

## MEPAG Wrap-Up: Findings and Future Activities Review

*(Revised before posting, based on in-meeting discussion + slight further revision to remove typos)*

- Findings Summary/discussion
- Upcoming studies
- Upcoming activities
  - Preparation and Schedule for next Decadal Survey
- Next Meetings



*NOTE ADDED BY JPL WEBMASTER: This content has not been approved or adopted by NASA, JPL, or the California Institute of Technology. This document is being made available for information purposes only, and any views and opinions expressed herein do not necessarily state or reflect those of NASA, JPL, or the California Institute of Technology.*

## Findings

- 1) MSR priority
- 2) MSR campaign
- 3) Non-MSR
- 4) Extended Missions
- 5) International Partners
- 6) R&A
- 7) Small spacecraft missions
- 8) International missions
- 9) Future studies (CAPS)
- 10) MAPSIT

## 1) Finding: MSR

**Finding.** MEPAG is greatly encouraged that NASA is openly and enthusiastically moving forward on Mars Sample Return, thereby addressing the Decadal Survey's top priority for NASA flagship missions.

*MEPAG encourages the Mars Exploration Program to maintain the goal of completing lean science-driven Mars Sample Return in the next decade and looks forward to receiving regular reports on progress made in technology development and international partnering.*

## 2) Finding: MSR campaign

**Finding.** MEPAG commends the steady progress on the Mars 2020 mission and welcomes the open discussion by NASA of the follow-on elements of Mars Sample Return (MSR). However, the totality of a lean science-driven MSR campaign across multiple missions, including post-landing sample analyses, requires constant and productive long term communication and coordination amongst NASA programs and international partners. It is important that there be designated points of contact and clear lines of communication during technological development of all key components of the complete MSR campaign.

*MEPAG suggests that NASA give strong consideration to integrated management of the entire multi-mission sample return campaign within the Mars Exploration Program, including scientific oversight to ensure that the scientific value of the returned samples is maintained.*

## 3) Finding: non-MSR

**Finding.** Mars Sample Return (MSR) remains a high priority for planetary science and the Mars Exploration Program, and continuing progress on science-driven MSR is welcome. However, enabling opportunities for the pursuit of other high priority Mars science objectives that can be addressed by the community in the coming decade would augment the science return to be gained from MSR alone.

*MEPAG encourages NASA to explore additional, open-call (competed) opportunities to address high priority planetary science goals in the Mars system during the era of MSR and afterward, in particular, those objectives that have long strategic lead times for the future exploration of Mars.*

## MEPAG Concerns 4: Mars Extended Mission budgets

FY 2019 President's Budget Estimates: NASA (P. 415, PS-69)

### FY 2019 Budget

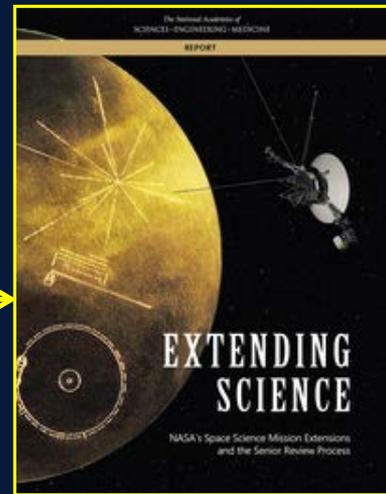
Budget Authority (in \$ millions)	Actual	CR	Request	Notional			
	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Mars Organic Molecule Analyzer (MOMA)	12.1	--	8.5	6.7	6.9	6.0	6.0
Aeroscience Ground Test Capabilities	14.6	--	21.5	22.2	22.2	22.2	22.2
ExoMars	2.2	--	2.3	2.1	2.2	0.0	0.0
Mars Program Management	24.2	--	19.8	19.8	20.0	13.7	15.3
Mars Future Missions	20.0	--	50.0	50.0	50.0	50.0	50.0
Mars Mission Operations	1.9	--	1.9	1.9	1.9	1.9	1.9
Mars Research and Analysis	10.0	--	10.0	10.0	10.0	10.0	10.0
Mars Technology	22.9	--	8.5	4.0	4.5	4.5	4.5
2011 Mars Science Lab	56.2	--	54.0	54.0	50.0	0.0	0.0
Mars Reconnaissance Orbiter 2005 (MRO)	28.0	--	27.0	27.0	26.0	26.0	25.0
Mars Exploration Rover 2003	12.5	--	12.0	0.0	0.0	0.0	0.0
Mars Odyssey 2001	10.8	--	11.5	11.5	0.0	0.0	0.0
Mars Express	3.0	--	3.0	0.0	0.0	0.0	0.0
Mars Atmosphere & Volatile Evolution	20.5	--	23.5	23.5	23.5	23.5	20.0
<b>Total Budget</b>	<b>239.0</b>	<b>--</b>	<b>253.5</b>	<b>232.7</b>	<b>217.1</b>	<b>157.8</b>	<b>154.9</b>

