



***EoC Study Update to Examine the
Cost, Schedule and Technical Changes
to NASA Projects***

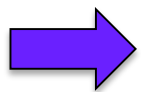
***Bob Bitten, Debra Emmons
The Aerospace Corporation***

***Steve Shinn, Chris Scolese
NASA Goddard Space Flight Center***

8 March 2018



Agenda



- Introduction
- EoC Recap
- BCI Background
- New EoC Missions & Results
- Comparison to Previous Results
- Summary





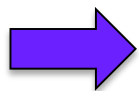
Introduction

- Objective
 - *Updated previous Explanation of Change data to see if results have changed in more recent set of missions*
- Added missions with GSFC participation launching after 2010
 - *Previous data set consisted of 25 missions with 8 Goddard missions*
 - *Compared 8 new Goddard missions with older data set*
 - LDCM, MAVEN, GPM, MMS, OSIRIS-REx, ICESat-2*, TESS*, RBSP
- Compare data of complete data set and Goddard-only missions
 - *Cost and schedule change from start of phase B, PDR and CDR to launch*
 - *Mass growth from start of phase B, PDR and CDR to launch*
 - *EoC binning and primary contribution to growth*
- Results demonstrate if the policies implemented by NASA HQ and Goddard since original study was conducted have had an effect on cost and schedule growth

* Note: still to be launched



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- Comparison of Operational Missions
- Flagship Mission Case
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Previous EoC Study Overview

- Study Purpose
 - *Understand the primary reasons for cost and schedule growth*
 - *Determine percentage of growth outside of the project's control*
- Approach
 - *Examined project documentation, including CADRe, milestone presentations, monthly project reports, etc., to develop a case history of each project*
 - *Conducted interviews with key project personnel to provide the insight required to understand all reasons for growth*
 - *Allocated growth events to "Explanation of Change" EoC "tree" to quantify reasons for growth*
- Result
 - *Examined 25 NASA missions launched in the last decade and conducted interviews to assess project's position on cause of growth*
 - *Identified common themes and developed recommendations based on data analysis and observations*



Previous EoC Study Summary

- Mission data collected for twenty-five NASA science missions
- Results of Mission Explanation of Change (EoC) categorization as a percent of the total cost increase from the start of Phase B
 - *5% External to NASA*
 - *27% External to the Project*
 - *31% Relative to Project Planning*
 - *37% Relative to Project Execution*
- Average cost increase from KDP-B (not including reserves or the launch vehicle) was 84%, decomposed as follows:
 - *27% additional cost increase due to HQ and external factors*
 - *26% cost increase from Phase B start until realistic programmatic baseline established (typically after confirmation)*
 - *31% cost increase after realistic programmatic baseline established*
- Set of 9 considerations identified
 - *Address complete life cycle, mission types and EoC categories*



Explanation of Change (EoC) Categorization “Tree” Example

- Standard worksheet allows display/calculation of roll-up results

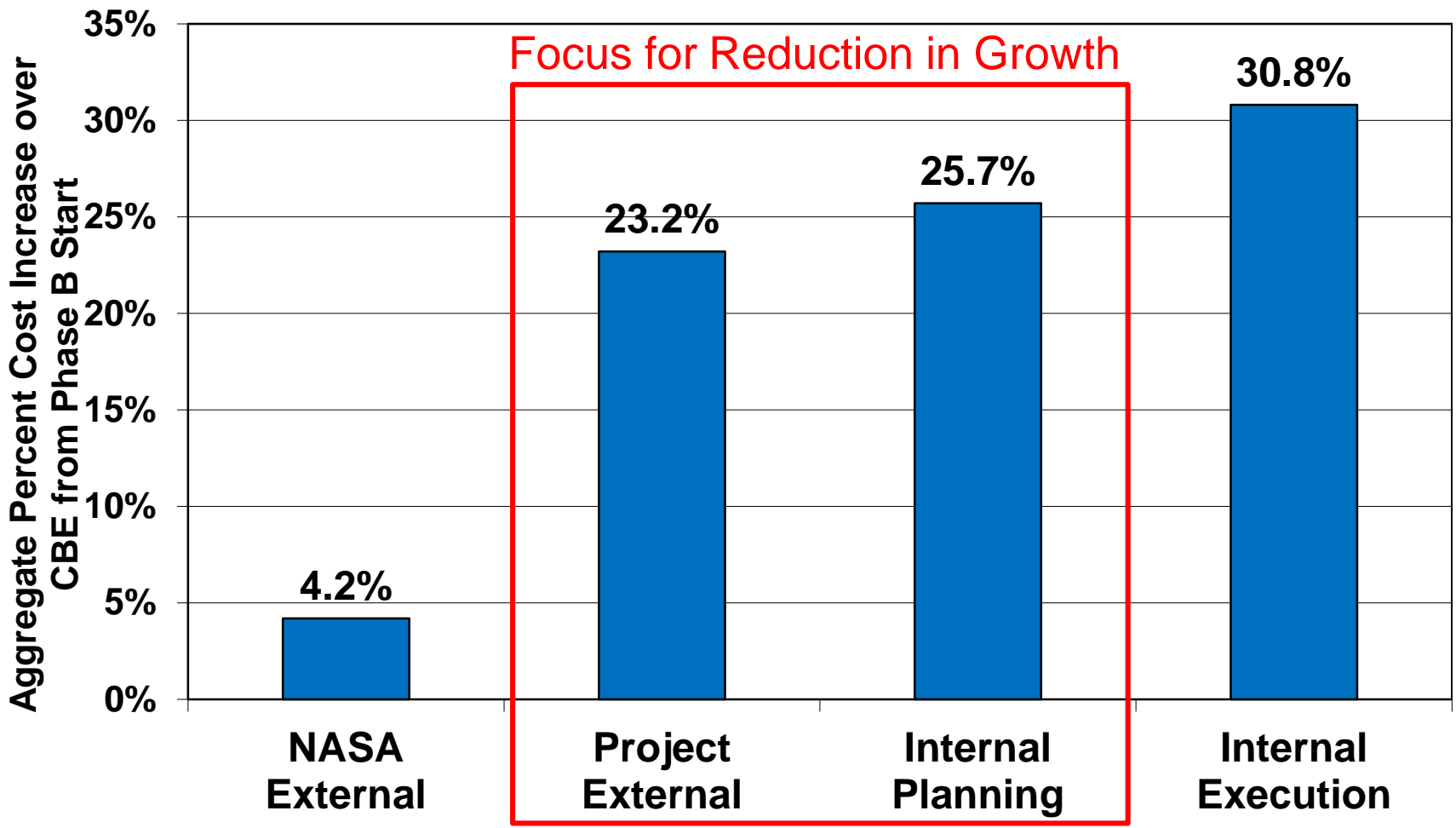
		\$66.0									
		Total Increase									
		\$52.9				\$13.1					
		NASA Internal				NASA External					
		80.1%				19.9%					
\$41.1				\$11.8							
Internal to the Project				External to the Project							
62.2%				17.9%							
\$21.7				\$11.8							
Project Planning				Agency Level (HQ)							
32.9%				17.9%							
		Design \$17.3				HQ1 Annual Funding \$0.0				NE1 Launch Vehicle \$13.1	
		Technology \$0.0				HQ2 Program Requirements \$6.7				NE2 Congress/OMB \$0.0	
		Risk Identification \$2.6				HQ3 Component Supplier \$0.0				NE3 Force of Nature \$0.0	
		Programmatic \$0.0				HQ4 Forced Budget Cap \$0.0				NE4 Industrial Base Issue \$0.0	
		Other \$1.8				HQ5 Full Cost Accounting \$0.0				NE5 Economic Issues \$0.0	
						HQ6 Other \$5.1				NE6 Other \$0.0	
\$19.4				\$0.0							
Project Execution				Center Specific (CS)							
29.3%				0.0%							
		Project Management \$0.0				CS1 Principles or Guidelines \$0.0					
		System Development \$19.4				CS2 Workforce \$0.0					
		Contractor Management \$0.0				CS3 Estimating Process \$0.0					
		Risk Mitigation \$0.0				CS4 System Development \$0.0					
		Other \$0.0				CS5 Other \$0.0					

