FLIGHT PROJECTS DIRECTORATE

Goddard Space Flight Center
Flight Projects Directorate's
Business Change Initiative: Improving Cost Control
2014 NASA Cost Symposium

Steve Shinn, NASA GSFC
Param Nair, NASA GSFC

August 12, 2014

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

AGENDA

- **Business Change Initiative**
  - Establishing a sustainable, long-term change framework
  - Measuring and verifying adoption of program, planning, and control best practices
- **Cost Management**
  - Analyzing cost at GSFC
  - Describing role and composition of the Cost Management Team
- **Improving Cost Control**
  - Employing an advocate joint confidence level (JCL) approach (presented at the 2013 NASA Cost Symposium)
  - Standardizing core cost estimating
    - Treatment of payload suite instrument costs
    - Treatment of Government furnished equipment or contributed hardware

"It is imperative that government programs deliver as promised, not only because of their value to the Nation but because every dollar spent on one program will mean one less available dollar to fund other efforts" -Government Accountability Office, 2013

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

BUSINESS CHANGE INITIATIVE OVERVIEW

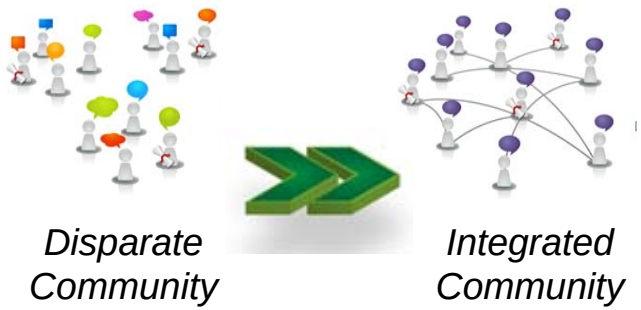
BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

BCI OVERVIEW

A comprehensive evaluation of management, communication, and information sharing mechanisms intended to improve cost, scheduling, and overall performance across the Flight Projects Portfolio

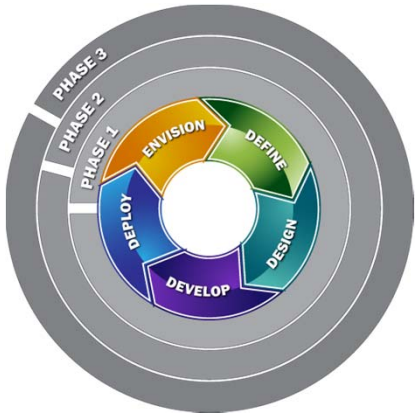
Current State

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



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



Phase I: Initial Implementation
Phase II: Additive and Enhancement
Phase III: Optimized Sharing

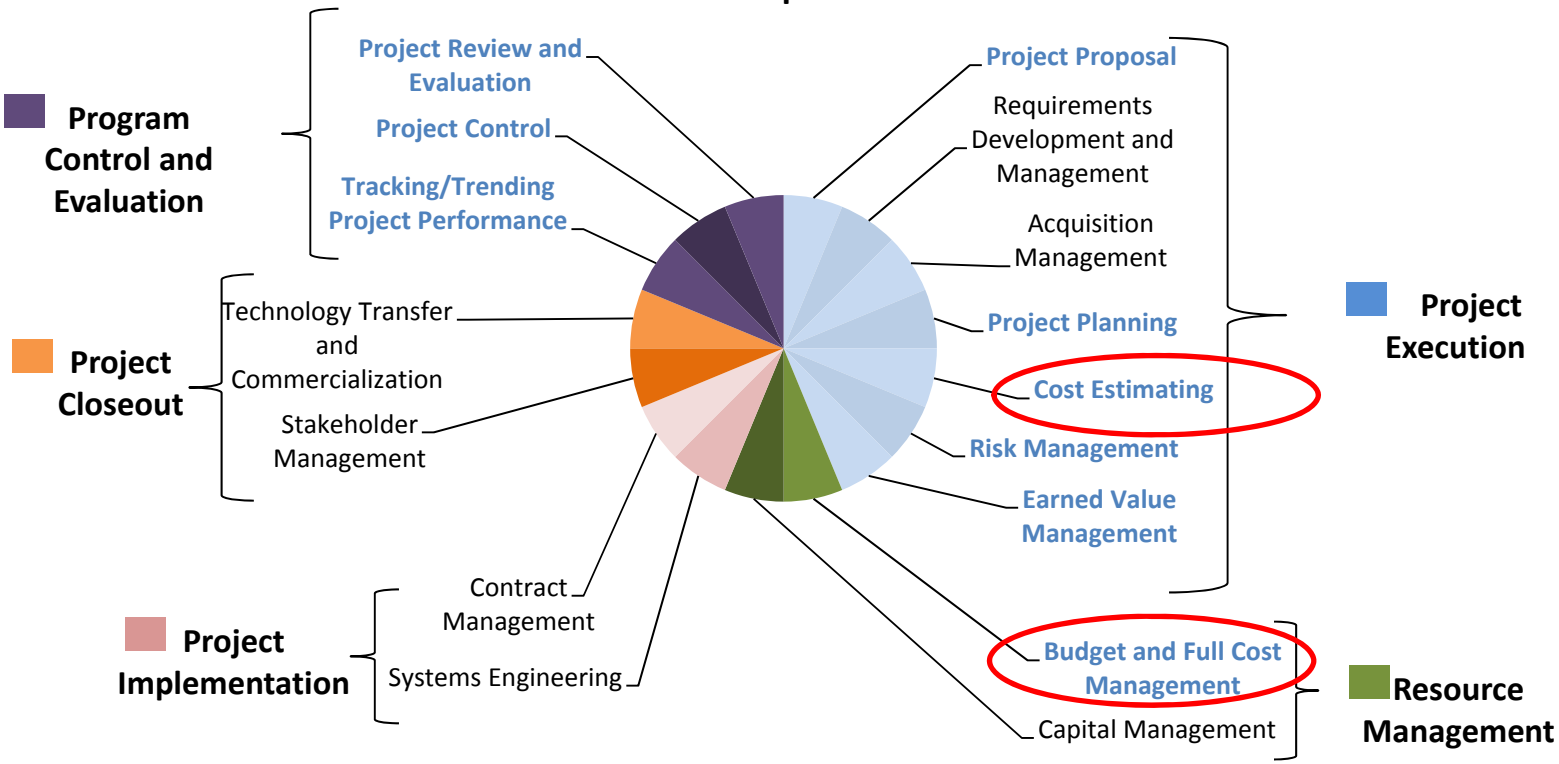
BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

