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Naval Surface Warfare Center Dahlgren Division Engagement Systems (G) Department Development of a Plan to Maintain, Expand, and Create Corporate Knowledge

Luis J. Rodriguez
Old Dominion University

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NAVAL SURFACE WARFARE CENTER DAHLGREN DIVISION

ENGAGEMENT SYSTEMS (G) DEPARTMENT

DEVELOPMENT OF A PLAN TO MAINTAIN, EXPAND, AND CREATE

CORPORATE KNOWLEDGE

by

Luis J. Rodriguez
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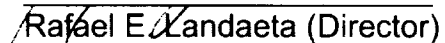M.E.M. August 2008, Old Dominion University

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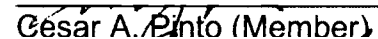
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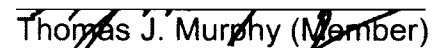ENGINEERING MANAGEMENT AND SYSTEMS ENGINEERING

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Approved by:

Rafael E. Landaeta (Director)

Pilar Pazos-Lagos (Member)

César A. Pinto (Member)

Thomas J. Murphy (Member)

ABSTRACT

NAVAL SURFACE WARFARE CENTER DAHLGREN DIVISION ENGAGEMENT SYSTEMS (G) DEPARTMENT DEVELOPMENT OF A PLAN TO MAINTAIN, EXPAND, AND CREATE CORPORATE KNOWLEDGE

Luis J. Rodriguez
Old Dominion University, 2013
Director: Dr. Rafael E. Landaeta

This dissertation presents the implementation of an organizational study in a technical organization that provides basic information for proper decision making to establish, continue, nurture, modify, transfer or terminate a Knowledge Management (KM) practice. Different aspects of an organization influence the capability to create and retain knowledge. Understanding the factors and the environment of the KM problem in an organization is essential for a successful plan and execution of knowledge creation, transfer and retention. The study purpose was to describe the contextual situation of the organization in terms of Human, Structural and Relational Capital; identify critical knowledge for the organization and knowledge at risk; and identify barriers for knowledge transfer and knowledge retention. The method presented in this project can partially fulfill the development of solutions per the objectives of this project. The actions recommended as a result of this study will help modify the organizational culture to support an environment of knowledge sharing. The study results also provide a baseline for KM metrics in areas that were not previously tracked by the organization. Limitations to the methodology were identified. Not enough participants answered the survey to identify knowledge at risk. The execution of this project and the study results support that KM can provide a structured approach for the development of solutions to the selected goals. Furthermore, it helps changing strategic objectives into specific actions supported by empirical data that can be executed at the working level of the organization. The study identifies what KM efforts are needed to continue to be used, modified, disregarded or implemented to meet the organization's KM objectives.

"When you want something, all the universe conspires in helping you to achieve it."

- Paulo Coelho, *The Alchemist*

I dedicate this dissertation to my children, Luis Armando and Natalia Valentina, may all their dreams come true; and to my wife Jessica, to whom I express a special gratitude for her unconditional support, words of encouragement, occasional reviews, and giving me a wonderful family.

ACKNOWLEDGEMENTS

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NSWCDD Engagement Systems G Department faces a Knowledge Management (KM) problem. First, the organization is threatened by a possible loss of corporate knowledge, and second the organization lacks the experience and knowledge to perform new roles in systems integration. To deal effectively with these two different but related situations the organizational leadership needs to examine the different factors affecting the problem and manage them to align with the strategic plan of the organization.

1.2   Problem Areas

1.2.1   Losing Corporate Knowledge

NSWCDD G Department faces losing corporate knowledge due to the following seven factors:

1. the ability to retain and/or transfer knowledge;
2. the challenge of managing generational diversity (four generations coexist within the organization);
3. potential manpower reduction as a result of a generation of employees being eligible for retirement and hiring limitations;
4. budget constraints as a result of an uncertain economy;
5. a limited pool of candidates to replace people eligible for retirement;
6. an increase in the percentage of employees with less than five years of service in the government;
7. in the last decade, the organization workforce has become more diverse in terms of gender, race, culture, age, and technical background, which has to come together to overcome these challenges. In addition, traditional management techniques, retention strategies and knowledge transfer techniques need to be revisited to assure takes diversity into consideration.

G Department has approximately 790 employees with a bi-modal age distribution and a large group of employees with less than five years of service in the government. Figure I and Figure II review the G Department Human Capital by age and years of service. Section 1.3 provides details about G Department organizational structure and objectives.

Figure I. G Department Employee Age Distribution in FY11

G Employees Years of Service in the Government
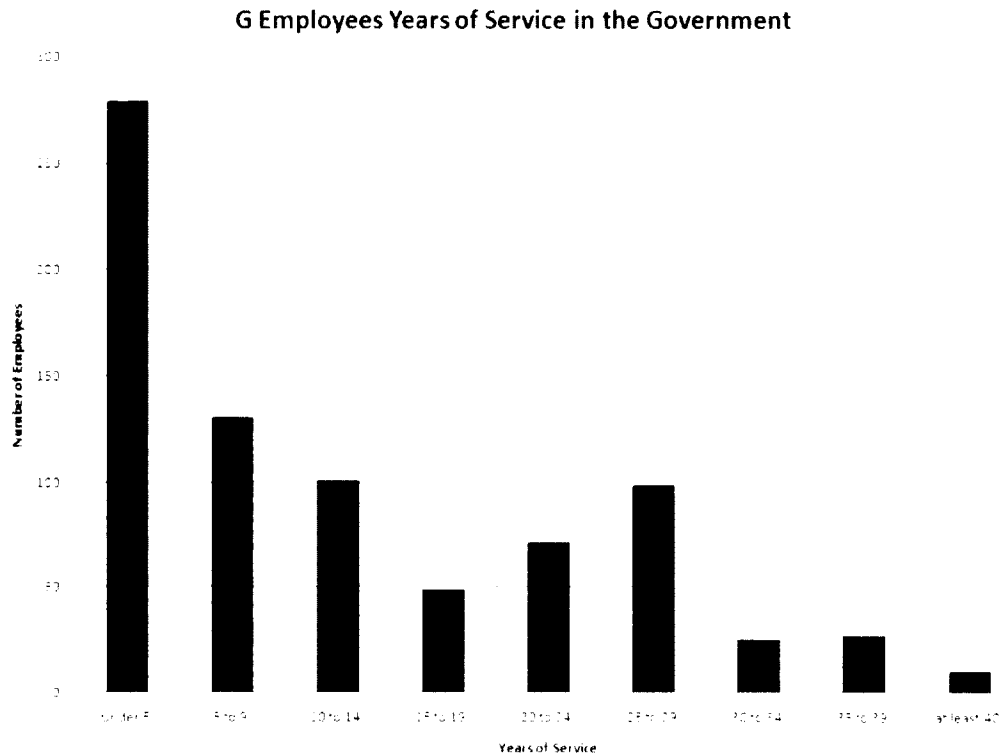
Figure II. G Department Employee Years of Service Distribution in FY11

1.2.2 Fulfilling Lead Systems Integrator Responsibilities

NSWCDD G Department will perform the role of "lead systems integrator" of System of Systems (SoS) in future government acquisitions. The knowledge necessary to perform the lead systems integrator role does not reside in the core knowledge of the organization. The organization needs to develop SoS integration knowledge within its constituents in order to fulfill its mission. SoS integration refers to the activities performed at all levels of the government acquisition process necessary to develop highly complex SoS (Garrett et al., 2011; Moreland, 2009). A SoS is a complex system exhibiting dynamic and emergent behavior that involves the integration of multiple, potentially previously independent, systems into a higher level system (Sousa-Poza, Kovacic, & Keating, 2008). To better understand the complexity of this knowledge area, below are definitions for "System" and "SoS". The International Council on Systems Engineering (INCOSE) assigned the following definition to "system":

A "system" is a construct or collection of different elements that together produce results not obtainable by the elements alone. The elements, or parts, can include people, hardware, software, facilities, policies, and documents; that is, all things required to produce system-level results. The results include system-level qualities, properties, characteristics, functions, behavior, and performance. The value added by the system as a whole, beyond that contributed independently by the parts, is primarily created by the relationship among the parts; that is, how they are interconnected. (Blanchard, 2008, p. 3)

Garrett et al., (2011) provides the following definition for SoS:

System of Systems—a set or arrangement of interdependent systems that are related or connected to provide a given capability. The loss of any part of the system will significantly degrade the performance or capabilities of the whole. The development of an SoS solution will involve trade space between the systems as well as within an individual system performance. [JCIDS, 2005, p. 92]

SoS generates capabilities beyond what any of the constituent systems is independently capable of producing (Sousa-Poza, Kovacic, & Keating, 2008). An example of a SoS is the theater Ballistic Missile Defense System (BMDS) as indicated by Garrett et al., (2011) with the following statement:

A recent example of a theater BMDS would be the joint response demonstrated by the United States and Japan in setting up defensive systems to prepare for the recent North Korean launch of the Taepodong-2 missile [Yamaguchi, 2009]. The BMDS created for the North Korean launch appears to consist of U.S. Aegis sea-

based missile defense capabilities [Kim, 2009], the two Japanese destroyers with U.S. Aegis BMD capability, Japanese and U.S. land-based Patriot Advanced Capability-Phase 3 (PAC-3) batteries, the Japanese network of FPS-5 and upgraded FPS-3 radars, and the U.S. FBX-T (AN/TPY-2) forward-based radar in Shariki. (MOD Japan, 2009, p. 89)

This example shows the complexity of a SoS as it includes diversity of systems, and it involves multinational considerations. An effective plan for G Department to develop the knowledge to perform the lead systems integrator role needs to consider the following factors:

- adequacy of the organization structure to provide for efficient, high performing teams for the research, development, test and evaluation, integration, and fielding of components, systems, and SoS;
- the workforce readiness to support lead systems integration roles;
- organizational and technical factors such as knowledge transfer, employees development, facilities, jobs and teams design, hiring limitations, attrition, and organizational culture.

Besides the organizational factors that affect knowledge creation and transfer, the plan has to consider the added complexity of long time developments (SoS development can take decades) and the dynamic needs of national defense (Garrett et al., 2011).

1.3   About G Department

1.3.1   Organization

G Department is one of six technical organizations within NSWCDD, the second largest in size in terms of number of employees in NSWCDD. The G Department Mission Statement is:

> *We support the warfighter with safe, innovative, and cost effective full spectrum engagement systems by*

conducting analysis, research & development, test &

evaluation, and systems engineering and integration.

G Department is currently organized in five divisions. Each division is composed of three or four branches:

- G20 Weapons Effectiveness and Launchers Division
  - o Launcher Systems (G21)
  - o Lethality and Effectiveness (G24)
  - o Advanced Concepts and Payloads (G25)
- G30 Gun Systems and Light Weapons Division
  - o Expeditionary Weapon Systems (G31)
  - o Gun Weapons Systems (G32)
  - o Precision & Advanced Systems (G33)
  - o Gun Fire Control System Development (G34)
- G60 Test and Evaluation Division
  - o Instrumentation and Analysis Branch (G65)
  - o Test Engineering Branch (G66)
  - o Test Execution Branch (G67)
- G70 System Safety Engineering Division
  - o Engagement Systems Safety (G71)
  - o Combat Systems Safety (G72)
  - o Platform Systems Safety (G73)
- G80 Platform Integration Division
  - o Advanced Platform Integration (G81)
  - o Unmanned Systems Integration (G82)
  - o Communications and Sensor Integration (G83)

1.3.2   Knowledge Management Systems in Use by G Department

A Knowledge Management System (KMS) is defined "as a series of inputs, processes, and outputs that interact with each other with the purpose of enhancing the performance and capabilities of a work unit through knowledge"

(Landaeta et al., 2009). G Department already has KMSs to develop and create knowledge in the organization. Some are inherent to the department, but most are in coordination with NSWCDD. Some of the most relevant workforce development programs and methods utilized at the NSWCDD level[1] are:

- Mentorship
- Individual Development Plan (IDP)
- Growth Opportunity and Learning (GOAL) Program
- Academic Fellowship Program (AFP)
- Academic Development & Professional Incentive (ADPCI) Program
  - o Onsite and offsite training (academic classes)
- Leadership training programs
  - o Explorations of Leadership Program (ELP)
  - o Mid-Level Leadership Program (MLP)
  - o Senior Leadership Program (SLP)
- Defense Acquisition Workforce Improvement Act (DAWIA) certifications[2]
- Supervisors Skills Development Program (SSDP)

At the department level, G Department has implemented:

- Specific technical training, as requested
- Technical briefs held regularly
- External assignments

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[1] Although these programs and methods are mandated at the NSWCDD level, the departments have a significant role in their implementation and effectiveness.
[2] Mandated by DOD.

Other knowledge management systems include the Professional Career
Launch (PCL) Program, patent application office, a corporate website, NSWCDD
NISE Technical Investment Program, Communities of Practice, and access to the
technical library. All these KMSs have served the purpose of contributing to the
continuous development and knowledge management of the organization.
However, these KMSs do not meet all of G Department needs. Table I below
describes and indicates what KM processes each of these KMSs addresses.

Table I. Knowledge Management Systems in G Department

Program	Description	KM Processes/Function
1. Mentorship	The program provides employees with the opportunity for communication and interaction between employees at different levels, within and across competency domains in an effort to provide opportunities to share organizational knowledge and experience.	Transfer and validation of knowledge within the organization.
2. IDP	Tools used during the performance review process where the employees communicate to their managers their development plan in terms of work experience, training and goals.	Knowledge organization/storage.
3. GOAL Program	Newly hired scientists and engineers at Naval Surface Warfare Center Dahlgren Laboratory in the ND-2 and ND-3 pay bands are required to complete the GOAL Program. The purposes of the GOAL Program are to expose the new employee to different types of work at NSWCDL and develop the new employees' skills and network.	Individual and organizational focused, knowledge assimilation.

Table I (continued).

4. AFP	A competitive, corporately funded workforce development program designed to assist NSWCDL employees in completing an academic degree or milestone. Provides tuition support for approved programs of study and time on-the-clock for study and/or class attendance.	Transfer and validation of knowledge from outside the organization.
5. ADPCI	ADPCI provides full-time NSWCDL federal civilian employees with incentives to enroll in academic course work, academic degree programs, and professional certification programs.	Transfer and validation of knowledge from outside the organization.
6. Onsite and offsite training (classes)	Preselected courses and trainings offered periodically to employees. Employees need to request enrollment.	Transfer and validation of Knowledge from outside the organization.
7. Leadership training programs	Selected employees participate in leadership training at different stages of their careers.	Transfer and validation of knowledge from outside and inside the organization, knowledge assimilation and application.
8. ELP		
9. MLP		
10. SLP		
11. DAWIA	Education and training standards, requirements, and courses for the civilian and military acquisition workforce. Certification is attained by satisfying a combination of education, experience, and training requirements.	Transfer and validation of knowledge from outside the organization.
12. SSDP	Intends to provide an understanding of the practical aspects of being a supervisor at NSWCDL.	Organizational focused, transfer and validation of knowledge within the organization.
13. Specific technical training, as requested	Employee initiated to Enroll in Academic Classes Certification Courses, attend short courses and seminars, attend conferences.	Transfer and validation of knowledge from outside the organization.
14. Technical briefs	Weekly presentations by employees on different technical and organizational topics.	Transfer and validation of knowledge within the organization, knowledge assimilation.

Table I (continued).

15. External assignments	Temporally work assignments outside NSWCDD.	Knowledge acquisition, assimilation and application.
16. PCL	Designed to new employees learn quickly about NSWCDL.	Knowledge assimilation.
17. Patent Office	Assists employees with the protection of intellectual capital.	Knowledge organization, storage, and protection.
18. Technical Library	Provides information and products in support of the technical community.	Knowledge organization, storage, and accessibility or dissemination.
19. Corporate Website	Central location for access to information such as head line news, recent public recognitions and awards, human resources, training, procedures, technical library, testing schedules, and other organizational data.	Knowledge organization and dissemination.
20. DD Workspace	NSWCDD corporate web-based tool to facilitate Department communications and workforce collaboration as an alternative to email.	Knowledge identification and access.
21. NISE Technical Investments	Internally funded technology investments for basic or applied research, development of technologies, or workforce development to recruit or retain needed scientific and engineering expertise.	Create knowledge and skills, apply knowledge.
22. Communities of Practice	1. Public Speaking Working Group. 2. Requirements Engineering Working Group.	Transfer of knowledge within the organization.

2. PURPOSE STATEMENT AND PROJECT OBJECTIVES

The purpose of this project is to assess the situation NSWCDD G Department faces and formulate possible solutions to the problem areas identified above. The development of a solution will depend on the findings of the study. The study will help determine if, in fact, G Department has a knowledge transfer or a knowledge creation issue. The objectives of the project are to:

- Develop a plan to maintain and expand organizational capabilities to deliver systems and capabilities to the warfighter – capability refers to the ability to perform, it is understood that G Department currently has the ability and knowledge to meet this goal.
- Develop a plan to create organizational capabilities to lead weapon systems integration efforts – the organization considers it currently does not perform this role, if the organization would start leading weapons systems integration efforts is unknown if someone has the knowledge to successfully undertake this role.

The objectives of this project are aligned with the organizational goals established in the NSWCDD Strategic Plan 2010-2015:

- Strengthen and Refine our Enduring Capabilities,
- Provide Mission Focused Capabilities to the Warfighter, and
- Align and Integrate our Business Operations.

2.1 Selected Strategic Goals and Objectives Description

This project will address the following strategic goals and objectives specified in the NSWCDD Strategic Plan 2010-2015:

2.1.1 Strategic Goal 1. Strengthen and Refine Our Enduring Capabilities

Aggressively pursue new capabilities to address emerging
challenges while continuing to sustain and refine current NSWCDD

enduring capabilities. Promote a culture of innovation and teamwork to solve warfighter problems of today and tomorrow, with particular focus on

- *Science and Technology (S&T)*
- *Analysis - Warfare, Design, Engineering, Modeling and Simulation (M&S)*
- *Warfare Systems Engineering & Integration (WSE&I)*
- *Software Engineering & Integration (SE&I)*
- *Critical Science and Engineering Expertise*
- *Test and Evaluation (T&E) (NSWCDD, 2010, p. 9)*

Objectives addressed:

- Science and Technology

Create a balanced portfolio across basic science, applied science and advanced technology development, and establish leadership in our primary research roles to advance the state-of-the-art for our technical capabilities.(NSWCDD, 2010, p. 9)

- Warfare Systems Engineering & Integration

Operate across both sites as a naval center of excellence in systems engineering and integration of warfare systems, translating needed mission capabilities into engineering solutions. (NSWCDD, 2010, p. 11)

- Critical Science and Engineering Expertise

Focus recruitment, workforce development and hands-on work for programs and projects in critical science and engineering disciplines required for Warfare Center research, development, acquisition, test, evaluation, and sustainment, with emphasis on sustaining essential government knowledge and supporting government Technical Authority. Examples of such critical expertise

areas at NSWCDD include broad areas such as system and
software engineering as well as niche areas such as system safety,
human systems integration, training, etc. A more complete set is
embedded in the knowledge areas that comprise our technical
capabilities (TCs). (NSWCDD, 2010, p. 13)

2.1.2 Strategic Goal 3. Align and Integrate Our Business Operations

Focus our resources to

- *Align and Shape Our Workforce to Achieve Our Vision*
- *Secure the Right Work to Enable Our Mission*
- *Ensure Operations Align to Our Mission*
- *Ensure We Have the Physical Assets and Agility to Execute Our Mission (NSWCDD, 2010, p. 23)*

Objectives addressed:

- Align & Shape Our Workforce to Achieve Our Vision
Recruit, develop, sustain and retain the diverse workforce needed to execute our technical mission. (NSWCDD, 2010, p. 23)

- Secure the Right Work to Enable Our Mission
Strengthen and refine our enduring capabilities through deliberate portfolio management while ensuring work supports the mission and strategic direction of the Division. (NSWCDD, 2010, p. 24)

- Ensure Operations Align to Our Mission
Align, document and execute our technical and business operations to enhance integrated Division decision making and achieve better planning, organizational agility and mission success. (NSWCDD, 2010, p. 24)

- Ensure We Have the Physical Assets and Agility to Execute Our Mission

Perform integrated asset management across the Division to ensure optimal use of physical resources to support our strategic initiatives. (NSWCDD, 2010, p. 25)

2.2   Problem Statement

The Naval Surface Warfare Center Dahlgren Division (NSWCDD) Engagement Systems (G) Department faces a KM problem. First, the organization is threatened with losing corporate knowledge and second the organization lacks the experience and knowledge to perform new roles in systems integration. To deal effectively with these two different but related situations the organization's leadership needs to examine the different factors affecting the problem and manage them to align with the strategic plan of the organization.

2.2.1   Problem Question

The following are the problem questions:

- How KM can support NSWCDD-G Department in meeting selected strategic goals and objectives established in the NSWCDD Strategic Plan (2010-2015)?
- To what extent does the current KM function fulfill supporting NSWCDD-G Department in meeting selected strategic goals and objectives?
- What are the gaps?
- How does the current KM function can be transformed/changed/enhanced to meet the needs of the NSWCDD-G Department?

The following are the sub-questions:

- What aspects of knowledge management: knowledge creation, gathering, organizing, disseminating, leveraging, storing, protecting and/or availability, will be addressed?

- What changes need to occur in the Human Capital, Structural Capital, and Relational Capital of the organization in order to meet the selected NSWCDD G strategic goals?

- What key competency areas NSWCDD G needs to retain or attain to successfully meet the selected strategic goals? Competency refers to the organization's ability to perform specific tasks or disciplines successfully and efficiently.

- What KM tools need to continue being used, modified, disregarded or implemented in NSWCDD G to meet the selected strategic goals?

- How will the organization measure the impact of implementing KM changes?

2.3 Project Framework

Rodriguez (2012) defines KM as

the explicit and systematic management of intellectual capital and the associated processes of creating, gathering, organizing, disseminating, leveraging (Sanders & Thiagarajan, 2005), storing and protecting organizational knowledge (Qureshi, Briggs & Hlupic, 2006), and using tools, and techniques that make available the right knowledge to the right knowledge worker, at the right time (Landaeta et al., 2009).

Intellectual capital is classified into three basic categories (Rodriguez, 2012):

- Human capital: the knowledge, skills and competencies of people in an organization; (Karagiannis et al., 2008; Sanders & Thiagarajan, 2005)

- Structural capital: the structures, processes, information systems, communication systems, patents, etc. that remain when employees leave; (Karagiannis et al., 2008; Sanders & Thiagarajan, 2005)
- Relational capital: the value of an organization's relationships with its external stakeholders (Karagiannis et al., 2008), customers (Sanders & Thiagarajan, 2005) and the value of internal social relations (Nahapiet & Goshal, 1998).

The conceptual model for this project (see Figure III) shows the variables and relationships that must be considered when addressing the KM in an organization (Rodriguez, 2012). The intellectual capital of an organization refers to the Human, Structural, and Relational Capital of the organization and the interactions between Human, Structural, and Relational Capital that provides value to the organization. The organizational goals and strategic plans serve as road maps for the leadership in the organization to manipulate the organization's intellectual capital in a way that produces value. Value refers to the things the organization produces that are considered useful, important or desirable (Qureshi, Briggs & Hlupic, 2006).

H = Human Capital

S = Structural Capital

R = Relational Capital
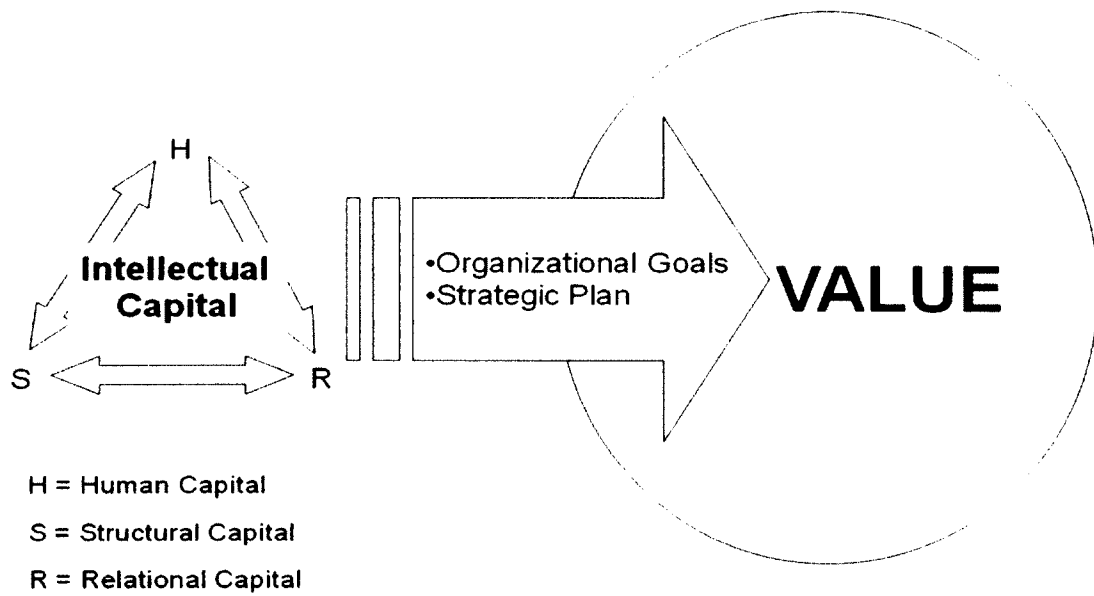
Figure III. Conceptual Model for the Relationship of the Main Variables in the Knowledge Management of an Organization

3. LITERATURE REVIEW

3.1   Human Capital

Knowledge is information combined with experience, context,
interpretation, and reflection (Devenport et al., 1998, p. #)

Human capital as defined by Sanders and Thiagarajan (2005) is the
knowledge, skills and competencies of people in an organization. Human capital
is lost when the employee leaves the organization (Karagiannis et al., 2008). In
today's environment, knowledge and skills are quite portable and the loss of
knowledge is a major potential downside for organizations (Rouse & Sage,
1999). This risk has not been overlooked by organizations in the United States.
In the Federal Government, supervisors are called to strategically manage their
human resources in creative ways to promote the retention of knowledge in the
organizations (McPhie & Rose, 2009). Bredillet (2004) indicates that Western
organizations have focused in managing explicit knowledge[3]. Since knowledge
resides in the employees, organizations must also consider the tacit elements of
knowledge[4]. A strategy utilized by organizations to retain knowledge is to
promote the transfer of knowledge between the employees.

Knowledge transfer is one of the main areas of KM. The complex socio-
technical system causes difficulty for knowledge transfer within an organization.
The analysis of the Universalist-Particularist and the Participant-Observer
paradoxes help us define the environment for this particular problem. To
understand the complex socio-technical system that is an organization consider
Kant's (1724-1804) domains of reality the "noumena" and the "phenomena".

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[3] Explicit knowledge refers to knowledge that can be codified (Meso & Smith, 2000).
[4] Tacit knowledge refers to the intangible aspects of knowledge such as the mental models,
believes and persuasions of an employee (Meso & Smith, 2000).

Noumena refers "to the thing in itself" in a practical sense what we know about the noumena is "how we think and understand things" and phenomena refers as "how we perceive things through our senses" (Pagliani & Chakraborty, 2008; Vernon & Furlong, 2007). The knowledge transfer problem has noumenological components, such as the organization's culture and politics, social interactions within and external to the organization, level of people's influence, and individual psychology, and phenomenological components which refers to any observable events; thus the researcher must look at the problem from a mixed-reality. Reality is a construct of the observer, defined by the observer's worldview, perception, set of ideas and assumptions (Ghoshal, 2005; Jones, 1972; Sousa-Poza, Kovacic, & Keating, 2008; Vernon & Furlong, 2007). Considering this definition of reality, "mixed-reality" refers to the researcher's construct of the organization and its environment as studied from an observatory perspective and from a participatory perspective. This is necessary because perception of reality can change depending on the degree of participation of the researcher or observer. The solution for the knowledge transfer problem is organization specific, multidisciplinary and multi-methodological.

3.1.1   How the Socio-technical Paradigm impacts knowledge transfer

There is no standard format or formula for knowledge retention in an organization. Successful knowledge transfer comes from a combination of techniques (DeLong, 2004). In the problem of knowledge transfer we cannot consider only the technical side of the problem nor the social side of the problem only. From a technical (rational) perspective, the knowledge to be transferred is explicit, formally organized, and detailed. This perspective will consider information management, the process for transmitting the knowledge, reports, management procedures, policies, practices, and routines. From a social (natural) perspective, the knowledge to be transmitted is informally organized, is tacit, and abstract. The knowledge resides in the worker and he/she may not be even aware of this tacit knowledge. We can talk about two types of tacit knowledge: individual tacit knowledge and team based (collective) tacit

knowledge (Berman, Down, & Hill, 2002). It is difficult to establish how much of the knowledge transfer problem correspond to technical or social attributes. Both, explicit and tacit knowledge have been identified as critical for the retention of organizational capabilities. Furthermore, knowledge can be defined into four types of knowledge according to awareness. These are Explicit Knowledge, Tacit Knowledge, Implicit Knowledge and Evident Knowledge; refer to Table II (Blankenship, Brueck, Rettie & Lee, 2007). Evident Knowledge refers to knowledge that the individual who has it is unaware that he has it, but their peers know he has it. This type of knowledge could be "evident" to an observer however the person who possesses the knowledge cannot explain it.

