Advanced Schedule Analysis

Justin Hornback
Program Manager
Advanced Analytics
Reed Integration, Inc.

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Topics

- Why Conduct Schedule Analysis
- Schedule Types
- Schedule Health
- Analysis Schedules
- Integrated Cost and Schedule Analysis

Sources:

- GAO, "GAO Schedule Assessment Guide, Best Practices for project schedules." May 2012.
- NASA/SP-2010-3403, "NASA Schedule Management Handbook," March 2011.
- PMBOK® Guide and Standards.
- DCMA EVMS Program Analysis Pamphlet.
  - Integrated Master Schedule (IMS) Data Item Description (DID).
- Joint Agency Cost Schedule Risk and Uncertainty Handbook

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Why are Schedules important?

- Schedules are not only a list of "things" and when they will be done.
- Schedules are the foundation for the execution of project to meet goals/requirements.
  - Identify relationships and interdependences of tasks
  - Identify required time to meet goals
  - Resources required to complete tasks
  - Progress effort
  - Sequencing decisions
  - Time phases budgets/cost estimates
  - Predict impact on schedule and budget of management decisions
  - Flexibility of schedule to external changes
    - Ex. Weather
  - Development of Risk Mitigation Plans

Why Conduct Schedule Analysis?

- GAO: “Simply put, schedule variances are usually followed by cost variances. Because some program costs such as labor, supervision, rented equipment, and facilities cost more if the program takes longer, a reliable schedule can contribute to an understanding of the cost impact if the program does not finish on time. In addition, management tends to respond to schedule delays by adding more resources or authorizing overtime. **Further, a schedule risk analysis allows for program management to account for the cost effects of schedule slippage when developing the life-cycle cost estimate.** A cost estimate cannot be considered credible if it does not account for the cost effects of schedule slippage. Thus, a well-planned schedule is a fundamental management tool that can help government programs use public funds effectively by specifying when work will be performed in the future and measuring program performance against an approved plan. Moreover, as a model of time, an integrated and reliable schedule can show when major events are expected as well as the completion dates for all activities leading up to them, which can help determine if the program’s parameters are realistic and achievable. A program’s success depends in part on the quality of its schedule. A well-formulated schedule can help analyze how change affects the program.

well-planned schedule is a fundamental management tool that can help government programs use public funds effectively by specifying when work will be performed in the future and measuring program performance against an approved plan.

Goal: Is the schedule feasible and at what cost?

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Schedule Types

- Integrated Master Schedule(IMS):
  - A schedule that includes the entire scope of effort, including the effort from government, contractor, and other key parties of a program for successful execution from start to finish.
- Analysis Schedule: Summary schedule based on Integrated Master schedule used to conduct schedule risk analysis and integrated cost and schedule analysis.
  - Maintain attributes of IMS: Task type, constraints, predecessor, successor, float, criticality, and start and finish dates.

Schedule Types cont.

- Scheduling Methodology: Rules and approaches for the scheduling Process.
  - Critical Path Method (CPM)
  - Theory of Constraints (TOC)
    - Critical Chain Method (CCM)
- Critical Path: The series of tasks, or even a single task, that determines the finish date of a project.
  - No Slack
- Critical Chain: Level loading of resources while maintaining flexible start times and ability to switch between task chains to keep project on schedule. Assumption that resources are always available. No series of tasks to determine finish date.

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Schedule Health

- Slightly varied criteria with the same goal to evaluate schedule quality:
  - NASA Schedule Management Handbook
    - STAT Tool
  - DCMA 14-point Assessment
  - GAO Schedule Assessment Guide (Basic Schedule Analysis)

Schedule Health = Schedule Quality

- NASA STAT
  - Tasks and Milestones without Predecessors
  - Tasks and Milestones without Successors
  - To Go Tasks with No Finish Ties
  - To Go Tasks with No Start Ties
  - Summaries with Logic Ties
  - Out of Sequence Relationships
  - Task and Milestones needing Updates
  - Actuals after Status Date
  - Tasks marked as Milestones
  - Tasks with estimated duration
  - Manual Tasks
- DCMA 14-point (The 5 percenter!)
  - Logic
  - Leads
  - Lags
  - Relationship Types
  - Hard Constraints
  - High Float
  - Negative Float
  - High Duration
  - Invalid Dates
  - Resources
  - Missed Tasks
  - Critical Path Test
  - Critical Path Length Index (CPLI)
  - Baseline Execution Index (BEI)

DCMA 14-point Logic

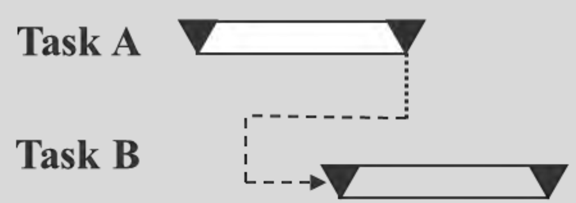
- Logic: Predecessor and Successor logic.
- Identifies tasks with missing logic links.
- Number of tasks without predecessors and/or successors **should not exceed 5%.**
- An excess of 5% should be considered a flag. The formula for calculating this metric is as follows:

$$\text{Missing Logic \%} = \frac{\text{\# of tasks missing logic}}{\text{\# of incomplete tasks}} \times 100$$

DCMA 14-point Leads

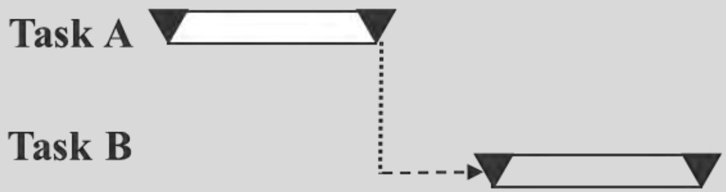
- Leads: Negative Time
- Identifies the number of logic links with a lead (negative lag) in predecessor relationships of tasks.
- Distorts the total float in the schedule and may cause resource conflicts.
- The **goal for this metric is 0.**

$$\text{Leads \%} = \frac{\text{\# of logic links with leads}}{\text{\# of logic links}} \times 100$$



DCMA 14-point Lags

- Lags: Built in time where no activity occurs before successor cannot start.
- Assesses the number of lags in predecessor logic relationship.
- The number relationships with lags **should not exceed 5%.**



$$\text{Lags \%} = \frac{\text{\# of logic links with lags}}{\text{\# of logic links}} \times 100$$

