

Infusing Science Objectives Into Moon And Mars Human Exploration

Scott Hubbard¹, Bruce Jakosky², and Clive Neal³

¹ Stanford Univ., scott.hubbard@stanford.edu

² Univ. of Colorado at Boulder, bruce.jakosky@lasp.colorado.edu

³ Univ. of Notre Dame, cneal@nd.edu

Humans to Mars Summit

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What, Why, When and How

- Ensure that science has an appropriate seat at the table in planning and implementing human missions to Mars and the Moon
 - Mission success and astronaut safety are the highest priorities
- Science offers sustainability to the Humans to the Moon and Mars Campaign
- Definition and Infusion of science objectives must occur as soon as possible.
 - As a result of early Architecture decisions, the Lunar community can only influence new science objectives beyond Artemis IV.
 - By analogy, now is the time for the Mars community to develop human-enabled science objectives before they may be foreclosed by engineering considerations
- Effort thus far has included a Space News OpEd, presentations to the Mars Exploration Program Analysis Group (MEPAG) and Lunar Exploration Analysis Group (LEAG) and meeting with NASA senior staff
- Next is definition of a joint LEAG-MEPAG group to draft a white paper on human enabled science at the Moon and Mars, followed by a National Academies study on the same topic

NASA has just released a first ever M2M Architecture Definition Document (ADD)

NASA/TP-20230002706



**Exploration Systems Development
Mission Directorate**

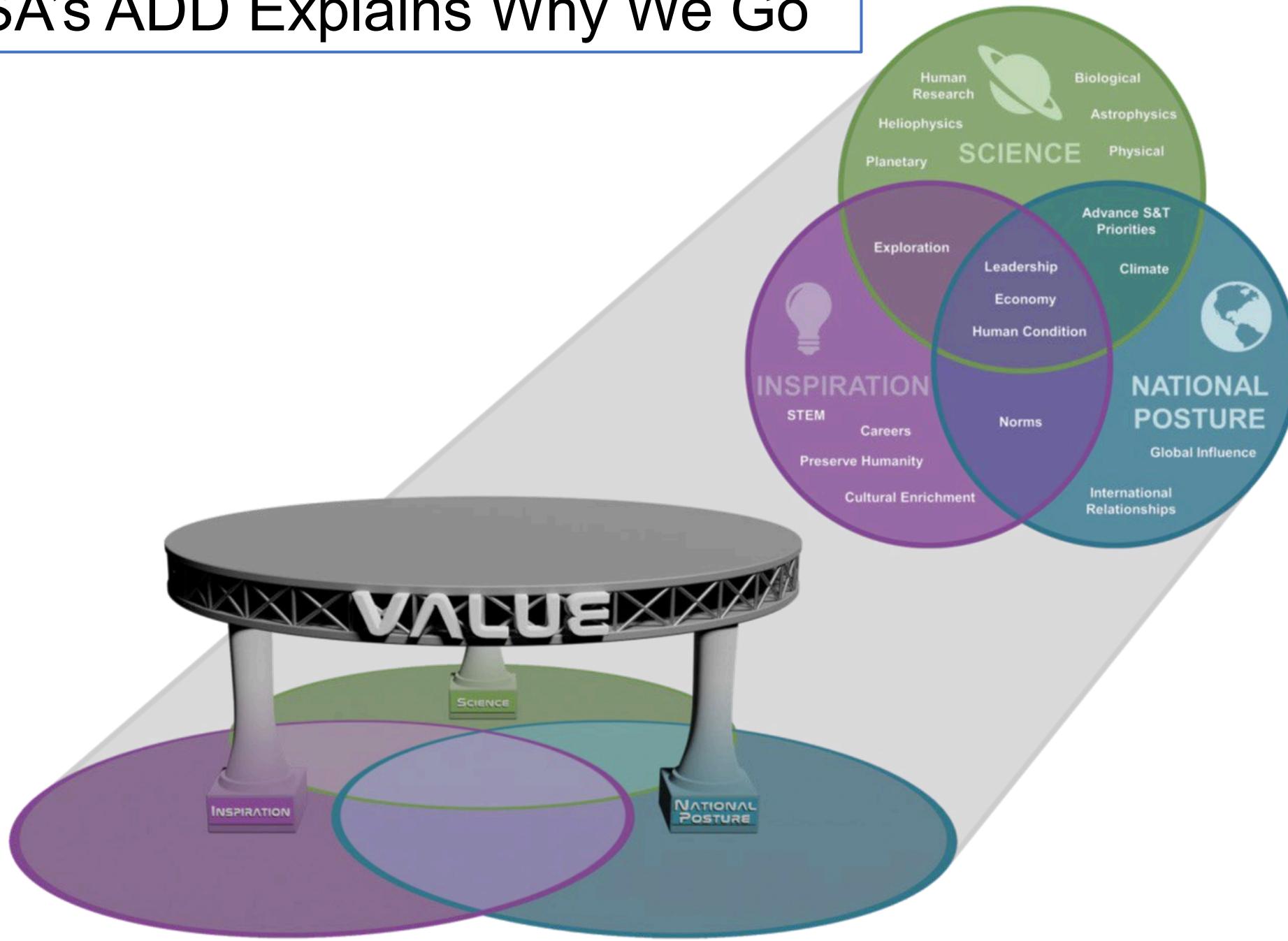
**Moon-to-Mars Architecture Definition Document
(ESDMD-001)**

