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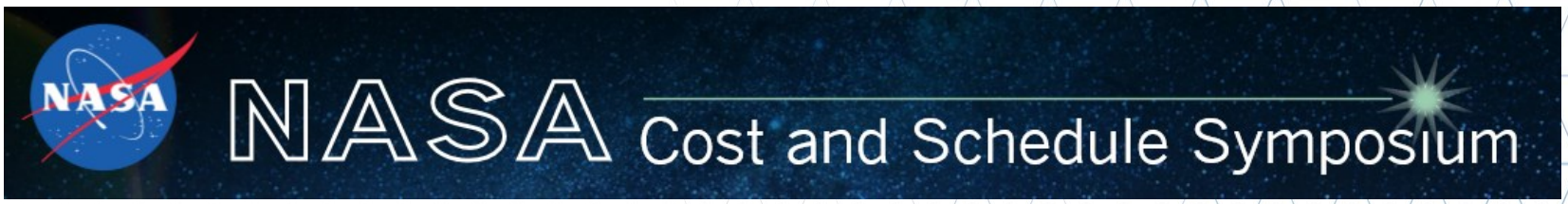

Faster, Better, But Maybe Not Cheaper: Class D and the PM/SE/MA Conundrum

NASA Cost & Schedule Symposium 2024

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Agenda

- Class D background
- Introduction
- Motivation
- Purpose
- Methodology
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- Tool Inputs
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NASA Class D Background

- Class D: “High risk tolerance that is driven more by programmatic constraints. This would normally represent a lower priority mission with a medium to low complexity”[1]
- Class D: “Cost and schedule are equal or greater considerations compared to mission success risks. Technical risk is medium by design (may be dominated by yellow risks). Many credible mission failure mechanisms may exist.”[2]

Mission and Instrument Risk Classification Considerations		
Priority (Relevance to Agency Strategic Plan, National Significance, Significance to the Agency and Strategic Partners)	Very High:	Class A
	High:	Class B
	Medium:	Class C
	Low:	Class D
Primary Mission Lifetime	Long, > 5 Years:	Class A
	Medium, 5 Years > – > 3 Years:	Class B
	Short, 3 Years > – > 1Years:	Class C
	Brief, < 1 Year:	Class D
Complexity and Challenges (Interfaces, International Partnerships, Uniqueness of Instruments, Mission Profile, Technologies, Ability to Reservice, Sensitivity to Process Variations)	Very High:	Class A
	High:	Class B
	Medium:	Class C
	Medium to Low:	Class D
Life-Cycle Cost	High :	Class A
	Medium to High	Class B
	Medium :	Class C
	Medium to Low	Class D

1. NASA Procedural Requirements 8705.4A, Risk Classification for NASA Payloads
2. Goddard Procedural Requirements 8705.4, Risk Classification Guidelines and Risk-Based SMA Practices for GSFC Payloads and Systems

Slide from 2022 ASQ Collaboration on Quality in the Space and Defense Industries Workshop (S. Pereira)

NASA Class D Background

- “It’s vital to continue leveraging Class-D missions to maximize science opportunities to augment our vast and robust science portfolio” – T. Zurbuchen[1]
- “These [Class D] missions are thus a critical part of the SMD mission portfolio, but only if their management processes are aligned with their overall goals…SMD has been pursuing a streamlined process for implementing Class-D missions that recognizes their unique and important role in SMD's mission portfolio, which can only occur if management processes traditionally applied to other mission classes don't inadvertently suffocate the innovative potential of these missions. We note that previous attempts for such management changes were not specific enough to drive this thought process.”[2]

Zurbuchen and Robinson, “Science Mission Directorate Town Hall” January 2018

[1] NASA Press Release. “NASA Policy Provides New Approach To Space Science And Technology Missions” 8-December 2017
[2] NASA Science Mission Directorate (SMD) Class D Tailoring / Streamlining Decision Memorandum – December 2017
Slide from 2022 ASQ Collaboration on Quality in the Space and Defense Industries Workshop (S. Pereira)

Introduction

- NASA Class D mission are becoming increasingly prevalent, and typically are lower cost missions
- In prior research, we found that Class D PM/SE/MA costs do not fall into the same cost estimating relationship range to hardware cost, compared to other mission classes
  - "Class D Missions PM/SE/MA" (NASA Cost & Schedule Symposium 2022)
    - Class D PM/SE/MA costs are higher (as a % of hardware) due to these functions role in the tailoring and execution of Class D requirements
    - While the wrap factor produced from this analysis was a step in the right direction, further use has shown that even within Class D missions, there's a wider range of possibilities that necessitates a more tailorable approach

Introduction

- Given this knowledge, and other factors noted in the following slides, we wanted to look into actual cost and LOE data for in-house Class D mission developments in order to help validate and bolster cost credibility of Class D PM/SE/MA estimates going forward

