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Viewpoint

Outcome-driven open innovation at NASA

Jennifer L. Gustetic [a,*], Jason Crusan [a], Steve Rader [b], Sam Ortega [c]

[a] NASA Headquarters, 300 E St SW, Washington, DC 20546, USA
[b] NASA Johnson Space Center, 2101 Nasa Parkway, Houston, TX 77058, USA
[c] NASA Marshall Space Flight Center, Huntsville, AL 35811, USA

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ABSTRACT

In an increasingly connected and networked world, the National Aeronautics and Space Administration (NASA) recognizes the value of the public as a strategic partner in addressing some of our most pressing challenges. The agency is working to more effectively harness the expertise, ingenuity, and creativity of individual members of the public by enabling, accelerating, and scaling the use of open innovation approaches including prizes, challenges, and crowdsourcing. As NASA's use of open innovation tools to solve a variety of types of problems and advance of number of outcomes continues to grow, challenge design is also becoming more sophisticated as our expertise and capacity (personnel, platforms, and partners) grows and develops. NASA has recently pivoted from talking about the benefits of challenge-driven approaches, to the outcomes these types of activities yield. Challenge design should be informed by desired outcomes that align with NASA's mission. This paper provides several case studies of NASA open innovation activities and maps the outcomes of those activities to a successful set of outcomes that challenges can help drive alongside traditional tools such as contracts, grants and partnerships.

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1. Introduction

In an increasingly connected and networked world, the National Aeronautics and Space Administration (NASA) recognizes the value of the public as a strategic partner in addressing some of our most pressing challenges. The agency is working to more effectively harness the expertise, ingenuity, and creativity of individual members of the public by enabling, accelerating, and scaling the use of open innovation approaches including prizes, challenges, and crowdsourcing. As stated by NASA Deputy Chief Technologist Jim Adams, “NASA recognizes that these methods present an extraordinary opportunity to inspire the development of transformative solutions by offering a means to engage with non-traditional sources of innovative ideas, all in a remarkably cost-effective way” [1].

At NASA, prizes, challenges and crowdsourcing complement our other traditional problem solving approaches to create a robust toolset of innovation approaches for use by a variety of programs. NASA has been a leader in the United States' use of prize competitions for quite some time. The White House recognized this leadership in their 2011 Report to Congress on prize competitions: “From the Centennial Challenges Program, to the NASA Open Innovation Pavilion, to the NASA Tournament Lab, NASA leads the public sector in the breadth and depth of experience and experimentation with prizes and challenges … [NASA is] best positioned to demonstrate results from the use of prizes and challenges. Examples and case studies from prizes and challenges run by [NASA] highlight[s] what can be expected from all Federal agencies as they begin using prizes for open innovation.” [2] Thus NASA is not only seen as a leader in this space, but also as setting the pace for future experimentation and teaching the rest of the government and the world.

NASA is supporting and learning from other Federal agency's prize competitions as well through the NASA Center of Excellence for Collaborative Innovation (CoECI) [3]. The CoECI was launched in November 2011 to advance the use of collaborative innovation techniques to improve Government missions. The CoECI helps NASA centers and other US Federal government programs run their first challenge driven open innovation activities.

This paper will highlight several case studies that show the

* Corresponding author. Present address: 300 E St SW, Washington, DC 20546, USA.
E-mail addresses: jennifer.l.gustetic@nasa.gov (J.L. Gustetic), jason.crusan@nasa.gov (J. Crusan), steven.n.rader@nasa.gov (S. Rader), sam.ortega@nasa.gov (S. Ortega).

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diversity of purposes and impacts open innovation have in stimulating space-related activities, including:

- Realizing new cost savings and encouraging the development of better products and solutions "on demand"
- Enabling NASA to bring out-of-discipline perspectives to bear and reach beyond the "usual suspects" to increase the number of minds tackling NASA's problem
- Stimulating the development of new commercial markets and thus new opportunities for business and jobs to form

2. Challenge programs and definitions

The United States Federal Government has been encouraged to find new and improved ways of solving problems and driving innovation through the use of existing/emerging open innovation tools and challenge platforms. The National Aeronautics and Space Administration (NASA) has adopted policy [4] to encourage the use of challenges, including prize competitions and crowdsourcing activities, to further the Agency's mission at all levels of the NASA organization. This section will describe NASA's definitions for terms such as prize, challenge, and crowdsourcing, which have non standard definitions across sectors and even within the US Federal government. It will also describe the structure and relationships between NASA's various prize and challenge programs.