BCI SCOPE

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 project planning and control (PP&C) methods, tools, processes, and knowledge to support improved performance and management decision making

PP&C Discipline Areas



BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

BCI APPROACH

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

ESTABLISHED	BCI DEPLOYMENTS
Agency Policy, Procedural Requirements NPR 7120.5, NASA Program and Project Management Processes and Requirements	▪ NASA Agency EVM Handbook (providing feedback and support)
Center Policy, Procedural Requirements GPR 7120.7, Schedule Margins and Budget Reserves	▪ 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)s ▪ 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)

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

FLIGHT PROJECTS DIRECTORATE

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

EXECUTIVE ROADMAP

Scheduling | Cost Estimating | Management Reporting | BRISK | Earned Value Management

Phase I — Complete

- Assessed agency and industry best practices
- Established Center-level schedule policy
- Increased accessibility to new policies and processes

- Advocated approach to Joint Confidence Level analysis
- Developed handbook

- Released Management Reporting Guidance

- Assessed current Earned Value architecture and environment

- Centralized knowledge

Phase II — 70% Complete / Complete by Sept 2014

- Developed scheduling tools to drive compliance and consistency

- Developed instructions to improve cost estimating and management

- Streamlined reporting activities
- Standardized document development

- Piloted new software
- Deployed EVM Curriculum Guide
- Created web environment for EV best practices

- Deployed business resources that enable the project teams to further integrate and collaborate

- Conduct analysis and assessments for schedules

- Expand publication of best practice instructions
- Develop library of cost basis of estimates

- Deploy tools that drive more efficient reporting

- Identify scalable and common toolsets to simplify earned value implementation and reporting
- Educate and train workforce on earned value concepts and techniques

- Design courses that enable and encourage employee development
- Host developmental dialogue sessions
- Create a business competency map

Phase III — Complete by Dec 2014

- Refine processes, guidelines, and tools

- Create cost analysis case studies
- Expand BPI library

- Monitor compliance
- Improve reporting efficiency
- Communicate performance

- Augment earned value curriculum
- Deploy process guide
- Host EV roundtables to identify solutions
- Implement a scalable EVMS

- Address knowledge gaps
- Refine FPD business development paths
- Sustain resource forums

Business Improvement and Optimization — Jan-Mar 2015

Action Teams work collaboratively to improve knowledge sharing and drive the application of best practices

End State — NLT Apr 2015

An integrated community of programs and projects that openly share and apply program planning and control best practices

