Topics

- Mars Science and Reconnaissance
- Architectures & Systems
- Human Health & Performance
- Policy: Opportunities and Challenges
- The Perception Element
Mars Science and Reconnaissance

Paving the Way for Human Exploration of Mars

• NASA Insight – successful landing and beginning of science campaign
  – First ever “Marsquake” recorded by seismometer
  – Start of “mole” hammer drill to penetrate 3 – 5 meters
Mars Science and Reconnaissance

Paving the Way for Human Exploration of Mars

• Opportunity Lost in 2018
  – Victim of a planet-wide dust storm
  – Celebration of how a “90 day” mission stretched to nearly 10 years
  – Tremendous science return and huge lessons for future human exploration

This panorama of 354 images taken in Endeavor Crater represents some of the last photos captured by Opportunity before it lost power
Mars Science and Reconnaissance

Paving the Way for Human Exploration of Mars

- Increasing Evidence for Water Near Mars’ Surface

Exposed Ice Scarp at 56.6 degrees south latitude. This section of nearly pure water-ice is more than 100 meters tall.
Mars Science and Reconnaissance

*Paving the Way for Human Exploration of Mars*

- **2020: The Year of International Mars Science Missions**
  - Mars 2020 launch in July
  - ExoMars rover “Franklin” and surface platform launch in 2020
  - China plans to launch a combined orbiter and lander mission
  - “Hope” mission marks the 50th anniversary of UAE independence with a launch in 2020

- **Beyond 2020?**
  - First steps taken for a joint sample return mission; planning underway
Architectures & Systems

Current Progress of the Elements Required for Mars
Architectures & Systems

Current Progress of the Elements Required for Mars

Figure AR. 1 Lunar Checkout and Infrastructure Enables a Variety of Exploration Missions to the Moon and Mars
Architectures & Systems

Current Progress of the Elements Required for Mars

Figure LM-1 shows an overview of the Lockheed Martin architecture elements. Image Credit LMCO
Architectures & Systems

Current Progress of the Elements Required for Mars

Figure B-2 Boeing Lunar Architecture with Comparisons to Apollo and Constellation Approaches

SpaceX Starship and Super Heavy Image Credit: SpaceX
Architectures & Systems

Current Progress of the Elements Required for Mars

• AM VI – The Sixth Workshop on Affording, Achieving, and Sustaining Human Mars Exploration
  – Brought together lunar and Mars advocates for 2 ½ days

• Key findings
  – Space Transportation and Propulsion Systems
  – Surface Systems, Technologies, and Operations
  – Recommendations for Future Trades and Studies
Human Health & Performance

Human System Risk for a Mission to Mars

Fig 1. Astronaut Serena Auñón-Chancellor examines her eye with a Fundoscope aboard the International Space Station with remote support from doctors on the ground. Image Credit: NASA

Fig 2. Astronaut Alexander Gerst practices CPR as cosmonaut Sergey Prokopev looks on during an emergency training session aboard the International Space Station. The onboard training provides crewmembers the opportunity to review safety procedures, communication methods and hardware necessary to manage a medical emergency. Image Credit: NASA

Fig 3. JAXA astronaut Norishige Kanai is photographed removing the Plant Habitat growth chamber door and the science carrier. Dwarf wheat plants are visible. Plant Habitat is a fully automated facility that is used to conduct plant bioscience research on the International Space Station. Image Credit NASA
Human Health & Performance

*Human System Risk for a Mission to Mars*

- **Key Areas to be Addressed:**
  - Multiple year-long missions in LEO (ISS) with diverse populations
  - Missions beyond LEO to address issues associated with long distance spaceflight
  - Stable, adequate funding for human health in space initiatives
  - Design and integration of the human system to allow for wider ergonomic and physiologic diversity of crew gender and body types
  - Expand plans to conduct Mars mission simulations involving crew stays on ISS to simulate transit followed by Mars analog ground station stays
Policy: Opportunity and Challenges

Achieving the Moon and Mars
Policy: Opportunity and Challenges

**Achieving the Moon and Mars**

- **Domestic Policy:**
  - Return to the Moon in 2024 and Humans to Mars in 2033
  - President’s Proposed FY2020 Budget: $21.109 billion, BUT...
  - Congressional Hearings
  - Legislative Outreach
  - Exploration Policy Finding: As lunar activities are developed, such plans should be constructed in a manner that should feed forward to and therefore advance the goal of human missions to Mars in the 2030s.

- **International Policy:**
  - Europe
  - Asia
  - Other
The Perception Element
How Public Interest Drives and Impacts Mars Exploration

• Key Areas of Public Interest in 2018:
  – ESA Announcement of Liquid Water “lake”
  – NASA Insight Landing

Mars Season 2 aired November to December 2018. Image Credit: National Geographic
Life On Mars: In preproduction with John Krasinski (above) slated to direct. Image Credit: Matt Sayles AP, Book Cover Art: Carl Wiens
The First aired September to November 2018. Image Credit: HULU
The Perception Element

How Public Interest Drives and Impacts Mars Exploration

Public Polling

In 2018, Insider, a sister publication of Business Insider, conducted a poll of Americans to assess their opinions about the priorities of the United States space program as well as their understanding of the NASA budget.


NASA’s Percent of the Federal Budget 2018

What Americans estimate and prefer it to be vs. reality

<table>
<thead>
<tr>
<th>Estimate</th>
<th>Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.4 %</td>
<td>7.5 %</td>
</tr>
</tbody>
</table>

FY 2018 Budget: 0.5 %
Apollo-Era Budget: 4.5 %

INSIDER poll conducted on SurveyMonkey Audience with 1037 respondents, Dec 1-2 2018. Insde Inc.