DCMA 14-point Relationship Types

- Relationship Types: Count of tasks containing each type of logic link.
- Finish-to-Start (FS) relationship type ("once the predecessor is finished, the successor can start") provides a logical path through the program and should account for at least 90% of the relationship types being used.
- Start-to-Finish (SF) relationship type is counter-intuitive ("the successor can't finish until the predecessor starts") and should only be used very rarely and with detailed justification.

$$\% \text{ of FS Relationship Types} = \frac{\# \text{ of logic links with FS Relationships}}{\# \text{ of logic links}} \times 100$$

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DCMA 14-point Hard Constraints

- Hard Constraints: Count of Hard constraints.
- Hard constraints [Must-Finish-On (MFO), Must-Start-On (MSO), Start-No-Later-Than (SNLT), & Finish-No-Later Than (FNLT)] may prevent tasks from being moved by their dependencies and prevent the schedule from being logic-driven.
- Soft constraints such as As-Soon-As-Possible (ASAP), Start-No-Earlier-Than (SNET), and Finish-No-Earlier-Than (FNET) enable the schedule to be logic-driven.
- Divide the total number of hard constraints by the number of tasks. The number of tasks with hard constraints **should not exceed 5%.**

$$\text{Hard Constraint \%} = \frac{\text{Total \# of incomplete tasks with hard constraints}}{\text{Total \# of incomplete tasks}} \times 100$$

DCMA 14-point High Float

- High Float: A task with total float greater than 44 working days (2 months).
- A task with total float over 44 working days may be a result of missing predecessors and/or successors.
- If the percentage of tasks with excessive total float **exceeds 5**%, the network may be unstable and may not be logic-driven.

$$\text{High Float \%} = \frac{\text{Total \# of incomplete tasks with high float}}{\text{Total \# of incomplete tasks}} \times 100$$

DCMA 14-point Negative Float

- Negative Float: A task with total float less than 0 working days is included in this metric.
- Helps identify tasks that are delaying completion of one or more milestones.
- Tasks with negative float should have an explanation and a corrective action plan to mitigate the negative float
- Ideally, **there should not be any negative float in the schedule.** (Re-plan)

$$\text{Negative Float \%} = \frac{\text{Total \# of incomplete tasks with negative float}}{\text{Total \# of incomplete tasks}} \times 100$$

DCMA 14-point High Duration

- High Duration: A task with a baseline duration greater than 44 working days (2 months), and has a baseline start date within the detail planning period or rolling wave is included in this metric.
- Determines whether or not a task can be broken into two or more discrete tasks rather than one.
- **The number of tasks with high duration should not exceed 5%.**

$$\text{High Duration \%} = \frac{\text{Total \# of incomplete tasks with high duration}}{\text{Total \# of incomplete tasks}} \times 100$$

DCMA 14-point Invalid Dates

- Invalid Dates: Tasks that have a forecast start/finish date prior to the IMS/Schedule status date, or has an actual start/finish date beyond the IMS status date are included in this metric.
- Task should have forecast start and forecast finish dates in the future relative to the status date of the IMS.
- Task should not have an actual start or actual finish date that is in the future relative to the status date of the IMS.
- There should zero (0) invalid dates in the schedule.

DCMA 14-point Resources

- Resources: Provides verification that all tasks with durations greater than zero have dollars or hours assigned
- The IMS DID (DIMGMT-81650) does not require the contractor to load resources directly into the schedule.
- If the schedule is not resource loaded, calculate the metric by dividing the number of tasks without dollars/hours assigned by the total number of tasks.

$$\text{Missing Resource \%} = \frac{\text{Total \# of incomplete tasks with missing resource}}{\text{Total \# of incomplete tasks}} \times 100$$

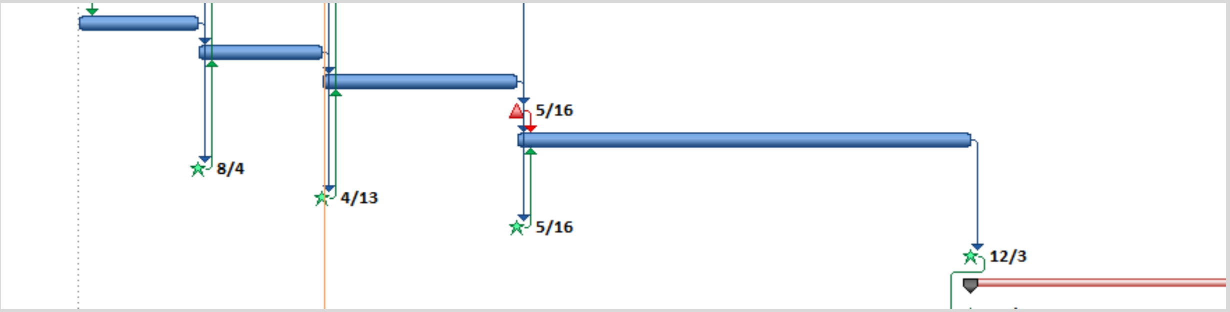
DCMA 14-point Missed Tasks

- Missed Tasks: A task supposed to be completed already (baseline finish date on or before the status date) and the actual finish date or forecast finish date (early finish date) is after the baseline finish date or the Finish Variance (Early Finish minus Baseline Finish) is greater than zero.
- Identifies how well or poorly the schedule is meeting the baseline plan.
- **The number of missed tasks should not exceed 5%.**

$$\text{Missed \%} = \frac{\text{\# of tasks with actual/forecast finish date past baseline date}}{\text{\# of tasks with baseline finish dates on or before status date}} \times 100$$

DCMA 14-point Critical Path Test

- Critical Path Test: Tests the integrity of the overall network logic and, in particular, the critical path.
- If the project completion date (or other milestone) is not delayed in direct proportion (assuming zero float) to the amount of intentional slip that is introduced into the schedule as part of this test, then there is broken logic somewhere in the network.



