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Author: Mr. Abraham T. Grindle
Massachusetts Institute of Technology (MIT), United States

Prof. Zoe Szajnfarber
George Washington University, United States
Dr. Annalisa Weigel
Massachusetts Institute of Technology (MIT), United States
Dr. Olivier de Weck
Massachusetts Institute of Technology (MIT), United States

TECHNOLOGY INFUSION IN THE NASA INNOVATION SYSTEM: CHALLENGES AND OPPORTUNITIES AS VIEWED THROUGH THE RAMSES STTR

Abstract

In order to execute the current US space exploration strategy, considerable investment in advanced research and technology (R&T) must continue to occur, leading to the important question of how best to distribute and manage the finite resources available. Presently, government space projects are increasingly suffering from schedule and cost overruns (GAO, 2007). Characteristics of the government space market, with its monopsony-oligopoly structure and complex robust products, limit the effectiveness of traditional commercial/free-market innovation strategies when they are applied to the space sector. Previous work by the authors (Szajnfarber, Richards, and Weigel, 2008) argued that 5 fundamental issues characterize the space innovation challenge; while NASA's innovation system was not explicitly designed to address these specific challenges, it does address each to some degree. For example, multiple technology infusion/development programs exist within NASA, expressly to leverage the innovative capacity of entrant firms. However, although these programs have been relatively successful in accelerating the development of new "component" technologies, their record of infusion into the overall NASA innovation system is more ambiguous.

The SBIR program in particular, as a Congressional mandate, has received attention in the literature (NRC, 2008; Archibald and Finifter, 2001). However, the metrics used to assess its merit are illustrative of the complexity of accounting for innovation infusion. For example, a recent review by the National Research Council (NRC) judged the SBIR program to be a relative success. It cited the fact that 40% of SBIR contracts resulted in one or more peer-reviewed publications, 25% resulted in one or more patent applications, and 20% successfully obtained one or more patents (NRC, 2008). By the NRC's criteria, a recently completed NASA Phase II STTR project, Rule-Based Analytic Asset Management for Space Exploration Systems – "RAMSES" (Grindle, Shull, and de Weck, 2008) - would be considered successful, as it resulted in multiple publications and at least one patent application. Yet, although a functional prototype was demonstrated, NASA has not yet committed to adopting this technology or to infusing it into a larger spacecraft system; patents and publications are poor indicators for "architectural" fit. For R&T programs to be effective, in addition to generating new component technologies, they must also facilitate the components' integration into flight projects.

The crux of this duality is embodied in the difference between "component" and "architectural" dimensions of innovation, as articulated by Henderson and Clark (1990). Specifically, system-level innovation can result from improvements in the elements (components), the linkages among elements (architecture),

or a combination of the two. Radical innovation, the desired outcome of many advanced space programs, requires both component and architectural innovation. However, in the current NASA innovation system, less emphasis is placed on funding for - or mechanisms to encourage - architectural innovation. Using specific examples from the RAMSES STTR, interviews with both NASA managers and other SBIR/STTR award recipients, and building on Henderson & Clark's framework, this paper examines the nature of the SBIR/STTR programs' interfaces with the overall innovation system. In so doing, it will address the following questions: Firstly, how well is the SBIR/STTR process designed and implemented, in terms of delivering both useful component and architectural innovations, and what improvements could be made? Second, what is the interaction of NASA's SBIR/STTR program with NASA's macro innovation system?