AUGUR

Schedule Analysis Best Practices for Capital Projects

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Summer 2024

Speaker Biography

- Mr. Dave Ingalls, EVP
- Augur Consulting: CEO and Co-Founder
- Certified Earned Value Professional by AACE
- 15+ years providing cost engineering and schedule analysis services to DoD and DOE
- Supports DoD and DOE providing expertise on project controls, schedule management, and IBR's
- Avid cyclist, data nerd, Seahawks fan, and father to two young children

AUGUR

Augur Introduction

Data Science/Data Analytics

Cost Analysis

- Lifecycle Cost Estimating, PPB&E Support, Program Planning
- IGCEs, Source Selections, Vendor Negotiations
- Specialized Cost Analysis: AoAs, BCAs, CAIV, Should-Cost

Schedule Analysis

- Schedule Construction and Maintenance
- Vendor Schedule Analysis, Schedule Health Assessments
- Schedule Risk Assessments, Critical Path Identification & Management

Performance Management

- Earned Value Management (EVM) Analysis
- Integrated Baseline Reviews (IBRs) & IBR Training
- Contract and Vendor Management

- Augur is an SDVOSB based in the DC metro area
  - Founded 2012
  - Support government customers in DoD, DOE, & other government agencies
- Provide analysis aligned to 3 Core Competencies
  - Cost, Schedule, and Performance Management
  - All work is underpinned by data science capability

Emphasis on Data Science has Inspired New Techniques for Problem Solving

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Section 1

GAO Best Practices and Schedule Construction

Problem Statement

Problem Statement	Objective
• Programs require a measurable baseline to determine program status and forecast future efforts • Program Managers (PMs) require an understanding of what constitutes a sufficient, defendable schedule	• Outline the schedule development process from schedule construction and analysis to risk mitigation • Define characteristics of a “good” schedule and how a PM can leverage the schedule to better track program progress

Evaluating a “good” Schedule

- Schedules (IMSs) adheres to GAO Best Practices (BPs)
  - BPs establish standards for schedule construction and maintenance
- Schedule meets thresholds for schedule construction metrics
  - Metrics can be evaluated for logic, lags/leads, constraints, slack, etc.
  - Contains no leads, Start-Finish logic, manual tasks, or hard constraints
  - Identify percentage of tasks within schedule that lack resources
- Schedule baseline is essential property of a “good” schedule
  - Baseline establishes program’s initial timeline by task
  - Leveraged to determine delta between planned vs actual timeline
  - Required in applying Earned Value (EV) to a program and its schedule

GAO Best Practices

Best Practices are not pass/fail; BPs should be tailored to project specific needs

Schedule Construction Scorecard

- Flags potential issues with schedule validity
- Limit use of constraints; conflicts with embedded dynamic schedule logic
- Keep short durations for tasks; break out long tasks
- Limit use of lags & keep them short; never implement a lead

Metric Scorecard (%)			
Metric	**Ranges**		
Logic	0-5%	6-10%	11-100%
	% of tasks with non-FS logic		
Lags	0-5%	6-10%	11-100%
	% of tasks with Lags		
High Duration	0-5%	6-10%	11-100%
	% of tasks with a high duration (> 44 days)		
Missed Tasks	0-5%	6-10%	11-100%
	% of tasks being completed after their baseline finish date		
Relationships	0-80%	81-90%	91-100%
	% of tasks with a FS relationship		
BEI	0-80%	81-90%	91-100%
	Number of Actual Tasks Completed / Number of Tasks Baselined to Complete		
Leads	0	1+	
	# of tasks with Leads		
Hard Constraints	0	1+	
	# of tasks with a Hard Constraint		
Invalid Forecast Dates	0	1+	
	# of tasks that have a projected start/finish date prior to status date and < 100%		
Invalid Actual Dates	0	1+	
	# of tasks with an actual start/finish after the status date		
Negative Float	0	1+	
	# of tasks with a Negative Float		

Schedule Construction Summary

- Construction metrics should be viewed as just a starting point
  - Metrics are a starting point for determining schedule health
- More important for a schedule to be “good” than right
  - Schedules are dynamic estimates that will never be 100% correct
  - Accuracy of the schedule is dependent on quality fundamentals
- There are multiple key fundamentals for a quality schedule:
  - Having a valid Critical Path
  - Realistic durations; identifying task durations requires lots of legwork
  - Tasks have logical and reasonable dependencies
  - Reasonable slack/float; unreasonable slack/float indicative of bad logic

