

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER**

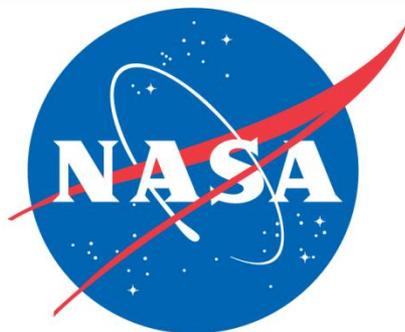
FLIGHT PROJECTS DIRECTORATE

**GSFC's JCL Journey:
Refining an Integrated Modeling Process**

Steve Shinn/Param Nair

2013 NASA Cost Symposium

August 27, 2013



GSFC's JCL JOURNEY: REFINING AN INTEGRATED MODELING PROCESS

SCOPE – BCI IMPROVING GSFC PP&C ENVIRONMENT

In late 2011, FPD created the BCI to examine the use of best practices, evaluate information sharing mechanisms, and identify suggested changes across the Directorate to improve cost, schedule, and technical performance.

Multiple teams are working to increase best practice sharing and deploying across programs/projects in PP&C methods, tools, processes, and knowledge to support improved performance and management decision making.



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OVERVIEW OF THE BCI—WHY IS CHANGE NEEDED AT GSFC?

Internal challenges include rising costs, schedule delays, disparate processes, a need to ensure optimally-trained staff, and a retirement wave that impacts our need to capture knowledge and best practices

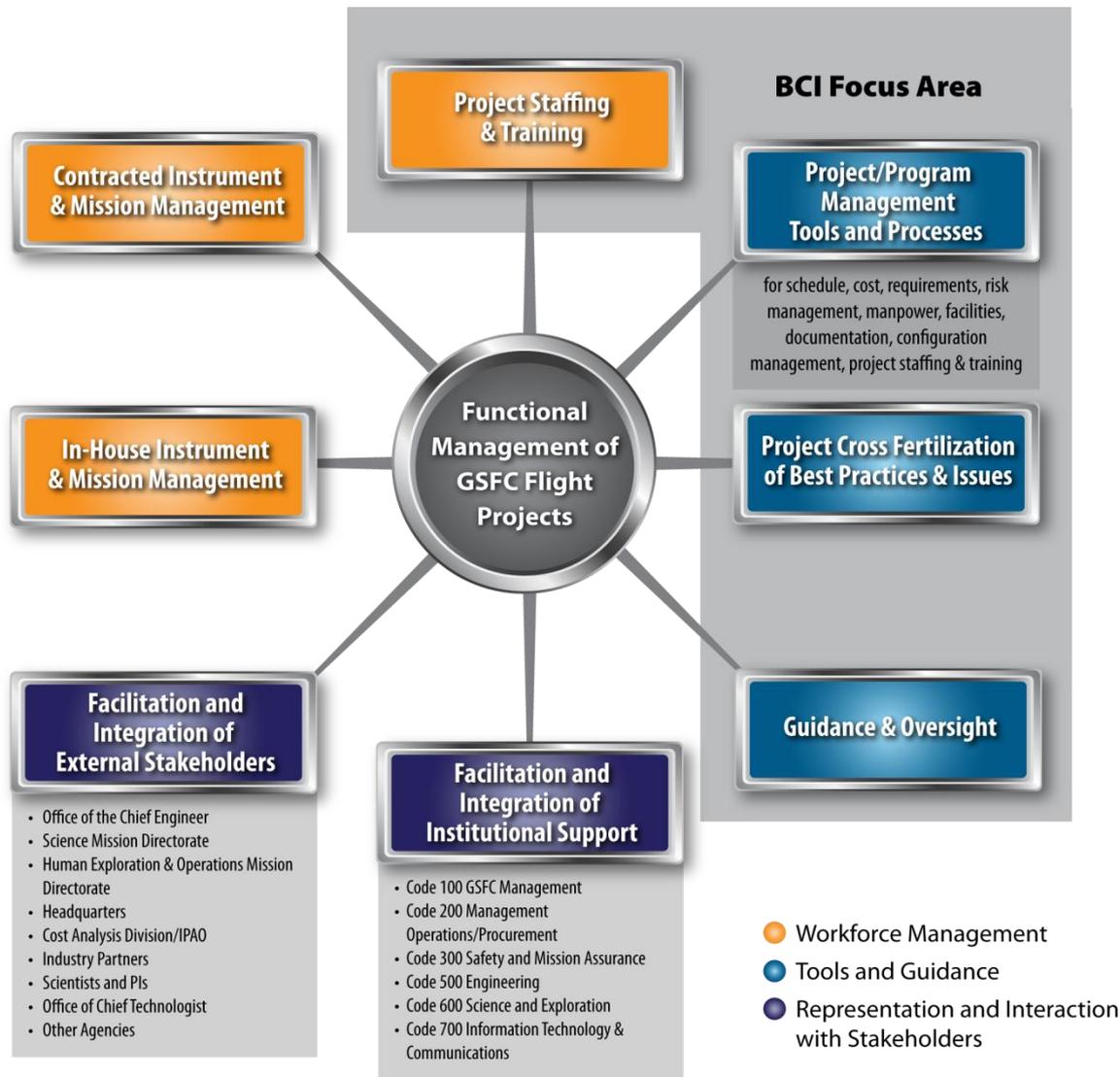
External challenges include a significant increase in external reviews and data requests; greater competition and stakeholder pressure; perceptions of GSFC's budgeting and scheduling challenges

Our world is changing as evidenced by recent GAO findings that NASA is not managing its projects well; budgets are tightening that will lead to additional scrutiny for selection—past performance does matter; being the “most technically competent” will no longer be enough

We are recognized globally as being world class in mission development and execution of projects, but we must also consistently utilize best practices and be recognized for meeting our budget commitments and schedule

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GSFC FPD PP&C RESPONSIBILITIES



