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Programmatic Insights: Behaviors Behind Mission Success

Lessons from NASA Project Execution, PP&C Integration, and Historical Performance

NASA Cost & Schedule Symposium

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OCFO

OFFICE OF THE CHIEF FINANCIAL OFFICER

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Aoccdrnig to a rscheearch at Cmabrigde Uinervtisy, it deosn't mttaer in waht oredr the ltteers in a wrod are, the olny iprmoetnt tihng is taht the frist and lsat ltteer be at the rghit pclae. The rset can be a total mses and you can sitll raed it wtihuot porbelm. Tihs is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the wrod as a wlohe.

Amzanig huh?

Moral of the story…you don’t have to be perfect to get it right.

Perspective Shapes Priorities

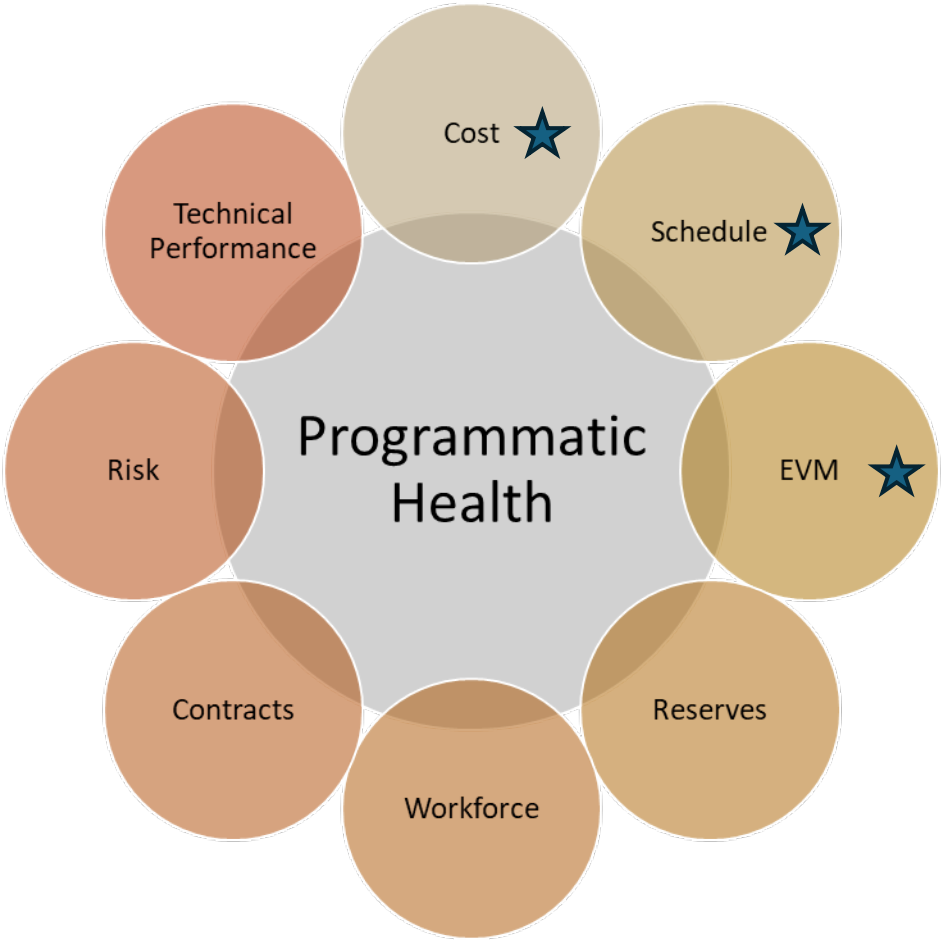
- Here's mine:
  - 20+ years at NASA
  - PP&C leadership roles across Astrophysics / Planetary / Human Space Flight
  - DPM/R on:
    - HST SM-4
    - OSIRIS-REx
    - Lucy
    - DAVINCI
    - Others
  - Former Astrophysics and Planetary Program Business Managers
  - Certified COR / acquisition strategy leadership
  - Former PP&C SME and now current PP&C Implementation Manager for GSFC OCFO
- My 'lens' has taught me that Programmatics is not bookkeeping…it's the early warning system

