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Class D: How Are We Doing?

Technical and Programmatic Performance of the First 35 NASA Science Missions with Risk Classification D

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May 2025

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Executive Summary

NASA's Class D missions represent an important segment of the agency's portfolio, designed with higher risk tolerance to enable more frequent scientific opportunities at lower cost points. This technical note presents an analysis of the 35 Class D missions selected to date (mid 2025) by NASA's Science Mission Directorate (SMD), examining both technical and programmatic success against SMD's stated goals of 80% technical success and 80% programmatic success (the 80/80 goal). Technical success was defined as those that launch go on to meet mission success criteria while programmatic success was defined as launch/delivery within the Management Agreement (MA) cost and schedule established at confirmation (KDP-C). Results reveal a striking contrast between technical and programmatic outcomes: while Class D missions demonstrate excellent technical success rates (only one failure, 93%), they consistently fall short of programmatic goals; no mission has met both cost and schedule MA commitments (0%). The portfolio has significant schedule delays (averaging 20 months) and cost overruns (averaging 18%), relative to the development organization's MA at confirmation. Discussion focuses on risk averse management and recommends modified practices to lower oversight, documentation, and process requirements. Additional statistics from the portfolio are also given an discussed. While this paper looks only at SMD, the other NASA Class D missions (all from NASA's Space Technology Mission Directorate (STMD)), exhibit the same excellent technical success and very poor programmatic success; they were not included since STMD did not state a success goal for their missions and the programmatic information is often unclear.

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I. Evolution of Class D at NASA

NASA's Science Mission Directorate (SMD) introduced Class D missions as a means to conduct innovative, lower-cost, and higher-risk science projects. These missions aim to complement the broader NASA science portfolio by delivering impactful results at a fraction of the cost and complexity of Class A–C missions. This report presents an evaluation of Class D mission performance, focusing on metrics of technical success and programmatic success. The goal is to provide a transparent summary of outcomes, support informed decision-making for future mission planning, and stimulate discussion on how to balance oversight with innovation.

Since 2009, Class D missions have paved the way for advancing scientific discovery within constrained budgets. In 2014, NASA SMD introduced significant pre-tailoring of NPR 7120.5, the procedural requirements governing flight programs and projects, specifically for Class D. This pre-tailoring reduced required documentation, limited external reviews, and allowed divisions to delegate key decision point (KDP) decisions. These changes facilitated faster development cycles and increased flexibility for principal investigators (PIs). The 2024 update to the Class D Implementation Plan further solidified these practices, reinforcing NASA's commitment to leveraging small, agile missions to accomplish science objectives efficiently.

The Class D designation supports missions with lower cost, shorter durations, and acceptance of higher technical and programmatic risk. NASA's approach allows greater freedom for PIs to experiment with novel scientific and engineering ideas, as well as unconventional management practices. Since the selection of NuSTAR in 2007, a total of 35 Class D missions have been selected. Of these, 33 have been confirmed, with 18 launched or delivered, 2 cancelled pre-confirmation, 2 cancelled post-confirmation, and 13 currently in development. Table I lists the 35 missions with year of selection and year of launch/delivery. The portfolio shows an interesting trend in increasing value at selection going from $86M for the first 18 selected missions (before March 2019) up to $124M for the later ones (costs in $FY24).

The program management organizations include the NASA centers (GSFC, JPL, MSFC, LaRC) which account for about half (18 of 35) of the selected missions. Other government supported lab institutions (SWRI, APL, NRL) account for 7, while industry (LM) lead 2, and universities (UCB, U Oklahoma, MIT, UNH, USU) are the remaining 8.

Note that some Earth Venture missions were designated Class C (not D) and that some SIMPLEx missions were 7120.8 (sub-class D, not D). Of interest may be that when Class D was introduced, NuSTAR was so designated even though development was underway. Similarly the Coronograph Instrument (CGI) for the Roman Space Telescope was re-designated as a Class D technology demonstration after development had started. Data for this study was from NASA's ONCE database, current at May 2025 [1].

While this paper looks only at SMD, the other NASA Class D missions (all from NASA's Space Technology Mission Directorate (STMD)), exhibit the same excellent technical success and very poor programmatic success; they were not included since STMD did not state a success goal for their missions and the programmatic information is often unclear.

