FLIGHT PROJECTS DIRECTORATE

Goddard Space Flight Center
Flight Projects Directorate's

Putting Schedule Performance Metrics Into Practice at Goddard

2014 NASA Cost Symposium

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AGENDA

- Impetus for Schedule Management Practices
  - Schedule Management Process Improvement
  - GSFC Scheduling Assist Team
  - FPD Best Practice Instruction Repository
- Mission Success and Programmatic Performance
  - Schedule Performance Metrics
- Change Management
  - Lessons Learned
  - Continuous Improvement

PUTTING SCHEDULE PERFORMANCE METRICS INTO PRACTICE AT GODDARD

IMPETUS FOR SCHEDULE MANAGEMENT PRACTICES

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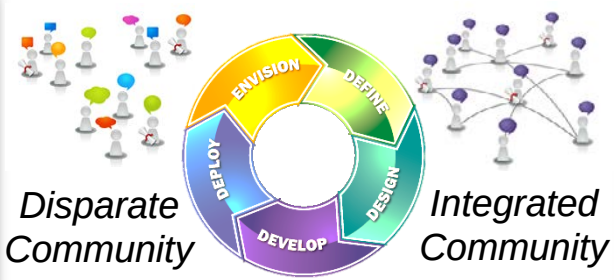
WHY CHANGE - BUSINESS CHANGE INITIATIVE OVERVIEW

Current State

- ✓ Rising costs, schedule delays, and inconsistent processes
- ✓ Greater competition for resources
- ✓ Oncoming retirement wave and corresponding knowledge gap
- ✓ Increasing external reviews and data requests



Business Change Initiative

Future State

- ✓ Increased visibility and accountability
- ✓ Improved management tools
- ✓ Established GSFC policies and procedures
- ✓ Enhanced training and knowledge sharing
- ✓ Standardized processes
- ✓ Early identification of risk

RESULTS

- ➢ Expand guidance on how to apply best practices
- ➢ Centralize information to improve accessibility
- ➢ Apply NASA, federal, and industry scheduling best practices
- ➢ Promote consistent schedule management procedures on all programs/projects
- ➢ Improve accuracy and precision in schedule management
- ➢ Mitigate schedule risks through informed teams and stakeholders
- ➢ Increase use and accessibility to guidance and resources

Flight Projects' must promote stronger, enhanced schedule management

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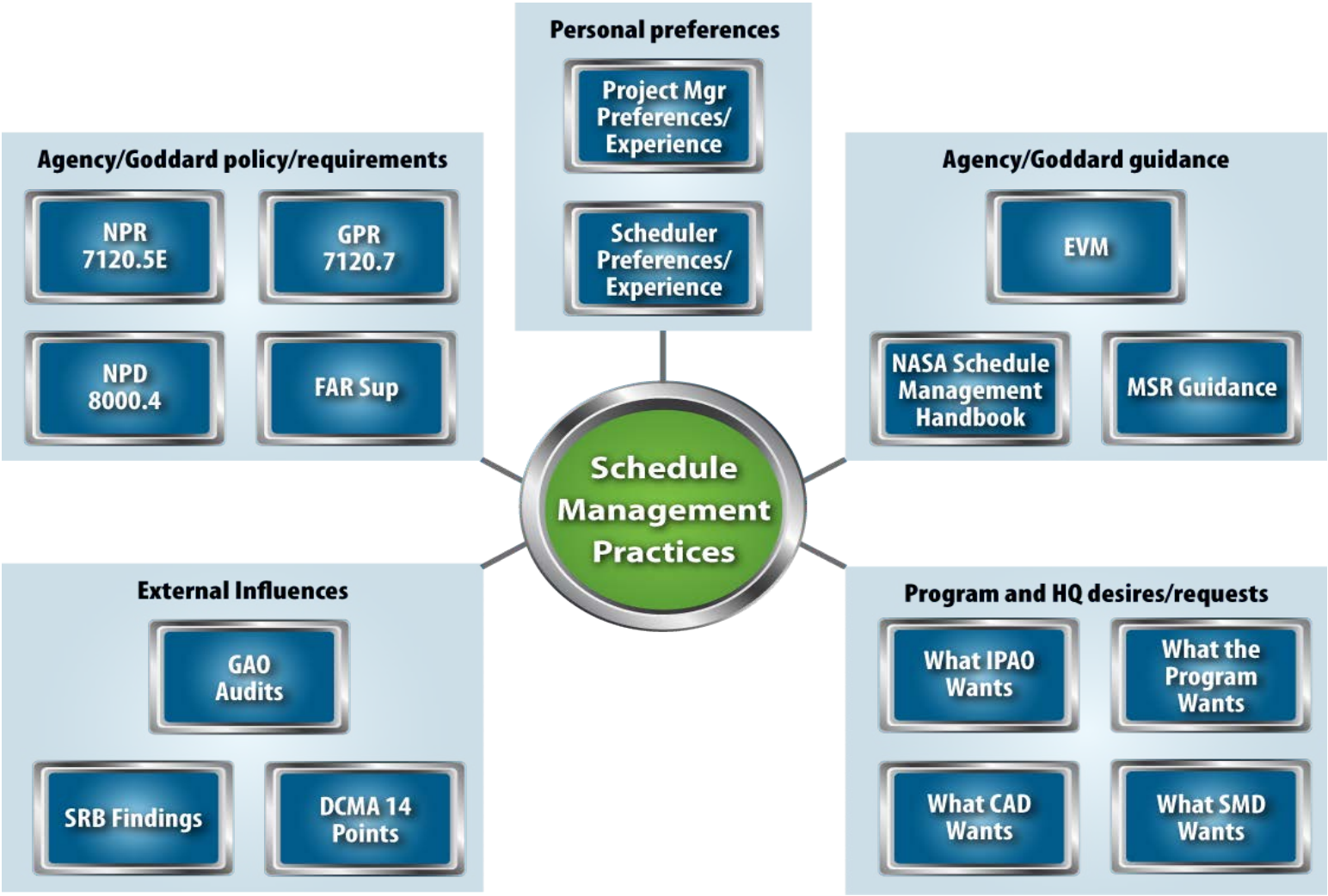
SCHEDULE INFLUENCES – POLICY, STAKEHOLDERS, AND STYLE