Cost + Schedule + EVM + Risk + Workforce = Decision Intelligence

What PP&C Really Is…

Window Into Mission Health

- None of these areas independently predict mission success.
  Integration does.
- Examples:
  - Schedule slip → workforce stretch → cost growth
  - Contract delay → integration compression → testing risk
  - Technical issue → reserve consumption → portfolio erosion

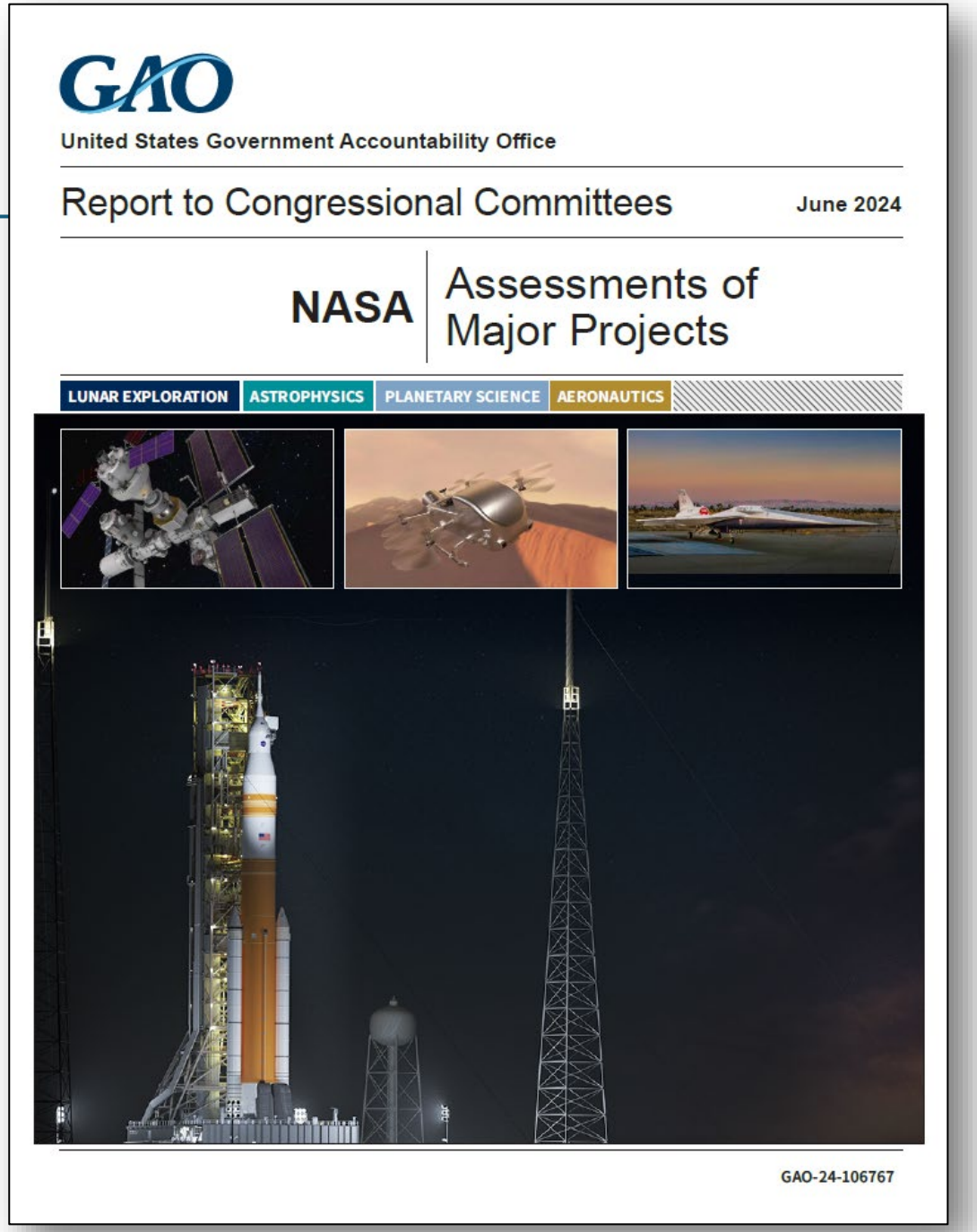


Problems rarely fail alone. They fail as systems.

