
# Annual Report 2019




















## International Space Exploration Coordination Group – ISECG

ISECG was established in response to the "The Global Exploration Strategy: The Framework for Coordination" (GES) which was released in May 2007. This GES Framework Document articulated a shared vision of coordinated human and robotic space exploration focused on solar system destinations where humans may one day live and work.

The purpose of ISECG is to provide a forum to discuss interests, objectives and plans in space exploration and to support promotion of interest and engagement in space exploration activities throughout society. The work of ISECG results in documents, papers, findings and recommendations that are critical in informing individual agency decision making. In 2019, ISECG´s membership increases to 20 organisations. The title page captures the addition of the Australian Space Agency, Luxembourg Space Agency, Polish Space Agency, Romanian Space Agency, and the Swiss Space Office. The members have been welcomed into ISECG in 2019, and demonstrate the increasing global importance of space exploration.

**INTERNATIONAL SPACE EXPLORATION COORDINATION GROUP**

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http://www.globalspaceexploration.org/

# Table of Contents

# 1 Executive Summary

In 2019, international momentum in Moon exploration further increased. ISECG agencies have focused on updating and expanding the lunar surface exploration scenario to reflect the changes and potential opportunities resulting from the recent plans. They decided to develop an update of the Global Exploration Roadmap (GER) published in 2018. The update (GER Supplement - Lunar Surface Exploration Scenario Update (2020)) will be guided by adjusted lunar surface exploration objectives and driven by the strategy of a long term sustainable presence on the Moon. Key features are Mars forward elements, science opportunities, in-situ resource utilisation, reusability, and night survival. Furthermore, the updated lunar surface exploration scenario incorporates refined key lunar surface elements such as a lunar power architecture and a communication architecture, and implementation strategies that focus on sustainable presence on the Moon.

As a major element supporting the GER, the definition of the GER Critical Technology Portfolio was completed in December 2019. It comprises extensive portfolio analysis and related mapping to agency technology development plans and activities. In the course of the review work subject-matter experts from participating agencies have been involved in validating individual descriptions and performance characteristics of technologies. The detailed gap analysis activities in 2019 focused on the assessment of 'Autonomous Systems' and 'In-Situ Resource Utilisation' (ISRU). It also revealed opportunities for international coordination and cooperation, and has made specific recommendations for closing the identified gaps.

In order to support future lunar exploration missions delivering the desired interest and engagement amongst the public, ISECG members undertook an analysis on how to extend communication reach and reaching non-traditional audiences through new engagement channels. The report, concluded at the end of 2019, offers insights into how to inform and engage the public in general and the youth in particular in all phases of missions related to human/robotic lunar surface exploration. It compiles various possibilities of how to bring the action to large audiences, making full use of the state-of-the-art technology and new ways of communication.

In 2019 ISECG agencies welcomed five new members:

ASA, Australian Space Agency

LSA, Luxembourg Space Agency

POLSA, Polish Space Agency

ROSA, Romanian Space Agency

SSO, Swiss Space Office

The ISECG published four webnews articles in 2019, addressing the following topics: the Polish Space Agency POLSA is a new member of ISECG; ISECG Senior Agency Managers meet to advance space exploration; the "ISECG Annual Report 2018"; and ISECG Senior Agency Managers meet to boost coordination toward Moon-to-Mars exploration.

# 2 ISECG Highlights, Achievements and Special Projects in 2019

### Update to the GER (2018) Lunar Surface Exploration Scenario

Given the emphasis by several agencies on human return to the Moon, ISECG agencies are focused on updating and expanding the lunar surface exploration scenario to reflect the changes and potential opportunities resulting from the recent plans. The GER (2018) reference architecture was the starting point for the refinement of the reference human lunar surface architecture which has also been guided by updated lunar surface exploration objectives. The updated lunar surface exploration scenario incorporates outcomes from ongoing study activities of the ISECG participating agencies. The update is driven by the strategy of a long term sustainable presence on the Moon guided by Mars forward, science, ISRU, reusability, and night survival.

Key accomplishments were:

- Generation of draft lunar surface exploration objectives guided by the ISECG exploration goals and sustainability principles.
- Incorporation of agency science and exploration community viewpoints in draft assumptions and strategies.
- Refinement of key lunar surface elements, including a lunar power architecture and incorporation of a communication architecture (provided by the Interagency Operations Advisory Group), and implementation strategies that focus on sustainable presence on the Moon.
- Definition of phases to include human lunar return, exploration and mobility, and Mars forward demonstrations leading to sustained lunar opportunities.