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INITIAL ENVIRONMENT – FLIGHT PROJECTS' SCHEDULE SELF ASSESSMENT (WHEN THE INITIATIVE BEGAN)

Requirement	NPR 7120.5E	NPD 8000.4	GPR 7120.7	NASA FAR Sup	NASA SMH	MSR Guidance	External Best Practice	Self Assessment
Project-Level Integrated Master Schedule	X						X	
Schedule Baseline	X						X	
Schedule Basis of Estimates	X							
Identify Schedule Risks	X	X					X	
Probabilistic Schedule Risk Analysis	X						X	
Schedule Management Plan	X				X		X	
Resource / Cost Loading the IMS	X				X		X	
Schedule Margin Planning			X					
Schedule Margin Reporting					X	X		
IMS Data Requirements Document					X			
Firm Fixed Price Contract Schedules				X				
Schedule Control Board					X			
Schedule Health Check					X		X	
Archival of IMS					X		X	
Scheduling In-House Work								
Project Schedule Book								
Control Milestone Performance Tracking					X			
Critical Milestone Tracking						X		
Giver/Receiver Lists					X		X	
Critical Path Reporting					X	X	X	
Baseline Execution Index (BEI)							X	
Current Execution Index (CEI)							X	
Hit Miss Index (HMI)							X	

Most Projects

Some Projects

Very Few Projects

Not Rated

Self-assessments help determine priorities for addressing scheduling practices

APPROACH TO CHANGE – SCHEDULE MANAGEMENT

- Assess scheduling practices on GSFC flight projects to identify what works well and which ones do not add value
- Clarify what Goddard and the Agency actually require projects to do from a project scheduling standpoint
- Learn what external organizations have to say about scheduling best practices and related criteria including:
  - NDIA ("Planning & Scheduling Excellence Guide")
  - PMI ("Project Management Body of Knowledge")
  - GAO ("Schedule Assessment Guide: Best Practices for Project Schedules")
  - DCMA ("14-Point Schedule Assessment Criteria")
- Understand how Goddard is doing from a schedule management perspective

Schedule measurement, analyses, and management needs to be unified

SCHEDULE DEPLOYMENT – SCHEDULE ASSIST TEAM

Objective: To provide a temporary, ad hoc group of planners/schedulers called upon to assist project teams and project planners/schedulers and to address specific scheduling requirements, needs, situations or problems including:

- Preparing for senior review board schedule assessments
- Preparing external and internal schedule audits
- Providing independent assessment of a project's or contractor's integrated master schedule (IMS) or related element such as a payload, instrument, or ground system
- Developing and/or assessing replans or workaround plans
- Selecting and setting up scheduling tools (MS Project, NASA STAT, GSAT, risk analysis tools, DCMA 14 point assessment tools, etc.) for project
- Implementing FPD Schedule Management Procedures and Guidelines (schedule management plans, baselining, performance reporting, etc.)
- Facilitating probabilistic schedule risk analyses
- Supporting integrated baseline review
- Providing special assessment/analysis support
- Mentoring schedulers assigned to new projects and junior scheduler new hires
- Facilitating schedule management training for project teams
- Conducting schedule peer reviews
- Supporting joint confidence level

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SCHEDULE DEPLOYMENT – BEST PRACTICE INSTRUCTIONS

Document Schedule Requirements in the Project Schedule Management Plan	Develop In-House Subsystem Schedules Using the PDL Checklist	Identify and Control Giver / Receiver Milestones	Design the Project Schedule Book	Assess Schedule Efficiency Along the Critical Path	Prepare an IMS Data Requirements Document
Assign a Lead Planner/Scheduler to the Project	Create an Integrated Master Schedule Database in MS Project	Plan the Project Schedule Margin	Report the Critical Path for MSR	Report Project Control Milestone Performance and Forecast	Resource/Cost Load the Project IMS
Organize the Project Schedule, Planning & Analysis Room	Estimate Realistic Activity Durations	Establish and Control the Schedule Baseline	Perform a Schedule Risk Analysis and Report Results	Report Total Slack Changes and Trends	Archive the Project IMS
Plan a Successful Schedule Summit	Document the Schedule Basis of Estimate	Implement a Schedule Control Board	Assess Baseline Schedule Performance with the BEI	Report Schedule Margin-to-Launch Trend	Assess Current Performance with the Monthly Hit/Miss Index
Develop the Project-Level Integrated Master Schedule (IMS)	Verify Schedule Integrity with Schedule Health Checks	Status and Update the Project IMS	Assess Current Schedule Performance with the CEI	Prepare and Update the MSR Critical Milestone Schedule	Reporting Summary Status with the Schedule Scorecard
Critical Path Length Index (CPLI)					