Table II. Four Types of Knowledge as Defined by Awareness[5]

Awareness		Types of Knowledge			
		Evident	Explicit	Tacit	Implicit
Self-Awareness	Unconscious, Unknown to Self	X		X	
	Conscious, Known to Self		X		X
Awareness by Others	Exposed, Known to Others	X	X		
	Unexposed, Unknown to Others			X	X

When considering knowledge transfer and retention one must also consider the complexity of the knowledge wanted to be captured. Figure IV shows how

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[5] Source: Adapted from Linda Blankenship, Terry Brueck, Melanie Rettie and Jim Lee, 2007; "Strategies to Help Drinking Water Utilities Ensure Effective Retention of Knowledge, Interim Report", Awwa Research Foundation and the U.S. Environmental Protection Agency.

types of information relate to knowledge retention; facts (explicit knowledge) are more easily captured, in contrast complex systems and decisions sometimes referred as "organizational wisdom" (implicit and tacit knowledge) are harder to retain and learn (Blankenship, Brueck, Rettie & Lee, 2007).

Knowledge Complexity

Hard

Complex Systems and Decisions

Difficulty of
Knowledge
Retention

Processes and Practices

Information and Facts

Easy
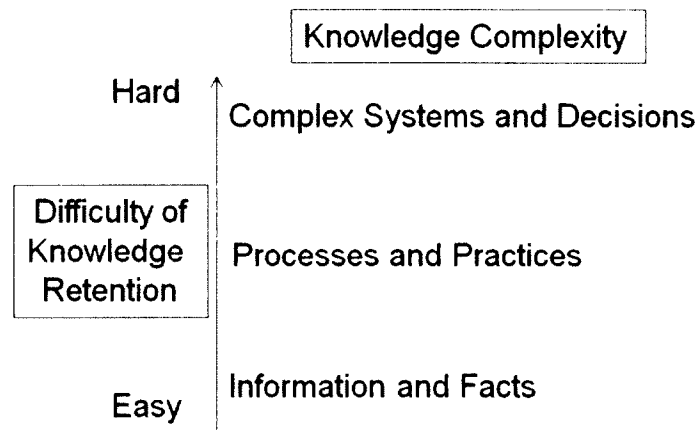
Figure IV. Difficulty of Knowledge Retention[6]

Another concept of interest when considering the problem of knowledge transfer is the term "understanding" as proposed by Sousa-Poza, Kovacic, and Keating (2008). In their proposition understanding is generated from the same situations as knowledge but it is not concerned with its own intransience. Understanding is context dependent and is influenced by practice or even learning.

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[6] Source: Adapted from Linda Blankenship, Terry Brueck, Melanie Rettie and Jim Lee, 2007; "Strategies to Help Drinking Water Utilities Ensure Effective Retention of Knowledge, Interim Report", Awwa Research Foundation and the U.S. Environmental Protection Agency.

3.1.2 How the Universalist-Particularist Paradox impacts knowledge transfer

A paradox is a true statement, or set of statements, that leads to a contradiction and a counterintuitive situation. Management of knowledge transfer within an organization can focus on two levels of KM as defined by Sveiby (2001):

    1. Individual perspective, which is focused in research and practice on the individual.

    2. Organizational perspective, which is focused in research and practice on the organization.

The organizational perspective can be considered a universalist approach to knowledge transfer. This approach focuses on the management of information, creation of processes, and establishment of databases with the expectation that the changes in the organization will induce the constituents to learn, create, share and/or transfer knowledge, thus the organization retains its capabilities. The individual perspective is a particularist approach. This approach focuses on the individuals of the organization, seeking to develop the organization's constituents at an individual level expecting that the development of each person will contribute to the organization creation and retention of knowledge. Under this approach, each individual would be encouraged to engage in continuous education and improve individual skills and competencies.

Currently, there are different methods in use to transfer and retain corporate knowledge. Some have a universalist approach, for example implementing a structure where younger and experienced employees learn about each other. Others have a particularist approach, using methods such as specific training or academic education paid by the organization and Peer Assist: a working meeting at the beginning of a project to import knowledge into the team (Milton, 2000), this last one also has universalist elements. This is not uncommon, organizations often use a combination of techniques and it is possible to see a combination of both approaches in a particular technique, for example,

Communities of Practice (Wenger, 1998). A Community of Practice is a group of practitioners within an organization, who do the same work, face the same challenges, and tackle the same issues, and who freely share operational knowledge (Milton, 2000) – in one way this technique can be considered universalist because it specifies a process that allows each person to share knowledge, but it also has particularist aspects because it specifies the particular knowledge area a group of people need to develop, share, transfer and/or retain, and concentrates in the development of the individual.

The way an organization manages knowledge transfer is widely influenced by what type of knowledge the organization is seeking to retain or develop. Transfer of tacit knowledge is managed differently than transfer of explicit knowledge. The selection of the knowledge transfer technique to be used also depends on the organization's interest and/or needs.

One aspect of knowledge transfer is learning. The learning process in organizations also has a universalist-particularist paradox embedded. Bredillet (2004) identified this paradox in the relationship between organizational and individual learning:

> *Many authors emphasize the paradoxical nature of the relationship between individual and organizational learning (e.g., Argyris and Scho¨n, 1978; Huber, 1991; Bomers, 1989). One can observe that an organization consists of individuals, and individual learning is consequently a necessary condition of organizational learning. In contrast, the organization is capable of learning independently of each single individual but not independently of all individuals (Argyris and Scho¨n, 1978).*
>
> *An organization learns through its individual members and is thus directly or indirectly influenced by individual learning. Therefore, it is not surprising that most theories about learning organizations are based primarily on observations of learning individuals, particularly*

in experimental situations (Sterman, 1989; Huber, 1991; Kim, 1993).

Hedberg (1981) makes a comparison between the brains of individuals and organizations as information processing systems. Organizations have cognitive systems and memories, through which certain modes of behavior, mental models, norms, and values are retained. For that reason, organizations are not only influenced by individual learning processes, but organizations influence the learning of individual members and store that which has been learned. This may take the form of manuals, procedures, symbols, rituals, and myths. Though the individual is the only entity able of learning, he or she must be seen as being part of a larger learning system in which individual knowledge is exchanged and transformed. (Bredillet, 2004, p.1120)

As Bredillet noted, learning of an organization and learning of an individual are intrinsically related.

3.1.3 Implications of the Participant-Observer Paradox

...it is argued that for the creation of robust methodologies, methods, approaches, etc. to deal with complex situations one must accommodate for the lack of understanding that is inherent in complex situations (Souza-Poza & Correa-Martinez, 2005, p. 1)

The knowledge transfer problem in an organization is a complex situation that not only deals with the transmittal of tacit or explicit knowledge but also with the interaction between tacit and explicit knowledge within the context it takes place. The phenomenological aspects of the problem can be identified, represented, and studied from an observatory perspective. However, this analysis will miss the noumenological aspects of the situation. Noumenological aspects such as the organization's culture and politics, social interactions within and external to

the organization, level of people's influence, and individual psychology can be better understood and studied from a participatory perspective. And even then, the study will not be able to completely identify and analyze the social component of knowledge transfer because of the complexity of the problem. The researcher needs to consider both perspectives. Failure to do so will end in incompleteness of the reality that it is intended to represent.

It has been suggested that all knowledge has both tacit and explicit components (Blacker, 1995; Boiral, 2002; Boland et al., 1994; Brown & Duguid, 1991; Cook & Brown, 1999; Hall & Andriani, 2003; Jasimuddin et al., 2005; Kogut & Zander, 1992; Lam, 1997; Lave & Wenger, 1991; Spender, 1996; Tsoukas, 1996). And that knowledge is not strictly polarized between tacit and explicit, but exists along a continuum of tacitness and explicitness (Jasimuddin et al. 2005; Kogut & Zander, 1992). If the researcher considers these statements to be true, then s/he has to be aware, that using the tacit-explicit dichotomy to classify information will always have the potential for incompleteness. The researcher also needs to consider the Nonaka and Takeuchi (1995) Socialization, Externalization, Combination and Internalization (SECI) model, when dealing with knowledge interactions, processes, and the creation of knowledge; and the generation of white space (Souza-Poza & Correa-Martinez, 2005) as s/he continues to detail the study of the problem. The white space represents the lack of understanding or information (non-monotonic situation); also gives room for new sub-situations (emergence) and changes in the environment. Figure V below shows the holistic view for the Participant-Observer Paradox when applied in the knowledge transfer problem and the elements for its consideration. The upper right corner of Figure V intends to shows the relation of knowledge, data, information, and wisdom, which are seen as levels of understanding (Nonaka & Takeuchi, 1995) and how it fits in the Participant-Observer paradox. Data are the simplest form of facts or collection of facts, when data are processed and put into context it becomes information (Clarke & Rollo, 2001), when information is integrated with experience, intuition, and judgment is then seen as knowledge (Lueg, 2001). Although the definition of knowledge is an on-going debate (Hoe,

2006), most scholars agree that knowledge is a higher level of understanding than information (Davenport & Volpel., 2001; Hoe, 2006). Wisdom is the highest level of understanding (Hoe, 2006) it relates to the ability to effectively use knowledge to achieve desired goals (Bierly, Kessler & Christensen, 2000). In the Participant-Observer Paradox data obtained from the observer point of view will need to be internalized and understood by the researcher or the person framing the environment. Those elements identified from a participant point of view will need to be externalized.
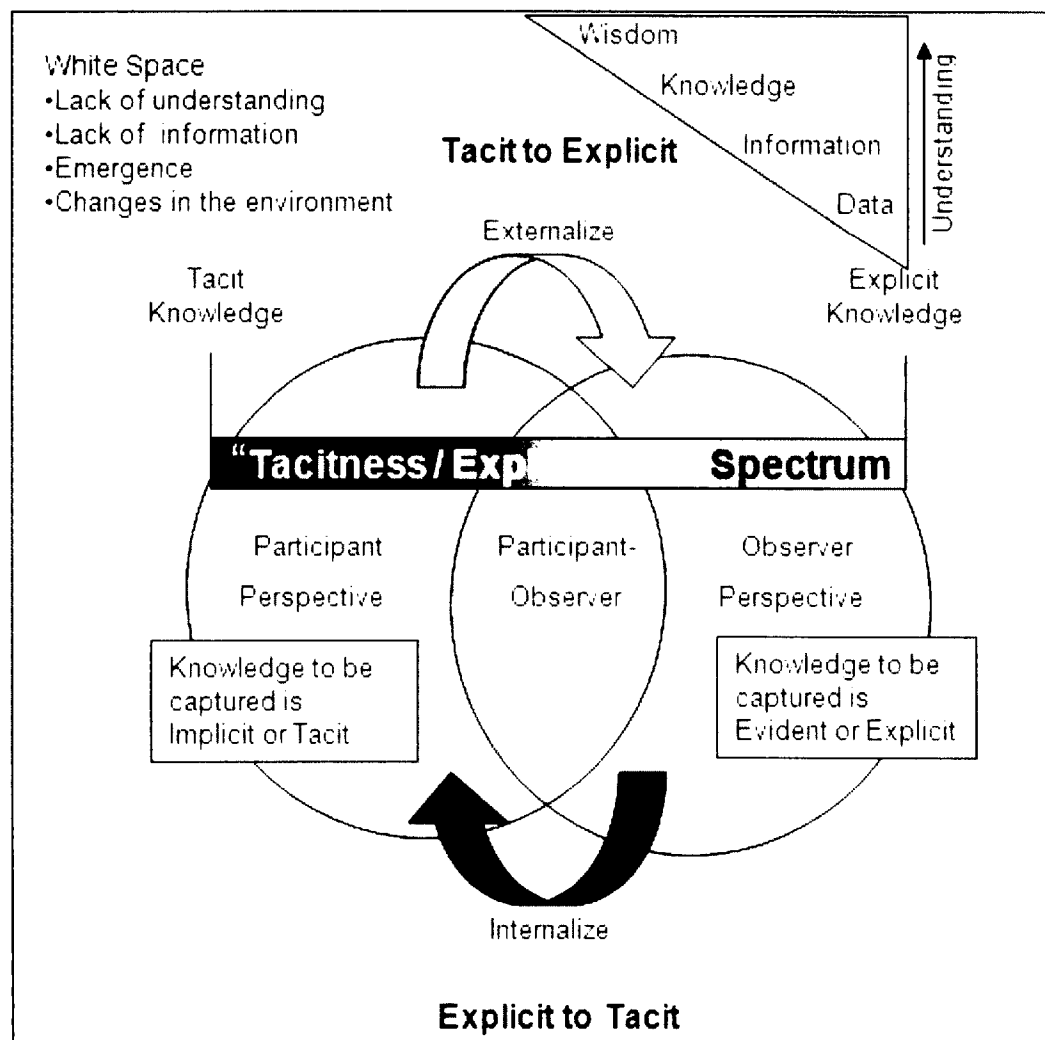
Figure V. Observer-Participant Paradox in the Knowledge Transfer Problem Holistic View

As mentioned before, knowledge transfer techniques are dependent on the type of knowledge (explicit or tacit) being transferred. But this is not the only condition for the selection of an appropriate technique.

3.2   Structural Capital

Structural Capital is the only type of intellectual capital that can be owned by organizations and is easier to share and reproduce than Human and Relational Capital (Kragiannis et al., 2008). It refers to the structures, processes, information systems, communication systems, patents that remain when employees leave (Karagiannis et al., 2008; Sanders & Thiagarajan, 2005). Many organizations strive to transform Human and Relational Capital into Structural Capital in an effort to increase organizational knowledge. Capturing the right information would only solve part of the problem, the timing and distribution of information to the right employee is critical for a successful KM system. Sharing all the captured "knowledge" with all employees will create an overload of information that often can get lost in the system or process, never be used, and not be cost effective. When designing a Structural Capital strategy, the organization must not disregard the social aspects embedded in the Human and Relational capital. Knowledge only resides on the employees, thus Structural Capital by itself should not be considered knowledge. The challenge and objective for organizations is then to determine the right cost effective Structural Capital that produces the best condition to meet organizational goals.

3.2.1   Selecting an Organizational Structure for Project Organizations

Organizational structures play a significant role in an organization's ability to promote knowledge sharing and learning. Organizational structure must be seen as open systems (Luthans, 2005) and designed in a way that promotes knowledge transfer and social interaction, can easily adapt to changes, reflects the values and cultural aspects of the organization, facilitates individual and group learning, and add to the organizations ability to produce value. Three commonly known organizational structures are the functional, the pure product,

and the matrix structures. Each has advantages and disadvantages. Some organizations use a combination of these to achieve their goals. There is no right or wrong when selecting an organizational structure, but the organizational structure used must optimize the company performance by achieving a balance between the social and technical requirements and providing individuals with a clear description of the authority, responsibility, and accountability for the work to proceed (Kerzner, 2006).

3.2.2 Learning Organizations, existent knowledge management techniques

An organization is capable of learning independently of each single individual but not independently of all individuals (Argyris and Schön, 1978). (Bredillet, 2004, p. 1121)

Learning organizations refer to those organizations that apply double-loop learning, practice not only adaptive but generative learning, show characteristics of continually questioning and challenging the status quo, are open to new ideas, employees throughout the organization share a vision, and there is an organizational culture that facilitates learning (Luthans, 2005).

Organizational KM is inherently related to the organization's ability to learn, both explicit and tacit knowledge. Bredillet (2004) observes that an organization learns through its individual members directly or indirectly influenced by individual learning. He also suggest that individuals are able to learn without the organization, that individual models can influence collective mental models, and that top management tends to be one of the most influential groups in the organization's learning process. Thus, organization must not rely on information systems for the creation of knowledge. The mutual shaping of information technology and society is what allows organizations to create and capitalize in knowledge (Rouse & Sage, 1999).

Some methods have been used by organizations in their effort to reduce knowledge lost due to attrition by retirement. Tacit knowledge transfer practices

include: storytelling, mentoring/coaching, after-action reviews, and Communities of Practice (DeLong, 2004); which are means to transfer the knowledge from the most experienced employees to the less experienced ones. Implementing a structure where younger and experienced employees learn about each other could improve team cohesion. Team cohesion has positive effects on group effectiveness. Members are concerned with their team's membership; in addition, have strong motivation for the team success. Another good outcome from teaming younger employees with more experienced employees is that younger employees bring new techniques, knowledge, and skills to the table. At the same time, team members learn about diverse perspectives from other members leading to more effective teams (Berman, Down, & Hill, 2002).

As mentioned before, retaining corporate knowledge is complex and challenging (DeLong, 2004). The organization has to be willing to continue implementing changes. Walker and Loosemore (2003) stated: "to deal effectively with the unexpected, flexibility had to exist at both team and individual level, in terms of capability, commitment, willingness and desire to be flexible about new options that were not envisaged in original plans" (p. #). As an alternative to transferring knowledge, the organization could accept lower skills and performance standards to fill positions (Berman, Down, & Hill, 2002) delivering lower quality products. Not a desired solution for an organization that seeks to maintain its cutting edge and reputation.

Planning is one of the major activities of learning organizations (Rouse & Sage, 1999). Although existent solutions seems to be "ready" to be implemented, organizations need to conduct a rigorous examination and study their KM programs performance before implementing further changes and adapting this to their strategic plan, that should continually be updated in learning organizations. How often a strategic plan is updated is specific to each organization; failure to meet performance standards, not meeting customer expectations, new requirements, or internal and external changes in the environment are some indicators that updates to the strategic plan are necessary. Realizing the full value of information and knowledge is strongly

related to organizations' abilities to learn and become learning organizations. Learning involves the use of observations of the relationships between activities and outcomes, often obtained in an experiential manner, to improve behavior through the incorporation of appropriate changes in processes and products. Thus, learning represents acquired wisdom in the form of abilities for skilled-based, rule-based or formal–reasoning (Rasmussen et al., 1994).

3.3   Relational Capital

Relational capital refers to the value of an organization's relationships with its customers (Sanders & Thiagarajan, 2005) and external stakeholders (Karagiannis et al., 2008), and the value of internal social relations (Nahapiet & Goshal, 1998). The value of Relational Capital includes the actual and potential resources embedded within the relationship or network possessed by the individual(s) or the organization (Nahapiet & Goshal, 1998). Studies show that scientists and engineers exchange knowledge in direct proportion to their level of face-to-face contact (Davenport, Long & Beers, 1998). This is critical information for technical organizations that want to improve knowledge creation and transfer practices. If an organization wants to increase individual learning to group learning it must strive to increase the number of personal interactions, create the right organizational climate, and promote a culture of knowledge sharing through a human network.

Relational capital is closely related to the term Social Capital as described by Vallejos et al. (2008), but the term Relational Capital as used herein also includes those relationships that are impersonal and not social in nature but add value to organizations, such as extended relationships by contract or virtual interface. Relational capital also focuses on the value that organizations obtain as a result of the establishment of these relations. Social capital (social relations) is the most influential element of Relational Capital since it can positively or negatively affect the motivation, performance, and productivity of individuals in an organization. Table III, below, lists the dimensions of social capital and their elements, although the table is not intended to include all the

relevant elements that affect each dimension, it does show the nature of each dimension. For example, the cognitive dimension is missing terms such as experience, commitment, loyalty and initiative; the relational dimension is missing elements such as identification; and the structural dimension is missing elements such as hierarchy and organization.

Table III. Social Capital dimensions and their elements7

Structural	Relational	Cognitive
Ties	Trust	Values
Stability	Norms of Reciprocity	Shared Narratives
Density	Participation	Shared Language
Configuration	Obligations	Culture
Connectivity	Diversity Tolerance	Codes

In today's environment, the importance of Relational Capital is enhanced when dealing with knowledge workers. Knowledge managers and supervisors must adapt to environments where they are more of a teammate and coach rather than a traditional boss, as they balance oversight with fostering empowerment when interacting with subordinates (McPhie & Rose, 2009). Also supervisors and managers are increasingly called on to organize communication networks rather than hierarchies. This might suggest a need for lower supervisory ratios (as a supervisor retires). As positions and working practices

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[7] Source: *Adapted from Vallejos, R.V., Macke, J., Olea, P.M. and Toss, E. (2008), IFIP International Federation for Information Procesing, Volume 283; Pervasive Collaboration Networks; Luis M. Camarinha-Matos, Willy Picard; (Boston: Springer), pp. 43-52*

evolve, such as telework, organizations need to find new norms for interactions and relationships.

3.4   Determining the Need for a Knowledge Management System

A Knowledge Management System (KMS) is defined "as a series of inputs, processes, and outputs that interact with each other with the purpose of enhancing the performance and capabilities of a work unit through knowledge" (Landaeta et al., 2009, p. #). This project assumes a KMS is socio-technical in nature and comprise a complex combination of Human Capital aspects such as organizational culture and people, Structural Capital aspects such as technology infrastructure, organizational structure and facilities (Landaeta et al., 2009; Meso & Smith, 2000) and Relational Capital aspects such as people interactions. Some of the reasons organizations may need to explore implementing or assessing their KMS or programs are to keep critical knowledge in the organization, prepare for expected programs, improve quality, prepare a pool of qualified employees for selected positions, prepare for attrition by retirement, threats of losing competitive advantage, evidence of a reduce capacity to innovate, or evidence of not meeting programs goals within budget and schedule. The desire to increase information technology should not be the driver behind a KM effort (Sanders & Thiagajaran, 2005).

In the Federal Government, there is a predicted mass exodus of skilled employees (DeLong, 2004; McPhie & Rose, 2009). Big waves of retirements usually come with corresponding waves of hiring. This presents a threat of potential knowledge lost and a need for knowledge transfer, training, and development to new employees. This is happening simultaneously as organizations strive to become more competitive and develop more complex systems in a more complex environment. A report from the U.S. Office of Personnel Management predicts that an estimated 53 percent of the Government's permanent, full-time employee pool will be eligible to retire through FY14 and that 57 percent of this eligible group will do so, with supervisors being more likely to retire since they tend to be older and with greater lengths of

service. This represents a challenge for recruitment and development of new leadership. In addition, the supervisory competencies required as well as the context where they are applied have been changing dramatically in recent years. Some of the challenges are leading and fostering an engaged diverse group of workers that requires a new set of knowledge, skills, and abilities; changes in demographics: shift in the age, tenure, and gender of subordinate and supervisory workforce; and developing strategies other than direct observation to manage employees, for example strategies to manage telework initiatives.

In addition, large-scale U.S. Department of Defense (DOD) and Intelligence Community (IC) acquisition programs have shown cost overruns and schedule delays. Meier (2008) identified several causes for cost and schedule growth on major DOD and IC programs:

- overzealous advocacy
- immature technology
- lack of technology roadmaps
- requirements instability
- ineffective acquisition strategy
- unrealistic program baselines
- inadequate systems engineering
- workforce issues

Lack of understanding of the future (uncertainty and ambiguity) has set these programs to failure due to lack of knowledge. Meier (2010) list of causal factors includes the following:

- inexperienced personnel in decision-making positions
- absence of succession management, planning, and mentoring programs in many organizations
- frequent program-manager rotations
- inexperienced Government source-selection teams
- overreliance on contractors

All these causal factors are related to not having the right knowledge, in the right place, at the right time during the life cycle of these programs.

3.5   Developing a Knowledge Management Plan

Earlier, in the literature review, it was mentioned that the solution for the knowledge transfer problem is organization specific, multidisciplinary, and multi-methodological. Before implementing a KMS the organization must study the systems that are already implemented, have clear goals of why the organization is undertaking a KM effort, and consider the social aspects before, during, and after the KMS is implemented. Davenport et al. (1998) indicated that KM projects primary sought to address either one or a combination of the following objectives:

- create knowledge repositories – the purpose is to create and organize documentation (memos, reports, presentations, articles) of "knowledge" and or information in order to be retrieved later
- improve knowledge access – the objective is to provide access to individuals to information or knowledge source to facilitate knowledge transfer
- enhance knowledge environment – seek to establish an environment that allows more effective knowledge creation, transfer, and use; and
- manage knowledge as an asset – the focus is on managing specific knowledge intensive assets, such as monitoring and protecting patents.

But before developing a KMS the organization needs to identify what needs to be addressed. A case study examining Tennessee Valley Authority's (TVA) strategy for knowledge retention involved identifying (Blankenship, Brueck, Rettie & Lee, 2007):

- Who has the knowledge?
- What knowledge is being lost?
- What are the business consequences of losing each item of knowledge?

- What can be done about the lost knowledge?

These four questions examine the cause and effect of specific knowledge in an organization and can provide great insight for the formulation of a solution. Nahapiet and Goshal (1998) indicate that knowledge is created through the processes of exchange and combination and propose that for these two processes to occur four conditions must exit: opportunity, creation of value, motivation and combination capability. These conditions are a combination of Human, Structural, and Relational Capital that are affected by the leadership and culture of the organization.

3.5.1 KM initiatives performance metrics

The Return on Investment (ROI) for KM initiatives often take a significant time to appear. In some cases, organizational acculturation to the KM initiative takes 18 to 36 months (DON, 2001); thus the importance of establishing a metric system that can provide ROI information and evidence to support analysis and decision making, such as the continuation, modification or termination of the KM initiative. To develop metrics for a KM effort the manager of the effort must identify the measures for each of the KM initiatives and identify a process to collect these measures. These measures provide organizations the ability to track and determine the benefits and effectiveness of the KM effort (Migdadi, 2009). The measure selection must be a balance between the number of measures and the value of these measures to the stakeholders. The performance measures should be based in the KM initiative objectives and it is normal that several measures are modified throughout the KM effort metric. The Department of the Navy Chief Information Officer developed the Metric Guide for Knowledge Management Initiatives, which includes a practical framework for measuring the ROI in KM initiatives. It also indicates that the value of a KM initiative is often hard to measure and it is not always easy to assign a dollar amount to things such as quality and innovation.

3.6   Implementing a KMS

Organizational cultures have an impact on the success or failure of new strategies being implemented. KMS managers must be aware that organizations may have different cultures across different departments or functional groups and must be concerned about the change and stability of the processes related to the implementation of KMS (Rodriguez, 2012).   Schein (2002) identified three stages (Table IV) in a change process that can be applied for organizational change in respect to KMS:

Table IV. The Change Process[8]

Stage	Description	Objectives
1. Unfreezing	Motivate the change target to look for new solutions. Changing the forces acting on the system.	• Disconfirm present state of the organization. • Induct anxiety or guilt on the individual or group because standards or ideals will not be met or maintained. • Create psychological safety to prevent individuals or groups to perceived the change as a threat. • Turn individuals or groups into active problem solvers. • Motivate change target to look for solutions.
2. Changing	Redefinition, learning and implementation of solution.	• Define the new status. • Provide the mechanisms for learning such that the change take place.
3. Refreezing	Internalization of the new processes, behavior, culture...	• Incorporate changes to the organization, groups or individuals.

[8] Source: Schein, E.H. (2002), "Models and Tools for Stability and Change in Human Systems", *Reflections*, Volume 4, Number 2, Society for Organizational Learning and the Massachusetts Institute of Technology, pp. 34-46.

Schein (2002) indicates that diagnostic interventions can be used to involve members of the target system in the planning of the change program, while influencing their thinking, finding facts about possible resistance to change, and learning about the present state. This process can be a great tool to unfreeze the system but it can also produce premature threat if not performed adequately.

3.6.1 Resistance to change

A statistic number provided by Campbell (2009) states that only 40 percent of the employees in an organization would change their working habits and adopt the project deliverables coming from their high-tech projects. Assuming similar reactions are adopted about organizational changes then the topics of change and stability rise in importance for the KMS manager. This brings up a paradox about change: employees in an organization want things to get better by doing the same (Schein, 2002). When planning for overcoming resistance to change Campbell (2009) explains the possible causes of resistance, listed in Table V; describes the type of resistors, listed in Table VI; and offers a few suggestions to improve the chances of mitigating resistance, listed in Table VII.

Table V. Causes of Resistance[9]

Causes	Causal Factors
1. Fear	Not understanding their new role Perception of becoming obsolete or punished for not performing as before Losing current knowledge power
2. Feelings of powerlessness	A perception that their ideas are not valued or management does not care about them
3. Absence of self-interest	Employees not perceiving the benefits of the project.

[9] Source: Campbell, G. Michael (2009). "Communications Skills for Project Managers", AMACOM – Book Division of American Management Association; Online version available at:http://knovel.com/web/portal/browse/display?_EXT_KNOVEL_DISPLAY_bookid=2585&VerticalID=0

Table VI. Type of Resistors[10]

Group	How to identify them
1. People who ignore the project and hope the project goes away.	People in this group will oppose the project quietly. A way to identify them is based on observations of their actions which usually do not match their words when they are asked to do something related to the project.
2. People who won't decide if they are in favor or against the project.	People in this group want to be in the winning side. Mistakes in the project can cause withdrawal of their support.
3. Blockers.	Middle-level management opposing the project.
4. Dissenters.	People in this group openly oppose the project, are hard to control, and usually have reasons to oppose certain aspects of the project.
5. Saboteurs.	People in this group are usually silent to senior management and will stab the project manager in the back if given the chance. This group is particularly dangerous since they would spread dissension and discord through rumors and misinformation.