National Aeronautics and
Space Administration

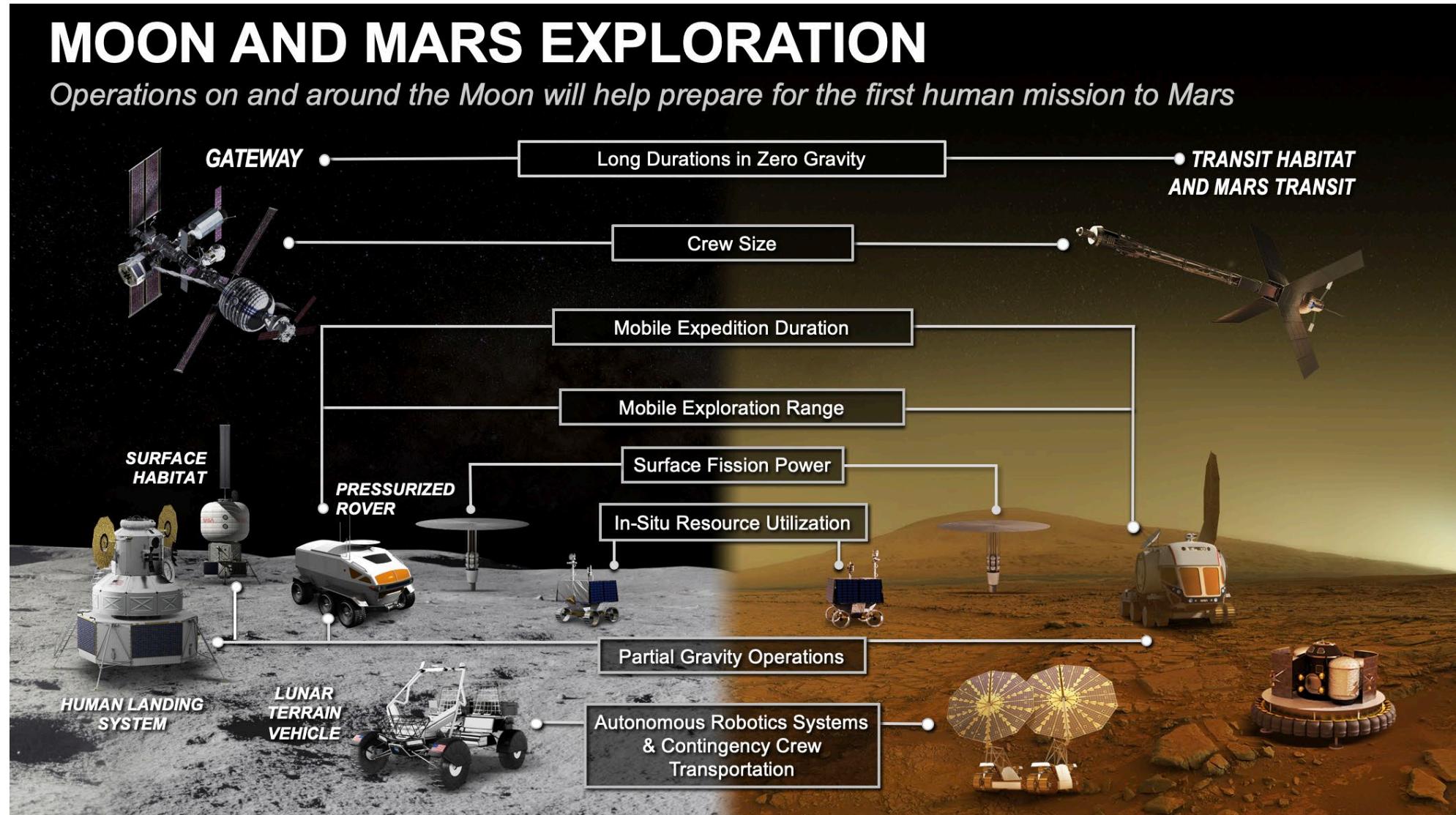
*Mary W. Jackson Headquarters
Washington, D.C.*

