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KNOWLEDGE MANAGEMENT AND CULTURE AT THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA) JOHNSON SPACE CENTER (JSC)

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KNOWLEDGE MANAGEMENT AND CULTURE AT THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA) JOHNSON SPACE CENTER (JSC)

BY

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Dedication

I would like to dedicate my thesis to my parents who always promoted higher level education and who told me that I could become anything I wanted be when I grew up.

"You have brains in your head. You have feet in your shoes. You can steer yourself in any direction you choose" (Seuss, 1990).

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ABSTRACT

KNOWLEDGE MANAGEMENT AND CULTURE AT THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA) JOHNSON SPACE CENTER (JSC)

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A critical component needed to maintain National Aeronautics and Space Administration's (NASA) mission will be Johnson Space Center's (JSC) ability to build off previous space program's lessons learned by utilizing knowledge management (KM) activities and practices. Currently, at the local level of NASA JSC, employees lack cultural enablers that can stimulate behaviors that promote knowledge management practices that within the organization. Through surveys conducted with current NASA civil servant employees, this thesis investigates current involvement and attitudes in knowledge management activities/programs and practices of NASA JSC employees at the local level. By understanding the local employee's involvement and attitudes of knowledge management, recommendations can be made on how to create a culture change that stimulates behaviors that promote knowledge management within the local level's of NASA JSC.

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CHAPTER I

INTRODUCTION

Since the National Aeronautics and Space Administration (NASA) began in 1958, the organization has been a leader in the aerospace research resulting in Apollo missions to the Moon, Space Shuttle and the creation of the International Space Station. NASA's mission statement is to "pioneer the future of space exploration, scientific discovery and aeronautics research" (NASA.gov, 2010). In order to fulfill this vision, NASA will need to continue to develop their knowledge management architecture in order to capture critical knowledge gained over that last fifty years.

NASA utilized the fundamentals of knowledge management (KM) well before the practice was established as a management discipline in the early 1990's (Nonaka, 1991). During few long-duration programs such as Mercury, Gemini and Apollo, NASA had the luxury of people sharing critical information across these early space flight programs. Knowledge management started in its primitive form at NASA with paperwork documentation and senior team members mentoring junior members on the foundations of aerospace. Upon completion of the Apollo Missions, NASA struggled to capture knowledge gained in a world of limited digital means, collecting what hard copies they could in repositories and federal archival libraries. However, as years progressed, digital/world-wide-web age hit, and NASA's missions and programs grew larger and larger with the Space Shuttle and the International Space Station, NASA's KM strategy became obsolete.

In 2002, the United States General Accounting Office (GAO) released one of the first federal reports on NASA's KM problems, focusing on their inability to share lessons across the Agency, specifically after the loss of the Mars Polar Lander and Climate Orbiter spacecraft. During the investigation of those failures, it raised concern about the Agency's ability to learn from other past experiences and apply those experiences (both positive and negative) to current NASA programs (GAO, 2002). Shortly after the GAO released their findings, NASA's Chief Knowledge Office (CIO) released his *Strategic Plan for Knowledge Management* as an agency-wide objective. The plan stated that NASA's proposed strategy was based on best practices in industry to date and was geared to address the internal drivers for enhancing the ability to share knowledge among projects, and promote the culture/environment need to encourage individuals and projects to share (Holcomb, L., 2002).

Since 2002, there have been other drivers for change in NASA's KM practice including the release of NPR 7120.6, *The NASA Lessons Learned Process,* which established the basic requirements for collection, validation, assessment and use of 'lessons learned' for future space programs (NPR 7120.6, 2005). The NPR required NASA to implement a Lessons Learned database to collect and disseminate past knowledge for current and future mission success to the public, denoting the website as the 'NASA Engineering Network,' which was established in 2005 and is still maintained today because of the NPR mandate.

In fall of 2006, NASA's agency KM practices filtered down to the Center level at Johnson Space Center (JSC) in Houston, TX. JSC Center Director, Mike Coats, created

the Chief Knowledge Office (CKO) position. The CKO's position was established to put focus on the growing need for KM at JSC. In one of the first significant acts of the CKO, a Center-wide KM assessment was completed in May 2007, called the Knowledge Management Assessment Project (KMAP), which assessed JSC's knowledge management maturity and recommendations for implementing a successful knowledge management program (KMAP, 2007). The assessment revealed that JSC had KM activities going on in various organizations, in varying complexities. However, results from the assessment found gaps in JSC's knowledge management maturity, specifically in some of the more notable processes/databases at JSC including library services, lessons learned databases, and web architecture. The KM gaps found at JSC affected the performance of the people, processes and technologies they are using.

Since the KMAP Assessment in 2007, several improvements have been made at JSC in attempt to close the gaps which the assessment identified. In May 2008, the CKO signed the first JSC Procedural Requirement that established requirements for the JSC Organizational Learning Program (JOLP) that was created to implement policy, standards and Center-wide architecture for KM activities at JSC (www.km.nasa.gov, 2010). The JOLP at JSC continues to improve KM architecture at a center-wide level; however impacts from their efforts are not yet being felt at a JSC local level (such as Divisions at the JSC center).

STATEMENT OF PROBLEM

NASA is at a critical juncture with the Space Shuttle retiring this year (2011), the retirement–eligible workforce rapidly growing, and the new Presidential direction for NASA to work with industry to develop the next future space vehicle. In order to ensure a smooth transition, JSC has established the need for mechanisms to manage the flow of its knowledge and continue to grow as a learning organization. Although, JSC has developed knowledge management architecture over the last several years, it has not reached in all levels of the organization in a successful manner. It is imperative that KM reaches all levels of the Center so that JSC can continuously grow and learn from their historical experiences in space exploration, and permit United States industry affiliates to benefit from those experiences as well.

The architecture for knowledge management exists at NASA, yet why has JSC's knowledge management strategies been unsuccessful at the local level? There are three critical dimensions of an effective knowledge management organization, 1) technology, 2) structure, 3) culture. A different spin on these core dimensions of effective knowledge management was given by J. Holm, a Chief NASA Architect at NASA's Jet Propulsion Laboratory, in 2006. She further developed the concept of three critical dimensions of an effective knowledge management organization by breaking into four key success factors. These four key success factors to an effective KM program include: culture, knowledge architecture, IT infrastructure and supporting services as seen in Figure 1 (Holm, 2006). Holm explains that NASA JSC has done a good job of creating and evolving its IT infrastructure and knowledge architecture to meet the needs of NASA JSC employees.

This has been achieved by a variety of databases with usable taxonomies that are offered to employees, such as NASA's Lessons Learned Information System (LLIS) (www.llis.nasa.gov, 2010) and Scientific and Technical Information (STI) system (http://www.sti.nasa.gov/STI-public-homepage.html, 2010). In addition to the databases, NASA JSC has created programs conducive to knowledge management initiatives such as special topic storytelling sessions and also technical engineering courses offered via NASA's Academy of Program/Project and Engineering Leadership (APPEL) program (http://www.nasa.gov/offices/oce/appel/home/index.html, 2010) given by the NASA's own subject matter experts. However, NASA JSC is missing one of Holm's four key success factors, and also the most crucial dimension (of the three) of an effective KM organization – culture. NASA JSC employees lack cultural enablers that stimulate behaviors that promote knowledge management practices.

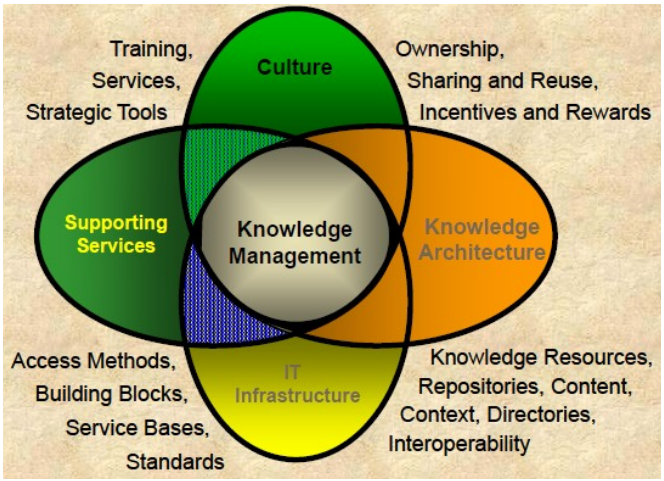


Figure 1: Knowledge Management Key Success Factors (Holm, 2006)

A critical component needed to maintain NASA's mission will be JSC's ability to build off previous space program's 'lessons learned' by utilizing knowledge management activities at JSC and undergoing culture change at the local levels. The local levels at JSC need to build a culture responsive to KM practices in order to implement a successful knowledge management architecture. In order to create a culture responsive to KM practices at NASA JSC local levels, a culture change is required. To create this change, NASA JSC employee's behavior also needs to change and in doing so will allow JSC to preserve significant lessons learned from fifty years as pioneers in space and space related technologies.

THE PURPOSE OF STUDY

The purpose of this study is to make recommendations to NASA JSC on how to create culture change within the organization that can stimulate behaviors in employees that promote knowledge management at the local levels. This is based on a literature review and by surveying NASA JSC employees on their current involvement (behaviors) and attitudes pertaining to knowledge management. The survey's results establish a baseline of the current culture, and therefore reveal areas for improvement where recommendations can be made.

SIGNIFICANCE OF STUDY

Of the four critical components to an effective KM program (culture, knowledge structure, IT infrastructure and supporting services), cultural acceptance is the most important pre-condition of a successful KM program. Without cultural acceptance, IT infrastructure, knowledge structures and supporting services would not be used at all - even if they existed. This concept is not unique just to NASA JSC, but throughout any organization/industry trying to manage knowledge as a learning/evolving/competitive organization. Therefore, this study of how to create culture change in an organization at the local level will benefit any other government and non-government organizations alike across a broad scale. Although, this study focuses on culture change in relation to KM practices and acceptance, the concepts used to create this change can apply to any type of culture change (or shift) within any organization.

However, this study specifically benefits NASA JSC by providing insight to the local culture in which their current KM is being used. This is achieved by analyzing results of a survey given to a local Division level at JSC, the Crew and Thermal Systems Division (EC). In addition, NASA JSC will be provided with recommendations on how to create a culture change that stimulates behaviors that make their KM a functioning tool and therefore an asset at JSC (specifically at the local levels of the organization) during this critical time in the aerospace industry.

It is imperative that NASA JSC has an effective KM program for a variety of reasons. First and foremost, NASA is the pioneer of space - going first where no one else has gone before. As such, NASA is a trailblazer for many other countries and private industries on the topics of aeronautics and aerospace technologies, how to live and work in space, and space exploration. Being the first to do anything in an evolving technological field requires sufficient capture of lessons learned, because as we all know – no one gets it right the first time. NASA JSC is the center of manned space flight, and requires a successful KM program to capture all the lessons learned and knowledge gained over the last 50 years of space flight. This benefits not only tax payers, but also those countries and private industries that are following in NASA's footsteps for the betterment of humankind. Therefore, the basis of a successful KM program is dependent on a culture that accepts the uses, practices and tools available to capture knowledge. It is imperative that NASA JSC's culture at all levels of the Center embraces KM. This will allow NASA JSC to have an effective KM program and thereby ensuring the future success of human space exploration and the ability for NASA to maintain the title as the 'pioneers of space exploration.' Through this study, I recommend how to create culture change required to stimulate employees' behaviors that promote KM program success.

RESEARCH QUESTIONS

What culture enablers are needed to stimulate employees' behaviors that promote knowledge management in local levels at NASA JSC? In order to answer this question, it is critical to understand the current culture in a local Division level at NASA JSC and those employees' current involvement (behaviors) and attitudes towards KM activities/programs. As such, a research survey was given to civil servant employees of the Crew and Thermal Systems Division (EC), a local Division at NASA JSC, to gauge their current culture.

ASSUMPTIONS

It is assumed that all respondents to the survey answered honestly and accurately to the best of their knowledge. It is also assumed that all participants work for NASA Johnson Space Center (JSC) as civil servant employees, employed by the government.

This thesis specifically surveys one local Division, out of many, at NASA JSC to create a representative assessment of involvement and attitudes regarding KM activities/programs at JSC. This thesis utilizes these survey results to draw important conclusions regarding current culture at the local levels at JSC and recommended cultural enablers that can stimulate behaviors that can promote knowledge management within the organization.

CHAPTER 2

INTRODUCTION

Chapter 2 is a review of literature. Main topics are (a) Overview of Knowledge Management: 1. What is Knowledge Management (KM)?, 2. History of Knowledge Management, 3. Critical dimensions of an effective Knowledge Management organization, (b) Knowledge Management at NASA Johnson Space Center (JSC), (c) How to facilitate culture change in an organization.

OVERVIEW OF KNOWLEDGE MANAGEMENT

What is Knowledge Management (KM)?

Thousands of definitions exist for the term 'knowledge management' depending on your point of view and emphasis in the field. The various interpretations of KM is mainly attributed to the fact KM is an emerging field of study, and therefore has resulted in a "less coherent and more fragmented" field (He, Lee & Hsu, 2003). Metaxiotis (*et al.*) believes that the complexity behind the field of KM is partially attributed to the difficulty in identifying knowledge itself (Metaxiotis, Ergazakis, & Psarras, 2005). Despite the many different interpretations of knowledge management, and for the purposes of this paper, knowledge management shall be defined as a process that effectively creates, capture, shares and uses organization-wide knowledge to improve the organization's performance (Gan *et al.*, 2006; Schultze *et al.*, 2002).

In general, practitioners and managers alike in the knowledge management field of study believe there are two broad approaches to knowledge management. One approach is the "hard" aspect of knowledge management, and the other focuses on the "soft" aspect of knowledge management (Sveiby, 2001; Mason & Pauleen, 2003). Sveiby refers to the hard approach as an "IT-Track" to knowledge management which focuses on the management of information and, knowledge is equated to an "object" (Sveiby, 2001). In this regard, this aspect of knowledge management focuses on the deployment and use of information technologies to enable knowledge management activities to be conducted within an organization (Mason & Pauleen, 2003). The main goal of this approach is to increase access to information through access and reuse of documents via repositories, well-developed taxonomy databases, and the internet. The hard aspect of knowledge management is primarily based on the concept that technology and access to vast amounts of information will make knowledge management successful (Mason & Pauleen, 2003).

