Global Exploration Roadmap Science White Paper Overview & Status

Greg Schmidt

Deputy Director, SSERVI

Exec. Secretary, GER SWP

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ISECG

- **International Space Exploration Coordination Group**

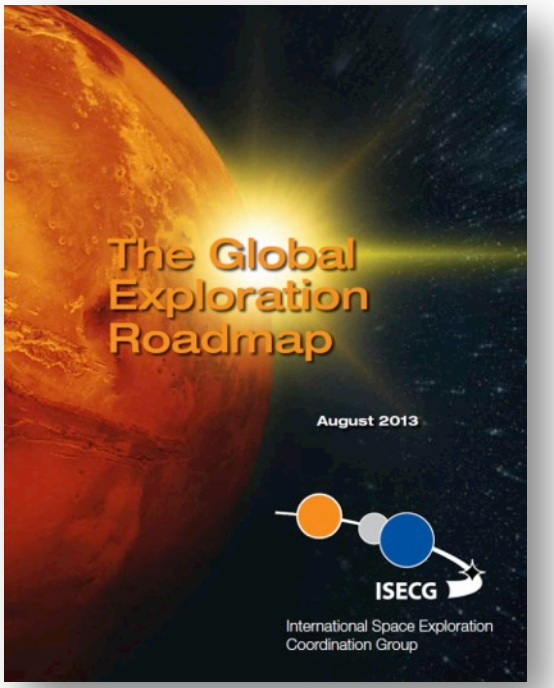
- **ISECG is a non-political agency coordination forum of 14 space agencies**
  - Website: www.globalspaceexploration.org

- **Work collectively in a non-binding, consensus-driven manner towards advancing the Global Exploration Strategy**
  - Provide a forum for discussion of interests, objectives and plans
  - Provide a forum for development of conceptual products
  - Enable the multilateral or bilateral partnerships necessary to accomplish complex exploration missions
  - Promote interest and engagement in space exploration among citizens and society

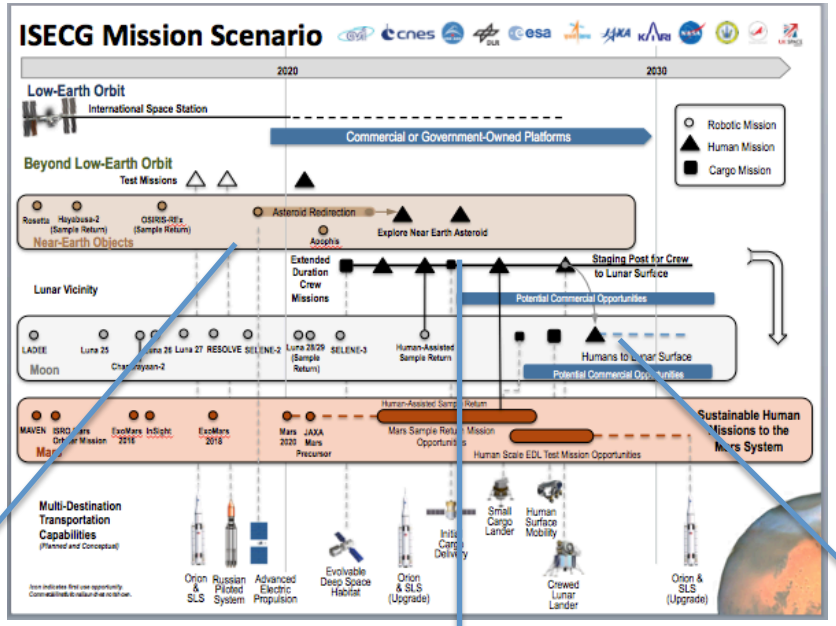
- **ISECG operating principles**
  - Open and inclusive
  - Flexible and evolutionary
  - Effective
  - Mutual interest