Mission	Mission or Payload	Division	Program	Selection /KDP-B	Launch/ Delivery
NuSTAR	Mission	Astro	SMEX	2007	2012
IRIS	Mission	Helio	SMEX	2009	2013
GEMS	Mission	Astro	SMEX	2009	2014
DSCOVR	Mission	JASD	NOAA	2011	2015
CYGNSS	Mission	Earth	EVM-1	2012	2016
NICER	Payload ISS	Astro	SMEX	2013	2017
ECOSTRESS	Payload ISS	Earth	EVI-2	2015	2018
Strofio	Payload Intl	Planetary	Discovery	2009	2018
SET-1	Payload DoD	Helio	LWS	2003	2019
IXPE	Mission	Astro	SMEX	2017	2021
Janus	Mission	Planetary	SIMPLEx	2019	2022
TROPICS	Mission	Earth	EVI-3	2016	2023
AWE	Payload ISS	Helio	SMEX	2019	2023
GUSTO	Balloon	Astro	SMEX	2017	2023
Roman/CGI	Payload	Astro	Roman	2020	2024
PREFIRE	Mission	Earth	EVI-4	2019	2024
CLARREO-PF	Payload ISS	Earth	ESSP	2017	2024
Solar Cruiser	Mission	Helio	STP	2020	2025
Lunar Trailblazer	Mission	Planetary	SIMPLEx	2019	2025
PUNCH	Mission	Helio	SMEX	2019	2025
EZIE	Mission	Helio	SMEX	2020	2025
GeoCarb	Payload	Earth	EVM-2	2016	2025
TRACERS	Mission	Helio	SMEX	2019	2025
SunRISE	Mission	Helio	SMEX	2020	2025
Carruthers	Mission	Helio	STP	2020	2025
ESCAPADE	Mission	Planetary	SIMPLEx	2019	2025
TSIS-2	Mission	Earth	ESSP	2019	2026
QuickSounder	Mission	JASD	NOAA	2022	2026
HERMES	Payload	Helio	LWS	2020	2027
GLIMR	Payload	Earth	EVI-5	2022	2027
PolSIR	Mission	Earth	EVI-6	2023	2027
INCUS	Mission	Earth	EVM-3	2021	2027
COSI	Mission	Astro	SMEX	2021	2027
JEDI	Payload Intl	Helio	LWS	2024	2028
EUVST	Payload Intl	Helio	SMEX	2022	2028

Table I. Listing of Class D Missions Selected by SMD (as of mid 2025), those below the double line have not yet been launched/delivered.

II. Stated Goals for Class D

The SMD articulated its success goals for Class D missions under the leadership of former Associate Administrator Thomas Zurbuchen [2]. Two key metrics were established: (1) at least 80% of Class D missions that reach launch should achieve mission success—defined as meeting Level-1 Threshold Science Requirements during operations; and (2) at least 80% of confirmed missions should remain within cost and schedule Management Agreements (MAs) established at confirmation (KDP-C). The MA is the cost and schedule commitment that the project management organization makes to SMD; there is also an Agency Baseline Commitment (ABC) which is the commitment NASA makes to Congress. The difference of the ABC above the MA is HQ held reserves (called Unfunded Future Expenses, UFE) which is to be used across the entire SMD portfolio to cover overruns due to circumstances beyond what the project has control over.

Figure 1 shows this 80/80 goal on a two axis plot with quadrants described. Since SMD stated the 80/80 goal as an appropriate balance of technical and programmatic risks, the responsible management of the portfolio would include tracking how we are doing. The performance of the portfolio would inform whether selections are being made that are too easy or two difficult, the lower left and upper right quadrants of the programmatic vs technical success plot. More interesting perhaps are the "off-diagonal" quadrants: taking too much technical risk (upper left) and being too risk averse (lower right).

Where do you think the portfolio actuals (to date) land on this plot?

Figure 1. Quadrant analysis showing SMD's stated goal of 80% technical success and 80% programmatic success in a two axis plot.

III. Technical Success to Date

Class D missions have demonstrated remarkable technical reliability despite relaxed oversight and limited documentation. Among the 14 missions that have launched and completed or entered operations, 13 achieved their technical objectives, yielding a 93% technical success rate. This far exceeds the stated goal of 80%. Up until just recently, the portfolio had no failures and 100% technical success. Only Lunar Trailblazer, launched in February 2025 failed; communication problems from the beginning; exact reason has not be published.