April 2023

NASA's ADD Explains Why We Go



Latest NASA graphic on “Moon to Mars”

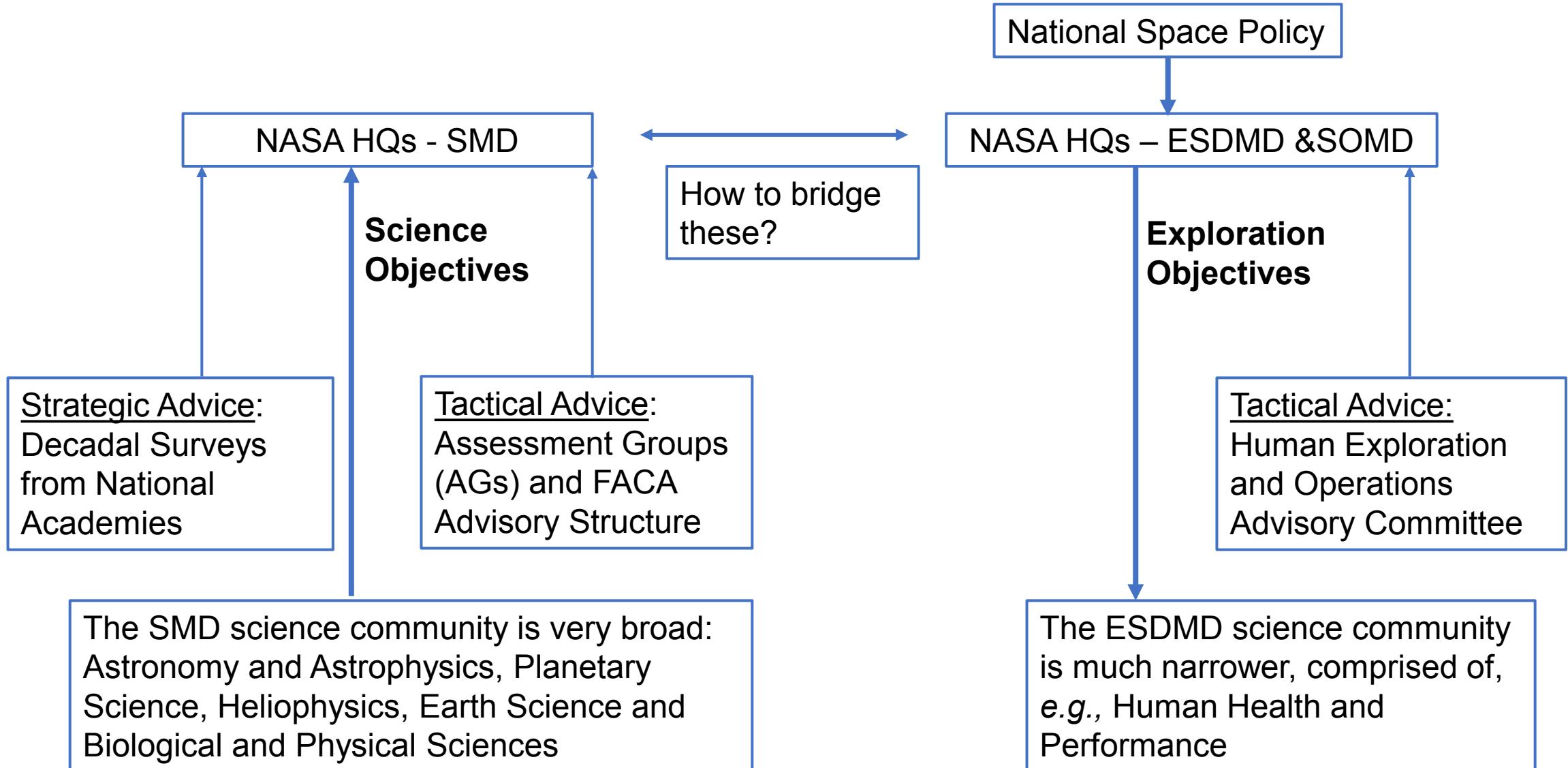


So where's the science...?

Issues on Infusing Science into the Current Architecture

- Exploration of the Moon and of Mars with humans is as inextricably linked to science as it is to hardware and engineering implementation
 - Science provides sustainability to human exploration
 - Scientific exploration of Mars will be influenced heavily by how (and how well) we do it at the Moon
- We are delighted to see that Artemis and the new H2M&M plans prominently display science as one of the 3 pillars of exploration
 - Recent appointments (e.g., Artemis Project Scientists) have been very encouraging. The PS will report to the Mission Development Manager (ESDMD equivalent of a Project Manager)
 - New organizational announcements are also welcomed though the community has yet to understand the roles of the Mars Campaign Office and Moon to Mars Program Office and their relationship to the Exploration Systems Science Integration Office and the Science Directorate
- Infusing science will require cultural change
 - Human exploration tends to be top-down, aimed at achieving an engineering goal with human safety paramount and utilizing a one-time or infrequent generation of science requirements.
 - Science is grassroots and consensus driven, aimed at science goals, and continually evolving as new information becomes available.
 - Cultures only change via leadership from the top over a long period of time (years), and therefore requires a long-term interactive dialog between communities.

NASA Science Community Stakeholders



Summary

- Ensure the dialog between leadership and communities continues and that science has a “seat at the table”
 - Designate a world-class Program Scientist at NASA HQs to guide science infusion
 - Ensure Artemis Project Scientists can interface directly with the project
 - Appoint a Mars Architecture Study Scientist to help guide early planning
 - Examples from SMD are MSR, Mars 2020/Perseverance and MSL/Curiosity
- Continue integrated strategic and tactical planning
 - The recent MEP plan for 2023-2043 contains many of the programmatic elements needed for sustainable Mars exploration in the near term that will lead to human missions
 - The Moon should have a similar plan building on the Artemis III SDT report
- Create regular independent review and broad community engagement
 - A M&M Campaign Review Board which produces formal Findings and Recommendations that must be dispositioned is needed in order to ensure substantive infusion of science
 - The planned NASEM study of human enabled science is vital, but a final report is 1-2 years away
 - Community engagement using LEAG+MEPAG and the FACA Advisory structure can fill the gap and help get buy-in from both communities on the ability to achieve world-class science