Note: Continuity is maintained within standing business functions

Business Change Initiative: Improving Cost Control

Example Deployments

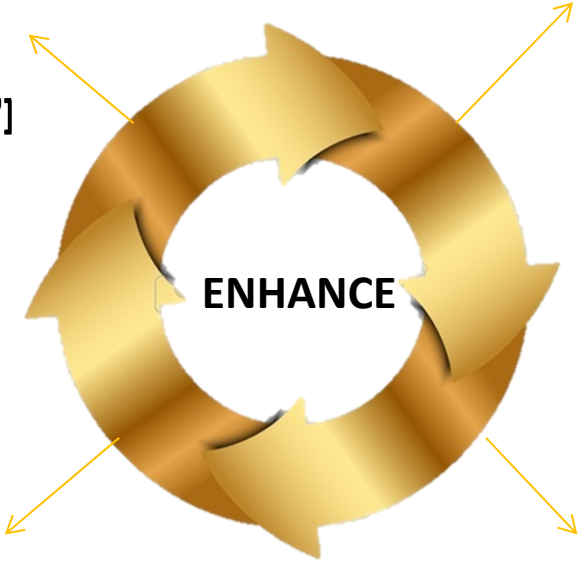
Action Team	Sample Past Deployments	Sample Upcoming Deployments
Scheduling	• Revised Procedures and Guidelines • Developed Schedule Best Practice Instructions • Created Scheduling Knowledge Network • Designed and deployed a schedule analysis tool	• Enhance Goddard Schedule Analysis Tool to include cumulative milestone capability and added reports • Establish Schedule Peer Review Teams • Conduct Schedule Risk Analyses
Management Reporting	• Updated MSR guidance • Produced earned value (EV) reporting templates for MSRs • Streamlined Portfolio Integrated Master Schedule	• Employ an Early Threat Assessment method at project and portfolio level • Enable real-time reporting reviews for project programmatic performance data
Cost Estimating	• Developed handbook to standardize and guide cost estimating processes • Applied consistent process to successfully perform cost estimating exercises for various projects	• Develop/release cost management best practice instructions (BPIs) • Share lessons learned Agency-wide from development of BPIs
Earned Value Management (EVM)	• Mapped architecture of EVM systems at Goddard • Developed EV reporting templates to support monthly status reviews • Procured new EVM tools that improve analysis • Designed enhancements to EV training curriculum	• Pilot EV budget tools • Develop variance analysis training • Create EVM Implementation Process Map with linked policies and resources • Implement a scalable performance reporting system
Business Rapid Information Knowledge & Skills (BRISK)	• Reestablished Knowledge Sharing Forum • Deployed Resource Analyst Assessment Tool • Facilitated improvements to program training • Centralized Professional Intern Program Repository	• Facilitate "Business Development Dialogues" with FPD program managers and business staff • Design NPR 7120.5E Business Overview training package and supplement resources • Evaluate Project Acquisition Workshop

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

THE FUTURE – SUSTAINABILITY MODEL FOR LASTING CHANGE MANAGEMENT

Accessible shared resources (guidance, templates, training) available to all project teams [SharePoint Portal and "Knowledge Networks"]

Chartered communities of practice to refine, improve, and release best practices [EVM Roundtables; Planning and Scheduling Lunch and Learns; KMAP Workshops]



Consistent, common PP&C practices to improve efficiency and effectiveness to meet all commitments [Best Practice Instructions; Procedural Guidelines]

Educated employees, a result of training material for all levels and curriculum guides for career development [BRISK and EVM Curriculum Guides; SATERN courses]

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

COST MANAGEMENT

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

BCI COST ESTIMATING TEAM

- **Team and Partners**
  - **Core Members:** Flight Projects Directorate, Resource Analysis Office, Project Deputy Program Managers – Resources, Project Planners
  - **Partners:** Flight Projects Directorate, Applied Concepts and Formulation Office, GSFC New Business Office, GSFC Procurement Division
  - **Collaborators:** GSFC Office of the Chief Financial Officer, GSFC Sciences and Exploration Directorate, NASA Jet Propulsion Laboratory, NASA Headquarters Cost Analysis Division
- **Accomplishments**
  - ☑ Released "GSFC Advocate Joint Confidence Level" SATERN course
  - ☑ Published Cost Estimating Best Practice Instructions
  - ☑ Updated and announced revisions to the NASA Instrument Cost Model tool
  - ☑ Published GSFC Joint Confidence Level Handbook
  - ☑ Employed reliable framework for JCL model assessments
- **Next Steps**
  - Publish series of cost management best practice instructions
  - Partner across NASA Centers and NASA-sponsored partnerships on best practices and lessons learned
  - Author cost analysis cost studies

Standardize and improve techniques and documentation of cost estimating processes
-Cost Estimating Team Vision

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

AS-IS STATE

Community Summary

- CFO Office (Code 150)
  - Program Analysis (Code 153) (1)
  - Cost Estimating, Modeling, and Analysis (CEMA)(Code 158) (1+ CEMA)
- Flight Projects (Code 400) (1 + Resource Analysis Office) (RAO)
- Best practices to share with other Centers
  - Centralized/coordinated repository of cost estimating data; continuing to create standard operating procedures and approaches to cost estimating
  - Implemented Joint Confidence Level (JCL) Handbook; implemented standard tool for JCL completion
  - Strong Independent Design Center (IDC) includes cost estimating
  - Developed strong relationships with cost groups across all organizations at GSFC as well as the Agency

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

AS-IS STATE

Advocacy/Non-Advocacy

- Parametric Modeling
  - Parametric validation of grassroots (proposals)/creation and development of accurate cost estimates (cost value management) – conducted variant
  - Generation of parametric point design cost estimates based upon master equipment list current-best estimate mass inputs and other supporting information – conducted variant
  - Variances - document differences for discussion (presented in form of charting, data collection, general Excel files, and export files)
- Joint Confidence Level
  - JCL process – prior to KDP-C, as required
  - Variances - document results of the analysis to include the project's baseline plan with schedule and cost margin and the project's 50 percent and 70 percent confidence levels for cost and schedule together

