

Participatory Exploration Policy Recommendations for the National Aeronautics and Space Administration

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Synopsis:

This paper discusses the role of “participatory exploration” as applied to NASA programs and projects, and describes how interested parties can contribute in a meaningful and useful way to the NASA mission. It provides a brief background on workforce, technology, and innovation challenges facing the agency. An overview is given on legislation passed in 2008 requiring NASA to engage the American public in the exploration experience and to identify opportunities for the direct involvement of the public, the private sector, nongovernmental organizations, and international partners.

Participatory exploration can be implemented via a user contribution system that adds measurable value through the aggregation of voluntary contributions from participants both inside and outside the NASA community. Examples of projects and programs within NASA that have successfully utilized user contribution systems and the benefits garnered through these systems are provided. In particular, specific recommendations for future participatory exploration initiatives are given based on experiences from the NASA CoLab project. Finally, the paper recommends several ways to address the requests of legislation, foremost among them creating a Participatory Exploration Group at NASA Headquarters to serve as a coordinating body for related initiatives and technologies across the Agency.

Background:

Since its inception, NASA has played a critical role as a world leader in science and technology, building a rich legacy of developing cutting-edge technology and making ground-breaking discoveries. Historically, those outside the walls of NASA and its many contractors have not played a substantial role in executing the Agency's mission; most of NASA's work has been the exclusive purview of a structured workforce of engineers and scientists.

Meanwhile, the rapid evolution of the Internet over the past two decades has fundamentally changed the way the world interacts. In recent years, a trend towards more widespread adoption of collaborative and participatory Web environments has emerged, resulting in the development of information and communication platforms that have transformed entire industries. Digital tools used for collaboration and information integration, such as Wikipedia, Facebook, YouTube, and Twitter, are becoming fundamental for enterprises to remain competitive in many major industries.¹

¹ *Application of Open Collaboration Technologies at NASA*. International Space University, Stiles, 2008

As demographics of the workforce evolve and the effects of globalization find their way into the work environment at NASA, the Agency will face significant new challenges. NASA has historically competed with industry to attract, hire, and retain a vibrant workforce, and this remains true today. However, workforce issues are compounded with a growing technical talent gap in the United States² related to Science, Technology, Engineering, and Mathematics (STEM) education. Additionally, the Agency continues to struggle to stay current with, let alone leverage, the latest business and innovation practices due to its reliance on organizational knowledge and time-hardened management practices.

Both programmatic and cultural solutions to these challenges are needed. Participatory exploration initiatives enabled by Web technologies and designed to explicitly promote collaboration both internally and externally, give NASA the potential to improve its business efficiency, and to attract workforce talent who not only meet the technical needs of the agency, but who are increasingly savvy in utilizing these tools in the workplace.

Participatory Exploration as a User Contribution System

Participatory exploration allows people from outside the NASA workforce, as well as within, to contribute in meaningful ways to their space program. The concept of participatory exploration was initially discussed in 2007 at the NASA Participatory Exploration Summit at Ames Research Center³. Participatory exploration was prioritized in the **National Aeronautics and Space Administration Authorization Act of 2008 (H.R.6063)**, stating:

“The Administrator shall develop a technology plan to enable dissemination of information to the public to allow the public to experience missions to the Moon, Mars, or other bodies within our solar system by leveraging advanced exploration technologies. The plan shall identify opportunities to leverage technologies in NASA’s Constellation systems that deliver a rich, multi-media experience to the public, and that facilitate participation by the public, the private sector, nongovernmental organizations, and international partners...”

Thus, not only is participatory exploration vital to NASA’s continued public relevance in the 21st century, the Agency has a clear mandate from Congress to pursue such opportunities. This raises the question of what form participatory exploration might take.

Another way to think about participatory exploration is in terms of a “user contribution system.” In the 2008 Harvard Business School article, *The Contribution Revolution: Letting Volunteers Build Your Business*, Intuit co-founder Scott Cook discussed his company’s drive to create a user contribution system as a way of “*aggregating and leveraging people’s contributions or behaviors in ways that are useful to other people.*” Also discussed are a number of companies that have extended open invitations to anyone from inside the company or outside alike – including

² Discussion at Committee on Prospering in the Global Economy of the 21st Century. (2007). *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*. Washington, DC: National Academies Press 2. PISA 2006 and 2003 studies

³ Proceedings of the Participatory Exploration Summit, NASA/CP--2007-214566, 2007.

employees, sales prospects, customers, and even critics – to voluntarily contribute in various ways to the mission of their enterprise.