DCMA 14-point Critical Path Length Index (CPLI)

- CPLI: Measure of the efficiency required to complete a milestone on-time.
- Measures critical path "realism" relative to the baselined finish date, when constrained.
- CPLI of 1.00 means that the program must accomplish one day's worth of work for every day that passes.
- CPLI less than 1.00 means that the program schedule is inefficient with regard to meeting the baseline date of the milestone (i.e. going to finish late).
- CPLI greater than 1.00 means the program is running efficiently with regard to meeting the baseline date of the milestone (i.e. going to finish early).
- CPLI less than 0.95 should be considered a flag and requires further investigation. The CPLI requires determining the program schedule's Critical Path Length (CPL) and the Total Float (TF).
- The CPL is the length in work days from time now until the next program milestone that is being measured.
- TF is the amount of days a project can be delayed before delaying the project completion date. TF can be negative, which reflects that the program is behind schedule.

$$\text{Critical Path Length Index (CPLI)} = \frac{\text{CPL} + \text{TF}}{\text{CPL}}$$

DCMA 14-point Baseline Execution Index (BEI)

- BEI: Metric is an IMS-based metric that calculates the efficiency with which tasks have been accomplished when measured against the baseline tasks.
- Measure of task throughput.
- Insight into the realism of program cost, resource, and schedule estimates.
- Compares the cumulative number of tasks completed to the cumulative number of tasks with a baseline finish date on or before the current reporting period. If a Program completes more tasks than planned, then the BEI will be higher than 1.00 reflecting a higher task throughput than planned. Tasks missing baseline finish dates are included in the denominator.
- BEI less than 0.95 should be considered a flag and requires additional investigation.

$$BEI_{cum} = \frac{\text{Total \# of Tasks Complete}}{\text{Total \# of Tasks Completed Before Now + Total \# of Tasks Missing Baseline Finish Date}}$$

Schedule Health Sanity Check

- Outside of specific metrics some great questions for analysts:
  - Does the IMS reflect the total scope of work?
  - Is the correct WBS element identified for each task and milestone in the IMS?
  - Do all tasks/milestones have interdependencies identified to reflect a credible logical sequence?
  - Are task durations reasonable, measurable, and at an appropriate level of detail for effective management?
  - Does the IMS include all contract and/or designated management control milestones?
  - Does the IMS reflect accurate current status and credible start/finish forecasts for all to-go tasks and milestones?
  - Has the IMS been resource-loaded and are assigned resources reasonable and available?
  - Is the critical path identifiable and determined by the calculated IMS logic network?
  - Is the critical path credible?
  - Has the IMS content been baselined and is it adequately controlled?
  - Is there an excessive and invalid use of task constraints and relationships of leads/lags?
  - Are right task and resource calendars used in the IMS?
    - What is the working calendar?
- If an analyst is reviewing a schedule that has passed earlier review, some great questions/thoughts to consider:
  - Schedule Performance Efficiency Analysis
  - Linear Projection of Actuals Based on Schedule Performance
  - Total Slack Trend Based on Schedule Performance
  - Schedule Margin/Reserve assessment
  - Correlating and validating the integration of cost and schedule
    - Were assumptions correct? Adjusted?
  - Assessing Resources
  - EVM performance

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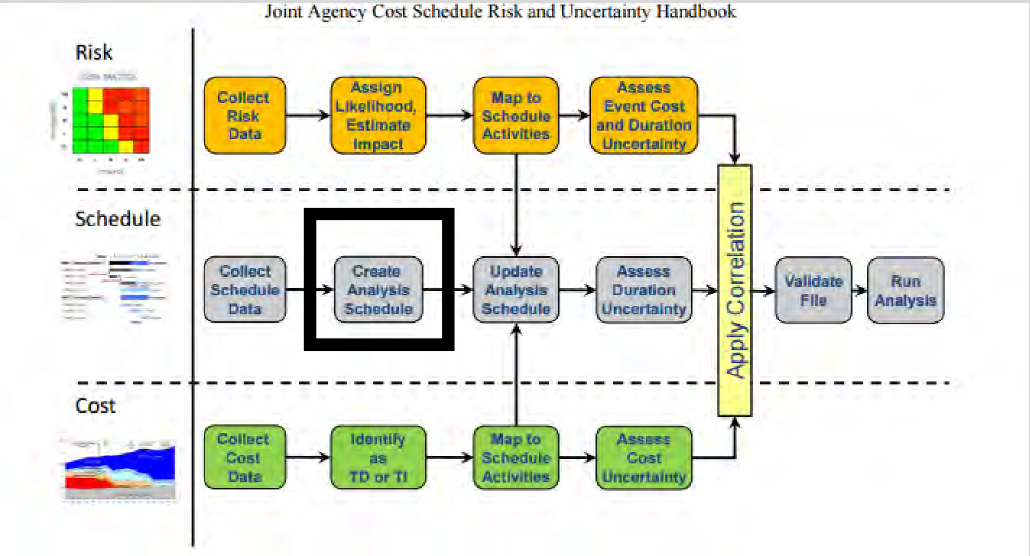
Analysis Schedules

- The Joint Agency Cost Schedule Risk and Uncertainty Handbook (CSRUH) details the Fully Integrated Cost/Schedule Method (FICSM).
- Provides Guidance for creating an Analysis Schedule suitable for the FICSM Process.



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Why Analysis Schedules?

- Very large/detailed schedules can make analysis very challenging.
  - Often multiple schedules linked to Program milestone schedule for management tracking
- Schedule does pass basic health checks, will not work for analysis.
  - No critical path
    - Many parallel activities with limited logic at Program/project level
  - Limited predecessor and successor relationships
  - Limited level of detail to identify and map schedule risks
- Required to assign Costs/Resources

What are Analysis Schedules?

- Goal would be to use Program/project Integrated Master Schedule (IMS)
- Logical network of activities/tasks required to complete the goals of a Program/project.
- Any schedule used to conduct schedule uncertainty and risk analysis.
  - Typically developed by the estimator/analyst.
  - Can be the Program/project schedule.
  - Often created in coordination with cost estimate/analysis.
  - Typically a summation of activities/tasks maintaining schedule network logic.

Analysis Schedule – Desired Attributes

- All activities defined using Work Breakdown Structure (WBS).
  - Entire scope is accounted for in schedule.
- Logic
  - All activities sequenced and utilize network logic.
- Resource loaded activities included.
  - Labor, material, overhead.
  - Time dependent and independent.
- Estimated durations included.
  - Reference to resources applied and external factors affecting duration.
  - Reference estimate foundations (ex. Expert opinion, historical).
- Critical path defined.
- Total slack, or float, identified.
  - Removed for risk and uncertainty analysis.
- Evidence of continuous updates, rolling wave approach.

- History detailed in schedule or baseline schedule provided.
  - Trend analysis.
  - Schedule analysis uncertainty foundations.
- Limited to no use of Level of Efforts (LOEs) or Hammock tasks.
  - LOE: **Latest** start dates and **earliest** finish dates.
  - Hammock: **Earliest** start dates and **latest** finish dates.
  - Not modeled in schedule analysis as activities should not fall on critical path, required capture for cost analysis.
- No or very limited use of task constraints.
  - Example: Launch window
- Utilizes standard working hours.
  - No schedule crashing.