★ = “Little PP&C”

Objective Examination

- “GAO's mission is to provide **Congress** with fact-based, nonpartisan information that can help improve federal government performance and ensure accountability for the benefit of the American people.”
- Purpose of this examination:
  - Author’s opinion that GAO’s analysis has always been fair, well articulated, and thorough often exceeding 100 pages
  - Annual reporting frequency allows for periodic updates
  - Publicly available allowing for wider discussion
  - Substantial history with reports now spanning 16 years (2009-2024)
  - Report perspective is from individuals external to NASA’s Executive Branch chain of command
  - Based on hundreds of hours of interviews with NASA project personnel and other “officials”
- This examination seeks to collect GAO’s reported lessons learned of programmatically successful missions, ie. within the ABC
  - Collected by a NASA PP&C SME…
  - Using GAO’s own words…
  - Interpreted through a DPMR’s experiences

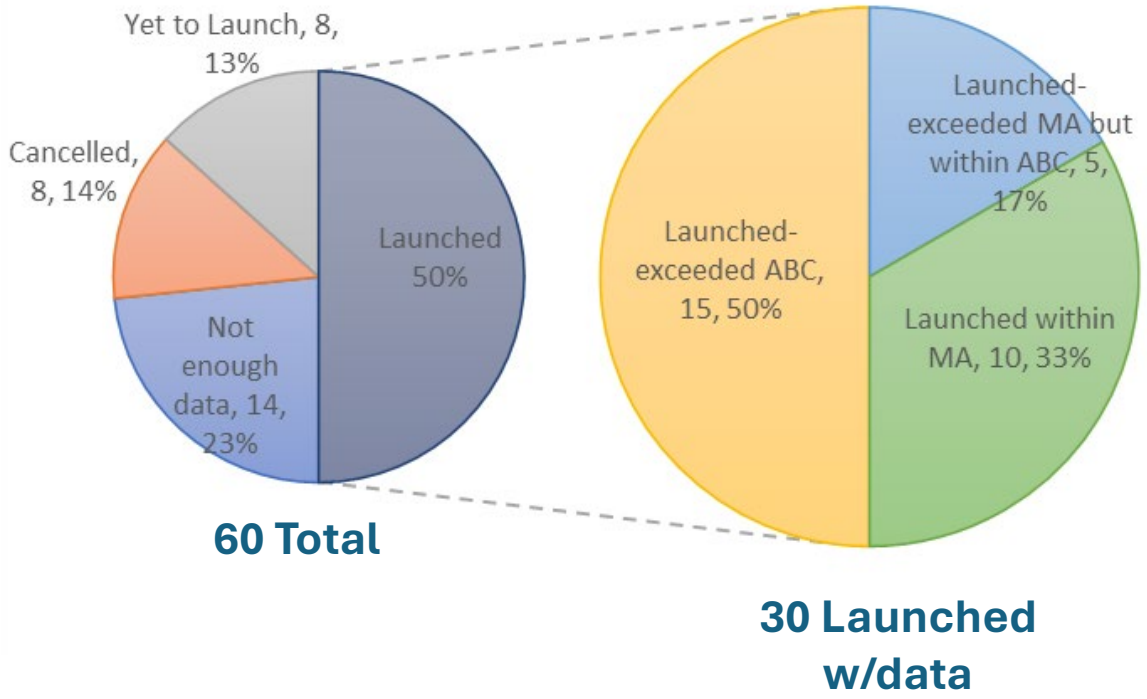


Historical Truth (GAO)

NASA's challenge isn't technical brilliance—it's execution discipline

Objective examination of 16 years' worth (2009-2024) of GAO *Assessment of Major Projects* – 60 missions in total

- 30 launched missions evaluated
- 15 (50%) met ABC commitment
- 10 (33%) met Management Agreement
- Successful missions repeatedly showed:
  - ✓ schedule commitment
  - ✓ rapid decisions
  - ✓ reserve use for real risk reduction
  - ✓ aggressive mitigation
  - ✓ scope discipline
  - ✓ willingness to descope when necessary



Schedule is King ie. Time is money – it is extremely rare for a mission to miss its LRD and stay within budget

