



# Why Less is More: Thoughts on Raising Cost & Schedule Estimating Literacy in the NASA Resources Community

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# Purpose

This presentation discusses our current NASA Joint Confidence Level estimate presentations within the context of “Cost and Schedule Estimating Literacy” for our projects. Some recommendations are offered to set the stage for a constructive dialogue on how to improve our deployment and cultural acceptance of JCL approaches and NASA cost and schedule estimating overall.

**IN THE DRIVER'S SEAT: PROGRAM PLANNING AND CONTROL**

**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 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

## IN THE DRIVER'S SEAT: PROGRAM PLANNING AND CONTROL

### BCI – FRAMEWORK

Action Teams support the development and assessment of different disciplines, program/projects, and activities in order to integrate efforts, institutionalize best practices, and enhance PP&C



- ◆ Initial five Action Teams focus on tangible actions to improve our effectiveness in sharing knowledge and best practices
- ◆ Progressing through five phases that guide changes from vision and definition through deployment
- ◆ Researching, surveying, and recommending best practices for streamlined project activities
- ◆ Creating guidance, templates, standards, tools, and training for FPD and the Center
- ◆ Implementing changes in core disciplines and adjusting as needed based on feedback and pilot implementations

◆ As the BCI progresses and additional opportunities for improvement are identified, additional focus teams may be formed. Currently, the BCI is initiating three new teams for Web Architecture, Configuration Management, and Project Management Tools

IN THE DRIVER'S SEAT: PROGRAM PLANNING AND CONTROL

GSFC PP&C ENVIRONMENT

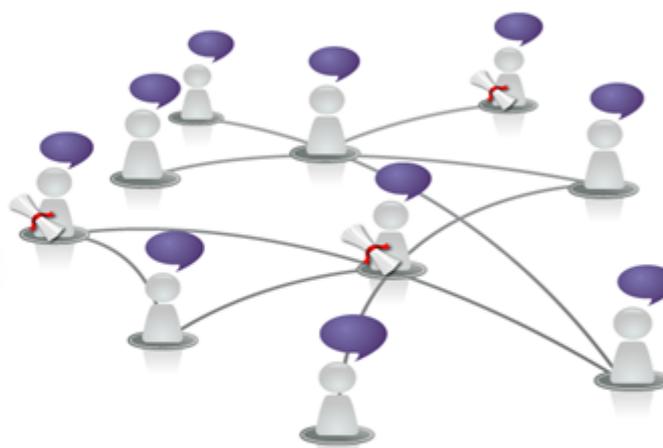
Current State



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*

# The Deployment Challenge

In observing a decade of business change management in NASA, our business subject matter communities are excellent at conducting intense debates and generating policy documents, methodologies, and handbooks. Our best intent is to support programs and projects.

In many cases however we fall short of “rolling out” or deployment. This is a matter of education and change management that must accompany the technical knowledge.

To your collective credit, the Joint Confidence Level estimating effort is moving steadily to more common and repeatable approaches.

We are now in a phase with the GSFC Business Change Initiative where we are focused heavily on successful deployment and shifting the GSFC culture.

<b>Table 2. Reasons for Cost Growth in NASA Projects</b>				
<b>Cost Growth Reasons</b>	<b>1970s</b>	<b>1980s</b>	<b>1990s</b>	<b>2000s</b>
Inadequate Definitions Prior to Agency Budget Decision and to External Commitments	X	X	X	X
Optimistic Cost Estimates/Estimating Errors	X	X	X	X
Inability to Execute Initial Schedule Baseline	X	X	X	X
Inadequate Risk Assessments	X	X	X	X
Higher Technical Complexity of Projects than Anticipated	X	X	X	X
Changes in Scope (Design/Content)	X	X	X	X
Inadequate Assessment of Impacts of Schedule Changes on Cost		X	X	X
Annual Funding Instability			X	X
Eroding In-House Technical Expertise			X	X
Poor Tracking of Contractor Requirements Against Plans			X	X
Launch Vehicle			X	
Reserve Position Adequacy		X		X
Lack of Probabilistic Estimating		X		X
“Go As You Can Afford” Approach				X
Lack of Formal Document for Recording Key Technical, Schedule, and Programmatic Assumptions				X

