

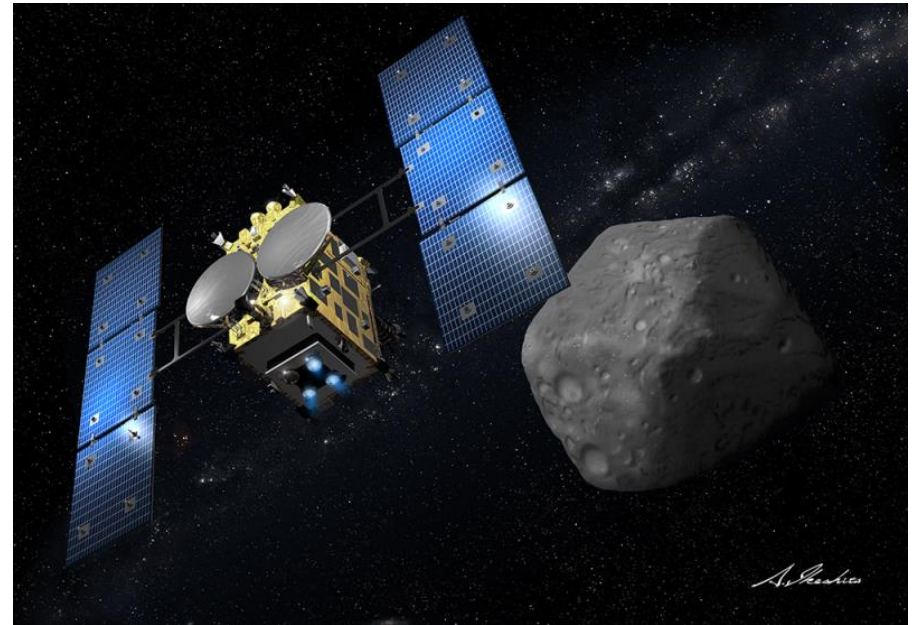
A composite image of space exploration. In the bottom left, the blue and white horizon of Earth is visible. In the center-left, the reddish-orange planet Mars is shown. In the top right, the large, grey, cratered Moon is depicted. The background is a dark blue space filled with numerous bright, multi-pointed stars.