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

DEPLOYMENTS – ADVOCATE JCL PROCESS FOR FLIGHT PROJECTS

- Improves project planning by **integrating cost, schedule, and risk**
- Focuses on the inputs to project plans instead of the outputs
- Complements many of the Agency's existing systems and activities (e.g., risk management systems, earned value management)
- Derives reserve levels from project's unique technical and programmatic characteristics and not dictated by standards or rules of thumb
- Incorporates schedule into the confidence level calculation
  - Forces project to address/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

The Advocate JCL process is still maturing but there is 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.

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

DEPLOYMENTS – EDUCATING PROJECTS ON JCL

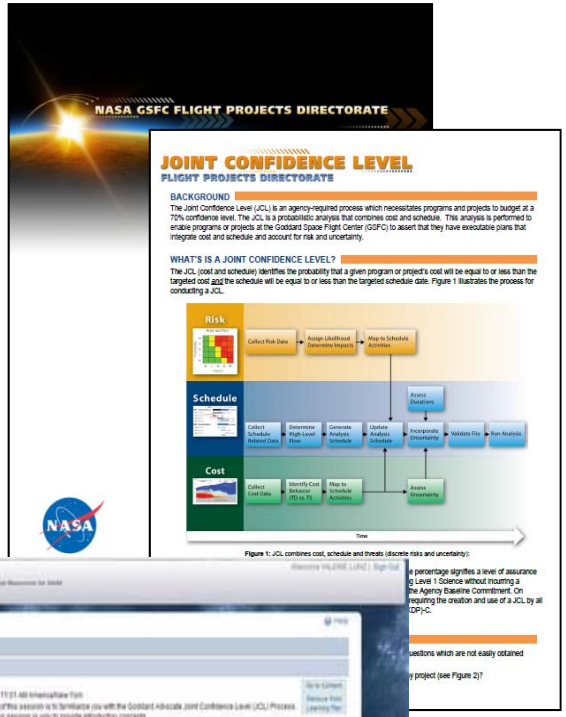
The Flight Projects Directorate at Goddard has commissioned several sources on JCL as references for the flight projects community

- JCL SATERN-based training course
- 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 community on the JCL process

- Goddard Master's Forum
- Combined Resources Forum
- Special topics at Senior Staffs
- One-on-one project support

JCL Handbook



JCL Training

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

IMPROVING COST CONTROL – CORE COST ESTIMATING

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

CORE COST ESTIMATING

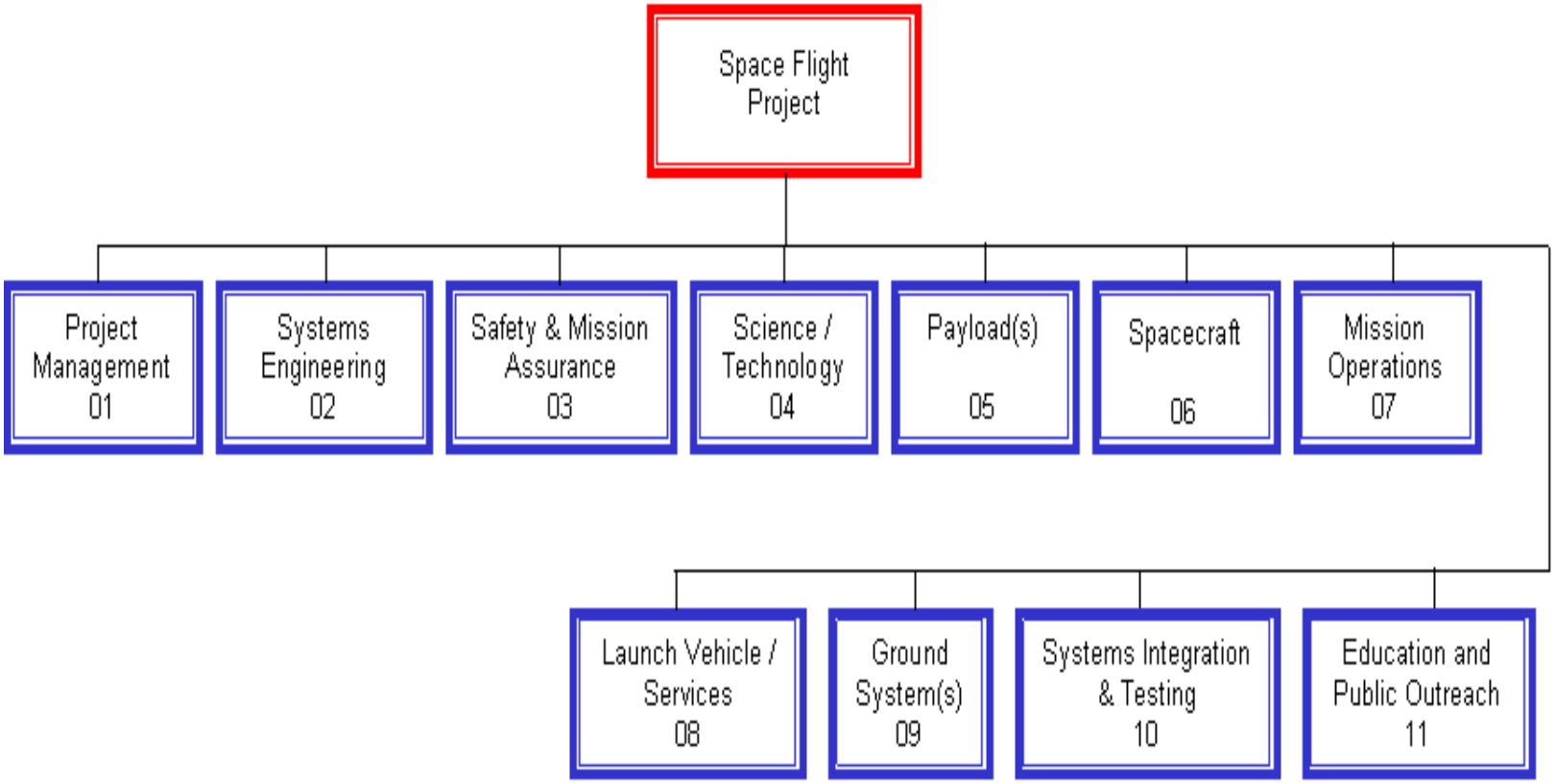
- **Data Collection => Normalization => Model Development => Application**
- **Desirable data attributes:**
  - **Complete**
  - **Error-free**