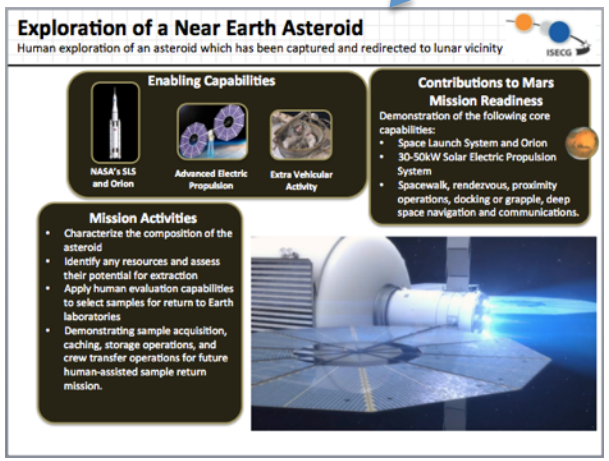
Global Exploration Roadmap

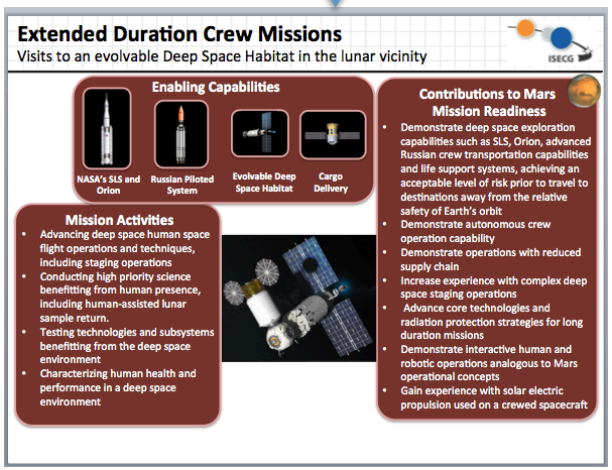
- **The GER is a human space exploration roadmap, recognizing the criticality of increasing synergies with robotic missions while demonstrating the unique and important role humans play in realizing societal benefits**
- **The non-binding document reflects a framework for agency exploration discussions on:**
  - Common goals and objectives
  - Long-range mission scenarios and architectures
  - Opportunities for near-term coordination and cooperation on preparatory activities
- **Since release of updated GER in August 2013, participating agencies have continued discussions and joint work in several areas which are of mutual interest**
  - China (CNSA) has joined the dialog
  - Increase understanding of design reference missions for early mission themes
- **Highlighting opportunities for the science community with a dedicated Science White Paper and within the GER itself is a priority**
- **Version 3 to be completed in 2016**

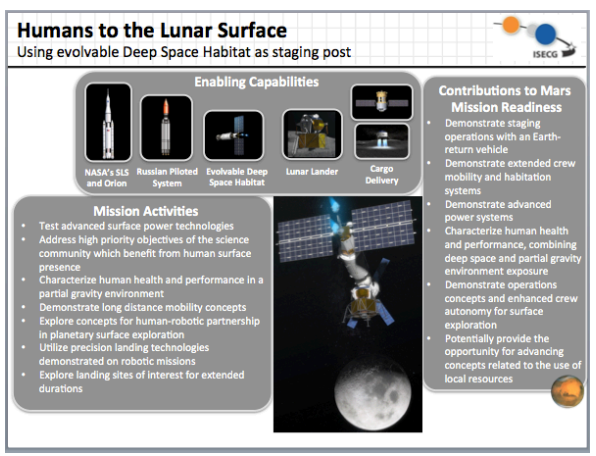


GER Mission Themes









GER Destination Themes Reference Missions

Cislunar Deep Space Habitat

- Crew of four
- Initially annual missions lasting 30 days
- Increase both duration & frequency later in the decade.

Near Earth Asteroid in Cislunar space

- Boulder collected using SEP-based s/c
- Crew of two visits asteroid boulder in lunar DRO