JAXA's Space Exploration Activities

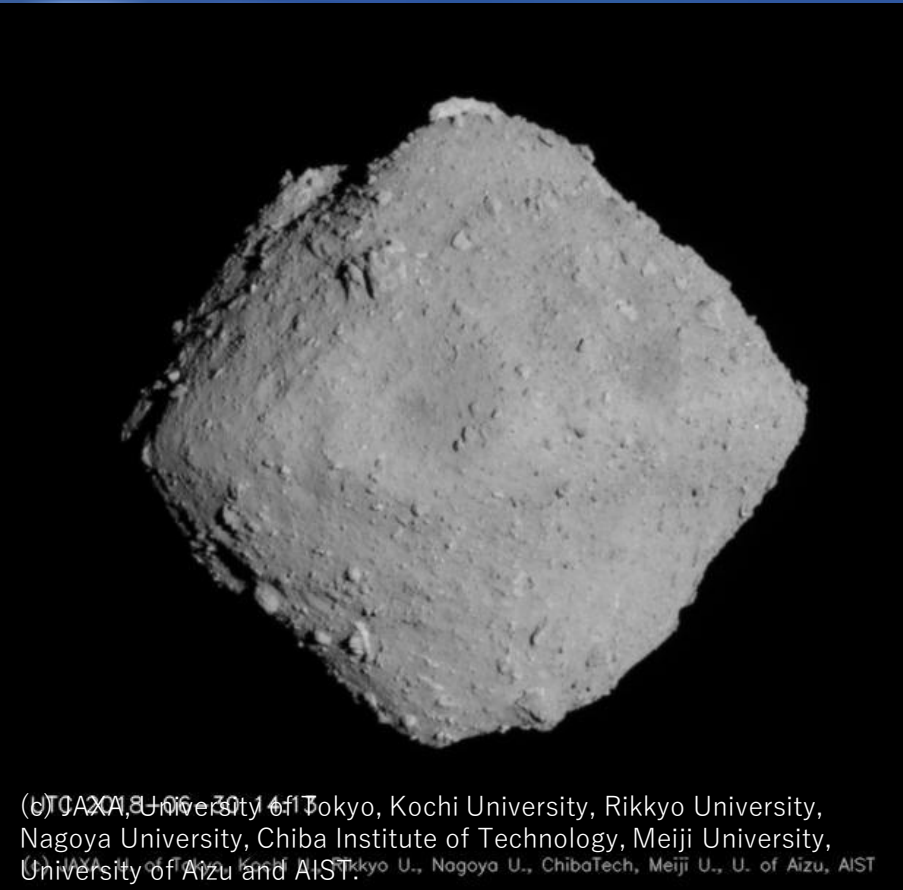
Jun Gomi,
Deputy Director General, JAXA

Hayabusa 2

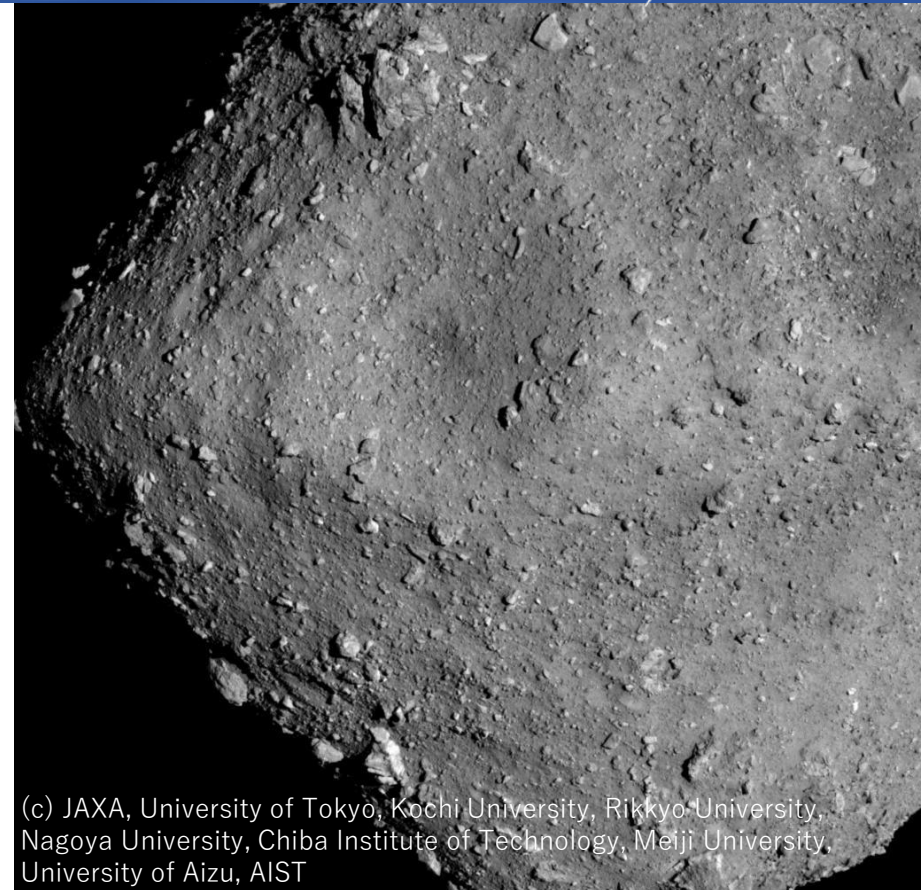
- ✓ **Asteroid Explorer** of the C-type asteroid
- ✓ Launched in December, 2014
- ✓ Reached target asteroid “Ryugu” in 2018
- ✓ First successful touchdown to Ryugu on February 22, 2019
- ✓ Return to Earth in 2020



Hayabusa 2



Asteroid Ryugu photographed from a distance of about **20 km**. The image was taken on June 30, 2018.



