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JAXA 宇宙探査イノベーションハブの紹介

Introduction to JAXA's Space Exploration Innovation Hub Center efforts

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1. Overview

Japan Aerospace Exploration Agency (JAXA) plans to proceed towards Lunar and Martian exploration under the framework of international space exploration. The Moon and other planets have significant gravity fields, which means they have a high affinity for ground technology. Therefore, new developments will likely incorporate a blend of both space exploration and ground technology. JAXA's Space Exploration Innovation Hub Center (TansaX)[1] promotes research and development by bringing existing players and newcomers together, driving toward sustainable exploration in the Lunar domain and farther beyond.

2. TansaX initiative

2.1. Concept

Today, we are on the cusp of an exciting re-entry into human and robotic exploration of the Moon and farther beyond to Mars, within the framework of international cooperation. Several exploration projects are currently underway and being vigorously promoted. However, the increased size of spacecraft, the prolonged development periods, and the associated development costs have been significant challenges in exploration.

To realize efficient and challenging space exploration within a limited timeframe, it is crucial to infuse new design concepts and the exit strategy for technological development while leveraging the capabilities of the commercial sector and academia. While methods such as spin-in, where terrestrial technology is applied to space exploration, and spin-out, where space technology is adapted back to terrestrial use, have been attempted, they have not consistently led to truly innovative developments.

TansaX introduces a unique strategy to address these challenges. Its goal is to concurrently acquire space exploration technology through collaborative efforts with the industry and academia, fostering open innovation and driving the development of breakthrough technologies. This approach not only benefits space exploration but also enhances commercial ventures on the ground. It's often referred to as the "Dual Utilization"

[1] TansaX website, https://www.ihub-tansa.jaxa.jp/english/

approach (Reference Figure 1). What sets this approach apart from the conventional one is that JAXA doesn't solely issue development orders to external entities based on its research agendas; instead, it involves private companies and universities in joint development on a shared research agenda. This approach, adopted by TansaX, aims to lower the barriers for entry into space exploration for non-traditional space entities.

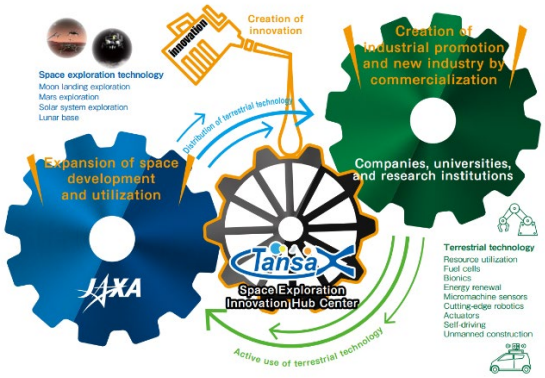

Figure 1. Concept of TansaX

2.2. Approach

To enable open innovation in research and development, TansaX employs a two-step approach for establishing joint research projects: a Request for Information (RFI) followed by a Request for Proposal (RFP). The RFI serves as a call for information, inviting private companies and universities to submit innovative technological concepts that could potentially overcome challenges in space exploration while also benefiting their own operations. JAXA then identifies technologies aligning with its exploration goals from the received RFIs and invites research proposals through the RFP process.

Participants to the TansaX initiative come from across Japan. The program received more than 1100 technical proposals that could potentially solve exploration challenges, and over 150 joint research projects have emerged. More than 230 entities participated, and remarkably, 90% of them were from the non-space sector, spanning various industry domains such as construction, health care, energy, material, chemical and more. Furthermore, private sector investment has exceeded government funding in promoting joint research activities.

3. Achievements

The collaborative research efforts undertaken by TansaX over the past nine years have yielded concrete results in terms of space exploration and technology demonstrations. One illustrative example is the transformable small Lunar robot, named SORA-Q, depicted in Figure 2. Joint research collaboration with JAXA commenced in 2016, focusing on the research theme "Small Robot Technology - Control Technology." This robot, SORA-Q, has been integrated into the "Small Lander for Investigating Moon – SLIM" mission. Upon landing on the Moon, it will acquire technical data about the Lunar surface. TOMI COMPANY, LTD has also

announced its plans to release a flagship model of the robot, a commercial based toy-product.

The Lunar Polar Exploration Mission (LUPEX) has integrated an imaging camera designed for water ice detection and a gas trace water meter, both of which stem from joint research conducted with TansaX (Reference Figure 3). These projects are now in the process of being prepared for installation in the LUPEX mission. Developed technologies will be used by the private companies to enhance their businesses on the ground.

Expanding beyond the domains of exploration rovers, sensors, and human habitation technologies, TansaX is on the verge of launching collaborative research endeavors aimed at shaping future infrastructure systems. In the ongoing 11th RFP, as of August 2023, TansaX has invited joint research proposals aimed at advancing energy generation, preservation, transportation, and utilization on the Lunar surface. These innovations are poised to significantly enhance both human and robotic exploration, by providing a more sustainable and scalable environment in the Lunar domain. TansaX's commitment to advancing Lunar exploration infrastructure, as well as science, along with the industry and academia remains steadfast as we press forward.

Figure 2. SORA-Q robot

Credit: TOMY COMPANY, LTD and Doshisha Univ.

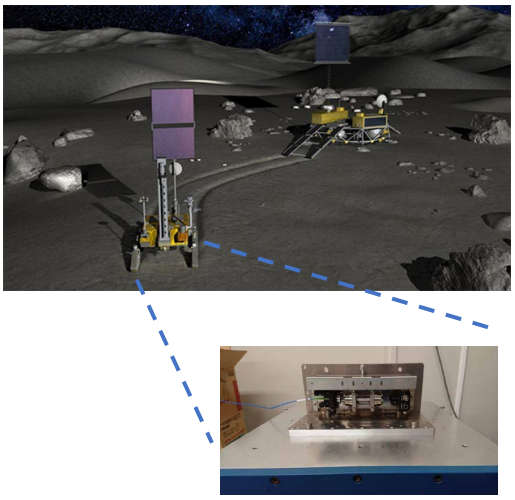

Figure 3. LUPEX and gas trace water meter

Credit: SHINYEI Technology Co., LTD., AIST, Osaka Univ., Ibaraki Univ., Kagoshima Univ., JAXA