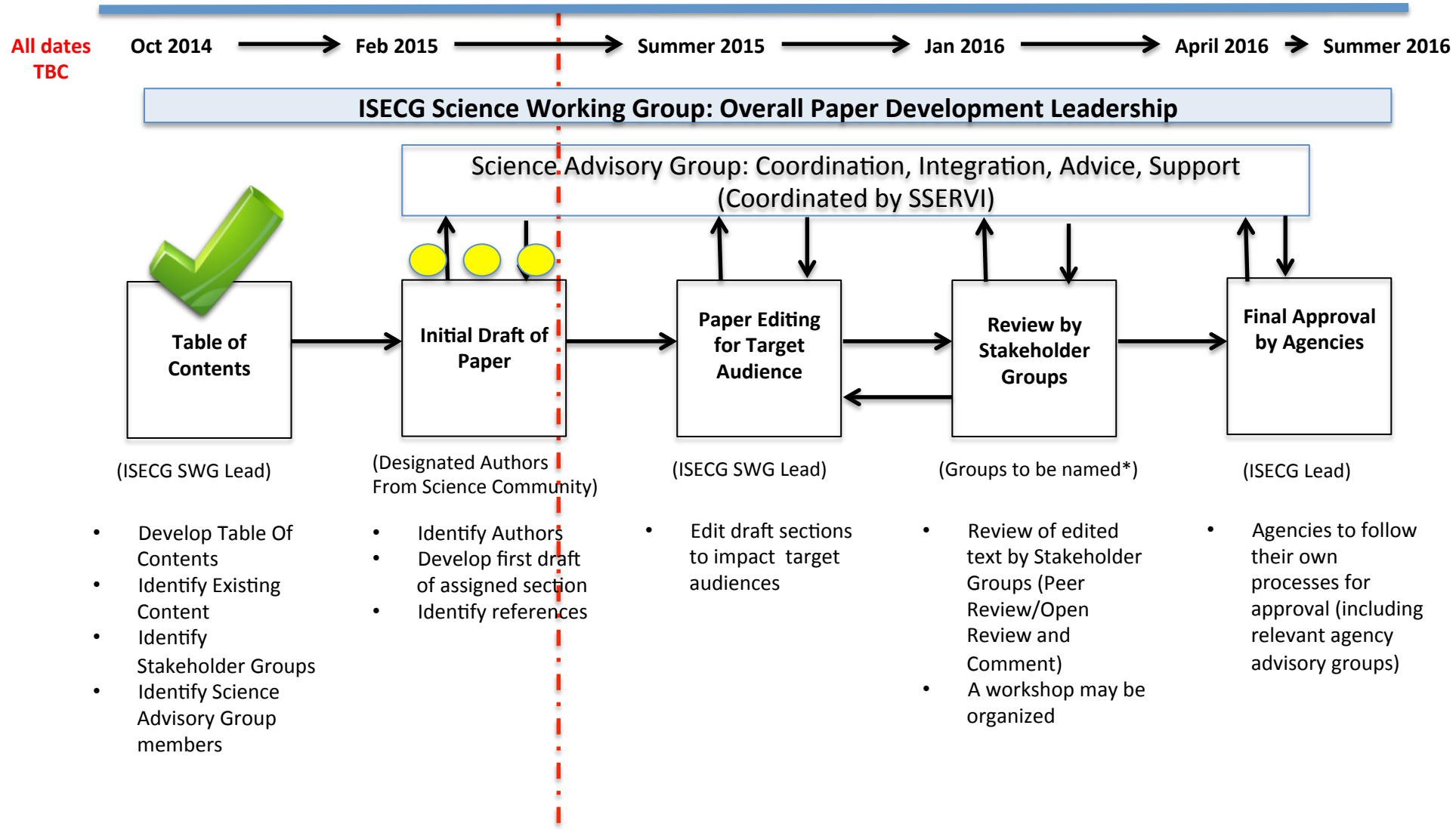
Lunar Surface

- Five 28-day missions with a crew of four
- One mission per year
- Reuse pressurized rover for each mission
- Rover is moved to next landing site in between crewed visits

Science White Paper – Concept & Scope

- **Target Audience: agency-level policymakers**
- **Describe an international view of the science that could be enabled by missions in the GER**
  - Engage the scientific communities in identifying these opportunities
  - Target the same stakeholder community as the GER – stakeholders, decision makers, broader human space exploration community while engaging the scientific community → concise formulation
  - Distribute as a companion document to the GER with next update (2016)
  - Focus on human missions and human/robotic concepts with emphasis on early mission themes, but incorporate the driving science priorities up to Mars
- **Foster a deeper mutual understanding of priorities, challenges and opportunities for both scientific and exploration communities**
- **Incorporate interdisciplinary scientific themes that**
  - involve various communities, e.g. Planetary Science, Space Science, Life Sciences, Astrobiology, Astronomy, Physical Sciences, potentially including Strategic Knowledge Gaps
  - Links to and translates substantive authoritative literature from the international science community
- **Transparent, interactive process allows for two-way communication on science opportunities and feedback on GER missions**