Asteroid Ryugu from an altitude of **6km**. Image was captured with the Optical Navigation Camera on July 20, 2018.

Hayabusa 2



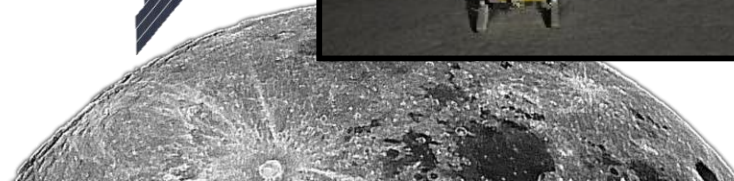
JAXA's Plan for Space Exploration

International Cooperation

- Utilization of ISS/Kibo
- Cis-Lunar Platform (Gateway)
- Lunar exploration and beyond

Industry & Academia Partnerships

- JAXA Space Exploration Innovation Hub
- Science Community discussions



JAXA's Overall Scenario for International Space Exploration

Mars, others



MMX: JFY2024



★ Initial Exploration

- Science and search for life



★ Full Fledge Exploration

- Utilization feasibility exam.

Moon

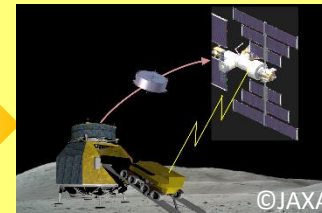


SLIM (JFY2021)



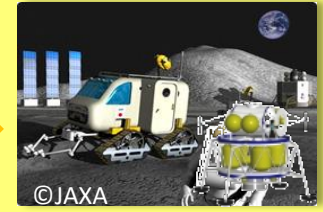
Traversing exploration (2023-)

- Science exploration
- Water prospecting



Sample Return (2026-)

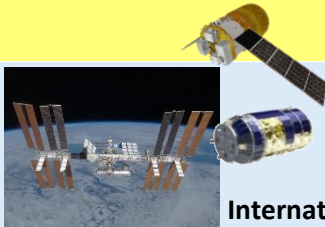
- S/R from far side
- Technology demo for human mission



Full-fledged Exploration & Utilization

- Cooperative science/resource exploration by robotic and human

Earth



International Space Station

HTV-X der. (2026-)

- Small probe deploy, data relay etc.

Gateway Phase 1 (2022-)

