



Report of the 7th GLOBAL MOON VILLAGE WORKSHOP &
SYMPOSIUM

6 – 10 December 2023

Kurashiki & Tottori, JAPAN

Final Report



1. From the “Local Organizing Committee and International Program Committee”

The Moon Village Association (MVA) was created in November 2017 and has been registered as a non-profit organization in Vienna, Austria. The goal of the MVA is to establish an informal global forum for governments, industry, academia and the public interested in the development of the Moon Village concept, meant as a global moon community fostering permanent links among all stakeholders. Each year since 2017, MVA organizes a major international event – a workshop and symposium at which global leaders in various fields relevant to humanity’s permanent expansion to Earth’s Moon gather to share progress, new ideas and relevant information.

The 7th MVA Workshop & Symposium in Kurashiki/Tottori, Japan was awarded by MVA nomination committee in 2022 at 6th MVA workshop and Symposium in LA. This gathering will provide a unique opportunity for stakeholders from around the world to directly contact one another, exchange opinions, make new contacts, and build relationships. We anticipate many positive products from this event.

The 2023 MVA workshop / symposium was held under the support of the Kurashiki-city, MASC (Mizushima Aerospace Cluster), Universities of Okayama, Tottori & Kyoto, SUHPHS (Science Union for Human Planetary Habitation in Space) and JAXA. It was held and operated in good shape and more than anticipated, where we have more than 190 participants and 25 sponsors from in and outside Japan. Kurashiki sessions were held on 7. and 8. December. On 9. December, we had two outreach events in Kurashiki and Okayama inviting general public of these cities. On 9. Tottori special symposium and outreach events were conducted. We enjoyed these gathering together with our participants where many exchanges happened among participants from scientists, engineer, researchers, students, people from startups and established industries, entrepreneur, and many from various communities.

Thanking to participants, sponsors and those who supported us, we have served you and working with you to make the Moon Village happen, and humanity’s sustainable and permanent expansion to the Moon. We believe this opportunity has spurred the movements toward the Moon Village into reality.

January 2024: Okayama, California and Tokyo



Eizo Nakamura
Chair Local Organizing Committee
Prof. Okayama University

Masashi Miura
Co-Chair Local Organizing Committee
Prof. ISAS/JAXA

John Mankins
Co-Chair International Program Committee 2023
Vice President Moon Village Association,

Yoshifumi Inatani
Co-Chair International Program Committee 2023
Prof. Emeritus ISAS/JAXA

2. Plenary sessions in Kurashiki the first and second day of the workshop and symposium



December 6, Welcome cocktail at Kurashiki

Prior to the first day, welcome cocktail was held in Kurashiki International Hotel. In the plenary sessions on the first day and the second day at Kurashiki, starting with the opening addresses from the Local Organizing Committee (LOC) as host organizations such as Kurashiki-city, Okayama, Tottori and Kyoto Universities, Moon Village association (MVA) representatives'

presentations followed, where various activities conducted by working groups of MVA were introduced.



December 7, Opening talks by Yasutomo Nasu (Okayama Univ), Eizo Nakamura (Okayama Univ), Kaori Ito (Mayor of Kurashiki city), John Mankins (MVA), and Masashi Miura (ISAS/JAXA)

The national program and activities of the government agencies' activities and those by major space industries and non-space industries in and outside Japan were presented.

MVA award for "distinguished activities on the commercial sectors" were delivered to Japanese space venture: ispace. Following the award ceremony, presentations from ispace and other Japanese and non-Japanese start-ups were presented.



Award to inpace

Based on the In-situ Resource Utilization (ISRU) on the Moon activities, vegetable-growing studies on the simulated asteroid soils were presented. The grown vegetable was served as “salad” at the Banquet at the social event on that evening in the “Ohara Museum of Art” as shown below.

In the afternoon on the first day, the breakout sessions for wide range of various topics have been conducted as presented in the following pages. Each breakout session, more than 30 people participated in.



On the second day in Kurashiki session, discussions and presentations from national agencies’ program and various research-encouraging promotions. Talks from major industries were also presented.