Paper Development Process



* Groups expected to include LEAG, SBAG, MEPAG, COSPAR, IMEWG, IPEWG, ISLSWG, national science groups, others

SAG Membership

- **Co-chairs:**
  1. Ben Bussey (NASA HEOMD Chief Scientist, USA) david.b.bussey@nasa.gov
  2. Jean-Claude Worms (ESF, France) jcworms@esf.org

- **Members**
  3. Gilles Clement (Univ. of Lyon, France) gilles.clement@inserm.fr
  4. Ian Crawford (Univ. of London, UK) i.crawford@ucl.ac.uk
  5. Mike Cruise (Univ. of Birmingham, UK) a.m.cruise@bham.ac.uk
  6. Masaki Fujimoto (JAXA, Japan) fujimoto@stp.isas.jaxa.jp
  7. Dave Hart (Univ. of Calgary, Canada) hartd@ucalgary.ca
  8. Ralf Jaumann (DLR, Germany) Ralf.Jaumann@dlr.de
  9. Clive Neal (Notre Dame Univ., USA) neal.1@nd.edu
  10. Gordon Osinski (Univ. of West. Ontario, Canada) gosinski@uwo.ca
  11. Masaki Shirakawa (JAXA, Japan) shirakawa.masaki@jaxa.jp
  12. Tim McCoy (Smithsonian, USA) mccoyt@si.edu

- **Executive Secretary**
  - Greg Schmidt (SSERVI lead, USA) gregory.schmidt@nasa.gov

KEY MESSAGE: THE SAG MEMBERSHIP IS STILL OPEN, ESPECIALLY TO ISECG AGENCIES AND COUNTRIES NOT YET REPRESENTED

SAG-SWP Support

- **Science Opportunities of a Cislunar Deep Space Habitat**
  - Co-Leads: Giles Clement & Gordon Osinski
- **Science Opportunities at a NEA in Cislunar space**
  - Co-Leads: Masaki Fujimoto & Tim McCoy
- **Science Opportunities on the Lunar Surface**
  - Co-Leads: Ian Crawford & Clive Neal
- **Other SAG members may choose to support one or more chapters.**

SWG Product Development

Table of Contents (as of 04/2015) – total ~20 pages

- **Exec. Summary (2)**
  - Methodology / Process
    - Document is developed by ISECG agencies incorporating science community perspectives
- **1. Linkage to GER (2)**
  - GER approach
    - Connection to GER Goals & Objectives (?)
    - Long-term horizon goal (Mars)
    - Near-term destination focus
  - Human-robotic partnership / Value of human presence
- **2. Science Topics (2)**
  - Capture the scientific interest of Moon/Asteroid research
  - Science topics (overview)
- **3. Cislunar Deep Space Habitat (4)**
- **4. NEA in Cislunar Space (4)**
- **5. Lunar Surface (4)**
  - Each chapter 3-5 to highlight
    - Short summary of the mission theme including DRMs → SWG
    - Scientific opportunities in relation to the science topics → SAG
    - Science recommendations → SAG
- **Conclusion (1)**
- **References (1)**
  - E.g. GER3, COSPAR PEX, Decadal Surveys, MEPAG report, ILEWG, others

SWP Science Topics

- **Living and working in space (= applied science ?)**
  - Overarching question(s):
    - How do we become a spacefaring species?
    - How do we sustain life in hostile environments? / Is life outside Earth sustainable? / Is human life confined to Earth?
  - Disciplines involved, e.g.
    - Human physiology, life sciences and life support
    - Prospecting and utilizing local resources
- **Our Place in the universe (= fundamental science ?)**
  - Overarching question(s):
  - Disciplines involved, e.g.
    - Astronomy
    - Planetary formation and evolution
    - Solar physics, space physics
  - Co-evolution of life in the planetary environment ?
  - Understanding the building blocks of life = astrobiology ?

Discussion

- Website – up soon!
  - Check sservi.nasa.gov
- Drafts will be released to the community ~Fall 2015
- Future review sessions
  - LEAG annual meeting
  - AGU?
  - LPSC
  - Online