- Support for Lunar science
- Science using deep space

Promote Commercialization

Gateway Phase 2

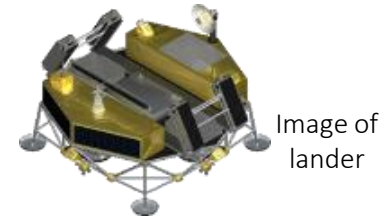
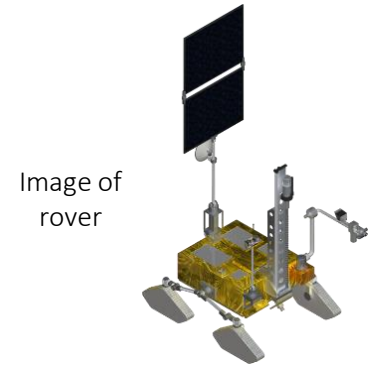
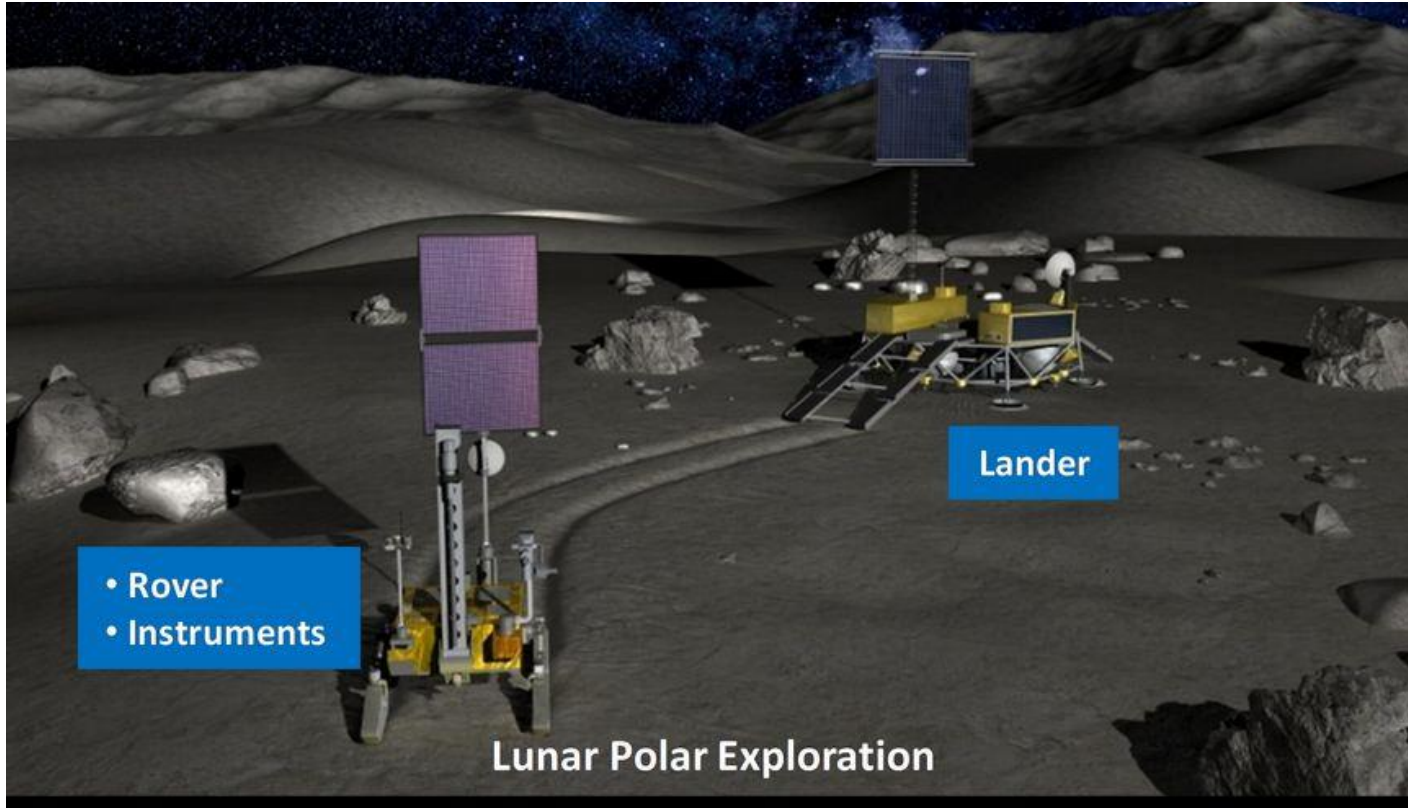
SLIM (Smart Lander for Investigating Moon)

- ✓ Demonstrate pin-point landing on the moon.
- ✓ Targeted launch in JFY 2021.



Joint Lunar Polar Exploration Mission

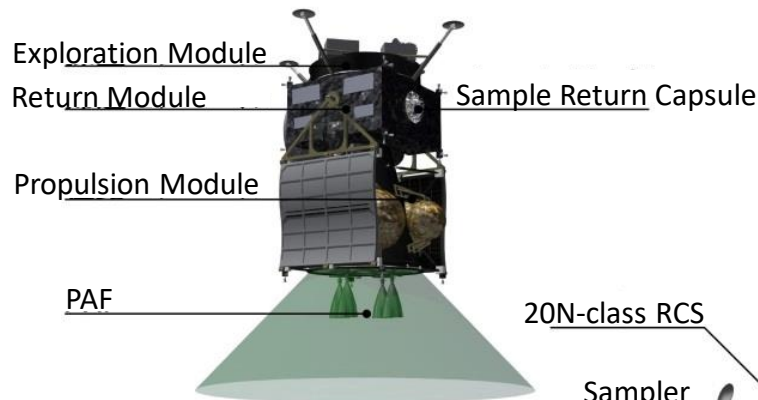
- ✓ JAXA-ISRO are conducting joint study on lunar polar exploration mission.
- ✓ Targeted launch in early 2020's.