Notable successes include missions such as NuSTAR, IRIS, DSCOVR, CYGNSS, NICER, ECOSTRESS, Strofio, IXPE, TROPICS, AWE, and IXPE; these missions significantly exceeded their minimum mission lifetime and are mostly all still operating. The first Class D mission, NuSTAR, is still operating after 12 plus years; it's design life was 2 years. These missions achieved high-quality science returns, demonstrating the simplified mission assurance and streamlined engineering approaches have not impaired mission outcomes. Instead, the high success rate may suggest that NASA's managers, engineers and scientists are not "cutting any corners" that have resulted in reduced on-orbit science performance or long life. Note that Roman/CGI and CLARREO Pathfinder are instrument projects that have delivered but not yet launched. Also, PUNCH and EZIE have their technical success call pending; they launched and are successfully operating but have not reached their minimum mission life.

IV. Programmatic Success to Date

While technical outcomes for Class D missions have exceeded expectations, programmatic performance has been more challenging. Not a single mission, so far, has launched/delivered before the confirmation (KDP-C) management agreement (MA), a programmatic success rate of 0%. Obviously, this falls significantly short of the 80% target.

Cost overruns for the portfolio averaged 18%, while schedule delays averaged 20 months as shown in Figure 2-5. The average growth/slip from selection is larger, 29% and 25 months. The overruns carry significant opportunity costs - the cumulative effect of effectively eliminates about one mission per year that NASA could otherwise fund. Common factors contributing to these overruns include optimistic planning assumptions, unforeseen integration challenges, and technology readiness. Many slips and overruns were due to circumstances outside of project control, specifically funding shortfalls relative the plan committed to at confirmation as well as rideshare scheduling and host platform readiness, COVID, and supply chain delays. Several of these overruns and delays beyond the project control for instrument and payload projects would have been better tracked (from a governance point of view) if the agreement had been to delivery instead of launch. This was realized by SMD and agreements (decision memos) for these type of projects are now based on delivery.

Programmatic data is based on NASA's ONCE database [1], with press release and interviews filling in gaps. Note that Roman/CGI delivered well before need to integration, so this one should probably score as on-time, although the MA is not clear due to its programmatic tie to Roman; it's programmatic success is scored NA. Also, several projects had delays of less than 6 months, which is almost expected when it comes to launch scheduling. Many projects include ABC LRD/deliveries with about one year of additional schedule margin, so likely 13 projects would have met their ABC; this study did not look at performance against ABCs since the SMD stated goal was against the MA commitments of the development organizations.

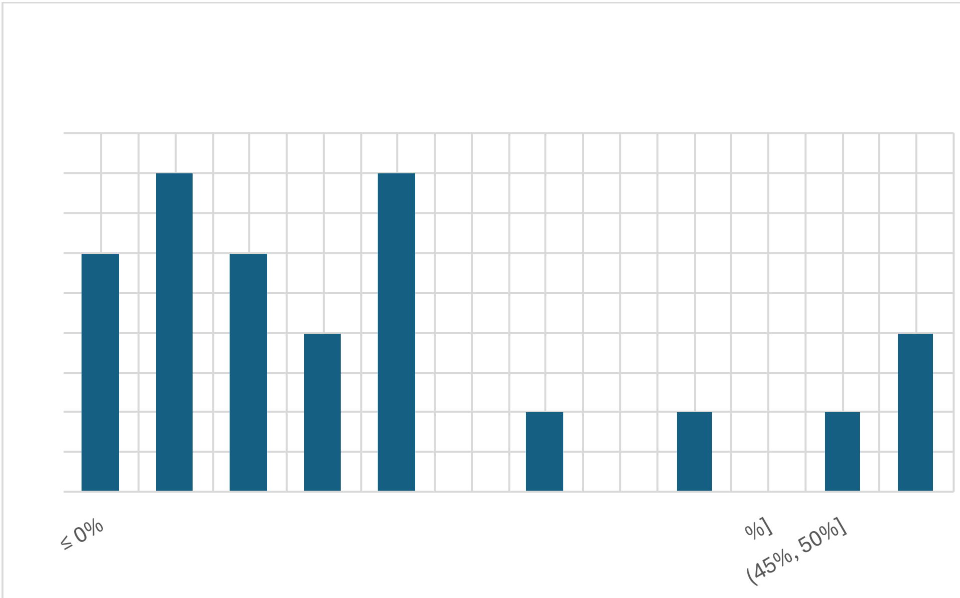

Figure 2: The distribution of life-cycle cost (LCC) overruns from the KDP-C Management Agreement across Class D missions. The average overrun is 18% and 3 missions came in on or below cost.