In the afternoon, activities of “reference model study for the society on the Moon” by Japanese study group were presented, where various considerations for architecture, business, legal, life-science and cultural issues in building society on the Moon were conducted.



One of the Japanese Astronaut; Mr. Norishige Kanai, who potentially goes to the Moon gave a talk for introducing Japanese astronauts' activities preparing for the upcoming lunar missions in the "Artemis program" were included in his talk.

Two panel discussions followed. One is for the lunar science and the others were topics how to promote business on the Moon. In the first panel talk, "New Lunar/Planetary Science spurs sustainable human activity on the Moon?" were discussed. Scientists from European and Japanese activities gave talks about how to proceed science as an initiator of large-scale investment which could be a driver to the following exploration, development activities and finally to the commercial activities. Transition and how to make it happen were discussed.

The second Panel was "What are the good business opportunity & environment on the Moon?" Seven panelists from both startups and established space joined and gave their talks about their ideas for business making and their strategies. Also discussed were what kind of support from their government is needed and expected, in order for these ventures to proceed their business on the Moon.

At the end of the Kurashiki-session of the workshop and Symposium, a wrap-up session was held. After summarizing Kurashiki-sessions, the results of the selection of the next MVA workshop and Symposium were announced. It is the Europe's turn and out of proposals, Luxemburg Space Agency (LSA) was awarded as an organizing entity of the MVA 2024 in Europe. Bob Lamborey from LSA has made a speech as an awardee.

3. What was presented and discussed in the Breakout sessions

Overview

On the first day afternoon, four breakout sessions and forty-seven presentations were made , and various technical and non-technical (cultural, anthropological, societal considerations and so on) issues were reported and presented in the parallel sessions. On each session, more than thirty people participated in the discussion and exchange.

Breakout Session 1: Architecture and Lunar Infrastructure

Architectural issues for construction and engineering aspect such as resource mining, building construction and engineering topics for various activities on the Moon. Extraction of resources such as metal and water out of Lunar regolith were discussed. Machining architecture for digging end effector, and power source and transmission issues are discussed. Also discussed are construction of infrastructure on the Moon such as Construction, Structure, Material, Energy, and Agriculture from viewpoint of general construction companies. Discussion on the Moon base as a long-time habitation facility and the quality-of-life considerations were also made.



Breakout Session 2: Human Factor / Radiation and Life support / Food / Science

Various presentations were made for the human activities from psychological and human relation point of view. For a very long-term human presence in space, necessary consideration of human evolution viewpoint, the minimum number of people as a member of the society in space was discussed. Also discussed are the influence of the space environment to the human body and mentality, from radiation protection and other different environment from those on the earth. Food production systems for the sustainable human presence in outer space was discussed. To simulate the life on the Moon, space exploration analog and simulated habitat in Hawaii was reported.

Breakout Session 3: Mining / Energy Architecture and Technical issues

Conducting studies for water mining and resource utilization, various studies promoted by Japanese industry group were presented. Mining methodology out of regolith and processing plant consideration in the south pole of the Moon for finding and mining water/icy regolith and extraction of Hydrogen and Oxygen out. Also discussed were necessary electrical energy source on the surface of the Moon. Space agriculture issues for taking a part of In-situ resource Utilization system were discussed, from viewpoint of selection of plant and food for life support demands. Other technical considerations for tele-communication/navigation and power transmission made use of both lunar orbital satellites and on the ground of the south pole of the Moon.

Breakout Session 4: Culture and Underground Cave Utilization

For conducting sustainable human activity in space, many new considerations have to be made, such as cultural and anthropological aspects. Various report from these contexts were presented. Underground caves (Lava tube) on the Moon were found and they are potentially good places to live from radiation protection and thermal conditions for sustainable human presence point of view. Various considerations for exploring and utilizing these caves such as construction methodology in the underground cave, thermal environment, communication and so on. A pioneering mission concept to explore the cave was also proposed.