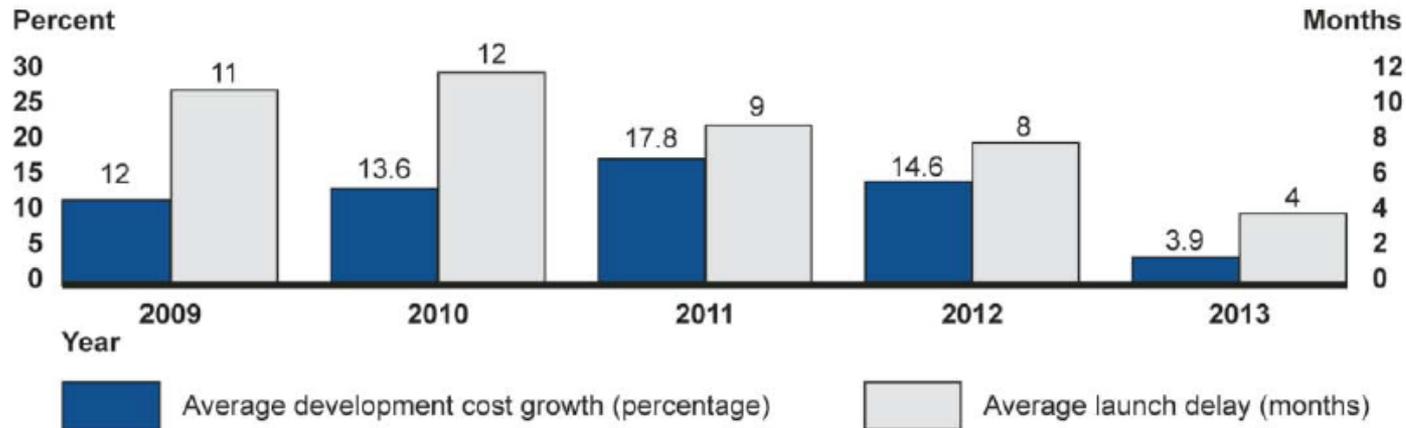
Source: NASA Advisory Council Meeting: Report of Audit and Finance Committee, Kennedy Space Center, February 5, 2009.

# External Agency Context- GAO

## What GAO Found

The performance of the National Aeronautics and Space Administration's (NASA) portfolio of major projects has improved in the areas of cost and schedule growth since GAO's first assessment in 2009. Average development cost growth and schedule delay for the current portfolio have decreased to about a third of their 2009 levels.

**Average Development Cost and Schedule Growth of Selected Major NASA Projects in the Implementation Phase, Excluding JWST**



Source: GAO analysis of NASA data.

Source: GAO, NASA: Assessment of Large Scale Projects GAO-13-276SP (April 2013), p. 2.

# External Agency Context – IG Report

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## **CHALLENGES TO MEETING COST, SCHEDULE, AND PERFORMANCE GOALS**

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Multiple factors underlie NASA's historical inability to meet project cost, schedule, and performance goals. However, based on our interviews with more than 80 individuals involved in all levels of management and project development, we identified four factors that appear to present the greatest challenges to successful project outcomes. The first three are long-standing issues, while the fourth is of more recent origin:

- Culture of optimism.
- Underestimating technical complexity.
- Unstable funding.
- Project manager development.

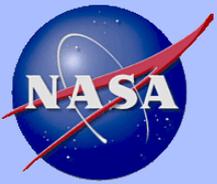
## External Agency Context – IG Report (cont'd)

One NASA OIG summary point (p. 13) is “To overcome the challenges identified in this report, it is critical that NASA continue to attract and retain high-quality project managers, adequately train and nurture these individuals, and provide them with ample opportunities to hone their skills.”

Observation: The OIG report focuses almost exclusively on the Project Manager and their role and challenges. GAO reports have a similar single focus.