The second approach to knowledge management is the "soft" aspect. Sveiby refers to this soft aspect of knowledge management as a "People-Track" that focuses on the management of people, and knowledge is equated to "a process," not technology (Sveiby, 2001). This approach to knowledge management is the capture and transformation of knowledge into a corporate asset through the management of people (Mason & Pauleen, 2003). It is an approach that typically is viewed as an organizational or management responsibility, where they focus on innovation, creativity, and knowledge sharing as a critical asset. This soft aspect of knowledge management requires an

organization to have a holistic view and encourage employees to share what they know in order to facilitate a successful knowledge management program (Gupta & Govindarajan, 2000). In this regard, the soft aspect of knowledge management emphasizes culture and people as the foundation for a successful KM organization.

The National Aeronautic Space Administration (NASA) seemingly takes more of the soft approach to knowledge management with their definition of knowledge management, "getting the right information to the right people at the right time, and helping people create knowledge and share and act upon information in ways that will measurably improve the performance of NASA and its partners" (http://km.nasa.gov/whatis/index.html, 2010). However, the culture and infrastructure required to meet the intent of NASA's definition is not fully visible at NASA Johnson Space Center (JSC). Further analysis and discussion of this topic will be explored later in this Chapter, *(b) Knowledge Management at NASA Johnson Space Center (JSC)*. Furthermore, to meet the objectives of this thesis and research study, the soft approach (culture and people-centric) is used for the methodology, analysis and recommendations.

History of Knowledge Management

A number of management theorists contributed to the evolution of knowledge management. As early as the 1951's, a Hungarian philosopher named Michael Polanyi was the first to define 'tacit knowledge' at the University of Aberdeen (Cortada, 1999). He emphasized that tacit knowledge was knowledge that is difficult to transfer to another

person by tangible means (writing it down or verbalizing). Polanyi later published a book about his concepts in *Personal Knowledge: towards a post-critical epistemology* (Polanyi, 1958). Through his work, Polanyi wanted to emphasize that the intellect also in science is connected with a passionate contribution of the person knowing. In addition to the definition of tacit knowledge, Polanyi gave the community his concept of knowledge based on 'three main theses:' (Cortada, 1999)

- True discovery cannot be accounted for by rules or algorithms
- Knowledge is both public and to a great extent personal (and contains emotions)
- Knowledge that underlies explicit knowledge is either tacit or rooted in tacit knowledge

The summary of these theses is that knowledge is not private but rather a social experience. Socially conveyed knowledge morphs with an individual's reality and thus creating the ability to convert tacit to explicit knowledge (Cortada, 1999).

Following Polanyi's work, other management theorists built their own concepts of knowledge creation and knowledge management off of his work. Theorists such as Drucker and Senge conceptualized knowledge as a management tool. Peter Drucker coined the term 'knowledge worker' in 1959 that was defined as individuals who are valued for their ability to interpret information within a specific subject area, and therefore could be used as organizational resources (Drucker, 1959). Peter Senge first popularized the concept of a 'learning organization' through his book *The Fifth*

Discipline published in 1992, which defined a 'learning organization' as an organization that is continually expanding its capacity to create its future (Senge, 1992).

With all of the theories and publications leading up to the 1990's, the discipline of knowledge management was established with Nonaka's assessment of a 'Knowledge-Creating Company' (Nonaka, 1991). Nonaka, a Japanese organizational theorist, explored the differences in American and Japanese cultures by explaining each of their viewpoints on how to quantify knowledge and knowledge creation. Nonaka stated that American cultures look at organizations as a 'machine for information processing,' and the only useful knowledge was quantifiable data that are embedded in procedures and universal principles. Meanwhile, their Japanese counterparts put more emphasis on knowledge creation and tapping into tacit, subjective insights of individuals that could be utilized by the company at large as benefits to the organization. Nonaka recognized that it was critical for there to be personal commitment, and for the employee's culture to be encouraging in order to promote knowledge sharing and creation (Nonaka, 1991).

Nonaka used Polanyi's work to help define his concepts on knowledge and 'tacit knowing' (Nonaka, 2009). Specifically, Nonaka built off Polanyi's work by better defining tacit and explicit knowledge. Tacit knowledge is 'the kind of informal, hard-to-pin-down skills' with an important cognitive dimension that consists of an individual's beliefs and perspectives. While explicit knowledge is easily transferred from one individual to another in the form of documents, figures, and other tangible forms of data collection. Nonaka's depiction of use of tacit vs. explicit knowledge has laid the foundation for knowledge management principles (Nonaka, 1991 and 1994).

Critical Dimensions of an Effective KM Organization

In looking to define critical dimensions of an effective knowledge management organization, three come into view: 1) technology, 2) structure, 3) culture. All three infrastructures are required for a successful knowledge management program, and are equally dependent on each other for success. Technology is a crucial element of the structural dimension needed to mobilize social capital for the creation of new knowledge (Gold *et al., 2001)*. Technology systems such as data/document repositories, the internet, and well-developed taxonomy databases are needed to facilitate easier access to information and access to that information quickly. Holm defines technology as giving an employee access to the tools necessary to deliver processes and services efficiently and effectively to an end user (Holm, 2006). However, most important of these respects to technology in an organization, information technology is the only viable mechanism to connect efficient to large numbers of a geographically dispersed people that enables individuals to have vast amounts of information at employee's disposal (Gupta & Govindarajan, 2000).

Another critical dimension of an effective knowledge management organization is the structure of the organization. Organizational structure is important in leveraging technological architecture (Gold *et al., 2001)*. Many organizations struggle with creating and sustaining a structure required for an effective knowledge management organization, while trying not to stifle collaboration and sharing of knowledge across internal divisions. O'Dell and Grayson suggest that some types of organizational structure promote

information hoarding, which goes against the fundamental practices of how an effective knowledge management organization should function (O'Dell & Grayson, 1998). Not only should a knowledge management organization structure promote knowledge sharing, it should also utilize a system of rewards and incentives – specifically for tacit knowledge sharing. It has been found that incentives and rewards encourage knowledge management activities amongst employees (Roberston & Hammersley, 2000; Ko, 2003). Lastly, other considerations have been acknowledged on how to create a successful knowledge management structure in an organization, such as Nonaka and Takeuchi's defined 'hypertext organization.' They discuss a type of success-oriented knowledge management structure that enables a five-stage process of knowledge creation to occur efficiently within an organization (Nonaka & Takeuchi, 1995). Ultimately, a successful knowledge management structure ensures knowledge transfer that must cross the organization's functional boundaries (Walczak, 2005).

The final critical dimension of an effective knowledge management program is an organization's culture (organizational culture). Current literature on knowledge management recognizes the inseparable relationship between culture and knowledge management (Nonaka and Takeuchi, 1995; Krogh et al., 2000). Not only is the relationship inseparable, Janz *et al.* further comments:

> *Organizational culture is believed to be the most significant input to effective knowledge management and organizational learning in that corporate culture determines values, beliefs, and work systems that could encourage or impede knowledge creation and sharing" (Janz et al., 2003).*

Similarly, Lee & Choi believe that an appropriate culture should be established within an organization to encourage employees to create and then share knowledge amongst each other (Lee & Choi, 2003). Furthermore, the interaction between employees is essential not only to the innovation process, but can also often be the basis for the creation of ideas and therefore have the potential for creating knowledge (Gold *et al.*, 2001). It is this interaction that creates knowledge and should be encouraged in an organization because is essential when attempting to convert tacit knowledge between employees (Nonaka & Takeuchi, 1995). Ironically, with all of published benefits and criticality of organizational culture, culture within an organization continues to be one of the most challenging issues organizations must tackle (Gold *et al.*, 2001; Fahey & Prusak, 1998). However, if an organization does not embrace an organizational culture suited for knowledge management practices, the other knowledge management critical dimensions will cripple. Culture remains to be the precondition, and also sustaining condition, required to make a knowledge management program thrive. In future sections, this thesis makes recommendations on to create culture change that can stimulate behaviors that promotes knowledge management within an organization in efforts to create an 'organizational culture.'

KNOWLEDGE MANAGEMENT AT NASA JOHNSON SPACE CENTER (JSC)

As stated earlier, JSC Center Director Michael Coats created the position of Chief Knowledge Officer (CKO) in Fall 2006 with the appointment of Jean E. Engle. Coats

created the position in hopes to develop a comprehensive KM program that could 'identify and capture fifty years of human spaceflight knowledge and make it readily available to current and future generations' (Engle and Fontenot, 2010). Shortly after Engle was appointed the CKO position, in Spring 2007, she base-lined JSC's existing knowledge management activities center wide via a comprehensive knowledge management maturity assessment (KMAP) conducted by Science Application International Corporation (SAIC). The four month long assessment investigated the maturity in three areas important to a knowledge management program: people, technology and process. The assessment unveiled some interesting results for JSC, including the center as a whole recognized the importance of knowledge management, but most people at the center did not know how to do it effectively.

In parallel with the assessment, Engle spent several months investigating other government organizations and commercial industries knowledge management practices – successes and downfalls alike. The one main concept she took from the KMAP assessment and her research on other knowledge management programs was that in order to initiate and also sustain a successful knowledge management program, a center should not impose a center wide process for capturing knowledge and lessons learned, but rather allow local organizations to capture, share and infuse lessons that work specifically for the organization's culture (Engle and Fontenot, 2010). Engle and Fontenot recognized that the most effective knowledge sharing happens from person to person and that only in the right cultural surroundings can that sharing be most effective.

Currently at JSC, there are several programs that support Engle's KM initiatives including databases, programs, and special events. However, of Holm's suggested key success factors of a strong knowledge management program (Holm, 2006), NASA and NASA JSC's initiatives mainly fall into only two of the four categories – knowledge architecture and IT infrastructure, refer back to Figure 1. Note, the four key success factors are comprised of a delicate balance of knowledge resources and repositories for the information (knowledge architecture), a usable taxonomy and adequate service bases (IT infrastructure), people/services that help an individual with training on how to use the repositories/databases (supporting services), and an environment that is conducive to knowledge sharing and management (culture).

A couple of more notable agency wide databases used all-across NASA that do an adequate job of achieving two of the four key success factors include the Lessons Learned Information System (LLIS) and the Scientific and Technical Information (STI) database. NASA's Lessons Learned Information System (LLIS) was created as a response to the GAO report conducted in 2000 (GAO, 2000). The database is an integrated program for identifying and documenting lessons learned from all organizations at the Center, with standard processes, procedures, and control points through both Directorate and peer reviews (www.llis.nasa.gov, 2010). Another database available to NASA JSC employees is the Science and Technical Information (STI) database. The STI database allows a NASA user access to a collected set of facts, analyses, and conclusions resulting from scientific, technical and related engineering research and development efforts, both basic and applied (www.sti.nasa.gov, 2010).

Other knowledge architectures and IT infrastructures exist more locally at NASA JSC as programs or academies. The Mentoring, Training and Competency Management System is a program that focuses on developing program and project managers from an Agency prospective. Above all, the program exposes the employee to other areas of the organization, via rotational opportunities, to bring competencies and skills back to his/her primary job and share lessons learned with co-workers. The Engineering Academy is another KM architecture resource for JSC employees. The purpose of the Engineering Academy is to capture expert knowledge and create an environment of learning for JSC's engineers. The Academy has integrated itself with the Academy of Program/Project & Engineering Leadership (APPEL) for knowledge sharing opportunities and programs including conferences, forums, publications and classes available to any JSC employee, with management approval. (http://www.nasa.gov/offices/oce/appel/knowledge/ks_index.html, 2010). The aforementioned KM databases, infrastructures and programs are a few of the available KM resources at JSC.

Finally, JSC has established several special events known as the "Storytelling Program," that can be considered an addition to NASA JSC's knowledge architecture. These events are typically 'brown-bag lunches' that allow a NASA employee to attend and interact with a panel of subject experts on a project/topic. In the past, the some of the more notable Storytelling events have been Hurricane Ike Lessons Learned held in September of 2006, and Apollo 11's fourteenth anniversary that included multiple sessions held in July 2010.

Although several different knowledge management initiatives exist at NASA JSC, they only begin to fulfill two of the four noted key success factors in a strong knowledge management program, knowledge architecture and IT infrastructure . The concern is that NASA JSC does not have the culture needed to support existing knowledge management initiatives at the local levels. In addition, a supportive knowledge management culture would allow knowledge sharing to occur on a day-to-day basis between employees, which is an important factor in a successful KM program.

HOW TO FACILITATE CULTURE CHANGE IN AN ORGANIZATION

Organizational Culture and Knowledge Culture

Many subject matter experts advocate the importance and need for organizational culture to be the focal point of effective knowledge management architecture (Janz, *et al.*, 2003; Nonaka and Takeuchi,1995; Oliver and Kandadi, 2006; Rastogi, 2000). Despite cultures' importance within the structure of a stable knowledge management architecture, little is known on how to create it. Yet, work has been done that lays out the framework of what an 'organizational culture' is and also factors that influence it.

Organizational culture composed of six categories including: 1) organizational structure, 2) information systems, 3) people, 4) rewarding systems, 5) leadership, and 6) processes (Gupta and Govindarajan, 2000; Al-Alawi, *et al.*, 2007). Organizational culture has been defined as

> *The shared, basic assumptions that an organization learnt while coping with the environment and solving problems of external adaptation and internal integration that are taught to new members as the correct way to solve those problems* (Al-Alawi, *et al.*, 2007; Park *et al.*, 2004).

This definition of organizational culture, and the established categories of it, takes a non-human interaction approach that focuses more on the elements of the framework rather than people. However, using the definition of 'knowledge culture' can help clarify the human aspect of culture within an organization. Knowledge culture has been defined as follows:

> *A way of organizational life that enables and motivates people to create, share and utilize knowledge for the benefit and enduring success of the organization (Oliver and Kandadi, 2006).*

The subject of knowledge culture focuses more on the people of the organization and can be viewed in conjunction with Gupta and Govindarajan's view of organizational culture, such as the following: 1) organizational structure (of people), 2) reward strategies (for people), 3) trust (in people) and 4) infrastructure (for people). This specialized view organizational culture can now be used to explore factors that affect knowledge culture in an organization, termed cultural knowledge management enablers.

