Do Firm-Fixed Price Contracts Curb Cost Growth?

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Introduction

- The results of this study seek to investigate Firm-Fixed Price contracts and their claimed cost benefits

- NASA has been working to alleviate cost growth on space missions for decades
  - *Estimating future cost and budgeting accordingly is a struggle for all programs*
  - *Different contract mechanisms have been implemented over time to alleviate cost growth*

- There are many contract mechanisms, but this study focuses on two common contract types:
  - ***Cost-Plus (CP):*** *government agency covers actual cost of the project as well as any cost growth experiences due to labor, material, or other fees*
  - ***Firm-Fixed Price (FFP):*** *government agency agrees to cover a fixed price, leaving the contractor responsible for additionally incurred costs*

Note: While there are multiple variants of CP and FFP contracts, including a variety of fee structures (fixed fee, fee award, incentive fees…etc.), the analysis in this study is strictly limited to the general CP and FFP structures for simplicity

Introduction Cont.

- CP contract mechanism ideally implemented when government requirements are not well-defined, and the likelihood of a modification to the scope of the project is high
  - *Advantages: Flexibility in development phase, allows the managing Center and bus supplier to dynamically design, manufacture, and integrate the product*

- FFP contract mechanism ideally implemented when the government requirements are well-defined, costs can be predicted, and the contractor has experience in manufacturing a product that fulfills the requirements.
  - *Advantages: Stable funding environments, transfers risk of cost growth to contractor*

- It is commonly accepted that “fixed-price contracts have less cost growth than other contracts because they are used in lower risk situations” [5]

Study Approach

- Study investigates historical cost growth of spacecraft for a variety of NASA science missions launched over the last 20 years, by comparing historical cost growth of CP and FFP spacecraft from contract start to delivery
  - *Contract start/award (typically found in a press release) to the delivery of the spacecraft bus (total contract value)*
  - *Dataset chosen for this study consists of spacecraft busses only*

- Data was gathered from:
  - *NASA Procurement Data View (NPDV) database*
  - *NASA Mission Cost Analysis Data Requirement (CADRe)*
  - *NASA Contact selection award announcements*
  - *Design review documents from NASA mission milestones*

Study Approach Cont.

- The dataset includes 42 NASA managed spacecraft from 1999-2018
  - *14 FFP spacecraft*
  - *28 CP spacecraft*

- The calculation that is used for percentage of cost growth in this study is:

$$Cost\ Growth = \frac{(Final\ Cost - Initial\ Cost)}{Initial\ Cost} \times 100\%$$

Where:

- *Initial Cost represents the best estimate at contract award*
- *Final Cost represents the actual cost at delivery*

- All the results which present 'Average Cost Growth' are based on the average of spacecraft cost growth

Study Approach Cont.

Dataset

CP Missions:

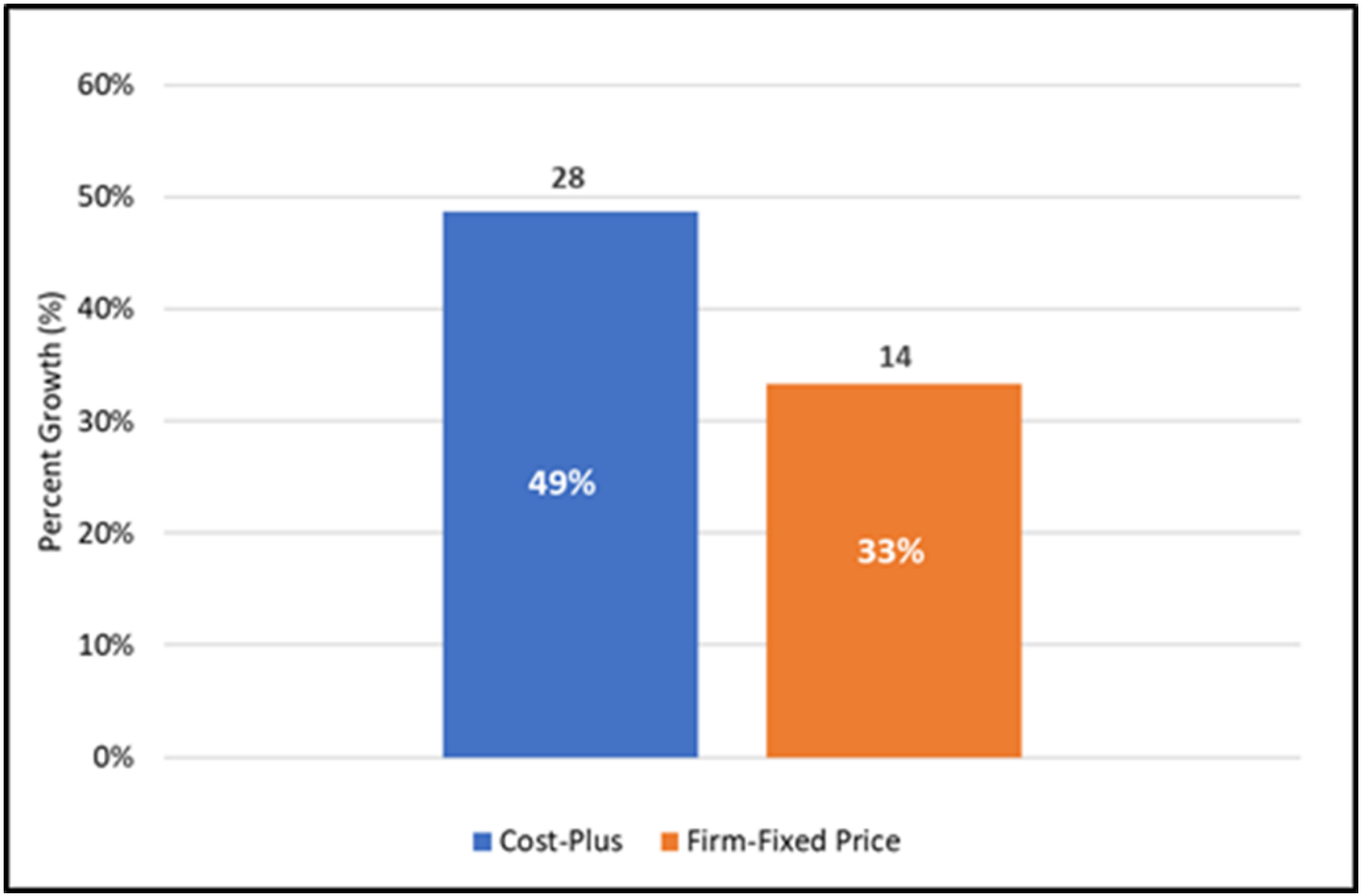
- CloudSat
- Dawn
- DeepImpact
- EO1
- GALEX
- Genesis
- GPM
- GRAIL
- IBEX
- IRIS
- Juno
- Kepler
- Landsat7
- MAVEN
- MESSENGER
- MRO
- NewHorizons
- NuSTAR
- OCO
- RBSP
- RHESSI
- SMAP
- Spitzer
- Stardust
- STEREO
- TESS
- THEMIS
- WISE

FFP Missions:

- ACRIMSAT
- AIM
- Coriolis
- FUSE
- GLAST
- GRACE-FO
- ICESAT
- ICESat-2
- JPSS-1
- LDCM
- NPP
- QuickScat
- QuikTOMS
- Swift