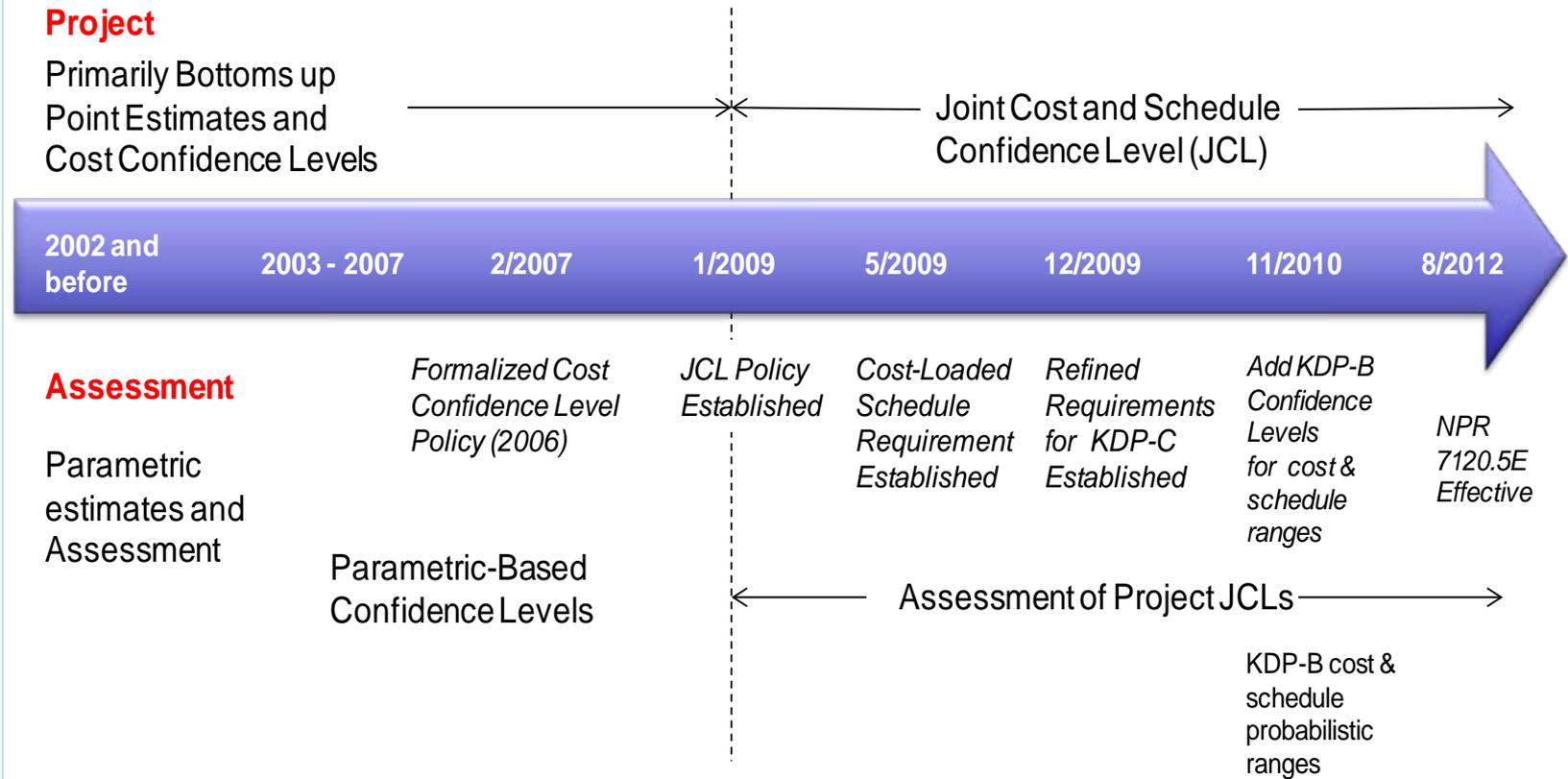
Questions: What about everyone else who supports the project manager? Do they need this “training” too? Can they assist with controlling scope, risk, schedule and cost?

The NASA JCL effort seems to be on the right track....



# Evolution to JCL at NASA

## Project Estimates (Advocacy)

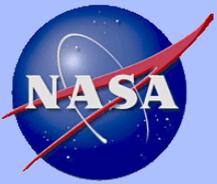


## “Independent” Estimates (Non-Advocacy)



# Primary Roles in JCL

- Project (Owner)
  - Owns JCL and probabilistic cost/schedule analysis and all products
- CAD (Consultant)
  - Policy and JCL advocate
  - Jump start consulting for projects – project advocate
  - Handbook and training
  - Models and Tools
- IPAO/SRB (Evaluator)
  - Evaluates KDP B probabilistic cost and schedule analysis
  - Evaluates the program and projects' JCL whenever a project are reviewed at KDP C or rebaselined