Table VII. Resistance Mitigations[11]

Action	Method
1. Ensure senior management is on board.	Use project champion or sponsor to assure the senior team is onboard.
2. Communicate clearly and make sure all communications are directed at specific people	Caution with broadcast e-mails since they represent a risk of people not reading the e-mails or assuming the project is not as important. Use the case for change to explain the project when necessary.
3. Ensure all mid-level managers/supervisors are on board.	This support is imperative since they supervise most of the work completed. They must be part of the implementation strategy.
4. Ensure employees are engaged.	Give employees with the opportunity to provide inputs and/or feedback on decisions made as part of the project.
5. Identify, engage and make sure key influencers are on board.	Informally communicate with them regularly and seek out their views.
6. Consider making people part of the changes when possible.	Allow for people to be part of the design of the changes.
7. Consider other initiatives that are occurring at the same time.	Keep people inform and engaged, and assure the project will not collide with other initiatives. Develop and implement a communication plan.

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[10] Source: Campbell, G. Michael (2009). "Communications Skills for Project Managers", AMACOM – Book Division of American Management Association; Online version available at:http://knovel.com/web/portal/browse/display?_EXT_KNOVEL_DISPLAY_bookid=2585&VerticalID=0
[11] Source: Campbell, G. Michael (2009). "Communications Skills for Project Managers", AMACOM – Book Division of American Management Association; Online version available at:http://knovel.com/web/portal/browse/display?_EXT_KNOVEL_DISPLAY_bookid=2585&VerticalID=0

Sources of resistance to change have been organized accordingly to where they occur in the change effort. Pardo Del Val and Martinez (as cited in Landaeta et al., 2008) identified sources of resistance to change during two stages, during the change initiative formulation and then during the change initiative implementation. The sources of resistance to change in these stages are listed in Tables VIII and IX as presented in Landaeta et al. (2008).

Table VIII. Sources of Resistance to Change in the Strategy Formulation Stage[12]

Sources of Resistance	Definition	Reference(s)
Myopia	Participants inability to have a clear vision of the future.	Barr et al. (1992); Kruger (1996); LaMarsh, (1997); Narine & Persaud (2003); Pardo Del Val & Martinez (2003); Rumelt (1995)
Denial	Refusal to accept any information that is not expected or desired.	Barr et al. (1992); Pardo Del Val & Martinez (2003); Rumelt (1995); Starbuck et al. (1978)
Perpetuation of ideas	Tendency to continue with present thought although situation has changed.	Barr et al. (1992); Kruger (1996); Pardo Del Val & Martinez (2003); Rumelt (1995); Zeffane (1996)
Implicit assumptions	Conjectures that are not discussed due to their implicit character that can affect the way participants perceive reality.	Pardo Del Val & Martinez (2003); Starbuck et al. (1978)
Communication barriers	Barriers that lead to information distortion.	Appelbaum & Wohl (2000); Hutt et al.,(1995); LaMarsh (1997); Le Tourneau (2004); Narine & Persaud (2003); Pardo Del Val & Martinez (2003)

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[12] Source: Table from Landaeta, R.E, Mun, J.H., Rabadi, G., and Levin, D. (2008), "Identifying sources of resistance to change in healthcare", Int. J. Healthcare Technology and Management, Vol. 9, No. 1, pp. 74-96

Table VII (continued).

Organisational silence	Limitation on the information flow with individuals who do not express their thoughts, resulting in decisions that are made without all the necessary information.	Morrison & Miliken (2000); Nemeth (1997); Pardo Del Val & Martinez (2003)
Direct costs of change	Price to be paid for what needs to be given up or invested in a change that is perceived as too high.	Carroll & Edmonson (2002); Moran & Brightman (1998); Le Tourneau (2004); Pardo Del Val & Martinez (2003); Rumelt (1995)
Cannibalisation cost	Costs resulting from a change that brings success to a product but at the same time brings losses to other products.	Pardo Del Val & Martinez (2003); Rumelt (1995)
Cross subsidy comforts	Comforts that results from the need for a change that is compensated through the high costs obtained without changes in another unit, so that there is no real motivation for change.	Pardo Del Val & Martinez (2003); Rumelt (1995)
Past failures	Failures from previous experiences that provide guidance and/or impediments to a change effort.	LaMarsh (1997); Pardo Del Val & Martinez (2003)
Different interests among employees and management	Lack of motivation exhibited by employees who value change results less than managers value them.	Pardo Del Val & Martinez (2003); Waddell & Sohal (1998)
Fast and complex environmental changes	Changes that result from lack of time, stress, and several change initiatives being formulated at the same time that could overwhelm personnel and consequently do not allow a proper situation analysis.	Ansoff (1990); Appelbaum & Wohl, (2000); Pardo Del Val & Martinez (2003); Rumelt (1995)
Reactive mind-set	Resignation that results from obstacles that are inevitable.	Moran & Brigthman (1998); Pardo Del Val and Martinez (2003); Rumel, (1995)
Inadequate strategic vision	Lack of clear commitment of senior management to changes.	Freer & Jackson (1998); Moran & Brightman (1998); Narine & Persaud (2003); Pardo Del Val & Martinez (2003); Rumelt (1995); Waddell & Sohal (1998)

Table IX. Sources of Resistance to Change in the Implementation Stage[13]

Sources of Resistance	Definition	Reference(s)
Relation between change values and organisational values	Gap between what is important for the individual and what is perceived important for the organisation	Klein & Sorra (1996); Pardo Del Val & Martinez (2003); Shalk et al.(1998)
Departmental politics	Change that can make entities lose power and some others gain power	Beer & Eisenstat (1996); Beer et al.(1990); Le Tourneau(2004); Pardo Del Val & Martinez (2003); Rumelt (1995)
Incommensurable beliefs	Strong and definitive disagreement among groups about the nature of the problem and its consequent alternative solutions	Klein & Sorra (1996); Pardo Del Val & Martinez (2003); Rumelt (1995); Zeffane(1996)
Deep rooted values	Importance of ethics and emotional loyalty	Appelbaum & Wohl (2000); Broadbent et al. (2001); Kruger, (1996); LaMarsh (1997); Narine & Persaud (2003); Nemeth (1997); Pardo Del Val & Martinez (2003); Strebel (1994)
Forgetfulness of the social dimension of changes	Changes in the psychological contract	Broadbent et al. (2001); Lawrence (1969); Pardo Del Val & Martinez (2003); Shalk et al.(1998)
Leadership inaction	Lack of leadership or leaders apprehension to change due to uncertainty	Beer & Eisenstat (1996); Burdett (1999); Hutt et al. (1995); Kanter (1989); Kruger (1996); Maurer (1996); Narine & Persaud (2003); Pardo Del Val & Martinez (2003); Rumelt (1995)
Embedded routines	Practices that become well-established over a long period of time	Hanna & Freeman (1984); Pardo Del Val & Martinez (2003); Rumelt (1995); Starbuck et al. (1978)
Collective action problems	Problems that result from lack of coordination and teamwork	Pardo Del Val & Martinez (2003); Rumelt (1995)
Lack of necessary capabilities	Gap in capabilities resulting from lack of knowledge, skills, abilities, resources, norms, tools, processes, among others, which are necessary to implement the change	Appelbaum & Wohl (2000); Carroll & Edmonson (2002); Freer & Jackson (1998); Pardo Del Val & Martinez (2003); Rumelt (1995)
Cynicism	Pessimism that the change effort will not succeed	Maurer (1996); Pardo Del Val & Martinez (2003); Reichers et al. (1997)

[13] Source: Table from Landaeta, R.E, Mun, J.H., Rabadi, G., and Levin, D. (2008), "Identifying sources of resistance to change in healthcare", Int. J. Healthcare Technology and Management, Vol. 9, No. 1, pp. 74-96

Landaeta et al. (2008) also indicates the importance of identifying and addressing sources of resistance to change before, during and after change efforts are implemented.

3.6.2 Developing a communication plan

Communication is a key factor in the change implementation success. Here are a few considerations when planning the message delivery (Campbell, 2009):

1. Stakeholder analysis: Analyze the target for the communication and clearly define the purpose
2. Plan the approach:
   a. Explain the situation from the most critical to the least critical
      i. Develop a case for change
      ii. Review the business case
   b. Present the problem solution
      i. Clearly define realistic goals
      ii. Scope of the project
      iii. Define process for scope change
      iv. Commitment of the time needed
      v. Rough estimate of timeline, resources requirements and cost
   c. Include the relation to the big picture/small picture
   d. How does it affect each individual and the benefits
   e. Questions/Answer section – anticipate possible questions
3. Deliver the message
   a. Select method, tools and technology
   b. Select frequency of message delivery, combination of methods
   c. Establish communication line processes

An organization must be capable of meeting two objectives in order to succeed, run the everyday business to meet targets and goals and change the business to grow and survive in the future. Failure to achieve these objectives carries a risk of obsolescence for the organization. In complex systems change

is more difficult because a solution might not be evident and requires different perspectives and diversity of expertise.

4. PROJECT METHODOLOGY

This project does not follow a traditional research-focused study format. This practice-oriented study seeks to evaluate and solve an actual organizational issue in a government laboratory. The study has been structured in a way that sufficient and valuable data will be obtained in order to develop a solution plan to the problem identified. The solution plan will be based in the findings of this study. The overall project methodology has 11 steps:

Step 1. Define problem questions

Step 2. Understand the existing body of knowledge

Step 3. Understand and describe the organization

Step 4. Define project scope

Step 5. Develop study methodology

Step 6. Define final data collection instruments

Step 7. Implement data collection plan

Step 8. Implement data analysis plan

Step 9. Interpret findings

Step 10. Refine and produce final study results

Step 11. Develop solutions and implementation plan.

In parallel with the implementation of the study methodology the researcher will check for the accuracy of the findings and the reliability of the procedures implemented to create validity for the study. A high level map of the project methodology is shown in Figure VI.

1 Define Problem Questions	2 Understand the Existing Body of Knowledge	3 Understand and Describe the Organization	4 Define Project Scope	5 Develop Study Methodology

				6 Define Final Data Collection Instruments

Create Study Validity

11 Develop Solutions & Implementation Plan	10 Refine and Produce Final Study Results	9 Interpret Finding	8 Implement Data Analysis Plan	7 Implement Data Collection Plan

Figure VI. Project Methodology Map[14]

4.1   Study Methodology

This section denotes the strategy of inquiry, specifies the form of data collection and the recording procedures, provides rationale for the procedures selected and the steps for data analysis, and provides the data interpretation and reporting techniques used for this project, which follows a mixed methods approach. A mixed methods approach was selected because the project seeks to reveal the nature of the situation, the setting, and the processes of the organization before developing solutions to the problem. Also, a mixed method approach provides qualitative and quantitative data that allows for verification and validation of certain assumptions within a real world context.

Before developing the methodology for this project data about the age, attrition, and hiring of employees, current organizational structure and history on some of the recent changes, the strategic plan and the strategic implementation plan in G Department were obtained and analyzed to determine if conducting the study was worth pursuing. Also, unstructured or informal interviews with some

14 Source: Adapted from Landaeta, R. (2003) Knowledge Management Across Projects, Dissertation, University of Central Florida

key management and personnel were conducted. The analysis of the preliminary data suggested there was a need for a knowledge management effort to be conducted that might require changes in the structural aspects of the organization and in the behavioral aspects of the constituents. This study did not seek to evaluate the performance of the employees, program managers (PMs) or line managers, nor did it seek to evaluate the effectiveness of the policies and practices currently in use to support knowledge transfer. In summary, this study was seeking to describe the organization in terms of Human, Structural, and Relational Capital variables; identify knowledge at risk and knowledge transfer and knowledge retention barriers, in order to formulate solutions and an implementation plan to meet G Department's knowledge creation and retention objectives.

4.2   Procedures

4.2.1   Strategy of inquiry selected for a qualitative study

This study utilized mixed methods procedures to capitalize on the strengths of qualitative and quantitative methods that can be used to address this complex problem. The use of mixed methods allows for a concurrent triangulation approach of different qualitative and quantitative data sources in order to provide a comprehensive analysis of the problem (Creswell, 2009). NSWCDD G Department was studied in depth on the subjects of intellectual capital as defined herein and the information gathered was classified in one of the three basic categories of intellectual capital: Human, Structural, or Relational Capital. The findings from this study cannot be directly generalized to other organizations. The processes selected for the data collection are specific to NSWCDD G Department. However, a proper context setting is incorporated in the data collection strategy and enough information and description about the context was provided to enable generalization and/or application to other situations or future projects.

4.2.2   Role of the researcher

The role of the researcher in a qualitative study is particularly important in the collection and interpretation of data. This makes imperative the explicit identification of the biases, experiences, values, and personal background of the researcher that could shape the interpretations formed during a study (Creswell, 2009). My perceptions of how KM should be addressed in an organization are shaped by my experiences. I have worked in NSWCDD G Department since July 2004, right after obtaining my Bachelors' of Science in Mechanical Engineering from the University of Puerto Rico-Mayaguez (BSME). I have worked in different programs as a mechanical engineer supporting US Navy weapon systems and since 2009 I have worked as a project manager supporting USMC programs. Supporting these programs enhanced my awareness of the different cultures among programs and the challenges about implementing changes across an organization.

Due to my experiences in the organization I bring certain biases to this study. I made a conscious effort to evaluate and report data from an objective position supporting my interpretations and reporting my reasoning. Also, I shared the data with subject matter experts external to G Department to obtain external validity. I performed all the data collection and analyses with the purpose to gain insight and promote understanding of the problem situation. This study was conducted on the following assumptions:

- Employees are the most important asset of an organization.
- The study portion of the project has an impact in the implementation of organizational changes.
- The data and its interpretation will be specific to this case rather than generalizations.

Also, I was responsible for the proper use, collection, distribution and publication of data in accordance with the organization policies.

4.2.3 Data collection plan

Organizations have different cultures, goals and contextual factors. Therefore, they must shape the knowledge retention strategy to their reality (DeLong, 2004). This data collection plan sought to:

1. Describe the contextual situation of the organization. The organizational context was described in terms of Human, Structural, and Relational Capital. Context comprises situational factors in the environment that are relevant for organization dynamics (Dey & Abowd, 1999; 2000; Hsu & Lee, 2009; Weyns, Haesevoets & Helleboogh, 2010). Characterization and understanding of the context is domain specific and is important to formulate and support decisions. The specific variables to describe the organizational context in this study are identified in Section 8.1.4, Table XII. As an example, some of the variables are: employees' experience in term of years of experience, attrition rates, projected growth of the work force in term of number of employees and organizational structure.

2. Identify critical knowledge for the organization and knowledge at risk. Such as: competencies in the organization, who has or where is the knowledge; and knowledge needs.

3. Identify barriers for knowledge transfer and knowledge retention. Such as: problems with KMS in use, formal and informal communication channels and barriers, and identify resources constraints.

Once the information in these critical areas was obtained and analyzed, a plan was developed that aligned with the organization's strategy. The data collection effort also served as "ground preparation" for people to expect changes. The organization must not ignore the effect that the data collection process has in the employees. This was used to promote awareness to the employees about the effort to improve the technical conditions, the importance of meeting the strategic goals, the importance of identifying and recruiting leaders for the implementation phase and, to mitigate the impact of resistance or adverse reaction from the employees to the organization's initiative of change (Schein,

2002). Table X identifies the data collection steps used in the study. All employees of G department were asked to participate in the survey by e-mails.

Table X. Data Collection Plan Steps

Steps	Methods	Purpose
Identify participants	Purposefully selected individuals for the study. Discussed with G Department Management objective of the study.	Obtain different perspectives, aware multiple sectors and key personnel of the project goals, and increase understanding of the management problems associated with knowledge transfer and the competencies necessary to perform NSWCDD G mission adequately.
Prepare participants	Explained the objectives of the project to participants. Explained the objective of the data collection method implemented to management.	Collect as much useful data as possible, mitigate resistance to the project.
Implement data collection methods (limited)	Conducted a limited data collection (pilot): Documents, surveys, interviews, observations	Collect data from multiple sources and identify feasibility and effectiveness of these methods.
Evaluate instruments	Conducted a limited data collection (survey pilot)	Identify weaknesses of the data collection instruments and data collection approach.
Define final instruments		Identify obstacles to the application of the data collection instrument and study approach. Identify opportunities to enhance the instrument and data collection approach. Enhance instruments and study approach.
Collect data	Implemented final instrument: surveys, interviews	Collect enough reliable and valid information.

4.2.4 Data recording procedures

The study data were obtained from: (1) Surveys administered to employees in G Department, (2) Interviews to G Department line managers (branch managers) and NSWCDD KMS managers, (3) thorough review of data, reports and previous studies and (4) observations from a participatory perspective. Table XI list the general data that were collected with the associated methods and the correlation to the importance to this study.

Table XI. Data Collection Methods

Data Collection Method	Strategy	Purpose
Documents	Reviewed and analyzed organizational documents, and kept a journal during the study.	To describe the study context adequately and supplement data collected from surveys and interviews. Keep track of progress, efforts made and results.
Surveys	Distributed and collected online using ActiveSurvey from Allegiance. Responses were considered "For Official Use Only" and will remain within the organization. The data collected will not be published. Only aggregate data were included in the report.	To collect and record specific information with the ability to conduct descriptive statistics.
Interviews	Conducted face-to face, one-on-one with KMS managers. Interviews to branch managers were conducted face-to-face in a group setting; conduct a semi-structured, open-ended interview and took notes. Interviews were not considered confidential, but they will not be made public. Only aggregate data and anonymous comments were included in the report.	To collect historical data, information from the participants' perspective views. These individuals are selected because they are in a particular position that can affect the implementation of KMS. If questions arise about what a participant meant, the researcher will be able to go back for clarification.
Observations	The observations focused on knowledge transfer practices observed in the organization as a participant.	This helps clarify some of the biases I might bring to the study. Also, compares or contrasts with the participants' responses to the survey or interviews.

The data collected was categorized into one of the three basic areas of intellectual capital in accordance with the conceptual model presented in Figure VII.
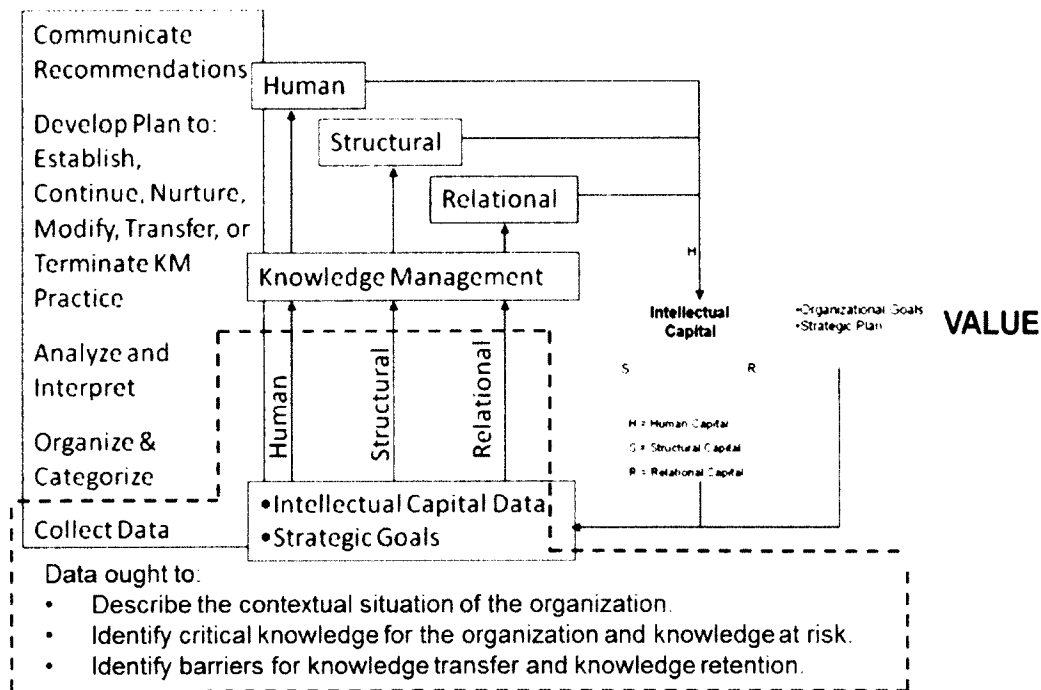
Figure VII. Study Methodology Conceptual Model[15]

Table XII, below, is a list of the types of data that were collected and how they was categorized. Each variable served as a data point to describe the organization accurately and provided a baseline that could serve for comparison in the future to identify the effect of the KM efforts and changes in the organization. Each data variable is identified by "D" (describe the contextual situation of the organization), "K" (identify knowledge at risk and who has or where is the knowledge) or "B" (identify the barriers for knowledge transfer and/or retention) to indicate the purpose of the data collection, the next column indicates the importance for collecting this information. The source of the data column specifies the expected source(s) of data: survey, interviews, document reviews, and/or Corporate Data System (CDB). Data from observations was collected

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[15] Source: Adapted from Rodriguez, L.J. (2012), Conceptual Model for the Development of a Plan to Maintain, Expand, and Create Corporate Knowledge in a Technical Organization, Proceeding of the International Annual Conference of the American Society for Engineering Management

throughout the data collection process and was identified as personal opinion during the data analysis.

Table XII. **Data Variables**

Variable	Purpose	Importance	Reference	Source of Data
Human capital type data				
(1) Line managers, PMs and employees' understanding of Lead Systems Integration and its complexity.	D, K	Clarify how the strategic objectives are changing the knowledge needs of the organization; support knowledge creation efforts; clarify knowledge needs	NSWCDD Strategic Plan 2010-2015	Survey, Interviews
(2) Leadership and management position towards KM.	D, B	Describe organizational context and prepare for implementation plan.	Holsapple & Joshi (2000), Migdadi (2009), Nahapiet & Goshal (1998), Sharp (2003)	Interviews
(3) Employees practices and preferences for acquiring explicit knowledge.	B	Determine most suitable knowledge transfer practices for NSWCDD G.	DeLong (2004)	Survey
(4) Employees practices and preferences for learning tacit knowledge.	B	Determine most suitable knowledge transfer practices for NSWCDD G.	DeLong (2004), Murphy (2003)	Survey
(5) New skills learning and usage.	B	Identify knowledge retention issues	Landaeta & Pinto (2009)	Survey
(6) Identify knowledge management systems preferences	B	Determine suitability of KMS for NSWCDD G	DeLong (2004)	Survey

Table XII (continued).

(7) Attrition history and identified reasons	D	Formulate adequate knowledge retention efforts; identify retirement patterns;	DeLong (2004)	Documents review, CDB
(8) Identify what roles are causing turnover.	D, B	Determine knowledge at risk	DeLong (2004)	Documents review
(9) Hiring history and hiring plans.	D	Consider knowledge transfer needs.		Interviews, CDB
(10) Projected future growth of the workforce.	D	Consider knowledge transfer needs.	DeLong (2004)	Interviews, Documents review
(11) Age demographics.	D	Identify and illustrate types of knowledge and skills that need to be retained; identify knowledge at risk.	DeLong (2004)	CDB, Survey
(12) Years of experience.	D	Understand the knowledge experience in the department; identify business implications for KMS.	DeLong (2004)	CDB, Survey
(13) Knowledge / competencies.	K	Identify knowledge gaps; identify specific knowledge needs; identify knowledge strengths in the impact of losing it; identify who has critical knowledge and who needs it, identify knowledge at risk.	DeLong (2004); Blankenship, Brueck, Rettie & Lee (2007)	Survey, Documents review
(14) Knowledge complexity.	K	Identify difficulties for transferring knowledge	Blankenship, Brueck, Rettie & Lee, (2007), Sousa-Poza, Kovacic, & Keating (2008)	Survey
(15) Awareness.	B	Identify employees awareness about other employees knowledge		Survey
Structural capital type data				

Table XII (continued).

(16) Investigate what communication tools employees use to transfer or acquire knowledge.	D, B	Identify forms and roles of communication; identify communication gaps and knowledge loss vulnerabilities	DeLong (2004)	Survey
(17) Perceived adequacy of the facilities for teams to perform their activities.	B	Identify what structural factors are affecting the implementation of KMS for knowledge transfer		Interviews
(18) Perceived adequacy of current organizational structure.	B	Identify what structural factors are affecting knowledge transfer.		Interviews, Observations
(19) Current organizational structure.	D	Describe and understand the organization, team formation and project dynamics; support knowledge retention efforts.	Luthans (2005)	Documents review
(20) Identify current knowledge management systems in use by employees.	D, B	Identify what method are in use to capture critical knowledge and how knowledge is transferred to the next users, support knowledge retention efforts.	DeLong (2004)	Survey, Interviews, Documents review
(21) Collaboration tools and practices.	D	Identify what methods are in use to share information in support of a collaborative environment.	Qureshi, Briggs & Hlupic(2006)	Survey, Observations
(22) Identify other undergoing efforts that affect the organizational structure and the implementation of KMS.	B	To properly plan and formulate solutions to the problem.		Interviews, Documents Review
(23) Identify the technology and tools available for knowledge capture and transfer.	B	Identify what method are in use to capture critical knowledge and how is transfer to the next users.	Bose (2004), Martini & Pellegrini (2005),	Documents review

Table XII (continued).

(24) Reward Systems.	D	Identify what organizational tools teams have to recognize employees performance.	DeLong (2004), Migdadi (2009) Roman-Velazquez (2005), Thompson (2009)	Documents review
Relational capital type data				
(25) Collaboration with people outside the branch, division, department or NSWCDD.	D	Identify formal and informal lines of communication, describe programs/project organizations; describe project dynamics and knowledge use/transfer practices.	DeLong (2004)	Survey, Interviews
(26) Identify the sponsors projects in the department.	D	Identify critical relationships that maintain organizational value		Documents review
(27) Identify if contractors are involved in the selected projects and describe the role of the contractors.	K	Identify critical external relationships that add value to the organization; identify critical knowledge outside G		Survey
(28) Relationship with sponsors.	D, K	Create baseline for plan formulation, identify relational practices of employees with the sponsors		Survey
(29) Team membership.	D	Describe team interactions and formation	Thompson (2009)	Survey, Interviews
(30) Size of the teams.	D	Describe teams' size	Thompson (2009)	Survey,
(31) Technical Diversity.	D, K	Describe teams composition, indicate knowledge diversity, contributes to competencies allocation in G (supports variable 12)	Vallejos et al. (2008)	Survey, Documents review

Table XII (continued).

(32) Participation.	D, B	Describe communication practices among the teams, identify possible knowledge sharing barriers	Vallejos et al. (2008)	Survey
(33) Trust.	D, B	Describe team practices, identify possible knowledge sharing barriers	Vallejos et al. (2008)	Survey
(34) Evaluations and critics.	D	Identify team communication practices; identify employees development and learning practices	Thompson (2009)	Survey, Interviews
(35) Distance.	D	Identify knowledge transfer challenges in scenarios with no-collocation such as teleworking, or sitting in different buildings		Survey
(36) Mentorship.	D	Identify knowledge sharing practices		Survey
(37) Connectivity.	D	Indicate how connected team members might feel and diversity of the team	Vallejos et al. (2008)	Survey
(38) Obligations.	D	Indicate clarity of communication among team members	Vallejos et al. (2008), Landaeta & Pinto (2009)	Survey

These variables traced back to the problem questions. The collective information these variables provide was used to answer each of the problem questions. Table XIII indicates the traceability of each variable to the problem question.

Table XIII. Variables Traceability to the Problem Questions

Practical Problem Questions	Variable(s)
How KM can support NSWCDD-G Department in meeting selected strategic goals and objectives established in the NSWCDD Strategic Plan (2010-2015)? And to what extent does the current KM function fulfill that mission? What are the gaps? How does the current KM function can be transformed/changed/enhanced to meet the needs of the NSWCDD-G Department?	The answer to these questions was the result of the analysis of the data which integrated all variables and information collected from the survey, interviews and documents review.
Sub-questions:	
1. What aspects of knowledge management: knowledge creation, gathering, organizing, disseminating, leveraging, storing, protecting and/or availability, will be addressed?	3, 6, 13, 14, 20, 21, 23
2. What changes need to occur in the Human Capital, Structural Capital, and Relational Capital of the organization in order to meet the selected NSWCDD G strategic goals?	All variables were categorized into one of the three basic areas of Intellectual Capital. This helped identify what kind of changes needed to occur in each of the categories.
3. What key competency areas NSWCDD G needs to retain or attain to successfully meet the selected strategic goals? Competency refers to the organization's ability to perform specific tasks or disciplines successfully and efficiently.	1, 5, 7, 8, 9, 10, 11, 12, 13, 14, 27, 28, 31
4. What KM tools need to continue being used, modified, disregarded or implemented in NSWCDD G to meet the selected strategic goals?	2, 3, 4, 6, 15, 16, 17, 18, 20, 21, 23, 24, 29, 30, 32, 33, 34, 35, 36, 37, 38
5. How will the organization measure the impact of implementing KM changes?	7, 8, 11, 12, 13, 15, 16, 17, 18, 20, 21, 23, 24, 25, 26, 28, 29, 31, 35, 33, 34, 36, 37, 38

4.2.5 Data collection instruments

Three data collection instruments were developed to support the different data collection approaches selected to conduct this study (survey and interviews). The survey was developed with triangulation of data in mind. The survey was essential in this project to provide for the opportunity to collect data from more participants and to gather data across the department. The survey

was conducted online using ActiveSurvey by Allegiance, a departmental survey tool that provided the option to participants for remaining 100 percent anonymous. The survey is included in appendix 15.1.3. Each survey question response provided information about a variable in G Department. In some cases responses to a question provide insight about two or more variables. Tables XIV, XV and XVI traces survey questions to the variables.