- Profile for Extended Missions' budgets is not consistent with recommendations from NAS study
  - They recommended at least flat funding after first two Senior Reviews for a mission
  - MRO, ODY, and MAVEN are required for Mars 2020 Rover relay and beyond

## Extending Science: NASA's Space Science Mission Extensions and the Senior Review Process (p. 59)

**Finding:** After the first few years of extended operations, most missions have implemented all (or almost all) practical steps to reduce costs. Further budget cuts often then result in disproportionate cuts to project-funded science activities, increasing risks that science will be diminished or not performed at all.

**Recommendation:** Given the demonstrated science return from extended missions, NASA should continue to recognize their scientific importance and, subject to assessments and recommendations from the Senior Reviews, ensure that, after the first two Senior Reviews, both operations and science for high-performing missions are funded at roughly constant levels, including adjustments for inflation.



- <https://www.nap.edu/download/23624>
- [http://sites.nationalacademies.org/SSB/CurrentProjects/SSB\\_169078](http://sites.nationalacademies.org/SSB/CurrentProjects/SSB_169078)

## 4) Finding: Extended Missions

**Finding.** The extended Mars spacecraft missions are providing very high science return for a very modest investment. Many extended missions are being counted on to provide critical coverage and relay for the follow-on missions of the “lean” sample return architecture. However, aging relay infrastructures and landed assets will need more, not less, support to meet their engineering requirements. Cuts to mission budgets result in restricted operations of functioning spacecraft and reduced data acquisition, negatively affecting programmatic interdependency and scientific goals. Science opportunities are typically lost disproportionately as a result.

*MEPAG encourages that NASA adhere to the recommendations in the National Academy of Sciences report on Extended Missions and continue to fund extended missions at roughly constant levels, including adjustments for inflation.*

## 5) Finding: International Partners

**Finding.** MEPAG recognizes the vital role international partners have played and will continue to play during the next decades of Mars exploration, particularly during the era of “lean Mars Sample Return.” However, ongoing and future Mars and planetary science collaborations are contingent on the ability to reconcile international cooperation with the interpretation of security restrictions without hindering needed scientific and technological collaborations on spacecraft missions.

*MEPAG encourages that the Science Mission Directorate review interpretations of security recommendations that may overly restrict the ability of international partners to fully carry out their agreed-upon responsibilities in mission development, operations, and data analysis while maintaining appropriate security.*

## 6) Finding: R&A funding

**Finding.** Over the past two decades of successful Mars exploration, the careful decisions to maintain a portfolio of investments in the scientific analysis of large data sets collected by spacecraft, at analog field sites, and in the laboratory have culminated in an advanced understanding of the planetary evolution of an Earth-like, habitable planet. The Mars Exploration Program and the Science Mission Directorate would benefit greatly by continuing to capitalize on the expertise developed within the planetary science community to enable further discoveries that feed directly back into exploration plans for sample return and remote reconnaissance. However, as decommissioned missions end or deal with reduced funding, researchers previously engaged in data analysis directly via mission resources will rely increasingly on traditional Research and Analysis (R&A) programs to preserve these efforts. MEPAG recognizes that there is debate about whether recent increases in R&A funding have been commensurate with the previous Decadal Survey recommendations. However, the fundamental issue is that the growing base of Mars data and the increasing pool of expertise will require increased R&A funding to best advance knowledge of Mars that is needed to plan for future missions beyond sample return.

*MEPAG recommends that R&A resources be incrementally increased in advance of a next decade of fewer non-MSR missions in order to exploit the rich value of the vast volumes of data already returned, and to ensure a critical core of expertise remains available to carry out associated science investigations and plan future missions to Mars, whether robotic or human.*

## 7) Finding: Small Spacecraft Missions

**Finding.** Recent advances in small spacecraft mission capabilities are certain to continue and will provide additional opportunities for focused science measurements that will address key science questions in the Mars Exploration Program. By clearly linking science objectives with plausible small spacecraft capabilities, MEPAG could create a framework for the definition and evaluation of the science capacity of such missions, as well as identify significant scientific opportunities. Two major challenges for the success of small spacecraft missions in deep space are: 1) how to get there, and 2) how to get the data back. There is much energy and creativity being devoted to what small spacecraft can do, much of it arising from academic and private sector investments.