Companies ranging from Hyatt to Best Buy to Proctor & Gamble to Starbucks, as well as leading Internet-only enterprises, now incorporate user-generated content through integrated online user contribution systems. Such systems create value for the business as a reciprocal consequence of the value they deliver to users, which can take the form of faster access to more relevant information (such as personalized purchase recommendations), new personal or business relationships, organization of personally selected and relevant content, and lower prices for content and services. This new user-generated utility also engenders a sense of accomplishment from contributing users and creates intense brand loyalty.

Benefits of Participatory Exploration to NASA

Leveraging participatory exploration through a user contribution system at NASA could help address many problems the Agency faces today, ranging from flagging public interest in the space program to the accelerating rate of new technology development in the private sector. The process for sourcing new ideas, solving difficult problems, or completing laborious tasks could be opened up through participatory exploration initiatives and transformed into a more organic and horizontally integrated process, in order to leverage the diversity and volume of talent and labor that is available outside of any given internal NASA workgroup.

Innovation and Problem Solving

Pairing the needs of NASA's experts with external talent could help NASA create a new, more sustainable process for innovation and problem solving, and thus help NASA more efficiently execute its mission.⁴ A user contribution system could enable NASA to "crowdsource" problem-solving, allowing millions of people external to the Agency, some of whom may have just the right combination of experience and expertise that is not available internally, to develop an innovative solution to a particular problem. Unfortunately, the current workplace culture and organizational structure within NASA does not often encourage the use of these more open and inclusive business practices. New ideas typically emerge from small "pockets of innovation" within NASA, usually confined to a relatively small network of people, and then climb through the bureaucratic approval tiers of management until they are either dismissed or adopted. However, the most knowledgeable or talented person to work on a particular task may not always already work for NASA or in the part of NASA where the particular need arose.

⁴ *The Value of Openness in Scientific Problem Solving*. Harvard Business School Working Paper, No. 07-050, Lakhani, et al., 2006.

Workforce Development

As discussed at the NASA Senior Management Council in April 2008⁵, participatory exploration can also serve as a bridge between the culture of a large government bureaucracy and a new generation of scientists and engineers intimately familiar with collaborative web technologies. However, current workforce policies do not readily permit NASA employees to leverage social media tools in the context of their ideas and their work. Despite the mandate for communicating the value of its work to the public, NASA lacks a comprehensive published policy for social media usage or inviting ideas from outside the organization. Thus, the burden typically rests on individual employees to ask for permission from their management to communicate with the public and other employees in open environments. Participatory exploration initiatives would bring the Agency back into a competitively innovative light for this new generation.

Public Outreach

NASA.gov reaches millions of people, but content is typically processed, edited, and moderated to such a degree that it 'sanitizes' NASA and shares none of the challenges, drama, and passion that drew many engineers, scientists, and enthusiasts to the space program in the first place. There is no opportunity for user-generated content either from the public or from a broader array of NASA employees other than the authorized Web Content Managers, which renders the "voice" of NASA far narrower and less engaging than it could otherwise be. Furthermore, when data and other content is released to the public it is typically done in a way that makes it difficult for third-parties to "mash-up"⁶ the NASA data with content from other sources and republish it in other useful forms.

NASA's public image, and its ability to return value to taxpayers, would benefit immensely from adopting well-established enterprise best practices for leveraging user-generated content, fostering online collaboration, and publishing content consistently and openly.⁷

Examples of Participatory Exploration

A number of projects have successfully used participatory exploration and helped define the concept. Examples of projects within NASA include:

- [Stardust@Home](#), where participants search for tracks of embedded interstellar particles from the Stardust Mission by looking at nearly a million online "focus movies" as only the

⁵ Next-Generation Presentation to the NASA Strategic Management Council.
<http://www.nasa.gov/news/reports>, 2008

⁶ In web development, a mashup is a web application that combines data from more than one source into a single integrated tool. The term Mashup implies easy, fast integration, frequently done by access to open APIs and data sources to produce results data owners had no idea could be produced. An example is the use of cartographic data from Google Maps to add location information to real-estate data, thereby creating a new and distinct web service that was not originally provided by either source. Wikipedia.org, 2008.

⁷ *The Future of Innovation: An ILO Institute Research Study*. ILO Institute, 2005.

- acuity of human eyes can.
- [NASA World Wind](#), a 3D planetary visualization tool developed in open source and used widely by academics, government agencies, and the public.
 - [Clickworkers](#), where volunteers perform image analyses for data from sources such as the HiRISE camera and the Dawn mission.
 - [Centennial Challenges](#), the NASA program where anyone is invited to solve challenges offered by NASA for a prize purse.
 - [MY NASA DATA](#), which offers authentic and usable Earth science data and explanatory resources and information to any public citizen scientist.