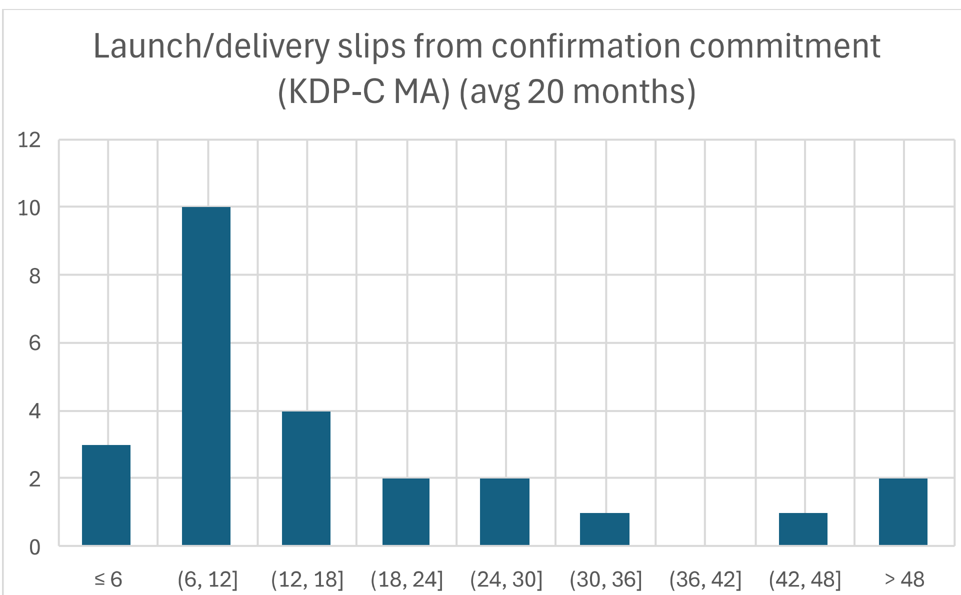

Figure 3: The distribution launch (or delivery) slips from the KDP-C Management Agreement across Class D missions. The average slip is 20 months and no missions had no slip; 3 missions slipped less than 6 months.

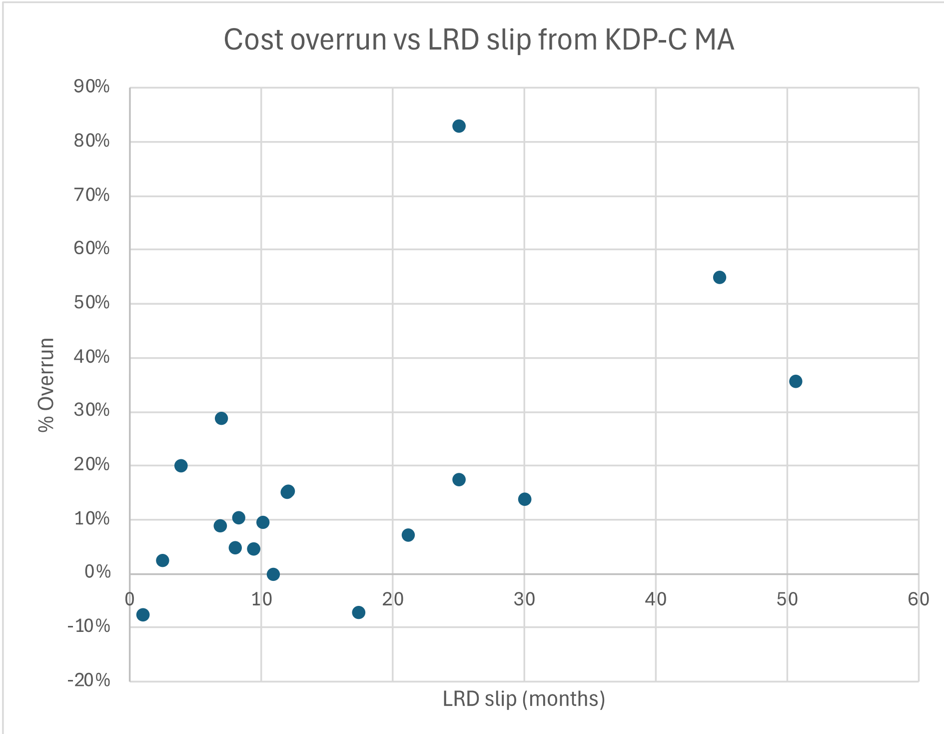

Figure 4: The LCC cost overrun versus the launch (or delivery) slips from the KDP-C Management Agreement across Class D missions. There is the expected general trend that those who experience schedule slips also overrun.