Required Recommended Future

- ✓ 32 planning and scheduling (P&S) best practices were developed based on GSFC successes, as well as practices identified from other Centers, industry and other agencies
- ✓ BPIs provide guidance on implementing the best P&S practices
- ✓ BPIs can be modified as needed and new ones can be added
- ✓ Examples, templates, tools, and other guidance are being developed and posted on the P&S Knowledge Network (SharePoint Portal)

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MISSION SUCCESS AND PROGRAMMATIC PERFORMANCE

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DEFINING SCHEDULE PERFORMANCE

	BENEFIT
▪ **Baseline Execution Index (BEI)** Measures actual work accomplished against the schedule baseline by comparing the cumulative number of tasks actually completed to the cumulative number of "baselined" tasks scheduled to be completed	*Indicator of overall schedule baseline performance – augments earned value management's schedule performance index (SPI)*
▪ **Hit/Miss Index (HMI)** Indicates, on a percentage basis, whether tasks actually completed were the ones planned to be completed in a specific period according to the schedule baseline	*Early indicator of performance deviation from the schedule baseline*
▪ **Current Execution Index (CEI)** Compares forecast dates from one status period to the next to determine how well the near term schedule represents what actually happens; it represents the fidelity of the forecast schedule and the project's or contractor's ability to execute tasks as projected each month	*Indicator of the quality of schedule forecasts ("did we do what we said we would do"?)*

EFFICIENCY

TIMELINESS

ACCURACY

Schedule performance analysis utilizes the IMS as a tool for making sound programmatic decisions

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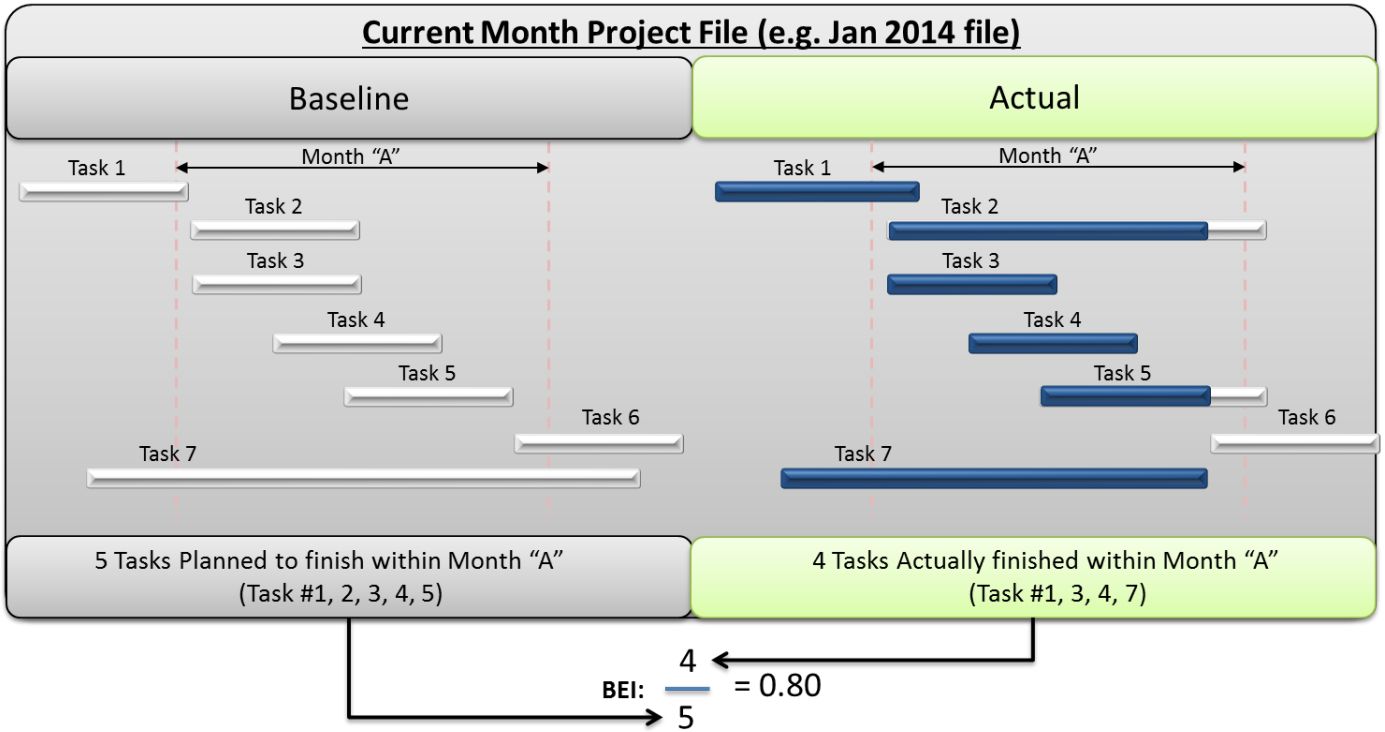
BEI

WHAT IS BASELINE EXECUTION INDEX AND HOW DOES IT WORK?