Examples of successful projects external to NASA include:

- [Galaxy Zoo](#), where participants classify images of galaxies taken by the Sloan Digital Sky Survey 2.5-m wide-angle optical telescope.
- [Google Lunar X Prize](#), an open competition to land a robot on the Moon, navigate it across the surface, and return images to Earth for part of a \$30 million prize purse.
- [SETI@Home](#), where people donate their computer's otherwise inactive time towards a SETI screen saver program that helps analyze data in the search for radio signals from possible extraterrestrial sources.
- [Folding@Home](#), the most powerful distributed computing cluster in the world and a Stanford project utilizing donated computer and PlayStation 3 CPU time to simulate protein folding. PlayStation 3 users also get news, weather, music, and a virtual globe while the simulation is running.

Although these projects are individually very successful, they are all independent efforts and do not benefit from an overarching strategy. There is no common codebase, no re-useable infrastructure, no set of best practices, and no knowledge base related to policy on public engagement. The result is that programs spend more human resources than should be necessary re-implementing features, re-discovering policies, and appealing to management for 'special case' consideration when, in fact, similar activities are already happening around the Agency.

Furthermore, there is no common repository that promotes these and similar opportunities. SpaceHack.org - a website where users can find and submit participatory space projects to share - is a good start, but is run externally by an enthusiastic space supporter.

Accomplishments and Lessons Learned from the NASA CoLab Initiative

Officially supported from February 2007 through November 2008, NASA CoLab was initially established to encourage participatory exploration at NASA and facilitate the connection of communities inside and outside of NASA, primarily through the use of online tools and in-person encounters. Supported by the Innovative Partnership Program and a large volunteer-driven community, NASA CoLab prototyped new public engagement methods through online community building and offline co-working of people with focus in different areas, initiating NASA's use of certain leading-edge Web 2.0 tools and techniques, and identifying the need for an open source software repository. NASA CoLab also organized conferences to engage internal and external experts in creating and sharing best practices for participatory exploration and other innovative collaboration efforts across the Agency. Specific accomplishments included:

- Evaluating new collaboration technologies, such as the micro-blogging service Twitter, and introducing them to NASA management prior to their widespread use within the Agency.
- Researching and implementing offline co-working spaces, both on NASA property and in urban centers, in order to connect working professionals with the public and infuse fresh ideas into the Agency.
- Regularly introducing Web 2.0 thought leaders and companies to NASA management.
- Regularly hosting events outside of NASA in which NASA’s work was introduced to communities of thought leaders in technology and media.
- Building an ongoing collaborative community of NASA and non-NASA volunteers from around the world through the first NASA use of the virtual world Second Life.
- Creating and propagating in mainstream and alternative media the meme of participatory exploration and NASA’s potential to be a leader in adopting “Government 2.0” practices.

Although the NASA CoLab project is no longer financially supported by NASA, it serves as a valuable prototype of a technology-driven organizational change effort within government. The lessons learned from the project are highly relevant to future participatory exploration initiatives at NASA and include:

- There is a strong interest in participatory exploration from existing NASA projects and from the public.
- A large familiarity gap exists between those who have grown up with collaborative technologies and those less familiar with them.
- In many cases, there is a natural fear or aversion to the unknown and, in some cases, even a strong suspicion that foundational collaborative technologies, such as instant messaging, can only be used for amusement.
- The benefits of collaborative technologies can be easily mis-communicated or over-hyped if an example is not given to demonstrate the value and relevancy of the tool to mission-related programs or projects.
- There is a frequent misconception that participatory projects do not have, or have very little, overhead. There is a cost required for the development of user contribution systems and the engagement of a wider audience through community management. Without defined resources, innovators are required to seek funding from existing projects to support non-traditional approaches. This is particularly difficult with current incentive structures that reward process rather than product, and consistency rather than innovation.
- Participatory exploration initiatives would immensely benefit from pilot projects. Pilot projects are needed for alpha and beta testing to iterate through initial challenges before widespread adoption, as well as to offer a developmental safe haven in order to successfully launch the project.

Recommendations

While there are many advantages and benefits to participatory exploration at NASA, there are also many challenges to overcome. We offer the following recommendations, based on our experiences, for moving forward with participatory exploration initiatives:

Eliminate the obstacles to working with the public:

- Increase the use of open-source software by creating clear policy guidelines, communities of practice, and hosting infrastructure that make it easier for NASA staff to use, produce, and receive contributions to open-source software projects. Formalize requirements for a continuous release process, whereby open source projects are not required to navigate complex approval processes, thus reducing the burden on developers, lawyers, and managers.
- Capitalize on the upcoming re-competition of NASA's website by actively infusing requirements for the development of NASA.gov as a user contribution system in the website requirements development process that is underway now.
- Create a single user account system for participatory websites that leverages the emerging OpenID⁸ and OAuth⁹ Web standards for user identification and authentication, possibly by extending the existing MyNASA account system, in order to reduce the entry barrier for new forms of participation.