Martian Moons eXploration (MMX)

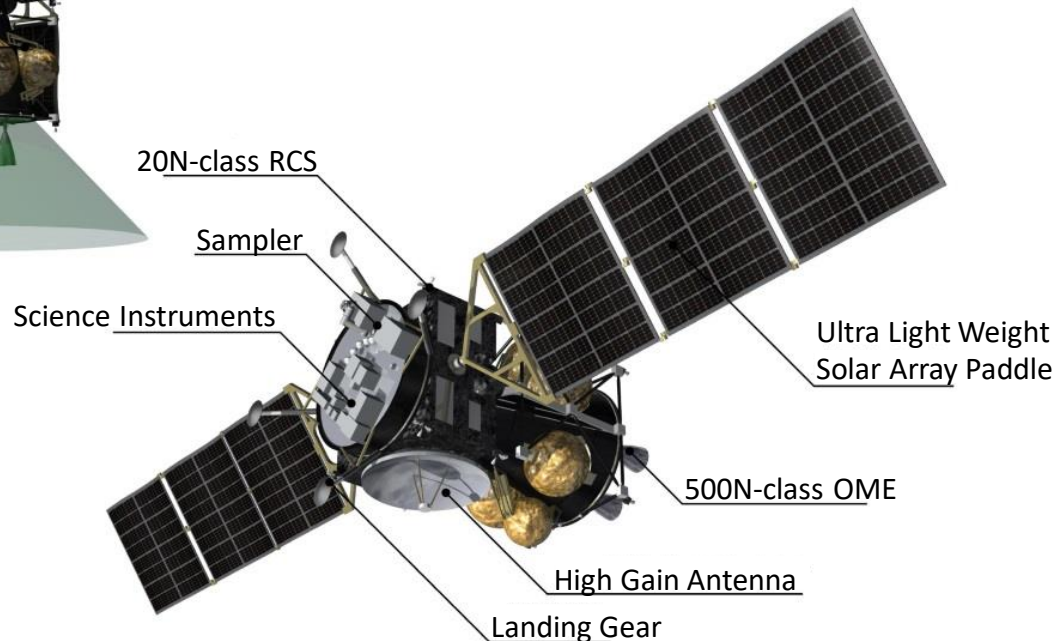
- ✓ Round trip to Martian system (Astronautics)
- ✓ Sophisticated sample retrieval technologies (Robotics)
- ✓ High rate mission data transmission (Communications)

