K2020 at ARC: One NASA Knowledge Strategy in a Federated Model

By Larry Prusak and Mark Schwartz

Between December 1 and 3, 2015, nearly 50 practitioners from the NASA knowledge community convened at the historic Dolce Hayes Mansion and the NASA Ames Research Center (ARC), both located in San Jose, California, for the third Knowledge 2020 event hosted by Dr. Edward Hoffman, NASA's Chief Knowledge Officer (CKO).

This third Knowledge 2020, designed to be the most NASA-driven meeting in the ongoing program, afforded participants time to make great progress over just a few of days: the agenda centered on the challenge of creating an agency-wide Knowledge Strategy among a network built upon a federated model. To that end, Dr. David Oberhettinger, Jet Propulsion Lab CKO, who wrote a framework document for this challenge, launched the first working group at the event, guiding several teams of participants through the framework that would begin the process.

Aims and Challenges

K2020 3.0, similar to the two previous events, focused on developing actions of the NASA knowledge strategy efforts in both theory and in practice: the participants, special guests, and presenters were an engaged and engaging mix of practitioners. Since the entire NASA knowledge program is an ongoing concern, this event was in keeping with the NASA policy and objectives of an evolving and dynamic knowledge project that is open to new ideas. The broader objectives of K2020 3.0, as stated by NASA CKO Hoffman, were similar to previous K2020s and are as follows:

- To actively engage speakers in sharing critical lessons that occur throughout the agency.
- To focus on new ideas that can help NASA in its many challenges.
- To provide a forum for comparisons and comparative solutions.
- To provide a space to build and enhance existing networks where knowledge can be developed and shared.
- To create an environment for reflection needed for learning to be socialized.

In his welcome at the Dolce Hayes, Hoffman introduced several of the themes to be addressed by the participants during the conference. These themes, which have been part of the mainstay of NASA's knowledge initiatives and actions for the past few years, include:

- The issue of Critical Knowledge - how to identify it, capture it, and encourage its use.
- How to evaluate Critical Knowledge in terms of Learning Solutions.
- An example of Lessons Learned and how they can be effective.
- How are some actions on Knowledge Retention being addressed by the NASA Knowledge Certification progress
- The development of NASA's overall Knowledge Strategy.

Welcome and Introduction

Hoffman stated during his introductory session that he had been asked how NASA identifies and effectively manages our knowledge that is critical for mission success. His response may have been familiar to some of the K2020 participants: sharing knowledge at NASA, especially critical knowledge, is at the core of what the NASA's Office of the Chief Knowledge Officer does. NASA's policy on knowledge management formally recognizes that knowledge at NASA is governed on a federated basis: each Center, Mission Directorate, and supporting organization can determine the approach that best meets their needs.

The Knowledge Policy further identifies six categories of knowledge activities as represented on the NASA Knowledge Map, such as Lessons Learned, but, Hoffman contends, there is nothing more powerful than our KM practitioners across NASA making themselves available to serve project and program managers and all of NASA's workforce in planning, executing, and reflecting on their work.

Hoffman stated: "We all know that we can help ensure mission success by making captured knowledge accessible at all stages of projects and programs." Practical examples include finding relevant lessons learned before a project begins, finding

experts or subject area expertise while in the middle of a project or program, and creating a case study or a lessons learned after a significant stage or at the end of a project or program.

“Currently,” Hoffman shared, “we are engaged in a major Critical Knowledge initiative and have created a flowchart to evaluate what people and leaders are finding most critical for their work.” The NASA CKO and his CKO Team have drafted a fishbone diagram to capture these reoccurring critical themes and are building a crosswalk for knowledge gaps to allow NASA to become more of a learning organization that strengthens staff development with knowledge services, by providing both motivating concepts and practical tools.

“Our meeting together to learn and reflect is another step forward for us,” Hoffman said during his conclusion. “We have come a long way in a short time. With so many discoveries being made by NASA right now in our missions millions of miles away, I am sure we are going to learn new things from each other right here as we make plans for the future.”

Some Center Specific Strategic Approaches

NASA Ames Research Center (ARC), the host facility, welcomed the K2020 participants. Dr. Donald Mendoza, senior systems engineer for Ames and the chairman of the Center’s Lessons Learned committee, presented on the history of knowledge sharing at ARC. He addressed the establishment of policies and procedures that the Center uses to capture and disseminate lessons learned, sharing his experience covering a board range of areas including spacecraft technology, information technology, and system safety and quality assurance. Mendoza, who has authored over 400 lessons learned covering all of these subject areas, added particular credibility to the ARC enterprise.

