



National Aeronautics and
Space Administration



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How Effective are NASA's Collaborations with Industry?

Dr. Moon J. Kim | Agency Investment Analysis Branch | May 2023

Outline

Background - Industry Collaboration Typology

Study Method and Approach – Measure of Effectiveness

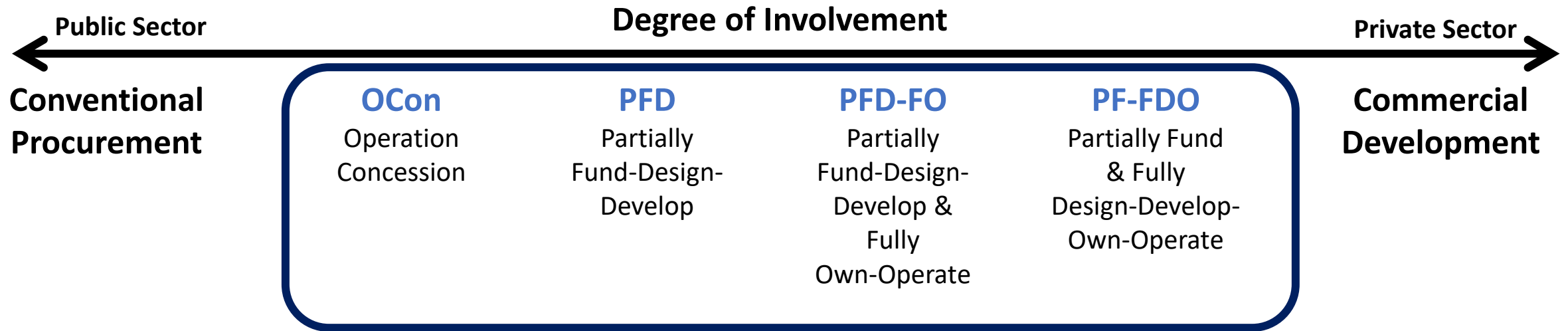
Industry Collaboration Assessment Results

Findings and Discussions

Recommendations

Future Research

Space Sector Procurement Arrangement Spectrum








































Public-Private Partnerships in Space Sector

Industry Collaborations

Procurement Arrangements		Conventional Procurement	Public-Private Partnerships				Commercial Development
			OCon	PFD	PFD-FO	PF-FDO	
Tasks	Public Entity	Manages and is responsible for all five tasks.	Fund, design, develop and own	Partially fund, design, and/or develop and fully own and operate	Partially fund, design and/or develop	Partially fund	Acquires services under fixed price contracts.
	Private Entity	Executes tasks under cost plus contracts.	Operate	Partially fund, design and/or develop	Partially fund design, and/or develop and fully own and operate	Partially fund and fully design, develop, own, and operate	Manages and is responsible for all five tasks.

Task Allocation

Task	Traditional Procurement	OCon	PFD	PFD-FO	PF-FDO	Commercial Development
Fund			 	 	 	
Design			 	 		
Develop			 	 		
Own						
Operate						

 Public Entity
  Private Entity

Risk and Reward Allocation



Public Entity



Private Entity

Risk & Reward		Traditional Procurement	OCon	PFD	PFD-FO	PF-FDO	Commercial Development
Risks	Funding						
	Construction						
	Technical						
	Business						
	Operational						
Rewards	Revenue	N/A					
	Access to Capability						

Reference: Kim, Moon J., Towards Coherence: A Space Sector Public-Private Partnership Typology, *Space Policy*, April 2023.

Industry Collaboration Assessment: Study Method and Scope

Measure of Effectiveness

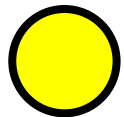
Effectiveness defined using major objectives for NASA's utilization of PPPs and Commercial Developments:

- Cost Savings
- Capability Development
- Commercial Market Development

Measures of Effectiveness (MOEs)	Did the partnership save NASA money?	Did NASA gain the access to the sought-after capability?	Did the partnership foster a commercial market?
Binary Outcome	Y/N	Y/N	Y/N



