MOON EXPRESS, INC.

A commercial lunar resources company competing in the $30M Google Lunar X PRIZE and selected by NASA for its $30M commercial lunar program.
Welcome To Moon Express!
People + Technology + Resources
The Founders

Naveen Jain
Founder, Intelius
Founder, InfoSpace
Trustee, Singularity University

Barney Pell
Founder, Powerset
NASA DS-1 Mission
Trustee, Singularity University

Bob Richards
Space Entrepreneur;
Phoenix Mars Mission;
Co-Founder & Trustee,
International Space University &
Singularity University
The Executive Team

Board

- **Naveen Jain**  
  Cofounder, Chairman  
  inome, Infospace, Microsoft  
  X PRIZE, World Innovation Institute

- **Dr. Robert (Bob) Richards**  
  Cofounder, Pres & CEO  
  Mars Phoenix, XSS-11  
  ISU, Singularity U, Optech

- **Dr. Barney Pell**  
  Cofounder, Vice Chairman  
  NASA Ames/Deep Space -1  
  PowerSet, QuickPay

Tech • Biz

- **Dr. James (Jimi) Crawford**  
  CTO & SW Architect  
  Google, Mars Exploration Rovers (Spirit, Opportunity)

- **Tim Pickens**  
  Chief Propulsion Engineer  
  SpaceShipOne (propulsion lead), Dynetics,  
  Orion Propulsion, Bigelow Aerospace

- **Jim Cantrell**  
  VP Flight Programs  
  JPL, CNES, SpaceX, Cosmos 1  
  Space Dynamics Laboratory

- **Michael Tanne**  
  VP Strategic  
  AdForce, Xdegrees, Verity  
  LinkedIn, ICON Aircraft

- **Daven Maharaj**  
  VP Operations  
  Mars Phoenix, XSS-11  
  Space Shuttle, Optech
Veteran Technical Leads

Tim Pickens
Chief Propulsion Engineer
SpaceShipOne (propulsion lead), Dynetics, Orion Propulsion, Bigelow Aerospace

Dr. James (Jimi) Crawford
CTO & SW Architect
Google, Mars Exploration Rovers (Spirit, Opportunity)

Steve Bailey
Principal Systems Engineer
Orion, Mars Reconnaissance Orbiter, Pathfinder, Artemis lander, Space Shuttle

Adrian Adamson
Principal Avionics Engineer
Orion, Hubble Servicing, MoonRise, MRO, Phoenix, Odyssey Orbiter

Jim Kaidy
Principal GNC Engineer
New Horizons, Messenger, LunarQuest

Tom Gardner
Principal Mission Engineer
Lunar Explorer, Ares 1, EKV, Mars Explorer, Lunar Prospector
Vibrant MOONHACKERS
Staff Demographics

~25 STAFF ON PAYROLL AS OF Q4 2012

Moon Express Team experience totals over 100 missions to most destinations in the Solar System:

- Asteroids
- Moon
- Mars
- Deep Space
- Venus
- Earth Orbit
- Mercury
- Phobos
- Jupiter
- Space Station
- Pluto

DEGREES

<table>
<thead>
<tr>
<th>Degree</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Bachelors</td>
<td>39%</td>
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<tr>
<td>Masters</td>
<td>43%</td>
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<tr>
<td>PhDs</td>
<td>17%</td>
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<table>
<thead>
<tr>
<th>Experience</th>
<th>Years</th>
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<tr>
<td>Under 30</td>
<td>61%</td>
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<tr>
<td>Space Exp</td>
<td>~168</td>
</tr>
<tr>
<td>Missions</td>
<td>~111</td>
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</tbody>
</table>
Strategic Location & Facilities
@ NASA Ames Research Park

MoonEx Offices & Engineering Labs

Singularity University

Lander Test Facility & Lander Test Vehicle

NASA Lunar Science Institute
The Opportunity

The Moon has long been thought to have massive opportunities for economic value for Earth, including resources and a base for in-space manufacturing and R&D.

But the political will and economics were not ready during the last 40 years since Apollo.

New conditions create an opportunity for commercial exploitation...

*The Technology, Science, Economics, and Politics are now right.*
China will send a lander to the Moon in late 2013 – and plans to build a Moon base.

Russia has announced plans to return to the Moon and also build a Moon base.

Europe, Japan and India have all successfully sent lunar orbiters to the Moon in the last decade.

The US currently has only one small orbiter mission planned in 2013.
The Opportunity

But the White House has embraced commercial space transportation and NASA has partnered with Moon Express to put the US back on the Moon.
Study Predicts $1.5 Billion Market for Commercial Lunar Services over Next Decade

By Marc Boucher  Posted July 16, 2009 10:20 AM  0 Comments

A study performed by the Futron Corporation predicts that companies such as those competing for the Google Lunar X PRIZE will be able to address a market in excess of $1 billion over the course of the next decade.

The results of the study resonate with the expectations of the X PRIZE Foundation, which conducts the $30 million competition that challenges space professionals and engineers from across the globe to build and launch privately funded spacecraft capable of exploring the lunar surface. The market projection demonstrates the breadth of commercial opportunities that companies are likely to pursue either during or after the conclusion of their Google Lunar X PRIZE missions.
Major Moon Markets

Study Predicts $1.5 Billion Market for Commercial Lunar Services over Next Decade

**Overall Market Size Estimate**

<table>
<thead>
<tr>
<th>Market</th>
<th>Estimated Size (2011-2019)</th>
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<tbody>
<tr>
<td>Hardware sales</td>
<td>$700M</td>
</tr>
<tr>
<td>Services for governments</td>
<td>$200-400M</td>
</tr>
<tr>
<td>Products for private sector</td>
<td>$30-160M</td>
</tr>
<tr>
<td>Entertainment</td>
<td>$10-100M</td>
</tr>
<tr>
<td>Sponsorship</td>
<td>$50-100M</td>
</tr>
<tr>
<td>Technology sales and licensing</td>
<td>$10-100M</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$1,000-1,560M</strong></td>
</tr>
</tbody>
</table>
Major Moon Markets

- Delivery of science & commercial payloads
- Supporting NASA & international exploration
- Resource prospecting & mining operations
- Facilitating space-based solar power
- Space-based manufacturing, research and development
- Space tourism & Entertainment
- Sample return for science and vanity markets
How Much is a Moonrock?