* Note: Increase above represents Phase B/C/D cost increase not including reserves



Previous EoC Allocation Summary for All 25 Missions

As a Percentage of Total Dollar Value Increase (from project CBEs)



Percentages Based on Aggregate Cost Increase over CBE from Phase B Start

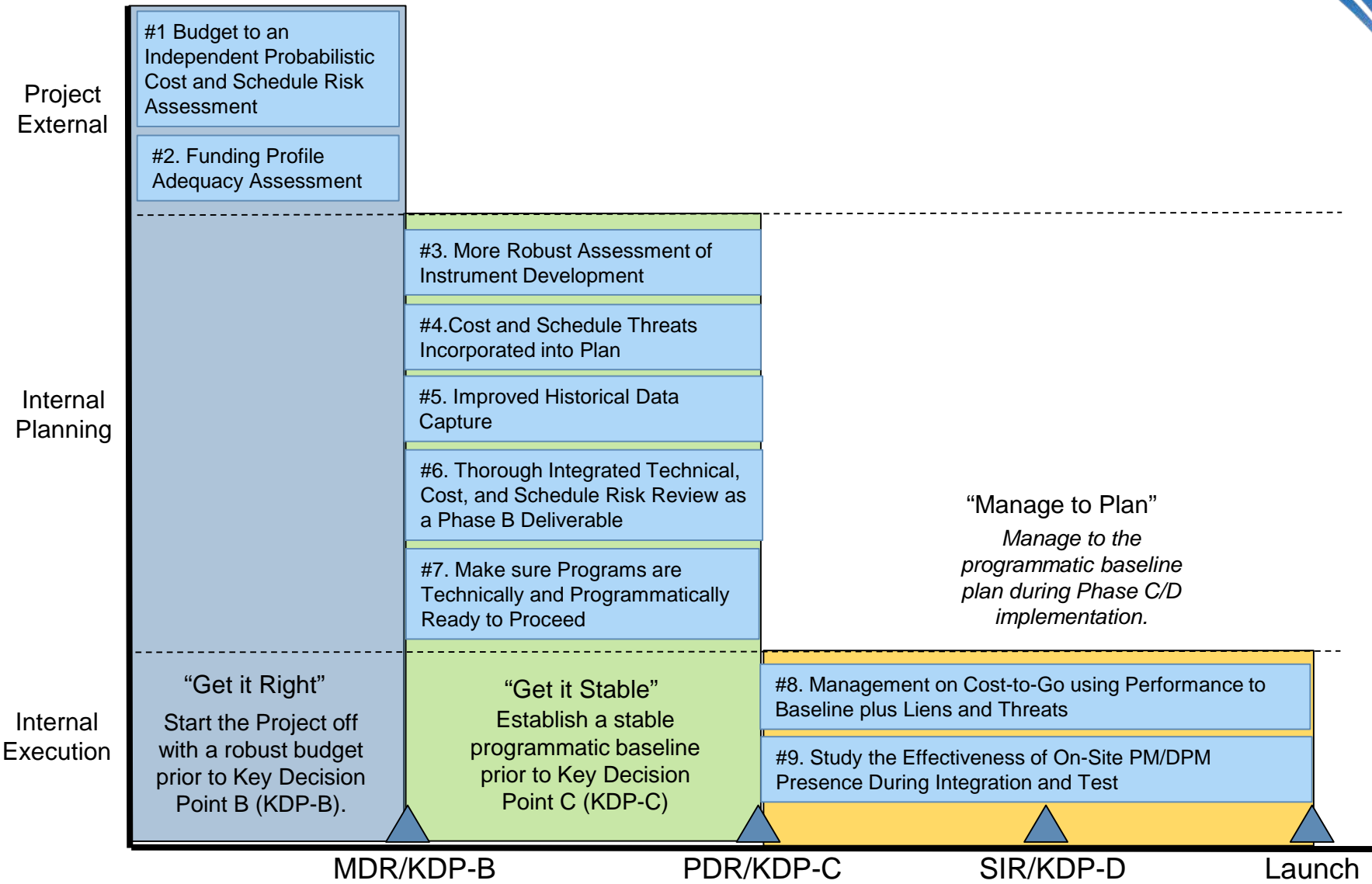


Previous Summary of Objectives for the Considerations

- 1) Initial Estimate Prior to KDP-B:
 - *Starting the Project off with a robust budget prior to Key Decision Point B (KDP-B), which is the entry point for the start of the Preliminary Design Phase B, is addressed by Considerations 1 & 2*
- 2) Program Stability at KDP-C:
 - *Establishing a stable programmatic baseline prior to Key Decision Point C (KDP-C), which is the entry point for the start of the Detailed Design Phase C, is addressed by Considerations 3 thru 7*
- 3) Execution During Phase C/D:
 - *Managing to the programmatic baseline plan during the mission implementation Phase C/D is addressed by Considerations 8 & 9*



