



Dawn of a New Space Age: the Global Exploration Strategy

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What is a 'Global Exploration Strategy'?

- ◆ **A strategy for exploring the solar system that encompasses the interests of many stakeholders including national space agencies, academia, and commercial investors**
- ◆ **Not a definition of 'how' we will explore - but - a definition of 'what' we hope to accomplish through exploration.**
- ◆ **A plan that encompasses the interests of many stakeholders including national space agencies, academia, and commercial investors**
- ◆ **A blueprint of exploration objectives that will serve as:**
 - **A starting point for future discussions between stakeholders regarding areas of potential collaboration**
 - **A tool for coordinating the efforts of stakeholders to maximize what can be accomplished**
- ◆ **An evolving plan that originally focuses on lunar exploration but will expand to include Mars and other destinations**
- ◆ **A plan that identifies enabling objectives and dependencies between objectives that drive the time-phasing of their accomplishment**



Components of Exploration Strategy

◆ Themes

- Provide the high level rationale for exploring the moon, answers the question “why?”
- Provide a framework for capturing the many objectives across multiple disciplines.
- Divided into two types – **core** and **crosscutting**.
 - **Core** themes address the primary activities to be conducted on the moon
 - **Crosscutting** themes address ways to maximize the benefit of the core themes

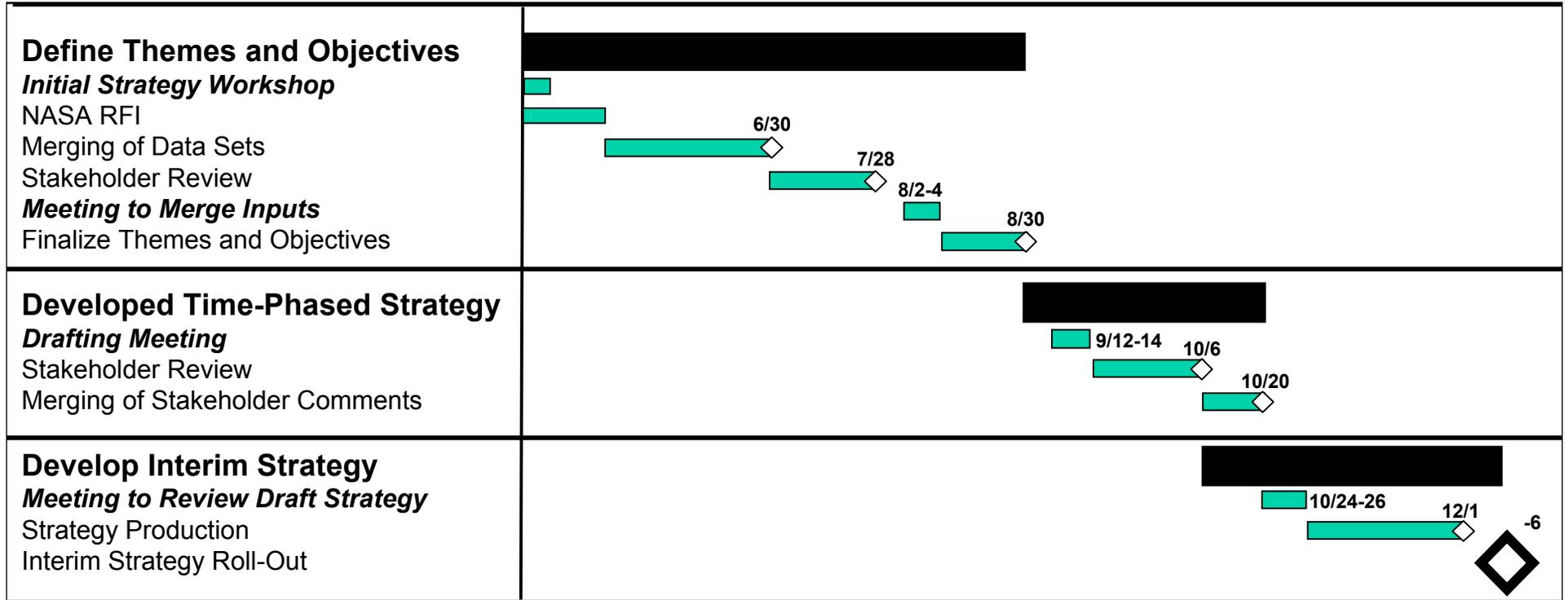
◆ Objectives

- ∞ Describe the discrete set of activities that the global community has defined as important in supporting the exploration themes.
- ∞ For example, the theme of using lunar exploration to prepare for future human Mars missions can be described by a set of associated objectives, such as mission simulations, human physiology research, and technology and operations validations.
- ∞ Serve as a means for breaking down the theme areas into achievable “chunks” of work that can be time-phased and prioritized – while still being at a strategic level.