Launch Configuration



Launch Mass : 3400kg
Mission Duration : 5 years

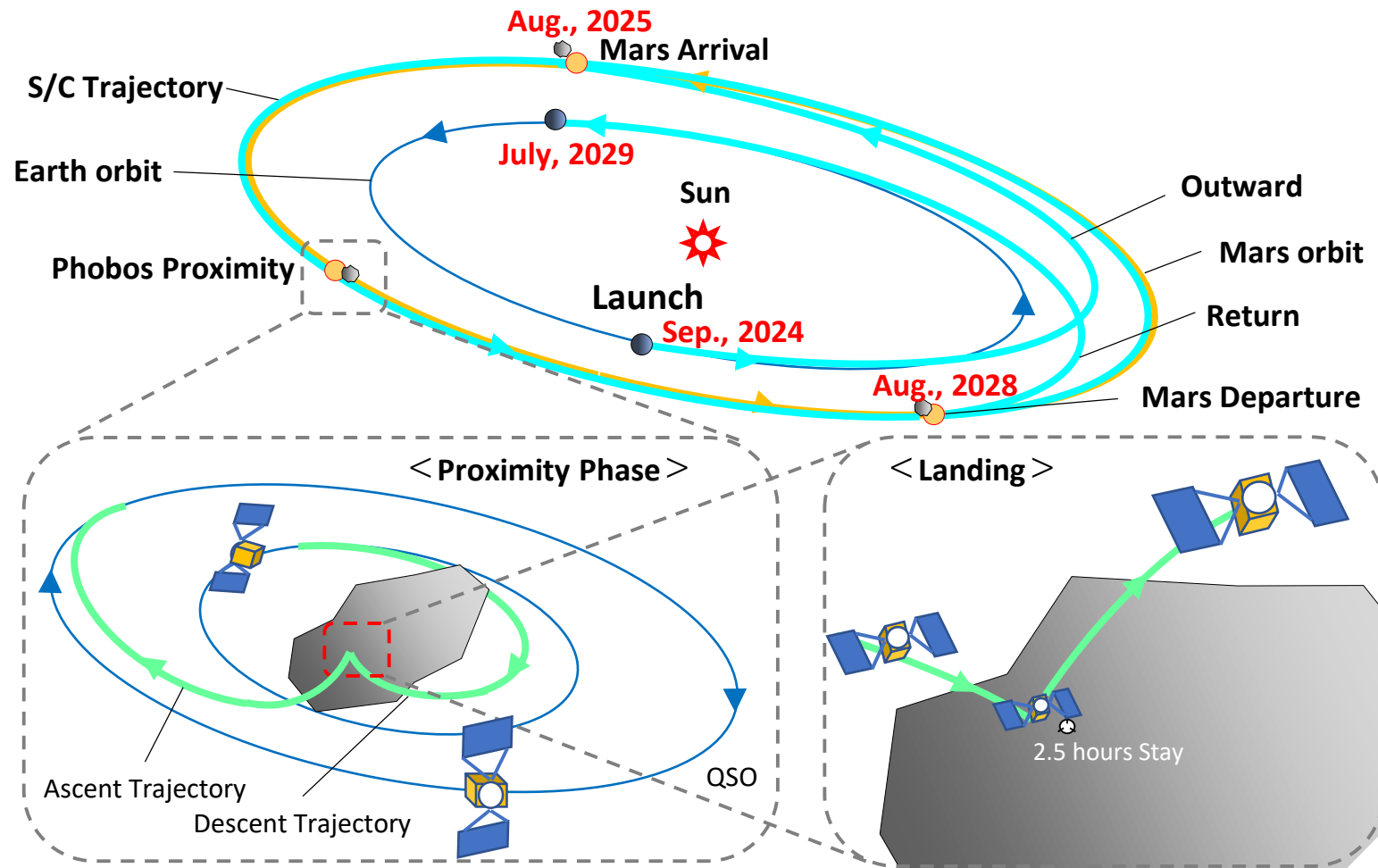
On-Orbit Configuration



(written above is an example, and could change in the future)

MMX Mission Profile

Interplanetary flight takes about 1 year for outward/homeward.
Trade-off study results in total **5 years trip**.



Open Innovative Explore Dual-use Technology to Ground and Space

Since 2015, JAXA and **private companies/research institutes** have brought together **cutting-edge technologies** for space exploration

- Exploration in a wide range of areas by distributed and collaborative multiple small spacecrafts
- Automatic and autonomous exploration
- In-situ resource utilization (ISRU)