Critical Path vs. Driving Path

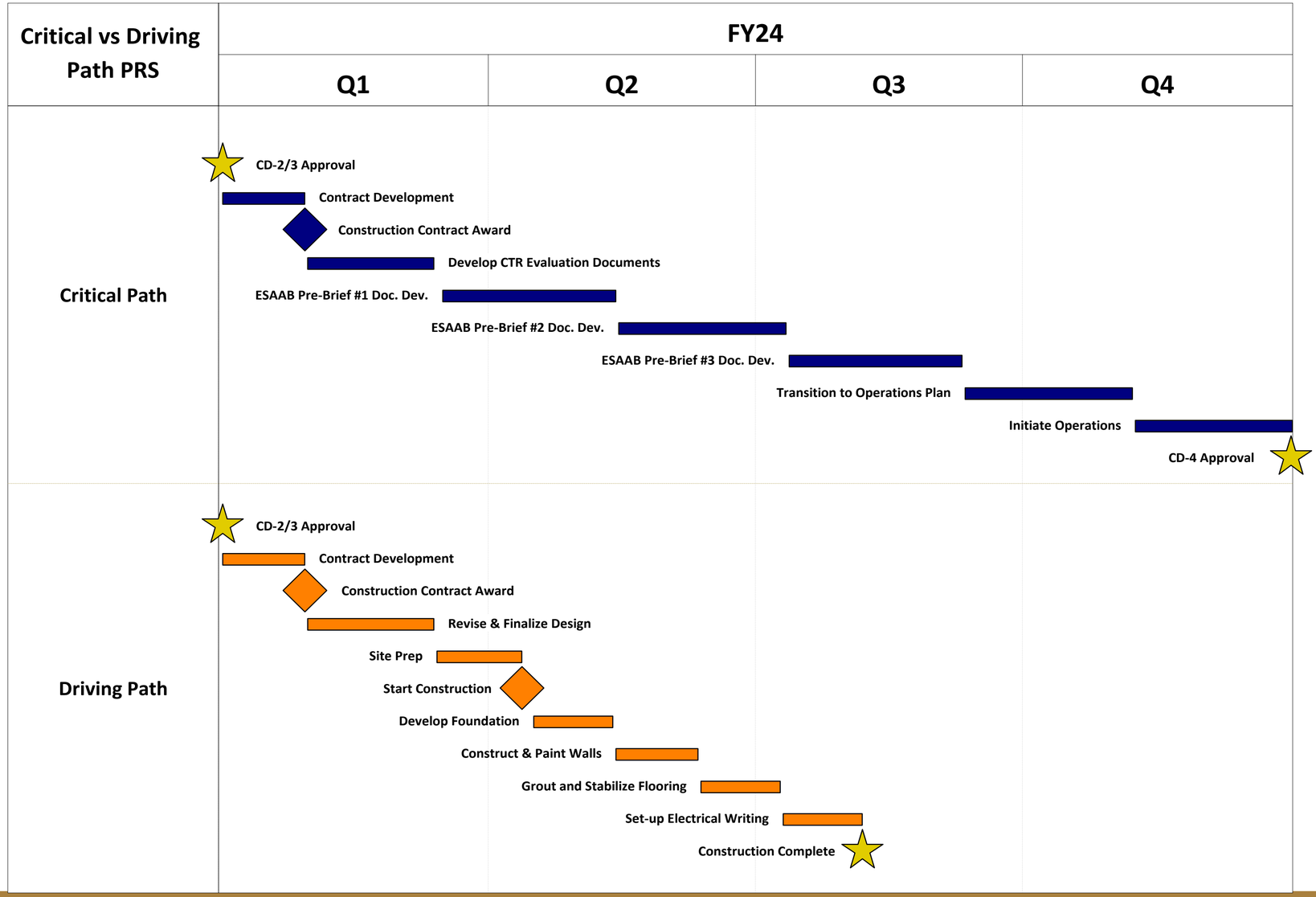
Critical Path

- Longest continuous path leading to last scheduled task
- Critical Tasks = 0 days Total Slack
- Fluid and evolving; Critical and Near-Critical tasks merit tracking
- Schedule contingency identified