If all three assessment criteria are Yes



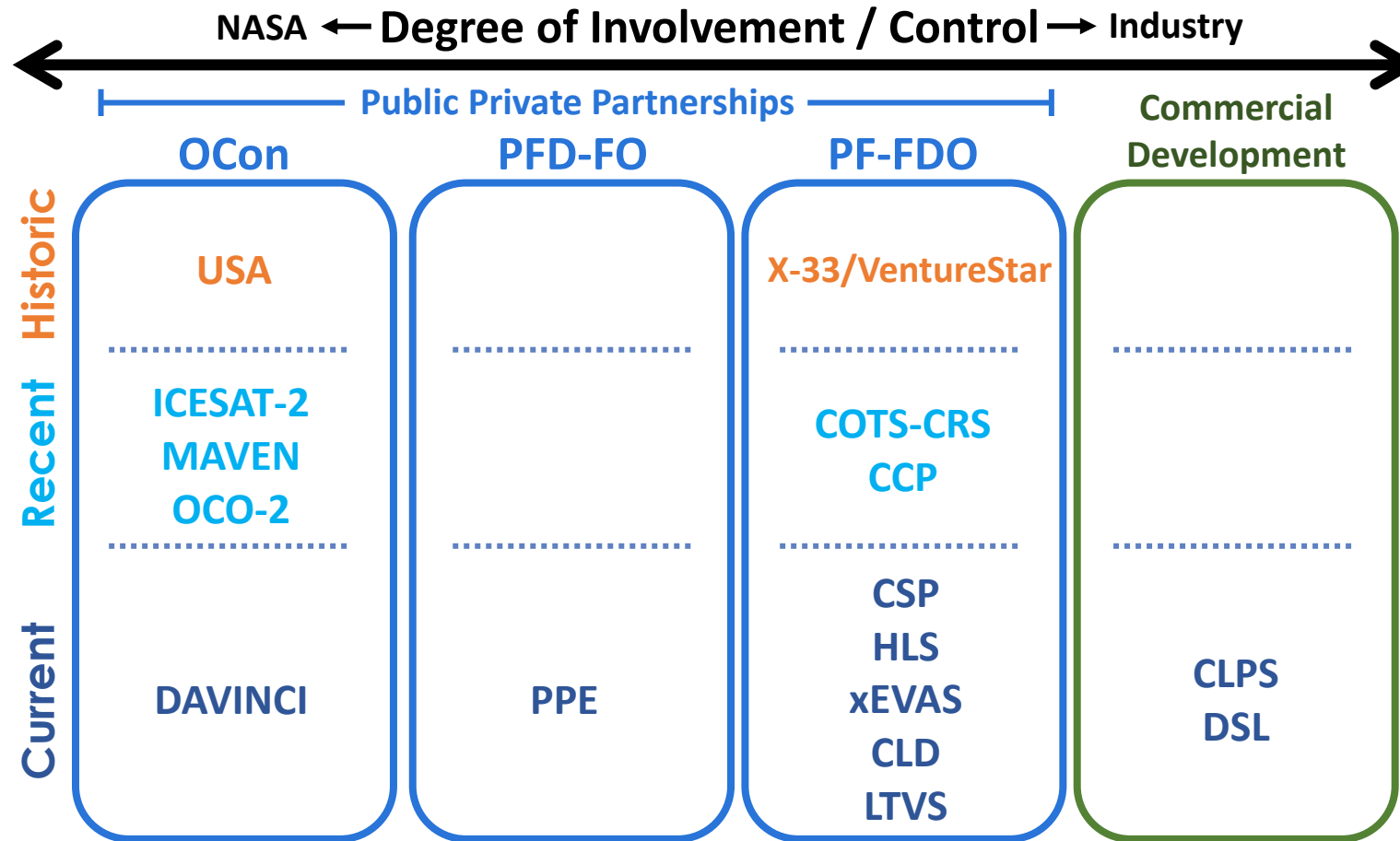
If one or two assessment criteria are No



If all three criteria are No

Effectiveness can be defined in various ways. The MOEs used in this study were based on the available data, resource, and analyst judgement.

Industry Collaborations in Scope



Mixed-Methods Approach

Cost-Savings

















- **USA Shuttle:** Comparison of budget for Shuttle operations per flight before and after the contract's period of performance
- **X-33/VentureStar:** NASA's funding for the partnership was considered lost, therefore no cost savings
- **ICESAT-2, MAVEN & OCO-2:** Comparison of operations costs estimated by the Mission Operations Cost Estimation Tool (MOCET) and actual operations costs. MOCET is NASA's parametric cost estimation tool for Phase E of science missions.
- **COTS-CRS:** Value for Money (VfM) assessment conducted in 2014 by HQ OCFO. VfM assesses the net present value of the total life-cycle cost of a PPP program against a hypothetical conventional procurement program.
- **CCP:** Modified/Simplified VfM assessment based on data provided by the Commercial Spaceflight Division

