The Mutuality Between Science and Commercial Exploration of the Moon

A presentation to the
2023 Planetary Science Decadal Survey Committee

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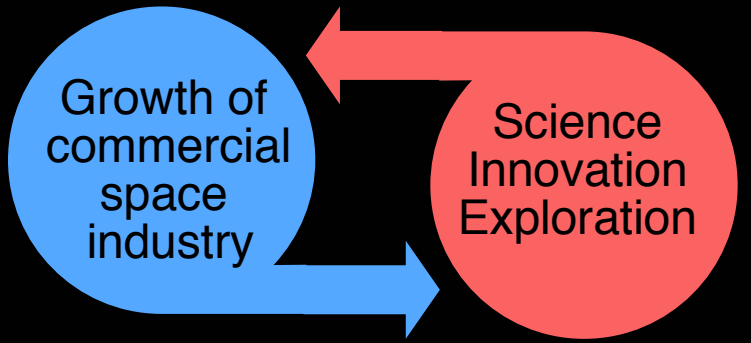
Outline of Presentation



- **Topic**: *What I'm talking about*
  - The mutuality between science and the commercial space sector
  - Relevance to the Decadal Survey
  - Historical examples of US government-commercial synergy
- **Significance**: *Why we should care*
  - CLPS and the evolution of NASA's role in the commercial space sector
    - What is working with the CLPS program
    - What could be improved with the CLPS program
    - NASA's future in commercial space
- Outstanding questions and recommendations

Planetary Science & Space Industry Have Mutual Interests

- Private companies rely on science to understand what is needed to successfully meet their commercial objectives.
  - Resources: identifying, locating, and determining accessibility
  - Assessing the feasibility of landing sites
  - Strategies for hazard mitigation
- As the industry advances beyond NASA's current capabilities these companies will need to invest in scientific research for their own profit and economic security
  - Improve understanding of geology
  - Advance cost effectiveness of manufacturing techniques
  - New locations and ways of accessing resources
  - Discovery of previously unidentified resources

Relevance to Decadal Survey

- Why this is worth your attention
  - NASA taking a role in government oversight to mitigate challenges of overcrowding and monopolization that tend to arise whenever companies compete for a scarce natural resource
  - The Decadal Survey is our opportunity to influence policy-making decisions. The Survey should include recommendations for what and how this relationship should be, particularly as it pertains to the interest of the planetary science community.

History of US Government-Commercial Synergy

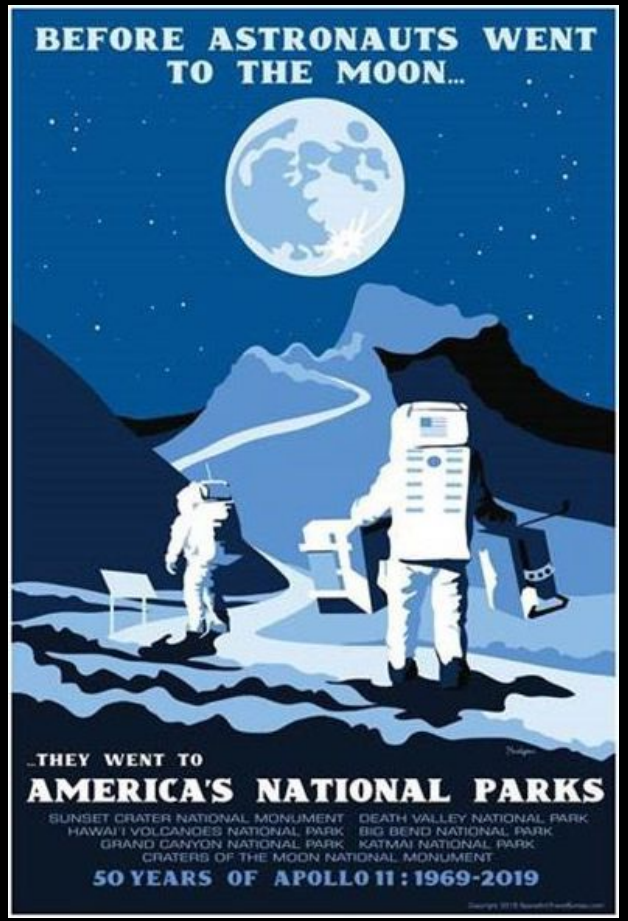
- U.S. Military
  - Arms production → interchangeable machine-made parts → mass production (example: Ford Model T)
  - Early development of the computing industry (example: ARPANET → Internet)
- Mining Industry
  - Need for government oversight → establishment of the U.S. Bureau of Mines → USBM research resulted in an important body of information about blasting materials and techniques with much wider applications