Table XIV. Survey Questions Traceability to Human Capital Variables

	Variable	Purpose	Related Survey Questions
1	Line managers, PMs and employees' understanding of Lead Systems Integration and its complexity	D, K	16, 17, 34
2	Leadership and management position towards KM	D, B	N/A
3	Employees practices and preferences for acquiring explicit knowledge	B	18, 19, 20
4	Employees practices and preferences for learning tacit knowledge	B	18, 19, 21, 22
5	New skills learning and usage	B	9, 10
6	Identify knowledge management systems preferences	B	18, 19, 20, 21, 22, 25, 26
7	Attrition history and identified reasons	D	N/A
8	Identify what roles are causing turnover	D, B	N/A
9	Hiring history and hiring plans	D	N/A
10	Projected future growth of the workforce	D	N/A
11	Age demographics	D	3
12	Years of experience	D	2, 4, 5
13	Knowledge / competencies	K	6, 7, 8
14	Knowledge complexity	K	10, 15, 33, 35
15	Awareness	B	11, 25, 26, 37, 56, 57, 58

Table XV. Survey Questions Traceability to Structural Capital Variables

Variable		Purpose	Related Survey Questions
16	Investigate what communication tools employees use to transfer or acquire knowledge	D, B	27
17	Perceived adequacy of the facilities for teams to perform their activities	B	N/A
18	Perceived adequacy of current organizational structure	B	N/A
19	Current organizational structure	D	N/A
20	Identify current knowledge management systems in use by employees	D, B	18, 19, 20, 21, 22
21	Collaboration tools and practices	D	36
22	Identify other undergoing efforts that affect the organizational structure and the implementation of KMS	B	N/A
23	Identify the technology and tools available for knowledge capture and transfer	B	N/A
24	Reward systems	D	N/A

Table XVI. Survey Questions Traceability to Relational Capital Variables

	Variable	Purpose	Related Survey Questions
25	Collaboration with people outside the branch, division, department or NSWCDD	D	1, 28, 36
26	Identify the sponsors of the selected projects	D	N/A
27	Identify if contractors are involved in the selected projects and describe the role of the contractors	K	12, 13, 14, 15
28	Relationship with sponsors	D, K	30, 31, 37, 38, 39
29	Team membership	D	24, 40, 41
30	Size of the teams	D	23
31	Technical Diversity	D, K	24
32	Participation	D, B	32, 41
33	Trust	D, B	42, 43, 44
34	Evaluations and critics	D	44, 45, 46, 47, 48
35	Distance	D	49
36	Mentorship	D	50, 51, 52, 53, 54, 55
37	Connectivity	D	29
38	Obligations	D	32

The other two instruments were two interview protocols. One protocol was developed to assist the interviews of line managers and the second protocol was developed to assist in the interviews to KMS managers. Appendix 15.1.1 and 15.1.2 have the Interview Protocol for Line Managers and the Interview Protocol for KMS Managers respectively. The interviews were semi-structured; the data collected from the interviews were recorded utilizing handwritten notes. These interviews were conducted after survey completion. The interviews were

conducted after the survey to prevent influencing the responses of the interviews participants in the survey. Although only a small group of people participated in both, it was preferable to have the survey answers "uninfluenced" in order to be able to do comparisons among G Department employees. A total of 9 out of 17 branch managers participated in the interviews. The interview to branch managers was conducted in a group setting. This was planned this way because of time constraints and to avoid miscommunication of ideas or study purpose among branch managers. Also, it provided the opportunity for managers' awareness of ongoing efforts among the branches and for instant clarification in case of disagreement or misconceptions. In addition to data collection, this interview setup had the following purposes:

- Identify disagreement among groups about the nature of the problem, their experience and position towards a solution;

- Discuss the purpose and needs of the study and prepare the organization first level leadership for changes or new ideas;

- Identify previous experiences that provide guidance and/or impediments to a change effort;

- Reduce communication barriers that lead to information distortion.

A presentation prior to start the study was given to division managers. Division managers are the "champions" of the changes in their organizations, the presentation helped bringing the senior team onboard the study and promoting voluntary participation. Table XVII traces the interview questions for the Line (Branch) Managers to the study variables.

Table XVII. Line Managers Interview Questions Traceability to Variables

Variable	Interview Questions Guidance
Human Capital	
(1) Line Managers understanding of lead systems integration and its complexity	• What is systems integration? • Do you consider your organization is ready to lead systems integration efforts? Why yes/Why not? • What programs in your branch currently involves systems integration and in what role do you support systems integration?
(2) Leadership and Management position towards KM	• What do you understand about Knowledge Management and Knowledge Transfer? • What do you think about the knowledge transfer programs in G Department • What Knowledge Transfer programs have you implemented in your branch or division? • What plans do you envision for the knowledge management Systems in you branch, division? • What areas have you identified needs improvement? • How do you see Knowledge Management systems contributing to your organization?
(9) Hiring history and hiring plans	• Do you have a plan that identifies your hiring needs for the next three years? • Have you identify the technical areas in risk of being lost?
(10) Projected future growth of the work force	• In the next five years, how do you envision your organization's Human Capital changing?
Structural	
(17) Perceived adequacy of the facilities for teams to perform their activities	• Have employees complained about the facilities and their ability to perform their work? • Have employees been unable to conduct tests, experiments or analyses or other task because of inadequacy of current equipment or facilities to perform their work? • Do teams in your branch have war rooms?
(18) Perceived adequacy of current organizational structure	• Have your employees express difficulties when working with other organizations (branches, divisions or departments)?
(22) Identify other undergoing efforts that affect the organizational structure and the implementation of KMS	• What undergoing efforts affect the implementation of KMS in your organization? • What and how externally imposed limits (budget, hiring freezes, travel brown out due to ERP, competing change initiatives including ERP, externally directed timelines, etc.) affect your plans to improve KM in your branch or division?
Relational	
(29) Team membership	• How employees are assigned to teams? • Who provides training to these employees when they are assigned to new tasks? • How quick they seem to be valuable members of a team?
(34) Evaluations and critics	• Who evaluates the employees and how often employees are provided feedback about their performance? • Are there differences between teams on how they evaluate their employees within a branch? • What differences have you noticed and how these impact employees' development?

The interviews for the KMS managers contributed to gathering data about KMS that affect G Department's aspects of knowledge management and traces to variable (20) – "identify current knowledge management systems in use by employees".

Section 5 provides a document traceability matrix for the variables identified in Table XII that were studied thorough documents review, which includes review of data, reports and previous studies in the department.

4.2.6 Define final data collection instruments

The finalization of the data collection instruments was intrinsically related to the validity of this study. This step in the project was to assure that the instruments measured what they intend to measure and that the data collected were accurate and sufficient to formulate an adequate solution to the organization's problem. Table XVIII below details the steps followed during the final definition of the data collection instrument.

Table XVIII. Data Collection Instrument Finalization Steps

Steps	Methods	Purpose
Identify weaknesses of the data collection instrument and data collection approach	Conducted a limited data collection (pilot). Took data through the analysis tools. Discussed with experts and the organization management if the instrument was collecting or measuring the data or areas that were intended to measure the data. Measured time consumption to implement and analyze the data. Then, revaluated the numbers of participants, number of questions and scope of the study. Compared the data collected to the study question and sub-questions.	Identify preliminary results and evaluate validity of the method and instruments, also to serve as an opportunity to verify the analysis tools.
Identify obstacles to the application of the data collection instrument and study approach		Assure the project can be implemented in the timeline proposed and make adjustment as necessary.
Identify opportunities to enhance the instrument and data collection approach		Obtain useful data that will help in the validity of the study and help in the formulation of solution to the problem.
Enhance instruments and study approach	Implemented recommendations Modified questions Eliminated questions Added new questions	Finalize data collection instrument and perform a valid study approach.

4.2.7 Data analysis plan and procedures

Data analysis occurred simultaneously with data collection. The approach of the data analysis was to look the data from the specific to the general, as suggested by Creswell (2009) in the steps shown in

Table XIX. Although the steps seem sequential, these did not follow a linear approach because of the data found and the information supplied by participants. The data were validated for accuracy of the information throughout the implementation of the data analysis.

Table XIX. Data Analysis Steps and Procedures

Steps	Procedure
Organize and prepare data for analysis	Transcribe interviews, type up field notes, rearrange the data into the different types
Read through all the data	Get general sense of the data and reflect to obtain general meaning and ideas, tone, impression, and use of the information.
Code the data	Categorize data, identify major topics, assemble data and perform preliminary analysis, will use descriptive statistic were adequately
Themes or Description	Identify themes, interconnect themes, and analyze them. Description involves the information about people, settings or events in a setting.
Interrelate themes/description	Discuss the several themes, their interconnection, and individual perspectives.
Interpret the meaning of the data	Lesson learned, call for actions, further questions,

4.2.7.1 Survey analysis

Each data variable in the survey provides information by itself. These were analyzed utilizing descriptive statistics for the organization as a whole. The data then were refined restricting the data using age group as the discriminators. Each data point for the different groups was compared against each other. The data also were analyzed by division to identify location of knowledge and any sub-cultural differences in G Department regarding knowledge transfer practices.

4.2.8 Interpretation of Findings

The purpose of the interpretation of finding is to support the formulation of solutions and the KM implementation plan for G Department. In terms of organizational change, the data seeks to support the decision about:

1. What - The data evaluation seeks to determine what aspects of the organization's intellectual capital need to be addressed

- Human

- Structural

- Relational

2. Who - Determine who would be involve in the change

3. When - The timing of when the change should occur

4. Why - strategic reasons to implement changes to the organization, if it should occur

How - Seek for indicators that suggest how the change should be performed, to reduce and avoid, where possible, resistance to change

Table XX below details the step to follow to complete the finding interpretation.

Table XX. Interpretation of Findings Steps

Step	Method	Purpose
Conduct inductive reasoning	Analyze themes and descriptions, conduct descriptive statistics	Identify areas that need improvement, Formulate solutions that fit the organization and minimize resistance to change
Literature review	Compare findings with information from literature Find information that address the problems identified	Minimize bias, formulate informed solutions to the problems identified, validate findings
Share results with experts	Present statistical and inductive interpretation	Validate inductive reasoning, discuss recommendations and possible solutions
Share results with management	Present statistical and inductive interpretation	

4.2.9 Strategies for validating findings

Creswell (2009) explains what validity and reliability means for a qualitative study:

Qualitative validity means that the researcher checks for the

accuracy of the findings by employing certain procedures, while

qualitative reliability indicates that the researcher's approach is

consistent across different researchers and different projects.

(Gibbs, 2001, p. 190).

In order to maintain reliability and validity in the procedures for this study the recommendations found in Creswell (2009) were employed. Below are listed the actions that were executed in this study to maintain reliability:

- Document steps of the procedures as much as possible (Yin (YEAR), as cited in Creswell, 2009),
- Set up study protocol and database (Yin (YEAR), as cited in Creswell, 2009),
- Check transcripts and avoid common mistakes during transcription (Gibbs (YEAR), as cited in Creswell, 2009)
- Keep codes definition constant and avoid shifting or drifting the codes definition (Gibbs (YEAR), as cited in Creswell, 2009).

Table XXI below details the strategies that were employed to maintain validity in the accuracy of the findings:

Table XXI. Validation Strategies

Strategy	Description
Triangulation	Multiple data collection methods at different times. Look for theme repetition and description consistency.
Checking	Follow-up interviews to a limited set of participants for clarification of their answer if necessary, also to check if participants feel the themes or descriptions found are accurate
Discrepant Information	Present all findings. Discrepancies, if found, will be presented, also the evidence is discussed to build credibility.
Clarify the Bias	Clarify the bias that might be brought to the study by commenting on how interpretation of the findings is shaped by experience and background.

4.2.10 Generalization

Generalization in a qualitative study is limited since the intent is not to generalize to individuals or places outside the study (Creswell, 2009). Organizational differences in structure, strategy, culture, and the context environment in which organizations operate make it difficult to generalize this

study. However, good documentation of the protocols, development and data findings will provide for repetition of the study or generalization of the findings to a new study.

4.3   Ethical Considerations

The data collection process required the collection and reporting of employees' age, branch, and position with the associated responses of the participants; the information was utilized for organizational evaluation purposes and not to categorize or "persecute" employees for their opinions or views. The responses and participants information will remain for the organization use only and will not be public. Only data in aggregate form were presented. The data collected belong to NSWCDD G Department. Sharing of the data will require NSWCDD G Department acknowledgement. This does not affect the reporting of the findings or the discussion for the study validity.

4.4   Significance of the Study

This project addressed the knowledge gaps by determining the needs of a technical organization from a practitioner's point of view. The study significance is described in terms of its importance to the organization, the practice of the engineering management profession, and academics.

A systematic approach does not exist to evaluate an organization's best approach to start a KM effort that provides enough information for decision makers to act upon situations based on empirical data that takes into account the complex reality of their organizations. In practice, current KM strategies lack the inclusion of organizational culture in their evaluation to pursue a KM effort. For G Department, this project aimed to develop a plan to meet the organization's strategic goals and to prevent loss of knowledge when individuals retire or leave the organization, taking their experiential knowledge with them. The study results can help identify recruiting goals and objectives as well as development tools for improvement of the employees. It can also improve organization effectiveness

and value by identifying and understanding Human, Structural, and Relational Capital to enable knowledge creation and sharing. This project followed a systematic approach to ensure the G Department is not investing resources in areas that, although may be visible, have limited impact on the organization's performance. Additionally, the information provided was used to rethink training investments, strategize about development and retention of the technical competencies over time and improve operations effectiveness to meet performance objectives (Rodriguez, 2012).

This project improves practice of the profession by demonstrating the practicality of the engineering management discipline and KM concepts when applied to actual problems in an organization. The findings and formulation of solutions will potentially highlight the importance of proper KM efforts in organizations to maintain value through the management of intellectual capital. In addition, this project provides insight or discovery of relationships, identification of critical knowledge in KM and knowledge transfer methods. The framework established in this project could be adapted to big, medium and small enterprises because it was developed to accommodate the organizational context.

This project provides an academic reference on the ability to implement KM concepts and principles in an organization and how to measure different factors that affect an organizations ability to create, transfer and retain knowledge. This project increases knowledge on how engineering management and KM concepts are implemented in a practical scenario, increases the understanding about KM and intellectual capital and can help discover future opportunities for study in other aspects of intellectual capital, KM or knowledge transfer in a technical organization. There is a lack of empirical evidence that KM makes a difference to organizational performance (McKeen, Zack & Singh, 2006). The approach of this study provides insight on the practicality of KM. This project systematically develops and implements an organizational study that provides basic information for proper KMS decision making and comprehensively explains how to measure critical variables that affect KM in an organization.

4.5　Preliminary Pilot Findings

The data collection instruments were finalized in a pilot study. Eleven branch heads participated in the pilot study. In addition to finalizing the survey instrument, the purpose of branch heads participating in the pilot study was to make them aware of the upcoming survey and gain support to promote employees participation. The data found in the pilot study were not disregarded. The data were evaluated and compared to the data collected with the final instrument. Variable 16 was deleted after the pilot because the related survey question (Question 27), did not fulfill the purpose. The reevaluation of the purpose showed that the variable did not provide the necessary information to answer the questions of the study.

4.6　Structure of Results and Analysis

The study results were presented in a descriptive, narrative form in order to communicate a holistic picture of the study, the experiences throughout the project, and the meanings of the findings. The report also includes descriptive statistics for some quantitative data as it may apply to provide concept clarification. The project outcome is a proposed solution and implementation plan that is supported by the findings of the study.

4.7　Develop Solution and Implementation Plan

The purpose of this project was to assess the situation NSWCDD G Department faces with the goal of developing a plan to maintain, expand and create corporate knowledge to meet the objectives already specified in this document. A solution and implementation plan was developed following the steps specified in Table XXII below.

Table XXII. Solutions and Implementation Plan Development Steps

Steps	Method	Purpose
Identify possible solutions	Review literature, discuss with management and create action plan. Analysis of the data in a practical way and rely on previous experience and discussion with experts.	Leverage on existent practices, empower management with the development of solutions and potentially the opportunity for their constituents to contribute in the formulation of the solutions .
Identify possible resistance		Plan and engage in resistance mitigation techniques.
Identify other constraints		Mitigate risk.
Discuss recommendation with experts and management	Meetings and/or presentation.	Develop the solution and implementation plan.
Select solutions to implement		
Develop communication plan	Evaluate alternative and discuss with management the best strategies for communication (written, e-mails, verbal, presentation, etc.).	Create momentum for the implementation phase, gain support, allow effective implementation of plan.
Finalize KM Plan	Written report.	For evaluation and/or approval.

5. RESULTS AND ANALYSIS OF THE DATA

Data analysis and collection started simultaneously. Each variable was analyzed independently and, when appropriate, compared to the analysis of other variables. The data for each variable came from specific survey questions, documents, or interviews. Table XXIII, below, specifies the documents used and traces them to the related variable that the information supported.

Table XXIII. Documents Traceability Matrix

	Variable	Source Document(s)
7	Attrition history and identified reasons	Corporate Data Base (CDB) attrition by age history report from 1995 to 2011; Exit Interviews repository data base; As Supervisors Retire: An Opportunity to Reshape Organization: A Report to the President and the Congress of the United States by the U.S. Merit Systems Protection Board.
8	Identify what roles are causing turnover	Exit Interviews repository data base; DEMO level descriptor addendum working papers.
9	Hiring history and hiring plans	CDB employees years of service report from 2005 to 2011, CDB employees age distribution report from 2005 to 2011, CDB employee count for G from 1995 to 2010; CDB employee count for NSWCDD from 1995 to 2010; CDB employees hiring by age report from 2005 to 2010; Engagement Systems Department, "State of the Department, ALL HANDS MEETING (2011)" presentation slides; Hiring Reform & USA Staffing Tool, An Overview of Process Change (2011); G Historical Personnel Count from 2002 to 2011.
10	Projected future growth of the workforce	Engagement Systems Department, "State of the Department, ALL HANDS MEETING (2011)" presentation slides; WC Hispanic Workforce Integration Advocacy Forum.
11	Age demographics	CDB employees age distribution report from 2005 to 2011, Engagement Systems Department, "State of the Department, ALL HANDS MEETING (2011)" presentation slides.

Table XXIII (continued).

12	Years of experience	CDB employees years of service report from 2005 to 2011, Engagement Systems Department, "State of the Department, ALL HANDS MEETING (2011)" presentation slides.
13	Knowledge / competencies	Engagement Systems Department, "State of the Department, ALL HANDS MEETING (2011)" presentation slides; Tutorial on Integration by Neil T. Baron presentation slides, G Engagement Systems Department presentation slides (2009); Program Value Management data base; G department annual training needs assessments classes list (2012); NSWCDD approved academic program list (2012); Position Bench Marks and Performance Criteria (2009, 2010 and 2011); FY12 Warfare Center Technical Capability Health Assessment (TCHA) (2012) working documents; NICAP G30 Working Papers; NSWCDD Technical Capabilities (TCs) spreadsheet, source: NAVSEA WFC Technical Capabilities (TC) Manual, Rev 4 , 1 June 2011; Systems Safety Engineering Division G70 (2010) presentation slides; Department of Defense Research and Engineering Strategic Plan (2007).
19	Current organizational structure	Engagement Systems Department, "State of the Department, ALL HANDS MEETING (2011)" presentation slides; NAVSEA Corporate Leadership
20	Identify current knowledge management systems in use by employees	NSWCDD internal web page, New Employee Development Program Guidance (2011), G Engagement Systems Department presentation slides (2009); Program Value Management data base; NAVSEA's Mentoring Program User Guide
22	Identify other undergoing efforts that affect the organizational structure and the implementation of KMS	Engagement Systems Department, "State of the Department, ALL HANDS MEETING (2011)" presentation slides; Marine Corps Programs / Expeditionary Warfare Town Hall Meeting presentation slides; *G Department DD Workspace Implementation presentation slides; G60 Capabilities Brief (2012); Enterprise Resource Planning (ERP) news letter (various 2010)*
23	Identify the technology and tools available for knowledge capture and transfer	G Department DD Workspace Implementation e-mail, goals and objectives document; G70 Product Review, Approval and Release Approval Process (2011), G space records by room update (2009); G Department M&S Community of Practice Draft presentation slides FY2008
24	Reward Systems	NSWCDD Honorary Awards (2009) list; G Department Non-Monetary Incentive Awards Process;
26	Identify the sponsors projects in the department	Engagement Systems Department, "State of the Department, ALL HANDS MEETING (2011)"; G Engagement Systems Department presentation slides (2009)
31	Technical Diversity	Engagement Systems Department, "State of the Department, ALL HANDS MEETING (2011)" presentation slides; G Engagement Systems Department presentation slides (2009); Program Value Management data base

Each survey question explored a specific situation, respondent practices or perceptions. Descriptive statistics was used to analyze the survey. The data were then refined, restricting some data to discriminators such as age group. Some variables were analyzed by division. The main tools used to evaluate the data from the survey portion of this study were descriptive statistics such as mean and standard deviation. Some survey questions sought to support the evaluation of more than one variable; this is indicated under each variable as seen below. Appendix 10.2 includes some of the data used to analyze each variable. The variables and the corresponding questions are analyzed individually in the following sections.

5.1   Human Capital Variables

5.1.1   Variable 1

Variable 1 analyzed "Line managers, PMs and employees' understanding of Lead Systems Integration and its complexity" using the following survey questions:

- Does your program involve systems integration? (Survey Question 16)
- If your program involves systems integration, what organization performs the role of systems integrator in your program? (Survey Question 17)
- I believe my team is qualified to perform as the lead systems integrator for the programs in my branch. (Survey Question 34)

The results from Survey Question 16 and question 17 indicated 70 percent of participants that they are involved in a program that requires systems integration. 78 percent of these respondents indicated the systems integration lead is a government entity, whereas 56 percent of these respondents selected G Department as the systems integrator. Responses by division for question 16 suggest that G30 and G80 divisions have more people involved in systems integration tasks or programs than the participants from the other divisions.

Responses per division for Survey Question 17 indicated 50 percent of G60 respondents selected G Department to be the systems integrator for the programs they support. This was the highest selection rate of any division. Organizationally, G60 supports other departments in NSWCDD including other branches in G Department. This might have indicated the program visibility. Some employees might be exposed to a more holistic view of the system and thus considered their work portion a subsystem that will be integrated to another system, while employees with less visibility of the program considered their project the "system". On the other hand, it may have indicated that G60 is more intrinsically involved in systems integration efforts that G Department leads, while other divisions seemed to have higher quantities of employees involved in efforts where other organizations are the systems integrator. Results by division also indicated G20 has a high percentage of employees (43 percent) that selected G Department as the systems integrator for their projects or programs. In contrast, 23 percent of G70 participants selected "contractor external to NSWCDD" as the systems integrator for the programs they support. This might indicate lesser involvement of G70 employees in internal systems integration efforts, also this division might have a high influence in Relational Capital with sources of knowledge for systems integration external to NSWCDD.

Responses to Survey Question 34 indicated that 64 percent of the survey participants believed their teams were ready to be lead systems integrators of the branch programs. There were some differences on respondents' confidence by division, G20 division seemed to have a high percentage in neutral (33 percent), while G30 had a lower percentage that selected neutral (6 percent). This might indicate a lack of understanding of what lead systems integrator work entails and that there are differences of division readiness for different types of programs and systems, or that there are differences in the complexity of the systems or program these divisions support. Additionally, only 188 respondents indicated that they are involved in a systems integration program; however, all survey participants responded to question 34 with only 17 percent in neutral.

The group interview of the branch heads provided insight about the first level line management's understanding of systems integration and how are they involved with it. The responses revealed a common understanding of the general areas involving systems integration; however, each branch head had a different perspective of the definition and indicated different levels of involvement in their respective branches. Additionally, the discussion indicated that the level of G Department involvement with systems integration or less complex systems is low. This suggested that a common definition or understanding about systems integration does not exist among the branches or divisions. The branch heads did not have a common understanding of departmental goals to develop the competency to lead systems integration efforts. Although the branch heads showed confidence in G Departments capacity to lead systems integration efforts, they were critical about who in the department will be qualified to lead such efforts at the SoS level. See the definition of SOS in Section 1.2.2.

5.1.2 Variable 2

Variable 2 analyzed "Leadership and management position towards KM" through interviewing branch heads. The branch heads that participated in the interviews were open to the discussion about KM. However, there was little understanding about the subject as a tool to prevent knowledge loss and maintain and develop competencies. Approximately, 60 percent of the branch heads participated in the group interview 30 percent of the branch heads did not responded to the interview invitation, the other 10% indicated having commitments that prevented them from participating in the event. This could suggest disinterest in the topic or that the branch heads were simply too busy to respond. A successful KM strategy should account for the work load or general disinterest of branch heads.

KM was not a commonly understood term among the participating branch heads. However, most had heard of the aspects and tools of KM such as learning, lessons learned, communities of practice, knowledge capturing and documentation and the relevance of time in the applicability of KM. However,

none of the branch heads indicated having a plan regarding KM in their branches, most efforts were limited to assuring work and funding for the branch members, hiring when more employees were needed and relying on their leads to indicate what skills should the new employee possess. During the discussions, branch heads indicated the following challenges related to KM:

a. The documentation and data are being disregarded after a person retires without a review of what needs to be kept. In most cases, the organization relies on the retiree to identify what and when needs to be transferred and to whom before they retire.

b. The branch heads indicated losing accessibility to experienced personnel and/or relevant documents.

c. The branch heads expressed concerns about the technical skills and abilities level in their branches. Most branch heads indicated looking into ways to develop their employees faster to not compromise quality.

d. The branch heads indicated the department needs to improve documentation and control of systems and products developed "in-house". These tasks are currently handled by project managers; the department does not have a process implemented for configuration management of systems in development or developed in-house.

e. Not every report that employees create would be useful for knowledge transfer such as technical reports, progress reports, and trip reports.

f. Constraints identified for implementing KM efforts: tools available, lack of common understanding of KM, funding, bureaucracy of procedures and limitations on the ability to coordinate and implement cross divisional efforts due to priorities and time available.

g. Branch heads indicated the web based sharing tool has potential value, but currently does not meet the needs for their knowledge sharing and retention goals.

h. When implementing a KM strategy, the privacy of people and groups was a concern.

i. Some knowledge areas are limited by funding for personnel.

j. Some branch heads indicated that there aren't enough hands-on tasks that can be used to develop the technical knowledge for high number of new employees.

k. Mentoring in branches strategy relies on employees' natural teaming evolution and on the group and project leads. The branch heads did not have a structured plan regarding mentoring or succession planning and rely on group leads to address personnel experience.

5.1.3   Variable 3

Variable 3 analyzed "Employee practices and preferences for acquiring explicit knowledge" using the following survey questions:

- When presented with a new technical subject or task, where do you go for technical information, background information, ideas on how to proceed, warnings and lessons learned? (Survey Question 18)

- When you need to make a programmatic decision, where do you go for background information, ideas on how to proceed, warnings and lessons learned? (Please rank your first 5 choices in your preferred order.) (Survey Question 19)

- Rank your top three challenges when trying to gain new knowledge. (Survey Question 20)

The purpose of this variable is to determine most suitable knowledge transfer practices for NSWCDD G Department based on employees preferences and current practices. Results for this variable indicated there are differences in

respondents' behavior depending on the knowledge of interest. Survey participants were asked to rank the first five choices in preferred order to the following questions:

a. When presented with a new technical subject or task, where do you go for technical information, background information, ideas on how to proceed, warnings and lessons learned? (Survey Question 18)

b. When you need to make a programmatic decision, where do you go for background information, ideas on how to proceed, warnings and lessons learned? (Survey Question 19)

In both cases, the choice that ranked highest is to approach a colleague or co-worker. For technical knowledge, the response suggested the preferences ranking was motivated by access to the information and convenience. There is also an inclination to use the internet and web sources as a primary way to find information. Looking the data by age, the age group 18-29 ranked "mentor" higher than the other age groups. While the age group over 55 ranked "mentor" the lowest. These results suggest a higher reliance of younger employees on mentors for technical guidance and information.