Previous Final Set of EoC Considerations

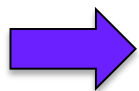




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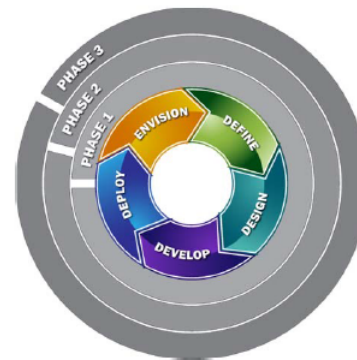
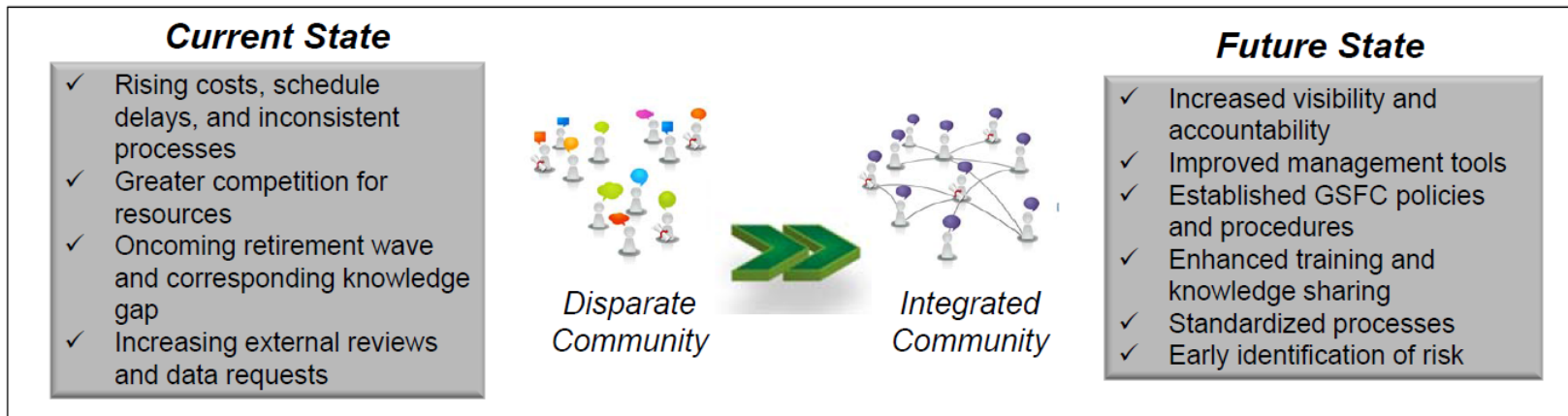


BCI Overview

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



Phase I:
Initial Implementation

Phase II:
Additive and Enhancement

Phase III:
Optimized Sharing

* As taken from "Business Change Initiative: Improving Cost Control", presented at 2014 NASA Cost Symposium, slide 4



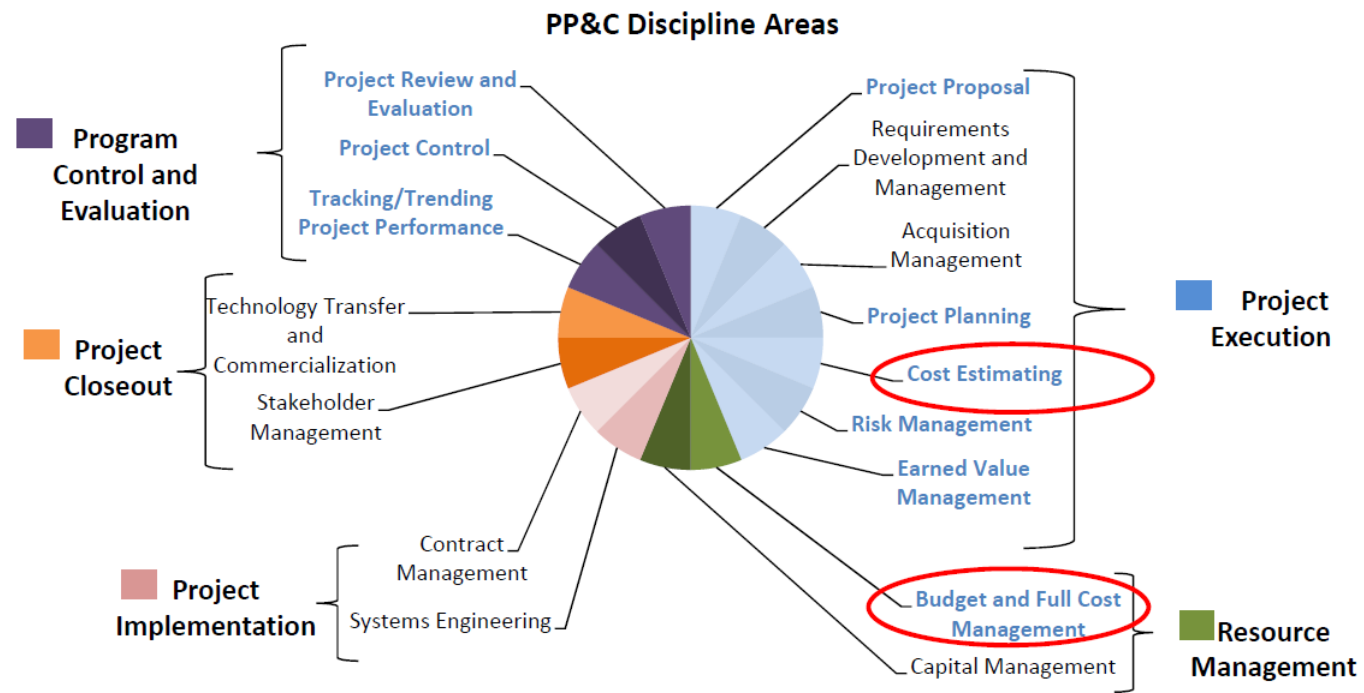
BCI Scope Covers All Areas of PP&C

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.