Historical Analog: Transcontinental Railroads

- Private financing supplemented with government loans
- Given sections of public land for every mile of completed railway (which railroads sold or used as collateral for loans)
  - Lunar land grants not an option, however government could provide right to use land to extract resources, which would be the property of the firm
- Guarantee revenues with government contracts in exchange for reduced transportation fees
  - CLPS
- Indirect support for supplemental elements of the railroad transportation system
  - Scientific data used for all aspects come from NASA-funded missions and projects

Completion of the first Transcontinental Railroad - Golden Spike ceremony at Promontory Summit, Utah, May 10, 1869. Photo by Andrew J. Russell

Historical Analog: National Parks



Space tourism

- National park managers encouraged private entrepreneurs to build hotels and related facilities to promote public visitation
  - Government could create a favorable regulatory climate for space tourism.
  - Expand the use of government facilities by private entrepreneurs as a means of encouraging public use and visitation.
- Those businesses then paid fees, which the National Park Service used to build additional roads and trails
  - A similar strategy could provide revenue NASA can use to expand and develop infrastructure.
  - NASA could also award lease contracts for habitation/support services of facilities in orbit and on the Moon.

Commercial Lunar Payload Services

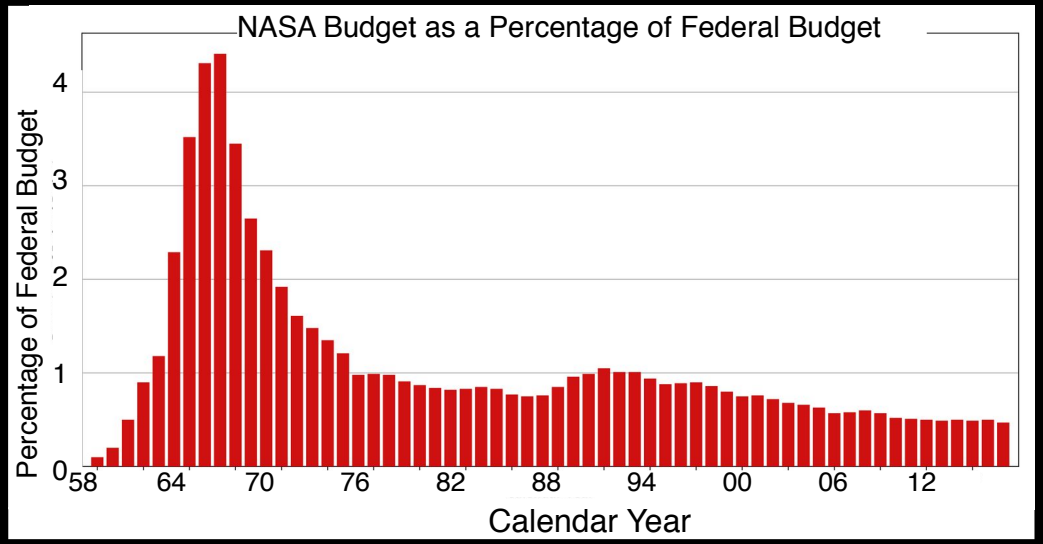
- Not your (grand)daddy's NASA contractor company
- NASA as a "lighthouse customer"
- CLPS: What works
  - CLPS moving at speed commensurate with commercial timescales
    - Demonstrates to the space community the seriousness of US return to Moon
  - More missions means more instrument PIs get to see their instrument selected and achieve faster science results
  - CLPS not limited to SMD

Evolution of NASA's Role

- CLPS: What could be improved
  - NASA should encourage and facilitate an interface between the CLPS payload developers and commercial partners to inform information about a mission
  - NASA should have a strategy for ensuring the competition is fair to all competitors, big and small.
- Beyond CLPS: NASA as a regulatory agency?
  - Clarifying property and mining rights over limited resources (e.g., water/ice, rocks of scientific interest)
  - Preservation of certain locations and resources; environmental protection
  - Worker safety

A Strategy for Mission Success

NASA's mission and goals have not been financially supported by the federal government for a long time



Mission Statement:

"Drive advances in science, technology, aeronautics, and space exploration to enhance knowledge, education, innovation, economic vitality and stewardship of Earth."