Increase the availability of NASA knowledge and data:

- Build and mandate adherence to standards and open APIs¹⁰ for all NASA data sets. NASA arguably generates the largest volume of public data in the world. Today, although much of it is public, mission data is typically in specialized formats that require custom tools and an in-depth knowledge of the mission to make use of it. Creating a common interface would allow not just enhanced value to be derived from this data but also facilitate the formation of a community of users who could support it.
- Improve internal knowledge-sharing between technical and business groups within NASA through co-working, community building, collaboration tools, and improved knowledge management systems, and expand those practices to interactions between NASA and the public.
- Develop a rich, extensible, and user-editable directory of employee skills, interests, and projects, to enhance internal collaboration and facilitate connections *inside* the Agency and its contractor community.

⁸ OpenID is an open, decentralized user identification standard, allowing users to log onto many services with the same digital identity. Wikipedia, 2008.

⁹ OAuth is an open protocol to allow secure API authorization in a simple and standard method for desktop, mobile and web applications. Wikipedia, 2008.

¹⁰ An application programming interface (API) is a set of functions, procedures, methods, classes or protocols that an operating system, library or service provides to support requests made by computer programs. Wikipedia, 2008.

- Implement categories and “tagging” on all NASA web content, policies, and internal directories.
- Formally approve and provide hosting for open, public research notes and lab books for scientists and engineers, where the research process can be made transparent, accountability improved, and feedback generated.
- Refine policies on controlled space-related technology to clearly define which technologies are truly sensitive and why.
- Shift the burden of proof in the release of information from the need to show that information is “safe” to publish to the need to show the information “is not safe” to publish. Implement time limits on response to forms requesting release by setting a default action of approval. Increase accountability by digitizing forms and allowing employees to track their request through the approval process.
- Make consideration of public participatory exploration opportunities a required element in the management of programs and projects, as well as mission design by including it as a level-1 requirement in project or mission planning.

Modify communication practices:

- Integrate participatory exploration, as defined in this paper, into the Agency’s Strategic Communications Strategy.
- Develop a communications policy that nominally encourages open publication of all internal Agency communications and establishes withholding of information as the anomaly requiring specific justification.
- Deploy agency-wide Web 2.0 communication tools, policies, and processes, such as those used by the world’s leading private technology enterprises.
- Benchmark successful organizations that have deployed and integrated Web 2.0 communications tools, policies, and processes.
- Provide an official structure to encourage, train, and support non-communications employees interested in public communications roles so that they may interact with the newly-contacted communities of which they may already be a part.
- Consider corporate blogging experience and online community-building and management skills when hiring communications staff, and allow people with those skills to implement best practices from those experiences.
- Build voluntary collaborative communities and create formal processes to leverage the time and skill of these communities for practical benefit to NASA programs and projects.
- Highlight and build on examples of successful crowdsourcing at NASA, as described in the section on Examples of Participatory Exploration.
- Open up ports for Instant Messaging, Internet Relay Chat, and Second Life on internal NASA networks, and clarify their approved use in facilitating work-related communication and collaboration.
- Actively avoid over-defining the exact use of web tools through policy, as such mandates cannot stay up to date and can inhibit the adoption of new tools.

Ensure support for widespread implementation of participatory exploration:

- Create a Participatory Exploration Group at NASA Headquarters that draws on staff from the CIO, Strategic Communications, and other relevant organizations (both internal and

- external) to serve as a coordinating body for related initiatives and technologies at the Agency level.
- The Participatory Exploration Group could also serve as advocates for relevant initiatives at the Center level, helping ensure local needs are met while still communicating a unified vision for NASA.
 - Fund the Participatory Exploration Group with an appropriate budget as a specific source of resources to create participatory exploration infrastructure and community.

Conclusion

Participatory exploration can help NASA address some of its most pressing challenges, including the changing demographics of the workforce, the effects of globalization, the need to keep pace with accelerating technological innovations, flagging public interest in NASA's work, and the need to accomplish an increasingly audacious mission with increasingly limited resources.

NASA has a number of examples of successful participatory exploration initiatives within current programs and projects that the new Administration can study. Notably, the NASA CoLab project generated and documented valuable experiences on how to implement participatory exploration at NASA.

Senior management can help NASA become a more efficient, effective, and transparent Agency by leveraging the opportunity that participatory exploration presents. Collaborative web technologies implemented as user contribution systems can enhance the Agency's ability to accomplish its mission by culling from a wider marketplace of ideas. An important first step would be to establish a Participatory Exploration Group at NASA Headquarters to coordinate participatory exploration-related initiatives and technologies across the Agency.

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