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GSFC PP&C ENVIRONMENT

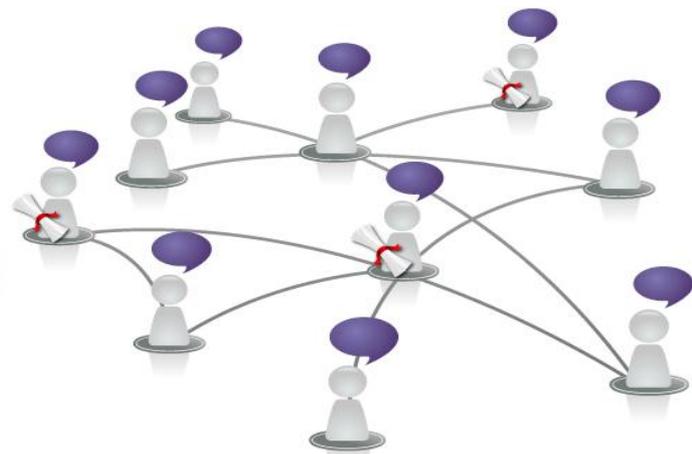
Current State



A disparate community with pockets of PP&C expertise, which is not well known, and where programs/projects often create their own unique solutions to solve problems



Future State



An integrated community to educate, openly share, and instill best practices across the organization and within programs/projects

Our Vision is increased collaboration with programs/projects consistently applying best practices and actions to foster cost-effective and on-time delivery for all missions

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BCI – RESPONSE TO CHALLENGES

Environmental Challenges

Rising costs, schedule delays, and disparate processes

Increasing budget constraints; perceptions of NASA and Center challenges

Possible retirement wave impacting knowledge capture and practices; need to ensure optimally-trained staff and sharing of best PP&C practices

Increasing external reviews and data requests

Our Response – BCI

Comprehensive evaluation of best practices and management, communication and information sharing mechanisms intended to improve cost, schedule and overall performance across the programs and projects

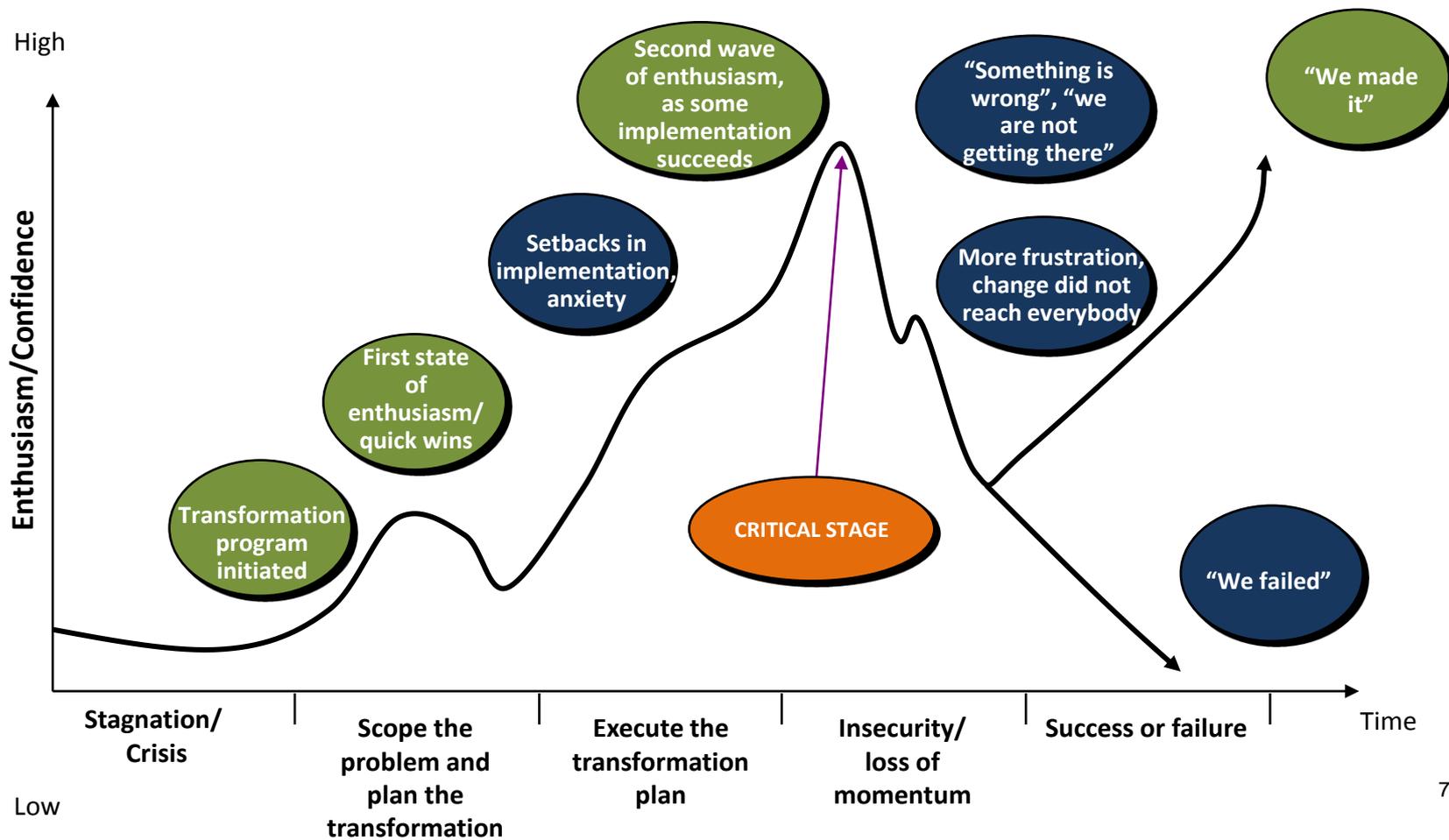
Outcomes

- ✓ Improved knowledge base and sharing
- ✓ Increased use of best practices
- ✓ Reduced duplicative workflows
- ✓ Improved decision making
- ✓ More commonality in approaches and tools
- ✓ Optimized resources
- ✓ Improved project performance

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DANGER POINTS IN ANY CHANGE INITIATIVE