*Source: NASA Independent Program Assessment Office Programmatic Assessment Group

Analysis Schedule - WBS Mapping

- All activities defined using Work Breakdown Structure (WBS).
  - Mapped to common WBS, traceable, repeatable.
  - Ensures scope is accounted for in schedule.
  - Additional benefit of Mapping to Lifecycle Cost Estimate.
  - Time phased with fiscal year.

1		**Missile System Project**	**1**	**2393 days**	**Tue 10/1/13**	**Thu 12/1/22**
2		Modeled Contract Award	1.1	0 days	Mon 12/2/13	Mon 12/2/13
3		**Ctr Award Delay**	**1.2**	**45 days**	**Tue 10/1/13**	**Mon 12/2/13**
4		Planned Award	1.2.1	0 days	Tue 10/1/13	Tue 10/1/13
5		Delayed Award	1.2.2	45 days	Tue 10/1/13	Mon 12/2/13
6		**EMD**	**1.3**	**1305 days**	**Tue 12/3/13**	**Mon 12/3/18**
7		**EMD HW Des & Dev**	**1.3.1**	**880 days**	**Tue 12/3/13**	**Mon 4/17/17**
8		EMD HW Sys Des	1.3.1.1	175 days	Tue 12/3/13	Mon 8/4/14
9		EMD HW Initial Des	1.3.1.2	180 days	Tue 8/5/14	Mon 4/13/15
10		EMD HW Detailed Des	1.3.1.3	285 days	Tue 4/14/15	Mon 5/16/16
11		EMD HW Final Des	1.3.1.4	240 days	Tue 5/17/16	Mon 4/17/17
12		**EMD Software**	**1.3.2**	**1305 days**	**Tue 12/3/13**	**Mon 12/3/18**
13		EMD SW Sys Des	1.3.2.1	175 days	Tue 12/3/13	Mon 8/4/14

*Project File Source: Joint Agency Cost Schedule Risk and Uncertainty Handbook (JA CSRUH) Supporting Documents

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Analysis Schedule - Logic

- Logic
  - All activities sequenced and utilize network logic in accordance with IMS.
  - Assumption of good IMS health.
  - If health is poor analyst needs to add logic to allow for schedule to replicate real changes and shocks to the schedule.

	Predecessors	Successors
22		
13	5	8,13
13		
13		5
13	4	2
18		
17		
14	2	9,38SS,41SS,18,28SS,31SS,34SS
15	8,18	10,19
16	19,9	11,21,20
17	20,10	43
18		
14	2	14,18
15	18,13	15,19
16	19,14	21,17,20,16
16	15	17,21
18	20,15,16	39FF,42FF,29FF,32FF,35FF,43
14	8,13	9,14
15	9,14	10,15
16	10,15	11,21,23,17
17	20,10,15,16	23,43
18		

Analysis Schedule – Resource Loading

- Resource loaded activities included in analysis schedule if time and demand allows.
  - Labor, material, overhead.
  - Time dependent and independent costs.
  - WBS level for cost mapping determined and maintained.

JACS TI Task Cost	JACS TI Cost Uncertainty	JACS TI Spending Contour	JACS TD Task Cost	JACS TD Cost Uncertainty
$0.00			**$0.00**	
$0.00			$0.00	
$0.00			**$0.00**	
$0.00			$0.00	
$0.00			$0.00	
$0.00			**$0.00**	
$0.00			**$0.00**	
$0.00		Flat	$1,200,000.00	LN*(165,125);Correl(EMD_CO
$0.00		Flat	$2,400,000.00	LN*(165,125);Correl(EMD_C
$0.00		Flat	$6,000,000.00	LN*(165,125);Correl(EMD_CO
$0.00		Flat	$2,400,000.00	LN*(165,125);Correl(EMD_CO
$0.00			**$0.00**	
[illegible]	[illegible]	[illegible]	[illegible]	

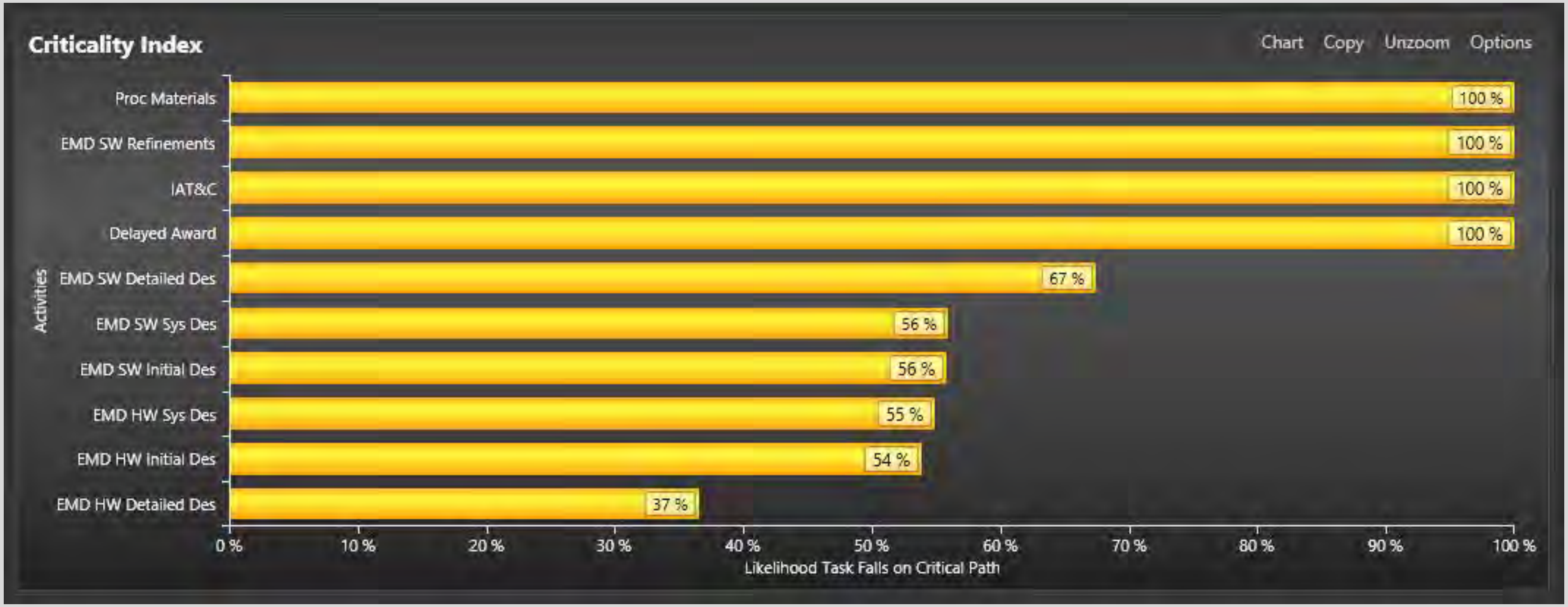
Analysis Schedule – Estimated Durations Included