Capability and Market Development

- Qualitative assessment based on the outcomes of the programs

Industry Collaboration Assessment Results

Effectiveness Assessment Summary

Program	Category	Assessment	Summary
USA Shuttle Operations	Historic		Shuttle operations contract resulting in no cost gains
X-33/VentureStar	Historic		Launch vehicle development that ended due to cost/schedule overrun
ICESAT-2	Recent		Actual average monthly operations cost is less than MOCET estimate
MAVEN	Recent		Actual average monthly operations cost is more than MOCET estimate
OCO-2	Recent		Actual average monthly operations cost is more than MOCET estimate
COTS-CRS	Recent		Positive VfM; Fostered commercial launch industry; NASA gained access to LEO/ISS
CCP	Recent		Cost savings for NASA; NASA gained crew access to ISS; Fostered an industry
DAVINCI	Current		In development – performance assessment cannot be completed
PPE	Current		In development – performance assessment cannot be completed
CSP	Current		In development – performance assessment cannot be completed
HLS	Current		In development – performance assessment cannot be completed
xEVAS	Current		In development – performance assessment cannot be completed
CLD	Current		In development – performance assessment cannot be completed
LTVS	Current		In development – performance assessment cannot be completed
CLPS	Current		In development – performance assessment cannot be completed
DSL	Current		In development – performance assessment cannot be completed

Completed Effectiveness Assessments

Program	Assessment	Cost	Capability	Market	Summary
USA Shuttle Operations		N	Y	N/A	Operations budget per flight decreased for two years in the early days of the partnership (FY96 and FY97), but returned to the previous level thereafter where flights per year remained low
X-33 / VentureStar		N	N	N	In 2001, the program was cancelled due to cost and schedule overruns caused by technical difficulties. No test flights had taken place.
ICESAT-2		Y	Y	N/A	Actual average monthly operations cost is less than MOCET estimate
MAVEN		N	Y	N/A	Actual average monthly operations cost is more than MOCET estimate
OCO-2		N	Y	N/A	Actual average monthly operations cost is more than MOCET estimate
COTS-CRS		Y	Y	Y	Study by BAH in 2014 found that the COTS and CRS programs resulted in positive VfMs, saving NASA several billions of dollars.
CCP		Y	Y	Y	Development: Life cycle cost of Orion Crew Exploration Vehicle was estimated as \$20-\$29B. The current estimate of the development phase of CCP is \$5.1b. Operations: Last time NASA paid Russia for a seat on Soyuz was for \$90.3M in 2020. The average seat price for the CCP missions under contract in 2020 was \$69.9m.

