National Aeronautics and
Space Administration

When Do Costs Peak?

Dr. Moon Kim

2024 NASA Cost and Schedule Symposium

April 25, 2024

AMES RESEARCH CENTER | ARMSTRONG FLIGHT RESEARCH CENTER | GLENN RESEARCH CENTER | GODDARD SPACE FLIGHT CENTER | HEADQUARTERS | JOHNSON SPACE CENTER | KENNEDY SPACE CENTER | LANGLEY RESEARCH CENTER | MARSHALL SPACE FLIGHT CENTER | STENNIS SPACE CENTER

OCFO

OFFICE OF THE CHIEF FINANCIAL OFFICER

Background

Common Anecdotal Assumption

- Cost peaks at the month of CDR and cools down thereafter for SMD projects

Study Questions

- When do costs peak?
- When do costs “cool down”?

Implication of Findings

- Offers a rule-of-thumb guide for NASA’s strategic budget planning, project planning and control, and project management

Data

N = 43

- SMD projects with SRR from 2003 and on, and launch year before 2024
- Excluded reimbursable projects (e.g., JPSS, GOES, etc.)
- Milestone dates from internal quarterly reports
- Project specification data from CADRe reports (7120.5 requirement)
- Monthly cost data from BOBJ (NASA internal accounting database)
- Excluded launch vehicle costs

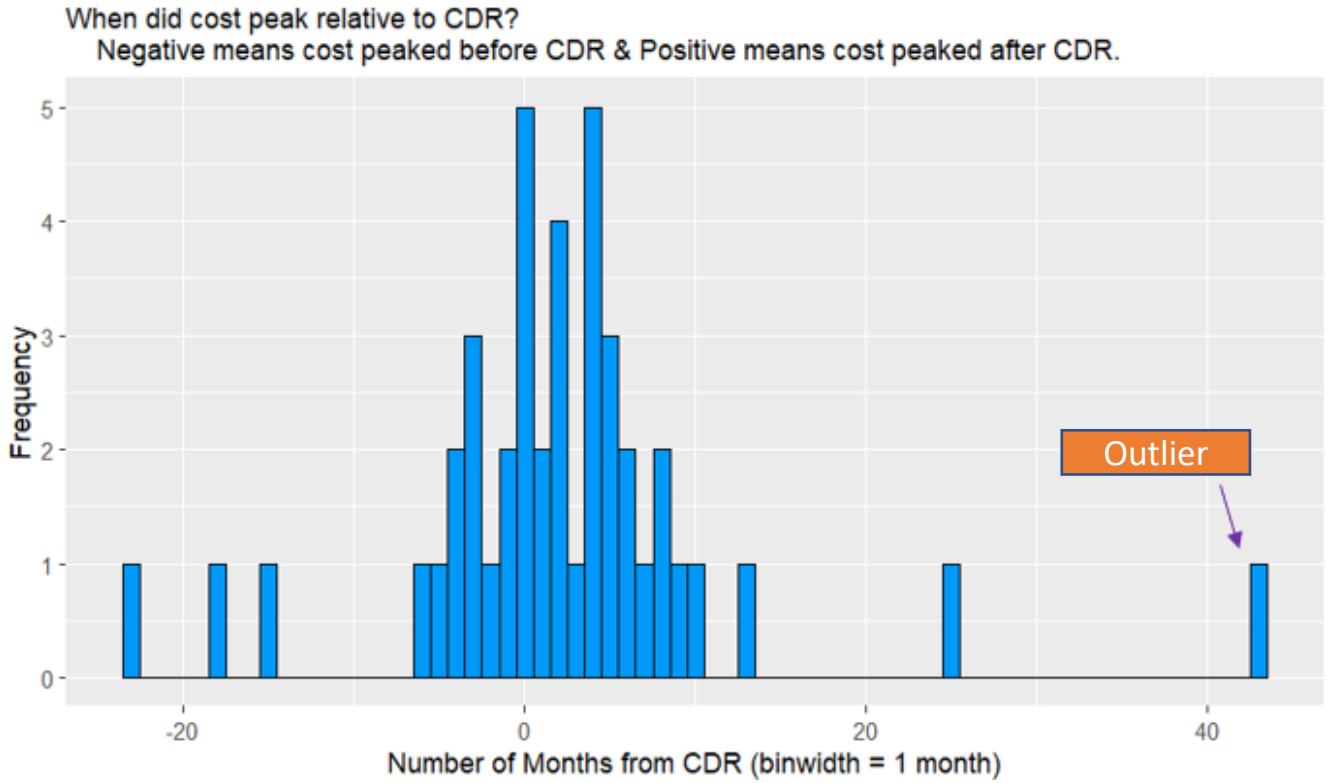
- Monthly cost smoothened using 5-month rolling average (2 prior months and 2 subsequent months)
  - Reduces month-to-month noise in data and enhances the visibility of underlying trends