Results

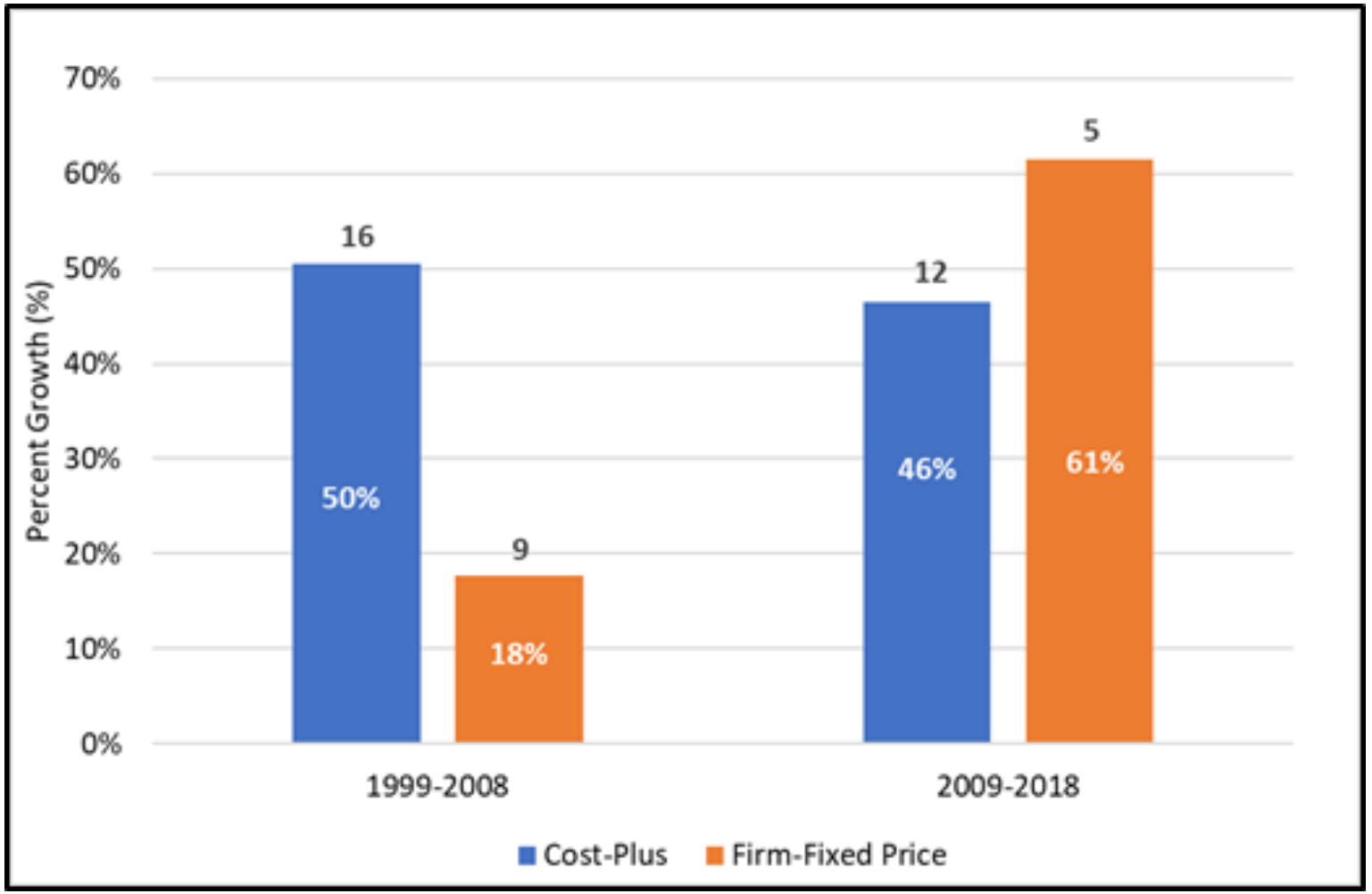
Average Cost Growth



CP spacecraft experience 16% more cost growth than the FFP Spacecraft

Results Cont.