- Estimated durations included.
  - Minimum, Most Likely, Maximum
    - Actual durations
    - Duration Percentage
  - Reference to resources applied and external factors affecting duration.
  - Reference estimate foundations (ex. Expert opinion, historical).
    - Baseline execution index
    - EVM
    - Experts
    - Analogous
    - Schedule Estimating Relationship (SER)

JACS Duration Uncertainty
Tri*(90,100,120,10,80);Correl(EMD_DUR=0.9)
Tri*(90,100,120,10,80);Correl(EMD_DUR=0.9)
Tri*(90,100,120,10,80);Correl(EMD_DUR=0.9)
Tri*(90,100,120,10,80);Correl(EMD_DUR=0.9)
Tri*(90,100,120,10,80);Correl(EMD_DUR=0.9)
Tri*(90,100,120,10,80);Correl(EMD_DUR=0.9)
Tri*(90,100,120,10,80);Correl(EMD_DUR=0.9)

Analysis Schedule – Critical Path

- Critical Path Defined
  - IMS critical path maintained in analysis schedule
    - Secondary, and tertiary path analysis.
    - Look for changes resulting from risk and uncertainty analysis.



Analysis Schedule –Slack, Float

- Total slack, or float (leads and lags), identified and removed where possible.
  - Removed for risk and uncertainty analysis by zeroing out the task duration.
  - Pulls Program finish date to the left.
    - Risk and Uncertainty analysis pushing back to the right to show a more realistic picture of schedule margin.
  - Schedule reserve or margin built into the schedule is removed.
  - If reserve/slack/float is allocated to a task and there is a plan to use it, it is no longer reserve or margin, it is mitigation, and in that case it is left in the schedule.
    - Document these assumptions/methodologies in your analysis.

Analysis Schedule – Updates and Baselines

- Evidence of continuous updates, rolling wave approach.
  - If multiple baselines are included in the schedule file analysts should protect data for use in informing performance or estimating uncertainty or risk factors.
  - NASA Example of what to look for from updates and new baselines as Programs mature:
    - Phase A: Concept and Technology Development: Preliminary schedules. Milestones should have predecessor and successor activities. Critical path should be identifiable; reasonable slack. Funded schedule reserve should be included, resources should be identified. Phased schedule synchronized phased budget
    - Phase B: Preliminary Design and Technology Completion: Baseline schedule. Reporting and other schedule management criteria should be in place and in practice by the project. Regular status updates, reporting, and performance analysis should be taking place in the project office. The schedule captures actuals (time and cost) at the appropriate WBS level.

Analysis Schedule – Level of Effort

- Limited to no use of Level of Efforts (LOEs) or Hammock tasks.
  - LOE: **Latest** start dates and **earliest** finish dates.
  - Hammock: **Earliest** start dates and **latest** finish dates.
  - Not modeled in schedule analysis as activities and should not fall on critical path, required capture for cost analysis.
    - Time Dependent
    - Example: Program Office Activities
      - Safety & Mission Assurance
      - Business Office
      - Education Outreach
- No uncertainty applied to LOEs
  - Schedule logic will push and pull these events

Analysis Schedule - Constraints

- Must Start On, Must Finish On, Start no later than than, etc.
- Reminder: A constraint prevents the calculated schedule from being pushed beyond a specific date for the task.
- No or very limited use of task constraints in schedule analysis.
- Will override schedule risk and uncertainty analysis.
  - Example: Launch window, must finish on
- Some are justified, provide detail/justification
  - Example: Start no earlier than a launch window.
- Soft Constraints: does not prevent the schedule form being changed based upon its dependencies.
  - Example: As soon as possible, Start no earlier than, etc.

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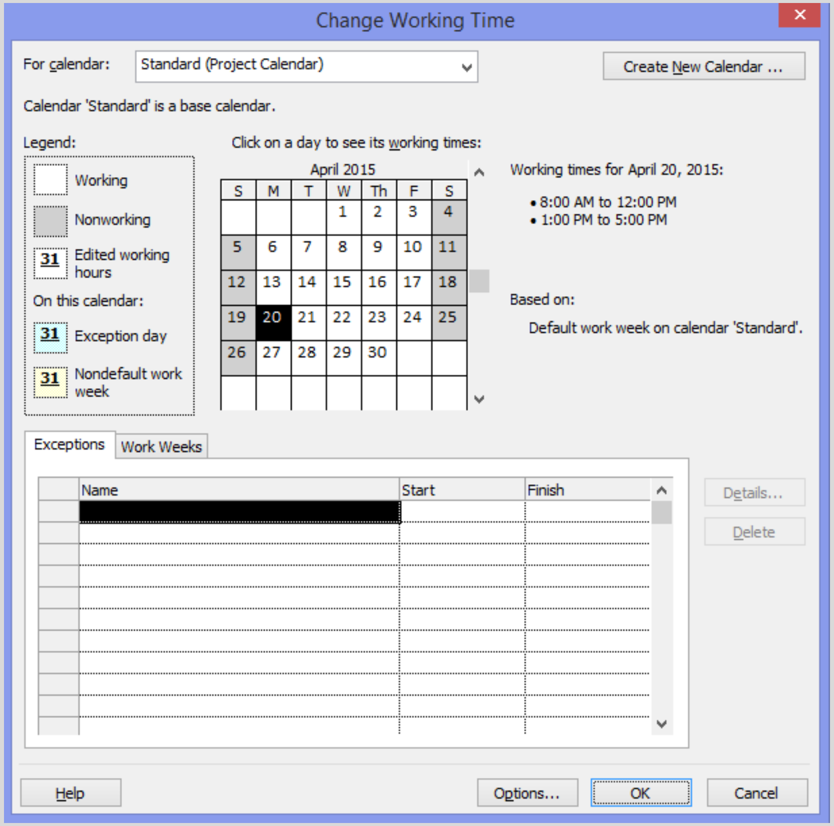
Analysis Schedule - Calendar