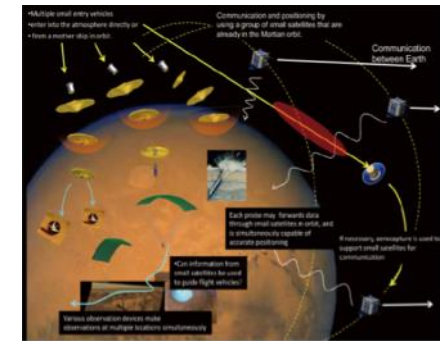
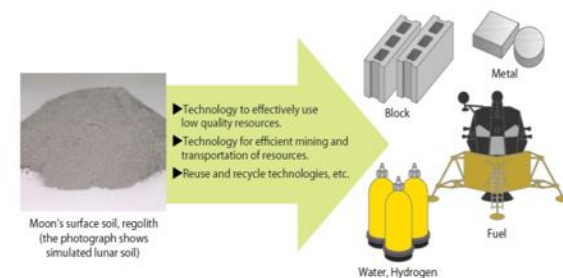
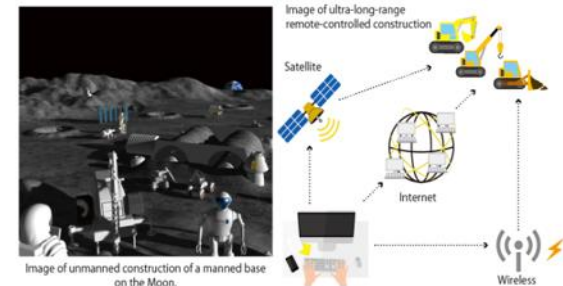
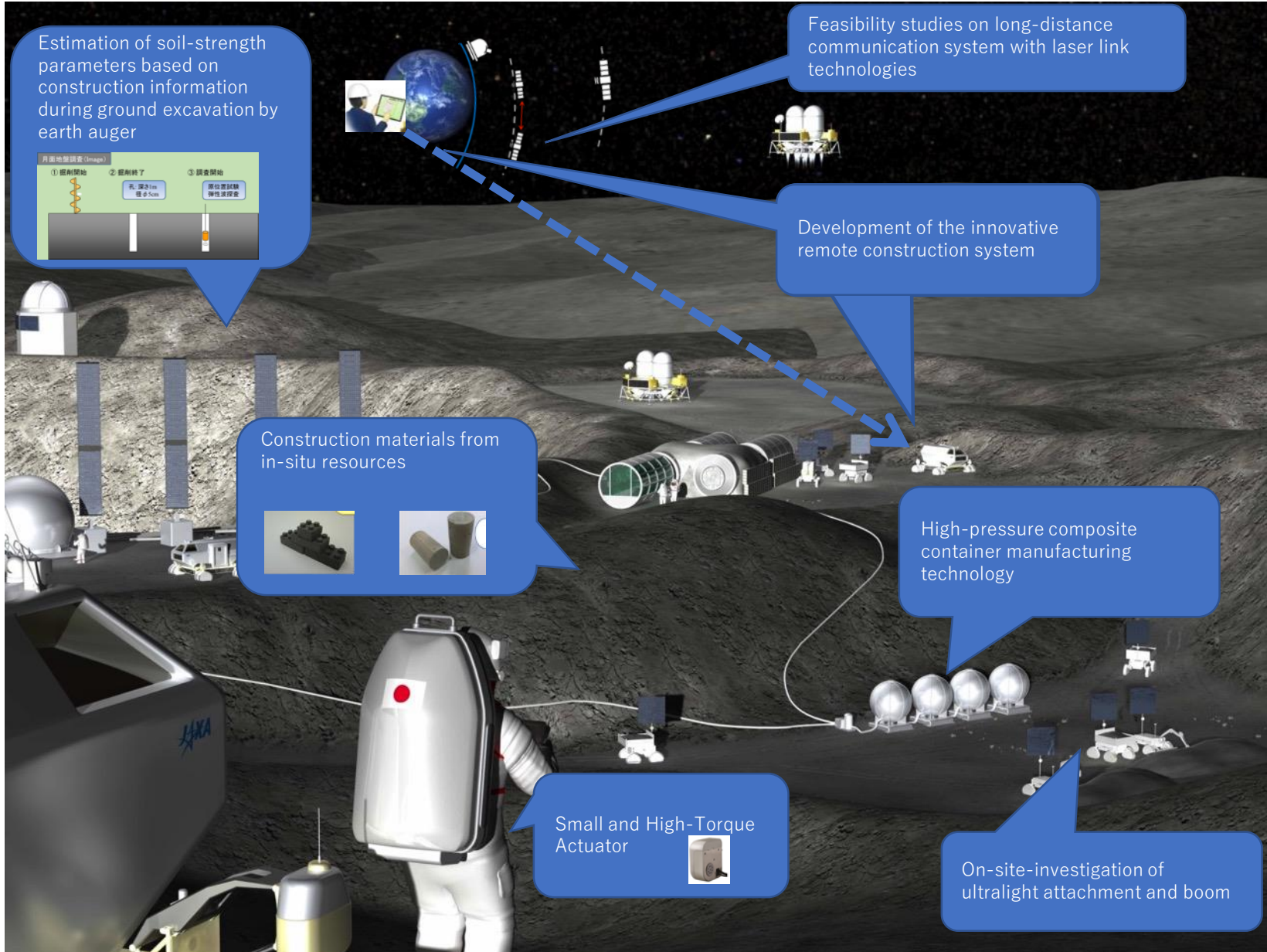


