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Lunar Exploration Science Campaign: A commercial-leveraged lunar mission program

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NASA

Executive Overview

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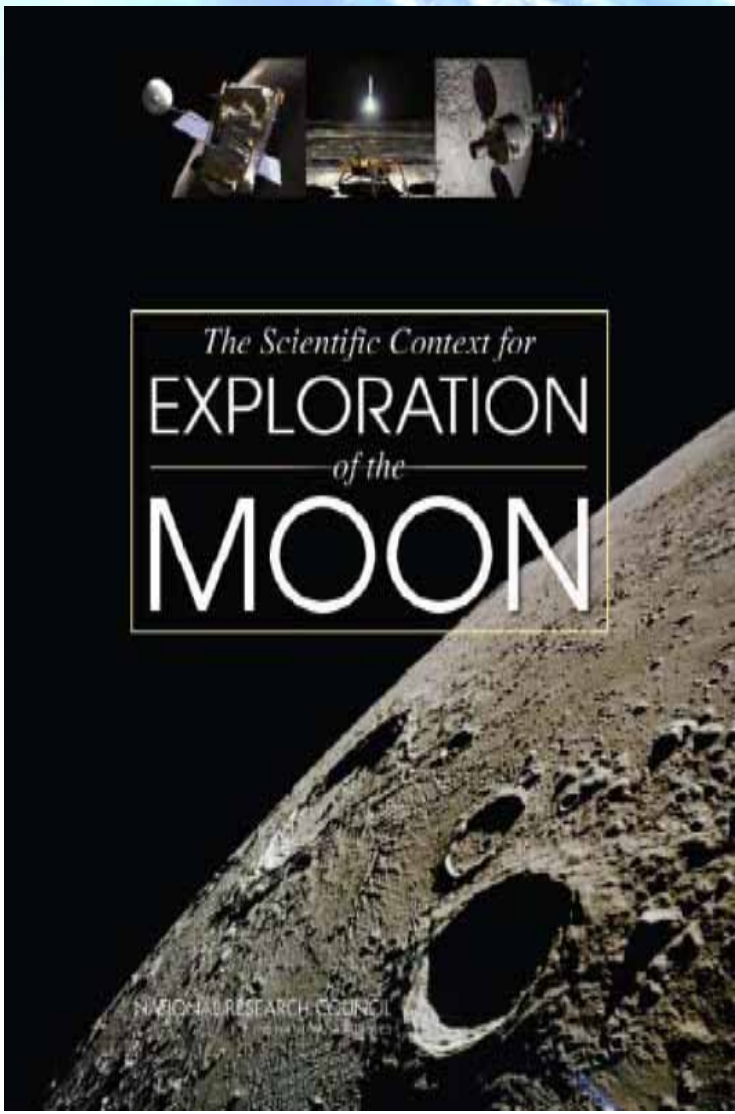
- **Discussion of establishing an aggressive lunar science campaign enabled by commercial leveraging with NASA…to a near-term technology demonstration on the lunar surface.**

National Research Council Report: " Scientific Context for Exploration of the Moon"

•**Asked by NASA SMD to provide guidance on the *scientific challenges and opportunities enabled by a sustained program of robotic and human exploration* of the Moon during the period *2008*-2023 and beyond**



Key Science Findings:

- ***Enabling activities*** **are critical in the near term**
- **Strong ties with *international programs* are essential**
- **Exploration of the *South Pole-Aitken Basin* remains a priority**
- ***Diversity of lunar samples*** **is required for major advances**
- **The Moon may provide a *unique location for observation and study of Earth, near-Earth space, and the universe***

Open Architecture: Infrastructure Open for Potential External Cooperation

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- **Lander and ascent vehicle**
- **EVA system**
  - CEV and Initial Surface capability
  - Long duration surface suit
- **Power**
  - Basic power
  - Augmented
- **Habitation**
- **Mobility**
  - Basic rover
  - Pressurized rover
  - Other; mules, regolith moving, module unloading
- **Navigation and Communication**
  - Basic mission support
  - Augmented
  - High bandwidth
- **ISRU**
  - Characterization
  - Demos
  - Production

- **Robotic Missions**
  - LRO- Remote sensing and map development
  - Basic environmental data
  - Flight system validation (Descent and landing)
  - Lander
  - Small sats
  - Rovers
  - Instrumentation
  - Materials identification and characterization for ISRU
  - ISRU demonstration
  - ISRU Production
  - Parallel missions
- **Logistics Resupply**
- **Specific Capabilities**
  - Drills, scoops, sample handling, arms
  - Logistics rover
  - Instrumentation
  - Components
  - Sample return