Cultural Knowledge Management Enablers

Cultural knowledge management enablers are comprised of a 'laundry-list' of different issues that can promote knowledge culture within an organization, see Table 1

as defined by Oliver and Kandadi (2006). Other authors have paralleled Oliver and Kandadi's influential factors that affect culture. Gan *et al.* focused on five factors that affect culture including collaboration, trust, learning, leadership and rewards (Gan *et al.*, 2006). One year later, Al-Alawi *et al.* focused on a similar, but different, five factors including trust, communication, information systems, rewards, and organizational structure (Al-Alawi *et al.*, 2007).

Organizational Issues (affecting knowledge culture)		
Agility in organizations	Innovation	Organizational functions
Business process management	Intranet	Organizational structure
Change management	KM evangelization	Performance appraisal
Collaboration	KM events	Physical work environment
Communities of practice (CoPs)	KM infrastructure	Pilot projects
Competitiveness	KM jobs and roles	Problem solving
Customer orientation	Knowledge maps	Professional development
Decision making	KM organizational structure	Recognition
Empowerment	KM projects	Recruitment
Enterprise information portal	Knowledge work	Resource allocation
Expert systems	Knowledge worker	Reward systems
Extranet	Lay-offs	Risk taking
Flexibility	Leadership	Search engines
Front-end managers	Learning	Senior management
Group motivations	Long-term vision	Short-term focus
Groupware	Loyalty	Sponsorship
Human resource management	Market orientation	Team behavior
Incentives	Middle level managers	Team leaders
Individual behavior	Neural networks	Tolerance to failures
Individual motivations	Openness to change	Training and development
Informal employee relationships	Openness to experimentation	Trust building

Table 1: Organizational Issues (affecting knowledge culture), Source: Oliver and Kandadi, 2006.

In KM literature today, there seems to be cohesiveness amongst authors on at least three core issues that can stimulate behavior that can promote knowledge

management in an organization's culture, 1) leadership with in an organizational structure, 2) time allocation to knowledge activities, and 3) incentives and rewards.

Leadership within an organizational structure is arguably one of the most crucial elements in influencing KM initiatives. Positive leadership in relation to KM initiatives is a vital aspect for developing a knowledge culture (Ambrosio, 2000; Oliver and Kandadi, 2006). An individual who holds a KM leadership role (typically shared with a management role) should demonstrate certain characteristics and traits such as: empowerment of employees, establish trusting relationships, promotes organizational goals, and be open to errors/mistakes made by subordinates. Much of current literature encourages the creation of a designated KM role (or job) in an organization, such as a Chief Knowledge Officer (CKO), chief Information Officer (CIO), knowledge manager, or an organization's equivalent (Bixler, 2002; Khalifa and Liu, 2003; Oliver and Kandadi, 2006; Rastogi, 2000). The role of CKO, or equivalent, is to promote knowledge culture and be accountable for knowledge management programs within an organization. Conversely, other literature has accentuated the need for leadership at all levels in an organization, specifically at low-level (team) management who are closest to the 'knowledge workers,' individuals in an organization that share and use knowledge (Oliver and Kandadi, 2006). These 'low-level' managers' roles are to uphold leadership traits similar to the CKO, yet are not the manager's full time role.

Second prominent factor to affect an organization's knowledge culture is an organization's ability to give knowledge workers time allocation to knowledge activities. Oliver and Kandadi's study in 2006 interviewed individuals throughout many

organizations. The study found that nearly every interviewed employee noted that time allocation time for employee learning, collaboration, knowledge creation and sharing activities are crucial to developing a knowledge culture (Kandadi and Oliver, 2006). Hanishch *et al.* research paralleled Kandadi and Oliver's research as well, finding that the time pressure of other 'higher priority' projects prevented the employees from conducting lessons learned workshops or meetings (Hanishch *et al.*, 2009). Because there is such a high need for an employee to have designated/chargable time for these knowledge activities in an organization, it is clear that an employee needs local, team leaders and middle managers to support this time allocation initiative to make the knowledge management initiative effective. Current knowledge management literature recommends that the amount of time dedicated to knowledge management activities should be embedded in an employee's job, and ultimately become an intuitive aspect of their day-to-day work (Bishop *et al.*, 2008). Once the KM activities become and intuitive aspect of day-to-day work, knowledge culture can flourish within an organization.

The third most prominent factor in current KM literature that can affect an organization's knowledge culture is incentives and rewards for those employees that participate and succeed in KM activities. Providing rewards and incentives for participation in successful KM activities has been cited as a critical aspect in ensuring an effective KM program (IRS Management Review, 2000; Bishop *et al.*, 2008; Oliver and Kandadi, 2006; Gan *et al.*, 2006; Gupta and Govindarajan, 2000). Rewards and incentives can range from verbal praise from management to financial rewards. Yet, research shows varying the success of different types of rewards conducive to KM

activities and the promotion of a knowledge culture. Rewards can be broadly characterized as either intrinsic or extrinsic rewards. An extrinsic reward typically involves some monetary gain for an employee, whereas an intrinsic reward is characterized by an outcome that gives an employee satisfaction via appreciation or praise from a job well done (Bartol and Srivastava, 2002). Many experts advise against the use of financial (extrinsic) rewards because they promote the wrong message for and have little impact on individual behavior (IRS Management Review, 2000). This sentiment is paralleled by many qualitative research studies where interviewed employees emphasized that the recognition and appreciation from management is more valuable than a monetary gain (Oliver Kandadi, 2006; Bishop *et al.*, 2008; Al-Alawi *et al.*, 2007; O'Dell and Grayson, 1998).

Ultimately, despite the cultural KM enablers that are emphasized in current KM literature, an organization should focus in on a diverse set of these cultural knowledge management enablers (as seen in Table 1) to create and sustain a successful knowledge management program. The areas of focus should be tailored to the specific organization, and perhaps even specifically tailored to local groups and divisions within that organization based on their individual needs. Jean Engle, CKO at NASA JSC, recognizes the need for this type of tailoring of a knowledge management program at the local levels in an organization by stating that:

> *Rather than imposing on center wide process for capturing and sharing lessons learned, for example, we followed the lead of the Department of Energy's distributed learning methodology, allowing organizations to capture, share, and*

infuse lessons in ways that worked for their particular cultures (Engle and Fontenot, 2010).

CHAPTER 3

INTRODUCTION

The purpose of this study is to make recommendations to NASA JSC on how to create culture change that stimulates behaviors that promote knowledge management within the local levels of the organization. An important aspect to this study is to understand the current culture and involvement of employees in KM activities/programs at NASA JSC's local Division levels. This study surveys one local Division at NASA JSC's called Crew and Thermal Systems Division, which is representative of other Divisions at NASA JSC. This chapter includes the research questions and a description of the research methodology.

RESEARCH QUESTIONS

The focus of the survey was on employees' involvement (behaviors) and attitudes towards available KM activities/programs at NASA JSC. In addition, the survey asks respondents about their reasons for not participating in more KM activities/programs, and what could be a potential enabler to participate more. In asking these survey questions, I hope to understand the current involvement (behaviors) and attitudes towards current KM activities/programs at NASA JSC, which helps the answer my thesis' research question of: What culture enablers are needed to stimulate employees' behaviors that promote knowledge management at local levels at NASA JSC? The questions that were asked can be seen in Appendix A.

METHODOLOGY

Research Population

This study included both male and female civil servant employees at NASA JSC who work in the Crew and Thermal Systems Division. As such, the target population for this study was the individual employees of NASA JSC who work in the Crew and Thermal Systems Division. The sample population for this study was all civil servant NASA JSC employees within the Crew and Thermal Systems Division (Brewer and Albert, 2006).

NASA JSC consists of approximately 3000 civil servants. Of the 3000 civil servants, there are 139 civil servant employees within the Crew and Thermal Systems Division at JSC. It was important to this survey to sample individuals that are civil servants, as opposed to contractor employees, within the Division. Other than previously described, there were no other discriminating factors to survey participation.

Research Design

Selection of Participants

Civil servant employees of the Crew and Thermal Systems Division were sent a copy of the survey via email from the Crew and Thermal System's Division (EC) Chief at NASA JSC. She used an email distribution list, 'JSC-DL-EC DIVISION,' to help limit the participation to EC's civil servants only, as the distribution list is maintained to

include only EC civil servant emails. The survey was accompanied by a brief letter that introduced myself, defined what knowledge management is, and explained the purpose of the survey (see Appendix B). The letter also explained that survey does not affect their job, nor NASA as a whole. The email/survey was distributed only once by the Crew and Thermal Systems Division Chief in March of 2010, and all the answered surveys used in this study were received within the same month.

Once the surveys were complete, the respondents were asked to return the survey in one of two ways: 1) send survey back to researcher, or 2) submit survey to share folder located on the NASA JSC network (respondent anonymity if desired).

Data Gathering

During the selection of participants and design of the survey, I tried to minimize measurement error and bias. Although, typical of any social research study, the measurement error and bias could not be completely eliminated. In particular, measurement (non-response) bias could have occurred with this survey. Out of the 139 employees in the Crew and Thermal Systems Division at NASA JSC, this research study survey received only 39 respondents. Therefore, it is possible that the 39 respondents' answers could differ from the potential answers from the non-respondents. Many efforts were tried to mitigate this issue by promoting the survey by word of mouth and by sending out reminder emails to all of the potential participants. Yet, despite my best

efforts, the participant involvement was not equal to the size of the Division to reflect the entire Division's opinion.

In addition to potential non-response bias, error could have been seen with accuracy of answers from the respondents. Typical of research surveys, people may advertently or inadvertently answer survey questions incorrectly. For example, people may not tell the truth in response to a survey question, they may not understand the survey question (or misread it), they may inaccurately use the ranking scales used in the survey, and/or they may incorrectly remember (or not remember at all) an experience with knowledge management.

Survey Design

Each survey question was authored to help answer this thesis' research question. In addition, each question was tailored to be as precise and simple as possible to minimize human error in the study. The goal of surveying civil servant employees within Crew and Thermal System Division at NASA JSC was to determine their current involvement (behaviors) and attitudes towards KM activities/programs at NASA JSC. In establishing a baseline of employee's behaviors and attitudes, I can create recommendations based on these findings, and therefore answer this thesis' question.

The first few questions of the survey were designed to understand the employee's familiarity and frequency of involvement of different types of KM activities/programs available at NASA JSC. The goal of these questions was to understand if Crew and

Thermal System Division's employees are aware and/or if they utilize the readily available KM activities/programs. In utilizing, or not utilizing, the available KM activity/program, it demonstrates an employee's involvement (behavior) towards the KM activity/program, which helps answer this thesis' research question. The next question asks the employee if he/she finds the KM activity/program useful to his/her job. This question allowed me to better understand if an employee is aware of a KM activity/program, and if they also find it useful to their job. This question is critical to follow the first few questions because the employee's response gave me insight to a potential reason why he/she does not participate more in the specified KM activity/program, even if they are familiar with it. Clearly, if the employee does not find it useful, he/she has no reason to stimulate behavior (attendance in this case) that promotes KM.

The next question asks about a more prevalent form of knowledge management at NASA JSC – mentoring. The question asks how much time an individual gives or receives mentoring on average per week. The goal of this question was to understand if the Crew and Thermal System's Division's employees effectively use one of the most effective means to capture and retain knowledge within an organization (Karkoulian, Halawi, and McCarthy, 2008). In addition, this question allowed me to understand if the mentoring at NASA JSC is a type of activity that can stimulate behaviors that promote KM, in one of the most effective ways.

Question 5 delves more into understanding why employees within the Crew and Thermal Systems Division do not participate in more KM activities/programs. The

question thoroughly gives six types of rationale, and allows for a 'fill-in' response of 'other.' Among the offered rationale (or potential answers to the survey question) are some of the top reasons employees do not participate more in knowledge management activities/programs. The goal of this question was to allow me to make insightful conclusions when comparing results of the survey to other similar research (or literature search) on what prevents a typical employee from participating more in KM activities/programs. This question's goal, in-turn, supports this thesis' research question by better understanding an employee's rationale for not more actively participating in KM and therefore allowing me to better understand potential cultural enablers to stimulate behavior that promotes involvement in KM activities/programs.

The following question (Question 6) attempts to understand if specifically 'management support,' or leadership, promotes or hinders an employee's involvement in KM activities/programs. This question's goal supports this thesis' research question to understand if management within EC promotes or hinders employee's involvement in KM related activities, which can be correlated to whether management can stimulate behavior that promotes the employees within EC to involve themselves in KM related activities.

The next question (Question 7) aligns with this thesis' research question directly by inquiring: What would increase your desire to participate more in KM related activities at JSC? The question asks the employee to rank all of the options against each other on a scale from 1 (least important) to 8 (most important). The goal of this research question was to understand what cultural enablers are most important to EC employees to

promote KM activity, and therefore allow me to make recommendations to a local level of NASA JSC on how to create cultural change via knowledge management enablers.

Lastly, to investigate potentially useful correlation data corresponding to Questions 1 to 7, the survey respondents were asked 1) gender, 2) age, 3) government pay scale level (GS level), and 4) number of years in the Crew and Thermal Systems Division (EC). The goal of this question was to attempt to make inferences between behaviors of certain demographic groups corresponding to the survey results.

Reliability and Validity

All surveys should aim to be valid and reliable. Reliability is defined as a "quality of measurement method that suggests that the same data would have been collected each time in repeated observations of the same phenomenon. Reliability does not ensure accuracy any more than precision does" (Babbie, 2008). On the other hand, validity is defined as a "measure that accurately reflects the concept it is intended to measure" (Babbie, 2008). Survey research is generally weak on validity and strong on reliability. This thesis' research survey falls under the same assessment. By presenting the entire target population with the same questions (standardized stimulus), the survey research attempts to eliminate unreliability in observations I made. In addition, I took care in wording the questions clearly and precisely to reduce the unreliability the survey respondent could impart. Validity in survey research is not as clear as reliability. Validity of this thesis' data can be considered weak because survey respondents do not

typically feel in the terms of ‘scales and rankings’ such as this thesis’ survey uses. People’s opinions/feelings in correlation to survey scales and ranking should be considered ‘approximate indicators’ of what the researcher intended. However, the definition of validity is relative to what is considered the ‘real’ definition of what is being measured. In this regard, survey responses are hard to quantify as ‘valid’ in general (Babbie, 2008).

Questions of a research survey should be worded in such a way to remove respondent bias. Bias is defined as the “quality of measurement device that tends to result in misrepresentation, in a particular direction, of what is being measured” (Babbie, 2008). This thesis’s research survey mitigated bias by wording survey questions to be clear and not leading.