*MEPAG encourages NASA to continue to support small spacecraft concept studies to help investigate engineering capabilities/challenges, coupled with science objectives and requirements. MEPAG also encourages identification of specific, near-term opportunities for small spacecraft missions/secondary payloads, and to the development by NASA with the commercial sector of technologies and infrastructure necessary to minimize the burden on individual missions for interplanetary propulsion and back-to-Earth telecommunication.*

## 8) Finding: International Missions

**Finding.** Long-lived, new, and planned international Mars spacecraft missions such as Mars Express, the ESA-ROSCOSMOS ExoMars Trace Gas Orbiter (TGO) and 2020 rover/surface platform (RSP), the United Arab Emirates HOPE orbiter, ISRO's Mars Orbiter Mission (MOM), and the JAXA Mars Moons Exploration (MMX) missions have provided--or hold great promise to provide--substantial contributions to Mars science.

*MEPAG congratulates these teams and their sponsors on the progress to date and looks forward to the data acquisition and analysis enabled by these missions and to the discoveries sure to come.*

## 9) Finding: Future Studies

**Finding.** The Committee on Astrobiology and Planetary Science (CAPS) recommended that a suite of studies be prepared in advance of the next Planetary Decadal Survey. Among these were (1) new cost and technical evaluations of the next elements of the sample-return campaign, and (2) analysis of medium-class missions to explore ancient and modern aqueous environments.

*MEPAG agrees with these recommendations and stands ready to work with NASA to provide assistance to complete these studies in a timely and efficient manner.*

## 10) Finding: MAPSIT

**Finding.** MEPAG acknowledges the importance of accurate, scientifically compelling, and standardized cartographic and geologic map products in the exploration of solar system bodies.

*MEPAG encourages interaction between the Mapping and Planetary Spatial Infrastructure Team (MAPSIT) and all Analysis/Assessment Groups (AGs) to help prioritize the products in most need of oversight and fabrication to achieve their exploration and analysis goals. MEPAG will strive to do its part, but wishes to understand how priorities can be set consistently across the program.*

## Potential study group ideas (1 of 3)

- SAG to explore polar landed mission concepts, including stationary lander with polar/astrobiology drill and/or science accomplished from rover missions, including power requirements for surviving Polar night with landed mission
  - Drilling into ice
- Network Mars Drop SAG, one element of which is PolarDrop, among other possible science goals, including survivability of “drop-off” missions.
- Team “X” studies of entire mission/systems, with science as driver
- Analysis of orbital entries/propulsion for Small Sats (Team “A”?), with notional missions to define the requirements

## Potential study group ideas (2 of 3)

- How do we evaluate the current/predicted engineering capabilities of small sats over the upcoming decade?
  - see PSDS3 Mars selections for starters?
  - Costing analyses (Hubbard et al.)
  - how can we marry the advertised capabilities of small missions and to specific science objectives from the community (to generate additional, realistic interest among science community)?
- Technology Capabilities: Evaluating key capability gaps and candidate technology investments that would address specific science goals and requirements
  - Start with CAPS recommendations on technologies
  - Interactions with PESTO
  - Cross-cutting with other AG technology needs
  - Consensus on well-quantified capability gaps (e.g., access to extreme terrain, age dating?), leading to recommendations on technology investments (in advance of DS)
    - as opposed to asking for inventory of all technology capabilities available

## Potential study group ideas (3 of 3)

- Analysis of CAPS-recommended studies
  - Mars Sample-Return Next-Step Missions
  - Mars Medium-Class Candidates
  - Mechanisms for Conducting Necessary Studies
    - Cost analyses to reach surface
    - Sample handling for small instrument analyses
    - In situ life detection technologies
    - Others.....
- SMD/HEO cooperation studies?
  - Trace/connect to MEPAG Goals
  - Differences between lunar and martian exploration