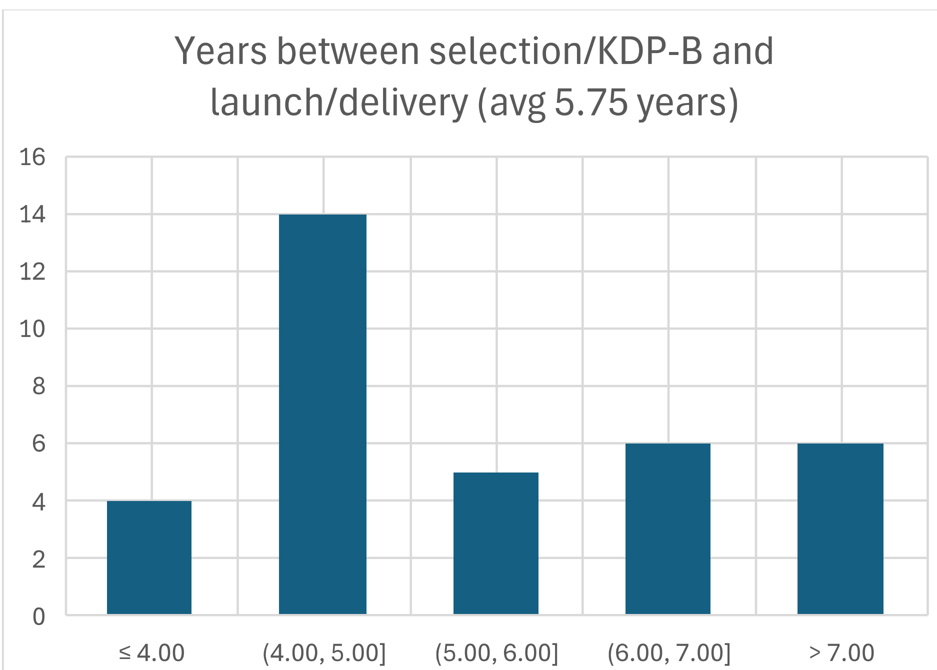

Figure 5: The time between selection/KDP-B and launch/delivery; the average is 5.75 years. The planned average time at selection is 3.67 years; the average slip from selection is 25 months.

V. How Are We Doing?

The analysis of Class D missions reveals a striking disparity between technical and programmatic success rates. The data indicates a nearly perfect 93% technical success rate (only one failure), demonstrating that these missions consistently meet their scientific and engineering objectives once deployed. However, the programmatic success rate is 0% against the stated MA cost and schedule goal. While the technical side has exceeded expectations, the programmatic side presents a more challenging picture.

SMD stated the 80/80 goal to balance for success in both technical and programmatic dimensions. The resulting portfolio performance to date is 93/0, clearly in the lower right quadrant of the two-axis plot, indicated by "management is too risk averse."

Table II is the list of missions with their technical and programmatic success. Figure 6 is the plotted performance to date of the Class D portfolio against the 80/80 goal.