CHAPTER 4

INTRODUCTION

A total of 39 employees (approximately 28%) submitted surveys for this research study, out of the available 139 civil servant employees within the Crew and Thermal Systems Division (EC). In analyzing the results, a few errors were noted in the responses. However, for the purposes of this study, the measurement errors were negligible and results were adjusted as necessary to obtain collective data for those affected questions.

With demographic data collected at the end of the survey, minimal statistical correlations could be made with other survey responses. As such, data analysis and interpretation does not focus on the collected demographic data.

OVERVIEW OF RESULTS

Results of Question 1 of the survey investigated Crew and Thermal System Division (EC) employees' familiarity of available knowledge management activities/programs at NASA JSC and can been seen in Figure 2, on a ranking scale of 0 (no familiarity) to 5 (high familiarity). The data is graphed on a frequency histogram displaying the number of EC employee's vs. their ranking of familiarity of KM activities/programs available at NASA JSC. The most significant finding from this question was that most people (23 people out of 39) are completely unaware of one of the five significant KM activities/programs available at JSC, the ASK Program and

Magazine. In addition, from Figure 2, it is clear that only a few employees are "highly familiar" with any of the activities, which is evident by the few employees ranking any of the KM activities/programs with a 4 or 5. Specifically, it can be noted that fewer than 10 EC employees (of 39 employees) ranked each of the KM activities/programs 4 or higher.

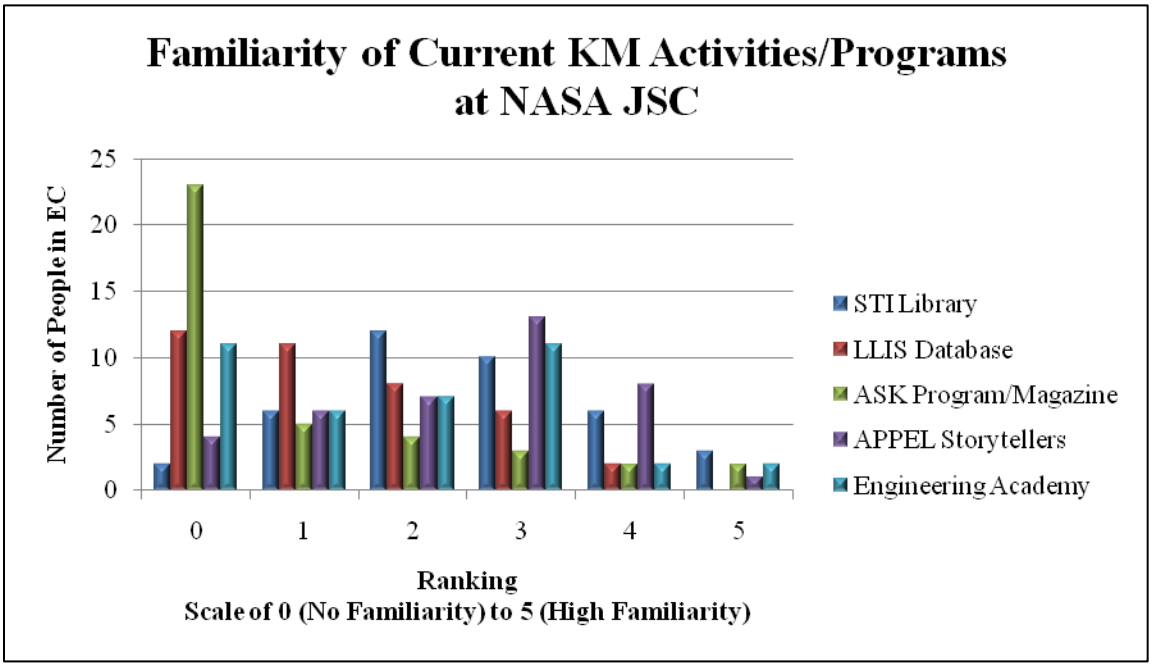


Figure 2: Graphical analysis of EC employee's familiarity, on a frequency histogram ranked on a scale of 0 (no familiarity) to 5 (high familiarity), of current KM activities/programs offered at NASA JSC.

Furthermore, in Figure 3, the mean values of the familiarity on current KM activities/programs from the EC employees can be analyzed. Specifically, the Scientific Technical Information (STI) Library and the Academy of Program/Project & Engineering Leadership (APPEL) Storytellers each had a mean value of 2.5 (out of 5.0) on the familiarity scale. Similar to the noted significance of Figure 2, the ASK Program and

Magazine showed the lowest mean value at 1.0 of a 5.0 scale. Yet, closely behind the ASK Program and Magazine ranking is the Lessons Learned Information System (LLIS) Database at only a 1.4 mean value out of a 5.0 scale. Statistic correlation was performed between Question 1 and respondent's GS level and age (end of survey), and there was only a weak correlation found between both, therefore no conclusions could be made.

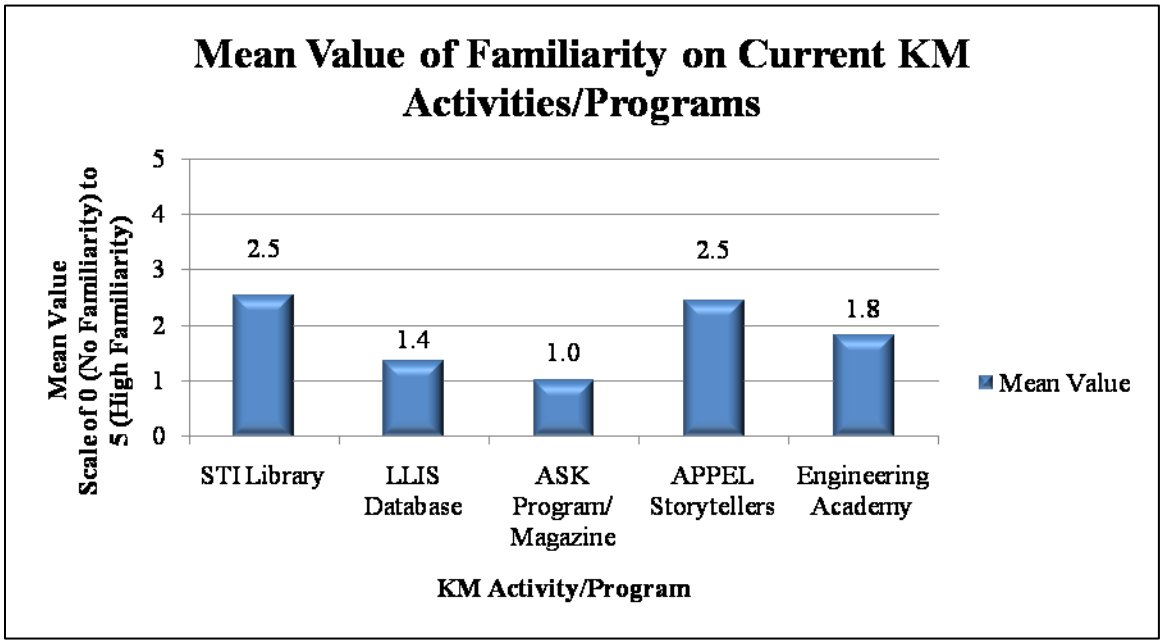


Figure 3: Graphical analysis of the mean values of EC employee's familiarity, on a scale of 0 (no familiarity) to 5 (high familiarity), on current KM activities/programs offered at NASA JSC.

To follow up on Question 1, Question 2 asks the EC employees the number of times they have participated in each of the noted KM activities/programs in the last year (2010) where applicable (i.e. only if they were familiar with the activity/program). If the

EC survey respondent did not know the activity/program existed (”0” familiarity on Question 1), then the respondent answered “N/A” for this question. The overall Question 2 survey results can be found in Figure 4, on a frequency histogram noting participation on a scale of “0 to 5+ times.” It is important to note that a significant number of EC respondents answered either “0” or “N/A” for most of the activities/programs, further accentuated in Figure 5. The Figure shows “No Participation” as the number of EC respondents that either were familiar with the KM activity/program, but participated “0” times or the respondent was not familiar with the KM activity/program at all and responded “N/A.”

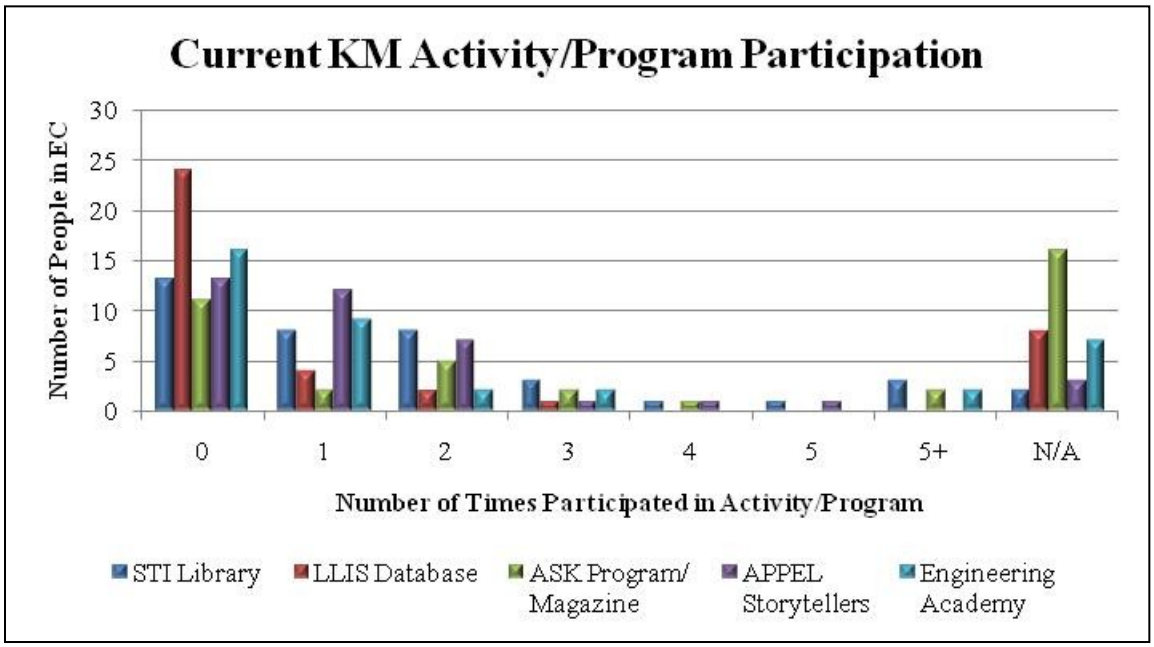


Figure 4: Graphical analysis of the number of times EC employees participated in the available KM activities/programs at NASA JSC in the last year (2010), on a frequency histogram noting participation on a scale of 0 to 5+ times, and N/A (not applicable).

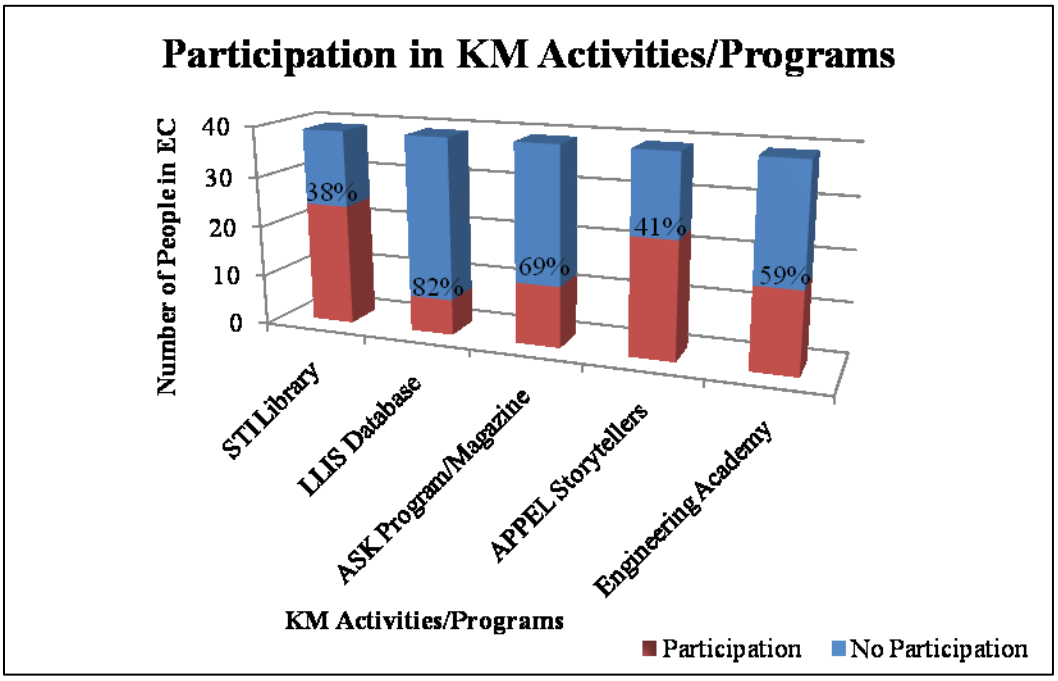


Figure 5: Graphical analysis of the number of EC employees that participated vs. no participation in the available KM activities/programs at NASA JSC over the last year (2010).

In addition, Figure 5 shows the number of respondents that participated ('Participation') in KM activities/programs available at JSC, which is quantified by the EC respondent that participated in an activity/program anywhere from "1" to "5+" times in the last year. It was found that a statistical majority of EC respondents did not participate in the LLIS Database (82% No Participation), ASK Program/Magazine (69% No Participation), or the Engineering Academy (59% No Participation). The two other remaining KM activities/programs also had relatively high non-participation; STI Library at 38% and APPEL Storytellers with 41% from EC employee respondents.

Question 3 of the survey ties back to both Questions 1 and 2 by asking the EC respondents the usefulness of the available KM activities/programs, ranked on a scale from 0 (not useful) to 5 (highly useful). The results of Question 3 can be found in Figure 6, specifically noting that the usefulness of each activity should vary with each individual. It is important to note here that the charting of "N/A" are EC employees that did not find this question applicable because are not familiar or have never participated in the activity, therefore these individuals are unable to rank the usefulness of the activity/program. Of the respondents that did not reply "N/A," Figure 7 displays the mean values of the respondents. It was found that EC respondents believed that the ASK Program/Magazine was the least useful out of the KM activities/programs, quantified with a mean value of 1.6 on a scale of 5.