Survey participants ranked four methods highly for Survey Question 19 (where do you go for knowledge to make a programmatic decision) are person to person; these approaches rely on Human and Relational Capital. Looking at the data by age, there is little difference in the participant preferences except in two choices "mentors" and "external references." Respondents over the age of 55 ranked "mentors" lower and "external contacts" higher than the other three age groups. These results highlight the benefits and importance of mentors earlier in the career, and perhaps suggest that senior employees have a broader network and more trust in external contacts. It may suggest that the programmatic decisions that senior employees need to make involve external organizations, while younger employees' programmatic decisions are internal to NSWCDD. Additionally, it may indicate that younger employees have not built trust with external sources. "Line Managers" ranked higher as a source of information for

programmatic decision than a source for technical information. Observations from a participatory perspective indicate programmatic decisions are complex in nature and tend to be more subjective than technical decisions, which are more easily supported by data. Considering the psychological component of a person making a decision, this behavior might be indicative that people who need information want to understand in depth how to make a decision or are seeking the comfort of another person approval, in this case the manager, or might be responding to fear to make mistakes. Employees might just be attempting to gain tacit knowledge from other employees' experience, since programmatic reasoning does not tend to be explicitly captured.

In Survey Question 20, participants were asked to rank the top three challenges when trying to gain new knowledge. The options "Do not know where it is," "Do not have time" and "No subject matter expert available" are the top three choices selected. "Do not have time" to gain new knowledge ranked among the top three for question 20, but "time" was not selected as a challenge for sharing information as responses to Survey Question 53 suggest. The top two options ranked are correlated if people perceive search time as wasted time. Perhaps the real problem is availability of information and employees willingness to overcome barriers to gain new knowledge. The following list looks at the data by age group:

1. The age group 55 and over ranked "organizational culture" and "poor quality of information available" as bigger challenges when trying to learn new knowledge than the other three age groups.

2. Age groups 30-39, 40-54 and 55 and over ranked "do not have time" second; however it ranked sixth for age group 18-29.

3. The alternative "Do not know where it is" was the highest ranking challenge when trying to gain new knowledge for three group ages. (18-29, 30-39, and 40-54), it ranked third for the age group 55 and over.

4. The alternative "Lack of motivation to learn" was ranked low for all age groups.

5. The first three reasons for age group 18-29 indicate not knowing who has the knowledge. Interestingly, this age group (18-29) also ranked "lack of funding" higher than any other group.

6. Age groups 30-39 and 40-54 ranked information complexity higher than the remaining age groups; this is congruent with the finding under variable 14 that measures perception about knowledge complexity.

5.1.4 Variable 4

Variable 4 analyzed "Employees practices and preferences for learning tacit knowledge" using the following Survey Questions:

- When presented with a new technical subject or task, where do you go for technical information, background information, ideas on how to proceed, warnings and lessons learned? (Survey Question 18)
- When you need to make a programmatic decision, where do you go for background information, ideas on how to proceed, warnings and lessons learned? (Please rank your first 5 choices in your preferred order.) (Survey Question 19)
- Where did/do you acquire the knowledge and skills necessary to perform your job? (Survey Question 21)
- Are you aware of the following practices in G Department? (Survey Question 22a)
- Have you participated in any of the following G Department practices? (Survey Question 22b)

The purpose of variable 4 is to determine the most suitable knowledge transfer practices for NSWCDD G Department. The responses to the questions considered for the variable suggested employees preferred to talk to a person when trying to get new knowledge. It was more evident when the employees are trying to get programmatic knowledge possibly because that's when employees are trying to learn tacit knowledge. The previous variable discussed Survey Question 18 and question 19.

On Survey Question 21, employees ranked "on the job training" and "peers" the highest for acquiring the knowledge and skills necessary to perform their job. These two methods are methods for acquiring tacit knowledge. Looking at the data by age groups, "on-the-job training" ranked highest for all group ages; "mentors" ranked lower for the age groups 18-20 and 30-39 than for age groups 40-54 and 55 and over. Interestingly, the group 55 and over identified mentors as a source of knowledge and skills to perform their current jobs even though this group did not identify mentors as a source of information in question 18 and question 19. This suggests that, at some point in their careers, they had a mentor that was critical for their development. The 18-29 age group ranked undergraduate education higher than the other three groups.

In age group 40-54, "Web based training" ranked relatively higher than in the other age groups. Web-based training might be an alternative learning strategy for this age group, but seems it is not a preference for the other age groups. This is important because the majority of line managers are in the 40-54 age group; if they are making decisions based on their personal preference, then they might be ignoring the preference of other age groups, perhaps causing conflict or being ineffective.

Responses to Survey Question 22a and question 22b indicate groups are unaware of existing efforts that seek to improve knowledge sharing in specific subjects or areas. Simple awareness of an ongoing effort does not translate into participation. The results suggested that KM efforts that targeted general knowledge had higher number of participants, KM efforts that target more specific subjects or knowledge areas tended to have lower number of participants. The evaluations should take it into consideration when developing metrics to evaluate the success of a KM effort.

5.1.5 Variable 5

Variable 5 analyzed "New skills learning and usage" using the following survey questions:

- How many years of experience do you have in your current position? (Survey Question 9)
- How long does it take to learn the skills to perform your current job adequately? (Survey Question 10)

The purpose of this variable is to identify knowledge retention issues in NSWCDD G Department. Responses to Survey Question 9 indicated 55 percent of survey participants have less than five years of experience in their current position. This could be a result of the recent hiring or employees performing new roles in their career progression. In FY11, approximately 35 percent of the employees had less than five years of experience in the U.S. Government.

Responses to question 10 gave the following indications:

- 29 percent of respondents think their positions' require more than three years of learning to perform their jobs adequately;
- 34 percent of respondents think their positions' require one to three years of learning to perform adequately;
- 65 percent of respondents age group 18-29 consider less than a year is a sufficient amount of time to learn the skills to perform their current job adequately, age groups 30-39 (62 percent), 40-45 (78 percent), and 55 and over (66 percent) selected time ranges higher than one year.

These results supports the idea that positions of more experienced personnel require more time to develop substitutes; and thus current experienced personnel are more difficult to replace. In addition, these results might indicate the need for planning for transition of employees with years in advance. Based on the results 63 percent of respondents will agree one year for training someone for a new role might not be enough.

5.1.6 Variable 6

Variable 6 analyzed "Identify knowledge management systems preferences" using the following survey questions:

- When presented with a new technical subject or task, where do you go for technical information, background information, ideas on how to proceed, warnings and lessons learned? (Survey Question 18)

- When you need to make a programmatic decision, where do you go for background information, ideas on how to proceed, warnings and lessons learned? (Please rank your first 5 choices in your preferred order.) (Survey Question 19)

- Rank your top three challenges when trying to gain new knowledge. (Survey Question 20) Where did/do you acquire the knowledge and skills necessary to perform your job? (Survey Question 21)

- Are you aware of the following practices in G Department? (Survey Question 22a)

- Have you participated in any of the following G Department practices? (Survey Question 22b)

- How do you learn from other members in your team (Survey Question 25)

- How do you learn from other teams? (Please select all that apply) (Survey Question 26)

The purpose of this variable is to determine suitability of KMS for NSWCDD G and identify barriers that would prevent the success of an existent KMS. Survey results for questions 18, 19, 20, 21 and 22 were discussed in variables 3 and 4. Respondents indicated they learn by doing and accumulating experience, and rely on colleagues for guidance. At the same time, respondents listed not knowing where the information is, time, or not knowing who the subject matter expert is as barriers to KM.

In Survey Question 25, participants were asked to select all that apply about how they learned from other team members. Responses indicated 96 percent of participants selected collaboration as one of the methods they use for learning from other team members; this was the method with the highest selection rate. This was followed by 73 percent that also selected occasional advice and then followed by reports with only 53 percent of respondents' selection. Looking at

the data by age groups, participants in age groups 40-54 and over 55 selected learning from reports more often than learning by storytelling, in contrast to the other two younger age groups (18-29 and 30-39) that selected learning by storytelling at a slightly higher rate than learning by reports.

The results for Survey Question 26 show a reduction in the use of storytelling, occasional advice and collaboration for inter-team learning compared to intra-team learning. This might indicate that it is more challenging or barriers exists to learn from employees that belong to other teams, that relationships between teams do not exist, or the opportunity to share information does not exist. However, results indicate reports are a source for technical information about other teams and tech briefs are currently serving as an opportunity for inter-team learning. Interestingly, the average selection of learning methods per participants was lower for inter-team learning than for intra-team learning, the average number of total methods selected was 3.24 versus 3.48 respectively.

5.1.7   Variable 7

Variable 7 analyzed "Attrition history and identified reasons" through reviewing documentation of historical personnel counts in the department human resources and human resources data though the CDB. Attrition data studied includes information from 1995 to 2011. Attrition is mainly caused by retirement and people moving to other organizations, some move to organizations internal to NSWCDD and others outside NSWCDD. The data reveal that since 2005 to 2009, employees in age group 18-34 are leaving the organization at higher levels than years before 2005. Furthermore, employees in this age group are leaving the department at higher rates than people are retiring. Currently, exit interviews are vague and do not specifically identify the reasons for an individual leaving the organization. The metrics about why and to where an individual is going when they leave the organization are limited in the information they provide. Attrition history also indicates that the majority of employees eligible for retirement would retire by age 59.

5.1.8 **Variable 8**

Variable 8 attempted to analyze "Identify what roles are causing turnover" through reviewing documentation; however, this variable was not answered. Current data available do not provide this information.

5.1.9 **Variable 9**

Variable 9 analyzed "Hiring history and hiring plans" through interviewing branch heads. The purpose of this variable is to identify knowledge transfer needs in the department. Historical data for personnel count from human resources indicate that from 2005 to 2010 approximately 350 new employees joined G Department. In FY11, approximately 35 percent of G employees have been less than five years with the organization.

Branch heads reported that hiring plan at the branch level is limited to hiring to attrition, and it is typically evaluated once or twice a year. In some cases, hiring is done to replace empty positions and, and in other cases, to backfill more senior positions for which it is more difficult to find replacement. Hiring plans are affected by corporate regulations and corporate level workforce plans. Both NAVSEA and NSWCDD are responsible for maintaining a pool of candidates. Different approaches to generating the candidate pool have been implemented from motivating middle school students to pursue college degrees in science and engineering to promoting internships for university students and faculty across the nation.

5.1.10 **Variable 10**

Variable 10 analyzed "Projected future growth of the workforce" through reviewing documentation and interviewing branch heads. The purpose of this variable is to identify knowledge transfer needs in G Department. Historical data for personnel count from human resources indicate the organization has grown from approximately 560 employees in 2002 to approximately 800 employees in

2012. Currently, NSWCDD is not planning to grow the size of G Department, but expects to maintain the current number of employees.

5.1.11 Variable 11

Variable 11 analyzed "Age demographics" through reviewing a Survey Question 3 and CDB. The purpose of this variable is to identify and to illustrate types of knowledge and skills that need to be retained and identify knowledge at risk when coupled with other survey questions. This survey question was used as a discriminator to analyze other variables. For survey analysis, age demographics were divided into four groups: 18-29, 30-39, 40-54, and 55 and above. These age group ranges were selected considering the following factors: similar generational age groups, expected years of experience in the labor market, and to encourage participation in the survey since previous survey in the organization has caused complaints when smaller age group ranges were utilized. The number of survey participants was compared to the actual number of employees in G Department for FY11; each age group was represented with a participation rate above 30 percent. Approximately 15 percent of employees were eligible for retirement as of FY11 and an additional 12 percent of employees were going to be available for retirement within five years.

5.1.12 Variable 12

Variable 12 analyzed "Years of experience" using the following survey questions:

- What is your current pay plan and grade? (Survey Question 2)
- What are your total years of service at NSWCDD? (Survey Question 4)
- What are your total years of service in G Department? (Survey Question 5)

The purpose of this variable is to understand the knowledge in the department assuming that years of experience indicate level of knowledge; and

to identify business implications for KMS; Survey Question 2 asked participants for their current pay plan and grade. This information is not included in the report; however, during the analysis it provided information about the distribution in terms of pay plan and grade of the survey participants. The years of service of survey participants was compared to the years of service in the government data for FY11. Each of the year of service ranges were represented with a similar distribution and the actual years of service range distribution. As of FY11, 35 percent of G employees have less than five years working in the government. This lack of experience might indicate the maturity levels of G Department employees regarding internal Relational Capital and Structural Capital knowledge.

Survey participants were also asked to indicate the total years of service in G Department. This information was compared to the total years of service in NSWCDD. Responses indicated 46 percent of participants have been in G Department less than five years compared to 35 percent that have been in the government for less than five years. This information indicates that many G employees come from other departments within NSWCDD.

5.1.13 Variable 13

Variable 13 analyzed "Knowledge / Competencies" using documentation and the following survey questions:

- What is your current position/performing role? (Survey Question 6)
- What are your areas of competency or knowledge? (Survey Question 7)
- What are your areas of product knowledge? (Survey Question 8)

The purpose of this variable is to identify knowledge gaps; identify specific knowledge needs; identify knowledge strengths and the impact of losing it; identify who has critical knowledge and who needs it; and identify knowledge at risk. Two problems with the survey affected the results for this variable:

1. Survey software truncated the data collected. Result for Survey Question 6 does not show answers for some roles in the report. The unreported results were captured under "other" for the truncated roles.

2. A higher participation rate is necessary to effectively and deterministically use information from the survey questions related to this variable. The analysis was conducted to evaluate the usefulness of this method, identify problems, and identify possible improvements to the methodology used.

Three areas were considered to evaluate the knowledge/competencies of the organization:

1. position or performing role,
2. skills knowledge, and
3. product (system/subject) knowledge.

Each area was examined as a whole for G Department and then by age group to identify if "pipelines" of knowledge where present. The tool does not evaluate quality or depth of knowledge; it just identifies if the Human Capital is present for the skills and/or product knowledge of interest.

Collecting performing roles per age group provides the ability to identify pipelines within the organization by collecting the number of people per position or roles in each age group. The methodology demonstrated to be feasible to determine this information and general self-perception of employees' roles; however, the methodology lacks validation and identification of the "depth of knowledge". An additional step would be required to adequately identify knowledge needs and knowledge at risk. At the department level, G collects and uses information about employee skills and what project they work on to determine knowledge pipelines. An observation is that the detail for the skills level collected is not specific enough to identify skills at risks. It was found that the department relied on the employees to identify their training needs to support the programs or projects with which they are involved; the branch heads are involved in the process that aids the employees in identifying the right knowledge

needs. Review of the training offered found that the available training focuses on skills and academic development.

Results for Survey Question 6 indicated a majority of survey participants perform as mechanical engineers, and the majority of the mechanical engineers are in age group 18-29. The results also indicated that the majority of project managers are in age groups 30-39 and 40-54. This finding could mean that to develop an employee to become a project manager, takes more than eight years (assuming that an employee starts with the organization after graduating from the university at age 22).

The second area, skills knowledge, was collected to evaluate a collection method to measure knowledge sustainment and Human Capital needs. The data were evaluated from two perspectives, first to identify the skills currently being used by the survey participants. The second was to identify skills used/gained by employees, but not currently used. Participants were able to select only one of the usage options for each competency area. Although the results from this question do not tells us how well each individual performs each task, they do identify general areas in which the department needs to assure that employees are competent. The responses N/A and never used are considered to mean the same for this question. During the data analysis, it was observed that the tool can be simplified to only two selections: "not in use/never used" or "currently used", if collected overtime, historical data can be used to determine if the knowledge area use is in decline by counting the total number of users.

It is interesting to note that some areas of competencies were selected at a high rate, even when there was less number of people that selected the roles that are meant to have those competencies. This indicates that regardless of the performing role, survey participants have cross-functional skills and need to work in areas that are outside the main areas of competencies for each role. This might also indicate that there are different levels within a skill or competency area and that employees might not have a clear definition of what it means to be competent in a skill. Additionally, employees might consider themselves to be

competent in areas that are not really their strengths. For example, looking at the results of currently used competencies by age groups, 19 percent of participants in age group 18-29 indicated having and using competencies of program management; however, zero participants in the age group 18-29 selected being in the program management role in Survey Question 6. Similarly, only 2 percent (one participant) in age group 18-29 selected being in a project management role but 28 percent selected having and using project management competencies.

If the data collection using the methodology in this study is analyzed at the branch level, the results would be useful to determine where in G Department the knowledge is being used and to identify possible learning collaboration efforts between divisions or branches. Although it is expected that the G Department knows where the knowledge is because the organization is organized by product or function, this information can also help them determine where a new function should reside if the organization wants to create or protect a competency. The results can also be used to accelerate competency development by identifying possible training needs. For example, CM seems to be widely used throughout the department; however, structurally there is not a CM competency in the organization. Communities of practice or organizational restructuring could help develop this competency if desired.

The third area, product knowledge, was collected to determine knowledge at risk. Results for Survey Question 8, refer to Table A.XXXII in Appendix 10.2, identify the areas that have low numbers of employees working these products. If the organization intends to preserve some of these knowledge areas, an attempt must be made to create explicit knowledge of key information or to establish strategic knowledge transfer efforts. Again, these indicators are limited by the relatively low percentage of participants in the survey for this variable.

The data collection was insufficient to determine with certainty the knowledge at risk and specific knowledge needs because the participation was only ~35 percent of the employees. Ideally 100 percent participation is required to collect the information necessary to meet the purpose of this variable. This can be possible if information is collected at the branch or division level and then an

integrated analysis is conducted. Another benefit of conducting this kind of analysis at the branch level is the possibility and ability of adding a valid knowledge level during the data collection. A self-perceived knowledge level was not collected in this study because it would need to be validated to be useful. In addition, the methodology used for the data or this variable provides information about common knowledge in the organization.

The NSWCDD 2009 Strategic Implementation Plan identifies the knowledge areas by competency, sub competency and application necessary to maintain current organizational capabilities and meet mission requirements. These knowledge areas are traced to each of the departments responsible for maintaining the capabilities. This document was going to be used for validating the survey results of variable 13.

5.1.14 Variable 14

Variable 14 analyzed "Knowledge complexity" using the following survey questions:

- How long does it take to learn the skills to perform your current job adequately? (Survey Question 10)
- Are members of your team contractors? (Survey Question 12)
- How is the contractor's knowledge being captured and transferred to others? (Survey Question 15)
- The program I am involved with has a very high level of technological complexity. (Survey Question 33)
- In my experience, it is very difficult to find support in the area of expertise required by my project. (Survey Question 35)

The purpose of this variable is to identify difficulties for transferring knowledge in G Department caused by the complexity of the knowledge that needs to be transferred. Survey results for Question 10, also discussed in Variable 5, indicate that:

- 29 percent of respondents think their positions require more than three years of learning to perform their jobs adequately;

- 34 percent of respondents think their positions require one to three years of learning to perform adequately;

- 65 percent of respondents in age group 18-29 consider that less than a year is sufficient time to learn the skills to perform their current job adequately, age groups 30-39 (62 percent), 40-45 (78 percent), and 55 and over (66 percent) selected time ranges higher than 1 year.

Results to Survey Question 12 indicate that 58 percent of the survey participants have contractor personnel in their teams. Results from question 15 indicated that the majority of the participants selected "interaction" as the method used to learn from contractor personnel. Refer to Table A.XXXIII in appendix 10.2.

Survey Questions 33 and 35 asked the survey participants to select their level of agreement with the following two statements:

- The program I am involved with has a very high level of technological complexity.

- In my experience, it is very difficult to find support in the area of expertise required by my project.

The results to Survey Question 33 have a mean of 5.84 and results for Survey Question 35 have a mean of 4.00. Although responses to Survey Question 33 indicates participants agree they work in projects with high technological complexity, counter intuitively, a relatively high percentage of the employees indicated in Survey Questions 35 that it is not difficult to find support in the areas needed in their projects. These results raise the following questions:

- Are the projects really highly complex?

- Are the employees protecting their importance in the organization?

- Are task requirements in the organization of lesser complexity than the program requirements?

- Is another organization doing the complex tasks?
- Is the organization is successfully developing the people for position needs?
- How many of the participants are involved in finding support to programs?

Besides these unknowns, 11 percent strongly agree and another 11 percent agree that is very difficult to find support in the areas of expertise needed. Looking at the data by age group, refer to Tables A.XXXV and A.XXXVI in Appendix 10.2, all age groups seem to agree in the level of technological complexity of their projects. However, in regards to finding people to support their programs, employees in ages group 30-39 and 40-54 have a higher percentage of agreement that it is difficult to find employees in the areas of expertise to support their programs. This might indicate a need of complex technical capability with perhaps limited network. Additionally, responses of age group 18-29 might indicate that employees in this age group might be working tasks that do not require depth of knowledge in a technical area, but contribute to a program that is itself highly complex. This findings agree with responses to Survey Question 6 by age group, "what is your current position/performing role?" (discussed in Variable 14), the majority of line manager, program managers, project managers, and system engineers are in the age groups of 30-39 and 40-54. These roles are typically the positions responsible with staffing projects and programs, developing employees and evaluating the quality of the work.

The results for Survey Question 33 and 35 also disagreed with the results of Survey Question 20, which indicated "No subject matter expert available" as a challenge when trying to gain new knowledge. Results for Survey Question 33 also disagree with the results of Survey Question 10 in age group 18-29; while 63 percent of respondents in age group 18-29 indicated to strongly agree or agree to be involved in programs with very high level of technological complexity. 65 percent of respondents in age group 18-29 consider that less than a year is sufficient time to learn the skills to perform their current job adequately. These results might indicate that employees in age group 18-29 might be underutilized,

performing at levels that compromise quality, evaluated at low performing levels or have a conflicting perception of reality.

5.1.15 Variable 15

Variable 15 analyzed "Awareness" using the following Survey Questions:

- Have you worked for other Branches within G Department or for other Organizations outside G Department? (Survey Question 11)
- How do you learn from other members in your team? (Survey Question 25)
- How do you learn from other teams? (Survey Question 26)
- I am very familiar with the work my sponsoring organization performs. (Survey Question 37)
- Do you know what expertise the members of your branch possess? (Survey Question 56)
- Are you aware of the programs your branch is working on? (Survey Question 57)
- Do you know who the sponsoring organizations are for the programs in your branch? (Survey Question 58)

The purpose of this variable is to identify employees' awareness about general employee knowledge. The survey questions sought to identify employees' exposure to other areas outside their current work environment and the employees' self-assessment about their awareness of expertise and programs in their branch. Results for Survey Question 11 indicated 73 percent of participants have worked in another organization outside their branch. Employees in the age group 18-29 have the lowest percentage (59 percent) that has worked outside their branch, while age group 30-39 indicated having work outside their branch in a higher percentage. See Tables A.XXXVII and A.XXXVIII in Appendix 10.2 for responses to question 11.

The second part of Survey Question 11 (11a), sought to identify organizations that G Department employees have worked at, outside their current area;

software issues truncated the results of Survey Question 11a, thus the results were not included in the analysis. The problem consisted in that the software allowed for providing over 15 selection alternatives (in this case 50) but the results report will only show 15. The survey software company was informed of the problem but the data could not be recovered.

Results for Survey Questions 25 and 26 were discussed in Variable 6. Responses to Survey Question 25 indicated 96 percent of respondents selected collaboration as one of the methods they use for learning from other team members; this was the method with the highest selection rate. The results for Survey Question 26 showed a reduction of use of storytelling, occasional advice, and collaboration for inter-team learning compared to intra-team learning. This might indicate there is limited awareness of other team's experience.

Results for Survey Question 37 indicated age group 18-29 mean (5.32) is below the population mean (5.69), while all other group ages are above the population mean. Comparing results from Survey Questions 37 and 56, results seem to indicate that participants have a higher awareness of their sponsor's work than about the expertise in their branch. This was deduced comparing the age group means to the respective sample means. However, participants indicate knowing what programs their respective branches are working on, although fewer participants know what organizations are the sponsors.

5.2   Structural Capital Variables

5.2.1   Variable 16

Variable 16 attempted to analyze "Investigate what communication tools employees use to transfer or acquire knowledge" Survey Question 27.

This variable was deleted after conducting the pilot. Survey Question 27 did not help identify forms and roles of communication or identify communication gaps and knowledge loss vulnerabilities due to communication. Reevaluating the purpose of the variable, it did not provide the information necessary to answer the questions of the study.

5.2.2 Variable 17

Variable 17 analyzed "Perceived adequacy of the facilities for teams to perform their activities" through branch head interviews.

The purpose of this variable is to identify what structural factors are affecting the implementation of KMS for knowledge transfer. In the interview to branch heads, facilities were identified as a constraint for creating collaborative environment for knowledge sharing due to space limitations and distance of location for some groups and branches. Analysis based on a participatory perspective about the facilities created the following observations:

- Some conference rooms lack access to the network or share sites.
- War rooms are not available for all project teams.
- Colocation of team members for some programs or projects is constrained by space availability and organizational structure.
- Space of current facilities is limited and would negatively affect the development of the lead systems integration role.
- If more hands-on projects are executed in G Department, sharing and distance of laboratories, shops and offices might present challenges for team communication, coordination, and performance.
- If future work has to be protected from exposure to unauthorized personnel, additional facilities with access control are needed.

5.2.3 Variable 18

Variable 18 analyzed "Perceived adequacy of current organizational structure" through observations and branch head interviews.

The purpose of this variable is to identify what structural factors are affecting knowledge transfer. The data for this variable are based on observation. The current organizational structure supports protecting and organization of system knowledge and some functional knowledge. This same structure seems to prevent building more collaborative environments and trust development of team

members of different branches or among teams of different branches. One contributor could be the physical distance that is created when members belong to other branches; it may cause conflicts about team or branch identification. Line mangers and project managers might have different objectives and visions about the organization and priorities about project goals. Decision-making is not clearly defined for project execution, conflict between project and line management might exist when in disagreement. This conflict sometimes can affect employee perception and trust of the organizational leadership.

The organization structure does not have a dynamic rapid restructuring environment; however, it does allow for relatively easy team structuring with members within the department and outside the department when line management support and resources are present. To support lead systems integration roles in G Department, some critical competencies need to be sustained or created in the organization. Also, some of the competencies needed to perform systems integration belong to other departments in NSWCDD or even other laboratories of NAVSEA. Some critical competencies exist within the department but higher levels of communication and collaboration need to exist.

5.2.4   Variable 19

Variable 19 analyzed "Current organizational structure" using documentation review. The purpose of this variable is to describe and understand the organization, team formation, and project dynamics and to support knowledge retention efforts. Section 2.2 has an overall description of the organization. Two of three divisions are focused on functional services of safety and test and evaluation. The other three divisions are organized by products areas. G Department has clear lines of formal communication and procedures in process. Clear authority defined for personnel management is identified.

5.2.5 **Variable 20**

Variable 20's purpose was to "Identify current knowledge management systems in use by employees" using the following survey questions:

- When presented with a new technical subject or task, where do you go for technical information, background information, ideas on how to proceed, warnings and lessons learned? (Survey Question 18)

- When you need to make a programmatic decision, where do you go for background information, ideas on how to proceed, warnings and lessons learned? (Survey Question 19)

- Rank your top three challenges when trying to gain new knowledge. (Survey Question 20)

- Where did/do you acquire the knowledge and skills necessary to perform your job? (Survey Question 21)

- Are you aware of the following practices in G Department? (Survey Question 22a)

- Have you participated in any of the following G Department practices? (Survey Question 22b)

The purpose of this variable is to identify what methods are in use to capture critical knowledge and how knowledge is transferred to the next users. Identification of KMS and how are they being used can support in the elaboration of KMS improvements and selecting or establishing new knowledge retention efforts.

The integrated analysis of the survey question responses for this variable indicates G Department needs to address the organizational culture, quality standards, information availability and awareness when establishing their KM strategy. Results for Survey Questions 18, 19, 20, 21, and 22 were discussed in Variable 3, 4, and 6 from a Human Capital perspective. Responses to Survey Questions 18, 19 and 21 indicated that survey participants rely the most on human networks and the usage of the internet to get the information they need. Survey Question 20 identified some barriers to get new knowledge. Survey

Question 22 measures the level of awareness and participation of respondents in KMS initiatives in G Department.

The program manager of the mentoring program at NSWCDD was interviewed. The responses indicated that only 34 employees from G Department were participating in the program in October 2011. This program was terminated in 2012 and a different approach to mentoring is being explored. In the group interview, the branch heads indicated that very few KMS are implemented at branch level. Some efforts are executed at the division level. For example, G70 division has training that seeks to accelerate and create commonality of understanding of processes, policies, and resource about G70 products and services. In G60 division, an effort was made to standardize execution of tests and to create templates for test planning and reporting; also positions were created that seek to centralize and sustain knowledge and competencies in certain policies, standards, products, and services.

5.2.6   Variable 21

Variable 21 analyzed "Collaboration tools and practices" using observation and the following survey question:

- In my experience, it is very easy to collaborate with others within: (my branch, my division, my department, NSWCDD) (Survey Question 36)

The purpose of this variable is to identify what methods are in use to share information that supports a collaborative environment. Practices for collaboration vary from team to team and are influenced by the members of the team. Survey Question 36 sought to measure the perceived ease of collaborating considering the organizational structure: within the branch, the division, the department, and outside the department but inside NSWCDD. The responses to Survey Question 36 have sample means of 6.08, 5.49, 5.04, and 5.09 for collaboration within the branch, the division, the department, and outside the department inside NSWCDD, respectively. Results might indicate the existence of structural barriers for collaboration. Although this study did not identified the barriers that

make it more difficult to collaborate with employees outside the same branch, a KMS strategy must consider that distance teaming is more challenging in this organization. Interestingly, collaborating within the department and collaborating with another department are perceived to present essentially the same level of difficulty.

