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MULTI-GENERATIONAL KNOWLEDGE SHARING FOR NASA ENGINEERS

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ABSTRACT

NASA, like many other organizations, is facing major challenges when it comes to its workforce. The average age of its personnel is 46, and 68 percent of its population is between 35 and 55. According to the U.S. Government Accounting Office, if the workforce continues aging, not enough engineers will have moved up the ranks and have the requisite skills to enable NASA to meet its vision for space exploration. In order to meet its goals of developing a new generation of spacecraft to support human spaceflight to the moon and Mars, the agency must engage and retain younger generations of workers and bridge the gaps between the four generations working today. Knowledge sharing among the generations is more critical than ever. This paper describes the strategies used to develop the NASA Engineering Network with the goal of engaging different generations.

1.0 Introduction

NASA, like many other organizations, is facing major challenges when it comes to its workforce. The average age of its personnel is 46, and 68 percent of its population is between 35 and 55. According to the U.S. Government Accounting Office [1], if the workforce continues aging, not enough engineers will have moved up the ranks and have the requisite skills to enable NASA to meet its vision for space exploration. In order to meet its goals of developing a new generation of spacecraft to support human spaceflight to the moon and Mars, the agency must engage and retain younger generations of workers and bridge the gaps between the four generations working today. Knowledge sharing among the generations is more critical than ever.

Preparing the next generation of leaders is not as simple as increasing training opportunities. The four generations have different communication styles and expectations of their work environment. For example, while the older generations might feel most comfortable communicating in person or via telephone, younger generations tend to prefer instant messaging or interfacing through social networking tools.

This paper describes the strategies used to develop the NASA Engineering Network with the goal of engaging different generations. The system includes a federated search engine, communities of practice, an expertise locator, and a portal to tie all the components together. By including both authoritative content from established leaders as well as collaborative content created by peer-to-peer communities, multiple generations are able to find what they seek and share what they know. Strategic communities of practice increase knowledge sharing by including both established leaders in engineering disciplines and younger engineers from the earliest stages of community development through deployment and maintenance.

Areas of discussion in this paper include tools and strategies to support multi-generational interaction and international implications of the changing workforce.

2.0 Background

2.1 About the NASA Engineering Network

The NASA Engineering Network (NEN) is a suite of information retrieval and knowledge-sharing tools specifically aimed at facilitating communication among engineers at all of the NASA centers and affiliated contractors. The network includes a metasearch capability, the Lessons Learned Information System, communities of practice formed along engineering disciplines, and a portal to integrate these components. Figure 1 illustrates the NASA Engineering Network.

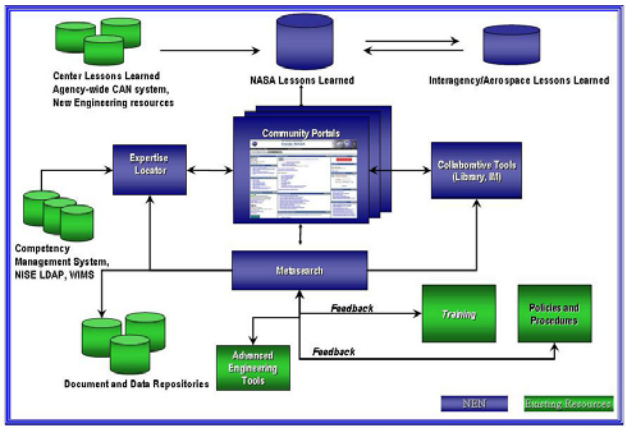

Figure 1: NASA Engineering Network

Following extensive benchmarking with organizations such as the U.S. Navy, U.S. Army Company Command, the U.S. Department of Commerce, and Boeing, it became clear that effective knowledge sharing systems in aerospace are aligned with the Office of the Chief Engineer. In addition, because the NASA Office of the Chief Engineer was responsible for overseeing the goals of sending astronauts to the moon and Mars as well as resolving issues that arose in the Columbia Accident Investigation Report, this office was most interested in implementing the NASA Engineering Network. What also became clear during this benchmarking was that an effective knowledge management system consists of search, a portal, communities of practice, and an expertise locator.