### Completion of Critical Technology Portfolio for Global Exploration Roadmap

The definition of the GER Critical Technology Portfolio was completed in December 2019 and is available on the ISECG website. ISECG agencies continued to undertake a thorough review of the GER Critical Technology Portfolio, whereby subject-matter experts from participating agencies validated the individual technology descriptions and performance characteristics. Such advanced technologies were subject of a categorisation according the NASA Technology Area Breakdown Structure (TABS) by ISECG's Technology Working Group. This categorisation is a key for the portfolio analysis and mapping to agency technology development plans and activities.

The detailed gap analysis activities focused on the assessment of 'Autonomous Systems' and 'ISRU'. The respective gaps assessment teams worked on identified technology gaps related to, but not limited by, the current GER mission scenario and revealed opportunities for international coordination and cooperation, and specific recommendations for closing the identified gaps. The gap closure analyses considered synergies between missions to the Moon and to Mars.

The Gap Assessment Analysis on 'Autonomous Systems' focused on several topics, including Vehicle Autonomy, Crew Autonomy, Crew Health and Performance Autonomy, Food Production, Robotic Caretakers and Stowage Management. The study was ended and the study report on 'Autonomous Systems' will be published early 2020 on the ISECG website dedicated to ISECG activities related to Advanced Technologies.

**Enhancing Public Engagement in Future Lunar Exploration Missions**

ISECG members recognised the need to engage stakeholders and to increase public support to realise sustainable exploration for future generations. In order to support future lunar exploration missions delivering the desired interest and engagement amongst the public, ISECG members undertook an analysis on how to extend communication reach and reaching non-traditional audiences through new engagement channels.

Key accomplishments were:

ISECG members produced a report offering insights into how to engage the public in general and the youth in particular with human/robotic lunar surface exploration by bringing the action to large audiences, making full use of the state-of-the-art technology and through new ways of communication. The document summarises:

- lessons learned and best practices for communicating and delivering benefits from space exploration to society, consolidating experiences encountered by ISECG space agencies;
- recommendations and ideas to enable and foster broad public engagement in future lunar exploration, and prioritisation with rationales;
- a view on technical requirement necessary to realise the ideas, based on the current reference architecture;
- recommendations how ISECG could further support agencies to implement engagement.

# 3 Outlook for 2020/2021

**ISECG Working Groups**

Exploration Roadmap Working Group (ERWG)

On behalf of ISECG, the ERWG primary focus is to release a supplement (GER Supplement – Lunar Surface Exploration Scenario Update (2020)) to the GER (2018) focusing on an updated lunar surface exploration scenario during the middle of 2020 to support participating agency planning. The EWRG, working with the IAWG, has created a draft set of lunar surface exploration objectives and associated performance measures, to drive the updated scenario. The GER Supplement will include a revised overview of agency plans and strategy for exploration since the publication of the GER (2018), the updated lunar surface exploration scenario, a discussion on industry capabilities, forward work, and how to get involved in ISECG.

The ERWG, based on review and guidance from the ISECG space agencies in late 2020, will work to evaluate the utility of and characterise the needed updates to the GER (2018) and GER Supplement to determine a recommendation on the necessity of a complete revision of those documents. The possibility of a full update to the GER will be addressed during the later part of 2020 or into spring 2021.

International Architecture Working Group (IAWG)

In conjunction with the ERWG, the IAWG will continue to refine and finalise the performance measures for the lunar surface exploration objectives. Additionally, the IAWG will continue to refine the lunar surface exploration scenario update leading to content to include in the GER Supplement. The primary focus will be completion of the lunar surface campaign and architecture to include in the supplement. The campaign and architecture will cover an exploration strategy built upon leveraging a build-up of assets on the surface to achieve the lunar surface exploration objectives.

Strategic Communications Working Group (SCWG)

The SCWG will continue to implement and coordinate communication of the ISECG mandate, its products and activities. Major activities will comprise the publication of ISECG webnews, as appropriate, and the preparation of the ISECG Annual Report 2020. Furthermore, the SCWG will support ISECG publications and ISECG contributions to international conferences. Here, a major focus will be on the communication and public outreach activities related to the lunar exploration scenario in the GER Supplement. The SCWG has started to review the contents of the ISECG website and will continue this work throughout 2020.