Following Mendoza, Manjula Ambur, the Associate CIO for Big Data Analytics and CKO at Langley Research Center (LaRC), presented and described the formulation of LaRC’s knowledge strategy and work with experts from all mission organizations. Ambur’s work exemplified knowledge sharing strategies in action. Key actions included LaRC’s Knowledge Portal, localized expert’s knowledge capture, and effective lessons sharing

sessions. Ambur also recently led the center-wide Big Data Analytics and Machine Intelligence team, which formulated a vision and roadmap for use of these transformational technologies to enable innovation, scientific discoveries, and systems optimization. She also described leading a multi-skilled and multi-organizational Big Data Analytics team, which is working on developing a solid capability for mission challenges; furthermore, she outlined her ongoing work with IBM Watson technologies and implementation of their Watson content analytics software for several technical domains corpus corpora enabling discovery of trends and insights. Also of interest was her work and LaRC's developing a prototype of 'Aerospace Innovation Advisor' with Q & A capability.

Application of Key Principles and Practices

There were several presentations devoted to the individual center's knowledge strategies, as well as those devoted to the overall knowledge strategy of NASA. JPL Chief Knowledge Officer David Oberhettinger has been working on both of these issues and therefore offered two presentations - one that was devoted to JPL's KM Strategic Planning and one focused on NASA's plan in general.

The JPL talk was structured around deliberative versus emergent approaches to strategic planning. The dialogue started with setting the stage for the knowledge environment at JPL. There were three critical points: 1) Investment in knowledge and intellectual capital may be greater than investment in physical capital; 2) JPL, maybe uniquely, cannot restore knowledge that is "lost" or unobtainable; and 3) JPL often runs into obstacles obtaining knowledge from sources outside of JPL.

Oberhettinger then went on to explain the differences between deliberate and emergent strategies. Deliberate strategies are ones that are planned and executed in a top-down manner. They are usually planned using rational analysis and generally practiced using resource allocation models that were pioneered and often used by large organizations with substantial resources. Emergent strategies are more focused on finding and propagating existing knowledge practices and policies that are already in use in the organization. They are more often found in smaller organizations that do not have quite as many KM resources at their disposals. Oberhettinger then proposed that a mixture of

these two approaches would be most suitable for JPL. This dual approach would allow both a formal plan and incorporate those existing practices that often "bubble up" from environments rich in knowledge.

Oberhettinger then discussed the need for "quick wins" that prove the value of KM to senior management. This has been a long-standing element in "selling" KM to others and has proven its effectiveness many times over. He gave three examples of these sort of quick wins: 1) The Open Access Initiative; 2) The Daily Mars Surface Ops Planning; and 3) Phase D to A Roundtable.

Oberhettinger has also been very active in developing the overall KM strategy for NASA by working with Dr. Hoffman and his team. He gave a brief overview of some of the major factors and themes being used in this process. Highlights included the governance model, which is a federated approach. This approach, developed over the last five years, is somewhat analogous to the relationship between a central authority co-existing with local autonomy. The NASA KM program has many features but can be briefly summarized as knowledge acquisition and sharing, focused on knowledge application and undergirded by knowledge leadership and management commitment. There are five more specific elements of this work: 1) Finding out what we know; 2) Archiving what we know in order to identify gaps; 3) Making better use of what we know, 4) Enabling intra-agency coordination; and 5) Encouraging continuous improvement processes.

A very important component of NASA's strategic emphasis is the identification and utilization of critical knowledge. Participants during the discussion noted that throughout the world, many knowledge plans and programs have failed because they were indiscriminate in how much information and knowledge they attempted to codify and put into systems. The guiding policy of this approach seemed to be "the more the merrier," and KM managers bragged about how much information the system contained. This strategy overloaded many systems with irrelevant, untimely, and plain useless information. To make matters worse, these systems usually made little effort to monitor the usage, timeliness, and value of its components so that it became a "mountain of irrelevancy" as one KM director called it. NASA CKO notes these lessons.

Participants concluded their open discussion with some tips on how to succeed as a CKO community as well as how to succeed with knowledge strategies. He finished by stating that a good CKO at NASA serves as a champion and facilitator of KM.

Key Elements of Strategic Thinking

Participants engaged in working groups addressing the questions posed by the framework:

Vision Statement & KM Program Attributes

- Brainstorm a set of candidate Agency KM vision statements and rank your top three. Explain ranking qualifiers.
- Identify attributes or guiding principles applicable to every Center / Directorate / Supporting Organizational KM program.

Vision Statement & KM Program Risks

- Brainstorm a set of candidate Agency KM vision statements and rank your top three. Explain ranking qualifiers.
- Identify the significant risks to successful KM program implementation and propose mitigations.

Agency KM Program Milestones

- Define a set of Agency KM program milestones that can be tied to NASA organizational objectives.

Supporting Presentations to Strategic Approach and Actions

Tim Barth, System Engineer at NASA Engineering and Safety Center (NESC), and Steve Lilley, Senior Safety Engineer at NASA Safety Center (NSC), provided a virtual presentation on Recurring Themes of Human Space Flight Mishaps; Barbara Kanki, retired NASA Research Psychologist, facilitated work groups that discussed ways to infuse the presented themes with lessons learned at the center and mission directorates level for the purposes of knowledge sharing.