5.2.7 Variable 22

Variable 22's purpose was to "Identify other undergoing efforts that affect the organizational structure and the implementation of KMS" using documentation review and branch head interviews. The group interview of branch heads revealed some of the barriers, practices and organizational culture at the branch level need to be considered to formulate and implement effective KMS. Below are the areas discussed during the interview:

- The interview responses indicated that no long-term plans exist at the branch level for hiring. Branch heads indicated that hiring experienced employees was difficult and rely on the limited pool of candidates available. Some branch heads discuss the hiring needs with their project leads year to year, but they did not discuss a plan to identify knowledge at risk. At the time of the interview, branches will hire to attrition and are limited by funding limitations, space availability, and work available.

- Succession planning is not undertaken at the branch level. Each person takes the responsibility of training the potential replacement. Branch heads do not control or are unaware of the time it takes the train for the positions in their branch as it depends on the amount of knowledge that needs to be transferred and the people involved.

- Facilities pose a constraint to creating collaborative environment for knowledge sharing.

- Efforts with the goal to support knowledge transfer or team learning among different teams currently do not exist. Collaboration exists as a need basis for task completion, but lessons learned or employee development coordination is not in place. Some concerns about creating

inter-team learning was that some programs are protective of their project and people, and branch heads think some project managers will not be willing to share all lessons learned if they are not success stories. Also, project and program managers do not want to distract their team members with other projects that might jeopardize performance or responsiveness of the team members.

- Branch heads indicated that some types of work experience develop the work force faster, but this type of work might not be available for every employee. Also, depending on the pace of the program some employees might be exposed to some experiences faster than others. Branch heads indicated interest in getting more hands on technical work for the development of their employees.

External factors not discussed in the interviews including hiring freeze, program funding uncertainty, cost reduction efforts (e.g., travel limitation), limited funding available for new endeavors, funding for the development of facilities and acquisition of equipment, and sponsor decisions of where and who develop technology affect planning and implementation of KMS at the branch level.

5.2.8   Variable 23

Variable 23's purpose was to "Identify the technology and tools available for knowledge capture and transfer" using documentation review. The purpose of this variable is to identify what methods are in use to capture critical knowledge and how it is transferred to the next users. G Department has processes that are clearly established for the creation, storage, access and protection of information defined and considered effective. Possible improvement areas for the processes are lead times for document revision and approval (these vary by division and by branch), and ease and awareness of access methods for different types of documents and information.

5.2.9   Variable 24

Variable 24 analyzed "Reward systems" using documentation review. The purpose of this variable is to identify what organizational tools teams have to recognize employees' performance. Exploration of this variable indicates that the department has clearly defined process and levels of recognition for employee performance. Implementation varies depending on the program and project leads communication with line management. Standards for recognition are defined and available at the branch, periodically some of the rewards systems are sent to all the employees by e-mail.

5.3   Relational Capital Variables

5.3.1   Variable 25

Variable 25 analyzed "Collaboration with people outside the branch, division, department or NSWCDD" using observation and the following survey questions:

- What is your current organization? (Survey Question 1)
- How often do you or your team regularly collaborate with organizations outside of your: Branch, Division, Department, Command (NSWCDD)? (Survey Question 28)
- In my experience, it is very easy to collaborate with others within: (my branch, my division, my department, NSWCDD). (Survey Question 36)

The purpose of this variable is to identify formal and informal lines of communication, describe programs/project organizations; describe project dynamics; and identify knowledge use/transfer practices in terms of Relational Capital. Results show G Department team efforts are cross-functional and multi-organizational. Results for Survey Question 28 are in Table A.XLIV in Appendix 10.2. Responses indicate the work collaboration is done mainly within branch level. The collaboration frequency reduces as organizational distance increases. The collaboration frequency between members within the department but outside the division seems to be at the same level that the collaboration frequency with

members outside the departments. Results for Survey Question 36 were discussed in Variable 21. Results might indicate the existence of structural barriers for collaboration. Similarly, collaborating within the department and collaborating with another department are perceived to present essentially the same level of difficulty. From a Relational Capital perspective, this might indicate that relationships of employees within the department might be limited to the scope of the team effort and barriers for collaboration are mainly distance. It might also indicate the possibility that G department has room for improving the strategy of networking relations within the department.

5.3.2   Variable 26

Variable 26 analyzed "Identify the sponsors of projects in department" using documentation review.

The purpose of this variable is to identify critical relationships that maintain organizational value. G Department employees have visibility at all levels and documentation clearly identifies sponsor organizations. G Department is engaged in the mission and objectives of the sponsor organizations. G Department tracks work and funding level, projects and anticipated future work from the sponsor at the department, division and branch level. G Department has a process to communicate new work and raise awareness to leadership at different levels throughout the department.

5.3.3   Variable 27

Analysis on Variable 27, "Identify what roles contractors support in the department" used the following survey questions:

- Are members of your team contractors? (Survey Question 12)
- If members of your team are contractors, what is the role of the contractor member? (Please select all that apply. Skip if your team does not consist of any contract personnel.) (Survey Question 13)

- What skills or knowledge does the contractor team member bring to the team? (Please select all that apply. Skip if your team does not consist of contract personnel.) (Survey Question 14)

- How is the contractor's knowledge being captured and transferred to others? (Survey Question 15)

The purpose of this variable is to identify critical external relationships that add value to the organization and to identify critical knowledge outside G Department, which is in use in G Department projects. Responses to Survey Question 12 indicate 58 percent of participants are in teams that have contractor personnel. The roles and knowledge areas that contractors support are identified in Table A.XLV and Table A.XLVI in Appendix 10.2. As discussed above in Variable 14, the majority of the participants rely on interaction to learn from contractor personnel. If a specific competency is desired to be transferred from the contractor to the employees, an explicit effort and knowledge capture technique needs to be implemented.

5.3.4 Variable 28

Analysis on Variable 28, "Relationship with sponsors" used the following survey questions:

- How often do you communicate with the sponsor? (Survey Question 30)

- To your understanding, how often does the project manager communicate with the sponsor? (Survey Question 31)

- I am very familiar with the work my sponsoring organization performs. (Survey Question 37)

- I have a very good relationship with the Point of Contact (POC) of my sponsoring organization. (Survey Question 38)

- The PM of my project has a very good relationship with the POC in the sponsoring organization. (Survey Question 39)

The purpose for this variable is to create a baseline for employee development plan and KMS objectives formulation, and to identify relational practices of employees with the sponsors. Based on survey results, program managers and project managers have higher frequency of communication with the sponsor than the other positions, this suggest the program and project managers are more connected to the sponsors and thus these positions are critical for the development of Relational Capital. The survey results also indicated that frequency of communication varies per the position. Some survey participants indicated having little communication with the sponsor. Results to Survey Questions 30 and 31 indicated that communication practices did not seem to vary per age group; however, 28 percent of participants in age group 18-29 indicated not knowing how often the project manager communicates with the sponsor, this might indicate unawareness on other areas as well and perhaps less team connectivity. Results to Survey Questions 30 and 31 analyzed by division indicated there are differences among the divisions in communication frequencies. It is possible that different organizational sub-cultures would affect position transition, team development, and the relationship with their sponsors. Results for Survey Questions 37, 38 and 39 indicated that employees in general have good relationships with their sponsors but again, shows slightly more connectivity between the PM and the sponsor.

5.3.5   Variable 29

Variable 29 analyzed "Team membership" using the following survey questions:

- Please indicate what organizations your team members belong to. (Survey Question 24)
- I have a very good relationship with all the members of my team. (Survey Question 40)
- Most of my team members feel free to talk during meetings if they disagree with something being said. (Survey Question 41a)

- On average, what percentage of the team members talk to make contributions during team meetings? (Survey Question 41b)

The purpose of this variable is to describe team interactions and formation as well as how employees feel in their teams. Team membership affects the performance of individuals, and how line managers, program managers and project managers handle team membership affect knowledge transfer and retention of the organization. As mentioned above, different branches might have different goals and objectives and sometimes this can cause conflict among themselves and with those of the program and project manager. Results to Survey Question 24 indicated the following:

- 66 percent of participants selected that they have team members that belong to their branch.
- 61 percent of participants selected that they have team members within the department but outside the division. This had a higher selection rate than team members within the division.
- 32 percent of participants selected having team members that belong to other branches within the division.
- 32 percent of participants selected having team members that are NSWCDD contractors.
- 30 percent of participants selected having team members from outside the department but within NSWCDD.
- 29 percent of participants selected team members that are in the government but in organizations outside the NSWCDD, this indicates the closeness of external personnel as considered team members.
- 25 percent of participants selected having team members that are contractors external to NSWCDD.

Results for Survey Question 40 have a mean of 6.05, indicating that, in general, participants perceived having good relationships with their team

members. The differences by age group were small. The sample means for age groups 18-29, 30-39, 40-54 and 55 and over were 6.21, 6.23, 5.85 and 6.03 respectively.

The results for Survey Question 41 provided a characterization of team member participation in meetings. This was collected to create a baseline that could be compared in future studies to measure the effectiveness of a KM effort if one of the goals is to increase team member participation. The population mean for Survey Question 41a was 6.01; the sample means for age groups 18-29, 30-39, 40-54 and 55 and over are: 6.08, 6.12, 5.90 and 5.97, respectively. Results to Survey Question 41b indicates 24 percent of survey participants are in teams where on average less than 50 percent of team members make contributions during team meetings. Results for Survey Question 41b by age groups 18-29, 30-39, 40-54 and 55 and over indicate 19 percent, 21 percent, 29 percent, and 25 percent respectively, are in teams where less than 50 percent of team members make contributions during team meetings on average. Refer to Tables A.LIV, LV, LVI and LVII in Appendix 10.2.

5.3.6 Variable 30

Variable 30 analyzed "size of the teams" using the following survey question:

- How many members are in your team? (Survey Question 23)

The purpose of this variable is to describe employees' perception of the size of the teams. Team size can affect connectivity of team members and indicate complexity of communication needs. Results to Survey Question 23 indicated three participants(1 percent) selected being in team size of one, 48 percent of participants selected being in teams with 2-7, 31 percent of participants selected being in teams with 8-15 members, 4 percent selected being in teams with16-25 members and 16 percent are on a team with over 25 members. The data by age group indicated that 21 percent of participants for both age groups 30-39 and 40-54 team sizes larger than 25 members, while only 6 percent of participants 18-29 and 5 percent participants in 55 and over selected being in team with over 25

members. This is consistent with the roles of line mangers, program and project managers, and systems engineers. In the pilot study, approximately 90 percent of the survey participant branch heads selected team with over 25 members and the remaining 10 percent selected 16-25. The difference in team size might indicate that some team members are segregated and potentially not sharing knowledge among themselves; further details are in Tables A.LVIII and A.LIX in Appendix 10.2.

5.3.7 Variable 31

Variable 31 analyzed "Technical Diversity" using documentation review and the following survey question:

- Please indicate what organizations your team members belong to. (Survey Question 24)

The purpose of this variable is to describe teams composition, indicate knowledge diversity, contribute to competencies allocation in G (data also supports Variable 12). The data from the survey indicate team diversity in terms of organization structure, Survey Question 24 was discussed in Variable 29, the data are in Table A.LII in Appendix 10.2. In addition, to evaluate technical diversity G Department tracks employees occupational categories, disciplines, and degree levels. The data are not included in the report, but they were considered in the evaluation.

5.3.8 Variable 32

Variable 32 analyzed "Participation" using the following Survey Questions:
- My team member's roles and responsibilities are clearly defined. (Survey Question 32)
- Most of my team members feel free to talk during meetings if they disagree with something being said. (Survey Question 41a)

- On average, what percentage of the team members talk to make contributions during team meetings? (Survey Question 41b)

The purpose of this variable is to describe communication practices among team members and identify possible barriers to knowledge sharing. Results for survey Variable 32 indicates 60 percent of participants agree or strongly agree that team member's roles and responsibilities are clearly defined; 22 percent selected somewhat agree with the statement. The population mean was 5.48. Sample means for age groups 18-29, 30-39, 40-54 and 55 and over are 5.19, 5.46, 5.56, and 5.72, respectively. These results might indicate that positions and roles are not explicitly defined or described to employees. Additionally, a full understanding of a position, role and responsibilities is attained with experience and entails a great deal of tacit knowledge. Results of Survey Questions 41 (a and b) were discussed under Variable 29.

5.3.9 Variable 33

Variable 33 analyzed "Trust" using the following Survey Questions:

- All of my team members provide high quality work with minimal supervision. (Survey Question 42)
- I feel very confident all my team members will complete their tasks in the time agreed. (Survey Question 43)
- I provide critical and useful feedback to other team members about their work performance. (Survey Question 44)

The purpose of this variable is to describe team practices and identify possible knowledge sharing barriers that might be caused by lack of trust. This data provides a baseline for developing metrics to measure change in this variable. Survey Questions 42-44 asked to indicate the level of agreement with each statement. Results for Survey Questions 42, 43, and 44 have population means of 5.54, 5.45, and 5.50, respectively. Sample means for questions 42 by age groups 18-29, 30-39, 40-54, and 55 and over are: 5.49, 5.66, 5.52, and 5.46,

respectively. Sample means for questions 43 by age groups 18-29, 30-39, 40-54 and 55 and over are: 5.49, 5.53, 5.43 and 5.31, respectively. Sample means for questions 44 by age groups 18-29, 30-39, 40-54 and 55 and over are: 5.04, 5.84, 5.59 and 5.28, respectively.

5.3.10 Variable 34

Variable 34 analyzed "Evaluations and critics" using the following survey questions:

- I provide critical and useful feedback to other team members about their work performance. (Survey Question 44)
- I provide feedback only when requested. (Survey Question 45)
- I receive feedback about my performance only when requested. (Survey Question 46)
- My team members provide critical and useful feedback about my work performance. (Survey Question 47)
- My team members provide critical feedback to other team members about their performance. (Survey Question 48)

The purpose of this variable is to identify team communication practices; identify employee relationship-based development and learning practices. Additionally, results for this variable indicate participant perception about the value of intra-team evaluation and critical feedback.

Results for Survey Question 44 were discussed in Variable 33. Mean results comparison of Survey Question 44 (mean 5.50) to Survey Questions 47(mean 4.58) and 48 (mean 4.58) seem to indicate participants perceive some team members' feedback of less quality than the feedback they provide. For all age groups mean results for Survey Question 44 were higher than mean results for Survey Question 47 and 48. Similarly, comparing means for Survey Question 45 (mean 3.77) and Survey Question 46 (mean 4.35) participants indicated being more proactive providing feedback than receiving feedback from team members. Sample means for Survey Questions 45 by age groups 18-29, 30-39, 40-54, and

55 and over are: 4.34, 3.65, 3.78 and 3.23, respectively. Sample means for Survey Question 46 by age groups 18-29, 30-39, 40-54 and 55 and over are: 4.42, 4.36, 4.39, and 4.15, respectively. Results by age group for Survey Question 45 indicate older employees are more proactive giving critical feedback.

5.3.11 Variable 35

Variable 35 analyzed "Distance" using the following survey question:

- Having team members participating in telework has NOT affected the performance of my team. (Survey Question 49)

The purpose of this variable is to identify the knowledge transfer challenges in scenarios without a shared location such as teleworking, or sitting in different buildings. In this study, only teleworking was addressed to determine the perception of the employees about the teleworking program effects in team performance. The results seemed to indicate the majority of survey participants do not consider teleworking disruptive for team performance, results have a mean of 5.41, and 11 percent of participants selected not applicable. Looking at the results by age groups, the opinion about how teleworking affects team performance seems to progressively change with age group. Sample means for Survey Question 49 by age groups 18-29, 30-39, 40-54, and 55 and over are: 5.62, 5.58, 5.35, and 4.91, respectively.

5.3.12 Variable 36

Variable 36 analyzed "Mentorship" using the following survey questions:
- Having a mentor within my branch has been very beneficial in my professional development. (Survey Question 50)
- Having a mentor within my division has been very beneficial in my professional development. (Survey Question 51)

- I consciously make an effort to share my knowledge with others in my team. (Survey Question 52)

- I am unable to share my knowledge with members of my team because I do not have time. (Survey Question 53)

- I like to share my knowledge with members of my team but I feel they are not interested in what I have to say. (Survey Question 54)

- If I were to retire or move to another position in the next two years, the time I have spent transferring knowledge to others has been adequate to ensure that my key experience is retained within the organization. (Survey Question 55)

The purpose of this variable is to identify knowledge sharing practices through mentoring in G Department. Survey Questions 50 and 51 sought to find the perception of participants on the benefits of having a mentor within their branch or division respectively. The mean was 5.49 for Survey Question 50 and 5.03 for Survey Question 51. The slight decline of the perceived benefits was measured because mentors are from different branches. Looking at the data by age groups for Survey Question 50, the mean progressively decrease as age increases. The mean for age group 18-29 is 5.93, for age group 30-39 is 5.73, for age group 40-54 is 5.29 and for age group over 55 is 4.58. Looking at the data by age groups for Survey Question 51, the mean progressively decrease as age increases. The mean for age group 18-29 is 5.36, for age group 30-39 is 5.16, for age group 40-54 is 4.97 and for age group over 55 is 4.26. In both cases, the value of mentorship is perceived higher at younger ages and mentors within the branch are perceived as more beneficial in average than within the division for all ages.

Results for Survey Questions 52-54, see Table A.LXXVII, suggest employees are aware of the importance of sharing knowledge with team members. Results also indicate time availability and team members' perceived receptiveness are barriers negatively affecting knowledge sharing for some employees. The shortfalls of current knowledge sharing practices in teams are more evident in the results of Survey Question 55 which have a population mean of 4.36. These

results suggest that not every employee has ensured their knowledge is retained within the organization. This study did not identify the critical knowledge that needs to be retained, but any KM strategy needs to consider that knowledge retention of critical positions might be at risk for all age groups.

5.3.13 Variable 37

Variable 37 analyzed "Connectivity" using the following survey question:

- Please indicate how often you participate in the following social activities with team members outside working hours. (Survey Question 29)

The purpose of this variable is to evaluate events that indicate how connected team members might feel and the diversity of the team. Results indicated some practical and relatively easy ways for teams to participate in social activities are apparently under used or participants are not interested in these activities.

5.3.14 Variable 38

Variable 38 analyzed "Obligations" using the following survey question:

- My team member's roles and responsibilities are clearly defined. (Survey Question 32)

The purpose of this variable is to indicate participants' perception about clarity of communication among team members. Results for Survey Question 32 were discussed in Variable 32. Results might indicate that younger age groups have lees understanding of the obligations in their positions. This can create dissatisfaction in the job and affect performance. In recent years, a higher percentage of employees in age groups 18-35 are leaving the organization, and employees seem to have a perception of being involved in highly complex projects the organization. G Department leadership needs to look into the clarity of the description in role earlier in an employee's career and review how younger employees are tasked.

6. DISCUSSION AND RECOMMENDATIONS

The purpose of this project was to assess the situation NSWCDD G Department faces and formulate possible solutions to the problem areas of losing corporate knowledge and fulfilling the role of "lead systems integrator". The problem was framed to answer the following questions:

- How KM can support NSWCDD-G Department in meeting selected strategic goals and objectives established in the NSWCDD Strategic Plan (2010-2015)? To what extent does the current KM function fulfill supporting NSWCDD-G Department in meeting selected strategic goals and objectives? What are the gaps? How does the current KM function can be transformed/changed/enhanced to meet the needs of the NSWCDD-G Department?

The following sub-questions were considered in the construct of the recommendations:

- What aspects of knowledge management: knowledge creation, gathering, organizing, disseminating, leveraging, storing, protecting and/or availability, will be addressed?
- What changes need to occur in the Human Capital, Structural Capital, and Relational Capital of the organization in order to meet the selected NSWCDD G Department strategic goals?
- What key competency areas NSWCDD G needs to retain or attain to successfully meet the selected strategic goals? Competency refers to the organization's ability to perform specific tasks or disciplines successfully and efficiently.
- What KM tools need to continue being used, modified, disregarded or implemented in NSWCDD G to meet the selected strategic goals?
- How will the organization measure the impact of implementing KM changes?

The execution of this project and the study results supported that KM can provide a structured approach for the development of solutions to the selected goals. Furthermore, it helps changing strategic objectives into specific actions supported by empirical data that can be executed at the working level of the organization. The actions recommended as a result of this study will help modify the organizational culture to support an environment of knowledge sharing. The study results also provided a baseline for KM metrics in areas that were not previously seen by the organization. The method presented in this project can partially fulfill the development of solutions per the objectives of this project. Limitations to the methodology were also identified. Not enough participants answered the survey to identify knowledge at risk; the participation rate was approximately 34%. The data were insufficient to effectively and deterministically identify the knowledge at risk and the data could not be validated with the data from the documentation available. The study identified what KM efforts need to continue being used, modified, disregarded or implemented to meet the organization KM objectives. Study results and analysis identify the weaknesses of the current KM function in the organization and describes critical aspects of the current organization's culture.

G Department leadership at the branch level is aware of NSWCDD strategic goals and objectives, but there are differences in the interpretation of the high level goals and how affects each division in G Department. Development or review of the division goals and objectives need to be revised, and G Department needs to develop an implementation plan that coordinates the development of Human Capital across divisions. It is necessary to attain a pool of qualified leaders for SoS integration efforts, create a cohesive network within the department and avoid knowledge or competency loss as a result of employees career progression or detachment. Currently, the KM management function at the branch and division levels has room for improvement. The recommendations made in this study need to be embraced by line managers and other leaders in the organization in order for any KM strategy to succeed and be maintained.

The study result for employees' practices and preferences acquiring explicit knowledge support the establishment of a KMS that seeks to create person to person relationships, increase trust among the employees, increase personal interaction and promotes knowledge sharing in verbal and written forms. Also, the study results indicate the majority of employees adjudicate their skills and knowledge acquisition to learning by doing and personal experience; the organization needs to assure exposure to less experienced employees to the competency areas of interest and establish mentorship or coaching. The study indicated some knowledge areas can benefit from direct KM efforts. The following areas were identified for product knowledge and skills:

Products:

Study responses indicated nearly 51 percent, 41 percent and 48 percent of survey participants have worked with ammunition, computing, and ship platforms. Employee development strategies that accelerate the knowledge development and expertise with these products can decrease employees development time, improve product quality, reduce effort duration times and increase customer satisfaction. At the same time, by developing basic knowledge of inexperienced employees, other KMS such as mentoring can focus on refining knowledge and skills that are more sophisticated, complex and/or position specific. Similarly, other product knowledge areas that seem to be widely used can benefit from similar efforts, such as fire control systems, batteries, missiles, launchers and guns.

Skills:

Configuration Management – study results indicated 39 percent of survey participants are involved in configuration management. At the same time, survey participants selected configuration management with the highest rate as the skill contractors bring to the team. In addition, the organization structure does not have a group that nurtures the development and sustainment of CM in the organization. CM is recognized as an intrinsic competency for system integration management. A KM strategy should address how the organization

will develop and maintain this competency as program complexity increases and lengths of programs increase as well.

Cost Estimation – 49 percent of survey participants indicated being involved in cost estimation. The study did not specify the type of cost estimation. Although the "depth of knowledge" needs to be verified and the responses validated, if in fact this is a skill widely used, a KM effort that helps to capture the real cost of different efforts can aid in the development of accurate cost estimation.

Generate Requirements – 49 percent of survey participants indicated being involved in requirements generation, however, only 13 percent participate in the "Requirements Working Group" community of practice. Promoting participation in this group can increase commonality of understanding in this knowledge area.

Systems Integration – study results indicated 50 percent of survey participants are involved in systems integration. However, study results indicated there is not a common understanding of systems integration, what the effort entails, who the lead integrator is, or a clear understanding of the different levels for systems integration. A KM effort that seeks to define systems integration efforts levels of complexity and develop people to manage and lead these different levels can be beneficial for the organization to develop people that can take on lead systems integration roles. For the KM effort to be successful, the changes in Human Capital need to consider development of employee product knowledge, skills, and network. The KM implementation strategy has to consider that most positions will require more than a year for a successful transfer of knowledge and skills. Survey results indicated that relying on adding contractor personnel to teams will not necessary assure knowledge and skills transfer to employees on development. Considering the imminent drain of knowledge the organization is facing, a knowledge strategy needs to start knowledge transfer before employees retire. Additionally NSWCDD should incentivize younger employees with challenging work and recognition systems to avoid knowledge drain in the younger age groups (18-29). Phase retirement or bringing back retired employees (full time or part time) can be used as a strategy to increase

the time for knowledge transfer, but such efforts need to establish specific objectives for employees' development and establish metrics to measure the effectiveness of the strategy. In addition, the implementation of KMSs need to be concise, visible and communicated to the employees in a way that details the reasons and expected impact of the effort.

Structural capital changes in G Department should address the organizational culture in term of processes, quality standards, information availability and dissemination. G Department has well-established processes for explicit knowledge gathering, organizing, and storing. However, the KM management strategy needs to address two aspects; one is the organizational culture and second is the employee awareness and knowledge about the department procedures for organizing, storing and disseminating different types of information. Two areas need to be addressed regarding knowledge availability and dissemination:

1. Identification and access to experts – this can be created improved by creating knowledge maps. At a minimum, branch heads need to be aware of the programs, efforts and expertise within G Department, and ideally within NSWCDD and other organizations. Since employees indicated using branch heads for programmatic decisions, branch heads need to be up-to-date in policies and regulations or at least have readily access and be ready to point the employees in the right direction or creating or providing the right point of contact. Knowledge maps can be created within a branch for branch member awareness and reference.

2. Different computer-based repositories exist that seem to have the same or similar purpose and objectives within the organization. Increase awareness of computer-based knowledge repositories and the usage of the library. Although the library has an electronic (web-based) version, the library rated too low for usage. To increase usage of computer-based systems, the KM effort should seek to simplify search procedures and to be as similar as possible to commonly-used search system. The improvement to the computer-based system need to include reduction of

redundancies and complexity for access to databases, promote knowledge on how to use existing tools and keep users aware of changes and improvements. Implementation of this effort also requires changes in the culture of the organization and employees practices. These changes can start by involving new employees in organizational tasks that involve the usage of these resources and rely on reverse coaching for promoting the usage of these knowledge repositories. For example, a new employee could be tasked 10 percent of the time to create a presentation to the branch about the history of a specific system or product area with which he is going to be involved. This task will also require that the new employee development program includes training about the usage of the library resources, development of technical writing, recognition of the importance of written reports as a method for knowledge sharing and learning of the review process and procedures.

Recommended changes in Relational Capital need to address the opportunity for inter-team knowledge sharing and creation of relationships and trust among people of different teams. To develop inter-team collaboration and create trust among member of different teams the organization has to go through a cultural change that includes changes in:

1. Communication across teams
   a. The purpose of establishing communication across teams is to provide the opportunity to share overall lessons learned and share successes, practices, methodology, technology and discoveries made. The knowledge acquired in one team can be used or improved in another team.
2. Social network across projects, branches and divisions
   a. The purpose of establishing relationships among these entities at different levels of the organization is to increase trust and collaboration. These two elements will be necessary to improve

quality of work and develop the competency of leading the SoS effort.

Most KMS implementation in G Department addresses individual skill development, but does not address accelerating product knowledge. Some of the KMS implemented in G Department address the development of Relational Capital. However, current methods impact team performance. For example, goal rotation and details require individuals to rotate out of their positions. This method adds value to the organization as they develop networking early on the career inside the organization, and the other program addresses developing relationships outside the organization and expanding organizational knowledge. However, these methods do not develop the Relational Capital of employees at the journeyman level that do not go in external rotations. Table XXIV, below, indicates recommendations for existing KM tools and indicates if the practice should continue being used, modified, or disregarded. Among those that require modification, some of the tool changes are in the methodology or implementation, others also have changes in the function they try to meet.

Table XXIV. Recommendations for current KMSs in G Department

Program/tool	Recommendation	KM Processes/Function
1. Mentorship	Modify. Implementation of this tool is needed to respond to the current environment. It has to be implemented at the branch level and mentoring techniques (formal and informal) need to be explain to mentors. Also, mentees need to understand their role as learners.	Transfer and validation of knowledge within the organization

Table XXIV (continued).

2. IDP	Keep	Knowledge organization/storage
3. GOAL Program	Modify. The program can be enhanced by adding specific developmental areas for organizational and product knowledge. For example, new hires can be involved in the execution and evaluation of Capstone Design Projects.	Previous: Individual and organizational focused, knowledge assimilation. New: Knowledge assimilation, transfer and validation of knowledge, application of knowledge
4. AFP	Keep	Transfer and validation of knowledge from outside the organization
5. ADPCI	Keep	Transfer and validation of knowledge from outside the organization
6. Onsite and offsite training (classes)	Keep	Transfer and validation of knowledge from outside the organization
7. Leadership training programs	This was not evaluated.	Transfer and validation of knowledge from outside and inside the organization, knowledge assimilation and application
8. ELP		
9. MLP		
10. SLP		

Table XXIV (continued).