Driving Path

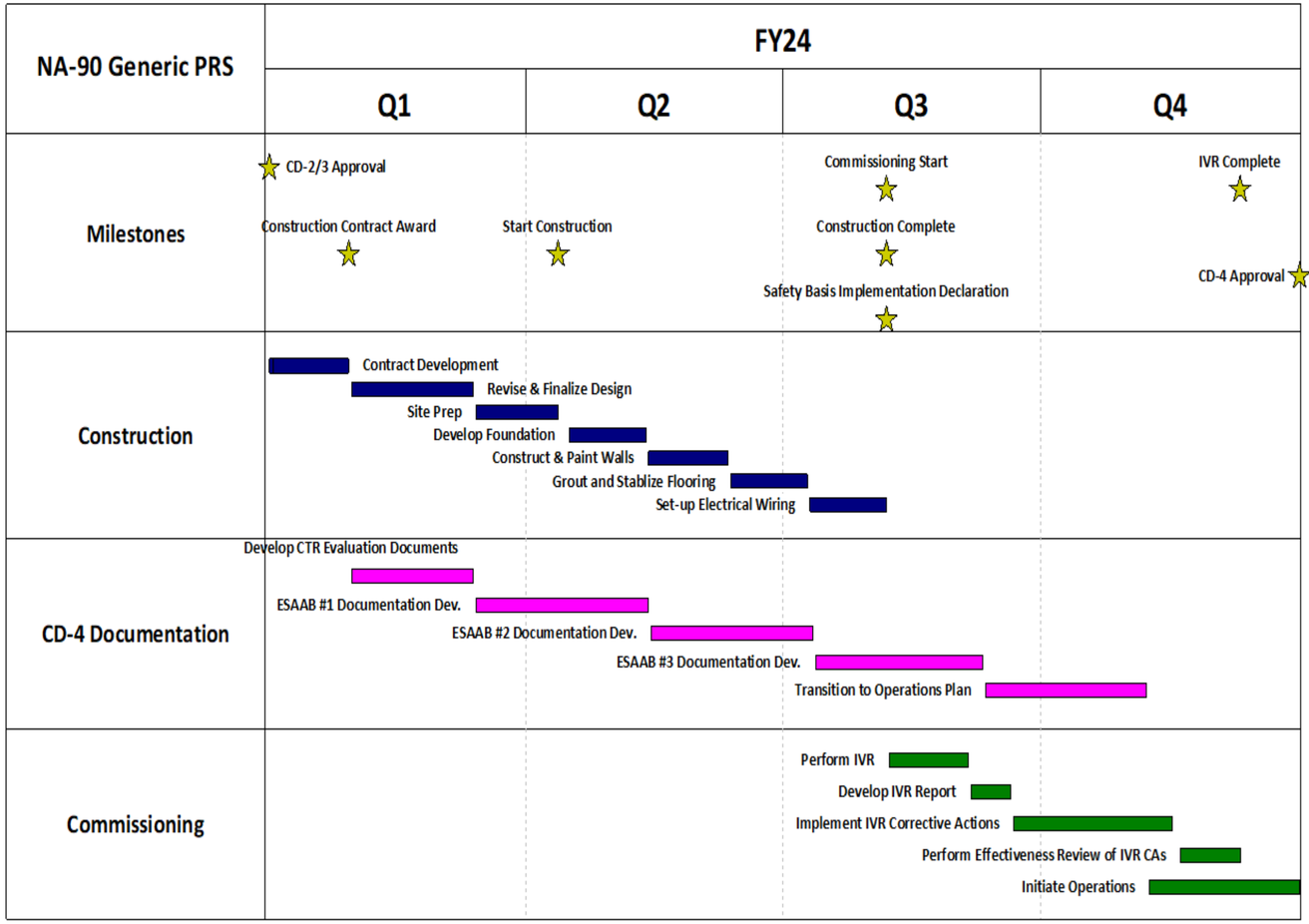
- Focus on driving predecessors leading to major milestones
- Flexibility in tracking Driving Paths; should reflect priorities
- Driving Path milestones may exceed last task in importance
- Align interdependencies

Critical/Driving Path Visualization



Program Roadmap Schedule (PRS)

- Multiple ways to develop a PRS
- Visual representation of IMS
- Showcases milestones & events
- Easy interpretation for PMs
- Presentable stakeholder format



Obstacles to Schedule Validity

Invalid Critical Path	*Issues caused by LOE tasks, constraints causing error, and dangling logic*
Lack of Baseline	*Required as a performance benchmark & to calculate schedule execution metrics*
Unrealistic Durations	*Each task must include a duration to calculate projected start and finish dates*
Manually-Scheduled Tasks	*Creates conflict with a schedule's dynamic model; prevents tasks from auto-updating*
No Custom Calendar(s)	*Default calendars don't capture many non-working days; issue on longer schedules*