Toward an action of the strategic plan, the CKO team proposes that in collaboration, a symposium be developed for July 2016 timeframe, with the goal of identifying the lessons that have been learned from Human Space Flight Mission successes and failures and the key factors as we move forward to ensure success. The CKO Team plans to work closely with key players such as Tim Barth and Steve Lilly, as well as Mike Lipka, NSC; Patrick Johnson, HEOMD; Michael Bell, KSC, and other members of the CKO community and senior leaders.

As part of their "capstone" assignment in Columbia University's Information and Strategy program, five students developed an index for determining what knowledge is truly critical for mission or agency success. Five scoring categories were developed to evaluate the knowledge that is available: 1) Risk; 2) Broadly Applicable; 3) Impact; 4) Benefit; and 5) Innovativeness. These classifications were designed in consultation with NASA knowledge community practitioners and are themselves an innovative way to evaluate knowledge value. The Index has not yet been implemented, but it was greeted enthusiastically by many members of the K2020 audience and spurred much lively discussion.

One of the other contributors at the conference was Patrick Johnson, Human Exploration and Operations (HEO) Mission Directorate CKO. Johnson laid out the updates he and his team have made to their original knowledge management plans. There were several themes to his talk, all of which were driven by 1) the need to identify and prioritize critical knowledge areas; 2) broadly capture relevant and applicable agency knowledge, 3) categorize this knowledge with filters, 4) and enable and encourage good usage by talks, publications, online tools, and internal publicity.

Training for the systems will include examples of essential tools for doing the analysis to identify critical knowledge needs. Some of these include Fishbone analytics, Risk matrixes, and Process mapping. This training is viewed as vital for the success of the KM plans.

The rest of the HEO presentation focused on the three main aspects of the critical knowledge plans: identification, categorization and capture. The identification plans consist of finding focus areas for attention that will be informed by semi-annual

interviews with relevant managers. The next step would be to discuss with these managers the capture plans that would focus on the knowledge that would be more likely to foster innovation, better procurement, communications, contractor oversight, and collaboration. The categorization will be divided into three categories: Project Life-cycle, Project Elements, and Knowledge service areas. These are further broken down into more discreet sub-elements. The last focus was on transferring of critical knowledge, which is often considered the most difficult task of these chores. The approach to this—as laid out by Johnson—was to develop a greater emphasis on organizational awareness. This will be accomplished by identifying or developing knowledge champions within projects and programs, utilizing knowledge referees to socialize knowledge usage to other parts of NASA, more training events, and developing a new training guide. Another feature of this program was producing a short series of videos, which have proven both popular and useful to the NASA community. Lastly, it was pointed out that the ease of finding critical knowledge goes a long way in making it useful. Establishing and updating a single repository—the Critical Knowledge Gateway—along with enhanced search parameters and more user-friendly indexes contribute greatly to this goal.

Another important part of the critical knowledge strategy that was discussed in length at K2020 was “lost knowledge” from various realities of work including turnover and retirement and other natural attrition of the workforce; this “stopping knowledge before it walks out the door” begged a need to use effective infrastructure—such as video capture—in place to try and capture this knowledge.

A presentation by John Marinaro, Director of NASA Safety Center Technical Excellence Office, focused on this particular issue. Marinaro stressed the need for the know-how of experienced NASA subject knowledge experts for several upcoming projects that will be ready for launch in the coming years. One of the ways this task is being addressed is thru the Knowledge Byte video system, which captures some NASA critical stories and cases in 3 to 5 minute segments. Though short, they are very effective. Marinaro emphasized the time crunch that all NASA employees are under—especially regarding finding time for training programs while in the midst of very critical projects. This is an ongoing issue that can be somewhat mitigated by technology-capturing the knowledge of experts both in and outside of NASA.

Conclusion

At the conclusion of the conference, there were four roundtables set up for discussion and final suggestions and comments from the participants. The tables were given a theme and asked to focus their comments on this theme, which could then be used to design the overall strategic plan. One table had the task of commenting on the Vision statement. What they stated could be exemplified by one comment: “To be able to know what you need to know within 30 minutes.” Other comments dealt more specifically with the NASA knowledge culture, its value as a connector of the whole agency, and its place in the agency’s overall ecosystem. Another table worked on challenges of hard Organizational Barriers to effective knowledge management at NASA. Some participants stressed “safety” in encouraging people to speak out. Others mentioned using social media in more effective ways to bridge these barriers. The third group focused on Risks. They remarked on the failure to close knowledge gaps created by attrition. The last topic was a perceived lack of leadership buy-in for the KM program and perhaps expecting too much of technological fixes, such as Search initiatives, for knowledge issues.