NEN was built following this model. NEN search is a single interface into 43 repositories both internal to the agency yet distributed amongst the various field centers, and from public sites such as the Defense Acquisition University Best Practices. The system, built on Vignette 7.4, has a central portal that includes links to the communities, search, and various engineering resources. Communities of practice are "groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis." [2] They have existed throughout history, through such organizations as guilds and professional societies. Because they are an effective means for capturing, sharing, and reusing knowledge, communities of practice provide a means for collaboration and innovation, and have become a more prevalent component of knowledge management strategies at many major organizations. [3] In fact, communities of practice are increasingly seen as "the best way to bring about the long-sought goal of creating a 'learning organization,' getting people to share their knowledge, and creating a pool of collective organizational intelligence." [4]

The community of practice concept at NASA grew out of early work in the idea of innovation at NASA and research from Kuhn's study that innovation occurs at the "edges" of communities—for example, when thermal engineers and mechanical engineers are brought together to work a complex problem. [5]

NASA underwent a series of core competency exercises from the late 1990s through the present, looking at the areas of expertise that would be needed to operate existing NASA projects and build a new human capability to the moon and Mars. These competencies were initially instantiated into NASA's Competency Management System (an online system that maps individuals to their competencies). The Office of the Chief Engineer and NASA Engineering Safety Center (NESC) later identified a smaller list of 25 key engineering disciplines that are at the heart of NASA's work. This list comprises the communities in the NASA Engineering Network. At the core of the NESC is an established knowledge base of technical specialists pulled from the ten NASA Centers and from a group of partner organizations external to the agency. This ready group of engineering experts is organized into 25 disciplines areas. Similar to Orr's study of photocopier repair technicians, where the "construction of their identity…occurs both in doing the work and in their stories" [6], engineers at NASA are accustomed to identifying themselves by their discipline. Engineering disciplines include: structures, systems engineering, environmental test, materials and processes, software engineering, and nondestructive evaluation.

These communities build upon existing virtual, programmatic, or traditional groups to the maximum extent possible to enhance already existing social networks and build others where necessary. Such online communities have as underpinnings innovative search capabilities to provide access to key information, discussion areas, and collaborative tools to allow engineers from all of NASA's partners and centers to seamlessly share ideas and work together. These communities are a natural fit for engineers, since it is in their nature "to share knowledge, to work jointly on finding solutions for complex problems." [7]

2.2 Four Generations of Workers

There are currently four generations of workers in the workplace today. Traditionalists, also called the World War II generation, were born before the

second world war. While most of these have retired, due to the current economy many have maintained their positions. They tend to be practical, disciplined, and loyal to their employers. Baby boomers, born 1946-1964, were the first generation to be raised with television. They tend to be idealistic, believe in self-improvement, and can be workaholics. Members of Generation X were born between 1965 and the late 1976. This is the generation that grew up with fast food, divorced parents, and early video games. They tend to value a strong work/life balance, are focused on the individual rather than the organization, and tend to be technologically savvy. Generation Y, also called Millennials, were born between 1977 and 1990. They have been using computers since they were children, tend to build relationships through instant and text messaging, and expect to work at multiple places during their career. [8] See Table 1 for an overview of the generations.

Generation	Year Born	Characteristics
Traditionalists	1937-1945	Loyal to employer, like face-to-face communication
Baby Boomers	1946-1964	Idealistic, workaholics, first gen. raised on TV.
Generation X	1965-1976	Value life/work balance, technologically savvy.
Millennials	1977-1990	Using computers since children, comfortable w/instant messaging and text

Table 1: Overview of the Four Generations

These four generations, in addition to having different styles of communicating and different expectations of the workplace, also has different views of technology. The New York State Personnel Council compared the technology of the four generations by how they listened to music when growing up: vinyl, 8-track, CD, and iPod/MP3. [9]

According to a survey conducted by the Pew Research Center, 73% of respondents stated that younger and older people are very different in the way they computers and new technology. [10]

All of the generations at work are online in some way or another, whether it's to enter their hours online, check email, or read the news. However, the basic communication styles and technology expectations of each generation differ greatly in the workplace. Traditionalists, for example, may be more comfortable making decision face to face, while Millennials feel confident doing this via instant messaging. Email use, in fact, is diminishing among the younger generation. Between 2004 and 2009, the percentage of teen use of email declined from 89% of survey respondents to 73%. [8]

In addition, people's expectations for Web 2.0 technology is increasing. Generation X and Millennials are highly likely to interact online either through games, blogs (both posting and commenting on other people's posts), or social networking sites sites. [8] While this survey reflects use of the Internet outside work, activity online sets expectations for what users will find at work as well.

The fact that there are four generations working at once for the first time in many years is important because understanding the needs of each generation can improve retention and engagement of personnel. [11]

3.0 Demographics of the Workforce

3.1. NASA Workforce

The NASA Workforce at NASA is not only aging, but the gap is growing wider. Figures 2 and 3 show the age of civil servants at the agency in 1993 and 2009 respectively. [12] Clearly the workforce is aging, but also losing influx of younger personnel.