Image of cooperative exploration with multilanders




More than 90% of the companies are **from non-space industries** such as construction, housing, machinery, material etc..

Our Vision in Image –to give you an idea



Estimation of soil-strength parameters based on construction information during ground excavation by earth auger



① 掘削開始
② 掘削終了
③ 調査開始

孔深2m
径5cm

掘削試験
特性調査

Feasibility studies on long-distance communication system with laser link technologies

Development of the innovative remote construction system

Construction materials from in-situ resources



High-pressure composite container manufacturing technology

Small and High-Torque Actuator



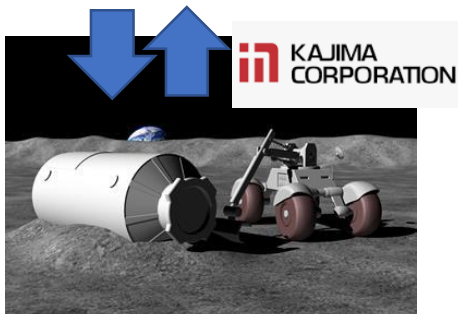
On-site-investigation of ultralight attachment and boom

Construction



At dam construction

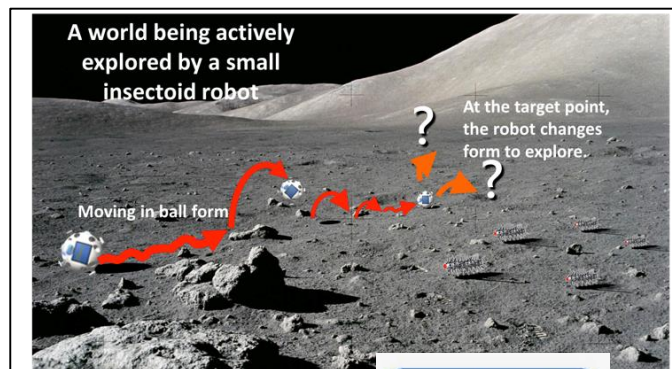
© Kajima Corp



Artist's rendering of a lunar outpost construction

- Remote controlled construction

Mini Robots Tech



- Insectoid robot for lunar surface activities

Agri Tech



袋培養設備



- Concept Study for Lunar Plant Factory

International Cooperation

- Utilization of Kibo -



- ✓ As of today, more than 200 satellites have been successfully deployed from Kibo.
- ✓ This year, 8 CubeSats developed by **Egypt, Guatemala, Indonesia, Mauritius, Nepal, Singapore, Sri Lanka, and Rwanda** will be deployed from J-SSOD.

JEM Small Satellite Orbital Deployer: J-SSOD



CubeSats developed by Sri Lanka and Nepal were handed over to JAXA Tsukuba Space Center in February, 2019

JAXA's vision for future cooperation in space exploration area



Many countries have deployed their country's CubeSats from ISS/Kibo.



Successful example of international collaboration.

How about a similar collaborative framework on the moon?

- Sustainability in space exploration requires wide participation from many players, including space emerging countries.
- Especially lunar surface exploration needs many opportunities of observation to fully understand the scientific features. Contribution from space emerging countries by rover or sensors are welcome.
- JAXA hopes to further promote space exploration activities, together with new players.