## Next MEPAG Meetings

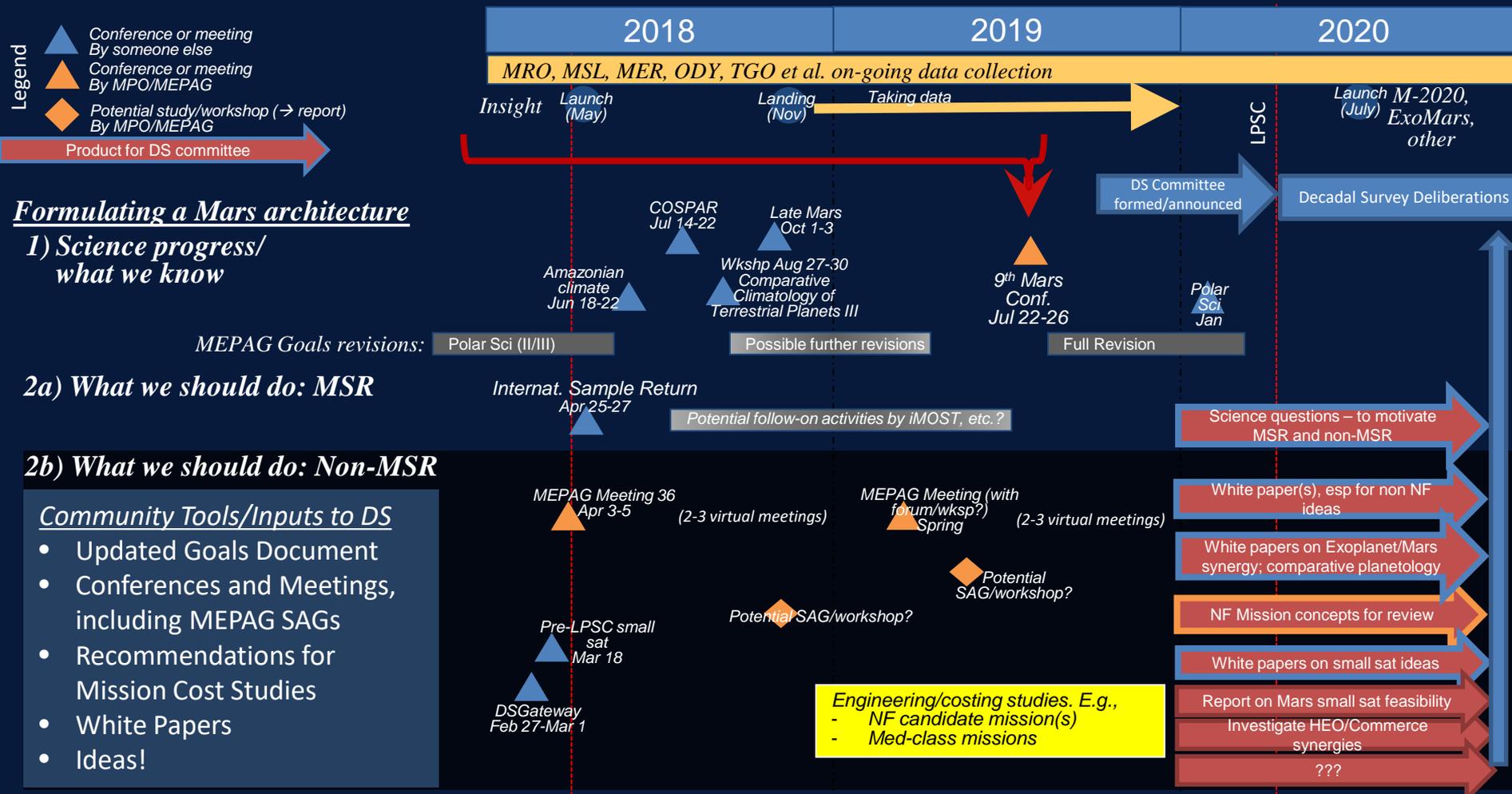
- Virtual Meetings #2+
  - Mid-term Decadal review committee report
  - Report from meetings:
    - 2nd International Conference on MSR
    - COSPAR
    - Planetary Protection Policy NAS study
    - Updates from DSN on Mars 2021 traffic jam
    - Amazonian Climate, Late Mars, Comparative planetology workshops
  - Update on discussions with international partners
  - Updates on budgets (e.g., Congressional action)



## Next MEPAG Meetings

- Face-to-face Meeting
  - SAG status reports?
  - Additional forum for Decadal Survey preparations?
  - Regular reports on \$50M engineering studies
  - 9<sup>th</sup> Mars preparations?
  - Technology
- Avoiding:
  - MSL team meeting Sept 24-28
  - Other meetings.....

# POTENTIAL Decadal Survey Preparation Timeline



## Formulating a Mars architecture

### 1) Science progress/ what we know

### 2a) What we should do: MSR

### 2b) What we should do: Non-MSR

### Community Tools/Inputs to DS

- Updated Goals Document
- Conferences and Meetings, including MEPAG SAGs
- Recommendations for Mission Cost Studies
- White Papers
- Ideas!

Thanks to Serina Diniega, Brandi Carrier, Winnie Hang, Colin McNutt, and Barbara Saltzberg for ongoing critical support of MEPAG meeting activities

Thanks everyone for attending

Additional feedback? Email

[MEPAGmeetingqs@jpl.nasa.gov](mailto:MEPAGmeetingqs@jpl.nasa.gov)

Speak with you next at MEPAG VM #2