The BCI must ensure continued momentum throughout the transition process

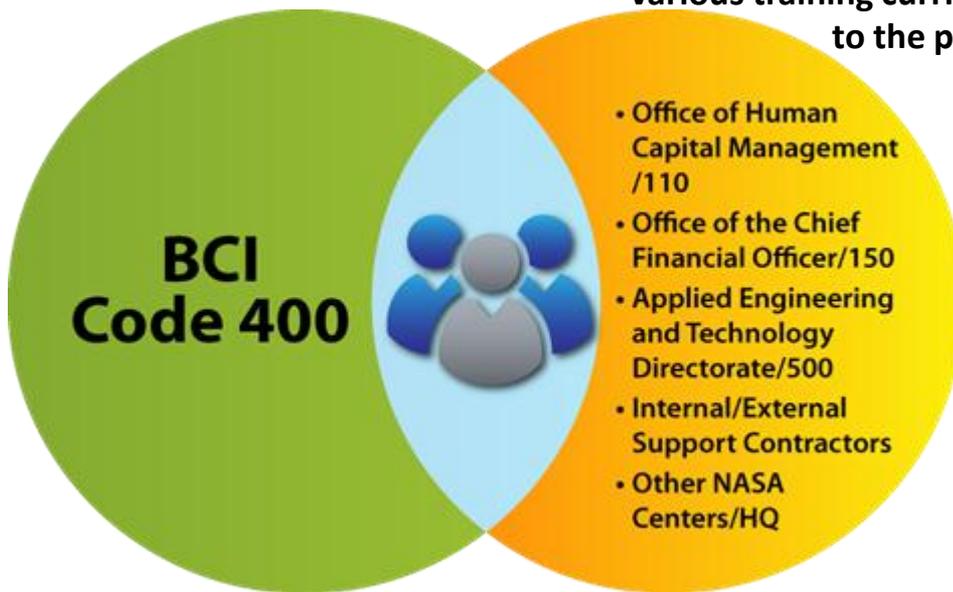


GSFC'S JCL JOURNEY: REFINING AN INTEGRATED MODELING PROCESS **COLLABORATIVE PARTNERSHIPS – ESSENTIAL TO SUCCESS**

Collaborated with GSFC Office of the Chief Financial Officer to create business training guidance and curriculum(s); coordinated on Center-wide EVM needs and approach

Partnered with NASA Headquarters (HQ) Office of the Chief Engineer (OCE) on Agency-wide EVM guidance; solicited input to improve Center's management reporting process and to expand various training curriculums and extend availability to the programs/projects

Worked with the Applied Physics Laboratory (APL) and Jet Propulsion Laboratory (JPL) to collect lessons learned and identify Schedule BPIs, EVM requirements, and practical aspects of the Joint Confidence Level (JCL) Process across organizations



Foster Internal Collaboration within a project between the Schedule, Cost, Technical, and Risk Management Disciplines

Collaborated with NASA HQ Cost Analysis Division (CAD) and other NASA Centers for JCL and cost estimating training

Collectively worked with GSFC Engineering and Human Capital Directorates to expand information repository for early-career professionals

Note: These are examples of partnerships and not an exhaustive list

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PP&C CHANGE INITIATIVES FRAMEWORK

All BCI implementations follow a similar approach to identify guidance gaps and leverage existing policies and practices

ESTABLISHED

BCI IN DEVELOPMENT

Agency Policy, Procedural Requirements

- NPR 7120.5E, NASA Program and Project Management Processes and Requirements
- NPD 1005.A, Policy for NASA Acquisition

- *NASA Agency EVM Handbook (providing feedback and support)*

Center Policy, Procedural Requirements

- GPR 7120.7, Schedule Margins and Budget Reserves
- JCL Memo from NASA Associate Administrator

- *GSFC/FPD Schedule Management Requirements Procedural Guidelines (PG)*
- *GSFC EVM PG*

Principles and Best Practices

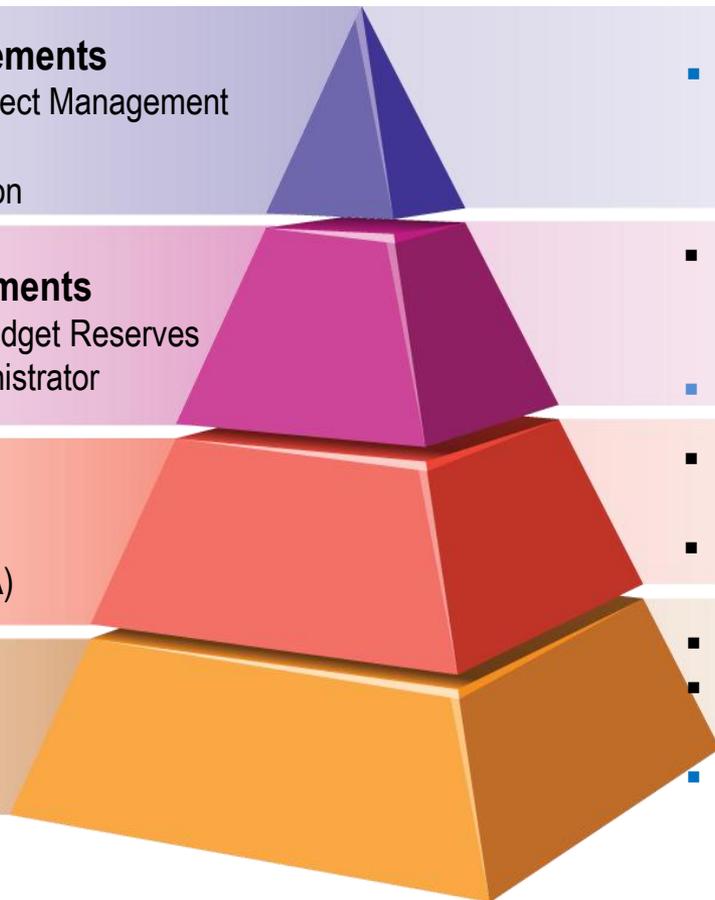
- Project Artifacts, Methods, Techniques
- Handbooks (GAO, DCMA, NDIA, NASA)

- *Schedule Best Practice Instructions (BPI)*
- *GSFC Joint Confidence Level Handbook*

Tools and Resources

- Commercial of the Shelf (COTS)
- Agency, Center Enterprise Licenses

- *GSFC EVM Enterprise License Upgrade*
- *Scheduling Knowledge Network (SharePoint Portal)*
- *Goddard Schedule Analysis Tool (GSAT)*



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BCI – SCALABILITY FOR PROJECT ASSISTANCE & COMPLIANCE, INCREMENTAL APPROACH TO ENSURE LASTING CHANGE



Program/Project Lifecycle

Survey and assess complete FPD program/project portfolio to understand similarities and differences



Applicability

Identify valid needs for each grouping of “like” programs/projects to balance conditions for feasibility and adoption