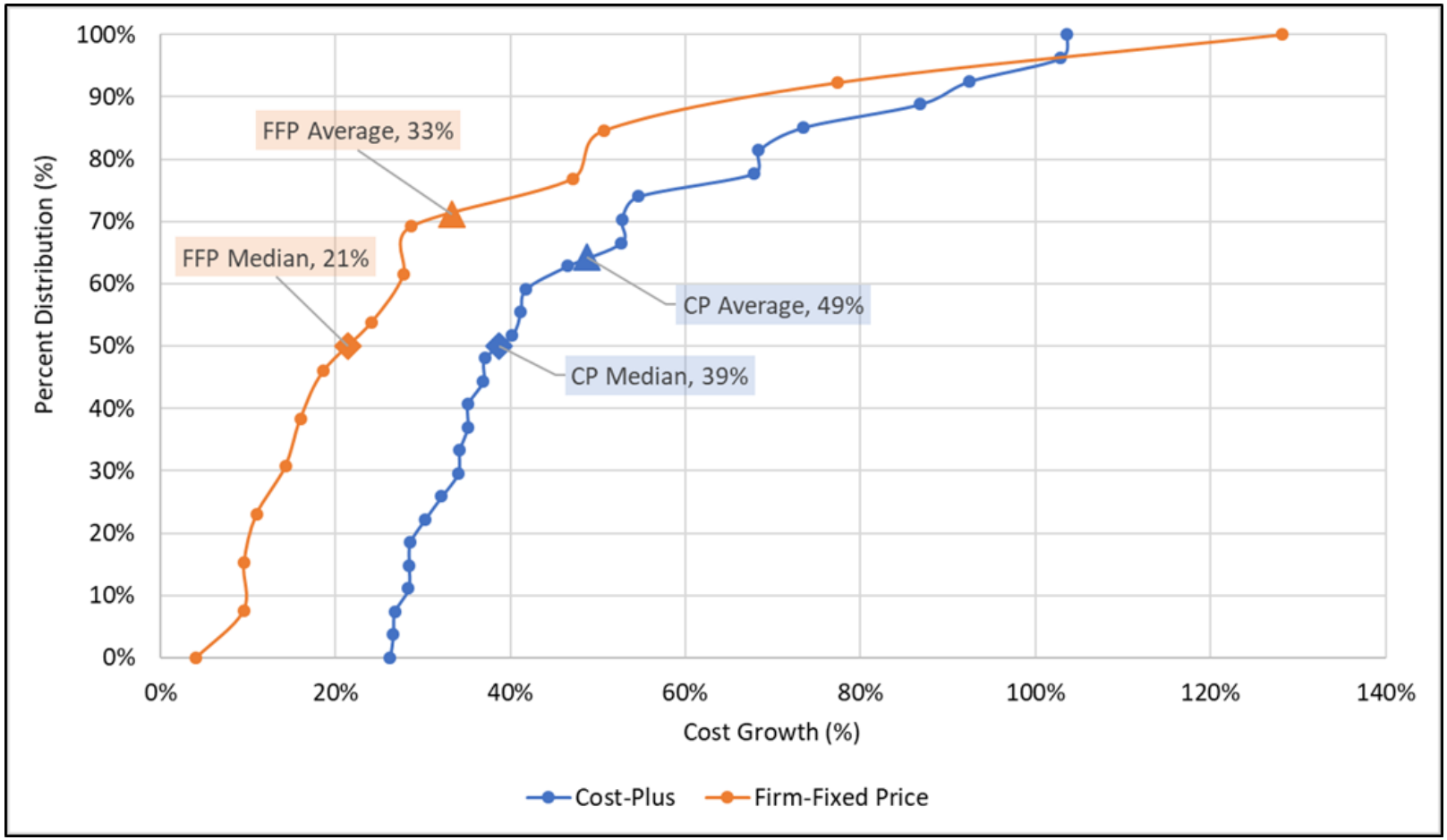
Average Cost Growth by Decade



FFP Spacecraft contracts studied have increased significantly in cost growth over the last 10 years, while the CP contracts has slightly decreased

Results Cont.