Technology Working Group (TWG)

In 2020, the TWG will continue to advocate coordination and collaboration in technology development efforts of individual ISECG space agencies in support of the GER. In particular, the TWG will continue to advance the Gap Assessment Analysis on ISRU; upon its completion the gap assessment report ‘ISRU’ will be released. In addition the TWG will begin a new technology gap identification and closure analysis focused on the critical technologies related to Nuclear Power and Propulsion. The technologies to be analysed will be, among the others, Nuclear Thermal Propulsion, Fission Power for Surface Missions and Multi-MWe Nuclear Power for Electric Propulsion.

**Major International Events Related to Space Exploration**

Underlined events will include ISECG presentations. (Status March 2020)

*NOTE: Changes of dates are possible due to the Corona virus pandemic*

- **36th Space Symposium**
  Colorado Springs/USA, ~~30 March-02 April 2020~~ - *postponed*
- **Humans to Mars Summit 2019**
  Washington D.C./USA, 31 Aug.-1 Sept. 2020 *(moved from May)*
- **GLEX, Global Space Exploration Conference**
  St. Petersburg/Russia, 01-03 September 2020 (*moved from June*)
- **70th International Astronautical Congress (IAC)**
  Dubai/UAE, 12-16 Oct. 2020
- **71st International Astronautical Congress (IAC)**
  Paris/France, 27 Sept.-01 Oct. 2021

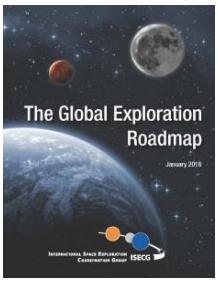
## Annex I

# Publications

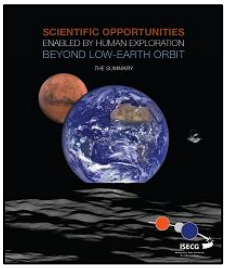
### ISECG Webnews 2019

- ISECG Space Agencies Welcome Polish Space Agency POLSA as New Member — March
- International Space Agencies Meet to Advance Space Exploration — March
- ISECG Annual Report 2018 published — August
- International Space Agencies Meet to Boost Coordination toward Moon-to-Mars Exploration — October

### Major ISECG Documents

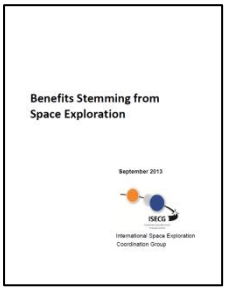



**The Global Exploration Roadmap (GER), January 2018**

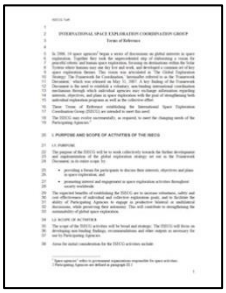



**Scientific Opportunities enabled by Human Exploration beyond Low Earth Orbit – The Summary**
(summary version)

**Scientific Opportunities enabled by Human Exploration beyond Low Earth Orbit – A ISECG Science White Paper**
(full version)




**Benefits Stemming from Space Exploration**



**ISECG Terms of Reference**

More ISECG documents and published papers can be found at **ISECG Publications**.

**Annex II**

# ISECG Members (status of March 2020)

| | | |
|---|---|---|
| Australia |  | Australian Space Agency (ASA) |
| |  | Commonwealth Scientific and Industrial Research Organisation (CSIRO) |
| Canada |  | Canadian Space Agency (CSA) |
| China |  | China National Space Administration (CNSA) |
| Europe |  | European Space Agency (ESA) |
| France |  | Centre National d'Études Spatiales (CNES) |
| Germany |  | German Aerospace Center (DLR) |
| India |  | Indian Space Research Organisation (ISRO) |
| Italy |  | Agenzia Spaziale Italiana (ASI) |
| Japan |  | Japan Aerospace Exploration Agency (JAXA) |
| Luxembourg |  | Luxembourg Space Agency (LSA) |
| Norway |  | Norwegian Space Agency (NOSA) (Member since January 2020) |
| Poland |  | Polish Space Agency (POLSA) |
| Republic of Korea |  | Korea Aerospace Research Institute (KARI) |
| Romania |  | Romanian Space Agency (ROSA) |

| | | |
|---|---|---|
| Russia |  | State Space Corporation (Roscosmos) |
| Switzerland |  | Swiss Space Office (SSO) |
| Ukraine |  | State Space Agency of Ukraine (SSAU) |
| United Arab Emirates |  | United Arab Emirates Space Agency (UAE Space Agency) |
| United Kingdom |  | United Kingdom Space Agency (UKSA) |
| USA |  | National Aeronautics and Space Administration (NASA) |
| Vietnam |  | Vietnamese National Space Center (VNSC) (Member since January 2020) |

## Annex III

# ISECG Working Groups

## ISECG Working Groups

Exploration Roadmap Working Group (ERWG)

The ERWG leads the human spaceflight roadmapping effort which is intended to establish a common roadmap, and common framework to promote partnerships in realising exploration missions. A summary of their work is communicated in regular updates of the GER.