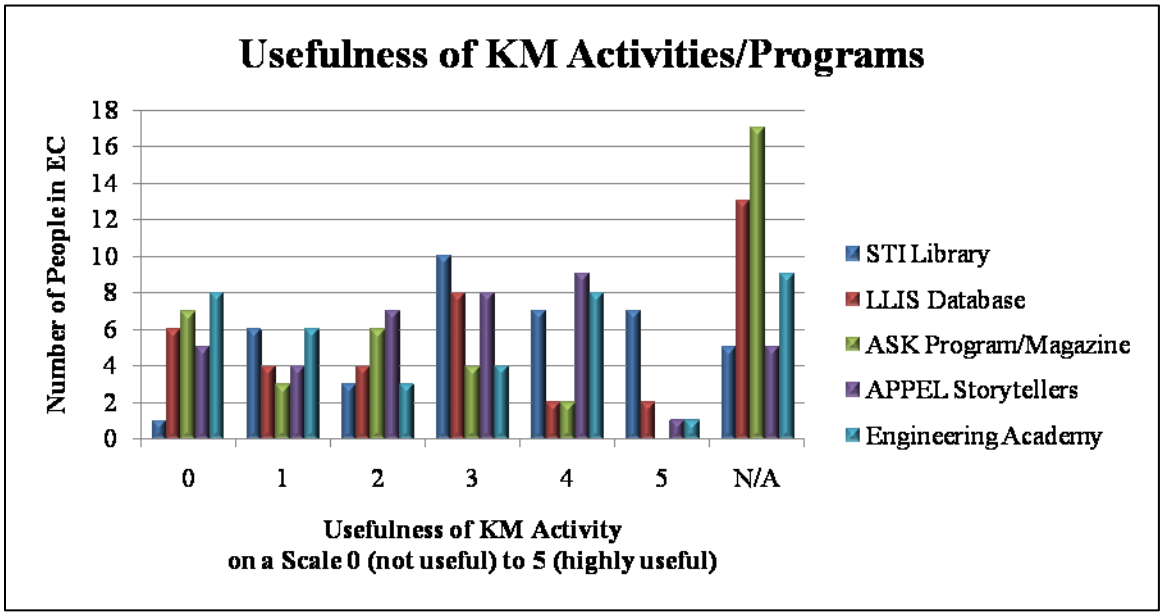


Figure 6: Graphical analysis of the number of EC employees that found KM activities/programs at NASA JSC useful on a frequency histogram ranked on a scale of 0 (not useful) to 5 (highly useful) and N/A (not applicable).

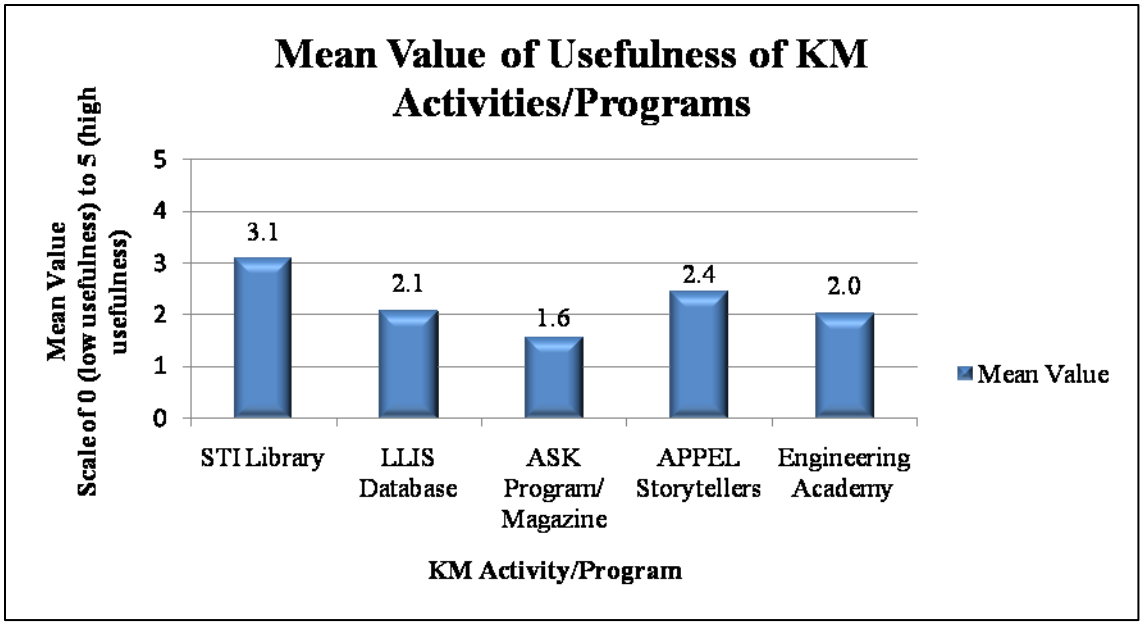


Figure 7: Graphical analysis of the mean values of EC employee's opinion of usefulness of the current KM activities/programs offered at NASA JSC on a scale of 0 (not useful) to 5 (highly useful).

Results from survey Question 4 focused on one of the most common types of knowledge management within organizations, mentoring. The EC respondents were asked how much time (on average) a week does the employee give or receive mentoring. Respondents were asked to check the box that applied to them varying from "Do not give mentoring (or receive mentoring), 30 min to 1 hour, 1 hour to 2 hours, 2 hours to 4 hours, or 4 hours or more." Figure 8 depicts these results on a frequency histogram, showing relatively few individuals spend time giving or receiving mentoring. Furthermore, this data was compared to each of the respondent's age, which was a demographic question asked of the respondents later in the survey. It was found that of the 39 respondents, 22 respondents were 36 years of age or older. Intuitively, it is assumed that an older

employee is more likely to give mentor a younger employee. Of the 22 respondents that were over the age of 36, 13 EC employee respondents gave mentoring for more than 1 hour on average each week. Similar to this assumption, younger employees should receive more mentoring from older employees. Of the 39 respondents, 16 respondents were 35 years of age or younger. Of the 16 respondents, it was found that only 8 of these EC employees received mentoring for more than 1 hour on average per week.

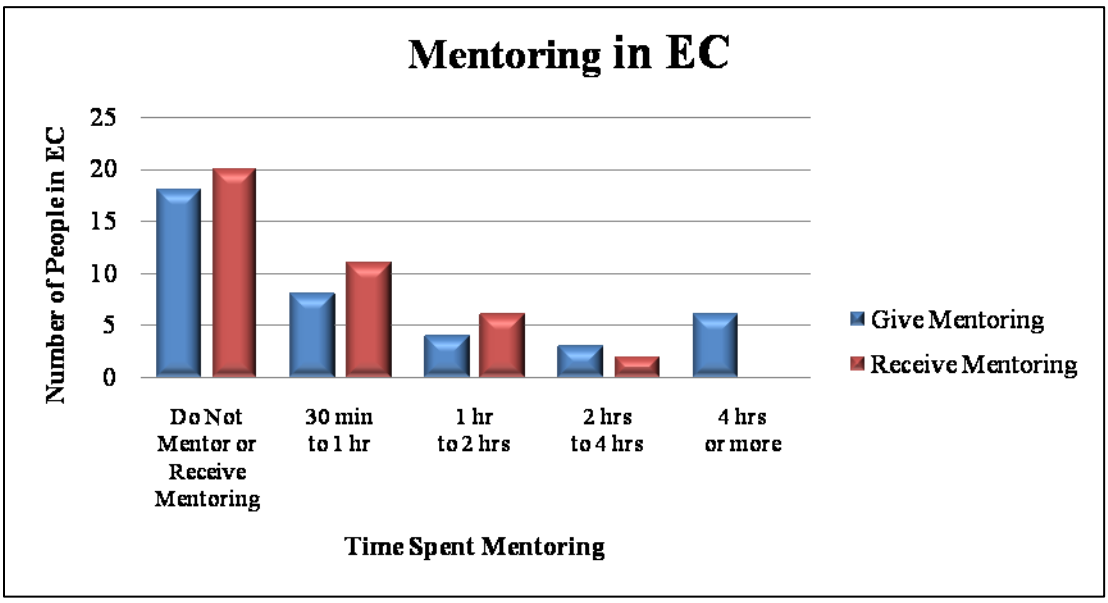


Figure 8: Graphical analysis of EC employee's frequency of giving or receiving mentoring.

Question 5 of the survey asked EC employees why they do not participate more in knowledge management activities/programs that are available at NASA JSC. As seen in Figure 9, of the 39 respondents, an overwhelming majority of 30 respondents answered that there was "not enough time in the work day to participate." This was roughly 80%

of the sampled population. The second highest reason that EC respondents do not participate more in KM activities/programs was found to be that the employees "did not know that the KM activity/program existed," with 18 out of 39 respondents (roughly 47% of the sampled population) responding with this reason. It is also interesting to note that only 1 of the 39 respondents answered that "no incentives or rewards" was the reason for not participating more in KM activities/programs.

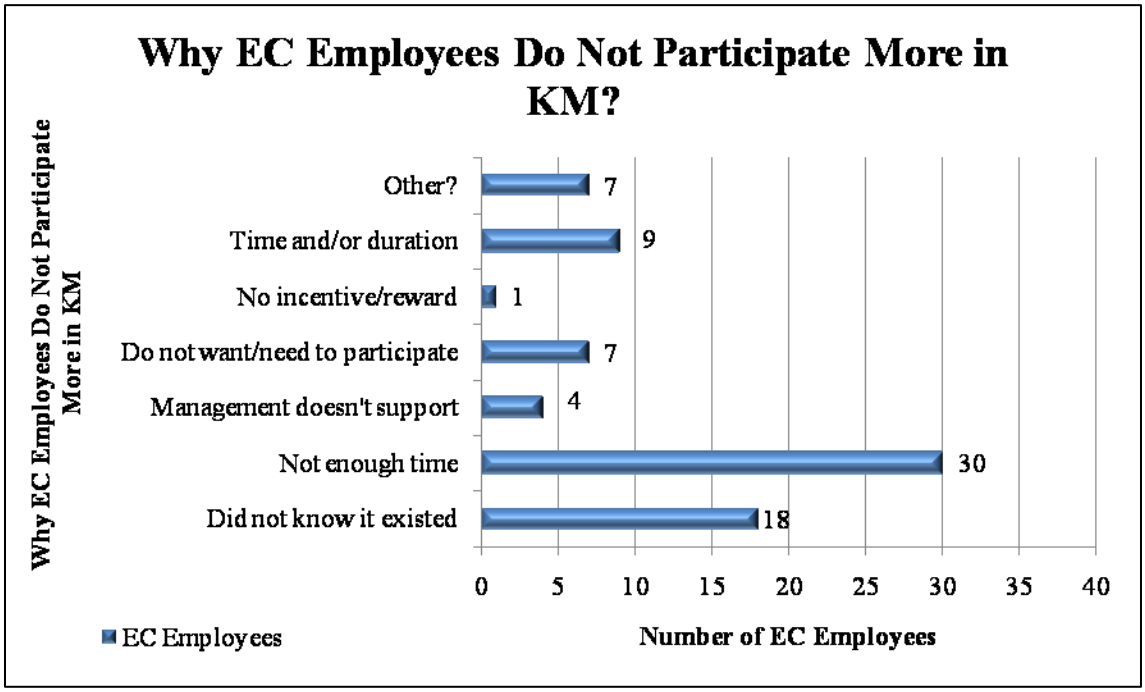


Figure 9: Graphical analysis of why EC employees do not participate more in KM activities/programs.

Question 6 of the survey asked EC respondents how their management supports knowledge management. Of the 39 EC respondents, a majority employees (68% of the

sampled population) stated that EC management supports KM by "formally assigning mentors to younger employees," as seen in Figure 10. In addition, a majority of EC respondents (55% of the sampled population) stated that EC management supports KM by "requiring archiving of major project documentation (requirements, designs, test reports, etc)." In comparison, the other possible responses given to the survey participants were significantly less frequently answered by the respondents versus the two noted majority responses above.

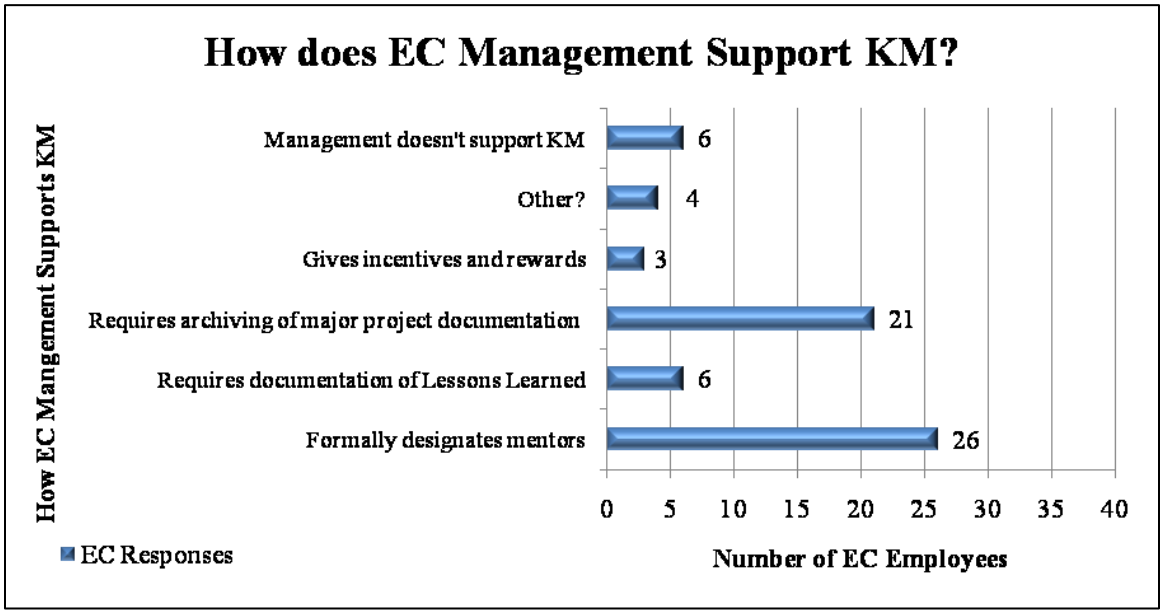


Figure 10: Graphical analysis of EC employee's opinion on how EC management supports knowledge management.