Current practice fails to meet these two standards despite written policy guidance to the contrary...

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

PAYLOAD SUITE INSTRUMENT COST CAPTURE

A WBS Refresher – 1 of 2



BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

PAYLOAD SUITE INSTRUMENT COST CAPTURE

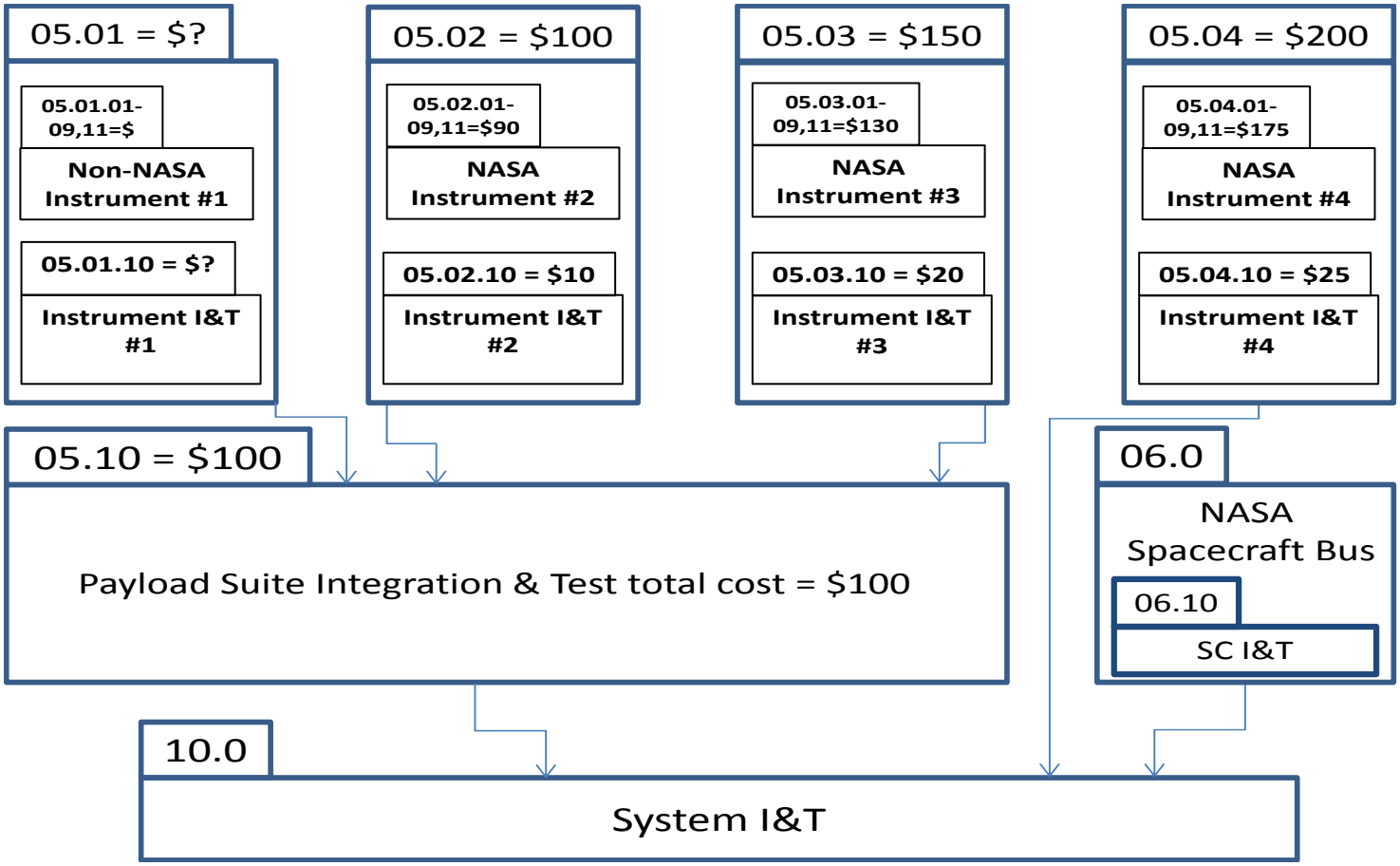
A WBS Refresher – 2 of 2

WBS Level 2	Element Name	Description
05	Payload	This element includes the special-purpose equipment and normal equipment, e.g., ground support equipment, integral to the spacecraft. This includes managing, and implementing the hardware and software payloads that perform the scientific experimental and data-gathering functions on board the spacecraft, as well as the technology demonstration for the mission.
06	Spacecraft	The spacecraft that serves as the platform for carrying payload(s), instrument(s), humans, and other mission-oriented equipment in space to the mission destination(s) to achieve the mission objectives. The spacecraft may be a single spacecraft or multiple spacecraft/modules (i.e., cruise stage, orbiter, lander, or rover modules). Each spacecraft/module of the system includes the following subsystems, as appropriate: crew, power, command & data handling, telecommunications, mechanical, thermal, propulsion, guidance