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SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Space Technology and System Management Practices and Tools (4)

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WHICH IS BETTER: PUTTING MANY EGGS INTO FEWER BASKETS OR FEWER EGGS INTO MANY BASKETS? A MODELING APPROACH TO EVALUATING SPACE RESEARCH AND DEVELOPMENT RESOURCE ALLOCATION

Abstract

Effective space R&D portfolio management is becoming an increasingly complex issue. Understanding the implications of today's R&D decisions for the effectiveness of future space missions is an area that remains largely unexplored. Choosing one option at the expense of others will have both obvious and subtle impacts on overall system design. These decision results can also be felt within the system as well as across related systems.

Given the complexity of constantly evolving technologies, understanding the impacts of particular decisions can prove difficult, if not impossible, to fully understand. Building on prior empirical work by the authors (presented in past IAC sessions), in this paper a model is developed that captures many of the ecosystem aspects of technology management. Pros and cons of investing resources into multiple smaller pathways versus fewer larger pathways are explored.

First, a so-called Garbage Can Model of Organizational Choice is developed that links R&D choices to problems and solutions as a function of organizational design. The energy (a function of time and money) required to generate various combinations of solutions as a function of discrete time steps is explored. This provides an understanding of how organizations can consider solving combinations of problems. The results of these choices are then mapped to design changes at the system level, using a design structure matrix (DSM), in order to measure the overall impact of combinations of possible decisions on spacecraft architecture. These combinations are iterated over time to understand possible technology combination evolutions as well as the space of alternative systems architectures. Examining the results of varying decision combination possibilities can help to help understand which choices lead to more rapid advancement both in terms of specific systems in addition to the broader architecture. Moreover, systems design iteration is explored to understand how particular changes impact the ability to make future design decisions by either creating new opportunity pathways or eliminating existing or potential future pathways.

This paper seeks to build a decision making framework that provides technology managers with additional insight into how they can make decisions that will have greater impact on accelerating technology development.