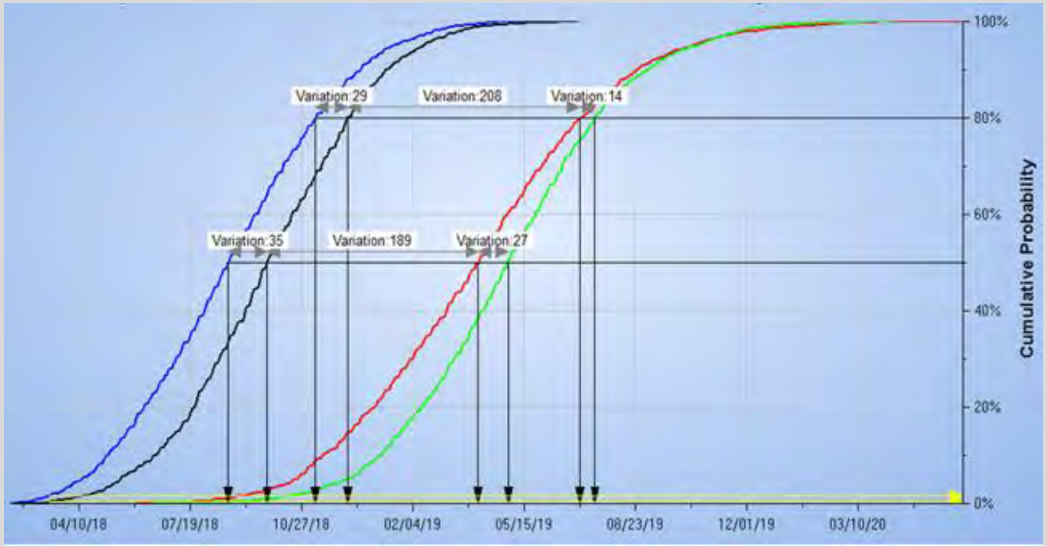
- Utilizes standard working hours.
  - Extra or long shifts can be used but must be documented and captured correction in schedule properties to be used for analysis.
- No schedule crashing.
  - Heroic efforts to improve schedule and cost performance



Schedule Risk Analysis

- Schedule Risk Analysis
  - Model Activity/Task Durations as Uncertain Quantities that have Probability Distributions
  - Combine Activity/Task Durations Statistically (Monte Carlo simulations) to Generate Cumulative Distributions of Project Total Duration
  - Obtain confidence level dates to determine additional amount of time to complete project
  - Identify best and deterministic date and probability of project completion date.
    - *Stephen A. Book. “Schedule Risk Analysis: Why It is Important and How to Do It. March 2002.

  - Discrete schedule risk mapping.
  - Schedule risk factor mapping.



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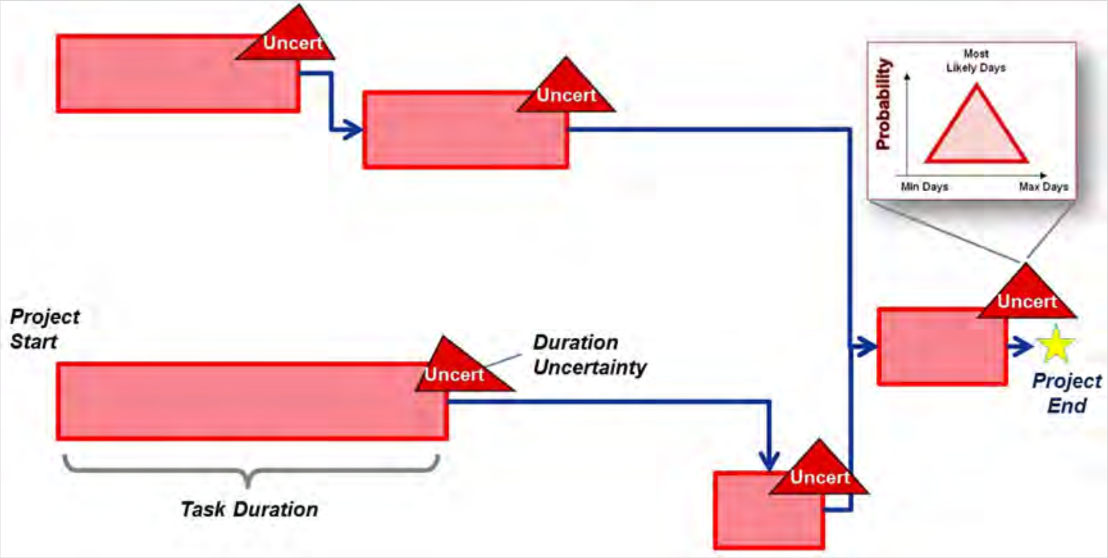
Schedule Risk Analysis - Uncertainty

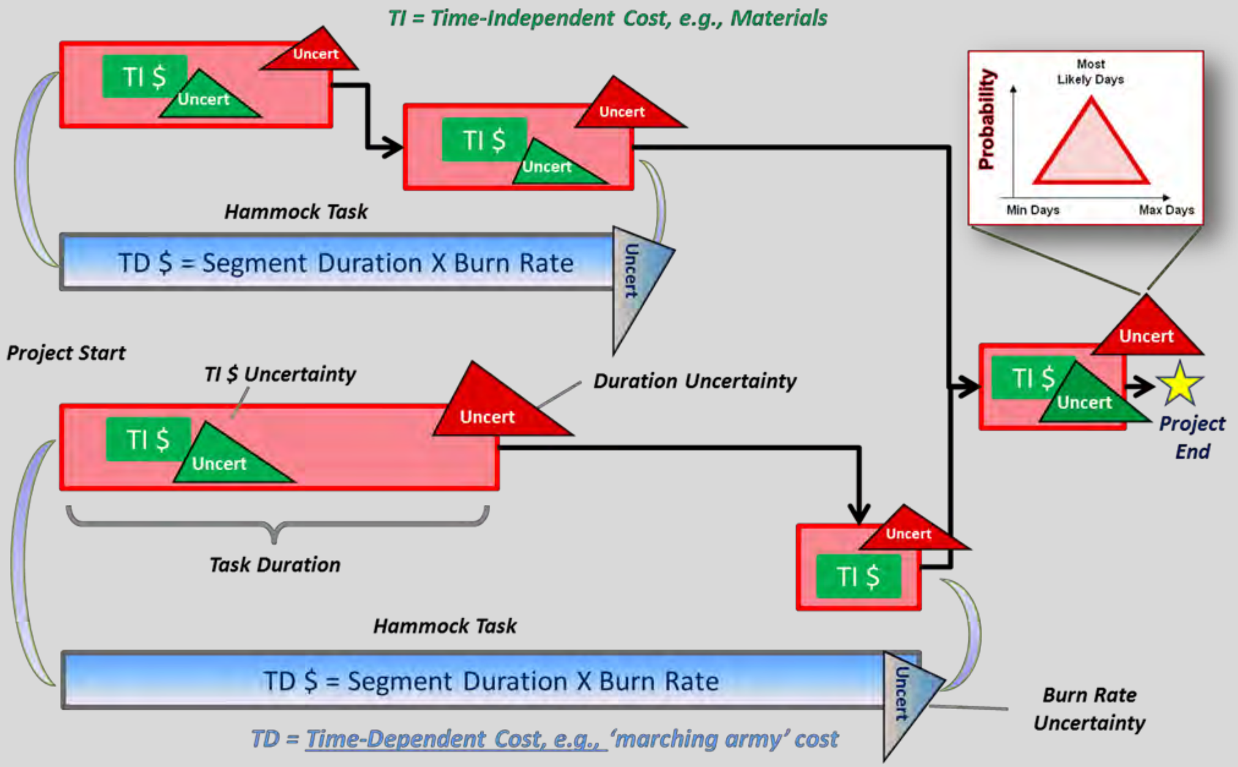
- A Program/project IMS is a schedule point estimate.
- By requiring three point estimates you as an analyst are obtaining high level uncertainty bounds.
- This uncertainty can be applied to task durations.