# Roles to Support JCL at KDP-C

- **Project Leader**
  - One individual to be responsible for coordination and integration
  - Typically a DPM, or someone similar with authority
  - Should have a good understanding of Project plan including cost, schedule, and risk
- **Scheduler**
  - One of the most important people in the JCL effort
  - Must be familiar with current Project schedules
    - Master Schedule (1-pager, PowerPoint)
    - Integrated Master Schedule (detailed, MS Project/Primavera, etc)
  - Needs to be ready to construct/ready analysis schedule
    - Should be able to reach back to technical experts, sys eng, etc.
- **Estimator or Resource Analyst**
  - Must be familiar with current Project budget, cost, and resource plan(s)
  - Should have access to phased cost data
    - WBS and lower level detail
- **Systems Engineer/Risk Manager**
  - Must be familiar with current Project RMS
  - Able to provide details for risk register
  - Should be able to reach back to risk owners/CAMs when needed

**Establish and Define Roles Early**

# What Does a Resources Analyst Need to Know?

NASA resources personnel have been focused too much on “transactional work”. Some NASA resources managers have evident knowledge and experience. Ideally, a well-rounded RA should know:

**Orientation**: landscape and context for their work

**Policy**: brief understanding of “why” we are doing this

**Current Trends and Initiatives**: what impacts work today (e.g. sequestration)

**Traditional**: core competency knowledge (e.g. NF533 analysis)

**Systems and Tools**: access to and use of SAP and other transactional and analytical systems

**Subject Matter & Consultants**: subject matter experts to call upon

**Career path opportunities**: linkage of acquired knowledge and performance above to career growth and future opportunities

Source: J. Bryson, NASA-GSFC, March 2006

# Knowledge Check-In

We recently conducted a quick informal poll of thirty GS-14 Financial Managers in the Flight Project Directorate at GSFC and received seventeen responses with the following results:

“Please reply with your best, immediate unresearched answers to the following three questions. No Googling please.

Question 1: What in your own words is a ‘Joint Confidence Level Cost Estimate’?

Question 2: What is the JCL cost estimate’s role in managing our projects?

Question 3: Who owns the JCL cost estimate when constructed?

Note that “I don’t know” is an acceptable answer.”

# Knowledge Check-In/Question 1

Question 1: What is the a 'Joint Confidence Level Cost Estimate'?

Answers:

**A cost and schedule probabilistic estimate *that incorporates all possible risks, threats, liens, uncertainties, mitigation strategies, etc.***

**It's an independent assessment of the project, conducted by HQ/IPAO during Phase A/B cycle of the project. The project needs to have funding available at least 75% of JCL Cost Estimate before it can proceed**

**A JCL Cost Estimate is the Project's most complete estimate at the time of the JCL Analysis requirement...I'd say the most beneficial aspect of the JCL Analysis was the nearly day-long discussion of the Project's risk list with the SRB Members during the PDR programmatic discussion.**

A probabilistic estimate that provides both cost and schedule outputs by factoring all elements of a project's cost, risks, and schedule profiles. A joint 70% confidence level is sought for both cost and schedule estimates and is compared against the project's baselined LRD and budget (without reserves).

**An estimate required by NPR 7120.5E to be used in a KDP review to determine if a Project should proceed to the next Phase.**

**Joint Confidence Level cost estimate is part of the Confirmation process and sets the projects ETC and anticipated schedule. I know they use new terms like KDPC.**

**The JCL is the gate you have to get through when the project is committing to their cost estimate. The project has to stand up and attest that they can complete their mission within the estimate and that they have enough reserves.**

# Knowledge Check-In/Question 1 (cont'd)

Question 1: What is the a 'Joint Confidence Level Cost Estimate'?

Answers:

**A cost estimate using a scientific model that includes certain allowances for variables. The JCL is Joint because it is built by an independent organization working for the Administrator utilizing input from the Project/Program. The estimate is designed to generate a cost estimate that assures a certain confidence level that the project can successfully be completed within the estimated cost.**

I BELIEVE THIS WAS PRESENTED AT PM CHALLENGE 2 YEARS AGO. I ALSO THINK IT HAS PRESENTED AT FOLLOW-UP MEETINGS. IT SEEMS REASONABLE BUT IT REQUIRES EXTENSIVE INVOLVEMENT BY THE PROGRAM MANAGER. HOW MANY MORE COST ESTIMATING SYSTEMS CAN A PROGRAM MANAGER HANDLE?