Motivation

- Requests for quick turnaround cost estimates have prompted technical teams to develop labor estimates for PM/SE/MA WBSs along with hardware estimates
- Sector management and other stakeholders have posed questions during past proposal reviews regarding PM/SE/MA estimates
- Need for validation of proposal estimates, both BUE and parametric

Purpose

The intent of this tool is to:

- Provide a sanity check for early estimates developed by technical teams (prior to a full up BUE)
- Serve as a cross check (based on actual LOE of past missions) to both BUEs and parametric estimates

Methodology

- Pulled schedule data and monthly cost data on past APL Class D missions
- Analyzed data to see how Class D projects were actually being staffed
- Discussions with SMEs in those competency areas, with a particular focus on SMEs with Class D mission experience
- Incorporated feedback from SMEs into the tool to more accurately reflect ideal staffing for APL-managed Class D missions

Assumptions

- Provides ROM-level estimate for PM/SE/MA WBSs
- APL managed
- NASA Class D missions
- Estimates Phases B/C/D only
- Outputs are shown in FY$K of users choice
  - Inflation utilizes the NASA New Start Inflation Factors

Tool Inputs

Fiscal Year $	2025
Cost Cap/Target ($M)	$ 150

Missions over $100M - strongly advised to include the DPM role for cost realism

Schedule			
Project Phase	***Start***	***End***	***Duration (mo)***
Phase B	6/1/2026	6/30/2027	13.1
Phase C	7/1/2027	10/31/2028	16.3
Phase D	11/1/2028	11/30/2029	13.1

Project Management	***Staff Level***
PM	S2
Deputy PM	S1
FM	A2
Planner/EVM	A2

Systems Engineering	***Staff Level***
SE	S2
SE other	S1

Mission Assurance	***Staff Level***
MA	S2
MA other	S1

- SE “other” includes other functions such as Component Engineering, Reliability, Radiation Engineering, Contamination, Etc.
- MA “other” includes other functions such as Configuration Management, Software Assurance, Etc.

Tool Output

Estimate by Phase ($K in chosen FY)		Phase Durations 13.1	16.3	13.1	FY$K 2025
WBS	Staff Level	Phase B	Phase C	Phase D	Total
Program Management					
PM	S2				
Deputy PM	S1				
FM	A2				
Planner/EVM	A2				
Total PM WBS		***$ 775***	***$ 1,146***	***$ 848***	***$ 2,769***
Systems Engineering					
SE	S2				
SE other (Reliability, Component Eng, etc.)	S1				
Total SE WBS		***$ 687***	***$ 1,388***	***$ 1,125***	***$ 3,200***
Mission Assurance					
MA	S2				
MA other (Software Assurance, Config Mgmt)	S1				
Total MA WBS		***$ 214***	***$ 368***	***$ 457***	***$ 1,038***
Total PMSEMA Estimate		***$ 1,675***	***$ 2,902***	***$ 2,430***	***$ 7,007***

Testing the Tool

	APL Class D Mission 1 (FY25$M)		
	Wrap Factor	via Class D ROM tool	BUE
Project Management	$ 1.5	$ 3.2	$ 4.0
Systems Engineering	$ 2.0	$ 3.1	$ 2.3
Mission Assurance	$ 1.7	$ 1.1	$ 1.5
Total	$ 5.2	$ 7.3	$ 7.8

WBS	*Staff Level*	*Phase B*	*Phase C*	*Phase D*	*Total*
Program Management					
PM	PS				
Deputy PM	S2				
FM	S2				
Planner/EVM	S1				
Total PM WBS		***$ 927***	***$ 1,387***	***$ 837***	***$ 3,151***
Systems Engineering					
SE	S2				
SE other (Reliability, Component Eng, etc.)	S2				
Total SE WBS		***$ 701***	***$ 1,422***	***$ 947***	***$ 3,070***
Mission Assurance					
MA	PS				
MA other (Software Assurance, Config Mgmt)	S2				
Total MA WBS		***$ 249***	***$ 436***	***$ 441***	***$ 1,125***
Total PMSEMA Estimate		***$ 1,878***	***$ 3,245***	***$ 2,224***	***$ 7,347***

Future Work

- Continue to update the data set with Class D actuals as they become available
- Possibility of adding options to the model such as the ability to estimate Class D instruments PM/SE/MA
- Customization of the model to include other organizations
  - Allow the option of tailoring to specific organizational costs for staffing

References

- “Class D Missions PM/SE/MA” NASA Cost Symposium 2022 (Clare, Kha, Whitley)
- NASA Procedural Requirements 8705.4A, Risk Classification for NASA Payloads
- Goddard Procedural Requirements 8705.4, Risk Classification Guidelines and Risk-Based SMA Practices for GSFC Payloads and Systems
- NASA Press Release. “NASA Policy Provides New Approach To Space Science And Technology Missions” 8-December 2017
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