Cost Peak

Month of Highest Cost

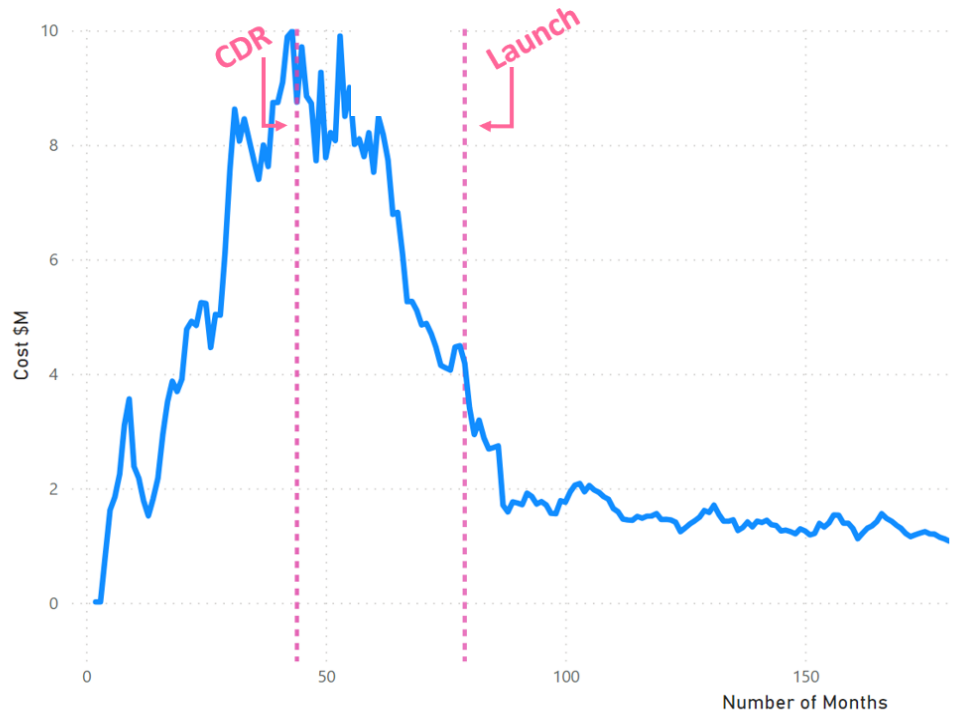
- On average, monthly cost is highest at 1 month after CDR month.
  - 2 months with outlier
- While CDR is considered 50% of project development lifetime (Phase A to Launch), projects accumulate ~40% of cost by CDR.
- Wide standard deviation of 8 months
  - Majority of projects experience highest monthly cost within 8 months of CDR (before and after)

Common assumption that cost peaks at CDR is misleading.



Cost Terminal Descent

Cool Downs



Sample Monthly Actuals Cost Curve
(smoothened)

SMD projects incur multiple cost peaks
Therefore, assuming cost "cools down" after the highest cost peak is misleading.

Cost Terminal Descent
Point at which monthly costs fall below 80% of the highest cost peak and remains below such level

- 42 out of 43 projects experienced terminal descent after CDR
- Average of 11 months after CDR with standard deviation of 8 months
  - 12 months with outlier
- ~52% of Total Cost by Terminal Descent

Predictors

Statistical methods (e.g., linear regressions, ANOVA, Fisher's Test, etc.) conducted to identify potential predictors

- Outcome variable: timing of peak events – highest cost and terminal descent
- Independent variables:
  - Lead Center
  - Mission Classification
  - Mission Category
  - Level of Heritage
  - Total Mission Cost
  - Total Mission Life
  - Dry Mass
  - Project Type
  - Theme
  - **Days in Continuing Resolution**: **the only statistically significant predictor**
    - Every 10 days in CR, highest cost peak and terminal descent pushed out by 1 month
    - Preliminary finding with simple regression
    - Possible Inference: cost curve characteristic depends on external factors, rather than the nature of project

Summary

Study based on empirical data. Previous cost curve timing analyses were mostly qualitative.

Common assumption was that cost peaks at CDR and cools down thereafter.

- Resulted in the belief that concerns around cost are mostly over after CDR

Results show that…

1) Projects reach highest cost month at CDR + 1 month, on average, but with high standard deviation.
2) Projects do not reach halfway point in terms of cost by CDR: ~60% cost remaining post-CDR.
3) Projects "burn hot" for another year post CDR and the cost terminal descent occurs thereafter, on average. Also, with high standard deviation.
4) These findings present that the common assumption that cost peaks at CDR and cools down after CDR is misleading – should be cautious using such assumption.
5) Interestingly, lack of statistical evidence for the factors internal to projects as predictors of peak events. But the number of days in CR (an external factor) seems to be a promising predictor.

Feel free to reach out to moon.j.kim@nasa.gov with any questions/comments!