navigation and control, wiring harness, and flight software. This element also includes all design, development, production, assembly, test efforts, and associated ground support equipment to deliver the completed system for integration with the launch vehicle and payload. This element does not include integration and test with payloads and other project systems.
10	Systems Integration & Testing	This element includes the hardware, software, procedures, and project-owned facilities required to perform the integration and testing of the project's systems, payloads, spacecraft, launch vehicle/services, and mission operations.

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

PAYLOAD SUITE INSTRUMENT COST CAPTURE

Notional Hardware Flow



Business Change Initiative: Improving Cost Control

Payload Suite Instrument Cost Capture

Actual Data

PAYLOAD	COST (RY$K)
Instrument 1	$4,426
Instrument 2	$2,225
Instrument 3	$2,343
Instrument 4	$673
Instrument 5	$706
Payload I&T	$6,328

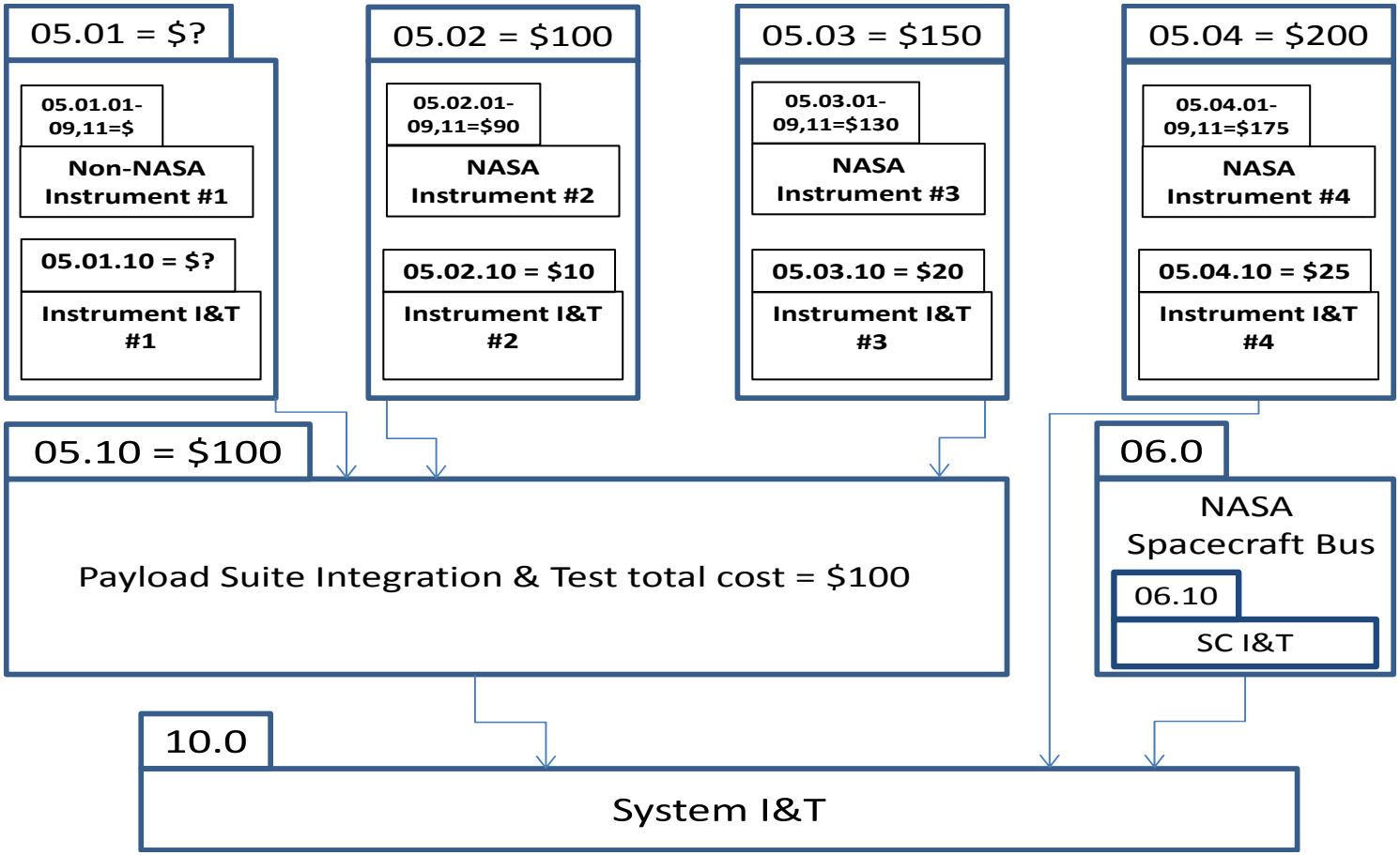
PAYLOAD I&T COST TREATMENT - RY$K	INSTRUMENT1	INSTRUMENT2	INSTRUMENT3	INSTRUMENT4	INSTRUMENT5
As Reported	$4,426	$2,225	$2,343	$673	$706
Assume even division of Payload I&T	$5,692	$3,490	$3,608	$1,939	$1,972
Assume Payload IT costs proportional to instrument cost	$7,126	$3,582	$3,772	$1,084	$1,137