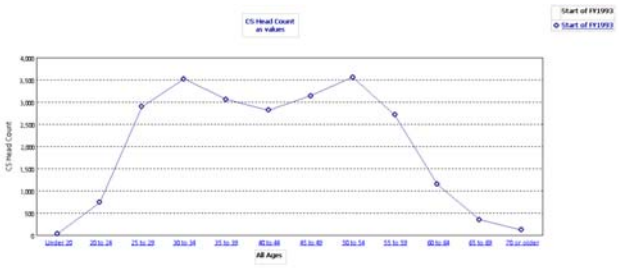

Figure 2: Age Distribution at NASA 1993

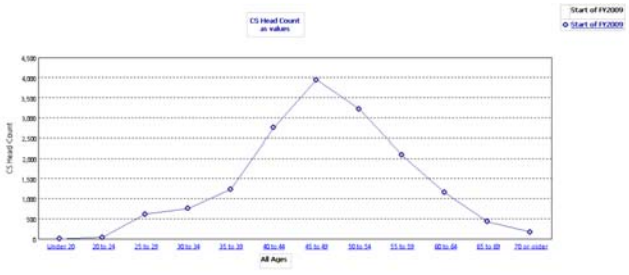

Figure 3: Age Distribution at NASA 2009

Because of these demographics, systems for sharing knowledge and everyday use must not only meet the needs of all four generations but also must pay

attention to the majority of users, who tend to be in their 40s. In addition, to the extent possible, systems must be designed in a manner that attracts younger generations and is in keeping with NASA's image of a forward-thinking, cutting edge organization.

4.0 Implementation of NEN

4.1 Current Capability

The NASA Engineering Network was primarily formed in response to the Columbia Accident Investigation Board [13]. However, because the agency is also interested in improving retention among younger generations of workers, the network became one site that began targeting the mix of generations.

The NEN site blends official, authoritative links such as vetted lessons learned and standards with more informal information via videos and other formats. Because younger generations in particular are accustomed to changing content with online sites, a concerted effort is made to change content on a regular basis. In mid-2009, the site was redesigned to have an icon-based navigation that would allow text to be more distributed; previous to that change most community and other NEN pages were so heavy with text, nothing stood out and it was difficult to navigate to relevant content.

This generational targeting is most apparent in the communities of practice. Each community has a leader who is a NASA Technical Fellow, a recognized leader in the field with an official appointment to oversee discipline stewardship and troubleshoot problems in their discipline. Having a leader meets the need of traditionalists and baby boomers to have a person with clear authority involved in the community. When a new community of practice is set up, leaders are asked to provide a photograph. Initially Tech Fellows provided an official picture with the leader in a suit and tie, and more often than not with an American flag in the background. After informal polling by NEN team members of younger generations, it was found that these pictures were off-putting and intimidating so pictures were replaced where possible with more casual images.

When communities of practice were first being developed, in 2006 and 2007, the Technical Fellows, by and large baby boomers, wanted to be sure that content on the site was vetted and that the community be seen more as one-way website than a collaborative and interactive space. In order to keep the Technical Fellows engaged and ensure the success of the communities, they were developed as static portals of content. Over time, however, the NEN team has worked with these leaders to help them see that interaction and collaboration are beneficial to the discipline and to the agency as a whole.

Content on the communities is also a mix of formal and informal. On the formal side are links to standards, best practices, and peer-reviewed journal articles. On the informal side are discussion boards that allow a user of any experience level to post questions and answers or any other sort of discussion. Communities also have the option of implementing an Ask an Expert feature. This feature allows any user to post a question based on pre-determined discipline areas (e.g., within the Mechanical Systems community, sub-disciplines include lubrication and tribology, gear and transmission systems, and spacecraft and instrument mechanisms). Once a question is answered, the pre-defined expert in the field receives an email prompt to respond. Both questions and answers are available online. The user does not need to know who the expert is, but is still able to interact via the community.

4.2 Near-Term Changes to Site

Several changes are planned for the site to make it even more friendly to multiple generations of users. To stay in keeping with what Millennials and Generation X users may be accustomed to, the ability to rate content and comment on content will be added. For older generations who may still be tied to email as their main information source, subscriptions and RSS feeds will be made available.

While the discussion boards were initially seen as the best way to enable collaboration on the sites, users found the discussion boards difficult to use and in fact prohibited collaboration. These discussion boards will be replaced by open source forums, which many NASA users are used to using in their non-work lives. This should greatly improve the interactive capability on the site.

Based on feedback from the Human Factors Technical Fellow and her team, the NEN is also getting a bit of a facelift to make it easier to use. Fonts will be made to stand out more, and color choices will be in keeping with usability standards. These changes will also be made to ensure that the system is in keeping with Section 508 compliance, which is the part of the U.S. Disabilities Act, established to ensure people with disabilities would be able to use online resources, in particular those created by government agencies.

5.0 Conclusion

With tighter economic times, the generation gap in the workplace is likely to continue to be an issue knowledge management professionals must be aware of. At NASA in particular, all generations of users must be taken into consideration when designing systems. After all, if the younger generation is disappointed by dated technology in their everyday applications, they are less likely to stay with the agency. It is critical to have this younger generation not only at NASA but also learning from older generations so that they can lead the next generation of space exploration.

6.0 Acknowledgements

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