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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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ANALYZING THE TRADEOFFS AMONG RESOURCE INVESTMENT PROFILES FOR NASA'S SCIENTIFIC INSTRUMENT R&D ECOSYSTEM

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 systems design. Although NASA has achieved enormous successes across its history, it is constantly looking for methods to increase effectiveness and the pace of innovation, and over time there have been significant improvements. However, the reality of today's flat budget creates an imperative to seek increasingly efficient resource allocation strategies.

Building on prior empirical and modeling work by the authors (presented in past IAC sessions), this paper seeks to expand understanding of both the short and long-term effects of different allocations of funding and manpower across scientific instrument R&D portfolios. We explore the impacts of two classes of intervention: 1) strategies for allocating resources to technology development and 2) workforce policies controlling time allocation to R&D vs. project activities by individuals. These strategies are tested through computer experiments. The underlying model captures key interactions among technology portfolios, mission selection, and workforce learning. It is grounded in extensive empirical observations of NASA's innovation landscape. In doing so, we explore how technology portfolios, missions, and the workforce all interact with each other over time.

One of the main areas of exploration within this framework is the impact of spreading vs. narrowing of investments. Qualitatively, the logic is as follows: Certain technologies are unlikely to make any progress without a "critical-mass" level of investment; depending on the magnitude required for "critical-mass" this might consume a substantial portion of the available budget. At the same time, without a steady flow of funding to a particular functional area, there is a risk that the community of researchers will refocus their interests or leave the community altogether; limiting the potential for work in this functional area to be restored later. Thus, given the need to both achieve meaningful progress in priority areas and maintain the capacity to advance other areas later, how should finite resources be allocated? The unique ability of our model to capture the interdependent evolution of technologies and workforce capacity enables an exploration of the nature of the tradeoff to be unpacked across a range of fixed funding levels. We show how achieving an appropriate balance becomes critical below a threshold of resource availability.