Goals:

- Be at the forefront of exploration and science.
- Develop and transfer cutting-edge technologies in aeronautics and space.
- Establish a permanent human presence in space.
- Enrich our nation's society and economy; contribute to a better life for this and future generations.

Decadal Survey Recommendations

- NASA should continue support to develop commercial space programs
  - Maintaining focus on developing a sustained human presence on the Moon over the coming decade is crucial for commercial space beyond LEO to become sustainable
  - For an ultimate objective of human travel to Mars, the Moon is the logical first step
- This program deserves (at least) the level of promotion, public outreach, and educational efforts afforded to Mars landers
  - Public support is crucial to success
- NASA should develop a 10-year plan for the NASA-commercial partnership for the Moon and Gateway that is goal-oriented
  - Development of partnership beyond 10 years
    - How NASA's role will transition from supported to customer

*** This topic is relevant to all planetary science – and really the future of all space (and Earth) science**

*** This panel advocate to all committee members for inclusion of these recommendations as part of broader planetary science recommendations to NASA**

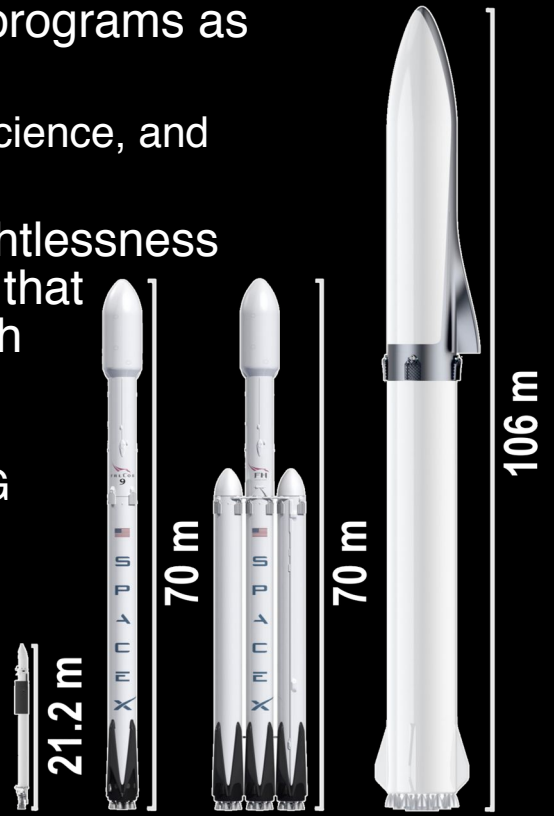
Conclusion

- For the first time in history, the private sector's capital, risk tolerance, and profit motive are being channeled into putting people in space.
- NASA is in a unique and valuable position to help create an international standard for future lunar exploration that can protect the scientific integrity and natural heritage of the Moon.
- We urge the Committee to place importance on the topic and include the recommendations in the Survey
- The 2023 Decadal Survey would be a truly profound historical document that laid the groundwork for establishing our future economy and society in space.

Extra

The Space Market

- Space-for-Earth
  - Government-led space programs as customers
    - National security, basic science, and national pride
  - Using vacuum and weightlessness of space to make things that cannot be made on Earth
    - Made In Space, Inc. to manufacture high-quality fiber-optic cable in zero-G
  - Using space-driven technology for Earth
    - Terrestrial travel using Space X's BFR



- Space-for-space
  - Supplying goods and services for astronauts employed by NASA and other government programs
  - ISRU
  - Space tourism

Example of government-commercial space synergy

In 2017, Luxembourg became the first European country to establish a legal framework securing private rights over resources mined in space, and similar steps have been taken at the domestic level in Japan and the United Arab Emirates. Moreover, nine countries (though Russia and China are notably missing) have signed the Artemis Accords, which lay out a vision for the sustainable, international development of the Moon, Mars, and asteroids. These are important first steps, but they have yet to be clearly translated into comprehensive treaties that govern the fair use and allocation of scarce space resources among all major spacefaring nations.

Moon First