Where leadership attention should go

High-Leverage Focus Areas

- launch readiness threats
- margin erosion
- unresolved cross-discipline issues
- integration bottlenecks
- long-lead hardware
- workforce loading



Low-Leverage Noise

- formatting debates
- isolated variance chatter
- administrative churn
- over-analysis of tactical minutiae

Spend 80% of your attention on the 20% of issues that move launch readiness

What Successful Programs Actually Do

Behavior Patterns of Effective Teams







Anticipate

- buy down risk early
- preserve margin
- over-communicate reality

Decide

- concise issue framing
- fast decisions
- clear ownership

Execute

- staffing surges
- alternate shifts
- engineering units
- parallel paths
- descopes if needed

Hope is NOT a Management Strategy

Behavioral Traits of the 10

Success Patterns Over Coincidence

1) Ruthless Commitment to Schedule (most common trait)

- Launch date was treated as sacred
  - MAVEN: missed window = 26-month slip
  - OSIRIS-REx: 39-day planetary window
  - Parker Solar Probe: 10-month launch cadence
  - Lucy: extra shifts / split ATLO teams / COVID workarounds
  - Landsat 9: absorbed shutdown + COVID + hardware issues and still hit baseline
- Schedule pressure created decisive management behavior

2) Aggressive Mitigation Instead of Waiting

- Successful missions acted early
- Repeated actions:
  - surge staffing
  - extra shifts
  - parallel procurements
  - early spare hardware acquisition
  - engineering units used in parallel
  - special investigations/trade studies
  - retesting immediately
- Examples:
  - MAVEN: ramped software staffing; borrowed spare hardware
  - Lucy: split workforce shifts; partial delivery strategy
  - GRAIL: engineering units used while waiting on avionics
  - GRACE-FO: launch delay converted into added risk reduction testing
- Attacked problems before problems attacked schedule

3) Smart Use of Reserves / Margin

- Not ‘reserves’ as emergency money but rather reserves as a management tool
- Repeated uses:
  - workforce augmentation
  - retest campaigns
  - hardware replacement
  - additional analysis
  - supply chain mitigation
  - parallel paths
- Almost every success story includes margin/reserve deployment
- Reserves were spent deliberately to protect launch readiness

4) Fast Decision Velocity

- Successful teams did not linger – instead, they:
  - framed problem clearly
  - made decision
  - moved
- Not:
  - prolonged coordination loops
  - endless study
  - delayed ownership
- Examples:
  - Lucy: quick COVID operational changes
  - MAVEN: immediate staffing increases
  - GRACE-FO: launch vehicle change → rapid pivot
  - Juno: engineering model investment
- Time-to-decision mattered

5) Technical / Programmatic Creativity

- Repeated unconventional but smart workarounds
- Examples:
  - borrow hardware
  - use engineering models
  - partial deliveries
  - parallel testing
  - alternate operational concepts
  - rephase work
  - use delay windows productively
- Creative adaptation without changing mission intent

6) Strong Scope Discipline

- Successful missions generally avoided:
  - uncontrolled requirement creep
  - adding “nice-to-have” scope
  - late changes
- When descopes were needed, they were executed
- Examples:
  - GPM descoped instrument
  - OSIRIS-REx descoped operations elements
  - PSP considered instrument descope
- Requirements discipline protected execution

7) Mature Leadership / Calm Execution

- Reading across all 10, tone is consistently:
  - measured
  - pragmatic
  - solution-oriented
  - not dramatic
  - action-minded
  - No panic.
  - No theatrics.
  - No victim mentality.
- Simple "Here's issue / here's mitigation / here's path.“ – Demonstrated leadership maturity