International Architecture Working Group (IAWG)

The IAWG leads multilateral reference architecture work, develops shared requirements, identifies critical functions and technologies and shares innovative architectural concepts. The IAWG is currently building concepts to augment the GER mission scenario, focusing specifically on characterising human missions to the lunar surface based on robust international partner contributions.

Strategic Communications Working Group (SCWG)

The objectives of the SCWG are to provide a clear, consistent and coordinated communication of the ISECG mandate, its products and activities, to support the development of ISECG products, as well as to support the exchange amongst members on stakeholder engagement activities. Major activities of the SCWG include the development of ISECG webnews, the preparation of the ISECG Annual Report and the facilitation of topical exchanges amongst members. The SCWG is fostering an exchange on lessons learned and best practices among ISECG members in communicating and delivering benefits resulting from investments in space exploration.

Science Working Group (SWG)

The Science Working Group coordinates with the international science communities on exploration planning and activities as required for the generation of ISECG products. Through the development of the Science White Paper, the SWG has established a Science Advisory Group, developed links into the global science community and coordinated activities with relevant science organisations. The SWG will continue to do so, recognising the strong role of science and the scientific opportunities in future exploration efforts.

Technology Working Group (TWG)

The goal of the Technology Working Group is to identify and raise awareness on critical technology gaps related to the GER, and to advocate coordination and collaboration in technology development efforts of individual ISECG members in support of the GER. The strategic nature of technology investments and the desire of members to focus investments to maximise their contribution potential while enabling meaningful and achievable opportunities for all participating ISECG members must hereby be recognised.

## Annex IV

# ISECG at a Glance: Scope and Background

**ISECG, the International Space Exploration Coordination Group serves as the forum where space agencies work together on means of strengthening individual exploration programs, facilitating collaborations and advancing the Global Exploration Strategy (GES) through the coordination of participating members' mutual efforts in space exploration. ISECG also supports promoting interest and engagement in space exploration activities throughout society. By the end of 2019, ISECG membership counted 20 space agencies[1].**

The **scope of ISECG** is broad and strategic. Its activities are based on the following **principles**:

- Open and inclusive
  - ISECG receives inputs from all interested space agencies that invest in and perform space exploration activities.
  - ISECG provides for consultations among all agencies with a vested interest in space exploration.
- Flexible and evolutionary
  - Existing consultation and coordination mechanisms are taken into account.
- Effective
  - ISECG workshops and products provide value to individual participating members.
- Of mutual interest
  - ISECG activities benefit all participants and respect national prerogatives.
  - ISECG activities allow for optional participation based on the level of interest.
  - ISECG participants focus on developing non-binding products - findings, recommendations and other outputs as necessary – based on consensus.

**Background**

In May 2007, an initial group of 14 space agencies jointly released "The Global Exploration Strategy: The Framework for Coordination". It describes a shared vision of coordinated human and robotic space exploration focused on solar system destinations where humans may one day live and work.

The GES identifies a common set of **exploration themes and benefits**:

- New knowledge in science and technology
- A sustained presence – extending human frontiers
- Economic expansion
- A global partnership
- Inspiration and education

One of the many Framework document findings was the need to facilitate information exchange among individual agencies regarding their interests, plans and activities in space exploration. Therefore, the GES called for a voluntary, non-binding coordination mechanism among interested space agencies. This call led to the establishment of **ISECG** by the participating agencies including the formulation of Terms of Reference (ToR).

[1] In alphabetical order: ASA and CSIRO (Australia), ASI (Italy), CNES (France), CNSA (China), CSA (Canada), DLR (Germany), ESA (European Space Agency), ISRO (India), JAXA (Japan), KARI (Republic of Korea), LSA (Luxembourg), NASA (United States of America), POLSA (Poland), ROSA (Romania), Roscosmos (Russia), SSAU (Ukraine), SSO (Switzerland), UAE Space Agency (United Arab Emirates) and UK Space Agency (United Kingdom). "Space Agencies" refers to government organisations responsible for space activities.