Basic Level:

$$BEI = \frac{\sum \#\ Tasks\ Actually\ completed}{\sum \#\ Baseline\ Tasks\ Planned\ to\ be\ completed}$$



BEI	Level
Good	> 0.80
Variance Analysis Required	<0.80

*** Note: BEI can go over 1.**

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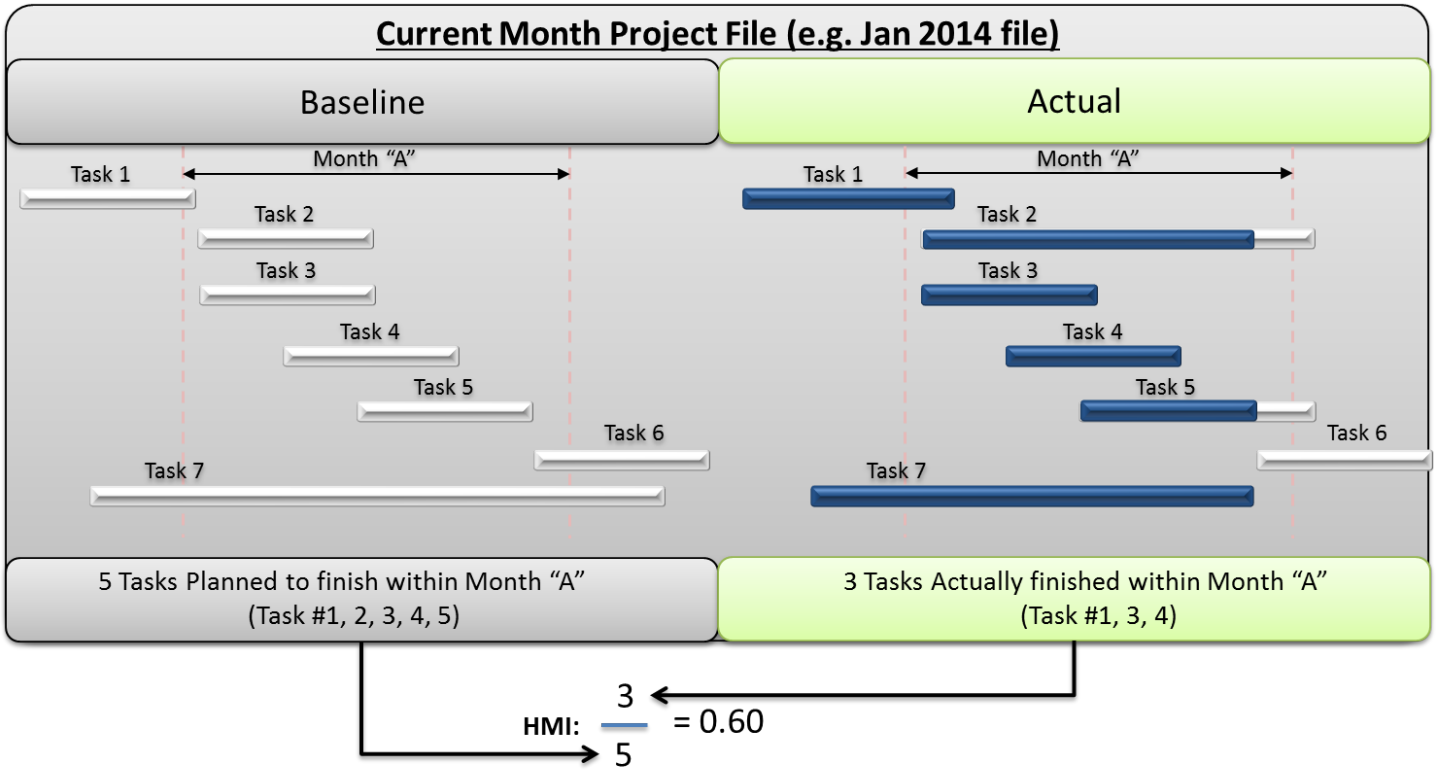
HMI

WHAT IS HIT/MISS INDEX AND HOW DOES IT WORK?

Basic Level:

$$HMI = \frac{\sum \#\ Tasks\ Actually\ completed\ on\ or\ before\ their\ baseline\ this\ month}{\sum \#\ Baseline\ Tasks\ Planned\ to\ be\ completed\ this\ month}$$