A JCL Cost Estimate, is an estimate that takes the project cost and schedule data within a software model, and allows a team to apply certain constraints/methods. The application of these methods produces a number of results displayed on a scatter plot. The compilation of all these individual points provides the JCL %. The various outputs, help to determine if the project has adequate resources for cost and schedule. This process can also help identify if there are any underscoped elements, or highlight any areas that risk mitigation activities would be recommended.

# Knowledge Check-In/Question 2

Question 2: What is its role in managing our projects?

Answers (sampling):

**In the case of ABC (project name), the estimate provided the basis for the Cost and Scheduled LRD in the Management Agreement (50% ) and the Agency Baseline Commitment (70%).**

**It is used to help the project determine what cost and schedule requirements are needed to have reasonable certainty that the project will be able to stay within that cost and schedule allotment.**

**It sets a bench mark to measuring how the project is doing as it relates to cost and schedule.**

**The JCL is a check to verify the Project's internal cost estimates for over-optimism or over-pessimism in its current cost estimate.**

**Without a successful JCL the project may not be able to complete their mission**

**it serves as a mark to evaluate the performance of the project in terms of Cost, Schedule and Technical aspects, in each cycle or phase of the project. The project may face termination if it's overrun by more than 20%, unless there's good explanations on why the project is overrunning**

**While the XYZ Project did not use the JCL further in the management of the project, our SRB Cost Team did. Every review after the PDR, we provided cost and risk updates to the team and they would run those updates through its JCL model. A half-day discussion about those inputs and results would take place each review between the SRB and Project. It was always a productive discussion and provided the SRB with confidence in our management of the project.**

A JCL cost estimate is one data point that can be used in helping to determine if a project has the adequate resources for both schedule and cost. Due to the nature of subjectivity that can be applied in the process, I think it is equally important to utilize other cost estimating techniques as well in evaluating a project's fiscal health.

# Knowledge Check-In/Question 3

Question 3: Who owns the JCL cost estimate?

Answers:

Eight answers basically said the project or Project Manager.

*In the case of ABC (project name), the project developed the JCL. Project should “own” it. Since it is the basis for both the Management Agreement and the Agency Baseline Agreement, I think all parties involved (Project, Center Mgmt, Agency Mgmt) should “own” it.*

**HQ/IPAO will conduct the independent assessment with a list of assumptions, with the concurrence from the project**

**A quick answer is whoever maintains the model! As previously discussed, XYZ Project did not update the JCL model but provided inputs each year to the SRB Cost Team. In essence, the Project owns the JCL estimate as it is the entity with the best resources to produce the estimate.**

**The Review team**

The Chief Engineer's Office

**I don't know. / Not sure**

The person with who the entity resides (ie project manager/fm, dpmr, 420...?)

**Not totally sure, but I think it would be owned by the project, center management and NASA headquarters responsible organization.**

**MY CONTINUOUS ANSWER TO ANY PROGRAM MANAGER: YOU ARE RESPONSIBLE FOR TECHNICAL PERFORMANCE, COST AND SCHEDULE.**

# Knowledge Check-In - Conclusions

- There is a basic understanding of the JCL process and its role among several FMs. There were some outlier answers that were not correct.
- Even among experienced FMs who have had JCLs on their projects, there was still some confusion about its use and ownership.
- Those who had only been at the RA level during this process did not provide strong answers.
- The ongoing role of the SRB in utilizing JCL results and updating their own analyses would be interesting to explore.
- Getting to common understanding and explanation would benefit all of us.

## Why Less is More

Today's primary JCL education is rightly focused on immediate preparation for a given project to perform a JCL estimate.

We recently presented to a general audience of RAs and FMs at GSFC about the JCL requirement and process. Even those without immediate JCLs coming encouraged to us to improve and present these materials to a wider GSFC audience.

What we are finding as part of our BCI effort is that in the areas of planning and scheduling, Earned Value Management, cost and schedule estimating, awareness of NPR7120.5E, etc. we can share fewer of the purely technical charts and only need to add a few charts to increase knowledge along the RA knowledge dimensions.