Lastly, the final question of the survey (Question 7) asked EC respondents what would increase their desire to participate more in knowledge management activities/programs by ranking given reasons against each other from 1 (least important)

to 8 (most important). An overview of results from all 39 respondents can be seen in Figure 11. It can be noticed immediately that not one of the eight particular reasons was observed as a statistical majority at any ranking level from 1 to 8. This is further accentuated in Figures 12 and 13 where the distributions in are practically even, seeing percent ranges at a minimum of 10% to maximum of 15%. Figure 12 charts EC respondent's ranking results from the ranges 1 to 4 (less important), which serves to note what EC respondents feel is "less important" of the given eight provided reasons. Figure 13 charts EC respondent's ranking results from the ranges 5 to 8 (most important), which serves to note what EC respondents feel is "most important" of the given eight provided reasons.

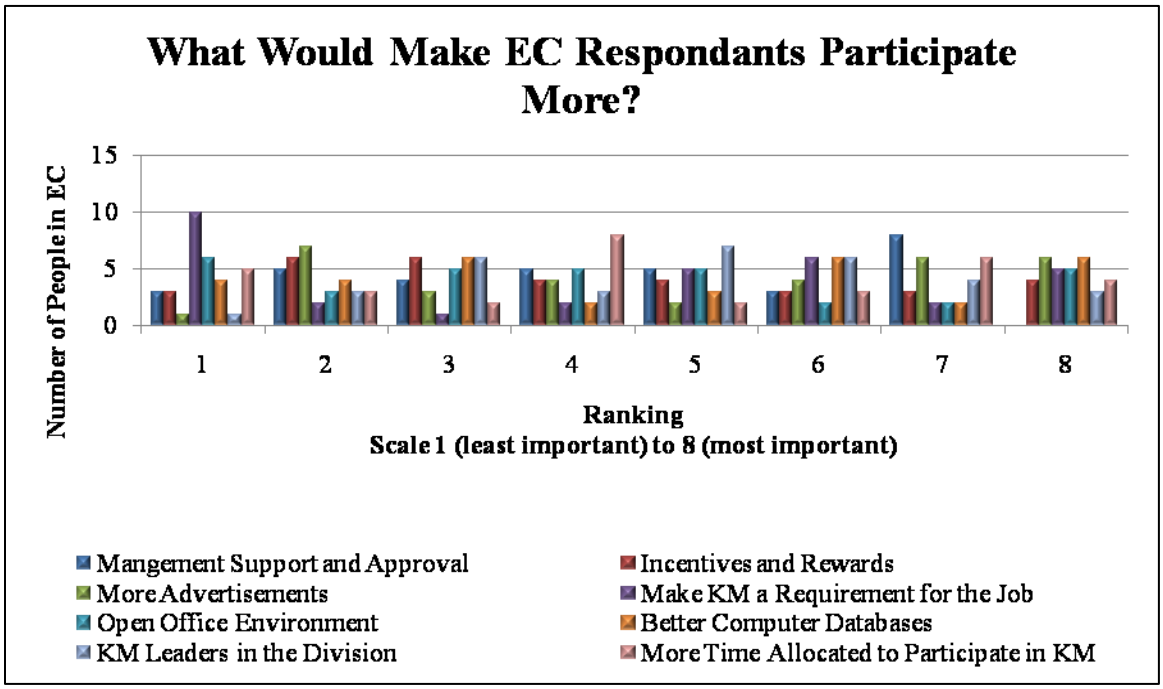


Figure 11: Graphical analysis of EC employee's opinion on what would make them participate more in KM activities/programs ranked from 1 (least important) to 8 (most important).

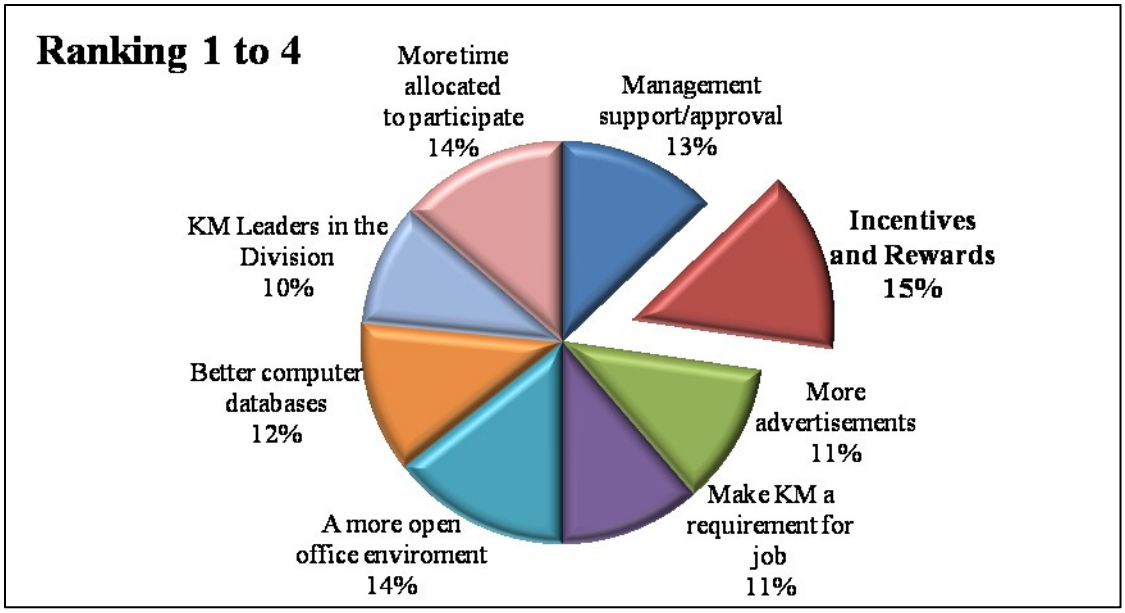


Figure 12: Graphical analysis of EC employee's ranking of least important reasons (1 to 4, of 8) that would increase their desire to participate more in KM activities/programs.

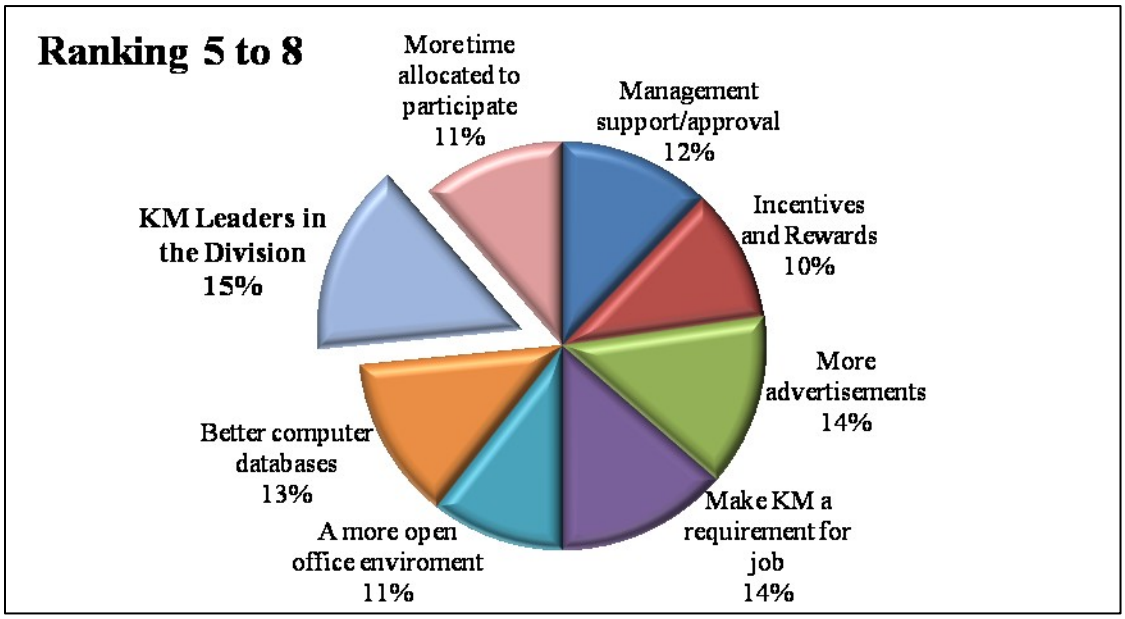


Figure 13: Graphical analysis of EC employee's ranking of most important reasons (5 to 8, of 8) that would increase their desire to participate more in KM activities/programs.

Yet, the EC respondents did have shifted opinions when they ranked the least important (1) and most important (8) reasons, as seen in Figure 14 and 15 respectively. Of the 39 EC respondents, 31% thought that "making the KM activity/program a requirement for their jobs" was the least important reason to participate more in KM activities/programs, Figure 14. On the opposite side of the spectrum, of the 39 respondents, 19% thought that "more advertisements about the KM activities/programs" was the most important reason to participate in more KM activities/programs. In a close second place, 18% thought that better having "better computer databases (searchable) to locate needed information" was the most important reason to participate more in KM activities/programs, Figure 15. However, despite the fact that EC respondents ranked high one "least" and one "most" important reason to increase their desire in KM activities/programs, as seen in Figure 14 and 15, the overall data shows that there is not a significant difference in number of EC respondents that ranked each reason from 1 to 8, as seen in Figures 11, 12, and 13.

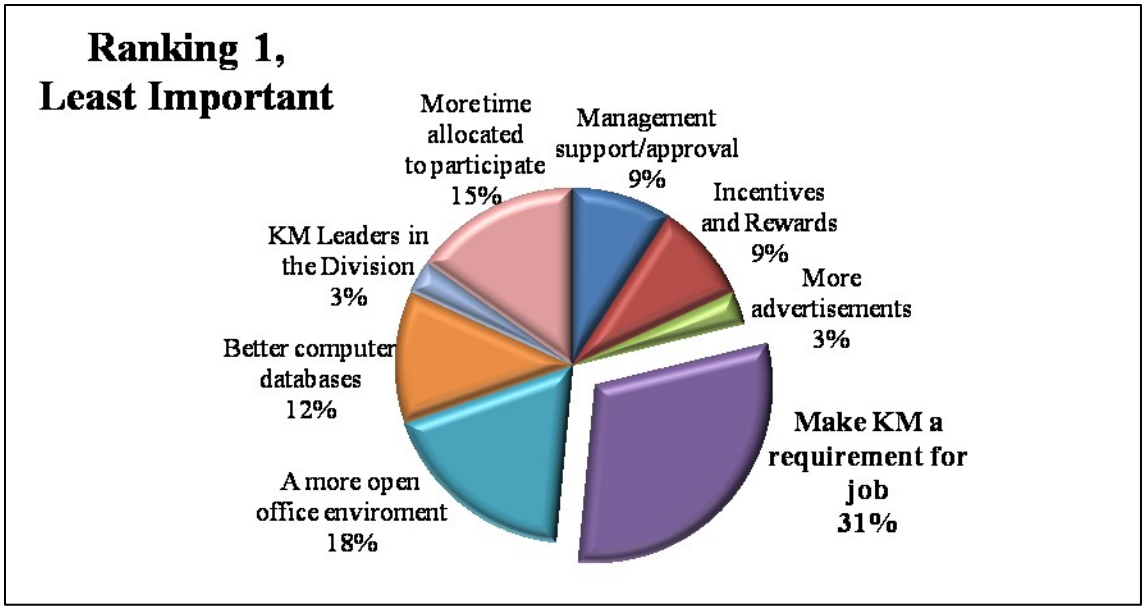


Figure 14: Graphical analysis of EC employee's ranking of the least important reason (rank of 1, of 8) that would increase their desire to participate more in KM activities/programs.

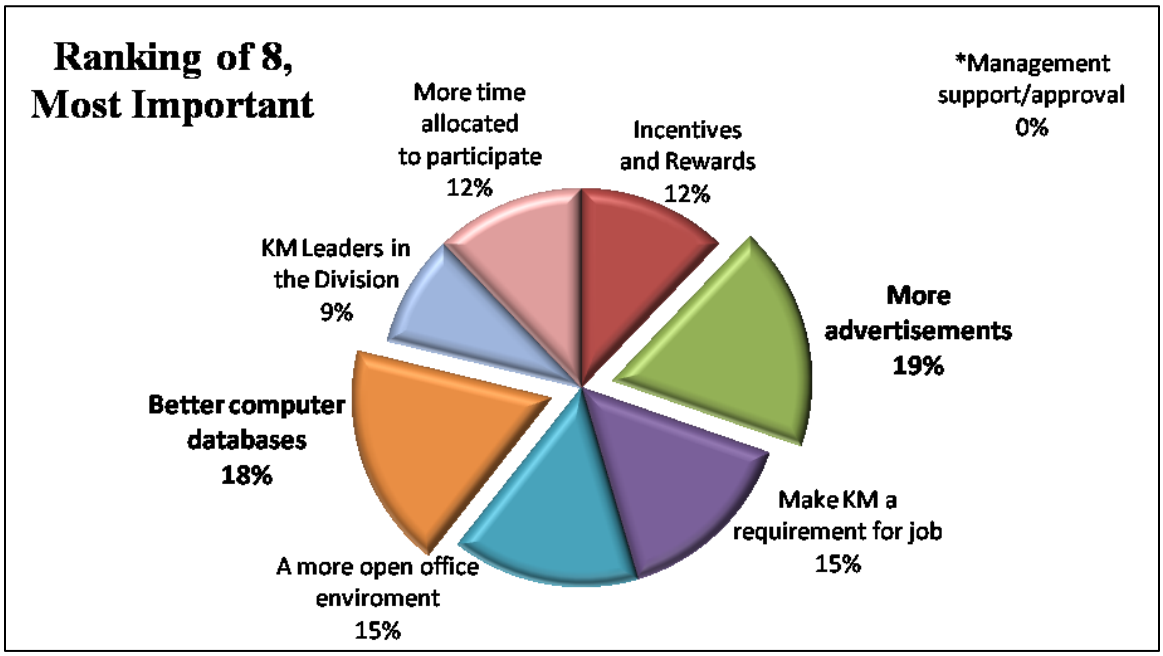


Figure 15: Graphical analysis of EC employee's ranking of most important reason (rank of 8, of 8) that would increase their desire to participate more in KM activities/programs.