HMI	Level
Good	> 0.80
Variance Analysis Required	<0.80

*** Note: HMI can't go over 1.**

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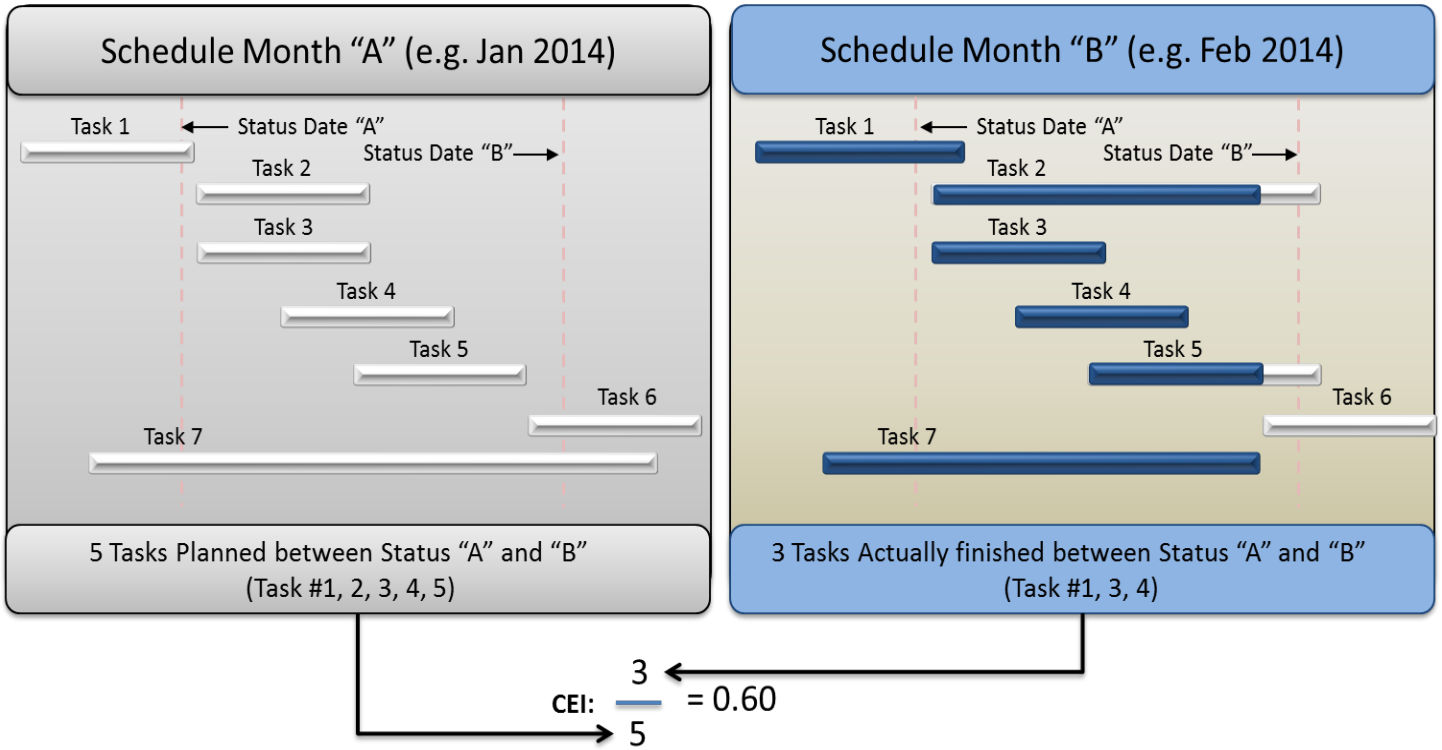
CEI

WHAT IS CURRENT EXECUTION INDEX (CEI) AND HOW DOES IT WORK?

Basic Level:

$$CEI = \frac{\sum \#\ Tasks\ Actually\ Completed\ in\ Month\ "A"\ (from\ Month\ "B"\ Schedule)}{\sum \#\ Tasks\ planned\ in\ Month\ "A"}$$



CEI	Level
Good	> 0.60
Variance Analysis Required	<0.60

*** Note: CEI <u>can't</u> go over 1.**

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GODDARD SCHEDULE ANALYSIS TOOL

The Goddard Schedule Analysis Tool (GSAT) is an initiative to provide automated solution for Goddard projects to comply with the Scheduling Procedure and Guidelines (400-PG-7120).

GSAT is a MS Project (2010/2013) add-in that will automatically calculate key schedule performance metrics such as BEI, HMI, and CEI and offer a schedule comparison feature.

GSAT was designed and built to be flexible to handle any GSFC MS Project file and has the capability to expand to incorporate new GSFC requirements as necessary.

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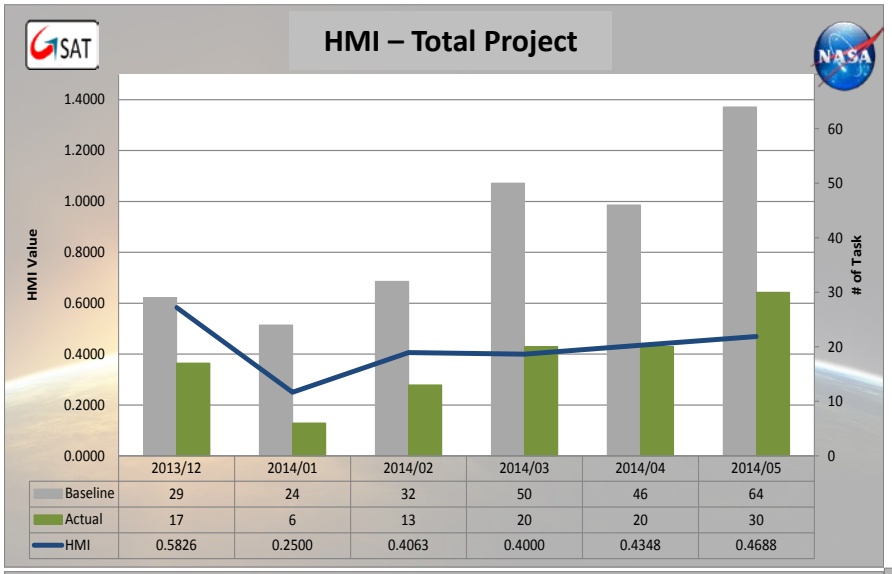
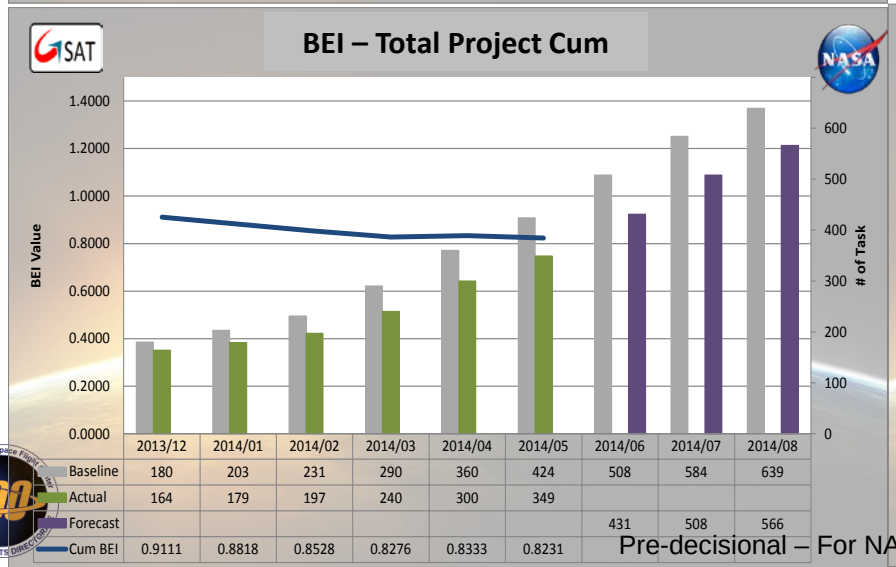
SAMPLE GSAT RESULTS - PROJECT #1