Compliance

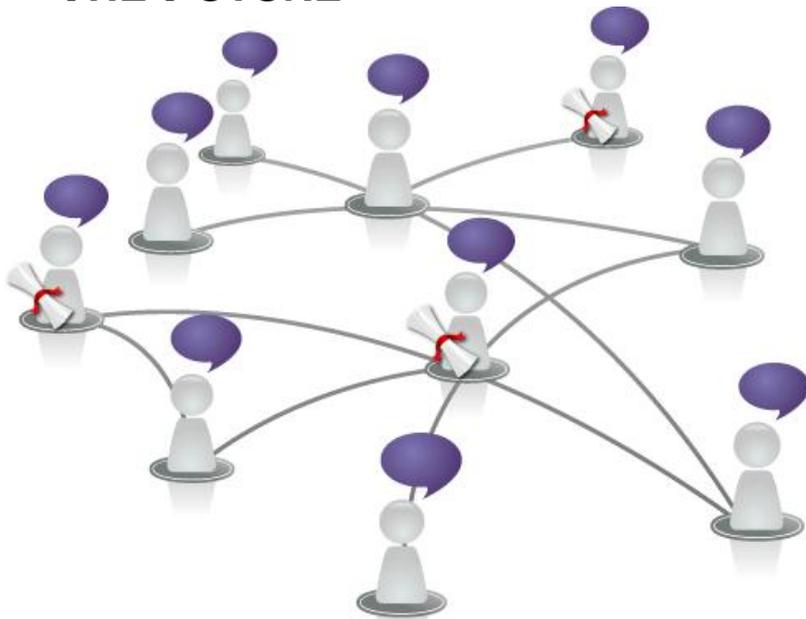
Provide tools, templates, guidance, and resources to facilitate fulfillment of requirements for all applicable groups

Prior to deployment, each change is developed with consideration of the affect on and significance to the GSFC project portfolio.

In many cases, various projects will be piloted to measure ability to adopt new practices, and tools and resources are developed from the feedback received to assist in acceptance

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THE FUTURE



We are uncovering best practices and identifying subject matter experts to leverage across the Center to improve our project management practices

The future of our projects is an integrated community of “expert” practitioners yielding:

- Improved cost and schedule performance
- Higher efficiency of projects and teams
- Improved integration and collaboration across teams
- Recognized lists of business systems SMEs
- Improved business training and skills development

Outcomes to include a proliferation of new approaches:

- Revamped and relevant training
- Improved workforce collaboration and feedback
- Implemented best practices across all the business practices
- Standardized tools and approaches
- New knowledge management, repositories and portals
- Standard operating procedures and guidelines

As we get these results, we are reminded:

- Most changes will be complex and multi-faceted
- Change must be deployed in a rational manner

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NEXT STEPS—THE PATH FORWARD

We have coalesced experts to direct projects to resources by organizing the community to share knowledge and resources. Now we need to:

Wrap Up BCI Discovery Phase—Finalize development of best practices

Plan for Specific Changes—Enhance new scheduling portal, restructure MSR over the next two months, etc.

Outline Deployment Strategy—Establish individual implementation plans for each change

Foster An Adaptive Environment—Encourage staff to support change and willingness to adapt

Encourage Leadership—Leverage Action Teams to lead the direction forward

Communicate the Change—Show that we have become a community of known experts and practitioners across all Directorates within the Center

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IMPACT

The BCI is an intensive change initiative and process to improve the overall project management capabilities of the Flight Projects Directorate.

As a result you will see:

- Improved cost and schedule reporting, analysis and action
- More consistent reporting and discussion across projects
- Improved integration and collaboration *between* projects
- Recognized lists of business systems SMEs
- Improved business training and skills development

New interfaces:

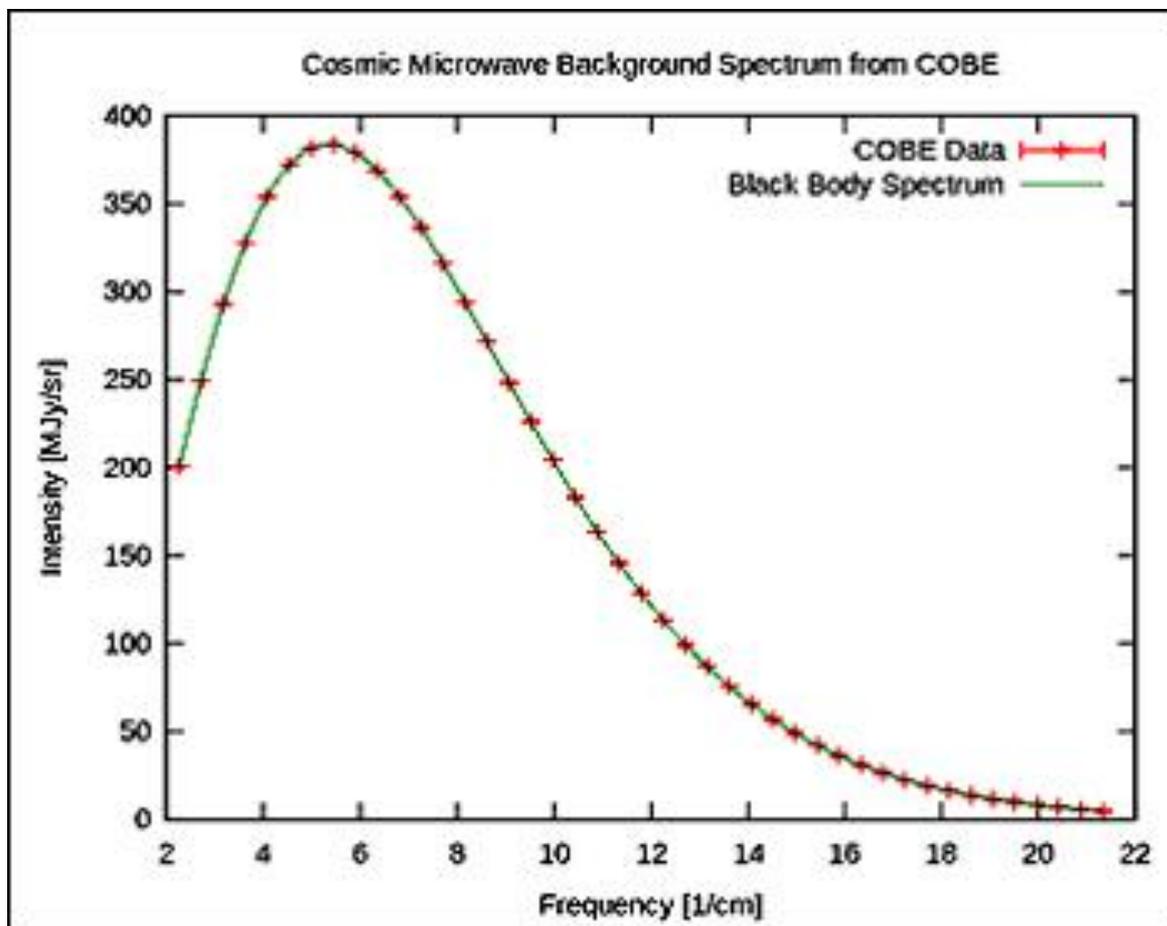
- It is critical to maintain partnership on common practices. We are looking to limit the amount of nearly redundant reporting for different audiences
- New activities include GSFC monthly analysis and assessment discussion