Exploration Strategy Development General Process for 2006

April June August October December





Exploration Strategy Initial Input

- ◆ **Workshop held April 25-28 to engage ‘strategists’ from around the world to identify compelling reasons for human and robotic exploration of the Moon as the first step in developing an integrated global strategy.**
- ◆ **Request for Information (RFI) released April 11, closed May 12, soliciting the same type of input.**
- ◆ **These two sources generated:**
 - **55 themes for lunar exploration**
 - **~800 lunar objectives ranging from near-term needs to far distant possibilities**
 - **International and commercial organizations’ view of lunar exploration**
 - **~120 issues and constraints to be addressed for enabling lunar exploration by a global community**



Exploration Strategy Overarching Themes

Core Themes address the primary activities to be conducted on the Moon

- ◆ **Use the Moon to prepare for future human missions to Mars and other destinations.**
- ◆ **Pursue scientific activities to address fundamental questions about the solar system, the universe, and our place in them.**
- ◆ **Extend sustained human presence to the Moon to enable eventual settlement.**



Exploration Strategy Overarching Themes

Crosscutting Themes address ways to maximize the benefit of the core themes.

- ◆ **Expand Earth's economic sphere to encompass the Moon and pursue lunar activities with direct benefits to life on Earth.**
- ◆ **Strengthen existing and create new global partnerships.**
- ◆ **Engage, inspire, and educate the public.**



Global Exploration Strategy Next Steps

- ◆ **Workshop and RFI results integrated and provided back to stakeholder communities for review and comment**
 - Request to Science Subcommittees today
 - Review results in July will be discussed in international space agencies meeting in early August
- ◆ **Analysis of preferred and/or required time-phasing of objectives**
- ◆ **Analysis to evaluate architectural, operational, implementation options for lunar objectives**
 - Parallel ESMD activity underway to define lunar architecture
- ◆ **Present interim global strategy at Second Exploration Conference**
 - December 4-6, 2006 in Houston



Exploration Strategy Development Process

- 1. Receipt of inputs on themes and objectives from workshop and RFI sources.**
- 2. Subject matter experts engaged to sort through raw inputs and consolidate. For example, in the areas of geology and astronomy, we enlisted external talent from the community to reduce the objectives dataset.**
 - Merged similar ideas; removed duplicates
 - Did not add content
 - Did not prioritize or rank
- 3. NASA strategy synthesis team (mostly group leaders from April workshop) *reviewed and adjusted* the work of the subject matter experts and *organized* objectives into categories to make draft more comprehensible.**



Output of the Process

- ◆ **Process resulted in 23 categories of ~85 objectives;**
- ◆ **Science-related categories listed below**
 - ∞ **Geology**
 - ∞ **Astronomy & astrophysics**
 - ∞ **Earth observation**
 - ∞ **Material science**
 - ∞ **Human health**
 - ∞ **Environmental characterization**
 - ∞ **Operational support science**
- ◆ **Each objective contains**
 - 1. Objective name**
 - 2. Summary statement defining the objective and specific activities associated with it**
 - 3. Value statement clarifying the objective rationale and general worth**



Example Exploration Strategy Objectives

High-level objective further broken down into 4 sub-objectives (total of 15)

Nine high-level geological 'objectives'

Category	Objective ID Number	Name	Summary	Value
Geology	mGEO1-3	Understand the origin and structure of the Moon.	Characterize the lunar geophysical state variables, including the lunar gravitational potential field (in detail) and heat flow, and the present and historic magnetic fields. Use geodetic information about the Moon to determine global-scale geophysical characteristics.	Characterizing these geophysical parameters in a planetary body other than Earth enables a more fundamental understanding, not only of the Moon, but of the importance of these parameters in all solid bodies.