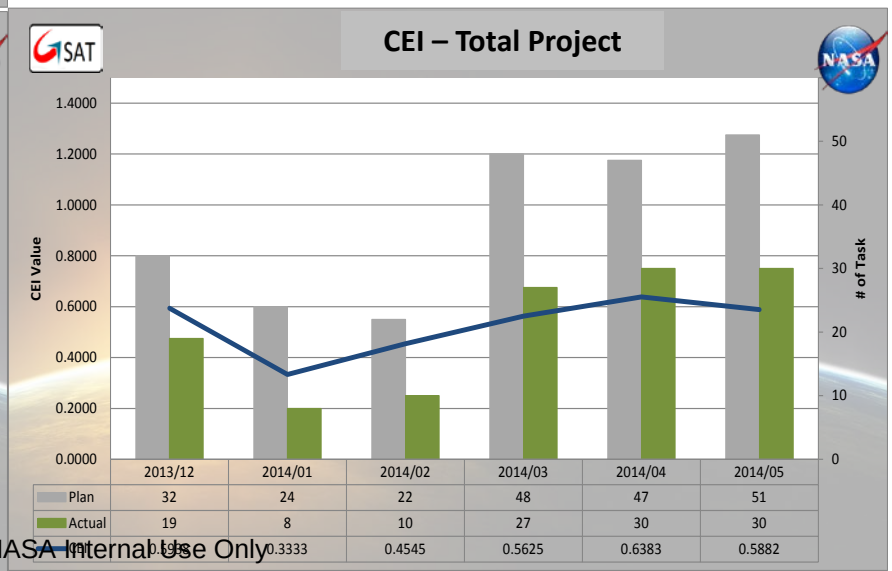


	2013/12	2014/01	2014/02	2014/03	2014/04	2014/05
Baseline	29	24	32	50	46	64
Actual	17	6	13	20	20	30
HMI	0.5826	0.2500	0.4063	0.4000	0.4348	0.4688

- HMI and BEI maintains efficiency
- BEI projection continues to trend up
- CEI dropped ~5%
  - pre-amp issues impacted efficiency
  - Mechanical plan forward if being refined and re-prioritized for critical design review and beyond



	2013/12	2014/01	2014/02	2014/03	2014/04	2014/05	2014/06	2014/07	2014/08
Baseline	180	203	231	290	360	424	508	584	639
Actual	164	179	197	240	300	349			
Forecast							431	508	566
Cum BEI	0.9111	0.8818	0.8528	0.8276	0.8333	0.8231	[illegible]	[illegible]	[illegible]



	2013/12	2014/01	2014/02	2014/03	2014/04	2014/05
Plan	32	24	22	48	47	51
Actual	19	8	10	27	30	30
Cum CEI	0.5938	[illegible]	0.3333	0.4545	0.5625	0.6383	0.5882

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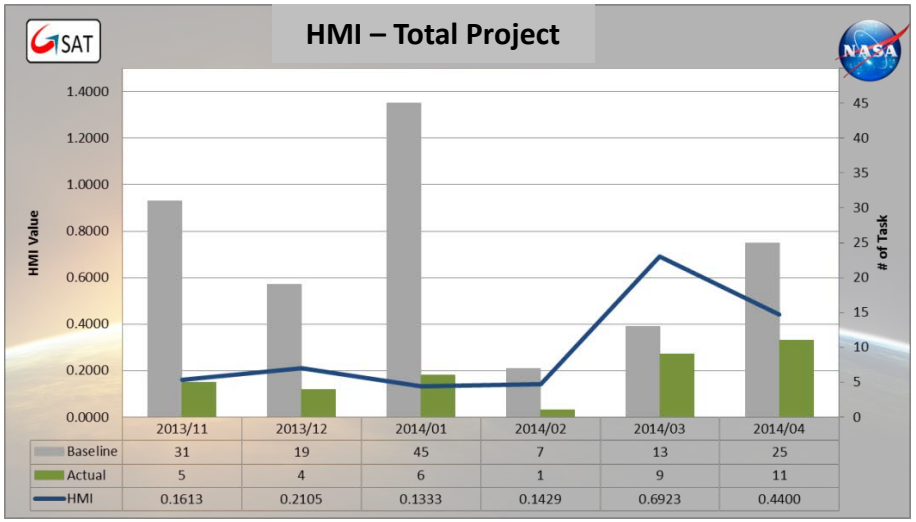
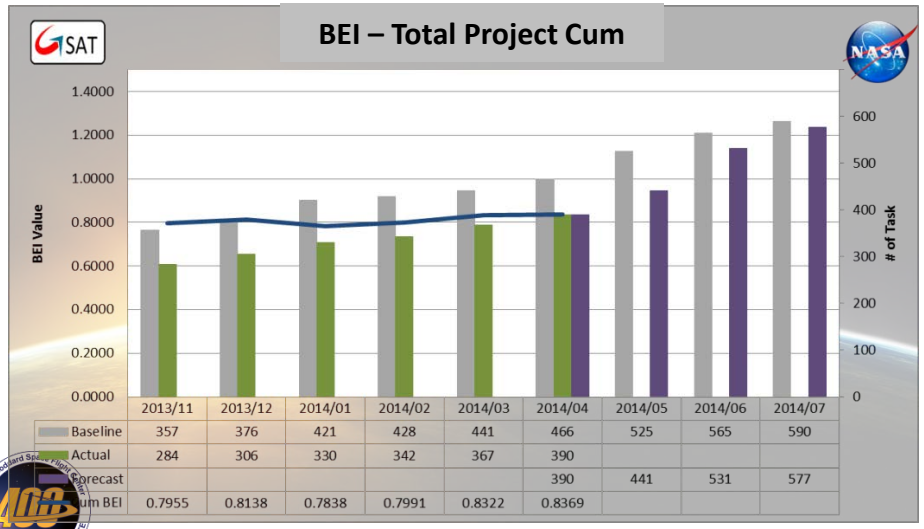
SAMPLE GSAT RESULTS - PROJECT #2