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SOME GSFC MODELING INSPIRATION

Cosmic microwave background spectrum measured by the FIRAS instrument on the [COBE](#), the most-precisely measured [black body](#) spectrum in nature

- [Error bars](#) are too small to be seen even in enlarged image
- Impossible to distinguish the observed data from the theoretical curve



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STEP 1 WAS TO POLL THE COMMUNITY – INTERVIEWED SEVERAL “PIONEER” MISSIONS...

CEAT JCL Interviews at GSFC 7/26/2013 16:13 Project: Maven		1	2	DURATION		5	6	7	8	9	10
Project Attributes		1 Project Phases covered by JCL	2 Starting Point of JCL activity	4 JCL Process Start (months before KDP-C)	3 Ending Point of JCL activity	5 JCL Process Activity End	6 WBS: Project Management included?	7 WBS: Systems Engineering included?	8 WBS: SMA included?	9 WBS: Science included?	10 WBS: Payload included?
JCL Process Evaluation Criteria		Weight									
Directorate Type Selection	SMD Robotic Competitive										
Organizational Merit	??%										
Programmatic	??%										
Technical Merit	??%										
Other Merit factors	??%										
	1	A thru Launch	MCR	3	Launch	KDP-C	Yes	Yes	Yes	Yes	Yes
	2	A thru D	KDP - A	6	Spacecraft Acceptance Review	Ongoing	No	No	No	No	No
	3	A thru E	Other	12	Other	TBD	TBD	TBD	TBD	TBD	TBD
	4	A thru F	TBD	Other	TBD						

STEP 2 WAS TO STANDARDIZE THE PROCESS – OWNERSHIP, EDUCATION, ROLES, AUTHORITY, ETC. 15

STEP 3 WAS TO COMPILE LESSONS LEARNED...

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SPREADING THE WORD ON JCL...

The Flight Projects Directorate at Goddard has also commissioned several sources of JCL information as references for the community

- JCL Handbook
- Technical and resource publications stored on an intranet website
- JCL handouts for quick distribution

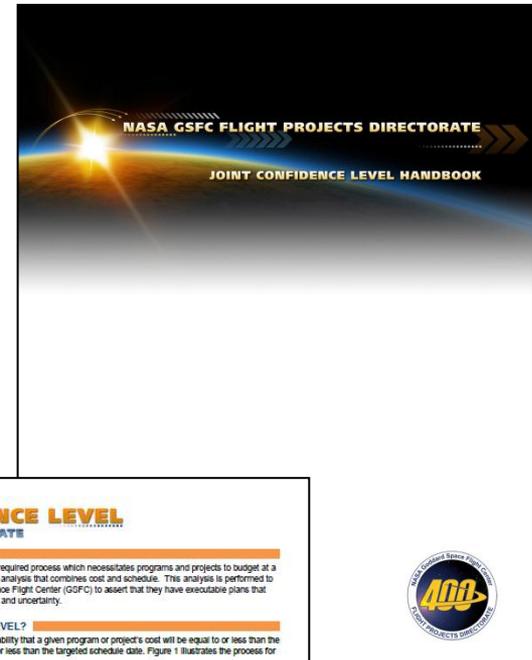
In addition, the BCI has participated in several GSFC training events to educate the Flight Project community on the JCL process

- Goddard Master's Forum
- Combined Resources Forum

Future plans include

- Briefings to senior leadership
- Ongoing briefings to project leadership

JCL Handbook



JOINT CONFIDENCE LEVEL FLIGHT PROJECTS DIRECTORATE

BACKGROUND

The Joint Confidence Level (JCL) is an agency-required process which necessitates programs and projects to budget at a 70% confidence level. The JCL is a probabilistic analysis that combines cost and schedule. This analysis is performed to enable programs or projects at the Goddard Space Flight Center (GSFC) to assert that they have executable plans that integrate cost and schedule and account for risk and uncertainty.

WHAT IS A JOINT CONFIDENCE LEVEL?

The JCL (cost and schedule) identifies the probability that a given program or project's cost will be equal to or less than the targeted cost and the schedule will be equal to or less than the targeted schedule date. Figure 1 illustrates the process for conducting a JCL.

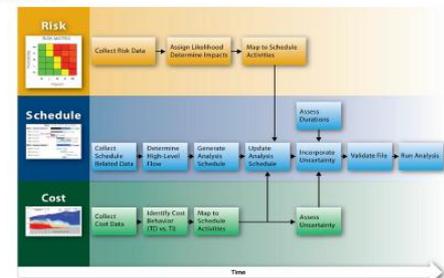


Figure 1: JCL combines cost, schedule and threats (discrete risks and uncertainty).

The term "Confidence Level" or "CL," for short, is expressed as a percentage. The percentage signifies a level of assurance (prescribed by NASA policy) that the project will have that probability of delivering Level 1 Science without incurring a premium in cost or schedule. NPR 7120.5E requires that a JCL be the basis of the Agency Baseline Commitment. On November 23, 2010, the NASA Associate Administrator signed a memorandum requiring the creation and use of a JCL by all major flight project teams as part of the process leading to Key Decision Point (KDP)-C.

WHAT ARE THE BENEFITS OF A JCL?