Mission	Technical Success	Programmatic Success	Selection /KDP-B	Launch/ Delivery	Selection/KDP-B to Launch/Delivery (years)
NuSTAR	Yes	No	2007	2012	4.6
IRIS	Yes	No	2009	2013	4.0
GEMS	Cancelled	Not Confirmed	2009	2014	5.0
DSCOVR	Yes	No	2011	2015	4.0
CYGNSS	Yes	No	2012	2016	5.0
NICER	Yes	No	2013	2017	4.2
ECOSTRESS	Yes	No	2015	2018	3.2
Strofio	Yes	No	2009	2018	9.3
SET-1	Yes	No	2003	2019	16.5
IXPE	Yes	No	2017	2021	4.9
Janus	Cancelled	No	2019	2022	3.7
TROPICS	Yes	No	2016	2023	7.4
AWE	Yes	No	2019	2023	4.7
GUSTO	Yes	No	2017	2023	6.8
Roman/CGI	Pend	NA	2020	2024	4.1
PREFIRE	Yes	No	2019	2024	4.9
CLARREO-PF	Pend	No	2017	2024	7.8
Solar Cruiser	Cancelled	Not Confirmed	2020	2025	4.2
Lunar Trailblazer	No	No	2019	2025	6.2
PUNCH	Pend	No	2019	2025	5.7
EZIE	Pend	No	2020	2025	4.3
GeoCarb	Cancelled	No	2016	2025	8.5
TRACERS	Pend	No	2019	2025	6.1
SunRISE	Pend	No	2020	2025	5.4
Carruthers	Pend	No	2020	2025	4.8
ESCAPADE	Pend	No	2019	2025	6.7
TSIS-2	Pend	No	2019	2026	7.4
QuickSounder	Pend	Pend	2022	2026	3.6
HERMES	Pend	No	2020	2027	6.8
GLIMR	Pend	No	2022	2027	4.9
PolSIR	Pend	Pend	2023	2027	4.2
INCUS	Pend	Pend	2021	2027	5.7
COSI	Pend	Pend	2021	2027	5.8
JEDI	Pend	Pend	2024	2028	3.9
EUVST	Pend	Pend	2022	2028	6.8

Table II. Technical and Programmatic Success for SMD Class D Missions (as of mid 2025)

Figure 6. Quadrant analysis showing the portfolio technical success (93%) and programmatic success (0%) against the stated 80/80 goal, clearly indicating portfolio performance to date indicates management is too risk averse.

VI. Discussion

The SMD Class D portfolio results to date against the stated goals indicate management is too risk averse. A consistent pattern of excellent technical performance coupled with poor programmatic execution suggests that Class D missions are achieving their scientific and engineering goals but at the expense of overruns and delays. This imbalance drives opportunity costs: an 18% average overrun and the recent selection rate implies almost one additional mission could be selected per year.

Based on the analysis, two primary approaches warrant consideration:

Option 1 is to maintain the status quo, accepting the current performance pattern based on the rationale that great technical success justifies the programmatic inefficiencies. However, this approach implicitly sacrifices potential scientific opportunities by consuming resources that could support additional missions.

Option 2 proposes a more assertive approach to improve programmatic performance by reducing administrative and oversight burdens that may not be adding commensurate value. Specific recommendations include:

- Cancelling more projects when cost overrun trends become obvious; this will lead to management weighing cost commitments more against technical risk
- Streamline reviews by eliminating Standing Review Boards for Class D missions and allowing the project management organizations to conduct their own external reviews
- Eliminate all NASA Key Decision Point (KPD) decisions/meetings other than confirmation; if the missions fail to progress, hold a cancellation decision

- Ensure NASA oversight is there to coach less experienced development teams in best practices in safely reducing scope, not to enforce compliance with traditional risk averse practices
- Simplifying documentation requirements to focus on essential project plans
- Eliminate NASA mission assurance requirements (other than safety) and use practices of the management organization
- Eliminating early over-analysis and excessive engineering in favor of system-level testing
- Conducting targeted experiments to eliminate suspected non-value-added practices
- Celebrate programmatic success, not just technical success
- If these measures do not yield improvements in programmatic performance while maintaining high technical success rates, further adjustments could be considered after a trial period of several years
- Think of traditional rules, oversight, and risk aversion as a "dial" with current Class D practices as the lower range of the dial…if the programmatic versus technical success goals are not being met then "turn the dial down more!"

NASA is a learning organization; it assesses it's project performance not just on a single project basis but also on a portfolio basis. SMD demonstrated leadership in the agency in stating clear goals for technical and programmatic success of its Class D portfolio. Now there is enough data to show that further adjustment is needed to bring cost and schedule performance up to the goal. There is clearly room lower the management risk aversion in oversight, process, document formality, and requirements to deliver on the promise of Class D which is more science for less money and acceptable technical risk.

References:

[1] NASA's ONCE database, current as of May 2025.

[2] Science Mission Directorate Class D Tailoring/Streamlining Implementation Plan as reported in "Mission Portfolio Risk Management" by Greg Stover, March 11, 2021 at the NASA Quality Leadership Forum.