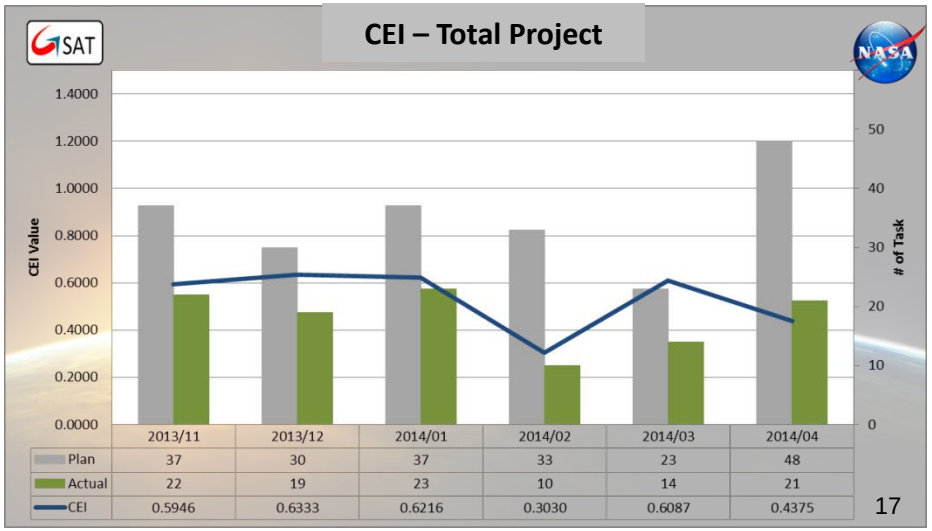


	2013/11	2013/12	2014/01	2014/02	2014/03	2014/04
Baseline	31	19	45	7	13	25
Actual	5	4	6	1	9	11
HMI	0.1613	0.2105	0.1333	0.1429	0.6923	0.4400

- HMI dropped to 0.44 (below reporting threshold of .80).
- Cumulative BEI is .84 (above reporting threshold of .80)
- CEI dropped to 0.44 (below reporting threshold of .60)



	2013/11	2013/12	2014/01	2014/02	2014/03	2014/04	2014/05	2014/06	2014/07
Baseline	357	376	421	428	441	466	525	565	590
Actual	284	306	330	342	367	390			
Forecast						390	441	531	577
Cum BEI	0.7955	0.8138	0.7838	0.7991	0.8322	0.8369			



	2013/11	2013/12	2014/01	2014/02	2014/03	2014/04
Plan	37	30	37	33	23	48
Actual	22	19	23	10	14	21
CEI	0.5946	0.6333	0.6216	0.3030	0.6087	0.4375

