Paper ID: 6799
student

SYMPOSIUM ON STEPPING STONES TO THE FUTURE: STRATEGIES, ARCHITECTURES, CONCEPTS AND TECHNOLOGIES (D3)
Joint Session on Space Technology and Systems Management Practices and Tools" – Part I (4)

Author: Prof. Zoe Szajnfarber
George Washington University, United States

Dr. Annalisa Weigel
Massachusetts Institute of Technology (MIT), United States

A PROCESS STUDY OF NASA'S SPACE SCIENCE INNOVATION SYSTEM

Abstract

Doing ground-breaking space-based science requires the continuous engineering of new, better, and more precise instruments. Yet, although innovation is implicit in space agencies' mission; lately, the sector has been heavily criticized for its performance in this respect [1, 2]. Innovation in this context is defined as the process through which new, cutting-edge technologies are conceived of, developed and integrated into space missions.[3] At NASA, innovation is nominally conducted, in a three stage innovation system. Promising ideas are initially explored through basic concept development. Next, the most promising of those concepts are further matured through applied RD. Finally, a very small subset of those, are infused into flight projects and undergo project-specific development. The flow of new concepts to implementation on flight projects is controlled by a series of gates – decision points, were progress is reviewed and the set of maturing capabilities that will go on to the next level are selected. The goal is to develop enough new capabilities now, so that future projects will be able to draw upon mature (i.e., low technology risk) versions of the capabilities they will require.

However, there is circular logic fundamental to this system. Projects need new technologies to accomplish their ambitious mission objectives, but prefer proven technology. A new technology isn't considered proven until it has been flown; in some cases, applied RD funding can't even be secured until interest from a flight project has been demonstrated. In practice, this Catch-22 is resolved through informal mechanisms; furthered by dedicated technologists, funded by programs that do not officially exist, and infused into flight projects via informal social interactions. Yet, current conceptual models of this innovation process (e.g., stage-gates [4, 5], policy windows [6, 7] and dynamic ambidexterity [8-11]), upon which many technology management decisions are currently based, do not capture the dynamics of the informal structure that has evolved. Preliminary evidence suggests that the current conceptualization is at best incomplete; at worst, wrong. This research seeks to develop a more complete, and nuanced, understanding of the mechanisms – formal and informal – which drive innovation at NASA, as a basis for future decisions. Specifically, it will address the following three research questions:

1) What is the structure of NASA's innovation system?

2) How do new capabilities traverse the innovation system as they are matured, and infused into flight projects?

3) Are there patterns of innovation mechanisms, important across multiple innovation pathways?