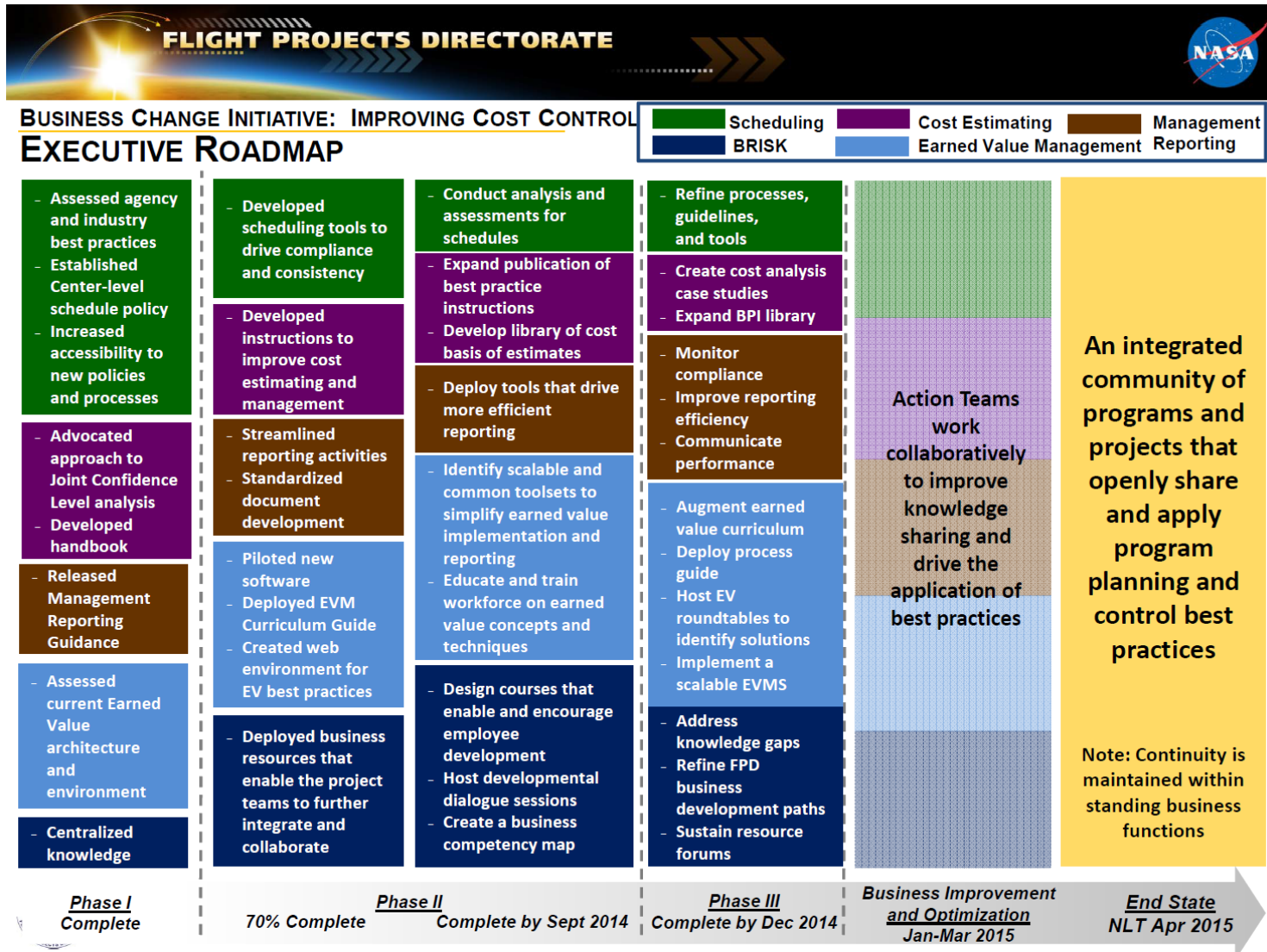
Multiple teams are working to increase best practice sharing and deploying across programs/projects in project planning and control (PP&C) methods, tools, processes, and knowledge to support improved performance and management decision making



* As taken from "Business Change Initiative: Improving Cost Control", presented at 2014 NASA Cost Symposium, slide 5



BCI Implementation Timeline



BCI Started Late 2011

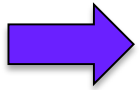
* As taken from "Business Change Initiative: Improving Cost Control", presented at 2014 NASA Cost Symposium, slide 7