Pre-decisional – For NASA Internal Use Only

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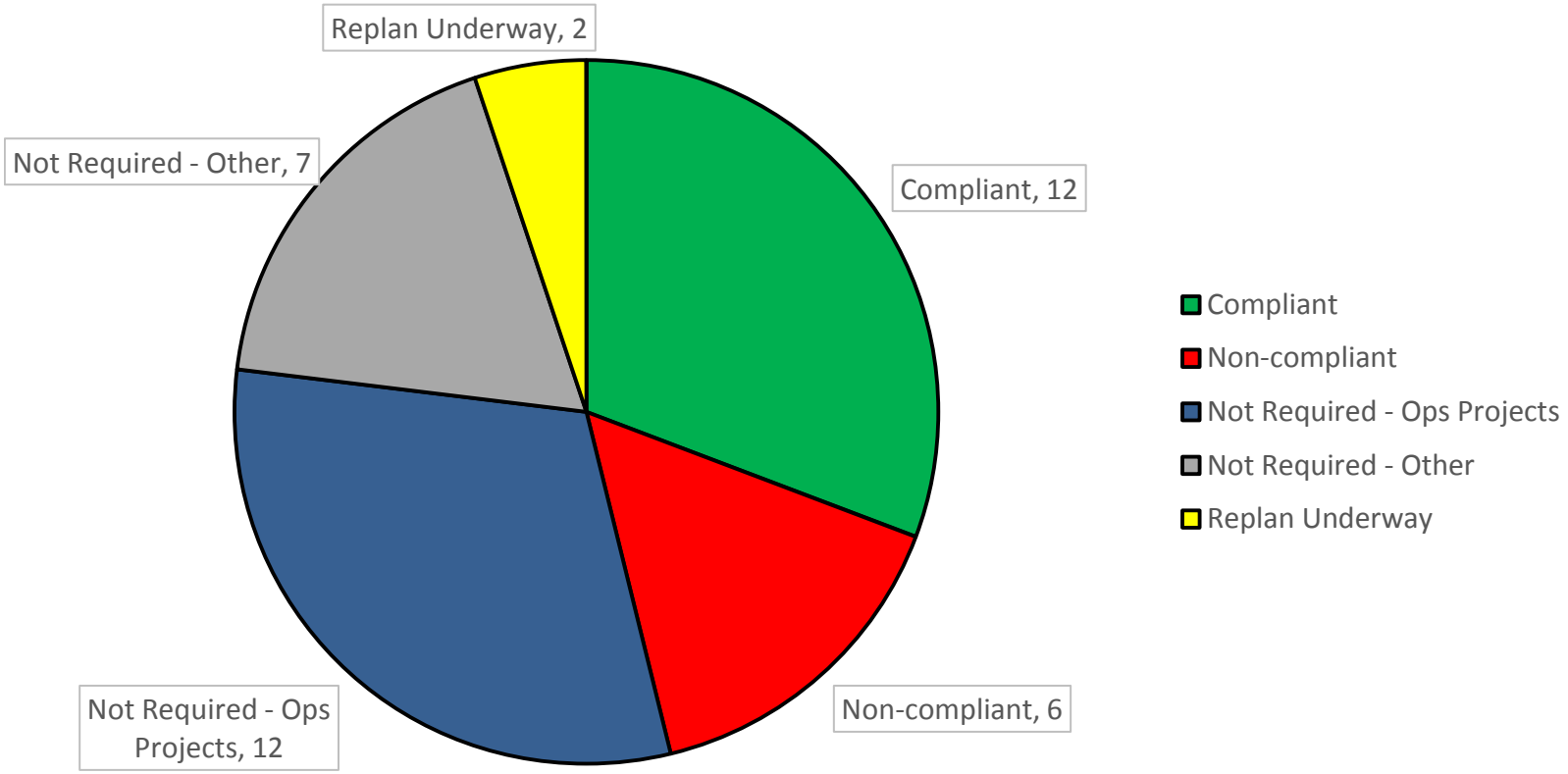
FLIGHT PROJECTS PORTFOLIO – SCHEDULE PERFORMANCE METRIC COMPLIANCE

39 Projects, Programs, or Divisions Reporting at March Tag-Ups



FPD employs change so that adoption may be scaled to the current state of the project

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CHANGE MANAGEMENT

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SCHEDULE PRACTICES – LESSONS LEARNED

- Schedule baseline control at the task level of the IMS (necessary for meaningful metrics results)
  - Back-testing metrics on a recently launched Goddard project indicated serious schedule performance problems and a possible launch delay – but the project office never maintained the schedule baseline so BEI and HMI were misleading
  - Back-testing on another recently launched project indicated very good performance and no performance-driven impact launch – the project office did maintain the schedule baseline so results were reliable
- Focus on the trend, or direction of performance, not the score
- Do not expect 100 percent efficiency (schedule depends on margin adequacy and potential workarounds)
- Base metrics on “early” dates from the IMS
- Inform and educate your project leadership team and other stakeholders about the metrics so they understand them
- Use “total project” summaries of the metrics to communicate schedule performance to external stakeholders – but drill down to lower-level WBS elements for internal project/program control

Schedule performance metrics should not be viewed in isolation and should consider schedule performance index, margin, slack, critical path, and risk

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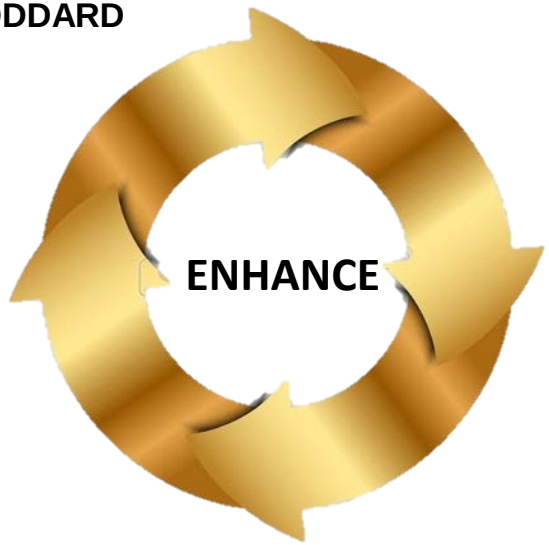
CONTINUOUS IMPROVEMENT



- Increase accessibility of GSAT to contractors/suppliers
- Enhance schedule baseline control practices
- Periodically re-examine variance thresholds
- Continue to identify and develop guidance and best practices
- Explore GSAT alternatives for Primavera-based IMS files
- Implement metrics-based schedule forecasting techniques
- Examine applicability of metrics-based duration uncertainty for schedule risks analysis

Discipline	Future Deployments
Schedule Management	• Enhance GSAT to expand capabilities to include a cumulative milestone capability and added reports • Conduct schedule risk analyses and educate FPD scheduling community on the schedule risk analyses approach • Identify strategy for MS Project Server as a Goddard-based solution for portfolio schedule management • Release V.2 of the Goddard FPD Procedural Guidelines for Schedule Management with added guidelines