Modeling Uncertain Durations

Schedule Risk Analysis – Uncertainty Schedule and Cost

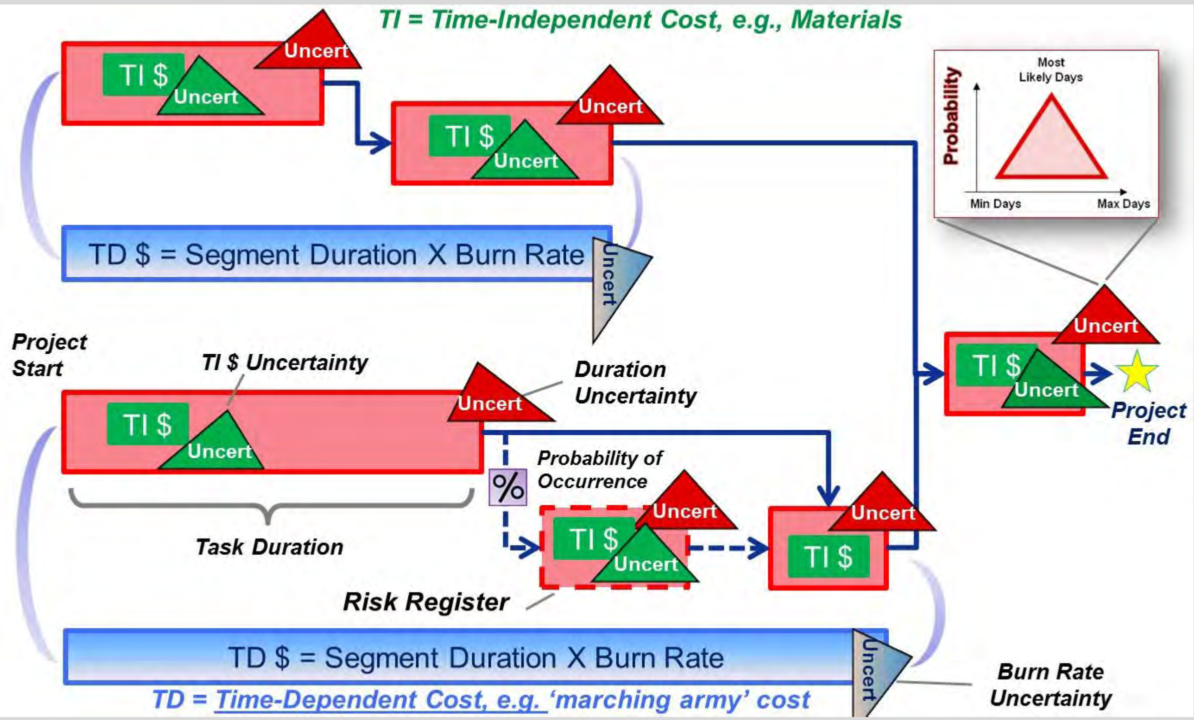
- Powerful modeling tool to combine schedule duration uncertainty with time dependent costs.



Modeling Uncertain Durations with Time Independent and Time Dependent Costs

Schedule Risk Analysis – Risk

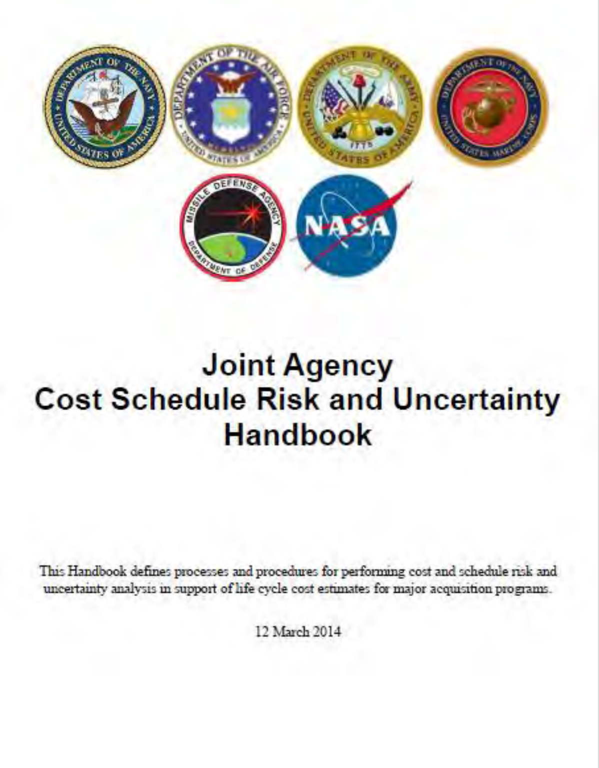
- Map risk events into the schedule.
  - Both Cost and Schedule



Modeling Risk Events

FICSM

- The Joint Agency Cost Schedule Risk and Uncertainty Handbook (CSRUH) Appendix B provides a guide to conduct and fully integrated cost and schedule method (FICSM) to integrate three pieces of information:
    1. Cost Uncertainty
    2. Schedule Uncertainty
    3. Risk



Joint Agency
Cost Schedule Risk and Uncertainty
Handbook

This Handbook defines processes and procedures for performing cost and schedule risk and uncertainty analysis in support of life cycle cost estimates for major acquisition programs.