NASA's Policy Directive 1090.1 [4] defines and explains the terms "challenges", "prize competitions", and "crowdsourcing" as follows. Collectively, these methods are broadly referred to as "Open Innovation" throughout this paper:

- Challenges use a focused problem-statement approach to obtain solutions and/or stimulate innovation from a broad, sometimes undefined, public rather than a specific, named group or individual. Prize competitions and crowdsourcing are two specific techniques for implementing Challenges.
- A challenge implemented as a prize competition is intended to stimulate innovation in a manner that has the potential to advance NASA's mission through the offer of a competitive award (e.g., those prize competitions implemented by NASA's Centennial Challenges Program). These challenges are typically administered by NASA or a third party allied organization and offered directly to the public.
- A challenge implemented through crowdsourcing is intended to solicit products, services, ideas, or content contributions from many people, often (but not necessarily) through the Internet, and may result in the making of award(s) (e.g., NASA Tournament Lab and NASA Innovation Pavilion). An award can be any form of recognition provided to a participant in a challenge, including a cash payment, value other than cash (e.g., payment of travel expenses, accommodation on a launch vehicle) and other forms of reward (e.g., recognition, invitation to an event) [4]. Crowdsourcing may use either NASA employees or external communities, may be for idea generation, strategic technology assay, product or service construct, education/outreach, or may be used to repurpose NASA technologies for earth-space benefit. These challenges are typically run using existing communities that are often organized or "curated" by commercial companies. While the communities are built and maintained by commercial entities, they tend to be open for anyone in the public to join and participate.

Offices and programs throughout NASA use prizes and crowdsourcing to address challenging problems for the Agency. NASA's Office of the Chief Technologist (OCT) provides strategy and policy for open innovation at NASA and plays a coordinating role for these numerous open innovation programs and projects, including:

- Since 2005, NASA's Centennial Challenge Program [5] has directly engaged the public at large in the process of advanced technology development that is of value to NASA's missions and to the aerospace community through prize competitions. The Centennial Challenges Program is part of the Space Technology Mission Directorate (STMD).
- In 2011, NASA established the CoECI to coordinate NASA's use of challenges implemented through crowdsourcing and to advance the use of open innovation methodologies to improve its own and other Agency missions. The CoECI is a Government-led, virtual center of excellence that serves to harness and redistribute the government's collective experience in, and best practices for, Open Innovation. The CoECI is supported jointly by NASA's Human Exploration and Operations Mission Directorate (HEOMD) and the Office of the Chief Technologist (OCT) and operated with support of the Human Health and Performance Directorate at the Johnson Space Center. The CoECI administers the NASA Tournament Lab [6], the NASA Innovation Pavilion [7], and NASA@Work [8]. CoECI uses these platforms to run challenges for both NASA internal projects and across other government agencies in an effort to introduce and infuse these new open innovation methods across all federal agencies.
- Several NASA offices have supported individual open innovation projects including: the Office of the Chief Information Officer has conducted the Annual International Space Apps Challenge [9] and the Office of Education has supported a number of education challenges including the Robotic Mining Challenge (formerly known as Lunabotics) [10].

3. Moving from benefits and types to outcomes

To date, many of the third party reports and Unites States Federal Government policy and guidance documents on open innovation have focused on the benefits of using the incentive prize approach or structural observations about prize "type". For example, one Office of Management and Budget Memorandum from 2010 lists the following benefits to the prize approach:

- Establish an important goal without having to choose the approach or the team that is most likely to succeed
- Pay only for results
- Highlight excellence in a particular domain of human endeavor to motivate, inspire, and guide others
- Increase the number and diversity of the individuals, organizations, and teams that are addressing a particular problem or challenge of national or international significance
- Improve the skills of the participants in the competition
- Stimulate private sector investment that is many times greater than the cash value of the prize
- Further a Federal Agency's Mission by attracting more interest and attention to a defined program, activity, or issue of concern
- Capture the public imagination and change the public's perception of what is possible [11].

At NASA, we believe that as the sophistication of challenge design grows however, the conversation should not focus on the benefits of the approach or challenge structure itself, but instead on the results and outcomes that challenges can provide. Furthermore, a clear understanding of intended outcomes from a challenge should be a guiding design factor in how challenges are designed and structured from the beginning. Outcomes should not be an