INTERPRETATION OF DATA

The data collected achieved the research goal of understanding employees' current involvement (behaviors) and attitudes toward current KM activities and programs within a local Division at NASA JSC, in this case - the Crew and Thermal Systems Division (EC). In addition, the data supports the assertion made earlier in this thesis that NASA JSC employees lack the cultural enablers that stimulate behaviors that promote knowledge management. The data collected in the survey supports this assertion.

EC employee survey respondents are not utilizing the readily available KM activities/programs at NASA JSC. The data collected in survey Questions 1 and 2 support this fact. As seen in Figure 3, the mean values of familiarity of the available KM activities/programs range from a minimum 1.0 to a maximum of 2.5, on a 5.0 scale. Very few respondents noted a "high familiarity" (a ranking of 4 or 5) on any of the five KM activities/programs. Furthermore, as seen in Figure 5, many of the KM activities/programs are "not participated" in by the EC employee respondents. Specifically, with 3 of the 5 available KM activities/programs a majority of respondents (of the 39 respondents) did not participate in the Lessons Learned Database (LLIS) (82%), ASK Program/Magazine (69%) and the Engineering Academy (59%). Of course, Question 2 is influenced by the fact of whether or not the EC respondent was familiar with the KM activity/program. If an EC employee was unfamiliar with the KM activity/program, it can be assumed that the KM activity/program was not adequately advertised to the respondent. However, in the cases where the respondent is familiar with

the KM activity/program, but did not participate, it is inconclusive at this point as to why the respondent did not participate more. This unknown is further explored in other survey responses.

To begin to understand possibly why an EC respondent does not participate more in the available KM activities/programs at NASA JSC, Question 3 asks the respondent if he/she finds the KM activity/program useful. If a respondent does not find the KM activity/program useful, it is intuitive that the employee is not encouraged to utilize it. However, Figure 7 demonstrates that of the respondents that did not answer "N/A" (because he/she is aware of activity/program) those respondents on average found the KM activities/programs moderately useful, minimum mean value at 1.6 (ASK Program/Magazine) and maximum mean value at 3.1 (STI Library). Therefore, it cannot be concluded that the KM activity/program's usefulness is the only reason more EC respondents do not participate more. Usefulness of the KM activity/program could be part of the reason respondents do not participate more, but it is not likely that it is the only reason.

Another observation noted from the survey was EC respondents are engaging in some mentoring activities at the local levels. Responses to Question 4 of the survey revealed that very few individuals are giving or receiving mentoring for more than 1 hour on average per week. To make more use of this data, Question 4 responses were compared to the respondents' ages to try to understand the dynamic of mentoring in EC. Intuitively, it is assumed that an older employee is more likely to mentor a younger employee. Of the 22 respondents that were over the age of 36, only 13 EC employee

respondents gave mentoring for more than 1 hour on average each week. Similarly, of the 16 respondents that were 35 years of age or younger, it was found that only 8 of these EC employees received mentoring for more than 1 hour on average per week. Therefore, it can be concluded from this data that EC respondents are not fully engaged in mentoring within the Division with roughly 50% of participation in mentoring by the respondents.

EC respondents are not participating more in KM activities/programs because of mixture of reasons, however the most predominant reason is because the EC respondent "does not have enough time in the work day to participate." As seen in Figure 9, a strong majority of respondents (30 of 39) noted that not having enough time in the work day to participate in KM activities/programs. The next predominant reason EC respondents did not participate more was because he/she did not know that the KM activity/program existed (18 of 39 respondents). Another interesting observation was that EC respondents responded that a lack of "incentives and rewards" did not prevent them from participating more, Figure 9. Several conclusions can be made from these survey responses. First, an employee needs to be given more time within the work day to be able to participate in available KM activities/programs. If the employee's full-time job responsibilities take up one hundred percent of their day, there is no clear incentive for an employee to participate by putting their job's responsibilities on hold to participate in knowledge management activities/programs. Secondly, it can be concluded that EC employees need to be exposed to more advertisements of available KM activities/program. By removing these barriers for employees, EC can stimulate behaviors that can promote knowledge management. Lastly, it can also be concluded that "incentives and rewards" are not a

reason that EC respondents do not participate more. In EC's culture, incentives and rewards are not seen as a knowledge management cultural enabler. This statement is further supported in responses to Questions 6 and 7.

The Crew and Thermal Systems Division (EC) management supports knowledge management within the Division. EC respondent's answers to survey Question 6 are depicted in Figure 10, which shows that management supports knowledge management in a variety of ways. However, EC respondents noted that the most significant way that EC management supports knowledge management was by formally designating mentors to employees, and also by requiring documentation of a project's major documents (requirements, designs, test reports, etc). Interestingly, when analyzing Question 4's data, it can be concluded here that although the Division management formally designates mentors in support of knowledge management, EC employees may (or may not) participate in mentoring. EC employee's level of participation and the time spent mentoring can vary from individual to individual that may or may not be an effective way of knowledge sharing for EC. Another interesting observation is that only 3 of the 39 respondents stated that "giving incentives and rewards" are used by Division management to support knowledge management. However, as concluded from results of Question 5, "incentives and rewards" are not valued by EC respondents as a cultural enabler to participate more in KM activities/programs. In this regard, the Division is rightfully not enabling an activity that would have no affect on promoting knowledge management within their culture.

There are a variety of ways to stimulate behavior that can promote knowledge management within the Crew and Thermal Systems Division, as seen in responses to Question 7 of the survey. EC responses revealed that all of the given responses (possible KM cultural enablers) to "What would increase your desire to participate more in KM activities/program?" weighed almost equally when analyzed, as seen in Figures 11 to 13. The question was worded in a way to force EC employees to 'prefer' one knowledge enabler vs. another, however the results demonstrated that each respondent was different on their the preference of one enabler over another that could increase their desire to participate more in knowledge management activities. However, out of this ranked system, it is more likely that a respondent would rank the number 1 position (least important) and the number 8 position (most important) with greater significance. With this assumption, it was noted that the most respondents (31%) thought that "making KM a requirement for their job" was the least important reason to increase their desire to participate more in knowledge management activities, Figure 14. Alternatively, most EC respondents replied that "more advertisements" (19%) and "better databases" (18%) would be the most important reason to increase their desire to participate more in knowledge management activities, Figure 15. The prevalence of responses in ranking at the extremes (1, least important and 8, most important) characterize EC's culture and what knowledge management cultural enablers are more valuable to them than others. However, because EC respondent's rankings to this question are almost equally distributed, it can be concluded that any of the given reasons (or knowledge management

enablers) could increase an EC employee's desire to participate more in knowledge management related activities/programs.

SUMMARY

The thesis's "Statement of Problem" focuses on the issue that NASA JSC employees lack cultural enablers that stimulate behaviors that promote knowledge management at the local Division levels. The survey distributed for this research provided insight into the Crew and Thermal Systems Division (EC) employee's opinions on familiarity of knowledge management activities/programs, quantity of participation, opinion on usefulness, mentoring involvement, barriers to more participation in KM activities/programs, how EC management supports KM, and what would increase EC respondents to participate more. By interpreting the data collected from the survey, several key observations and conclusions were made.

EC respondents do not utilize the available KM activities/programs at NASA JSC; despite the fact the respondents find the activities/programs moderately useful. EC management does support knowledge management within the local Division by predominately supporting formal mentoring, as well as requiring archiving of major project documentation. Although, EC respondents acknowledged that the Division management supports mentoring, it was found through data interpretation that only roughly half of the employees that responded engaged in mentoring activities, and those that do spend less than an hour a week on average giving or receiving mentoring.

Mentoring is one of the easiest ways to knowledge share in an organization and, without this knowledge transfer, institutional knowledge as well as lessons learned can be lost. In addition to insufficient mentoring occurring within EC, some of main barriers that the EC respondents encounter that prevent them from participating more KM activities/programs are 1) EC respondents do not enough time in the work day to participate and, 2) the EC respondents are unaware the KM activity/program exists. Alternatively, it was found that "incentives and rewards" are not a barrier for EC employees wanting to be more involved in knowledge management practices and activities/programs. Furthermore, it would not be effective enabler of knowledge management for EC management to make a formal system of "incentives and rewards." Yet, other knowledge management enablers could be established to stimulate behaviors of EC respondents, which could create a culture change if implemented correctly. EC employee's survey responses revealed that (depending on the person) any of the recommendations given on the survey (knowledge management cultural enablers) could increase their desire to participate more in knowledge management activities/programs. As such, all enablers were considered when making recommendations on how to create cultural change that can stimulate behaviors that promote knowledge management for NASA JSC's Crew and Thermal Systems Division.

CHAPTER 5

Throughout this thesis the idea of how to create cultural change that stimulates behaviors that promote knowledge management in the local levels of NASA JSC has been explored in many ways. First, the literature search investigated what knowledge management is, current knowledge management at NASA JSC, and how to create cultural change in an organization. Then, this thesis gave an overview of results from a knowledge management survey answered by a sample population of the Crew and Thermal Systems Division. The survey investigated current involvement (behaviors) and attitudes of employees from a local Division at NASA JSC, the Crew and Thermal Systems Division (EC), towards currently available KM activities/programs. By interpreting the data collected in the EC survey responses and utilizing literature search investigations, I am to answer this thesis' research question by making recommendations on how to adjust EC's culture to stimulate behaviors that promote knowledge management activities at the local level of NASA JSC. Furthermore, NASA JSC can use these same recommendations given to EC as a baseline that could be paralleled for use in other local level Divisions at NASA JSC.

OBSERVATIONS OF THE CREW AND THERMAL SYSTEM'S KM CULTURE

Several cultural observations were noted while interpreting the data from the survey distributed to the target population of the Crew and Thermal Systems Division (EC), a local level Division at NASA JSC. As stated in this thesis' literature search, in KM literature today, there is cohesiveness amongst author's recommendations one three core issues for stimulating behavior that can promote knowledge management in an organization's culture, 1) leadership with in an organizational structure, 2) time allocation to knowledge activities, and 3) incentives and rewards. One of the most interesting observations from the conducted research was that contrary to literature search recommendations, giving EC employees "incentives and rewards" to promote knowledge management would <u>not</u> be a successful cultural knowledge management enabler. As stated in this thesis' literature search, in KM literature today, there is cohesiveness amongst author's recommendations one three core issues for stimulating behavior that can promote knowledge management in an organization's culture, 1) leadership with in an organizational structure, 2) time allocation to knowledge activities, and 3) incentives and rewards. In this thesis' findings, one of the three prevalent ways to stimulate employee's behavior to promote KM was found to be inapplicable to the EC Division at NASA JSC. This is further supported in the survey results in a few areas. In Question 5, only 1 of 39 respondents stated that the reason he/she did not participate more was because of "incentives and rewards." In addition, for Question 7, the frequency of EC respondents that ranked "receiving incentives and rewards" as the least reason to

participate more in knowledge management activities, on a scale 1(least important) to 8 (most important) as seen in Figure 12. Interestingly in survey responses to Question 6, it was found that EC management doesn't formally give "incentives and rewards." In supporting the findings from the survey, it is good that EC management does not promote incentives and rewards as a knowledge management enabler, which is clearly ineffective (or not valued) in the culture it is used in.

Of the aforementioned three core issues for stimulating behavior that can promote knowledge management in an organizational structure, leadership within the organizational structure was deemed important to the employees/respondents of the Crew and Thermal Systems Division (EC). Although the results from Question 7 of the survey demonstrated that of the eight key knowledge management enablers that could increase an employee's desire to participate more in KM activities/programs were pretty evenly recommended, "KM leaders in the Division" was ranked on average the highest (ranked between 5 and 8) by many of the EC employees, Figure 13. This emphasizes the fact that EC employee's need leadership in their culture to promote and keep them aware of KM activities and other KM practices. This further touches on the point of EC employee's response to Question 5 ("What prevented the employee from participating more?"); it was found that 24% of employees did not know that some of the available KM activities/programs even existed. This issue was also revealed in EC employee's responses to Questions 1 where the mean values of familiarity of available KM activities/programs were relatively low. Currently, EC does not have a knowledge management representative (leader) that actively communicates to employees about KM

activities/programs and other useful knowledge management practices that could be utilized.

The last of the three core issues previously mentioned for stimulating behavior that can promote knowledge management in an organizational structure is time allocation to knowledge management activities. EC's culture recognizes this as an important factor as well. In survey responses to Question 5, 30 out of 39 employees responded that the reason they do not participate more in KM activities/programs is because they feel that they "Do not have enough time in the work day to participate." The response to this question was one of the only statistical majority responses received from the study, indicating a strong and unified response from EC employees about their culture. Of the question's other possible responses, the response "Do not want/need to participate" received only 7 out of 39 responses, indicating the majority of EC employees would like to participate however they have barriers preventing from involving themselves more. From an EC culture prospective, this is a good sign that a majority of EC employees are willing to adapt to a more knowledge management friendly culture, but need assistance to make it happen.

However, beyond the fact that literature emphasizes these three core issues, it is truly a mixture of knowledge management cultural enablers that can promote KM in EC's culture. This is noted in the fact that when EC employees were asked what would increase their desire to participate in KM activities/programs (Question 7) their highest ranked preferences was for more advertisements on knowledge management programs and for better computer databases. Of course, it is easily understood why more

advertisements would be an enabler for EC's culture (or any culture for that matter), but a more interesting KM cultural enabler specific for EC's culture is a demand for better searchable computer databases. This makes sense for an engineering organizational culture that needs highly technical information at their fingertips and for that information to be easily retrieved. Databases that EC culture is requesting could be utilized for knowledge sharing (such as lessons learned), or reusing codified knowledge specific to the organization. Databases are considered a part of IT infrastructure, which was previously defined in this thesis as one of the four critical components to an effective KM program by Holm, which are culture, knowledge structure, IT infrastructure and support services (Holm, 2006). Therefore, it is somewhat intuitive that EC is requesting a stronger IT system to be able to support KM in a more significant way. It is seen here why culture is an important pre-requirement to the other three components of an effective KM program, because the databases first have to be promoted, accepted, and found to be useful by employees for an IT infrastructure to even begin to be effective in the organization.

All of these observations of the EC culture can be used to make recommendations to EC on how to create a culture change that can stimulate behaviors that promote knowledge management.