- JCL analysis can disclose answers to difficult operational project management questions which are not easily obtained otherwise. Examples of these questions include:
- What funding do I control? What is the Agency Baseline Commitment for my project (see Figure 2)?
 - Is the project's Life Cycle Cost scheduled?



JCL Fact Sheet



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LESSONS LEARNED

- 1) Assemble the proper JCL team. Recent participation at Goddard is mostly uniform with good functional representation:

GSFC Flight Project	Project Manager	DPMR	Systems Engineer	Discipline Expert	Scheduler/Planner	Risk Manager
Project 1	A	I	I	I	I	I
Project 2	A	I	A	A	I	
Project 3	A	I			I	I
Project 4	A	A	I	I	I	I
Project 5	A	I	I	I	I	I

Note: We always use internal and external consultants to work with project functional specialists in all aspects of JCL model development and the presentation of results

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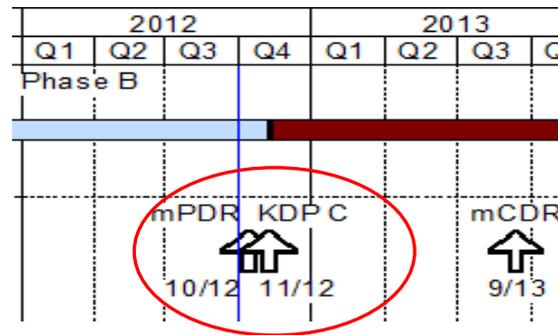
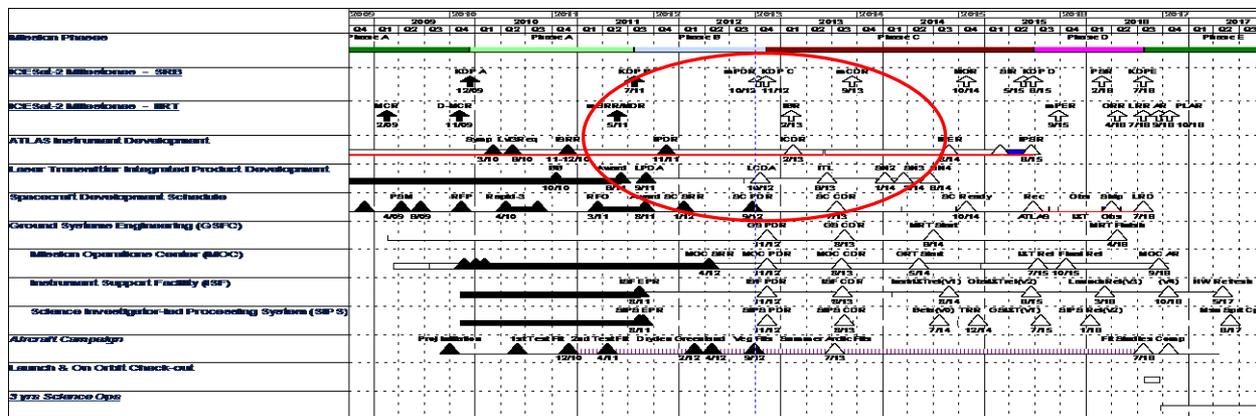
LESSONS LEARNED (CONTINUED)

2) Projects have ranged from 3.5 to 9 months to develop their JCL products. Knowing when to start is important. GSFC has the following guidelines:

Project with little JCL experience/very complex mission JCL preparation to start 6-8 months prior to KDP-C

Project with moderate JCL experience / moderately complex mission JCL preparation to start 4-6 months prior to KDP-C

Project with extensive JCL experience / comparable Mission or out of house JCL preparation to start 2-4 months prior to KDP-C



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LESSONS LEARNED (CONTINUED)

- 3) All recent JCL activity at Goddard has utilized an Analysis Schedule with “compression rates” ranging from 25% to just 1% of the underlying IMS. Platform advances can strongly influence this choice:

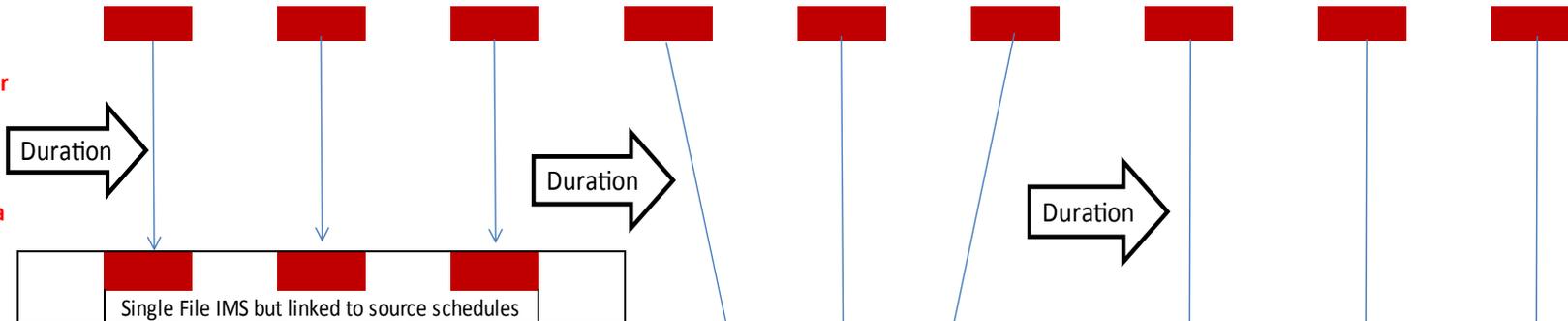
 = Individual Component Schedule

SCENARIO 1

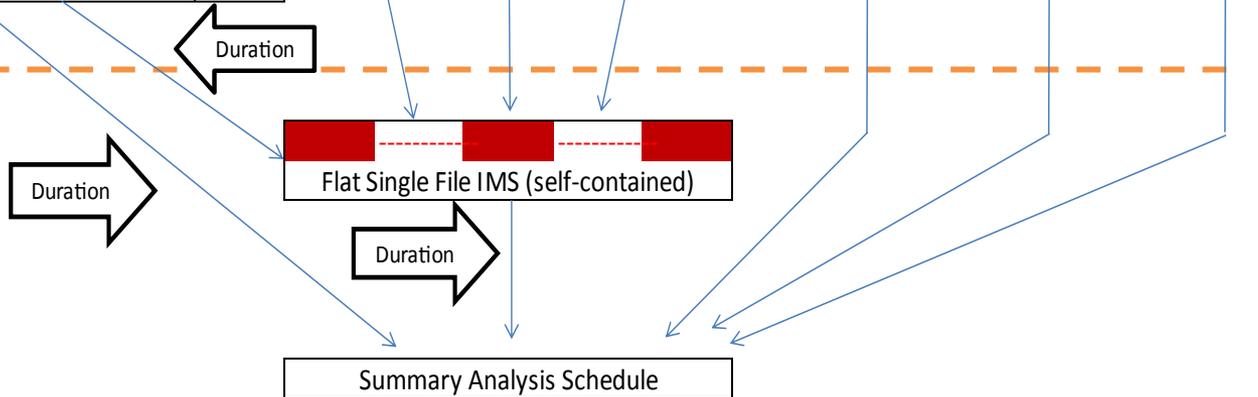
SCENARIO 2

SCENARIO 3

JCL not possible with multiple files or even with single files linked to source external files



JCL only possible with single, fully self-contained files



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LESSONS LEARNED (CONTINUED)

- 4) Cash flow and risk mitigation aspects of the software have been underutilized – the current focus on the 50% JCL or 70% JCL values override all else.
- 5) Inter task correlation research is sparse. The risk driver approach has yet to be implemented.
- 6) A truly data-informed basis to inform risk and uncertainty bounds appears to be universally acknowledged and rarely addressed – the primary factor appears to be a lack of historical data at the right granularity. It is encouraging to see CAD sponsor research at schedule allocation as well as linking parametric costs to JCL inputs.
- 7) The active management of discrete risk registers is a prerequisite. Advocate JCL assessments are performed in an environment that also has the SRB and other independent assessors at work – the project's ability to defend its risk posture and approach is crucial.

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We offer the following five items as worthy of discussion in the broader resource communities of practice at NASA...

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JCL DISCUSSION ITEM #1:

TREATMENT OF THREATS (RISKS VS. ISSUES VS. UNCERTAINTY)

Status or "as of" date

		GPR 7120.4D		
		Discrete Risk	Issue	Collective, non-discrete risks
	Prior Period Cost and Schedule of threat			
Likelihood	Known	Unknown	"Known"	Unknown
Consequence	Known	Unknown	Unknown	Unknown
Actual		Discrete Risk		Uncertainty
No Simulation		Simulation		
Advocate JCL				

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JCL DISCUSSION ITEM #2:

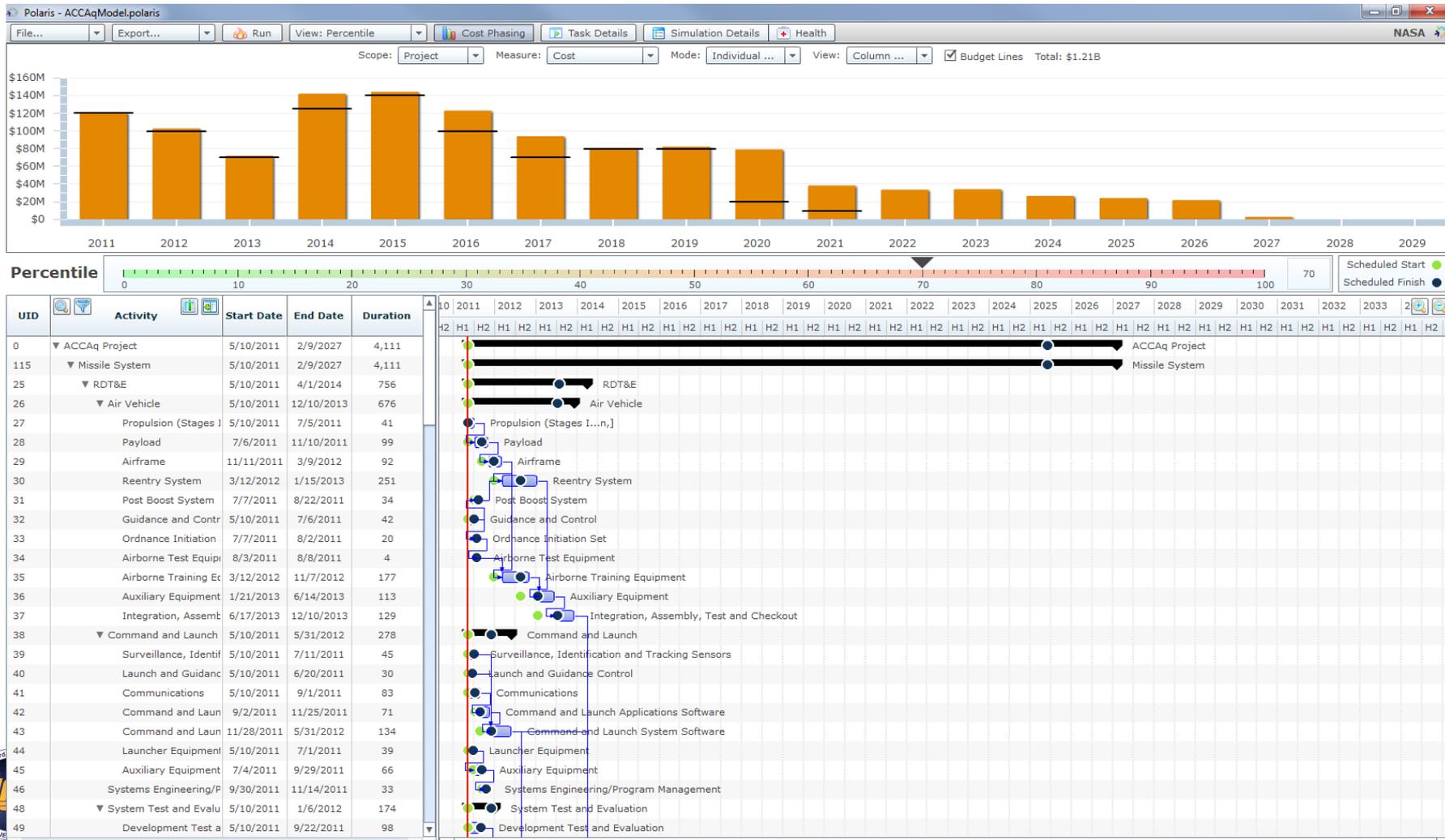
DOES PRIOR PERIOD OR HISTORICAL STATUS IMPLY AN ABSENCE OF COST UNCERTAINTY? AN ABSENCE OF SCHEDULE UNCERTAINTY?

