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Strategies & Architectures as the Framework for Future Building Blocks in Space Exploration and Development (1)

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IN-SPACE ASSEMBLY PLATFORM: THE ENABLER FOR SWARM ROBOTIC IMPLEMENTATION INTO ORBIT

Abstract

The ISS has been the foundation for decades of robotic development and the enabler of immensely successful monolithic robotic concepts. These robotics were well suited to the international cooperation era of maximising capability within the space environment. Future space development in-orbit will be aiming for high-value operations and the development of commercial space opportunities. This will hinge on the success of the ISAM (In-Space Servicing, Assembly, and Manufacturing) sector, with what capabilities can exist in-orbit, and at what costs to space missions. This emerging field has had a recent high-profile mission cancellation in OSAM-1 and a stop-start nature post MEV-1 demonstrating on-orbit servicing. This work focusses on the strategic changes needed to mission architectures to allow for a successful market creation.

This paper proposes an In-Space Assembly Platform (ISAP) to host and enable robotic utilisation for the development of space. This architecture will be a key link in the future in-space supply chain, a multi-purpose in-space hub to drive forward the capabilities in-orbit across the sector. In essence a construction facility, that embodies the philosophy of an industrial revolution being brought into space, providing robustness to future space operations. This key supporting infrastructure will aid commercial interests in-orbit as well as the assembly and deployment of spacecraft structures that are larger than the launch fairing. The effect of this architecture on the space ecosystem is detailed within this work, with the varying potential capabilities being mapped to the strategic advantages that would be provided.

A key focus of the development of a platform to host multiple robotic entities, is to ensure that the movements within the industry to more cost-effective individual robotics, do not impact the ability to operate in-space. Current robotic trends highlight the push for more modularity at the expense of specialised functionality, an acceptance for higher failure rates, and capabilities to 'just' cover the mission requirements to avoid workload saturation. This is all with the aim to produce cheaper robotic alternatives, to enable more mission architectures and drive business away from 'set and forget' spacecraft, to reconfigurable spacecraft that can update their missions. The main solution for an individual loss in robotic operating ability, is to facilitate the hosting of multiple "simpler" robotic arms, which in a team-working capacity, can emulate factories and assembly lines on Earth and produce an output that far exceeds the current monolithic robotic concepts in the major performance indicators.