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

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AN ANALYTIC APPROACH TOWARD DETERMINING THE FUTURE OF THE INTERNATIONAL SPACE STATION (ISS)

Abstract

The International Space Station (ISS) is an international asset whose primary mission has evolved over the years due to a range of factors, including shifting priorities of political leadership from participating countries, budgetary constraints, and the inevitable alignment of expectations with reality. ISS was originally conceived to serve as a world-class laboratory for scientific research, a stepping stone to eventual human missions beyond low Earth orbit (LEO), a beacon of international leadership and diplomacy, and a hub of space commercialization. Although all of these themes have been present throughout the life of the program, the emphasis among them has periodically shifted. NASA, Roscosmos, ESA, JAXA, and CSA have committed to operate ISS through 2024, with existing NASA feasibility studies already concluding that it is possible to operate ISS through at least 2028. Considering the international investment into ISS of hundreds of billions of dollars, along with the international relations benefits this endeavor produces, what can be done with the ISS going forward given existing plans for human exploration beyond LEO and expected budget constraints?

Bryce Space and Technology has formulated and analyzed different ownership and operating concepts for ISS after 2024, with the intention of furthering the understanding of the breadth of possible alternatives for the future of ISS and the associated benefits and drawbacks of these alternatives. We evaluated multiple concepts, drawn from literature on the disposition of government assets, which run the spectrum from traditional government-owned and -operated concepts to full privatization. Included within this spectrum are various government-commercial combinations and the de-orbiting of ISS. In order to evaluate these concepts, further review of the literature was performed to identify and assess various Figures of Merit (FoMs) in order to elucidate the potential issues surrounding each possibility. We were then able to use these assessments to compare the unique benefits and drawbacks of each concept. A hierarchical structure of FoMs was developed, with the highest level categories represented as Economic, Strategic, Public Appeal, Science Technology, Risk, and Cost. Sensitivity analyses were performed to understand the impacts of internationalization, development of alternative space stations in LEO, and budget changes. Future human space exploration goals for each major space agency are considered.

Results are shown that can provide further insight into the tradeoffs and pitfalls of many potential issues surrounding what may be done with the ISS beyond its current funding lifetime.