Within this 'bin' there are still multiple kinds of investigations, that have different mission implications

Have we managed the balance between lumping and splitting appropriately?



Exploration Strategy Review Assignment

What we are asking the NAC Science Subcommittees to do with this review request?

- ◆ **Provide *additions* to the list of draft lunar objectives**
 - Check for completeness - are there any objectives that should be added to this set?
 - Note that any proposed additions should be significant gap-fillers

- ◆ **Provide *modifications* to the list of draft lunar objectives**
 - Clarify existing text
 - Modify the text to broaden the type of activities in that obj.

- ◆ **Provide comments on the format chosen for organizing this material (is grouping at right level?)**

Note: Welcome to comment on categories other than science ones, such as in situ resource utilization, if interested.



Exploration Strategy Review

- ◆ **Access to material for review**
 - Review material available electronically after this meeting
 - file: LunarExplorationObjectives.xls
 - Use online drop box established for science subcommittees by SMD

- ◆ **Points of contact for review assignment include**
 - SMD: Lisa May (Lisa.May@nasa.gov)
 - ESMD: Jeff Volosin (jeffrey.f.volosin@nasa.gov)
 - Strategy Synthesis Team science members: Dave Beaty (David.Beaty@jpl.nasa.gov) and Laurie Leshin (laurie.a.leshin@nasa.gov)

- ◆ **Schedule for review assignment**
 - Informal inputs to NASA at September science subcommittees meeting
 - Formal input to NASA after delivery to NAC at October meeting

- ◆ *Note*: Request one consolidated response per subcommittee.



Breadth of Review

Other stakeholders conducting a review of the global exploration strategy include:

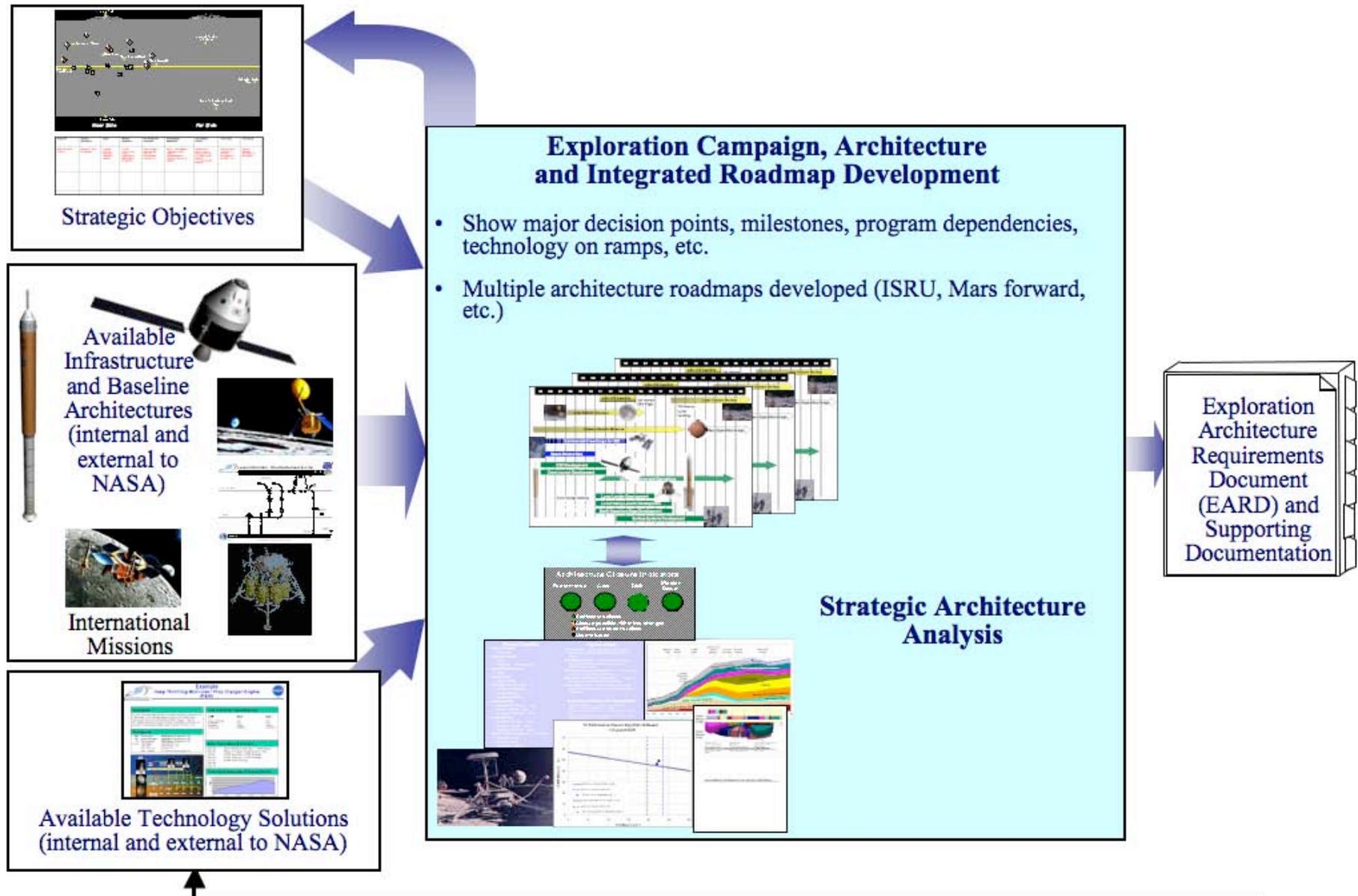
- ∞ International space agencies (14)**
- ∞ Lunar Exploration Analysis Group (LEAG), special action team led by Jeff Taylor and Steve Mackwell**
- ∞ Lunar Commerce Roundtable**
- ∞ NASA field centers**
- ∞ ESMD lunar architecture team**
- ∞ Space Enterprise Council**
- ∞ Other?**



