MEPAG Report to the Planetary Science Subcommittee

John Mustard, MEPAG Chair
The MEP has been extraordinarily successful over the past decade with the theme “Follow the Water”

The Mars Science Laboratory mission marks the transition to the theme Habitability: to understand if Mars is or was ever habitable

MEP has been science and discovery driven
  – Long-range planning where science results feed forward to the next phases
  – Strategic and competed missions at every Mars opportunity
  – Strong public and bi-partisan support for the MEP has been central to its level of funding over the past decade

The science and engineering communities are poised to embark on the ambitious and challenging objective of sample return, in the context of a balanced program

The FY2009 and notional out-year budgets are inadequate to meet this SMD goal

MEP established in 2000 with new money, and SINCE that time has constituted about 43% of planetary
The Past Decade for the MEP

Launch Year

<table>
<thead>
<tr>
<th>Operational</th>
<th>2007</th>
<th>2009</th>
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<tbody>
<tr>
<td>Mars Global Surveyor</td>
<td>In Primary Science Phase; huge success</td>
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<tr>
<td>Mars Odyssey</td>
<td>Productive for 10 years; no longer active</td>
<td>Now entering 3rd Extended Mission</td>
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<tr>
<td>Mars Express</td>
<td>Progressing technically; Cost concerns</td>
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<td>Mars Reconnaissance Orbiter</td>
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<td>Phoenix</td>
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Science pathways responsive to discovery

Planned for 90 Days; still making discoveries after 4 years

MEPAG Activities Since the last PSS Meeting

• MSL Cache SAG
  – Assess how the MSL cache contributes to the goals of the MEP
• Next Decade SAG
  – Define the science scope and needs of MSR missions as part of MEP
• Human Exploration of Mars SAG
  – Define scientific activities for eventual human exploration of Mars
• Mars Strategic Science SAG
  – What are the 1st and 2nd priorities for strategic missions prior to MSR?
• Mars Architecture Tiger Team
  – Respond to OMB request for MEP next-decade architectures in light of the FY09 budget and five-year projections
• MEPAG Meeting February 20, 21 2008
FY2008 Next Decade

Launch Year

2011
- Competed Aeronomy Scout Mission
  - MAVEN or TGE

2013
- Mars Science Orbiter
  - Orbital science with potential for landed geophysical package
  - Extends telecom infrastructure

2016
- Competed Scout Mission

2018
- Twin Mid-Rovers
- Long-Lived Surface Network
- Astrobiology Field Laboratory

2020+
- Mars Sample Return
History and Projections of Budgets

Mars Exploration Funding

Past funding

5-year plan

SMD Planning Budget
SMD’s Proposed Next Decade Mars Exploration Program

Launch Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>2009</td>
<td>Competed Aeronomy Scout Mission (MAVEN or TGE)</td>
</tr>
<tr>
<td>2011</td>
<td>TBD mission based on budget and science feed-forward</td>
</tr>
<tr>
<td>2013</td>
<td>TBD mission based on budget and science feed-forward</td>
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<tr>
<td>2016</td>
<td>MSR Element #1</td>
</tr>
<tr>
<td>2018</td>
<td>MSR Element #2</td>
</tr>
<tr>
<td>2020</td>
<td>Sample Receiving Facility online by 2022</td>
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Group looked at two types of architectures:

1) A science-driven architecture based on the SMD plan and the recommendations of the NRC Decadal Survey, the MEPAG Goals committees, and the MEPAG Science Analysis Groups over the past 5 years.

2) Budget-driven architectures based on the recently released President’s 5-year budget (FY09-FY13). For the FY14-FY20 period the group considered 2 options:
   a) The current SMD Planning budget with a significant funding increase in FY17 through FY20.
   b) A flat funding profile that was based on the average of FY10-FY12 for FY14 through FY20.
MEPAG Assessment of Mars Architecture

Mars Program Funding

Funding Level ($M RY)