Agenda

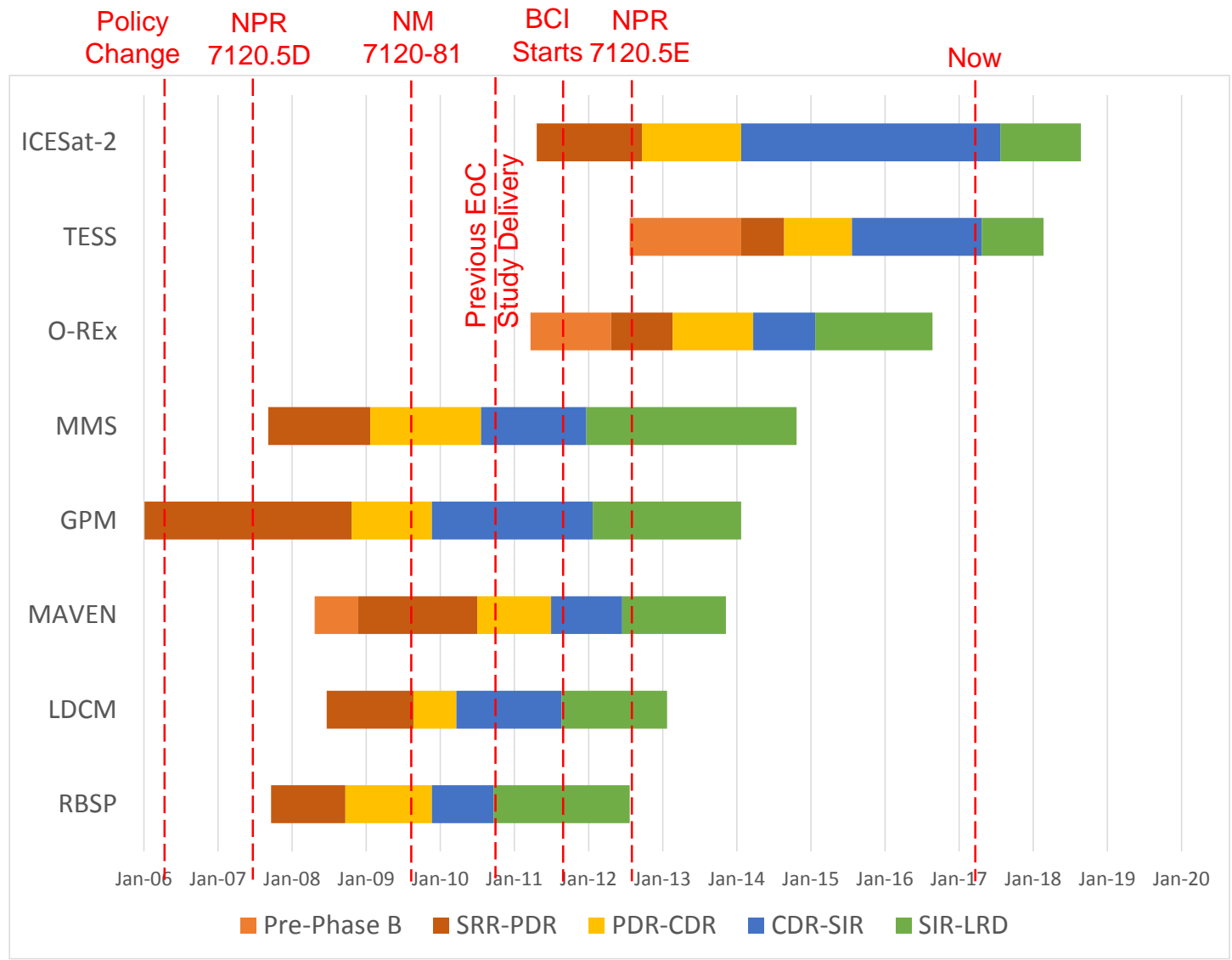


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New EoC Mission Timeline



All new EoC missions held their KDP Cs after joint cost and schedule confidence level policy was in place



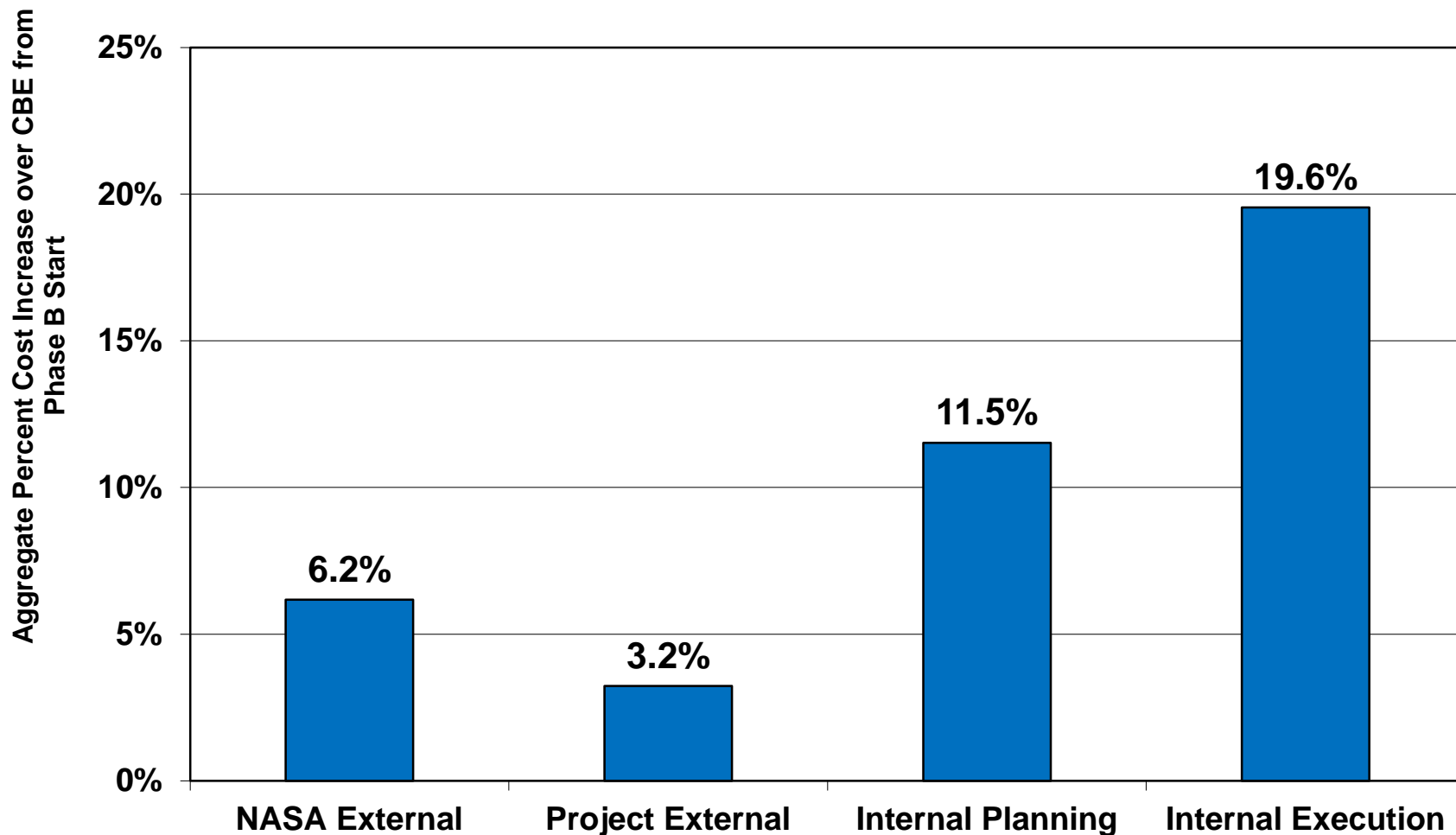
Results Explanation – Change & Growth

- Resource (cost, schedule & mass) change/growth is shown for 3 phases
 - *From start of Phase B to launch*
 - *From PDR to launch*
 - *From CDR to launch*
- Sensitivity to “growth” as growth can only occur from KDP-C (i.e. PDR) since that is when project is baselined
 - *All differences in resources at each milestone is referred to as “change”*
- Change defined relative to CBE at that point
 - *i.e. Percent Change @ PDR = (Actual – CBE @ PDR) / (CBE @ PDR)*
- The latest estimate is considered for missions yet to be launched
 - *This data will change as all 3 missions are undergoing some form of cost and schedule adjustment*
- Data from four missions (GOES-R, JPSS-1, JWST and TESS) are not considered as further review is needed