11. DAWIA	This was not evaluated. Observation: the implementation of these courses has been modified to meet employees' development and application of knowledge required in the organization.	Transfer and validation of knowledge from outside the organization
12. SSDP	Keep.	Organizational focused, transfer and validation of knowledge within the organization
13. Specific technical training, as requested	Keep.	Transfer and validation of knowledge from outside the organization
14. Technical briefs	Keep.	Transfer and validation of knowledge within the organization, knowledge assimilation
15. External assignments	Keep.	Knowledge acquisition, assimilation and application
16. PCL	Keep.	Knowledge assimilation
17. Patent Office	Keep.	Knowledge organization, storage, and protection
18. Technical Library	Modify. Need to improve accessibility and awareness of employees on how to use the resources available. Although the library has an electronic site and reliable sources, many employees use more web searches than the technical library.	Knowledge organization, storage, accessibility and dissemination
19. Corporate Website	Keep. Modify.	Knowledge organization and dissemination

Table XXIV (continued).

20. DD Workspace	Modify. Needs to improve reliability, accessibility, and ease of use. For virtual tools to be successful, training on how to use them is necessary.	Knowledge identification and access, knowledge dissemination
21. NISE Technical Investments	Keep.	Create knowledge and skills, apply knowledge
22. Communities of Practice	Modify. Recommend KMS managers of these efforts to promote success and benefits of these efforts and perhaps focus in addition of the technical improvement to develop the creation of relationships and increase networking. Communities of practice should be encourage but not managed by line management.	Previous: Transfer of knowledge within the organization New: Knowledge identification and access, transfer of knowledge within the organization

New KM tools recommended to be implemented:

1. Succession planning – Planning for succession for critical non-management positions should be considered not only for positions held by retirees, but also to fulfill vacancies due to career progression. An opportunity to identify replacement and near future (within three years) vacancies is during mid-year and end of year reviews, through the IDP process. Efforts regarding succession planning should focus on encouraging sharing of relationships, expanding the network of the replacement and validating the replacement readiness.

2. Inter-team learning – The strategy for inter-team learning should first focus on the knowledge sharing among new employees under the guidance or supervision of more experienced employees. Implementation should start at the branch level to develop the culture of knowledge sharing among different teams. Topics should be those of interest to the branch and employees development.

    a. Technical design reviews – technical design reviews are commonly conducted within a team. The envisioned practice would include members from other teams to participate in technical design

reviews. This will provide for knowledge sharing, opportunity of knowledge creation for less experienced employees, and the possibility of quality improvement for the design and future designs. This activity should be championed by the branch head or designated person in the branch and has to be supported by the program/project managers. Program/project managers are very influential in the culture of the organization and should be included in the refinement and implementation of this effort. Performance-related rewards such as recognition, public recognition, and challenging work should be implemented to encourage participation in inter-team activities. As the practices of inter-team knowledge sharing are embedded in the culture of the organization, the effort can expand to the division level. This can be accomplished by assigning "connector" positions at division level that coordinate knowledge sharing between teams. This designated people will have the most up-to-date information of project progress and share the information with the community. The overall purpose of the inter-team knowledge sharing activities is to promote creation and development of Subject Matter Experts (SMEs) in specific subjects. Implementation of the effort has to avoid becoming a requirement that will add risk to program schedules. Engineers and project managers should plan to participate in technical reviews as part of the system or design development.

b. Branch presentations – project presentations at branch meetings can be used for awareness, knowledge identification and relationship creation.

3. Workshops - Implement organization specific training for products knowledge development. Strategically designed product knowledge training can accelerate the learning process of the employees. In addition, the workshops will help in the identification and development of subject matter experts in different topics contributing to the transfer and

validation of knowledge within the organization, and identification of knowledge. Other benefit of this approach includes facilitating the concentration of mentorship efforts for job specific tasks, this is desirable because a big quantity of potential mentors can be leaving the organization in the near future, and the number of new employees can be overwhelming for assigning mentors to each employee within the organization.

4. Knowledge maps – Each branch needs to identify the knowledge and level of expertise resident that each individual contributes to the branch, and estimate the impact of losing that employee within a year or up to three years. One of the objectives of this process is to identify critical jobs that are essential to the organization that are occupied by retirement-eligible incumbents, employees in plans of conducting details or rotations or leaving the team as career progression. This will help in the planning for hiring the right individuals, creating mentorship relationships, and establishing succession planning if applicable. The knowledge maps should be descriptive of the individuals' areas of expertise, product knowledge and experience. This tool should aid employees identify personnel with the right knowledge in a timely manner. Also, it can provide information to employees for areas of work that might be of interest.

5. Job design - Performance metrics must include areas that address KM. Managers must be challenged about their succession planning approach, in particular for G Department project managers, systems engineers and subject matter experts. Job design and responsibilities for experienced employees must include coaching and mentoring, and how is the mentor developing skills to be better mentors. Job design and responsibilities for new or less experienced employees need to encourage reverse mentoring, a method to develop a reverse mentoring culture is to assign new employees organizational tasks or challenging technical tasks that

requires 10-20% of the employees time for a period of time. At the end of the task the employee needs to give a presentation to the branch. This type of task will accomplish the development of organizational knowledge of the employee, and contribute to knowledge dissemination.

G Department needs to prioritize what elements of KM it desires to address. Only two or three areas should be addressed at a time, understanding that every change implementation will have an effect in the next effort. The purpose to start any changes in the intellectual capital of the organization is to create value. Based on study results and the strategic objectives considered in this project it is recommended that G Department KM strategy addresses the following areas first:

- Inter-team learning and collaboration
- Succession planning
- Mentoring and coaching

Although, some recommendations were made on how to implement KMSs in G Department , branch heads need to be involved in the formulation, communications and implementations of KMSs, supported by higher level leadership. After implementing the KM efforts, the new environment can be measured for employees' perception of the effectiveness of the KMSs implemented and the variables that affect KM as identified in this project; results from this study can serve as baseline information for future assessment and historical comparison about KM aspects of the organization.

7. IMPLEMENTATION PLAN

The objectives of this project were to:

1. Develop a plan to maintain and expand organizational capabilities to deliver systems and capabilities to the warfighter – capability refers to the ability to perform, it is understood that G Department currently has the ability and knowledge to meet this goal.

2. Develop a plan to create organizational capabilities to lead weapon systems integration efforts – the organization considers it does not currently performs this role, if the organization would start leading weapons systems integration efforts currently is unknown if someone has the knowledge to successfully undertake this role.

The results of this study provide the necessary information to lay out a plan that addresses these two objectives based on the organization culture and KM status and needs. The following Work Breakdown Structure (WBS) establishes the KM plan for G Department.

7.1 WBS

1. KM Plan in NSWCDD G Department
   1.1. Prepare organization
      1.1.1. Develop communication plan
      1.1.2. Identify KMSs effort champions
      1.1.3. Identify KMS managers
      1.1.4. Identify resources
   1.2. KM metrics
      1.2.1. Data collection
      1.2.2. Data integration and analysis
      1.2.3. Reporting
   1.3. Intellectual Capital

1.3.1. Human Capital sustainment & development

    1.3.1.1.   Skills

        1.3.1.1.1.   Workshop

            1.3.1.1.1.1.   Systems integration

                1.3.1.1.1.1.1. Identify experts

                1.3.1.1.1.1.2. Prepare workshop action plan

                1.3.1.1.1.1.3. Execute workshop

            1.3.1.1.1.2.   Configuration management

                1.3.1.1.1.2.1. Identify experts

                1.3.1.1.1.2.2. Prepare workshop action plan

                1.3.1.1.1.2.3. Execute workshop

            1.3.1.1.1.3.   Cost estimation

                1.3.1.1.1.3.1. Identify experts

                1.3.1.1.1.3.2. Prepare workshop action plan

                1.3.1.1.1.3.3. Execute workshop

            1.3.1.1.1.4.   Generate requirements

                1.3.1.1.1.4.1. Identify experts

                1.3.1.1.1.4.2. Prepare workshop action plan

                1.3.1.1.1.4.3. Execute workshop

        1.3.1.1.2.   Mentorship

            1.3.1.1.2.1.   Identify critical positions

            1.3.1.1.2.2.   Conduct mentorship training for mentors

            1.3.1.1.2.3.   Identify potential replacement

        1.3.1.1.3.   Succession planning

    1.3.1.2.   Product/systems

        1.3.1.2.1.   Workshops

            1.3.1.2.1.1.   Weapons

            1.3.1.2.1.2.   Ammunition

            1.3.1.2.1.3.   Computing

            1.3.1.2.1.4.   Ship platforms

1.3.2. Structural Capital improvement KMSs

1.3.2.1. Facilities

1.3.2.2. Processes

1.3.2.3. Information systems

    1.3.2.3.1. Knowledge maps

    1.3.2.3.2. Technical library

1.3.2.4. Job design

    1.3.2.4.1. Performance metrics

1.3.3. Relational Capital development

    1.3.3.1. Internal

        1.3.3.1.1. Inter-team learning and communication

            1.3.3.1.1.1. Communities of practice

                1.3.3.1.1.1.1. Develop Action Plan and Responsibility Matrix

                1.3.3.1.1.1.2. Collect Metrics

            1.3.3.1.1.2. Enhanced technical reviews

                1.3.3.1.1.2.1. Develop Action Plan and Responsibility Matrix

                1.3.3.1.1.2.2. Collect Metrics

            1.3.3.1.1.3. Branch presentations

                1.3.3.1.1.3.1. Develop Action Plan and Responsibility Matrix

                1.3.3.1.1.3.2. Collect Metrics

        1.3.3.1.2. Social network

1.3.4. External

    1.3.4.1. Detail-end close out branch presentations

7.2   Action Plan and Responsibility Matrix

Below is a proposed action plan to implement a KMS that supports inter-team learning and collaboration.

- Improvement area – Inter-team learning and collaboration
- Description of KMS – Working Group
- Objectives of the KMS - The objective of the working group is to develop a specific skill and/or knowledge area by creating the opportunity for junior engineers to share real, relevant examples of

ongoing efforts. The working group will promote knowledge sharing and the creation and development of Subject Matter Experts (SMEs) in specific subjects. It will create awareness of ongoing efforts, tools and techniques, and challenges among engineers in the branch developing shared understanding, and aligning action.

- KMS approach - The working group will be championed by the branch head or designated person. The meetings can be scheduled regularly during the changing stage and frequency can be changed as needed during the re-freezing stage, see Table XXV below. Use of facilitators, skilled at extracting knowledge and senior engineers knowledgeable in the subject should be present in the meetings and guide the discussions.

Table XXV. Action Plan and Responsibility Matrix

Stage	Actions	Responsibility
Unfreezing	Discuss KMS and value proposition with staff members and senior engineers	Branch Head
	Announce plan at branch meeting	Branch Head
	Share written plan of KMS including objectives, role responsibilities	Branch Head
	Recruit volunteers, assign KMS Manager	Branch Head
	Develop metrics specific to KMS	Branch Head, KMS Manager
Changing	Meet with project leads and identify opportunities	KMS Manager
	Fill up event preparation sheet	KMS Manager, Event Lead
	Identify participants	KMS Manager, Event lead
	Schedule meeting/event	Event lead
	Conduct meeting/event	Event lead
	Document meeting/event learning points	Designated note taker
	Review and share documentation with participants and ask for input	Event Lead
	Share final document with branch	KMS Manager
	Update metric (if applicable)	KMS Manager, Branch Head
Refreezing	Include execution of this practice as part of performance metrics	Branch Head
	Periodically update the branch of the benefits of the KMS and how it impacts the branch	Branch Head
	Share metrics	Branch Head
	Re-evaluate KMS implementation	Branch Head, staff
	Modify KMS as necessary	Branch Head, KMS Manager, staff

Figure VIII below is an example of a working group event preparation sheet. It identifies specific resources and provides information of the things that need to be in place to conduct the event. This type of document aids in the time and effort necessary to manage and conduct the working groups.

Event Preparation Sheet		
Topic:		
Presenter:		
Proposed date:		

Identify Critical Knowledge and Resources

Critical Knowledge	Resources	Comments
Ex. Mechanical design	Senior Engineer "X"	Availability only on Fridays

Identify tools and equipment

Tools and Equipment	Comments
Ex. Conference room with computer that supports modeling software	Room "y" in building "z"

Figure VIII. Example of Event Preparation Sheet

8. CONCLUSIONS

A study methodology was proposed to assess the situation NSWCDD G Department faces and formulate possible solutions to the problem areas of losing corporate knowledge and fulfilling the role of "lead systems integrator". After examining the different factors affecting the problem and managing them to align with the strategic plan of the organization, the study results provided basic information for proper decision making to establish, continue, nurture, modify, transfer or terminate a Knowledge Management (KM) practice in G Department. The study results also provided information to establish metrics that measures the KM function in G Department. The data collection sought to:

- Describe the contextual situation of the organization. The organizational context was described in terms of Human, Structural, and Relational Capital.
- Identify critical knowledge for the organization and knowledge at risk.
- Identify barriers for knowledge transfer and knowledge retention.

Limitations to the methodology were identified. Not enough participants answered the survey to identify knowledge at risk. Knowledge usage by employees and pipelines were identified but the data could not be validated.

The execution of this project and the study results supports that KM can provide a structured approach for the development of solutions to the selected goals. Changes in Human Capital need to address organizational culture, development of product knowledge, and increase awareness and develop understanding of employees about what Systems Integration is and what are the goals of the organization. Changes in the Structural Capital of the organization need to improve identification and access to knowledge in the organization, and implement processes that encourage inter-team learning and knowledge sharing. Changes to the Relational Capital of the organization need to focus on the development of internal networking with programs such as mentorship and succession planning. The focus is to include the creation of critical relationships

during the process of knowledge transfer. Relationships need to be created internal to G Department and external to NSWCDD. Internal relationships need to focus on the creation of inter-team trust and knowledge sharing. Table XXVI below traces the conclusions to the supporting data or discussion sections.

Table XXVI. Conclusions Supporting Sources Traceability Matrix

Conclusion	Supporting Source
Changes in the Human Capital need to address:	
• organizational culture	Results of Variables 2, 3, 4, and 6
• development of product knowledge	Results of Variables 13; G department annual training needs assessments classes list (2012); NSWCDD approved academic program list (2012); Position Bench Marks and Performance Criteria (2009, 2010 and 2011); FY12 Warfare Center Technical Capability Health Assessment (TCHA) (2012) working documents; NICAP G30 Working Papers; NSWCDD Technical Capabilities (TCs) spreadsheet, source: NAVSEA WFC Technical Capabilities (TC) Manual, Rev 4 , 1 June 2011
• increase awareness and develop understanding of employees about what Systems Integration and what are the goals of the organization	Results of Variables 1,14, 15, NSWCDD Implementation Plan Engagement Systems Department, "State of the Department, ALL HANDS MEETING (2011)" presentation slides; Tutorial on Integration by Neil T. Baron presentation slides, G Engagement Systems Department presentation slides (2009)
Changes in the Structural Capital of the organization need to:	
• improve identification and access to knowledge in the organization	Results of Variables, 3, 4, 17, and 20; G Department "DD Workspace" Implementation presentation slides
• implement processes that encourage inter-team learning and knowledge sharing	Results of Variable 3, 4, 15 and 36
Changes to the Relational Capital of the organization need to:	
• focus on the development of internal networking with programs such as mentorship and succession planning	Results of Variables 20, 22, and 36, results of interview with KMS Manager for NSWCDD Mentoring Program
• creation of critical relationships during the process of knowledge transfer internal to G Department and external to NSWCDD	Results of Variables 26, 28, and 36; G Engagement Systems Department presentation slides (2009)
• Internal relationships need to focus on the creation of inter-team trust and knowledge sharing	Results of Variables 15, 25, and 29

G Department KM proposed strategy coordinates the development of Human Capital across divisions. This is necessary to attain a pool of qualified leaders of SoS integration efforts, create a cohesive network within the department and avoid knowledge or competency loss as a result of employees career progression or detachment. The proposed KMSs seek to create person to person relationships, increase trust among the employees, increase personal interaction and promote knowledge sharing in verbal and written forms.

8.1   Limitations and Recommendations for Future Research or Projects

A limitation to the study was the identification of knowledge at risk. Limitation may be due to sample size or knowledge inquiry approach. Future research can focus on methods and technics to identify knowledge at risk in an organization and quantify the impact of losing knowledge to the organization.

Future applied projects can focus on the development of instruments and techniques for measuring the Return of Investments (ROI) for implementing a KMS. These methods can consider researching the value of Human, Structural, and Relational Capital to the organization and methodologically quantify how a specific KMS impacts the "value" for the organization. In addition, this information can be used to support leaders and managers make informed decisions about KMS selection, prioritization, modification or discontinuation in their organization.

Results in this project showed some differences by age groups in knowledge practices. Future studies can further look into knowledge acquisition and sharing practices by gender and age and investigate how, if valid, does team diversity increases KM complexity. Applied projects can focus on the development of knowledge management practices that consider these differences and can further support decisions about selection of KMS and knowledge transfer methods considering differences in Human Capital. This would be relevant for example to improve knowledge sharing practices such as mentorship and succession planning.

Another area of study can explore how "time" influences peoples' approach for selecting a knowledge transfer method over another; what is the impact in cost and value to the organization and what the limitations in knowledge acquisition and validation are for different common knowledge transfer practices. Understanding this can justify organizational efforts to promote KMS or KM tools for the capture and sharing of explicit knowledge that do not rely on interpersonal relations or vice versa support KMS that encourage knowledge sharing through interpersonal relations. Results from this study can also serve as basis for the development of ROI metrics.

In the Literature Review, it was mentioned that the solution for the knowledge transfer problem is organization specific, multidisciplinary, and multi-methodological. A final recommended area of future study can be the generalizability of some of the study variables results by performing similar studies to different types of organizations and evaluating if some variables influence KM more than others. Similarly, future studies can also look into implementing this project in a different size or type of organization. These studies can look into behavior and preference patterns of Human Capital for different industry types and organizational age distribution.

9. REFERENCES

Berman, S.L., Down, J. & Hill, C.W.L. (2002). Tacit knowledge as a source of competitive advantage in the National Basketball Association. *Academy of Management Journal, 45*(1), pp. 13-31.

Bierly, P.E. III, Kessler, E.H. & Christensen, E.W. (2000). Organizational learning, knowledge, and wisdom. *Journal of Organizational Change Management, 13*(6), pp. 595-618.

Blacker, F. (1995). Knowledge, knowledge work and organization: an overview and interpretation. *Organization Studies, 16*(6), pp. 1021-46.

Blanchard, B.S. (2008). *System Engineering Management*, (4th Ed.). City: John Wiley & Sons.

Blankenship, L., Brueck, T., Rettie, M., & Lee, J. (2007). Strategies to help drinking water utilities ensure effective retention of knowledge. Interim Report, EMA, Inc., APQC, Awwa Research Foundation, Denver, CO.

Boiral, O. (2002). Tacit knowledge and environmental management. *Long Range Planning, 35*, pp. 291-317.

Boland, R., Tenkasi, R. & Te'eni, D. (1994). Designing information technologies to support distributed cognition. *Organisation Science, 5*(3), pp. 456-75.

Bredillet, C.N. (2004). Projects: Learning at the edge of organization". In P.W.G. Morris, & J.K. Pinto (Eds.), *Wiley Guide to Managing Projects,* pp. X-XX. City: John Wiley & Sons.

Brown, J., & Duguid, P. (1991). Organisational learning and communities of practice: Toward a unified view of working, learning and innovation. *Organization Science, 2*, pp. 40-57.

Campbell, G.M. (2009). *Communications skills for project managers.* City: AMACOM – Book Division of American Management Association

Clarke, T., & Rollo, C. (2001). Corporate initiatives in knowledge management. *Education and Training, 43*(4/5), pp. 206-214.

Cook, S., & Brown, J. (1999). Bridging epistemologies: The generative dance between organizational knowledge and organizational knowing, *Organisation Science, 10*(4), pp. 381-400.

Creswell, J.W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). City: Sage Publications, Inc.

D'Adamo M., & Kols, A. (2005). A tool for sharing internal best practices. INFO project. Retrieved from: http://infoforhealth.org/practice/InternalBPs/index.shtml.

Davenport, T., & Volpel, S.C. (2001), The rise of knowledge toward attention management. *Journal of Knowledge Management, 5*(3), pp. 212-221.

Davenport, T.H., De Long, D.W., & Beers, M.C. (1998). Successful knowledge management projects. *Sloan Management Review, Winter 1998*, pp. 43-57.

DeLong, D.W. (2004), *Lost knowledge, confronting the threat of an aging workforce.* City: Oxford University Press.

Dey, A.K., & Abowd, G.D. (1999). Towards a better understanding of context and context-awareness", Panel Statements, *Proceedings of the 1st International Symposium on Handheld and Ubiquitous Computing.* City, dates held.

Dey, A.K., & Abowd, G.D. (2000). Towards a better understanding of context and context-awareness. Presented at the CHI 2000 Workshop on The What, Who, Where, When, Why and How of Context-Awareness. City, April1-6, year.

DON. (2001). *Metrics guide for knowledge managment initiatives.* City: Department of the Navy Chief Information Officer.

Garrett Jr., R.K., Anderson, S., Baron, N.T., & Moreland Jr., J. D. (2011). Managing the interstitials, a system of systems framework suited for the Ballistic Missile Defense System. *Systems Engineering, 14*(1), p 87-109.

Ghoshal, S. (2005). Bad management theories are destroying good management practice. *Academy of Management, Learning and Education, 4*(1), pp.75–79.

Hall, R., & Andriani, P. (2003). Managing knowledge associated with innovation. *Journal of Business Research, 56*, pp. 145-52.

Hoe, S.L. (2006). Tacit knowledge, Nonaka and Takeuchi SECI Model and informal knowledge processes", *International Journal of Organization Theory and Behavior*, Business Module p. 490.

Holsapple, C.W., & Joshi, K.D. (2000). An investigation of factors that influence the management of knowledge in organizations. *Journal of Strategic Information Systems, 9*(2/3), pp. 235-261.

Jones, W.T. (1972). World views: Their nature and their functions. *Current Anthropology, 13*(1), pp.79–80, 81–109.

Karagiannis D., Waldner, F., Stoeger, A., & Nemetz, M. (2008). A knowledge management approach for structural capital", In T. Yamaguchi (Ed.), *PAKM, LNAI 5354*, pp. 153-146. City: Publisher.

Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology.*Organization Science, 3*, pp. 383-396.

Lam, A. (1997). Embedded firms, embedded knowledge: Problems in collaboration and knowledge transfer in global cooperative ventures. *Organization Studies, 21*(3), pp. 487-513.

Landaeta, R. (2003). *Knowledge management across projects.* Doctoral Dissertation, University of Central Florida.

Landaeta, R,E., Pinto, C.A. & Kotnour, T. (2009). Assessing faulty knowledge management systems in project-based organizations", *International Journal of Knowledge and Learning, 5*(2), pp. 122-143.

Landaeta, R.E, Mun, J.H., Rabadi, G., & Levin, D. (2008). Identifying sources of resistance to change in healthcare. *International Journal of Healthcare Technology and Management, 9*(1), pp. 74-96

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* Cambridge: Cambridge University Press.

Lueg, C. (2001). Information, knowledge, and networked minds. *Journal of Knowledge Management, 5*(2), pp. 151-160.

Luthans, F. (2005). *Organizational behavior* (10th ed.). New York: McGraw-Hill.

McKeen, J.D., Zack, M.H., & Singh, S. (2006). Knowledge management and organziational perfromance: An exploratory survey. *Proceedings of the 39th Hawaii International Conference on System Sciences* (pp. 1-9). IEEE. City, dates held.

McPhie, N.A.G., & Rose, M.M. (2009). As supervisors retire: An opportunity to reshape organizations", *A Report to the President and the Congress of the United States by the U.S. Merit Systems Protection Board.* Retrieved from xx.

Meier, S. R. (2008). Best project management and system engineering practices in the preacquisition phase for federal intelligence and defense agencies. *Project Management Journal, 39*(1), pp. 59-71.

Meier, S. R. (2009). Causal interference on the cost overruns and schedule delays of large-scale U.S. federal defense and intelligence acquisition programs", *Project Management Journal, 41*(1), pp. 28-39.

Meso, P., & Smith, R. (2000). A resource-based view of organizational knowledge management systems. *Journal of Knowledge Management, 4* (3), pp.224-234.

Migdadi, M. (2009). Knowledge managment enablers and outcomes in the small-and-medium sized enterprises. *Industrial Management & Data Systems*, 840-858.

Milton, N. (2000). Managing subsurface knowledge; Three initiatives in BP. In K. Ofstad K., J.E. Kittilsen & P. Alexander-Marrack (Eds.), *Improving the Exploration Process by Learning from the Past*, Norwegian Petroleum Society (NPF) Special Publication 9, pp. 251-257. City: Elsevier Science B.V.

Moreland, Jr, J.D. (2009). Structuring a flexible, affordable naval force to meet strategic demand into the 21st century. *Naval Engineers Journal, 121*(1), 35–51.

Murphy, T.J. (2003), "Controlling "brain drain": Preserving intellectual capital in aging civil service organizations", Doctoral Dissertation, Touro University International.

Nahapiet, J., & Goshal, S. (1998). Social Capital, intellectual capital, and the organizational advantage. *he Academy of Management Review, 23*(2), pp. 242-266.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge creating company.* Oxford: Oxford University Press.

NSWCDD (2010). NSWCDD Strategic Plan 2010-2015, NSWCDD/MP-10/9. Retrieved from http://www.blahblah.com.

Pagliani, P., & Chakraborty, M. (2008). Trends in logic, a geometry of approximation rough set theory. *Logic, Algebra and Topology of Conceptual Patterns, 27*, pp. 3-42.

Qureshi, S., Briggs, R.O., & Hlupic, V. (2006). Value creation from intellectual capital: Convergence of knowledge management and collaboration in the intellectual bandwith model. *Group Decisions and Negotiations, 15*, pp. 197-220.

Roman-Velazquez, J. (2005). An empiric study of organizational culture types and their relationship with the success of a knowledge management system and the flow of knowledge in the U.S. government and nonprofit sectors. In M. Stankosky (Ed.), *Creating the Discipline of Knowldge Management, the Latest in University Research* (pp. 66-91). Burlington, MA: Elsevier, Inc.

Rodriguez, L.J. (2012), Conceptual model for the development of a plan to maintain, expand, and create corporate knowledge in a technical organization, *Proceedings of the International Annual Conference of the American Society for Engineering Management.* City, dates held.

Rouse, W.B., & Sage, A.P. (1999). Information technology and knowledge management. *Handbook of system engineering and management.* City: John Wiley and Sons.

Sanders, E.S., & Thiagarajan, S. (2005). *Performance intervention maps.* Alexandria , VA: ASTD Press.

Schein, E.H. (2002). Models and tools for stability and change in human systems. *Reflections, 4*(2), pp. 34-46.

Sharp, D. (2003). Knowledge management today: Challenges and opportunities. *Information System Management , 20*(2), pp. 32-37.

Souza-Poza, A., & Correa-Martinez, Y. (2005). Pragmatic idealism as the basis for understanding complex domains: The trinity and SOSE. *Journal, volume*(number), pp. xx-xx.

Sousa-Poza, A., Kovacic S., & Keating C. (2008). System of systems engineering: An emerging multidiscipline. *International Journal of Systems Engineering, 1*(½), pp. xx-xx.

Spender, J.C. (1996). Competitive advantage from tacit knowledge? Unpacking the concept and its strategic implications. In B. Moingeon & A. Edmondson (Eds), *Organizational Learning and Competitive Advantage*, pp. 56-71. London: Sage.

Sveiby, K.E. (2001). What is knowledge management?" Retrieved from www.sveiby.com/Portals/0/articles/KnowledgeManagement.html.

Thompson, L.L. (2009). *Making the team. A guide for managers* (3rd ed.). City: Pearson Prentice Hall.

Tsoukas, H. (1996). The firm as a distributed knowledge system: A constructionist approach. *Strategic Management Journal, 17*, pp. 11-25.

Vallejos, R.V., Macke, J., Olea, P.M., & Toss, E. (2008). IFIP International Federation for Information Processing. In L.M. Camarinha-Matos, & W. Picard (Eds.) *Pervasive Collaboration Networks,* pp. 43-52. Boston: Springer.

Vernon, D., & Furlong, D. (2007). Philosophical foundations of enactive AI. In M. Lungarella, M. Iida, J.C. Bongard, & R. Pfeifer (Eds), *50 Years of Artificial Intelligence*, pp. 53-62. Heidelberg: Springer-Verlag.

Walker, D.H.T., & Loosemore, M. (2003), Flexible problem solving in construction projects on the National Museum of Australia project. *Team Performance Management: An International Journal, 9*(1/2), pp. 5-15.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity (Learning in doing: Social, cognitive and computational perspectives).* Cambridge: Cambridge University Press.