The following are some candidate slides to be added to the generic Agency JCL slides:

## JCL-to-Budget Relationship NPR7120.5E

2.4.3.2 At KDP I/KDP C, tightly coupled and single-project programs (regardless of life-cycle cost) and projects with an estimated life-cycle cost greater than \$250 million shall develop a resource-loaded schedule and perform a risk-informed probabilistic analysis that produces a JCL. The JCL is the product of a probabilistic analysis of the coupled cost and schedule to measure the likelihood of completing all remaining work at or below the budgeted levels and on or before the planned completion of Phase D.

2.4.4 Mission Directorates shall plan and budget tightly coupled and single-project programs (regardless of life-cycle cost) and projects with an estimated life-cycle cost greater than \$250 million based on a 70 percent joint cost and schedule confidence level, or as approved by the Decision Authority.

2.4.4.1 Any JCL approved by the Decision Authority at less than 70 percent shall be justified and documented.

➔ *We should provide the basics on what a JCL estimate is and make sure all Financial Managers understand this hard connection to Center and the Agency Baseline Commitment and the budget and UFE processes.*



# Cost and Schedule Assessments at NASA

- Advocate Cost Assessments:
  - Grass roots (based upon Full Cost Builder; can include vendor estimates)
  - Price H / SEER
  - Other?
- Non-Advocate Cost Assessments:
  - RAO (GSFC)
  - Project Standing Review Board (SRB)
  - Private companies (Booz Allen Hamilton, The Aerospace Corporation, SAIC, etc.)
- Schedule Assessments:
  - Analogous to Cost Assessments: both advocate and non advocate

➔ *We should provide everyone with a basic understanding of the types of cost and schedule estimates we perform in NASA.*



# JCL Lessons Learned - Benefits

- Improves project planning by integrating cost, schedule, and risk products and processes
- Focuses on the inputs to project plans instead of the outputs
  - NASA management resonates with the discussion of specific technical and programmatic inputs
  - Facilitates better communication between the project and the independent review team
- Complements many of the Agency's existing systems and activities (e.g., Risk Management Systems, Earned Value Management)
- Reserve levels are not dictated by standards or rules of thumb, but derived from the project's unique technical and programmatic characteristics (treated as unfunded future expenses)
  - Facilitates better understanding and communication of project health to external stakeholders
- Incorporates schedule into the confidence level calculation
  - Genesis of Joint Cost and Schedule Confidence Level (JCL)
  - Forces project to address and understand time independent and time dependent costs
  - Enforces scheduling best practices (i.e., schedule health checks)
- Strengthens risk management
  - Quantifies risks in terms of cost and schedule impacts
  - Addresses risk realization instead of only risk mitigation

At Goddard, the Advocate JCL process is in its infancy but there's mounting evidence that it holds significant potential for budgetary and operational benefits. Once we climb higher on the learning curve, the same model can be both understood and have the support of both the project and the independent reviewers. This can boost ownership and commitment to meeting cost and schedule goals which is what the Business Change Initiative is endeavoring to target.

## Other slides under consideration

These are some other slides that may help with acceptance and culture change in this area:

**JCL Success stories:** We are developing an informal examination of how the JCL was utilized for the LDCM Project to set up the UFE profile. Further, how ultimately the HQ-held UFE provided the safety net that changed the risk posture and decision approach on the LDCM Project. Are the other Agency success stories and lessons learned that can be share with a general resources management audience?

**Subject Matter Experts:** Building from the “Roles” list in the Project JCL orientation, we would like to identify experts for Cost & Schedule estimating as “go to” people for our resources community.

# Recommendations

- Continue to improve awareness of the JCL-to-UFE linkage in our Budget training materials and get the JCL “success stories” to a broader audience
- Examine where a JCL estimate is really a one-time event or are there benefits to supporting its continued use by Standing Review Boards and others?
- Develop a 1-hour Cost & Schedule Estimating 101 and deploy its content in multiple venues (CAD Presentations, CFO University, OCE Program Planning and Control/Independent Assessment, local Center training).
- Research and discuss whether to formalize measurements of “Cost and Schedule Literacy”.

# Summary

Perhaps the best approach to “Raising Cost & Schedule Estimating Literacy” will come from our collective efforts to develop knowledge and training materials along the dimensions of “What Does a Resources Analyst (or Financial Manager or Deputy Project Manager-Resources) Need to Know” and to deploy them commonly in multiple venues.