Best Practice Opportunity

- Question: How can we resolve schedule construction issues?
  - Answer: Leveraging Integrated Baseline Reviews (IBRs)!
  - Allows for proactive analysis of schedule construction / assumptions
  - Identify schedule errors prior to baselining schedule and PMB
  - Improve accuracy of execution metrics through a healthy schedule
- IBR an opportunity to baseline & establish a good IMS
  - PM & Vendor meet to communicate for mutual understanding of plan
  - Program's planned schedule can be baselined during the IBR
  - Identify and rank potential risks that could occur during execution

Section 2

Schedule Analysis and Management

Introduction to Schedule Analysis

- Critical and Driving Path(s)
  - Critical Path(s) can change; track critical **& near-critical tasks**
  - Manage driving path(s) leading up to major program milestones
- Logic Issues
  - Identify out-of-sequence, incomplete, and missing/dangling logic
  - Errors in logical dependencies can cause unreasonable float/slack
- Schedule Metrics
  - Execution Metrics provide starting point to determine IMS progress
  - Earned Schedule is a form of EV designed for schedule evaluation
- Baseline Integrity
  - Establish baseline to conduct comparative analysis with projections
  - Consider re-baseline if current IMS does not reflect program reality

Critical Path (CP) Analysis

- Critical path analysis key to effective schedule evaluation
  - PMs should track how critical path changes month to month
  - Highlight driving predecessors that lead to project completion
  - Track near-critical tasks; these may become critical in the future
- Confirm the critical path is valid (BP #6)
  - Objective to identify & resolve risks pushing completion date ASAP
  - Resolve LOE tasks, constraints/lags causing errors, & dangling logic
- PMs should balance critical path with driving path analysis
  - Critical paths may not capture important milestones and events
  - PMs should analyze driving paths that lead up to crucial milestones

