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THE EVOLUTION OF AVATAR COLLABORATION IN SPACE: INNOVATION, OPPORTUNITIES  
AND CHALLENGES OF NEW SPACE BUSINESS DEVELOPMENT

**Abstract**

Recent expansion of space business will likely be the continuing trend, with the growth of private investment in various space activities. Governments of major space-faring countries are also putting emphasis on nurturing new space businesses in various ways, while implementing their own projects. On this premise, this paper will attempt to analyse the developments of collaboration among stakeholders such as space agency, private companies including start-up, academia, and local governments.

Japan Aerospace Exploration Agency (JAXA) partnered with ANA Holdings Inc. (ANA HD) and later with avatarin Inc (avatarin), a spin-out start-up company of ANA HD, in JAXA Space Innovation through Partnership and Co-creation (J-SPARC) initiative. It aims to catalyse new space-based business on real-world Avatar technologies. Avatar pursued by ANA HD and avatarin is essentially a robot controlled by a human that will enable a person to see, hear, feel and interact freely in a remote environment in real-time. It is a kind of disruptive innovation both for an airline company making profit by transporting passengers and space agency relying on astronauts for important tasks.

Building on previous works by the authors of this paper and Harvard Business School Case featuring this avatar collaboration, this paper sheds light on several aspects of innovation observed in the process, and the evolution of this collaboration. This pursuit of new space business started with the establishment of consortium open to companies and organizations from all sectors interested in using avatar technologies. Since then, this space avatar project partnership developed between avatarin and JAXA resulted in technology demonstration session in which a space avatar was deployed inside the Japanese experiment module of the International Space Station. The avatar was then made available for the general public to operate from a non-laboratory, public setting on Earth, which became the world's first successful event of this kind. Collaboration has continued, evolving with the participation of academia, aiming to examine, develop and demonstrate the use of space avatars in business and service areas. In February 2022, the early phase of collaboration was awarded the Prime Minister's prize, the highest prize of Japan Open Innovation Prize.

Questions that will be addressed include the respective roles of stakeholders to develop market-oriented technologies and backgrounds of such changes. It will also address momentum created through synergies between utilization of avatars in space and on the ground, as well as challenges associated with new business development.