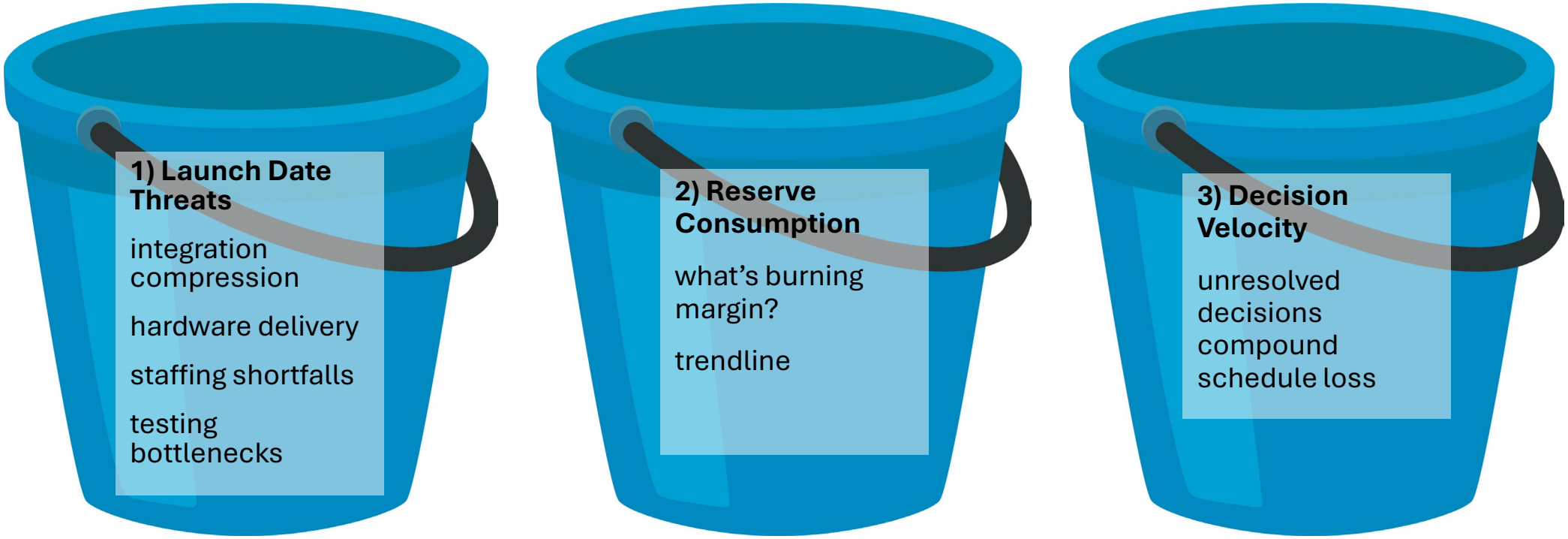
Successful missions were not problem-free. They were action-oriented, schedule-focused, and disciplined

What Determines Mission Success

1. **Integrated awareness**
   – cost + schedule + workforce + risk
2. **Ruthless prioritization**
   – focus on launch drivers
3. **Fast, informed decisions**
4. **Early and aggressive mitigation**
5. **Calm, disciplined execution**