** US/NASA Developed hardware

Fundamental Change for NASA

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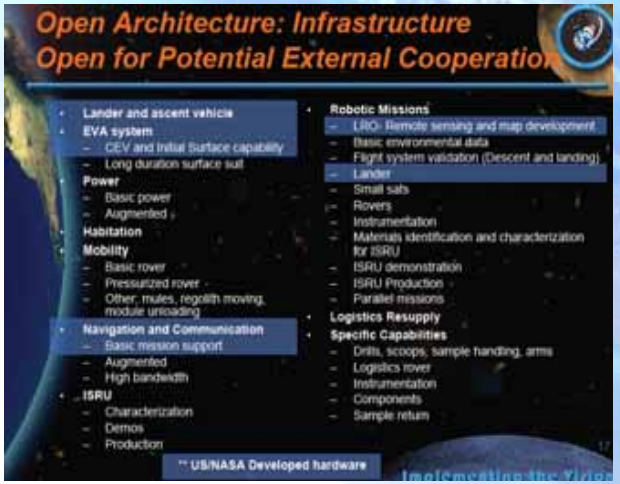
Apollo Model

From NASA as **the** customer funding prime contractors on a cost plus fixed fee basis

Insufficient Government Resources



COTS Model

To NASA as **a** customer and partner, working with other customers, financiers, and emerging space companies on fixed price basis to secure capabilities, services and products

Options for Commercial Participation in NASA Missions

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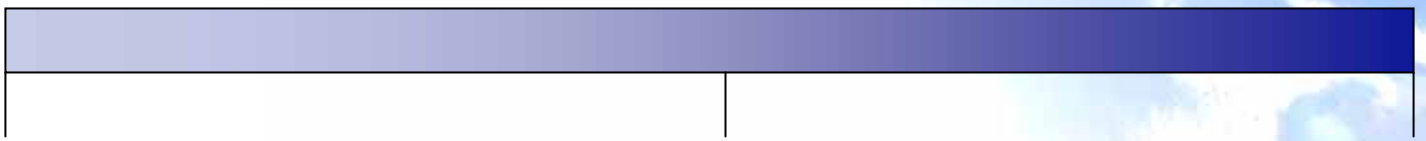
Spectrum of Options for Commercial Participation



Lunar X-Prize
(Commercial funded and managed)

Lunar Exploration Science Campaign - Regular Small Missions to the Moon
(Hybrid model - NASA and commercial funding and management)

Lunar Precursor Robotic Program
(NASA funded and managed)

- **Lunar Comm/Nav**
- **Lunar Micro-Landers**
- **Lunar Observatories**
- **Lunar Sample Return (e.g. dust)**
- **ISS National Lab Science**
- **Earth Observations**
- **Sub-Orbital Observations**
- **Free Flyers**

☐Potential Lunar Missions

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Science

- Lunar meteoroid impact dating
- Lunar seismic monitoring
- Lunar observatories
- In-situ dust characterization
- Small sample (mg) return

Technology

- Lunar descent/ascent module design
- Lunar dust characterization
- Lunar communication and infrastructure
- Power beaming
- Habitat design
- Surface mobility

Commercial

- Communication nodes and infrastructure
- Power and mobility infrastructure
- Cargo transport services
- Entertainment, media, internet and education
- Observatories

Commercial Orbital Transportation Services (COTS)

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- **COTS Project executed in two phases:**
  - **Phase 1: Technical Development/Demonstration funded Space Act Agreements (FSAA)**
  - **Phase 2: Competitive Procurement of Orbital Transportation Services**

> ***COTS Phase 1 is NOT a procurement or contract for products and services – It is NASA's catalyst for technology demonstrations where the potential high return on investment outweighs the associated financial risk***

- **Commercial partnerships are important for sustaining the Exploration Vision over the years!**
  - **The Vision must be made affordable and leveraging technology innovation from the broad industry is key to that effort.**

- **KEY QUESTION - <u>Can the COTS business model be used for more than just "COTS" for a larger acquisition strategy tool supporting Exploration?</u>**
  - **Or…is it one process for only one project?**

- **Work backwards from "20xx" to establish the strategic/tactical planning required to meet the vision.**


RETURN TO THE LUNAR SURFACE
Lunar Exploration Science Campaign
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Next “COTS” Project?

Possible Scenario for Lunar Science

(1) Establishing an aggressive lunar science campaign to the lunar surface

(2) Enabled by commercial leveraging with NASA

(3) Leading to a near-term technology demonstration on the surface.

Source: Carnegie Mellon University

Key Points for the Lunar Campaign

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- **Small, Discovery-class or New Frontier-class missions**
- **Frequent, multiple flights (*KEY*)**
- **Commercially-leveraged: open competition for lunar services**
- **NASA/LPI/LEAG could define the science and campaign**
- **Industry provide the transportation….“Fed-Ex” to the surface**
- **Could address technology-risk reduction**
- **Infrastructure development (comm)**

Commercial interest in the moon is growing….