PAYLOAD I&T COST TREATMENT - %	INSTRUMENT1	INSTRUMENT2	INSTRUMENT3	INSTRUMENT4	INSTRUMENT5
As Reported	0%	0%	0%	0%	0%
Assume even division of Payload I&T	129%	157%	154%	288%	279%
Assume Payload IT costs proportional to instrument cost	161%	161%	161%	161%	161%

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

PAYLOAD SUITE INSTRUMENT COST CAPTURE

Notional Hardware Flow Revisited



Business Change Initiative: Improving Cost Control

Payload Suite Instrument Cost Capture

Summary of Proposed Changes

INSTRUMENT	COST
1	??
2	$100
3	$150
4	$200

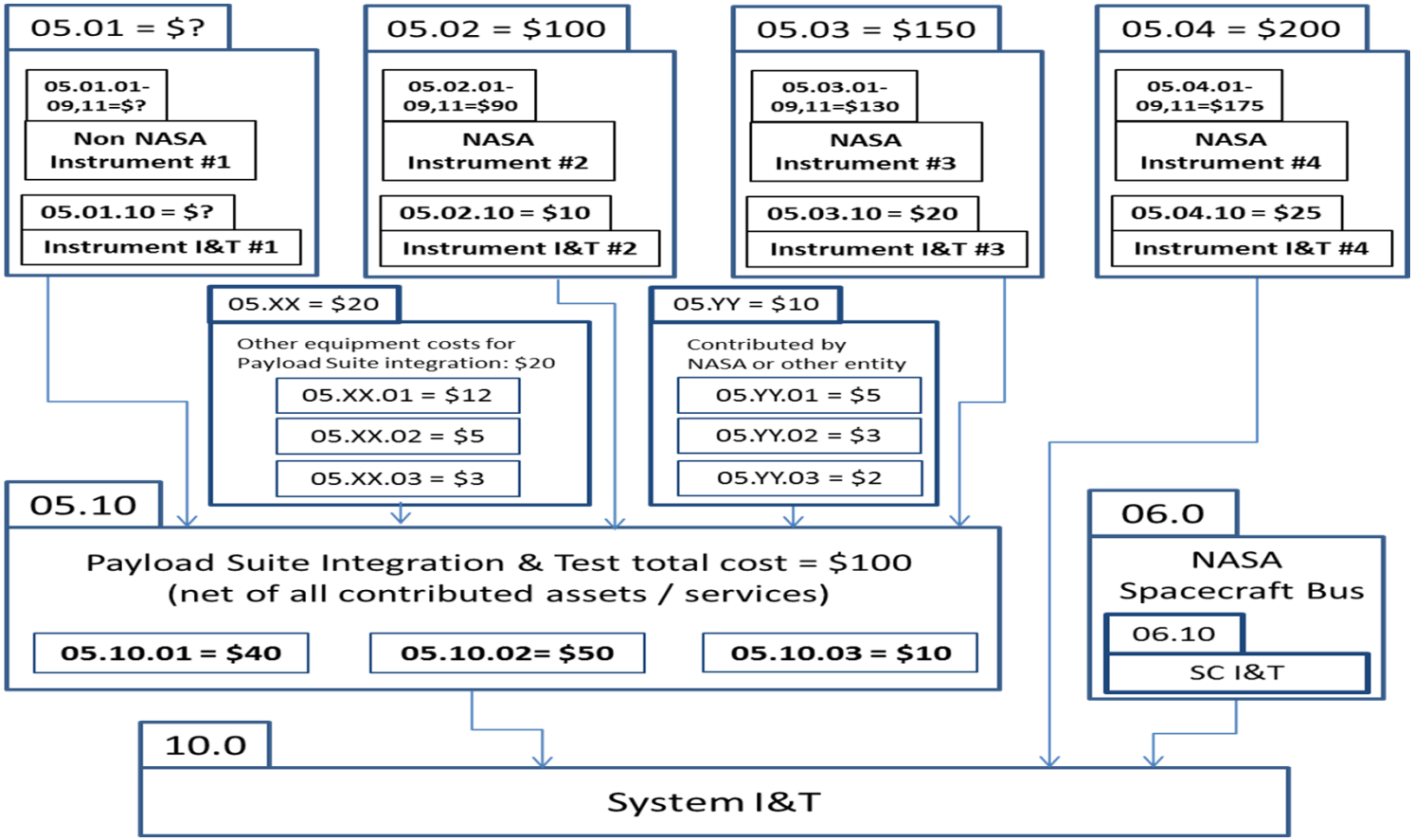
INSTRUMENT	PAYLOAD SUITE I & T COST
1	$40
2	$50
3	$10
4	N.A.
TOTAL	$100