EoC Allocation Summary for New GSFC Missions

As a Percentage of Total Dollar Value Increase (from project CBEs)



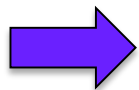
Percentages Based on Aggregate Cost Increase over CBE from Phase B Start



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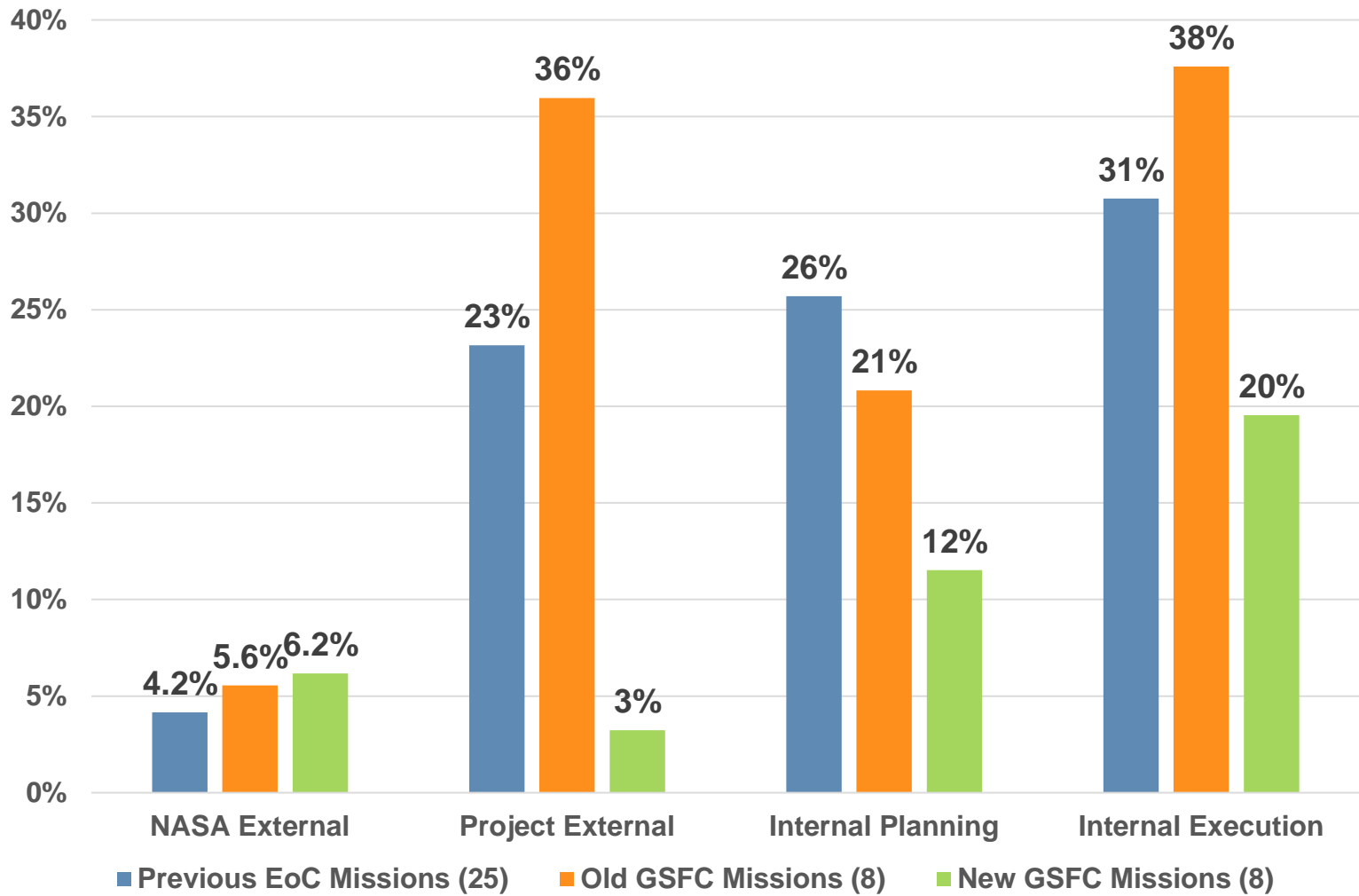


Comparison of Old and New Goddard Missions

- Old Goddard Mission data set (8 missions)
 - *SDO*
 - *EO1*
 - *MAP*
 - *GLAST*
 - *LRO*
 - *STEREO* (*considered a GSFC mission although significant APL participation*)
 - *Swift*
 - *ICESAT*
- New Missions (8 missions)
 - *LDCM*
 - *MAVEN*
 - *MMS*
 - *OSIRIS-REx*
 - *RBSP* (*included in this study although an APL managed mission*)
 - *GPM*
 - *ICESat-2* (*estimated*)
 - *TESS* (*estimated*)