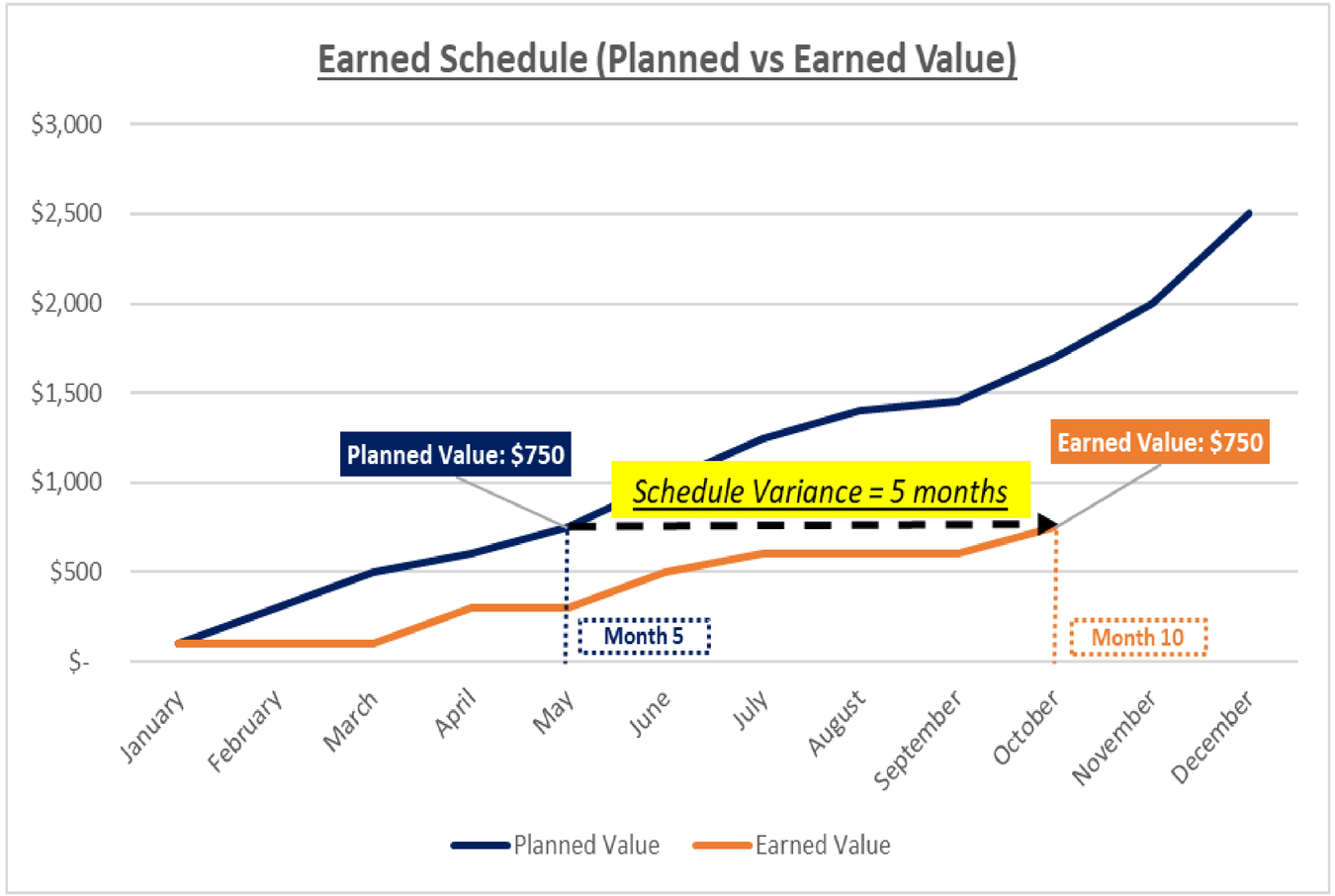
Schedule Execution Metrics

- Execution metrics compare baseline plan to actual progress
  - Provides insight into program progress through quantifiable data
  - Updating IMS w/ actuals required for execution metric calculations
  - Various metrics provide different perspectives of schedule status
  - Proper schedule construction & baseline needed for valid metrics
- Common schedule execution metrics include:
  - Baseline Execution Index (BEI) – Number of tasks completed compared to the number of tasks baselined to be completed
  - Current Execution Index (CEI) – Near-term accuracy of forecasts
  - Hit or Miss (HoM) - Percentage of tasks completed at/before their baseline finish date. Stricter criteria compared to BEI
  - Critical Path Length Index (CPLI) – Float density on critical path

Earned Schedule 101

- Earned Schedule is a variant of EVM
  - Time-based interpretation of EVM data
  - No additional data required for analysis
  - Yields performance index of PV vs. EV, but does not incorporate critical path

- Earned Schedule assesses Schedule Variance in a different manner
  - Compares planned time to "earn" a given value against the actual duration needed
  - Planned Value represents PMB; original plan for that work to be completed
  - Graphic depicts 10 months needed to earn 5 months of planned value