Backup

Keep the Main Things the Main Things



Not Usually Mission Killers

minor monthly variance noise

administrative churn

reporting format debates

isolated tactical friction

Spend 80% of your attention on the 20% of issues that move launch readiness

What Program Executives Should Ask

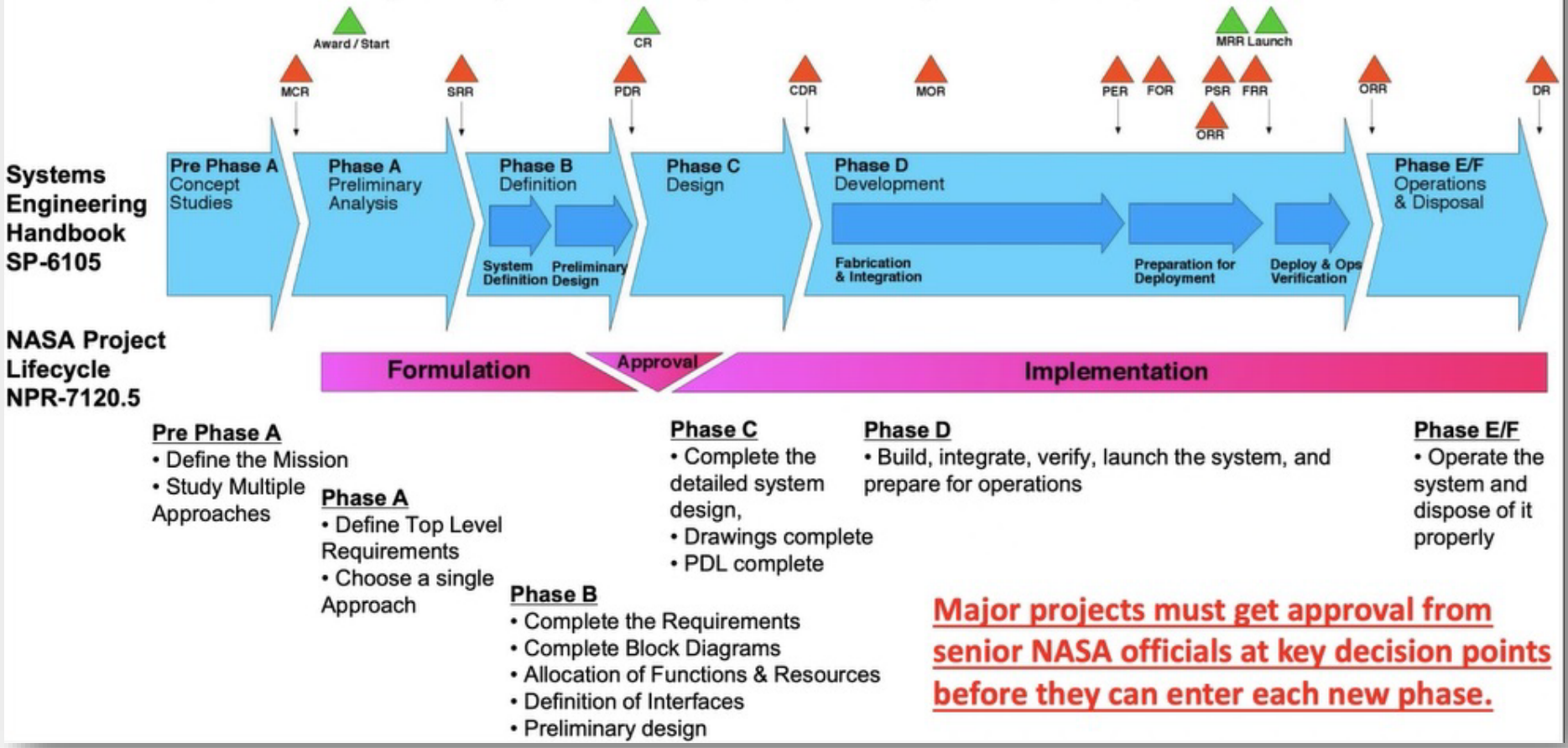
Five Questions That Matter

- What threatens launch?
- What is consuming schedule margin fastest?
- Where are we slow to decide?
- What are we assuming will “work out”?
- If we had to descope tomorrow—what would it be?