Cost Increase Allocations* – Comparison of Data Sets

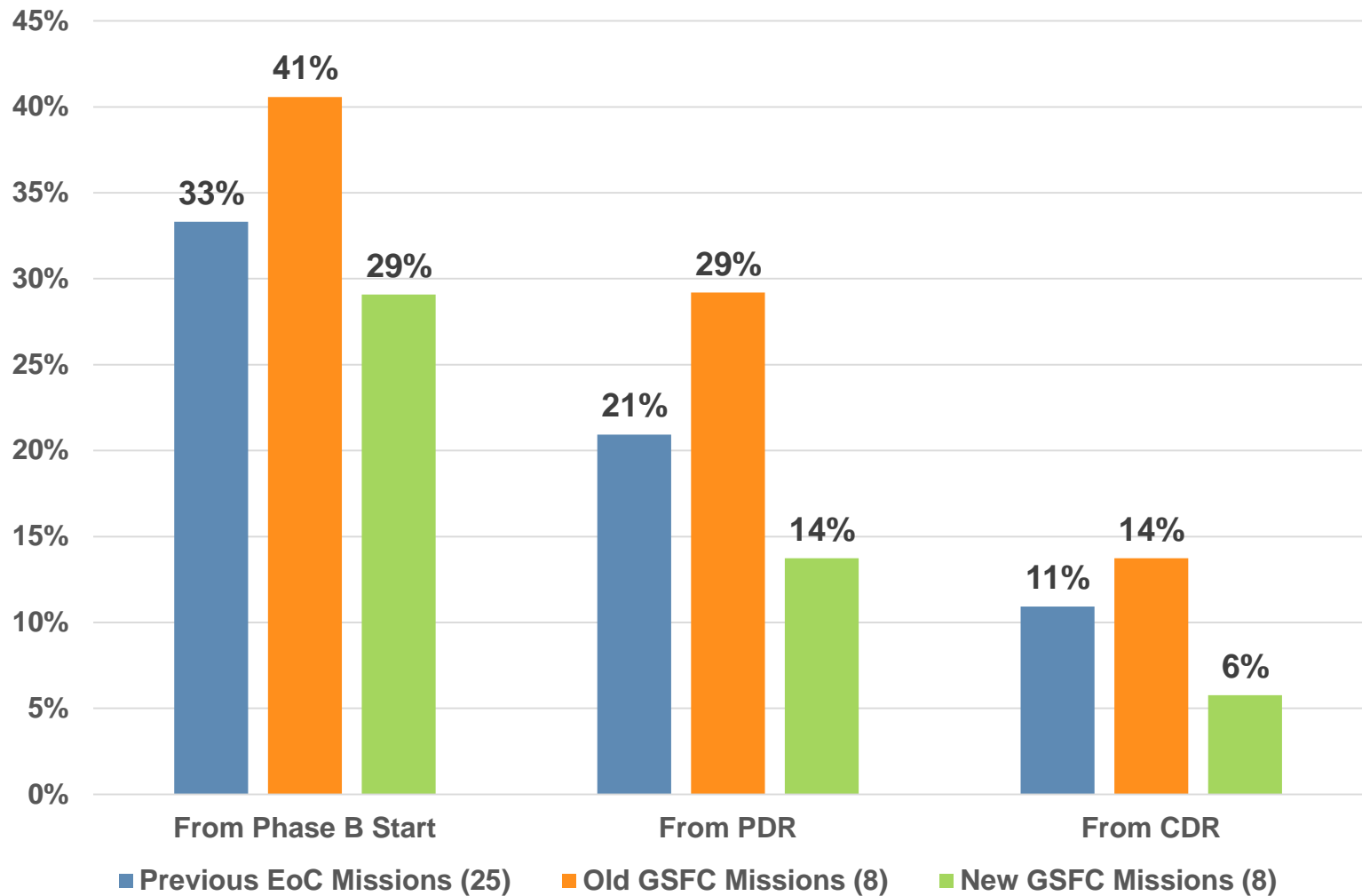


* Note: Increase from Phase B start

Although increase from NASA External issues is similar, much less for other categories



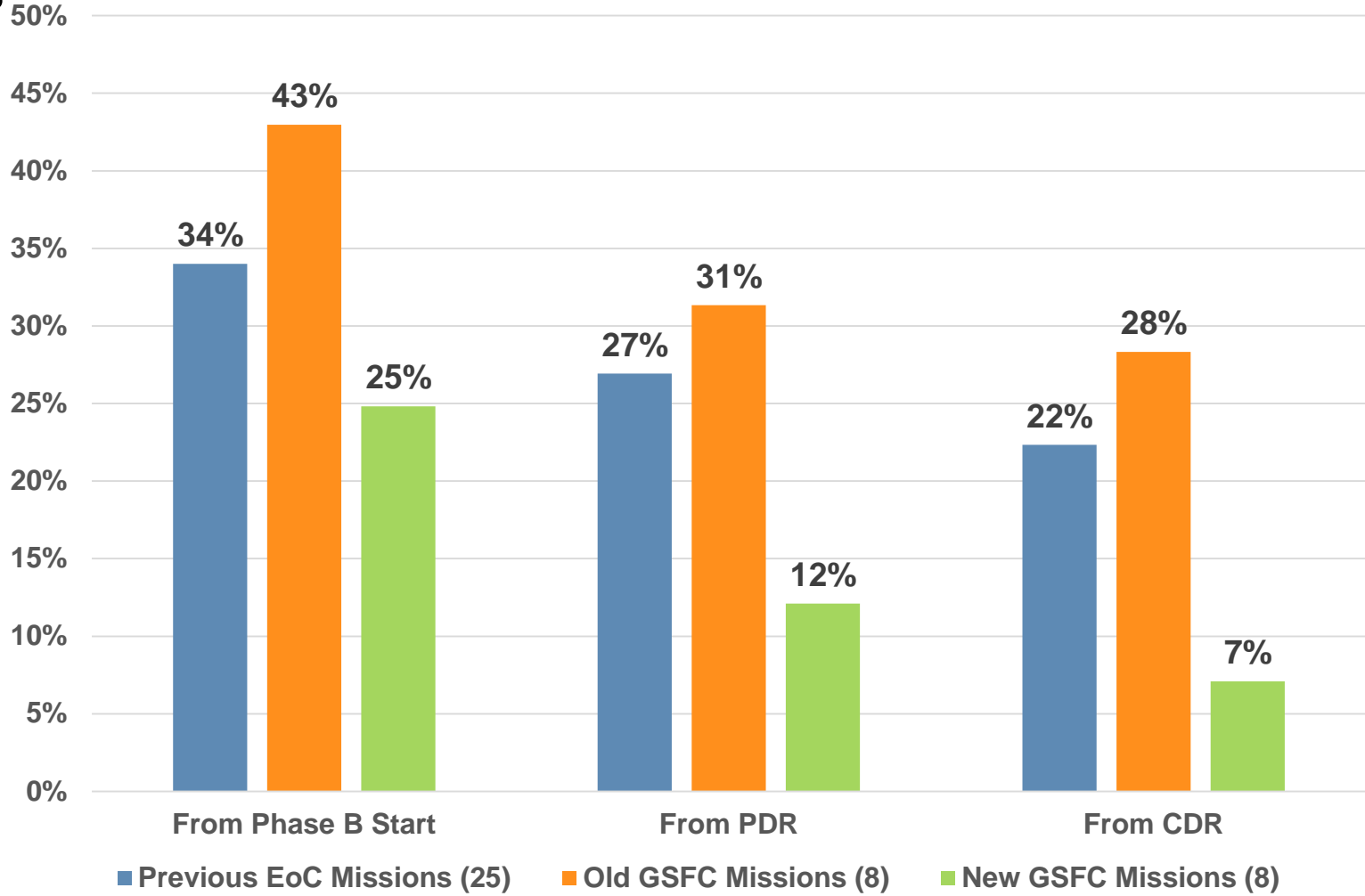
Mass Increase over CBE – Comparison of Data Sets