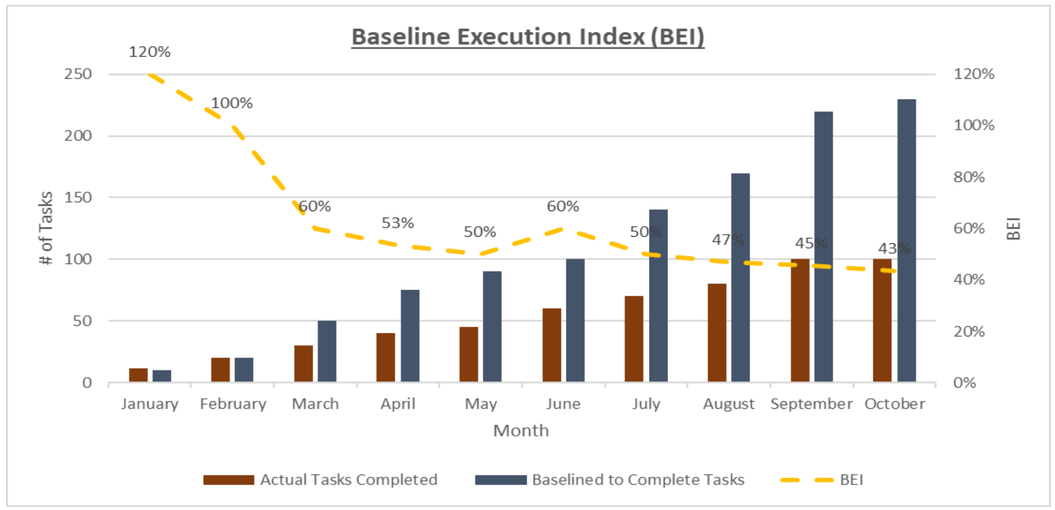
Earned Schedule Metrics

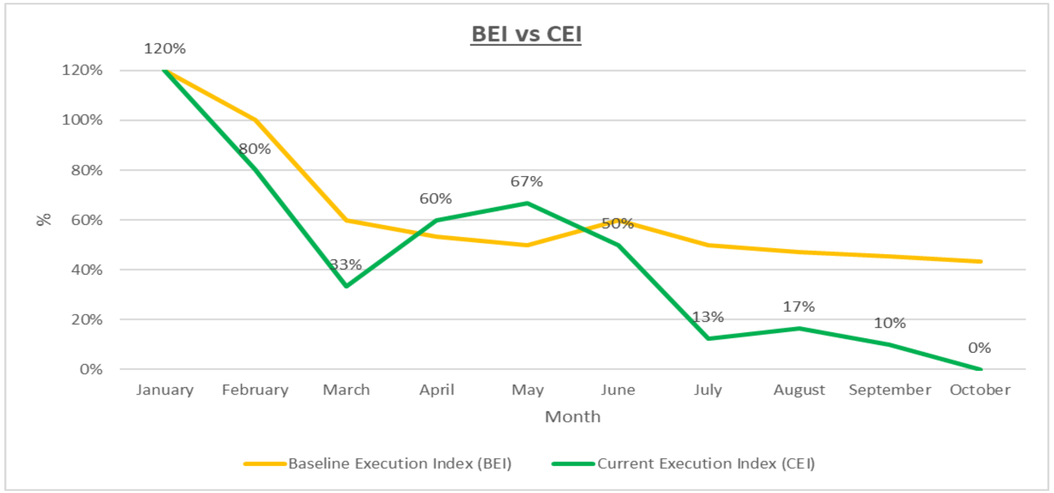
- Earned Schedule Variance (ESV):
  - Delta in time between planned vs. actual achievement of ESV
  - Highlights status of where schedule is against where it should be
- Schedule Performance Index - time (SPIt):
  - ESV performance metric on a 1.0 scale – useful for ES forecasting
- To Complete Schedule Performance Index (TSPI):
  - Ratio of work required to forecast complete schedule (sanity check!)
- Duration to Complete (DTC):
  - Forecast calculation for the number of months of work remaining
  - Should decrease by one month after every month - often doesn’t

Earned Schedule does not focus on critical tasks; it evaluates breadth of activities