- FY08 Plan
- Level Funding
- SMD Proposed Plan

03/03/2008
### Architecture Assessment Summary

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<tr>
<td>SMD Balanced Program (1)</td>
<td>MSL</td>
<td>Scout</td>
<td>MSO</td>
<td>MSR-L</td>
<td>MSR-O</td>
<td></td>
<td></td>
<td>Exceeds total funding; Improper cost phasing</td>
</tr>
<tr>
<td>SMD Budget Plan (2a)</td>
<td>MSL</td>
<td>Scout</td>
<td>MSR-O</td>
<td></td>
<td>MSR-L</td>
<td></td>
<td></td>
<td>Scout with MSR in 2022</td>
</tr>
<tr>
<td>SMD Budget Plan (2a); Earliest MSR</td>
<td>MSL</td>
<td>MSR-O</td>
<td>MSR-L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MSR-only program MSR in 2020</td>
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<tr>
<td>Level Mars funding FY14-20 (2b)</td>
<td>MSL</td>
<td>Scout</td>
<td>MSO</td>
<td>Rover</td>
<td></td>
<td></td>
<td></td>
<td>No MSR</td>
</tr>
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**Key points**

- Given adequate funding the SMD plan can maintain the Mars Program and achieve its science goals
- With the SMD Budget plan
  - MSR options have only Scout mission between MSL and MSR
  - ≥11 year period between NASA Mars landings (2009 to ≥2020)
  - A 4 year gap exists between flight elements of MSR
  - Only 5 months of surface operations for MSR rover launched in 2022
Implications

1. The SMD planning budget, which includes the President’s 5-year decreasing budget, does not support the SMD architecture even with the planned rapid increase in funding beginning in FY17
   - Estimated cost of this balanced architecture is ~$6.5B, including an estimated cost of an MSR mission with modest scientific goals of ~$5B; however total SMD funding for new missions through FY20 is $4.2B
   - Phasing of SMD funding does not ramp up in time for a mission in 2016 nor for MSR launches in 2018 and 2020

2. The MSR mission estimated cost of $5B would require a substantial international contribution above the $3.5B U.S. contribution currently planned
   - International planning proceeding well with ExoMars, possible cooperation in 2016, and strong desire to contribute significant MSR elements (e.g. orbiter) BUT
   - Community is deeply disappointed in budget and concerned how this will affect commitments

3. The SMD planning budget through FY20, together with substantial international contribution could support MSR with some adjustment in phasing. However, the options would be:
   - An MSR program with Scout in 2013 followed by the launch of the MSR mission elements in 2018 and 2022; or
   - An architecture dedicated to the earliest launch of MSR, with no missions following MSL and the launch of the MSR mission elements in 2016 and 2020
Implications

4. **If the needed reinstatement of the funding for Mars exploration to levels of $500-900M per year does not occur soon, then MSR will not happen per schedule**
   - Projected funding levels in FY11-FY16 are ~$390M per year
   - Level funding could support medium-sized missions launched every other opportunity (not flagships)

5. **A Mars architecture consisting of MSL followed by the launch of MSR elements in 2016 & 2020 (no Scout) or 2018 & 2022 (with Scout) would have a devastating effect on the Mars Program**
   - Lack of progress toward the four goals of planetary science set out by the NRC Decadal Survey
   - Loss of scientific balance
   - Loss of technical and scientific expertise as a result of the >11 year hiatus between landed missions of MSL and MSR

6. **In all planning exercises the Mars Program should remember that:**
   - Major technology development is required starting at least 5 years prior to the MSR development
   - The existing assets at Mars have great capabilities that can be utilized to support future missions, including site characterization and certification, atmospheric characterization, and relay
Conclusions

• Endorses the SMD MEP architecture
• The FY2009 and beyond budgets do not support this architecture
• All MSR options require international participation
• The SMD budget as presented would only support a Scout mission in 2013, MSR Orbiter in 2016, and MSR lander in 2022 at the earliest
• MSR is dependent on the assumed increases in funding from $300-400M per year (FY11-13) to $600-900M per year in the future
• Investment of $200-$300M in the FY10-FY13 needed to make MSR credible
Summary of MEPAG’s 2008 Analysis of MSR

There are many possible attributes of MSR that affect the ultimate scientific return of the mission
• if they were all added the cost of the mission would go out of reach
• if none were added we would sacrifice a major part of the value of the mission.

03/03/2008
MSL has the potential to collect and store samples that would be of interest to MSR. MEPAG recommends that MSR be designed with the option to recover this cache.

However, this cache cannot be the only samples returned by MSR:

- The mass of cache samples is only 130 grams
- The samples in the cache will not be labeled, so linkage to original context is no more than a hope
- The samples will be rattling against each other on the way back, so some level of cross-contamination is assured, and if the samples fracture, they could become disastrously commingled.
- The MSL sample acquisition system (scoop) is capable of acquiring only weathered rocks from the surface (no fresh rocks).
- Regolith/dust samples are impossible