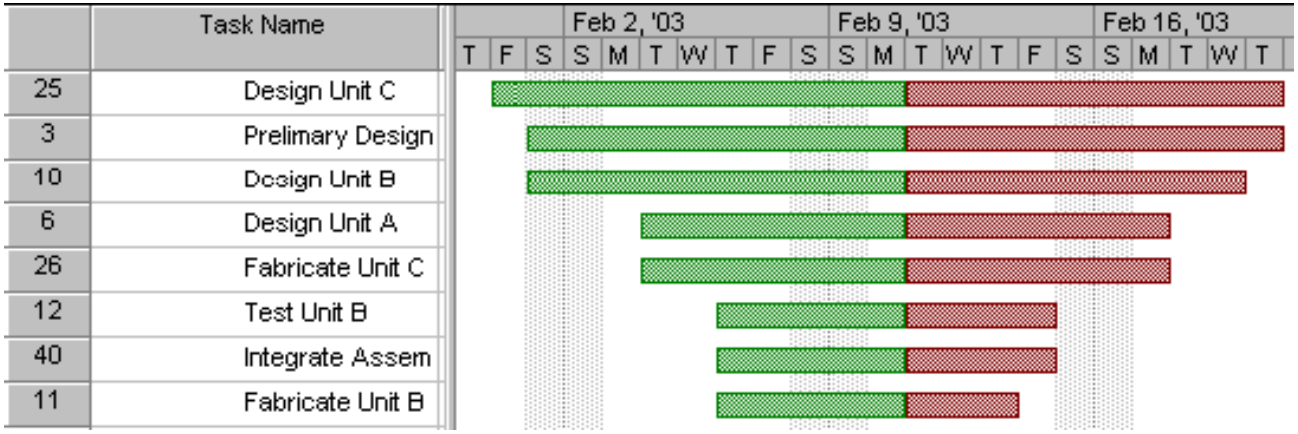


Risk Critical Index is assigned to each task, and displayed directly to the left of each Gantt bar = represents the percentage of times that task appeared on the critical path after risk was introduced.

Default Risk + © color-codes the tasks to represent different conditions. Tasks colored **blue** represent tasks that do not appear on the critical path, tasks in **red** are tasks that are on the critical path, if everything proceeds as planned, and **magenta** tasks are tasks that appear on the critical path after risk is introduced.

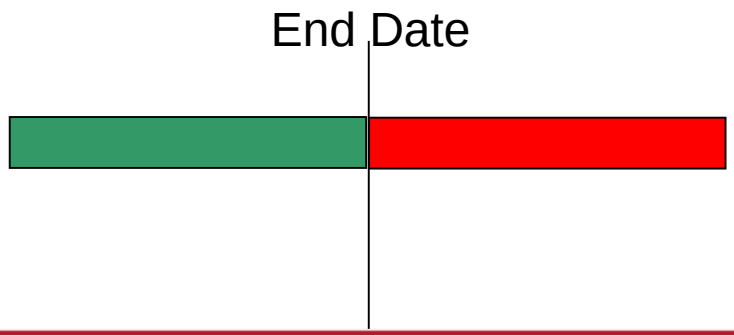
NOTE: There are some user defined fields associated with this criticality index, such as days of float or defining magenta as appearing on the critical path in greater than X% of the simulations. Left alone, defaults are zero float and 75% for magenta.

Sensitivity analysis



- This analysis determines each tasks' impact (via forward/ backward pass calculations) on the end date if the minimum (optimistic) thru the maximum (pessimistic) durations come true

If the contractor took action to ensure that the minimum duration came true, they could shave off the amount of time equal to the green bar off the end date of the program.



If the worst case ended up occurring for this task and the maximum duration came true, the contractor could expect the end of the program to push out by an amount of time equal to the red bar.

SRA – Additional Benefits

- Promotes diligent schedule maintenance
- Promotes continuous schedule structure improvement
- Fosters dedication to detail regarding rolling wave, scope updates, new task additions

Building an SRA-capable integrated, networked schedule encourages the master scheduler to follow sound scheduling techniques, industry best-practices, and promotes proactive corrections of errors and discrepancies in the day-to-day maintenance of the program IMS.

Summary

- Do you know durations of future tasks with certainty?
- SRA can be a valuable tool
- What is the probability of completing PDR on time?
- Where should management focus attention
  - For risks and opportunities?

Other resources

- EVM 263 - Principles of Schedule Management
- GAO Schedule Assessment Guide (2015)
- Planning & Scheduling Excellence Guide
- Joint Agency Cost & Schedule Risk Uncertainty Handbook

Questions?