If leadership knows these answers, surprises become rare

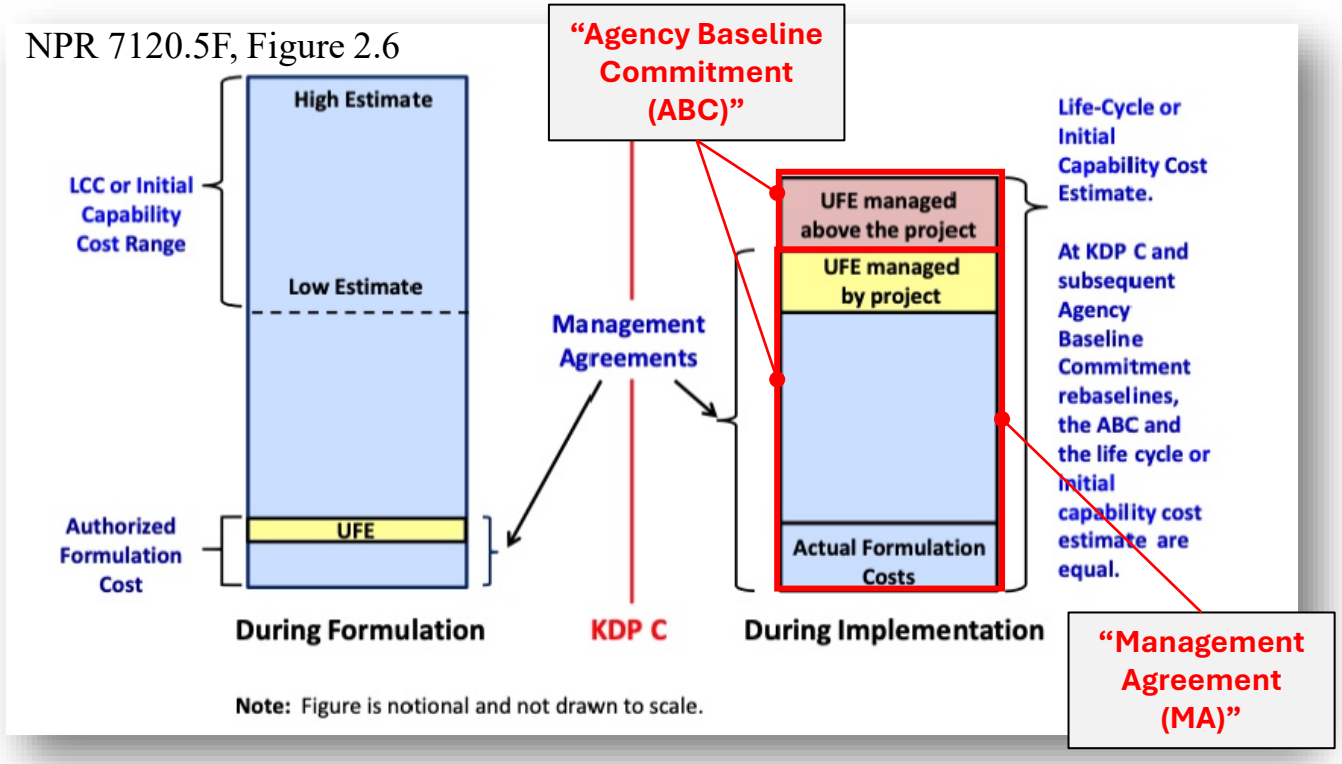
Background (1/3) – Mission Lifecycle

- **Conceiving and Developing a Mission is a Sequence of Activities**
  - **"Crawl before you Walk, Walk before you Run"**
  - A) Define Goals, Evaluate Multiple Approaches, Select a Single Best Approach,
    B) Decompose System to Lower Elements, Validate ("Design the Right System"),
    C) Detailed Design ("Design the System Right"), D) Build, Integrate, Verify, E) Operate



Background (2/3) – Establishing the ABC

- **NPR 7120.5F, Section 2.4.1.5**: All single-project program managers and project managers shall document the Agency's LCC estimate or initial capability cost estimate and other parameters in the Decision Memorandum for Implementation (KDP C), and this becomes the **ABC (Agency Baseline Commitment)**. The ABC is the baseline against which the Agency's performance is measured during the implementation Phase. The ABC for programs and projects with a LCC of $250M or more forms the basis for the **Agency's external commitment** to **OMB and Congress**.



- 2.4.4.2 At KDP C, Mission Directorates shall plan and budget single-project programs (regardless of LCC) and projects with an estimated LCC greater than $250M based on a **70 percent JCL** or as approved by the Decision Authority.
- 2.4.4.4 At KDP C, Mission Directorates shall ensure funding for single-project programs (regardless of LCC) and projects with an estimated LCC greater than $250M is consistent with the **Management Agreement and in no case less than the equivalent of a 50 percent JCL** or as approved by the Decision Authority.

Background (3/3) – GAO's charge

- NASA - Assessments of Selected Large-Scale Projects (**March 2009**)

  "The explanatory statement of the House Committee on Appropriations accompanying the **Consolidated Appropriations Act of 2008 directed GAO** to prepare project status reports on selected large-scale NASA programs, projects, or activities. This report responds to that mandate by **assessing 18 NASA projects, each with a life-cycle cost over $250 million**. The combined life-cycle cost for these 18 projects exceeds $50 billion."

- NASA - Assessments of Major Projects (June 2024)
  - "Why GAO Did this Study"

    "The National Aeronautics and Space Administration (NASA) plans to invest billions in the coming years in science and exploration space flight initiatives. The scientific and technical complexities inherent in NASA's mission create great challenges in managing its projects and controlling costs. **In the past, NASA has had difficulty meeting cost, schedule, and performance objectives** for some of its projects. The need to effectively manage projects will gain even more importance as NASA seeks to manage its wide-ranging portfolio in an increasingly constrained fiscal environment.