BACK-UP MATERIAL



Architecture Analysis Development Process



Note: Charts and graphs shown are notional



23 Categories for Objectives

- ∞ **Geology**
- ∞ **Astronomy & astrophysics**
- ∞ **Earth observation**
- ∞ **Material science**
- ∞ **Human health**
- ∞ **Environmental characterization**
- ∞ **Operational support science**
- ∞ **Life Support & Habitation**
- ∞ **Environmental Hazard Mitigation**
- ∞ **Power**
- ∞ **Communication**
- ∞ **Guidance, Nav & Control**
- ∞ **Surface Mobility**
- ∞ **Transportation**
- ∞ **Operational Environmental Monitoring**
- ∞ **General Infrastructure**
- ∞ **Operations Test & Verification**
- ∞ **Lunar Resource Utilization**
- ∞ **Historic Preservation**
- ∞ **Development of Lunar Commerce**
- ∞ **Global Partnership**
- ∞ **Public Engagement & Inspiration**
- ∞ **Program Execution**



LEAG Special Action Team Membership

Leads:
Jeff Taylor
Steve Mackwell

Patricia Arnold
Frank DiBello
Ken Ford
Kevin Greene
Larry Taylor
Paul Eckert
Paul Spudis
Mike Duke
Mark Robinson
Leslie Gertsch
Ariel Anbar
David Carrier
Howard McCurdy
Aileen Yingst
Jim Blacic
Brad Blair

Tony Ricco
Mike Wargo
Chris Culbert
Jerry Sanders
Bill Larson
Kurt Sacksteder
James Crawford
Dennis Grounds
John Charles
Don Bogard
Noel Hinners
Maria Zuber
Jim Head
Sherrie Klug
Norm Sleep
Wayne White
Marc Postman



Output of the Process

- ◆ **Science-related categories with Subject Matter Experts**
 - ∞ **Geology - Dave Beaty, Don Bogard, Laurie Leshin**
 - ∞ **Astronomy & astrophysics - Bill Oegerle**
 - ∞ **Earth observation - Bill Oegerle**
 - ∞ **Material science - Jitendra Joshi**
 - ∞ **Human health - David Tomko, Louis Ostrach**
 - ∞ **Environmental characterization - Dave Beaty, Gale Allen, Jitendra Joshi**
 - ∞ **Operational support science - Brent Sherwood**