December 7, Breakout sessions

4. Sponsors and Exhibit

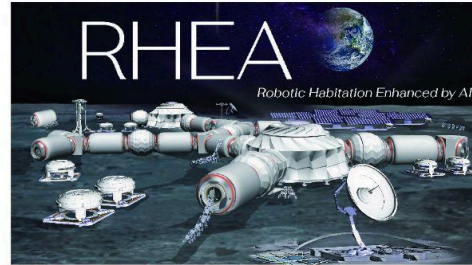
An exhibition by many sponsors of MVA 2023 Workshop & Symposium was made. The exhibition hall was located right next to the main hall. Many people visited the exhibition hall between sessions. The exhibition hall was bustling with activity during the symposium, which created an atmosphere that suggested the construction of a village on the moon is a practical endeavor rather than a dream.

We prepared coffee in the exhibition room. Thus, every break participants visited the exhibition hall. Considering all participants in Kurashiki (165) visited at least twice in a day, in total ~660 people visited the exhibition over the two days of the symposium. The number of sponsors was 30, including 1 platinum, 4 gold, 8 silver, 13 bronze, and 4 personal sponsors. There were 17 booths. The logos for sponsors were posted on the web page, on a poster outside the hall, on a poster at the entrance of the venue and on the complimentary conference bag. The sponsors provided novelty goods, such as pens, USB sticks, stickers, books, and notebooks. These were given to participants with the conference bag.