RECOMMENDATIONS ON HOW TO CREATE CULTURE CHANGE WITHIN EC TO PROMOTE KM CULTURE

To answer this thesis' research question, it was critical to understand EC's current culture in order to make recommendations on how to create cultural change that can stimulate behaviors that promote knowledge management at the local level. As Jeanie Engle (CKO at NASA JSC) noted, "Rather than imposing center wide processes for capturing and sharing lessons learned, we are allowing organizations to capture, share, and infuse lessons in ways that work for their particular cultures" (Engle and Fontenot, 2010). Similarly, I have made recommendations for EC with their specific needs in mind, which can be applied to other areas at NASA JSC with minor modifications.

First recommendation: Make it useful. EC survey respondents (employees) found currently available KM activities/programs only moderately useful to them. To create cultural change that stimulates behaviors in employees to participate/use these KM activities/programs, they must be useful. Once they are deemed useful, the culture will shift to utilizing these activities/programs after realizing their benefits. So, the question then becomes how to make the activities/programs more useful for EC employees?

There are three specific ways to make KM activities/programs more useful for EC employees. First, there needs to be a subset of activities/programs that are specific to EC employee's needs. Such as, 'Storytellers' sessions could be held to focus on "EC specific" issues/lessons learned and also presented by other EC employees. Yet, accompanying this recommendation, NASA JSC should not get rid of the center wide APPEL Storyteller sessions rather the EC Storyteller session would be in addition this

program to make it more applicable and useful for an EC employee. Secondly, EC management should require employees to formally document lessons learned from projects/activities. Currently, in EC, documenting lessons learned is only a 'recommended practice' at the conclusion or during projects, and it should be mandated throughout. Capturing these lessons learned is critical for NASA and the future of space exploration that will allow other engineers and scientists to benefit from the last fifty years of space pioneering. However, this recommendation is not as simple as requiring the lessons learned to be documented. Hand in hand with this, it is also recommended that these lessons learned are entered into a computer database that has a taxonomy that allows the employee/user to easily search and locate needed information quickly and efficiently. It is critical that the employee finds the search engine (taxonomy) useful; otherwise it will not be utilized and will be written off as a 'hassle' instead of a benefit. NASA JSC has a Lessons Learned (LLIS) database, however few employees submit to it; therefore the database is not as useful as it could be. It is recommended that EC employees either submit to this database, or create an EC LLIS database for internal specific use (although could be used by another NASA JSC employee). Lastly, to make knowledge management activities/programs more useful, it is recommended that EC employees be trained on available NASA JSC (or future EC) databases and how to search within them. This recommended training will allow the employee to be able to more effectively navigate the database and locate the needed information thereby making the database more useful.

Second recommendation: Create leadership at the local level (the EC Division). EC management should appoint an existing leader within the Division to be a KM representative with several years of experience. It is important that this KM representative be well respected and motivational to other EC employees. This type of "representative" role is typically given to new hires or to an employee that just needs to keep busy beyond their full-time job. Yet, that selection method could be fatal to the organization trying to create cultural change. It is critical to adequately select an individual that can be an influential promoter of KM within the organization. Otherwise, the KM representative position and the promotion attempts will be relatively unsuccessful. The new KM representative's roles and responsibilities would include (but not limited to) promoting available knowledge management activities/programs and practices, be the point of contact for any KM related questions, receive and disseminate flow-down information from the Chief Knowledge Officer (CKO) at NASA JSC, and continuously find ways to improve the existing knowledge management activities/programs and practices for the benefit of EC employees. By creating a designated KM representative at the local level, the Division employees will be more likely to be aware of activities/programs available to benefit them. This specifically addresses one of the more significant observations from the results of the research survey that employees do not know that KM activities/programs exist and why they are useful. By formally designating a KM representative within the Division, employees should acknowledge the importance of KM to management (a sign of priority mission/directives) and should stimulate an employee to participate more than normal – knowing the activity

exists and that management openly backs the knowledge management activity/program or practice.

Third recommendation: Make time available for the employee to participate in knowledge management. The cultural change required for this recommendation would be for EC management to make formal verbal and written support of available knowledge management activities/programs and practices available. When EC management formally acknowledges and openly supports KM, employees will be more likely to participate more knowing that management supports the activity/program or practice. Furthermore, EC management will be required to reassess work loads of employees to see any of their employees are over-worked to a degree where they are not able to participate in the available KM activities/programs. Once workloads are deemed acceptable, employees are more apt to participate once their full-time job requirements are no longer a barrier for participation. In addition to management's support, it is logical to understand that once KM activities/programs become more useful and applicable to them, they will want to participate more. Intuitively, people want to make time for things that they enjoy or find beneficial. Therefore, this issue of "making more time for the employee" is further helped when the KM activities/programs become more useful to the employee. By getting management's support, a cultural change is possible that can stimulate behaviors of employees to promote knowledge management.

SUMMARY

Holm identified the four key success factors of an effective KM program: 1) culture, 2) knowledge structure, 3) IT infrastructure, and 4) support services (Holm, 2006). Of these four critical components, culture is the most important component since it is a pre-requirement to the other three factors of an effective KM program. If the people within the organization are not conditioned to be a knowledge management accepting culture, IT infrastructure, support services and knowledge structure are rendered ineffective.

Through a research survey given to a local level Division at NASA JSC, the Crew and Thermal Systems Division (EC), it was found that NASA JSC employees lack cultural enablers that successfully stimulate behaviors that promote knowledge management. Many of the EC respondents were not aware of current KM activities/programs offered at NASA JSC, and infrequently participated in them when they were aware of the program. The respondents stated that the main reason that they do not participate more in the available KM activities/program was because there is not enough time in the work day to participate. In addition, respondents were not negatively affected by the fact they do not receive incentives and rewards for participating in KM activities/programs. This was an insightful finding because incentives and rewards are noted in KM literature as an effective enabler of knowledge management culture; however within EC it seems to be an ineffective. Also, from the research it found that EC respondents acknowledge a variety of knowledge management cultural enablers that

could increase their desire to participate more if implemented. It is understood that it takes a diverse set of enablers to truly create a culture accepting of knowledge management practices and programs.

Recommendations have been made to address this thesis' research question of how to create cultural change that stimulates behaviors that promote knowledge management at the local levels of NASA JSC, and can potentially be adapted to other local levels of NASA JSC. These recommendations include making the KM activities/programs more useful and specific to employees at the local level, creating a KM representative leadership position at the local level, and lastly, giving employees time to participate in KM activities/programs by gaining active support from management. In abiding by these three key recommendations, the Crew and Thermal Systems Division will go through a culture change that will stimulate employee's behavior to promote and utilize knowledge management.

A critical component needed to maintain NASA's mission will be JSC's ability to build off previous space program's lessons learned by utilizing knowledge management activities and practices and undergoing culture change at the local levels of the organization. Ultimately, a successful culture change is heavily dependent on the employee's behaviors and attitudes toward knowledge management. That is why it is critical to put a variety of knowledge management cultural enablers in place that are tailored to that local Division's needs in order to stimulate the right behaviors that promote knowledge management. By promoting KM, NASA JSC can continue to grow and succeed in abiding by their self-declared definition of knowledge management:

"getting the right information to the right people at the right time, and helping people create knowledge and share and act upon information in ways that will measurably improve the performance of NASA and its partners" (http://km.nasa.gov/whatis/index.html, 2010).

APPENDIX A – KM Survey Distributed to EC

Knowledge Management at
NASA Johnson Space Center Survey

Optional
Name: _____
Email: _____

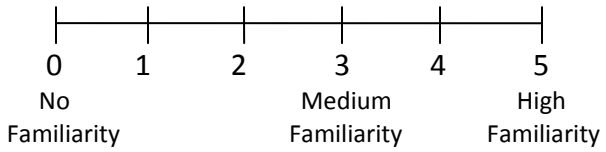
Required
Mail Code: _____

Knowledge Management (KM) is defined by NASA as getting the right information to the right people at the right time, and helping people create knowledge and share and act upon information in ways that will measurably improve the performance of an organization and its partners.

For the Crew and Thermal Systems Division (EC), KM activities can be participated in through a variety of ways including (but not limited to) attending JSC center-wide KM programs, capturing lessons learned from a project, using NASA or non-NASA affiliated computer databases for research/learning, or as simple as being a mentor.

Please fill out the below survey below:

1. There are many types of knowledge management programs/activities at NASA JSC. Please rank your level of familiarity of each KM program using the scale below (0 to 5):



__ Scientific and Technical Information (STI) Library Services

__ Lessons Learned Database (LLIS)

__ Academy Sharing Knowledge (ASK) Program/ASK Magazine

__ Academy of Program/Project & Engineering Leadership (APPEL) Storytellers

__ Engineering Academy

__ Other _____

2. If you ranked any of the items above (Question 1) higher than a '0' (No Familiarity), please specify the number of times you participated, attended, or used the program/activity over the last year (2010):

   __ Scientific and Technical Information (STI) Library Services
   __ Lessons Learned Database (LLIS)
   __ Academy Sharing Knowledge (ASK) Program/ASK Magazine
   __ Academy of Program/Project & Engineering Leadership (APPEL) Storytellers
   __ Engineering Academy
   __ Other _____

3. Out of the listed programs/activities at NASA JSC above (Questions 1 and 2), please rank the usefulness of <u>each</u> KM program/activity to your job using the scale below:

0	1	2	3	4	5
NOT useful/applicable			Moderately useful		Highly useful

   __ Scientific and Technical Information (STI) Library Services
   __ Lessons Learned Database (LLIS)
   __ Academy Sharing Knowledge (ASK) Program/ASK Magazine
   __ Academy of Program/Project & Engineering Leadership (APPEL) Storytellers
   __ Engineering Academy
   __ Other _____

4. Another significant KM activity at NASA is mentoring. If you mentor an individual, or receive mentoring, how much time a week (on average) do you receive/give mentoring? (1 time = 30 minutes)?

   NOTE: If your mentoring activity is more on a "monthly basis," scale your time weekly.

   Give mentoring:

   ☐ Do not mentor ☐ 30 min to 1 hour ☐ 1 hour to 2 hours ☐ 2 hours to 4 hours ☐ 4 hours +

   Receive mentoring:

   ☐ Do not receive mentoring ☐ 30 min to 1 hour ☐ 1 hour to 2 hours ☐ 2 hours to 3 hours ☐ 4 hours +

5. What prevented you from attending more of the KM programs/activities? Check all that apply.

   ☐ Did not know the program/activity existed

   Please specify which one(s):_____

   ☐ Not enough time in the work day participate

   ☐ Management does not support use or attendance (i.e. chargeable time)

   ☐ Do not want or need to use or participate

   ☐ No incentive or reward

   ☐ Time and/or duration of the program/activity is not convenient

   ☐ Other (please specify): _____

6. In what ways does your management support knowledge management? Check all that apply.

   ☐ Designates (formally assigns) mentors to younger (new hire) engineers

   ☐ Requires documentation of Lessons Learned in projects

   ☐ Requires archiving of major project documentation in a database (requirements, designs, test reports, etc)

   ☐ Incentives and rewards (including verbal or written appreciation and praise)

   - If checked, what was the incentive or reward? _____

   ☐ Other (please specify): _____

   ☐ Management does not formally support knowledge management activities
   NOTE: This may mean they could think KM is important, but does not actively support it in a notable way.

7. In your opinion, what would increase your desire to participate in more knowledge management activities* at JSC? Please rank importance from 1(least important) to 8 (most important):

   __ Management support/approval to participate

   __ Incentives and rewards

   __ More advertisements on KM activities at the Center

   __ Make KM activities required by job description or management direction

   __ Open office environment (i.e. more open office spaces and open doors, to promote knowledge sharing, mentoring and communication)

   __ Better computer databases (searchable) to locate needed information

   __ KM Leaders within a Division to promote KM activities

   __ More time allocated to be able participate in KM activities

*A KM activity is defined as (but not limited to) any of the KM programs at NASA (as listed in Question 1), mentoring, documenting Lessons Learned, using computer databases for research/learning, etc.

Please provide demographic information for this study

1. Gender
   - ☐ Male
   - ☐ Female

2. Age
   - ☐ 18 to 25
   - ☐ 26 to 35
   - ☐ 36 to 45
   - ☐ 46 to 55
   - ☐ 56+

3. GS Level
   - ☐ GS 9 to 11
   - ☐ GS 12
   - ☐ GS 13
   - ☐ GS 14+

4. Number of years in the Crew and Thermal System's Division (EC)
   - ☐ 0 to 5 years
   - ☐ 6 to 10 years
   - ☐ 11 to 20 years
   - ☐ 21+ years

OTHER COMMENTS:

Care to share something related to your experience with knowledge management, and/or something else I should consider in my study?

_____
_____
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APPENDIX B – Introduction to Survey

Hello ~

For those who do not know me, my name is Katherine Toon and I am an engineer in the Life Support and Habitability Branch (EC3). I've been here a little over 5 years and I am currently pursing my Masters in Engineering Management at University of Texas at Austin.

My Masters degree requires a Thesis Report, and I have chosen to research knowledge management at NASA JSC, specifically within the Crew and Thermal Systems Division. In short, Knowledge Management (KM) is defined by NASA as getting the right information to the right people at the right time, and helping people create knowledge and share and act upon information in ways that will measurably improve the performance of an organization and its partners.

The surveys are at your discretion and anonymous if you wish. They have no impact to your job or NASA. These are strictly to provide statistical insight into current knowledge management programs/activities used in EC and what you find useful.

I GREATLY appreciate your participation. The survey itself should take you no more than 10 minutes to complete.

You can either return the survey directly to me, or place them in the following share folder by **Friday, March 18th:**

\\jsc-ifs-02\data\ea\ec_shr\knowledge_management_survey\

*Note: Please rename the file before saving it to the share folder, so you don't copy over another person's file.

If you have any questions, please feel free call or email me.

Thanks again,
Kate

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VITA

Katherine Parker Toon was born in Louisville, Kentucky. After completing her work at Frisco High School, she entered the Texas A&M University in College Station, Texas. She received the degree of Bachelor of Science in Biomedical Engineering from the Texas A&M University in December 2006. Since graduation, she has been employed at the National Aeronautics and Space Administration Johnson Space Center in Houston, Texas, as an Aerospace Engineer. In September 2009, she entered Graduate School at The University of Texas at Austin.

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This thesis is typed by the author.