- **Question: can we use this interest to leverage lunar science and exploration goals?**
  - **The resulting in a public/private partnership could increase science return, lower net costs, while achieving commercial objectives for industry.**

How could the COTS model help?

Relative to the lunar science campaign, it is felt that this COTS-business model could be critical to:

- **Enabling the campaign (sooner than later…)**
- **Enabling global science on the moon**
- **Enabling ESMD risk reduction**
- **Enabling more commercial opportunities relative to the moon. (ex: lunar commercial communications).**
- **Getting more public interest and participation**

What's Industry up to….?

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- **Aug 2006 <u>Commercial Orbital Transportation Services</u>**
  - **NASA awarded two contracts worth a total of $500 million**
    - **SpaceX and Rocketplane Kisler**
  - **develop new vehicles to support and supply the ISS.**
  - **both companies expected to have vehicles ready by 2009.**
  - **the contracts mark the first time NASA has hired private companies for such services, but *it may not be the last*.**

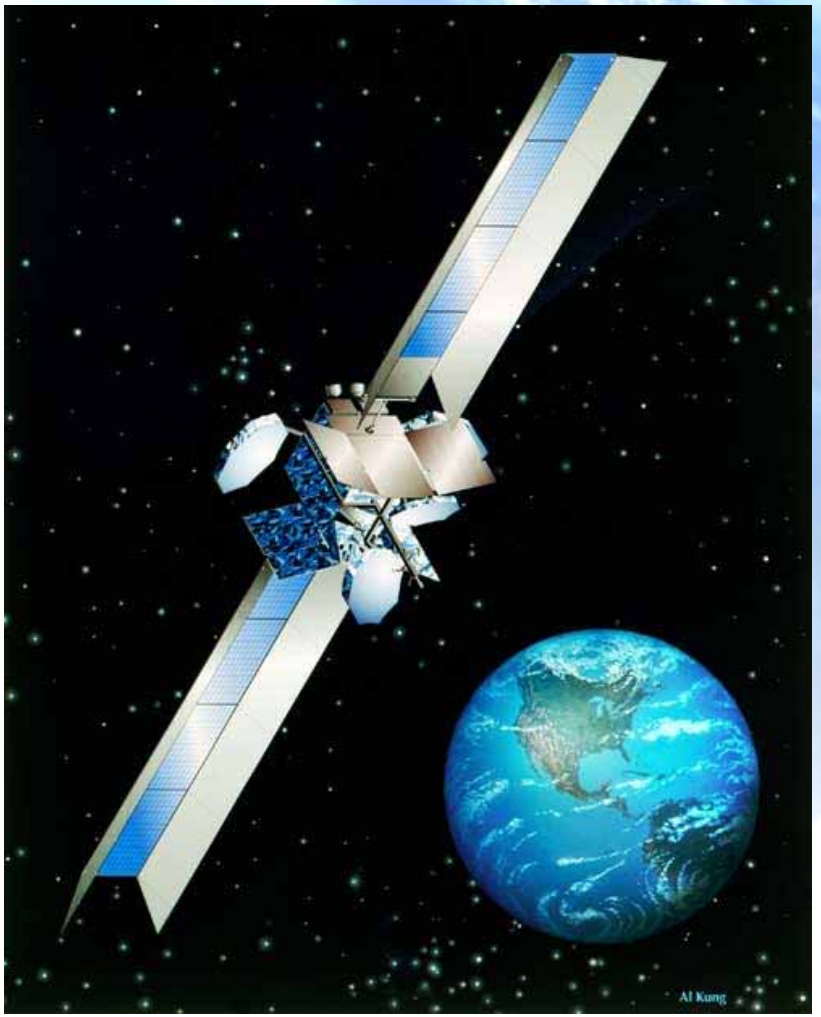
- **Sept 2007 <u>Moonshot Prize</u>**
  - **Google Inc. announced it would put up $30 million in prizes for the first companies to safely land a rover on the moon by 2012.**

- **Sept 2007 <u>International Lunar Observatory (ILO)</u>**
  - **Space Age Publishing contracts with Space-Dev for lunar lander prototype for ILO mission.**

- ***Perspective – increasing interest in private sector/industry in the moon.***

"Commercial Services" for Lunar Communications

- **A unique opportunity for NASA & industry collaboration to provide important infrastructure supporting VSE**
  - **open standards**
  - **Government/commercial leverage**
  - **new services**
- ***Significant potential for sale of commercial services to NASA and other customers***



What's Next?

- **LESC white paper submitted to SMD**
  - **If approved, 90-day study to assess campaign and market**
- **LPI birthday in 2008**
- **International Lunar Decade (2008-2018)**