List of Sponsors

Platinum sponsor



Gold sponsors



Silver sponsors



Bronze sponsors



MITSUBISHI CHEMICAL



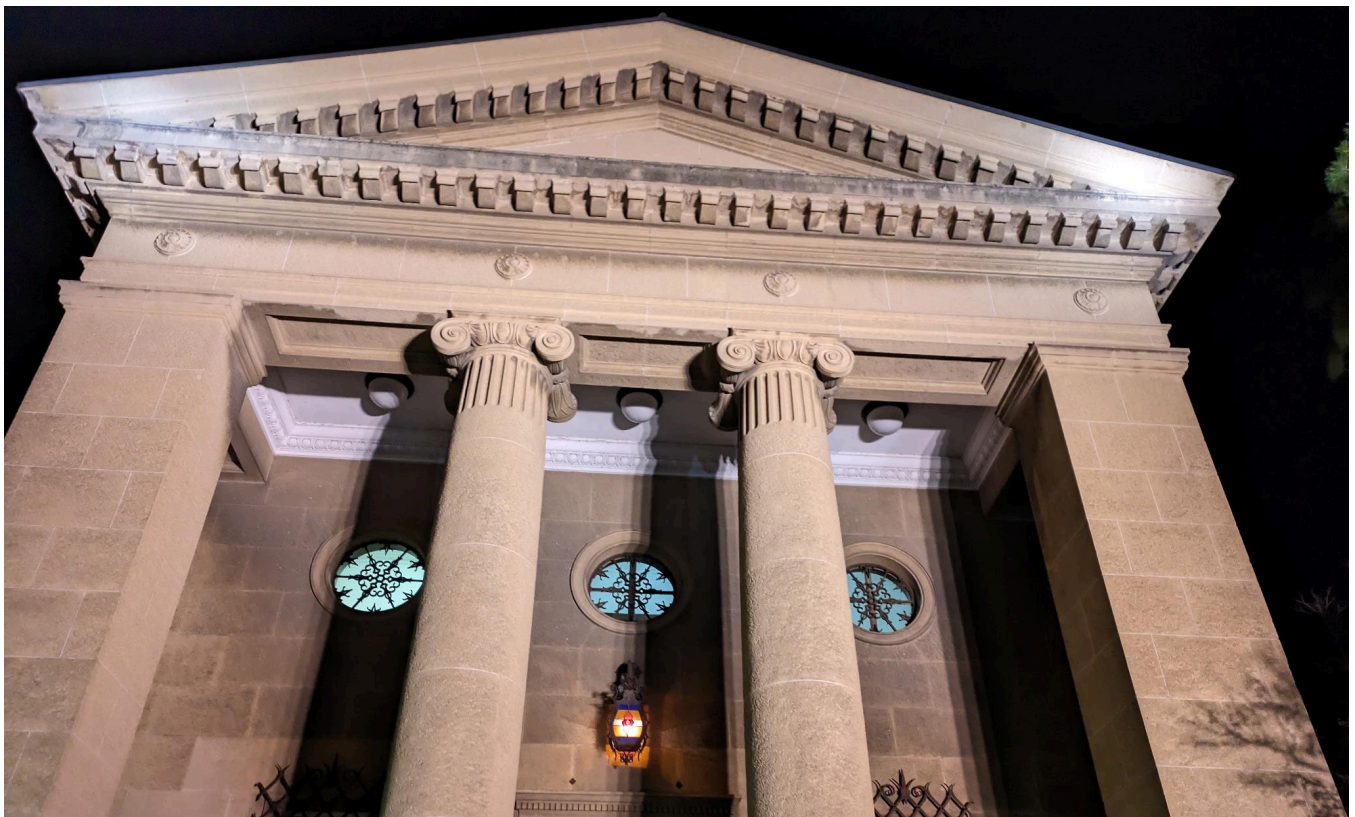
Special thanks



Conference bag and Sponsors panel

5. Sponsored Banquet at Ohara Museum of Art

Ohara Museum of Art, in the very historic court of the Kurashiki city, is famous for its collection of masterpieces from in and out of Japan, particularly for its modern-premodern arts. Taking a look at these arts and enjoyed the sponsored banquet of the MVA symposium and workshop. Enjoying these arts, local foods and drink, more than 200 participants including host organizations, city and Kurashiki chamber of commerce, and so on exchanged. Also served was vegetable grown from asteroid soils presented in the session on the day. Due to the unexpected large number of participants, we were obliged to do this banquet in the garden of the museum. It was a very cold day outside but a very good opportunities for participants to enjoy the night.



Banquet at Ohara Museum of Art

6. Kurashiki Outreach Event

On December 9, an outreach event was held by the support of Kurashiki-city and MASC, we invited general public from Kurashiki city by the support of the city and Ms. Kaori Ito of Mayer of the city. Having more than 250 participants joined with us, talks about space missions like Hayabusa asteroid mission, lunar business making and so on. Following these talks, one of the Japanese astronauts Mr. Kanai of JAXA has made a talk about introducing his flight and half a year stay at ISS, and the latest activities for the readiness to the flight and stay on the Moon. Exchange with Kurashiki people, students and children have been conducted, and we believe they were stimulated much about space and Moon Village activities.



December 9, Outreach event at Kurashiki

7. Okayama Outreach Event

On the same day December 9, another outreach event was held primarily operated by Okayama University research group for planetary and material analysis science in the Okayama-city. Conducting analysis of asteroid sample carried back from Ryugu to the earth by Hayabusa2 mission, they have found rich organic material and to think about how to grow plant on the Moon from ISRU perspective. They organized asteroid redirect, utilization of lunar cave and possibility to grow vegetables there on the Moon. General public and students enjoyed these vegetables and had opportunity to take a look at asteroid samples in their lab. and remotely operated manner.



December 9, Outreach event at Okayama

8. Tottori Special Symposium

The Tottori special symposium featured various presentations on space-related topics. Professor Hisashi Tsujimoto opened the event, discussing the Arid Research Institute's efforts to transform harsh environments into fruitful ones using plant-sustaining technologies. John Mankins introduced the historical context and current activities of the Moon Village Association. Dr. Katsuaki Tanaka of AMURAPO highlighted commercially driven activities in Tottori, including the Lunar Terrace and the use of sand dunes as a proxy for lunar surfaces in Augmented Reality. Yosuke A. Yamashiki focused on three essential "Core" Concepts and the establishment of "Terra Windows" for space migration, emphasizing the consideration of ecosystems and "Terra Windows" instead of planetary-wide "Terraforming."

The core-biome session included discussions on challenges in Earth analogues for space, ocean environments, space aquaculture, life support systems, and recycling on the International Space Station (ISS). The afternoon sessions covered material circulation, soil microorganisms and plants, and the development of small Direct Air Capture (DAC) devices. The day included a visit to the Tottori Sand Dune and Sand Museum, a farewell cocktail, and an optional simulated astronaut activity via AR glasses on a virtual moon at night.