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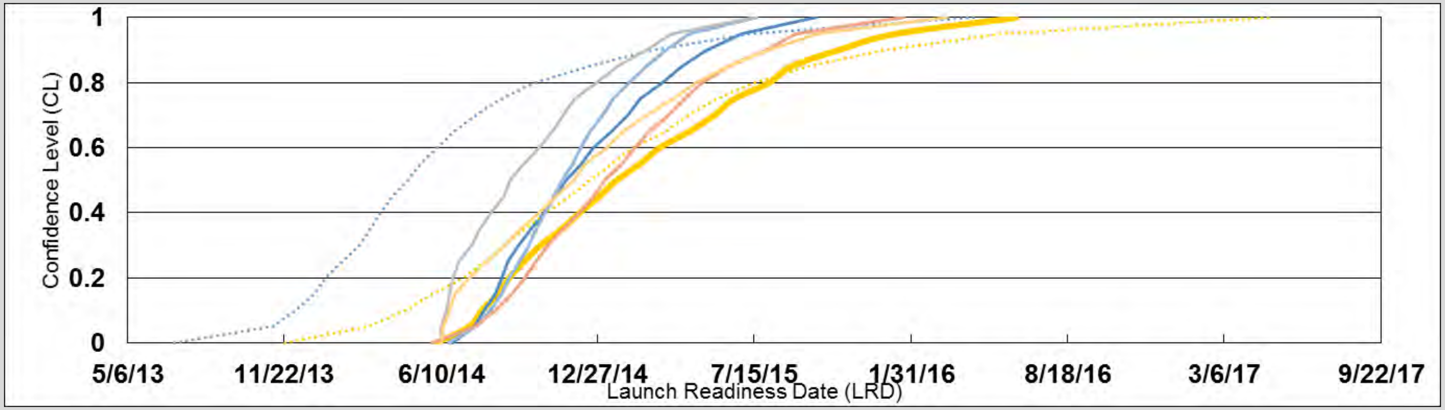
Pitfalls of Analysis Schedules

- Merge Bias: two or more uncertain paths merge at one milestones pushing it to the right more than if the individual paths leading to it.
- Model creation over summarizes task durations and logic.
  - Loss of details of individual tasks and logic
  - Critical Path sensitivity
- Scenario lottery
  - Running large number of scenarios to achieve desired result.



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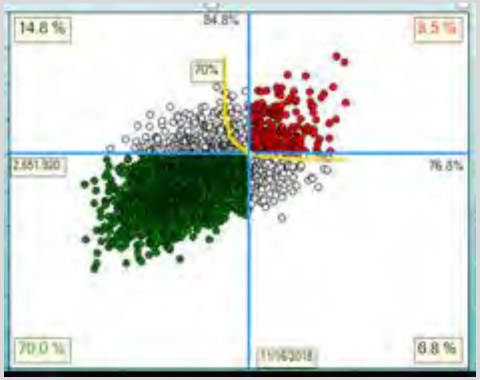
Inadequate Schedules

- Budgets are not suitable for Cost Basis of Estimates and therefore notional deadlines (ex. Launch date, budget cycles) are not suitable for Schedule development.
  - Independently derived duration estimates.

Importance to Joint Cost/Schedule Confidence Level Development

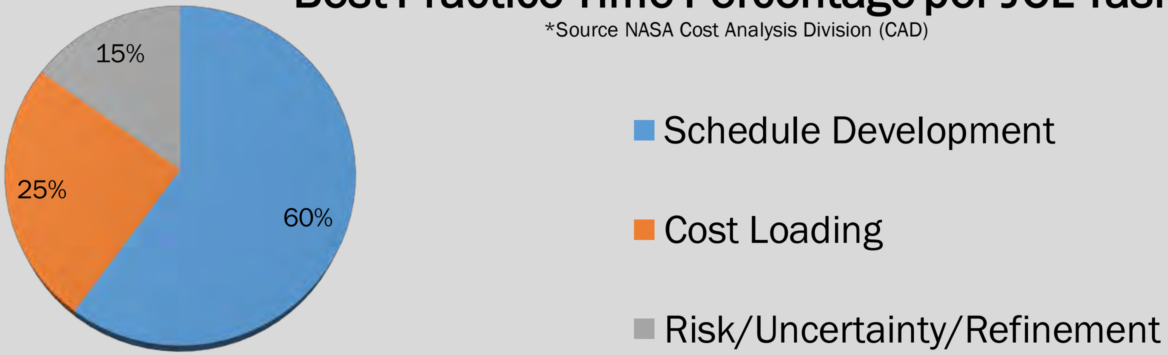
- Growing implementation of Joint Cost/Schedule Confidence Level (JCL) highlights importance of Schedules, ex. NASA.
- JCL development procedure steps:
  1. Develop the Schedule (60%)
  2. Cost/Resource Load the Schedule (25%)
  3. Incorporate Risks (Cost/Schedule)
  4. Conduct Uncertainty Risk Analysis
  5. Obtain Results and Plot outputs
  6. Analyze Results and Refine

  (15%) [steps 3–6]



Best Practice Time Percentage per JCL Task

*Source NASA Cost Analysis Division (CAD)



Point of Contact

Justin Hornback, PMP, CCEA

Program Manager/Analyst – Advanced Analytics

Reed Integration, Inc.

jhornback@reedintegration.com

757-541-8035 (o)

757-435-0050 (m)

www.reedintegration.com

Additional Resources:

- GAO, "GAO Schedule Assessment Guide, Best Practices for project schedules." May 2012. http://www.gao.gov/assets/600/591240.pdf
- NASA/SP-2010-3403, "NASA Schedule Management Handbook," March 2011.
- PMBOK® Guide and Standards. http://www.pmi.org/PMBOK-Guide-and-Standards.aspx
- DCMA EVMS Program Analysis Pamphlet. http://www.dcma.mil/policy/200-1/PAM-200-1.pdf
- Integrated Master Schedule (IMS) Data Item Description. http://dcarc.cape.osd.mil/files/evmcr/ims_did.pdf
- Joint Agency Cost Schedule Risk and Uncertainty Handbook. https://www.ncca.navy.mil/tools/csruh/JA_CSRUH_16Sep2014.pdf