New Goddard missions seem to be more mature throughout milestones



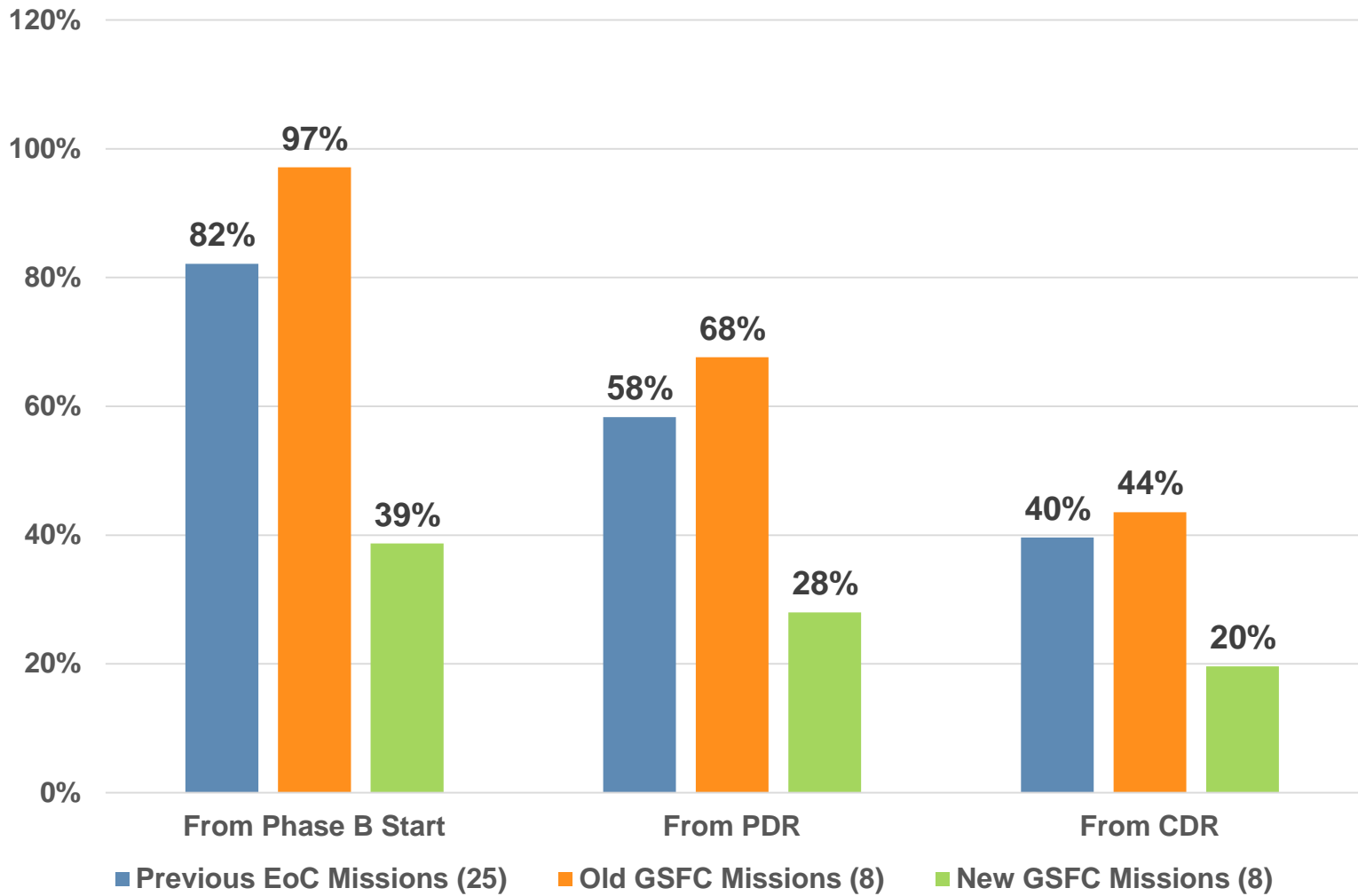
Schedule Increase over Baseline – Comparison of Data Sets



New Goddard missions have significantly less schedule growth from each milestone



Cost Increase over CBE – Comparison of Data Sets



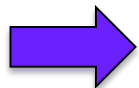
New Goddard missions have significantly less cost increase from each milestone



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Summary



- Results shows some distinct differences from previous data
 - *Mass increase of new Goddard mission is less for each milestone, implying that designs are more mature for newer missions*
 - *Schedule growth is less for new Goddard missions, implying that baseline mission development schedule is more robust for concepts being developed*
 - *Cost increase is less for new Goddard missions, implying that the baseline cost is more appropriate*
 - *NASA external impacts are similar for all data sets (at 5-6% of reserve usage) while new missions have significantly lower project external issues and lower internal planning and execution issues*
 - *Projects have lower cost and schedule increases due to better planning and execution of missions*
- Results indicate NASA Policy change and Business Change Initiative has resulted in reduced cost and schedule growth in Goddard missions
 - *The processes and policies put in place should continue to enable cost and schedule growth control for future Goddard mission concepts*