INSTRUMENT	WBS	FINAL COST
1	05.01 + 05.10.01	?? + $40
2	05.02 + 05.10.02	$100 + $50 = $150
3	05.03 + 05.10.03	$150 + $10 = $160
4	05.04	$200

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

GOVERNMENT FURNISHED EQUIPMENT OR OTHER CONTRIBUTED HARDWARE

Notional Hardware Flow Revisited



Business Change Initiative: Improving Cost Control

Government Furnished Equipment or Other Contributed Hardware Refinement

INSTRUMENT	WBS	FINAL COST
1	05.01 + 05.10.01	?? + $40
2	05.02 + 05.10.02	$100 + $50 = $150
3	05.03 + 05.10.03	$150 + $10 = $160
4	05.04	$200

INSTRUMENT	WBS	FINAL COST
1	05.01 + 05.10.01 + 05.XX.01 + 05.YY.01	?? + $40 + $12 + $5 = $?
2	05.02 + 05.10.02 + 05.XX.02 + 05.YY.02	$100 + $50 + $5 + $3 = $158
3	05.03 + 05.10.03 + 05.XX.03 + 05.YY.03	$150 + $10 + $3 + $2 = $165
4	05.04	$200

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

IMPLEMENTATION

Guidance 1 of 2

- **Rule 1: Timing**
  - All cost adjustments must be made prior to entry into the NASA System of Record (e.g., Cadre, etc.). If this is not possible, these adjustments to costs should be fully documented in the text fields of these systems of record so that the proper cost of an instrument can be retrieved.
- **Rule 2: Procurement**
  - Procurement experts at GSFC consider this change to be readily implemented within existing contract reporting requirements, so long as the request for proposal for payload integration is properly developed. Specifically, the requiring technical organization needs to establish **a work breakdown structure for payload integration that supports the above-defined cost reporting segregation**. The work breakdown structure needs to define/segregate each payload instrument integration effort, so that the cost is properly segregated / reported (such that it includes all costs prior to system integration and testing on a per instrument basis).

BUSINESS CHANGE INITIATIVE: IMPROVING COST CONTROL

IMPLEMENTATION

Guidance 2 of 2

- **Rule 3: Vehicle**
  - The vehicle to obtain this information is either via an EVM system and EVM reporting requirements (for contracts that require EVM) or via the contractor Financial Management (533) report. For 533-based reporting, it is essential that the contract defines the reporting level against the work breakdown structure at a low enough level that the required segregation is obtained.
- **Rule 4: Frequency**
  - Cost apportionment should be performed and reported with the frequency of normal cost reporting.

Do not try this halfway through a project – it can get very expensive - in more ways than one

IMPLEMENTATION

Areas for Further Research

- **Definitions:**
  - The definition of a bus versus a payload suite needs to be clarified for planetary or other missions where a “probe” or “rover” detaches from the traditional spacecraft and carries the payload suite to the site of the science investigation. In these scenarios, it is not clear whether the traditional definition of a spacecraft bus as the item that carries the payload to the site of science investigations is a single unit. This, in turn, can affect what constitutes the payload suite.
- **No Fly Zone?**
  - This best practice instruction does not apply to foreign payload suite integrators unless they agree to provide this degree of insight…?