December 10, Special symposium at Tottori



Demonstration at lunar terrace



Group-shot at Tottori sand dune

9. Tottori Outreach Event

An outreach event at the Sand Dunes Center in Tottori focused on Japanese-speaking participants. CEO of INAMI Space Laboratory, discussed potential space business opportunities in Tottori, drawing inspiration from The Fairy Tale of the White Hare of Inaba. He proposed building a shrine on the Moon named after the White Rabbit Shrine for spiritual support. Cosmo Girls group highlighted their activities, aiming to address gender disparities in the space industry. CEO of WARPSPACE USA discussed advancements in communication satellites and laser communication. Kajima Corporation is promoting an artificial gravity facilities on the Moon and Mars, and a panel discussion. In the latter half of the session, Tottori Prefecture's Industrial Future Creation Division introduced promotion for space of the prefecture. Finally, all participants had a panel discussion. The event concluded with a "Kirin Lion Dance" a local and historic performance. Fifty participants gathered and enjoyed the outreach event.



Outreach event at Tottori

10. Statistics

Registered participants	208
Number of sponsors	30
(platinum 1, gold 4, silver 8, bronze 13, and personal 4)	
Participants from sponsors	58
Participants from Japan	186
Participants abroad	22
Kurashiki-session	
Number presentations of plenary session	38
Number presentations of breakout session	47
Number of Panel talks	2



Tottori special symposium

Number presentations	15
Number of participants	50

Outreach events (including non-registered general public)

Participants in Kurashiki (Mabi-hall)	250
Participants in Okayama-Univ.	200
Participants Tottori Sand Dune Center	100

11. Program overview

Day 0 (December 6, 2023) Welcome Cocktail / Badging @ Kurashiki Kokusai Hotel (17:00-19:00)

Day 1 (December 7, 2023) Workshop & Symposium @ Kurashiki City Art Museum Main Hall (9 :00-20 :00)

- Opening Address, Co-Host Addresses
- MVA Activities Overview
- Plenary Talks
- MVA Award Ceremony & sponsored Luncheon
- Plenary Talks
- Breakout Session 1 (Kurashiki City Art Museum Main Hall)
 - 1-1. Architecture
 - 1-2. Lunar Infrastructure
- Breakout Session 2 (Geibunkan, Room A)
 - 2-1. Human Factor / Radiation
 - 2-2. Life support/Food/Science
- Breakout Session 3 (MASC Exhibition Hall)
 - 3-1. Mining/energy Architecture
 - 3-2. Technical issues
- Breakout Session 4 (Geibunkan, Room B)
 - 4-1. Culture,
 - 4-2. Underground Cave Utilization
- Banquet (18:00-20:00) Ohara Museum of Art Main Gallery and Garden

Day 2 (December 8, 2023) Workshop & Symposium @ Kurashiki City Art Museum Main Hall (9 :00-18 :00)

- Plenary Talks
- Sponsored Luncheon



- Astronaut Special Guest Talk
- Plenary talks: Moon Village Reference Model Study
- Panel Discussion 1: Science to drive Sustainable Human Activity on the Moon
- Panel Discussion 2: How to promote Commercial Activities on the Moon
- Wrap-up & Closing of MVA Workshop & Symposium 2023 Kurashiki-part

Day 3 (December 9, 2023)

- Transport to Tottori (Departure time & place(s) to be announced on site)
- Guided Kurashiki Historic Court Walking (English) & Lunch, upon onsite request, 10:00-13:00
- Kurashiki Outreach Event in Japanese @ Mabi Fureai Center, Kurashiki, 10:00-13:00
- Okayama Outreach Event in Japanese @ Mori-no-machi grace in Okayama, 9:30-17:00

Day 4 (December 10, 2023) Tottori Special Symposium & Outreach Event (9:00-18:00)

- Opening address
- Special symposium (Core-Biome) session Part 1
- Demonstration Field at Lunar Terrace & Luncheon
- Special symposium (Core-Biome) session Part 2
- Visit to Tottori Sand Dune and Sand Museum
- Special Outreach Talk (in Japanese)
- Farewell MVA Workshop & Symposium

Appendix 1: Booklet (Separate PDF file)

Appendix 2: Website (Separate PDF file)