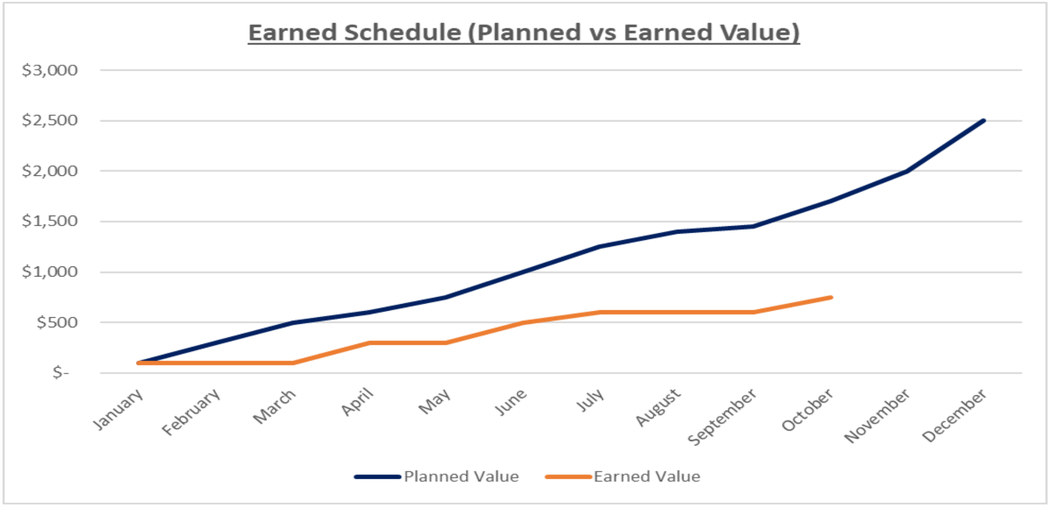
Schedule Analysis Dashboard

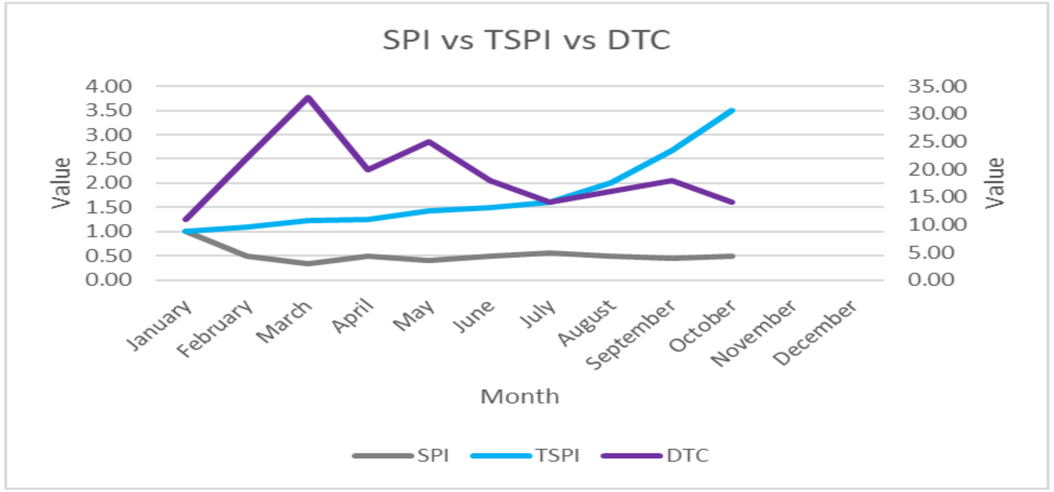
Schedule Execution Metrics





Earned Schedule Metrics





Schedule Analysis Summary

Schedule analysis has the following objectives…

Construction Phase

- Adherence to GAO Best Practices
- Evaluation of Schedule Health
- Validation of Critical Path
- Resolution of construction errors and mutual buy-in of scope/time

Execution Phase

- Independent assessment of current schedule progress and path forward
- Dependable forecast of outcomes
- Comparison of baseline vs. actuals
- Implementation of risk mitigations