Status or "as of" date

		GPR 7120.4D		
		Discrete Risk	Issue	Collective, non-discrete risks
	Prior Period Cost and Schedule of threat			
Likelihood	Known	Unknown	"Known"	Unknown
Consequence	Known	Unknown	Unknown	Unknown
	Actual	Discrete Risk		Uncertainty
	No Simulation	Simulation		
Advocate JCL				

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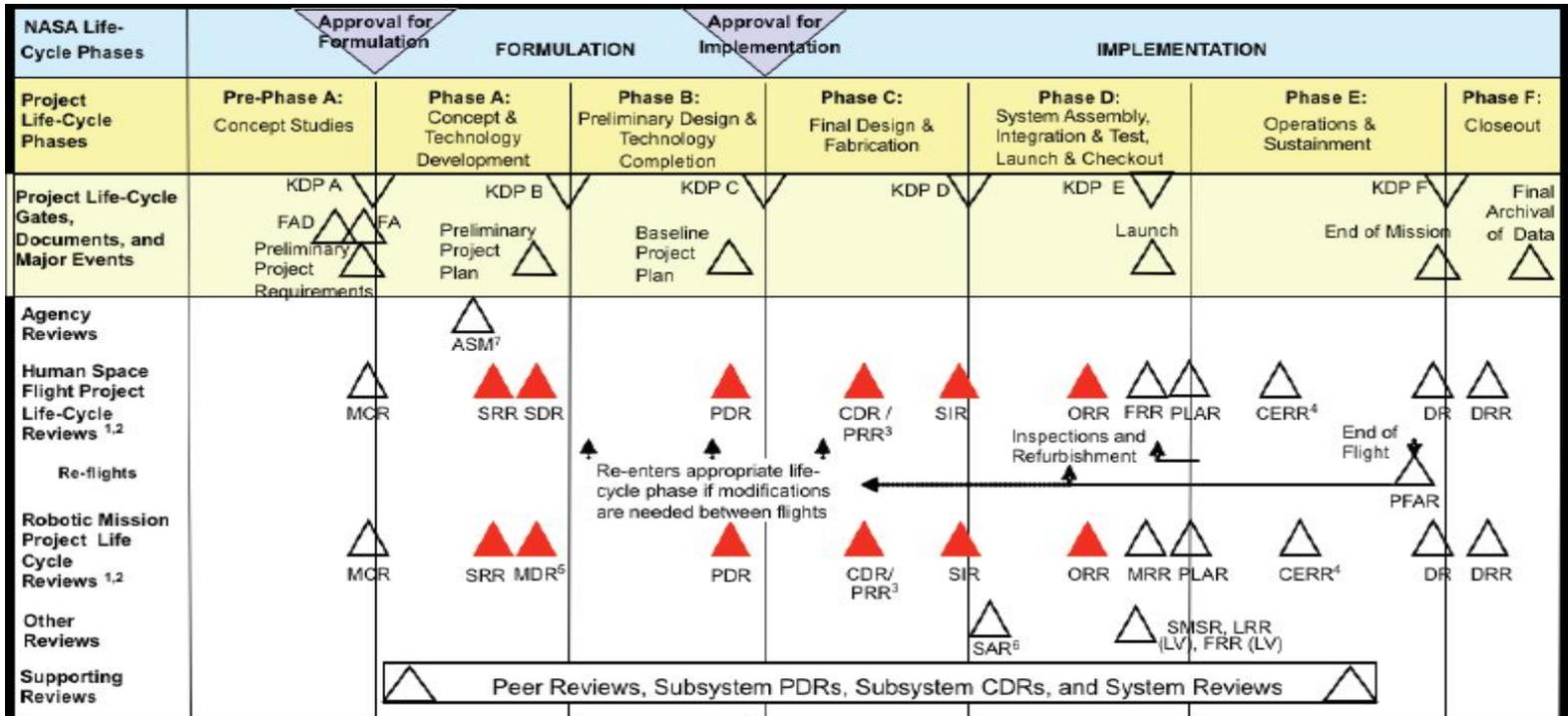
JCL DISCUSSION ITEM #3: Is "GOAL SEEKING" ACCEPTABLE?



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JCL DISCUSSION ITEM #5:

CAN JCL UTILITY EXTEND BEYOND SETTING BUDGETS?



FOOTNOTES

- Flexibility is allowed as to the timing, number, and content of reviews as long as the equivalent information is provided at each KDP and the approach is fully documented in the Project Plan.
- Life-cycle review objectives and expected maturity states for these reviews and the attendant KDPs are contained in Table 2-5.
- PRR is needed only when there are multiple copies of systems. It does not require an SRB. Timing is notional.
- CERRs are established at the discretion of program
- For robotic missions, the SRR and the MDR may be combined.
- SAR generally applies to human space flight.
- Timing of the ASM is determined by the MDA. It may take place at any time during Phase A.

ACRONYMS

- ASM - Acquisition Strategy Meeting
- CDR - Critical Design Review
- CERR - Critical Events Readiness Review
- DR - Decommissioning Review
- DRR - Disposal Readiness Review
- FA - Formulation Agreement
- FAD - Formulation Authorization Document
- FRR - Flight Readiness Review
- KDP - Key Decision Point
- LRR - Launch Readiness Review
- LV - Launch Vehicle
- MCR - Mission Concept Review
- MDR - Mission Definition Review
- MRR - Mission Readiness Review
- ORR - Operational Readiness Review
- PDR - Preliminary Design Review
- PFAR - Post-Flight Assessment Review
- PLAR - Post-Launch Assessment Review
- PRR - Production Readiness Review
- SAR - System Acceptance Review
- SDR - System Definition Review
- SIR - System Integration Review
- SMSR - Safety and Mission Success Review
- SRB - Standing Review Board
- SRR - System Requirements Review

▲ Red triangles represent life-cycle reviews that require SRBs. The Decision Authority, Administrator, MDA, or Center Director may request the SRB to conduct other reviews.