    Per congressional direction, this report provides an **independent assessment of selected NASA projects**. In conducting this work, GAO compared projects against best practice criteria for system development including attainment of knowledge on technologies and design as well as various aspects of program management. The projects assessed are **considered major acquisitions by NASA**—each with **a life-cycle cost of over $250 million**. No recommendations are provided."

Examination Ground Rules

- Study analyzes GAO annual reports from 2009-2024
- Dataset evaluates Development (Ph. A-D) cost performance at KDP-C commitment and launch milestones **ONLY**
  - This span accounts for the majority of cost activity and often the time range growth occurs
- GAO only assesses missions with an LCC (Ph. A-F) over $250M and were Confirmed (passed KDP-C)
- Excludes ARTEMIS missions – too sophisticated of a structure
- ABC (Agency Baseline Commitment) values include the LV (Launch Vehicle) – MA (Management Agreement) values do not
- GAO often uses the latest project estimate for actual cost in the final reporting year – dataset has been updated to use CADRe for cost at launch (increases precision)
- ABC underruns are instances where the mission does NOT use all the HQ UFE – MA underruns are instances where the mission does NOT use any HQ UFE at all
  - MA variances given 5% grace for HQ-directed scope, etc.
- Notable
  - MA/ABC and HQ UFE policy (70% JCL) was instituted in 2006 with NPR 7120.D but was in practice earlier
    - Particulars were codified in the mission KDP-C Decision Memo (DM)
  - NPR 7120.5 ABC breach policy:
    - Rebaseline if "ABC development cost [grows] by 30 percent or more“
      - Requires Congress to reauthorize the project
    - "Development cost includes all project costs from authorization to proceed to Implementation (Phase C) through operational readiness at the end of Phase D”
    - NASA policy further requires a Replan, amendment to DM, and congressional notification, at a 15% breach (or a 6-month delayed "major milestone“)
  - Oldest DM in dataset is from Dawn in 2005 but with limited programmatic information

General Dataset Observations – ABC Performance

- "Success" defined as 0% cost growth over established KDP-C ABC commitment
- 44 missions have launched
  - 8 have yet to launch
  - 8 have been cancelled/indefinitely paused
- 30 missions have launched with Commitments & LCC data for this analysis
  - 15 launched within the ABC commitment – 50% success rate
  - Based on 7120.5 JCL policy, this should be a 70% success rate
- Performance by Mission Characteristic
  - No discernable difference between AO vs. Directed, or Planetary vs. Earth-orbiting missions
  - GSFC-led missions fare better than JPL-led
  - Cat 2/3 missions struggle along with Classes A, C, and D
  - Cat 1 and Class B missions perform well

Success = 0% cost growth over KDP-C ABC commitment

Type	Successes	Fails
AO	6	6
Directed	9	9
Category		
Cat 1	6	2
Cat 2	8	11
Cat 3	0	2
Risk Classification		
A	0	1
A/B	0	1
B	10	3
B/C	1	0
C	3	8
D	0	2
Scientific Destination		
Planetary	5	6
Earth-orbiting	10	9

General Dataset Observations – MA Performance

- Narrowing focus to the 15 launched missions successfully within the ABC commitment
- "Success" defined as less than 5% cost growth over established KDP-C MA commitment
- Examining performance against MA
  - Overall, missions that maintained the ABC also maintained the MA
  - **Data shows only 10 out of original 44 (22.7% success rate) launched missions met their MA commitment**
- Performance by Mission Characteristic
  - No discernable difference between AO vs. Directed
  - GSFC-led missions fare better than JPL-led
  - Cat 2 missions struggle along with Classes B/C and C
  - Cat 1 and Class B missions perform well

ABC successes subset - perf against MA

Success < 5% cost growth over KDP-C MA commitment

Type	Successes	Fails
AO	5	2
Directed	5	1
Category		
Cat 1	3	1
Cat 2	2	6
Cat 3	0	0
Risk Classification		
A	0	0
A/B	0	0
B	5	2
B/C	0	2
C	0	3
D	0	0
Scientific Destination		
Planetary	4	1
Earth-orbiting	2	6