Percent Distribution of Contract Cost Growth



Only three FFP missions out of 14 missions achieved <10% contract cost growth

Pitfalls of FFP

- Why did the FFP contracts in this study experience cost growth?
  - *Changes in instrument schedules which caused delays in the overall mission schedule*
  - *Delays to mission by the addition of new ground/data support*
  - *Additional instruments added which required a redesign of the spacecraft*
  - *Funding delays which caused inefficient use of resources*
  - *Mistakenly formulating a basis of estimate by assuming high heritage or a clone of a previous spacecraft*
  - *Workmanship and/or subcontractor errors in the spacecraft design and manufacturing*
  - *Requirement changes and/or additional scope being added after the initial contract was signed leading to an Engineering Change Request (ECR)*

- NASA missions are too important to let the spacecraft provider default on their contract

- Fixed-price contracts are very ‘hands off’ for government agencies which can complicate their programmatic management

FFP mechanism cannot be used as an automatic cost growth restraint

Recommendations

- In order to increase the success of a FFP contract, a project needs to show the following characteristics:
  - *Firm design, manufacturing, and production requirements*
  - *Stable system with mature technology*
  - *Stable and defined external interfaces*
  - *Motivated and experienced suppliers that can absorb any overruns*
  - *Upfront systems engineering*
  - *Budget adequacy and stability*
  - *Transparent and rigorous risk reduction*
  - *Effective well established communication methods between managing Centers and subcontractors*

Conclusion

- The results of this study show that both CP and FFP contracts for NASA spacecraft experience cost growth
  - *CP contracts experience slightly more cost growth than FFP*
  - *FFP contract cost growth has increased in the last 10 years*

- The cost growth of FFP contract shows that the effectiveness of the FFP contract mechanism (specific to NASA spacecraft) in curbing cost growth may be deteriorating
  - *The results run counter to industry perceptions and may signal a troubling trend as FFP contract popularity continues to grow*

- The idea of using an FPP as a ‘jack of all trades’ type contract is not effective and the industry accepted truth that FFP contacts do not experience cost growth is incorrect

- FFP contracts are rarely fixed, and therefore NASA should request additional oversight to ensure mission and programmatic success

References

1. "NASA's Use of Award-Fee Contracts," Office of Inspector General, 2013.
2. "SpaceRef," [Online]. Available: http://www.spaceref.com/news/viewsr.html?pid=33479.
3. "NASA's Engineering and Technical Services Contracts," Office of Inspector General, 2019.
4. M. Callaway, S. Hastings, A. Moeller, "Applicability of Fixed-Price Contracts for Successful Cost Control," IEEE, 2019.
5. S. Hastings, M. Callaway, A. Moeller, "Acquisition Guidance for Affordability Overview: Using Fixed-Price Contracts as a Contributing Tool for Successful Cost Control Presentation," 2017.
6. S. Arnold, S. Horowitz, P. Patel, G. Davis, "Lessons from Literature on Effects of Contract Type on Satellite Acquisition," Institute for Defense Analyses, 2013.
7. M. Hayhurst, R. Bitten, S. Shinn, D. Judnick, I. Hallgrimson, M. Youngs, "Historical Mass, Power, Schedule, and Cost Growth for NASA Spacecraft," IEEE, 2016.
8. D. Lowenstein, J. Lagrotta, "Test Strategies for minimizing the overall cost of test in moving from "cost based/government furnished equipment" to "firm fixed price" contracts," IEEE, 2012.
9. "Performance of the Defense Acquisition System 2014 Annual Report," 2014.
10. S. Arnold, S. Horowitz, P. Patel, G. Davis, "Lessons from Literature on Fixed-Price Contracting," 2013.
11. M. Callaway, S. Jones, "A Case Study: Limitations and Constraints of Fixed-Price (Incentive, Firm Target) Contract," 2020.
12. F. Kendall, "Use of Fixed-Price Incentive Firm (FPIF) Contracts in Development and Production," Defense AT&I, March 2013.

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