

From Earth Missions to Deep Space Exploration (05)
International Plans and Concepts (4)

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VALUE-BASED DECISION MAKING FOR AN EVOLUTIONARY EXPLORATION PROGRAM

Abstract

NASA's current plans for human spaceflight include an evolutionary series of missions based on systematic technology development for returning to the Moon to test the viability of long-term human outposts, intercepting asteroids for science and planetary defense, and exploring Mars and the outer planets. Although the system architecture definition has the greatest impact on the eventual performance and cost of an exploration program, selecting an optimal architecture is a difficult task due to the lack of methods to adequately explore the architecture design space and the resource-intensive nature of architecture analysis. This paper presents an analysis of the net present value of the life cycle cost for space system architectures within an evolutionary exploration program. A modeling framework has been developed to mathematically represent the space system architecture design space using graph theory. The architecture design space, which includes staging locations, technology selection, and system functionality, for each mission destination is explored. Cost meta-models have been developed for each system type within the architecture, and these are used to compare options, taking into consideration the net present value of the entire evolutionary exploration program.