~$2M per gram in 1993 dollars

(~$3.2M per gram in 2012 dollars)

Allowing for a 2/3 market dilution, a 1 kilogram lunar sample returned to Earth could be worth >$1B today

Moon rocks in numbers

3 sources of moon rock (US Apollo missions; Soviet Luna missions; meteorites)

270 Rocks given as gifts to nations of the world

160 Total missing rocks from Apollo 11 and 17 missions

24 missing in the US

$5m (£3.1m) offered on black market for Honduras goodwill moon rock

$442,500 (£280,800) Price of 0.2 grams of lunar dust from Luna 16 mission in 1993
Known Lunar Resources

• Water for rocket fuel and in-space life support
  – Moon-based fuel production transforms economics of space
• Precious metals
  – Platinum is crucial for fuel cells, cleantech, oil refining
  – Paladium, Osmium, Gold all have high value
• Rare earth elements
  – Lithium is crucial for batteries, cellphones and much more
  – China is hoarding these, and new sources will have high value
• Helium-3
  – H-3 is required for fusion systems in development, and medicine
• Industrial metals (like aluminum) for earth-orbit construction
  – Massively cheaper than launching materials from Earth
Why Are There Lunar Resources?
The Moon is an Asteroid Magnet
Technology

There are four disruptive technology areas that lead to our opportunity:

1. Commercial Launchers
2. Avionics micro-miniaturization
3. DoD propulsion systems
4. NASA Common Spacecraft Bus (CSB)
1. Commercial Launches

Commercial launches (e.g. SpaceX) lower cost and raise opportunities for medium-lift-to-moon vicinity

Athena 2 (Lockheed)  Falcon 9 (SpaceX)  Taurus (Orbital)
2. Micro-Miniaturization

Micro-miniaturization of spacecraft technologies (e.g. avionics & power) substantially lower cost and increase value and opportunity of small spacecraft doing big things.
3. DoD Propulsion Systems

Commercially available high-thrust, lightweight propulsion systems from US DoD offer proven hardware and software technology systems ideal for autonomous cost and fuel-efficient precision lunar landing.
4. Common Spacecraft Bus

NASA’s Common Spacecraft Bus (CSB) offers low cost reuse of modular platform for lunar and other space missions, covering design, software, testing, and operations.
Science

- Planetary data system makes all lunar data available for analysis and mining
- Discovery of significant water on the moon enhances economics of rocket fuel production
- Science of asteroid impacts reveals value of lunar mining opportunities for precious metals
Economics

• Shift to private/public partnerships creates new opportunities for commercial space
• Success of SpaceX and likely IPO in next 2 years creates investment halo for space ventures
• Costs of energy resources and precious metals have multiplied
• Costs of H-3 has multiplied for medical applications, with further increase potential for fusion market
A new international space race is emerging, centered on the Moon

China, Russia, Japan, India & Europe are all making significant efforts to explore the Moon & build a Moon base in next 10-15 years

US policy has been to reduce space costs but to encourage private sector as a customer

Climate change fears and energy challenges have prompted large-scale infrastructure investments

Mining on Earth subject to tensions between resource production and environmental pressures
NASA: Our Customer

- Moon Express was selected by NASA in 2010 as one of only six US companies eligible for its $30M Innovative Lunar Demonstrations Data (ILDD) program.
- Moon Express ranked first among all companies, scoring the highest possible grades in all evaluation categories.
- Moon Express was one of only three ILDD contractors selected for initial funding, and one of two who successfully completed the latest ILDD milestone.
- Moon Express has since acquired two of the three active GLXP-ILDD teams.

Buzz Aldrin signing CSB HTV
Moon Express entered into a partnership with NASA in October 2010 for the development of its robotic lunar lander system.

Moon Express and NASA Ames recommissioned a lander test vehicle and facilities as the baseline for the Moon Express lunar lander.

Moon Express is harvesting $MM of technology transfer and IP rights from NASA under this unique partnership.

Dr. Alan Weston, NASA Ames Director of Programs Welcomes the Moon Express engineering team to NASA Ames during a Mission Management Review meeting.
Google $30M Lunar X PRIZE

Sponsored by Google and managed by the X PRIZE Foundation

A follow-on challenge to the successful $10M Ansari X PRIZE for the first private spaceship

$20M Grand Prize to first private team to land on Moon, travel 500 meters and broadcast HD images and video to Earth

Moon Express was announced as an official contender on Oct. 26th, 2010
Moon Express is ranked among the Top 10 “newspace” companies alongside SpaceX, Virgin Galactic and others.
MoonEx Lander Test Vehicle (LTV)
(derived from NASA Ames HTV/CSB)
MoonEx Lander Test Facility (LTF) (commissioned in partnership with NASA)
LADEE Orbiter Vehicle
(Our sister-spacecraft at NASA Ames)
LADEE Orbiter Vehicle
(Our sister-spacecraft at NASA Ames)
LADEE Orbiter Vehicle
(Our sister-spacecraft launching Aug 13)
Moon Express uses cubesat technology in a micro-hopper solution to mobility.
We’re Going to the Moon!