Section 3

Schedule Risk and Risk Mitigation Strategies

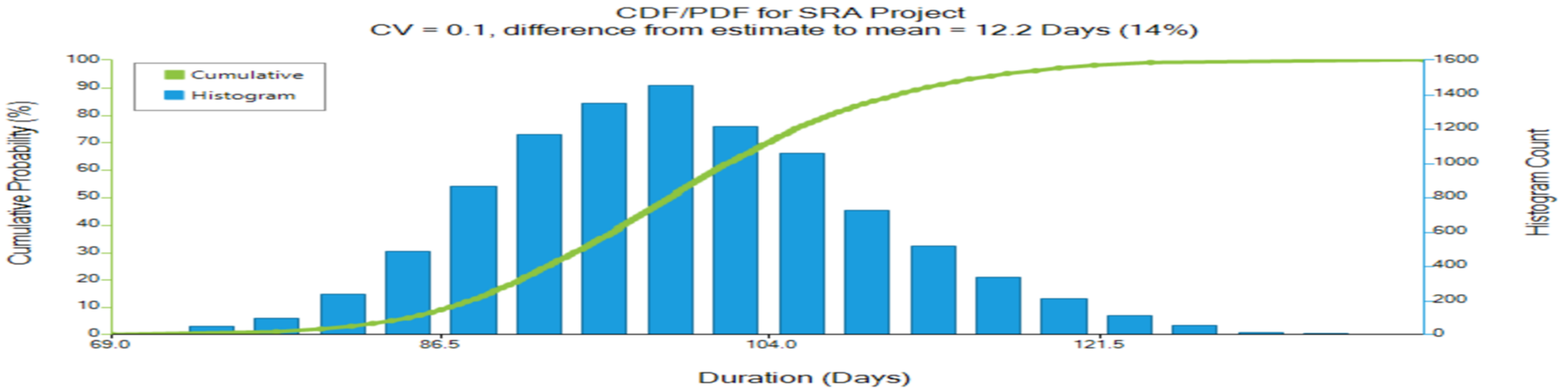
Risk & Uncertainty Overview

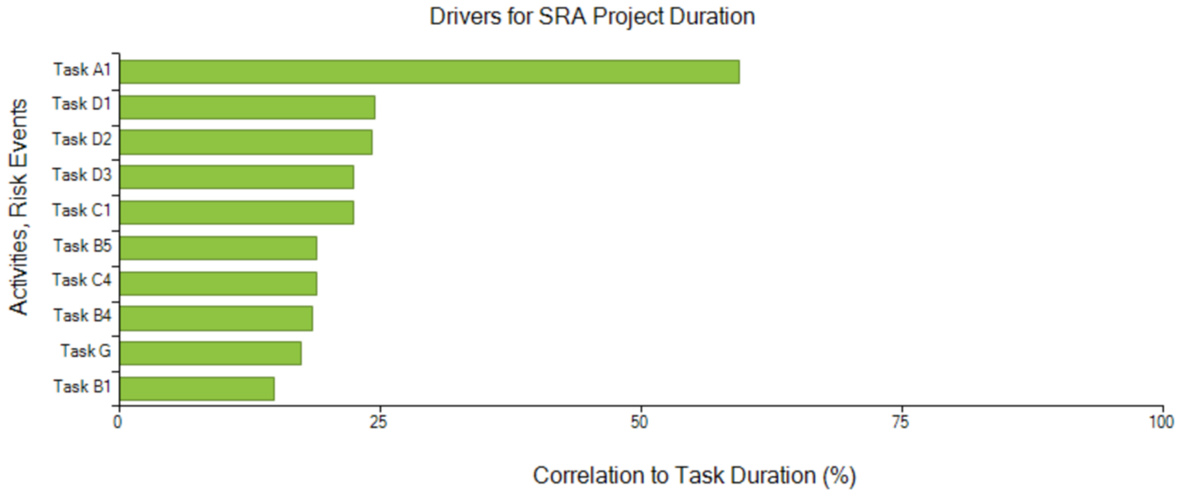
- Risk vs Uncertainty
  - Risk: Discrete events that may cause schedule overrun
  - Uncertainty: Distribution of potential duration outcomes for a task
- Need to identify potential risks & uncertainty in schedule
  - Review programmatic risk registers (i.e. risk cube charts)
  - Stakeholders can provide input on risk and uncertainty
  - Run Schedule Risk Analysis (risk events to Monte Carlo simulation)
- What to do when risks occur?
  - Root Cause Analysis (RCA): identify original source of the risk
  - Risk Mitigation Strategies: develop plan to reduce risk impact
  - Provide recommendations to PM and stakeholders based on IMS

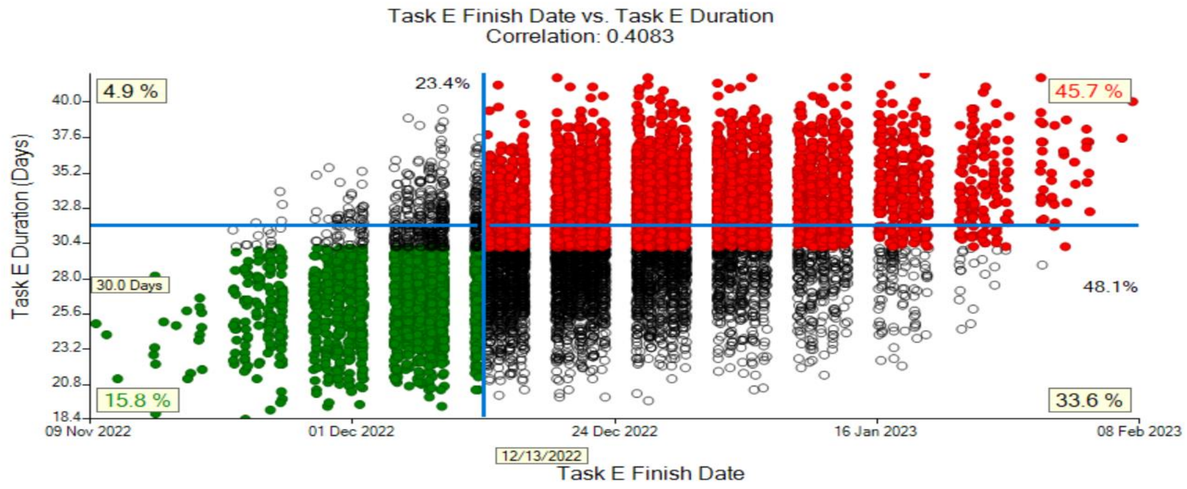
Schedule Risk Analysis (SRAs)

- Conducting a Schedule Risk Analysis (BP #8)
  - Implement risk & uncertainty into IMS to identify potential delays
  - Model risk events to represent possible discrete incidents
  - Utilize uncertainty to capture range of possible outcomes
  - Assess probabilistic schedule utilizing Monte Carlo simulation
  - Leverage probable outcomes to calculate schedule contingency
- SRAs can be conducted at varying levels of complexity
  - Implement what makes most sense for the program and schedule
  - Can be specific events in the IMS or a formal SRA
  - Basis for ‘What-If’ analysis & developing Courses of Action (COAs)

SRA Visualization Examples







Risk Mitigation Strategies

- Conduct Root Cause Analysis prior to mitigation planning
  - Identifies original friction point that led to program risk
  - Solves paradigm of “not solving a problem you don’t know exists”
  - Identifies a clear relationship between risk and schedule execution
  - Leverage results to propose appropriate mitigation strategies
- Common risk mitigation strategies include:
  - Resource realignment and/or escalation
  - Eliminate superfluous tasking
  - Overtime labor / Increased Funding
  - Early procurement of long lead materials

Questions?