Industry Collaboration Assessment Discussions

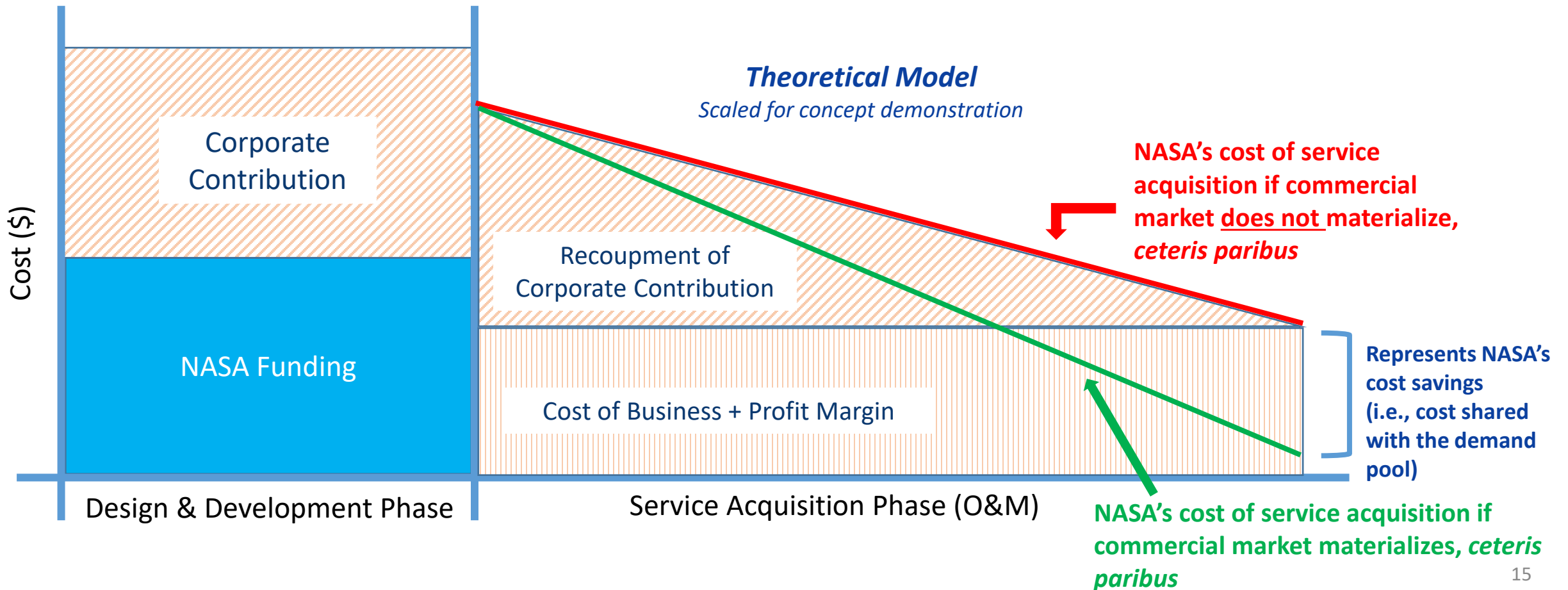
Findings

- NASA engages in more industry collaborations, both in the number of programs and the variety of collaboration types.
- Mixed results in the past partnerships with the private sector – **some are effective, and some are less effective** based on the metrics used in this study.
- More than half of the current programs we examined are PF-FDOs - significant private sector involvement and control.
 - The possibility of cost-savings depends on the idea that NASA can share the cost of business with the commercial demand pool (i.e., NASA is one of the many customers).
 - Therefore, effectiveness of this type of PPP depends on the development of the relevant commercial markets, and the speed to which they develop.

In PPPs and Commercial Developments, NASA's cost for service acquisition decreases IF the relevant market matures with additional demand sources to share the total cost

Industry partners are profit-driven private corporations. The nature of such corporations requires revenue generation that exceeds expenses, including corporate contributions. Otherwise, they do not generate profit and will be forced to business closure.

In theory, if NASA is the only customer for a capability, the service acquisition cost for NASA will equal the expenses plus any profit margin.



Other Findings

1. NASA's funding in PPPs can expedite the development of technologies in the industry pipeline.
2. Macroeconomic factors can adversely impact NASA's industry collaborations.
3. Related to the above point, industry partners are sometimes subjected to business closure.
4. In many cases, NASA's industry collaborations are not mutually exclusive - NASA engages in multiple collaborations and conventional procurements with each industry partner.

Recommendations

- ***NASA Chief Acquisition Officer's Intent for 2023* is to “implement performance metrics informed by proven analytical techniques” for strengthening our acquisition and program management performance.**
 - A systematic, standardized method to assess the effectiveness of PPPs and commercial developments would benefit our understanding of the nature of the various types of collaborations
 - Assessing cost-savings also requires baseline comparisons - Establishing IGCEs with the conventional procurement assumption could be an example
- **In line with CAO's intent, following are potential first level changes:**
 - Define “effectiveness” for industry collaborations that is aligned with overall Agency strategy
 - Develop a set of measures of effectiveness (MOEs)
 - Collect relevant data throughout program life cycle to enable empirical assessments

Future Research Questions

- What are the implications of the various partnerships in terms of the effects to the Agency's expertise and resources?
 - What would happen if NASA relies on one type of procurement arrangements over the others?
- Do contract types (e.g., cost-plus, firm-fixed, SAA, etc) affect effectiveness of industry collaborations?
- Are there relationships between collaboration type and effectiveness?
- What are the strengths and weakness of each industry collaboration?
- What are the effects of each collaboration to industry development?
- What situations/environments/conditions lead to success for each type of collaborations?

Thank you

The purpose of this study was not to be criticize programmatic performance of the programs. Rather, it was to investigate the broader question of how we could measure the Agency's effectiveness in industry collaborations.

Let's begin the discussion on the appropriate MOEs for PPPs and Commercial Developments as NASA and other space agencies increasingly utilize non-traditional procurement arrangements.

moon.j.kim@nasa.gov