10. APPENDICES

10.1 Instruments

      10.1.1 Interview Protocol for Line Managers

      10.1.2 Interview Protocol for KMS Managers

      10.1.3 Survey

10.2 Survey Results

10.3 Letter of Approval to Conduct Study in G Department

10.4 NSWCDD IRB Consent to Conduct Study in G Department

10.1   INSTRUMENTS

10.1.1   Interview Protocol for Line Managers

This interview seeks to gather data about G Department's line managers understanding and position towards different aspects of knowledge management. The information being requested will help G Department formulate departmental strategies to improve the organization's ability to meet current and future goals effectively.

Analysis results will be based on a combination of events and cannot be traced to any individual or event. Individual responses will remain anonymous and not be reported to any person nor be traced to any specific event or person. Participation in this interview is voluntary, with no penalties or reprisals for not participating or completing. Table A.I below traces the interview questions to the variables identified for the "NSWCDD Engagement Systems Department (G), Development of a Plan to Maintain, Expand, and Create Corporate Knowledge" project.

Table A. I. Line Managers Interview Questions Guidance

Questions
• What is systems integration? • Do you consider your organization is ready to lead systems integration efforts? Why yes / Why not? • What programs in your branch currently involves systems integration? • In what role do you support systems integration?
• What do you understand about Knowledge Management and Knowledge Transfer? • What do you think about the knowledge transfer programs in G Department • What Knowledge Transfer programs have you implemented in your branch or division? • What plans do you envision for the knowledge management systems in you branch, division? • What areas have you identified needs improvement? • How do you see knowledge management systems contributing to your organization?
• Do you have a plan that identifies your hiring needs for the next three years? • Have you identify the technical areas that are in high risk of losing them?
• In the next five years, how do you envision your organization's Human Capital changing?
• Have employees complained about the facilities and their ability to perform their work? • Have employees been unable to conduct tests, experiments or analyses or other task because of inadequacy of current equipment or facilities to perform their work? • Do teams in your branch have war rooms?
• Have your employees express difficulties when working with other organizations (branches, divisions or departments)?
• What undergoing efforts affect the implementation of KMS in your organization? • What and how externally imposed limits (budget, hiring freezes, travel brown out due to ERP, competing change initiatives including ERP, externally directed timelines, etc.) affect your plans to improve KM in your branch or division?
• How employees are assigned to teams? • Who provides training to these employees when they are assigned to new tasks? • How quick they seem to be valuable members of a team?
• Who evaluates the employees? • How often employees are provided feedback about their performance? • Are there differences between teams on how they evaluate their employees within a branch? • What differences have you noticed and how these impact employees' development?

10.1.2 Interview Protocol for KMS Managers

This interview seeks to gather data about KMS that affect G Department's aspects of knowledge management. This questionnaire traces to variable (20) – "identify current knowledge management systems in use by employees" identified for the "NSWCDD Engagement Systems Department (G), Development of a Plan to Maintain, Expand, and Create Corporate Knowledge" project. The information being requested will help G Department formulate departmental strategies to improve the organization's ability to meet current and future goals effectively.

The questions for KMS Managers include:

- How many employees participate in this program?
- What organizational goals is this program addressing?
- What is (are) the objective(s) of the program?
  - create knowledge repositories – the purpose is to create and organize documentation (memos, reports, presentations, articles) of "knowledge" and or information in order to be retrieved later
  - improve knowledge access – the objective is to provide access to individuals to information or knowledge source to facilitate knowledge transfer
  - enhance knowledge environment – seek to establish an environment that allows more effective knowledge creation, transfer, and use; and
  - manage knowledge as an asset – the focus is on managing specific knowledge intensive assets, such as monitoring and protecting patents
- What is the purpose of the program?
  - What knowledge is being transfer or captured?
  - How is this knowledge being transferred to the next user?

- What measurements are being used to identify the benefits of the program?
  - Who developed this metric?
  - Is ROI being measured?
  - How / what methods are being utilized to assure or improve chances of success of the program?
- Who is in charge of implementing the program?
  - What undergoing efforts affect the implementation of this KMS?

10.1.3 Survey

This survey seeks to gather data about current competencies in G Department and the practices and preferences for knowledge transfer of G Department employees. The information being requested will help G Department formulate departmental strategies to improve the organization's ability to meet current and future goals effectively.

Analysis results will be based on a combination of events and cannot be traced to any individual or event.
Individual responses will remain anonymous and not be reported to any person nor be traced to any specific event or person. Participation in this survey is voluntary, with no penalties or reprisals for not participating or completing.

We recognize your time is valuable and appreciate you taking the time to complete this survey.

Please provide the best answer to each of the following questions

1. What is your current organization?

G01-G09	G30	G60	G70	G80
G20	G31	G61	G71	G81
G21	G32	G65	G72	G82
G24	G33	G67	G73	G83
G25	G34			G84

2. What is your current pay plan and grade?

ND02 / GS01-08
ND03 / NT03 / GS09-11
ND04 / NT04-05 / GS12-13
ND05 / NT06 / GS14-15
Other

3. What is your age?

18 to 29
30 to 39
40 to 54
55 and above

4. What are your Total Years of Service in NSWCDD?

Under 5
5 to 9
10 to 14
15 to 19
20 to 29
30 to 34
35 to 39
Over 40

5. What are your Total Years of Service in G Department?

Under 5
5 to 9
10 to 14
15 to 19
20 to 29
30 to 34
35 to 39
Over 40

6. What is your current position / performing role? (please select 1)

Line Manager	Scientist
Program Manager	Principal for Safety (PFS)
Project Manager	Safety/PESOH Engineer
System Engineer	Electrical Technician
Mechanical Engineer	Mechanical Technician
Electrical Engineer	Machinist
Software Engineer	Drafter
Computer Scientist	Financial (Analyst, Contracts)
Aerospace Engineer	Statistician
Test Engineer	Other, please specify:
Mathematician	

7. What are your areas of competency or knowledge? Please indicate if never used or used: more than five years ago, between the last 3 to 5 years, or currently use.

Knowledge Area	Used			
	never	>5 years ago	3 to 5 years ago	Currently
Program Management				
Project Management				
Cost Estimation				
Generate Requirements				
Architecture Engineering				
System Integration				
System Engineering Management				
Cost Analysis				
Risk Management				
Configuration Management				
Quality Management				
Develop Standards				
Fielding Systems				
Procurement				
Logistics				
Legal				
Lean & Six Sigma				
Modeling and Simulation				
Finite Element Analysis (FEA)				
Plan and Execute Test and Evaluation Events				
Develop Training and Education Materials				
Conduct Technical Training				
System Design				
Component Design				
Review Designs				
Drafting				
Software Design & Development				
Software Integration				
Software Testing				
Software Quality Assurance				
Design experiments for system safety				
Conduct analysis approaches for system safety				
Test Execution Operations				
Plan and Conduct Research				
Ballistics				
Insensitive Munitions				
Lethality and Effectiveness				
Communications				
Pulse Power				
Nuclear Energy				
Human Systems Integration (HIS)				
Chemical, Biological and Radiological Warfare Defense (CBR-D)				
Shock and Vibration				
Target Vulnerability				
Instrumentation				
Fabrication				
Electromagnetic				
IT				
Information Security				

Knowledge Area	Used			
	never	>5 years ago	3 to 5 years ago	Currently
Thermal dynamics				
Fluids dynamics				
Structures and materials				
Chemistry				
Biology				
Numerical Analyses and Algorithm Development				
Other, please specify:				

8. What are your areas of product knowledge? Please indicate if never used or used: more than five years ago, between the last 3 to 5 years ago or currently use.

	Used:			
Knowledge Area	never	>5 years ago	3 to 5 years ago	Currently
Minor Caliber Guns				
Medium and Large Caliber Guns				
Ammunition				
Torpedoes				
Grenades, Flashbangs				
Mortars				
Launchers				
Missiles				
Fuzing				
Rockets				
Warheads				
Non-lethal weapons				
Guidance Systems				
Robotics				
Sensors (acustic, infrared, vibration)				
Autonomy Systems				
Radars				
Fire Control Systems				
Tracking Systems				
Targeting Systems				
Power Systems				
Satellites				
Weapon Mounts				
Electromagnetic launcher Systems				
Explosives				
IEDs				
Armor				
Mines				
Unmanned Aerial Vehicles (UAVs)				
Ship Platforms				
Vehicle Platforms				
Aircraft platforms				
Night Vision Equipment				
Batteries				
Imaging				
Computing				
Propellants				
Packaging				
Chemical and Biological detection systems				
Chemical and biological hardware decontamination, personnel decontamination and medical systems				
Directed Energy Systems				
Directed Energy Technologies				
Lasers				
Electronic Warfare				
Electro Optic Systems				
Geographic Information Systems				
Fiber Optics				
Displays				
Other, please specify:				

9. How many years of experience do you have in your current position?

Less than 2 years
2-5 years
5-10 years
Over 10 years

10. How long does it take to learn the skills to perform your current job adequately?

0-6 months
6-12 months
1 -3 years
3-5 years
Over 5 years

11. Have you worked for other branches or organizations?

Yes	No

Which ones? Please select all that apply:

G01-G09	G30	G60	G70	G80
G20	G31	G61	G71	G81
G21	G32	G65	G72	G82
G24	G33	G67	G73	G83
G25	G34			G84
Z Department	W Department	K Department	Q Department	C Department
NSWC Indian Head	NSWC Port Hueneme	NSWC Panama City	NSWC Carderock	NSWC Crane
CDSA Dam Neck	NSWC Corona	DOD	ONR	NASA
US Navy	US Marines	US Airforce	US Army	Coast Guard
CD&I	MARCORSYSCOM	NRL	DOE	ARL
				Other

12. Are members of your team contractors?

Yes	No	I do not know.

13. What is the role of the contractor member?

Line Manager	Scientist
Program Manager	Principal for Safety (PFS)
Project Manager	Safety/PESOH Engineer
System Engineer	Electrical Technician
Mechanical Engineer	Mechanical Technician
Electrical Engineer	Machinist
Software Engineer	Drafter
Computer Scientist	Financial (Analyst, Contracts)
Aerospace Engineer	Statistician
Test Engineer	Other, please specify:
Mathematician	I do not know

14. What skills or knowledge does the contractor team member bring to the team?

	Select		Select
Program Management		Design experiments for system safety	
Project Management		Conduct analysis approaches for system safety	
Cost Estimation		Test Execution Operations	
Generate Requirements		Plan and Conduct Research	
Architecture Engineering		Ballistics	
System Integration		Insensitive Munitions	
System Engineering Management		Lethality and Effectiveness	
Cost Analysis		Communications	
Risk Management		Pulse Power	
Configuration Management		Nuclear Energy	
Quality Management		Numerical Analyses and Algorithm Development	
Develop Standards		Human Systems Integration (HIS)	
Fielding Systems		Chemical, Biological and Radiological Warfare Defense (CBR-D)	
Procurement		Shock and Vibration	
Logistics		Target Vulnerability	
Modeling and Simulation		Instrumentation	
Finite Element Analysis (FEA)		Fabrication	
Plan and Execute Test and Evaluation Events		Electromagnetic	
Develop Training and Education Materials		IT	
Conduct Technical Training		Information Security	
System Design		Thermal dynamics	
Component Design		Fluids dynamics	
Review Designs		Structures and materials	
Drafting		Chemistry	
Software Design & Development		Biology	
Software Integration		Other, please specify:	
Software Testing			
Software Quality Assurance			
Lean & Six Sigma			
Legal			

15. How is the contractor's knowledge being captured and transferred to others?

Is not captured	Establishing Processes	Interaction
Reports	Provides Training	Contributing to Database
Mentoring	Provides Reviews	Other, please specify:

16. Does your program involve systems integration?

Yes	No

17. What organization performs the role of systems integrator in your program?

G Department
NSWCDD (Other than G Department)
Government Organization (External to NSWCDD)
Contractor at NSWCDD
Contractor External to NSWCDD
Other *(please specify)*:_____
Does not apply (answered no to question 2)

18. When presented with a new technical subject or task, where do you go for technical information, background information, ideas on how to proceed, warnings and lessons learned? Please rank your first five choices in your preferred order.

	1	2	3	4	5
Internet Public Domain (Google, Wikipedia, etc.)					
Internet Gov. (NKO, Dahlgren Website, DTIC, Databases, etc.)					
Colleagues, fellow coworkers					
Subject Matter Expert internal to NSWCDD					
Mentor					
External contact					
Line Management, Supervisor					
Tech Briefs					
Library					
Internal references: Reports, Instruction Manuals					
Conferences					
Formal training					
Other, please specify:_____					

19. When you need to make a programmatic decision, where do you go for background information, ideas on how to proceed, warnings and lessons learned? Please rank your first five choices in your preferred order.

	1	2	3	4	5
Internet Public Domain (Google, Wikipedia, etc.)					
Internet Gov. (NKO, Dahlgren Website, DTIC, Databases, etc.)					
Colleagues, fellow coworkers					
War room					
Subject Matter Expert internal to NSWCDD					
Mentor					
External contact					
Line Management, Supervisor					
Tech Briefs					
Library					
Internal references: Reports, Instruction Manuals					
Conferences					
Formal training					
Other, please specify:_____					

20. Rank the top three challenges when trying to gain new knowledge?

Do not know where it is	Information complexity	People do not want to share knowledge
No Subject Matter Expert available	Lack of motivation to learn	Lack of funding
Hard to understand new information in my area	Organizational culture	Out of your branch knowledge area
Do not have access to databases	Poor quality information available	Other, please specify:
Do not have time	People do not have time to share knowledge	

21. Where did/do you acquire the knowledge and skills necessary to perform your job? (rank top 5 answers)

	1	2	3	4	5
Undergraduate education					
DAWIA					
Peers					
Internships					
Web-Based Training					
Continuous Academic Development					
On the job training					
Mentors					
Conferences					
Other, please specify:					

22. Are you aware of, participate, and/or have participated in the following practices in G Department?

	Aware		Have participated in this groups or activities	
	Yes	No	Yes	No
Technical Briefs				
Requirements Working Group				
Public Speaking Working Group				
New Employee Development Program (NEDP)				

23. How many members are in your team?

1
2-7
8-15
15-25
25+

24. Please indicate what organizations your team members belong to (select all that apply)

Branch
Division
G Department
NSWCDD (Other than G Department)
Other Government Organization (External to NSWCDD)
Contractor at NSWCDD
Contractor External to NSWCDD
Other (please specify): _____
Does not apply (answered no to question 2)

25. How do you learn from other members in your team? (Select all that apply)

Collaboration	Reports	Lesson Learn Presentations
Storytelling	Communities of Practice	I do not learn from other members
Occasional advice	Tech Briefs	Other

26. How do you learn from other teams? (Select all that apply)

Collaboration	Reports	Lesson Learned Presentations
Storytelling	Communities of Practice	I do not learn from other teams
Occasional advice	Tech Briefs	Other

The following questions ask you about how often you perform different practices.

27. Deleted.

28. Do you or your team regularly collaborate with organizations outside your _____

	Always	Almost Always	Often	Sometimes	Seldom	Almost Never	Never
Branch							
Division							
Department							
NSWCDD							

29. Please indicate if you participate in social activities with team members outside working hours and indicate how often:

Activity	Never	Daily	Weekly	Monthly	Semiannual	Yearly	Other
Lunch							
Sports							
Night Out							
Branch activity							
Division activity							
Others:							

30. How often do you communicate with the sponsor?

Daily or more often	Weekly	Monthly	Never

31. To your understanding, how often does the project manager communicate with the sponsor?

Daily or more often	Weekly	Monthly	Never

The following questions ask for your degree of agreement or disagreement with a number of statements.

32. Team member's roles and responsibilities are clearly defined.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

33. The program I am involved has a very high level of technological complexity.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

34. I believe my team is qualified to perform as the lead system integrator for the programs in my branch.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

35. In my experience, it is very difficult to find support in the area of expertise required by my project.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

36. In my experience, it is very easy is to collaborate with others within my

	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree
Branch							
Division							
Department							
Organization NSWCDD							

What difficulties, if any, have you experience when collaborating with others:

Branches	
Divisions	
Departments	
Organizations	

37. I am very familiar with the work my sponsoring organization performs.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

38. I have a very good relationship with the POC of my sponsoring organization

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

39. The PM of my project has a very good relationship with the POC in the sponsoring organization.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

40. I have a very good relationship with all the members of my team.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

41. Most of my team members feel free to talk during team meetings if they disagree with something being said.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

On average, what percentage of the team members talk to make contributions during team meetings?

0-25	25-50	50-75	75-100

42. All my team members provide high quality work with minimal supervision.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

43. I feel very confident all my team members will complete their tasks in the time agreed.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

44. I provide critical and useful feedback to other team members about their work performance.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

45. I provide feedback only when requested.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

46. I receive feedback about my performance only when requested.(not counting mid-year and end of year reviews)

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

47. My team members provide critical and useful feedback about my work performance. (not counting mid-year and end of year reviews)

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

48. My team members provide critical feedback to other team members about their performance.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

49. Having team members participating in telework has not affected the performance of my team.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree
Does not apply						

If applicable, please indicate how telework has affected team performance:

50. Having a mentor within my branch has been very beneficial in my professional development.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

51. Having a mentor within my division has been very beneficial in my professional development.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

52. I consciously make an effort to share my knowledge with others in my team.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

53. I am unable to share my knowledge with members of my team because I do not have time.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

54. I like to share my knowledge with members of my team but I feel they are not interested in what I have to say.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

55. If I were to retire or move to another position in the next two years, the time I have spent transferring knowledge to others has been adequate to ensure that my key experience is retained within the organization.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree

The following set of questions asks you about how well do you know about programs in your branch.

56. Do you know what expertise the members of your branch possess?

No	Just members of my team	Some	Many	Most of them

57. Are you aware of the programs your branch is working on?

No	Just know my program	A few programs	Some programs (around half)	Most or all of the programs	Most of current and future programs

58. Do you know who the sponsoring organizations are for the programs in your branch?

No	Just know my program	A few programs	Some programs (around half)	Most or all of the programs	Most of current and future programs

Thank you very much for completing this survey!

10.2   SURVEY RESULTS

Variable 1 related survey results.

Table A. II. Results by age group to Survey Question 16

Survey Question 16: Does your program involve systems integration?

	18-29		30-39		40-54		55 and over	
Yes	37	69%	53	71%	73	72%	24	62%
No	17	31%	22	29%	28	28%	15	38%

Table A.III. Results by division to Survey Question 16

Survey Question 16: Does your program involve systems integration?

	G20		G30		G60		G70		G80	
Yes	22	45%	49	88%	20	57%	42	65%	51	94%
No	27	55%	7	13%	15	43%	23	35%	3	6%

Table A.IV. Results to Survey Question 17

Survey Question 17: If your program involves systems integration, what organization performs the role of systems integrator in your program?

Organization	Selection	Selection %
G Department	105	56%
NSWCDD (organization other than G Department)	22	12%
Government Organization (external to NSWCDD)	20	11%
Contractor at NSWCDD	0	0%
Contractor External to NSWCDD	29	15%
Other	12	6%
Total Responses	188	

Table A.V. Results by division to Survey Question 17
Survey Question 17: If your program involves systems integration, what organization performs the role of systems integrator in your program?

	G20		G30		G60		G70		G80	
G Department	10	43%	34	20%	15	50%	5	24%	39	20%
NSWCDD (organization other than G Department)	4	14%	0	0%	1	4%	13	27%	4	8%
Government Organization (external to NSWCDD)	4	14%	3	6%	0	0%	8	17%	4	8%
Contractor at NSWCDD	0	0%	0	0%	0	0%	0	0%	0	0%
Contractor External to NSWCDD	5	18%	9	17%	2	7%	11	23%	2	4%
Other	0	0%	3	6%	2	7%	5	10%	2	4%

Table A.VI. Results to Survey Question 34
Survey Question 34: I believe my team is qualified to perform as the lead systems integrator for the programs in my branch.

Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree	Total Responses
91	79	31	46	5	5	7	264
34%	30%	12%	17%	2%	2%	3%	Mean 5.6

Table A.VII. Results by division to Survey Question 34
Survey Question 34: I believe my team is qualified to perform as the lead systems integrator for the programs in my branch.

	G20		G30		G60		G70		G80	
Strongly Agree	13	27%	25	46%	12	34%	14	22%	26	49%
Agree	13	27%	18	33%	11	31%	17	26%	16	30%
Somewhat Agree	3	6%	7	13%	3	9%	12	18%	5	9%
Neutral	16	33%	3	6%	7	20%	14	22%	4	8%
Somewhat Disagree	1	2%	1	2%	1	3%	2	3%	0	0%
Disagree	1	2%	0	0%	0	0%	1	2%	2	4%
Strongly Disagree	1	2%	0	0%	1	3%	5	8%	0	0%
Total Responses	48		54		35		65		53	
Mean	5.29		6.16		5.62		5.06		6.09	

Variable 3 related survey results.

Table A.VIII. Results to Survey Question 18

Survey Question 18: When presented with a new technical subject or task, where do you go for technical information, background information, ideas on how to proceed, warnings and lessons learned? (Please rank your first 5 choices in your preferred order.)

Method	Rank Score
Colleagues, fellow co-workers	2923
Internet Public Domain (Google, Wikipedia, etc)	2493
Subject Matter Expert internal to NSWCDD	2275
Internet Gov. (NKO, Dahlgren website, DTIC, Databases, etc)	1340
Internal references: Reports, Instruction Manuals, etc	1058
External Contact	709
Formal Training	632
Mentor	631
Line Management, Supervisor	615
Library	542
Tech Briefs	285
Conferences	227
Other	107

Table A.IX. Results by age group to Survey Question 18

Survey Question 18: When presented with a new technical subject or task, where do you go for technical information, background information, ideas on how to proceed, warnings and lessons learned?

Method	rank score 18-29	rank score 30-39	rank score 40-54	rank score 55 and over
Colleagues, fellow coworkers	632	846	1067	378
Internet Public Domain (Google, Wikipedia, etc.)	560	748	843	342
Subject Matter Expert internal to NSWCDD	364	619	955	337
Internet Gov. (NKO, Dahlgren website, DTIC, Databases, etc.)	270	336	498	236
Internal references: Reports, Instruction Manuals, etc.	248	273	372	165
External Contact	77	190	322	120
Library	142	128	166	106
Formal Training	116	233	183	100
Line Management, Supervisor	137	164	251	63
Conferences	40	52	95	40
Other, please specify:	0	40	30	37
Tech Briefs	48	46	160	31
Mentor	262	146	223	0

Table A.X. Results to Survey Question 19

Survey Question 19: When you need to make a programmatic decision, where do you go for background information, ideas on how to proceed, warnings and lessons learned? (Please rank your first 5 choices in your preferred order.)

Preference	Rank Score
Colleagues, fellow co-workers	3008
Subject Matter Expert internal to NSWCDD	2368
Line Management, Supervisor	2055
Mentor	1141
Internal references: Reports, Instruction Manuals	1028
Internet Public Domain (Google, Wikipedia, etc)	947
Internet Gov. (NKO, Dahlgren website, DTIC, Databases, etc)	820
External Contact	634
Formal Training	602
Tech Briefs	202
War room	191
Other	178
Library	134
Conferences	94

Table A.XI. Results by age group to Survey Question 19
Survey Question 19: When you need to make a programmatic decision, where do you go for background information, ideas on how to proceed, warnings and lessons learned? (Please rank your first 5 choices in your preferred order.)

Method/Preference	rank score 18-29	rank score 30-39	rank score 40-54	rank score 55 and over
Colleagues, fellow co-workers	611	871	1127	399
Subject Matter Expert internal to NSWCDD	393	644	972	359
Line Management, Supervisor	419	541	808	287
Internal references: Reports, Instruction Manuals	264	292	318	154
External Contact	56	143	297	138
Internet Gov. (NKO, Dahlgren website, DTIC, Databases, etc)	177	245	282	116
Internet Public Domain (Google, Wikipedia, etc)	255	213	385	94
Other, please specify:	0	68	28	82
Formal Training	97	148	276	81
War room	21	46	98	26
Conferences	10	23	37	24
Mentor	357	368	393	23
Library	44	33	34	23
Tech Briefs	21	53	108	20

Table A.XII. Results to Survey Question 20
Survey Question 20: Rank your top three challenges when trying to gain new knowledge.

Challenge	Rank Score
Do not know where it is	1713
Do not have time	1248
No Subject Matter Expert available	1165
Information complexity	859
Poor quality information available	703
People do not have time to share knowledge	667
Out of your branch knowledge area	657
Lack of funding	635
Do not have access to databases	546
Organizational culture	545
People do not want to share knowledge	373
Hard to understand new information in my area	324
Other, please specify	260
Lack of motivation to learn	113

Table A.XIII. Results by age group to Survey Question 20
Survey Question 20: Rank your top three challenges when trying to gain new knowledge.

Challenge	rank score 18-29	rank score 30-39	rank score 40-54	rank score 55 and over
No Subject Matter Expert available	241	300	427	197
Do not have time	154	387	518	189
Do not know where it is	440	564	549	160
Poor quality information available	143	187	231	142
Organizational culture	66	159	191	129
Information complexity	144	298	310	107
Out of your branch knowledge area	206	150	200	101
Lack of funding	174	101	272	88
Do not have access to databases	104	185	177	80
Other, please specify	12	52	134	62
Lack of motivation to learn	24	12	24	53
People do not want to share knowledge	64	102	155	52
People do not have time to share knowledge	169	201	259	38
Hard to understand new information in my area	104	116	79	25

Variable 4 related survey results.

Table A.XIV. Results to Survey Question 21

Survey Question 21: Where did/do you acquire the knowledge and skills necessary to perform your job?

Resource	Rank Score
On-the-job Training	2238
Peers	1529
Undergraduate Education	1382
Mentors	1313
Continuous Academic Development	746
DAWIA	538
Web-Based Training	477
Other, please specify:	473
Conferences	401
Internships	234

Table A.XV. Results by age group to Survey Question 21

Survey Question 21: Where did/do you acquire the knowledge and skills necessary to perform your job?

Resource	rank score 18-29	rank score 30-39	rank score 40-54	rank score 55 and over
On-the-job Training	398	654	879	307
Peers	335	441	529	224
Mentors	306	382	485	140
Undergraduate Education	381	434	429	138
Continuous Academic Development	153	273	220	100
Other, please specify:	62	121	196	94
DAWIA	126	136	190	86
Conferences	40	110	171	80
Web-Based Training	78	77	245	77
Internships	109	49	66	10

Table A.XVI. Results to Survey Question 22
Survey Question 22a: Are you aware of the following practices in G Department?
Survey Question 22b. Have you participated in any of the following G Department practices?

	22a. Awareness			22b. Participation		
	Yes	No	Total Responses	Yes	No	Total Responses
Technical Briefs	264	5	269	209	61	270
	98%	2%		77%	23%	
Requirements Working Group	126	143	269	36	232	268
	47%	53%		13%	87%	
Public Speaking Working Group	189	80	269	16	249	265
	70%	30%		6%	94%	
New Employee Development Program (NEDP)	217	51	268	99	168	267
	81%	19%		37%	63%	

Variable 5 related survey results.

Table A.XVII. Results to Survey Question 9

Survey Question 9: How many years of experience do you have in your current position?

Time Range	Responses	Distribution
Less than 2 years	57	21%
2 to 5 years	90	33%
5 to 10 years	68	25%
More than 10 years	54	20%
Total Responses	269	

Table A.XVIII. Results by age group to Survey Question 9

Survey Question 9: How many years of experience do you have in your current position?

	Total Responses	18-29		30-39		40-54		55 and over	
Less than 2 years	57	21	37%	17	30%	14	25%	5	9%
2 to 5 years	90	26	29%	30	33%	31	34%	3	3%
5 to 10 years	68	6	9%	24	35%	24	35%	14	21%
More than 10 years	54	0	0%	5	9%	33	61%	16	30%

Table A.XIX. Results to Survey Question 10

Survey Question 10: How long does it take to learn the skills to perform your current job adequately?

Time Range	Survey Participants	Distribution
0 to 6 months	42	16%
6 to 12 months	57	21%
1 to 3 years	90	34%
3 to 5 years	42	16%
> 5 years	37	14%
Total Responses	268	

Table A.XX. Results by age group to Survey Question 10

Survey Question 10: How long does it take to learn the skills to perform your current job adequately?

Time Range	18-29	18-29 Response Distribution	30-39	30-39 Response Distribution	40-54	40-54 Response Distribution	55 and over	55 and over Response Distribution
0 to 6 months	15	28%	13	17%	8	8%	6	16%
6 to 12 months	20	37%	16	21%	14	14%	7	18%
1 to 3 years	14	26%	26	34%	39	39%	11	29%
3 to 5 years	4	7%	15	20%	15	15%	8	21%
> 5 years	1	2%	6	8%	24	24%	6	16%
Total Responses	54		76		100		38	

Variable 6 related survey results.

Table A.XXI. Results to Survey Question 25
Survey Question 25: How do you learn from other members in your team?

Method	Selections	Distribution
Collaboration	257	96%
Occasional advice	197	73%
Reports	143	53%
Storytelling	128	48%
Tech Briefs	67	25%
Communities of Practice	60	22%
Lessons Learned Presentations	57	21%
Other, please specify	24	9%
I do not learn from other members	2	1%
Total Responses	935	
Number of respondents	269	
Average number of selection per respondent	3.47	

Table A.XXII. Results by age group to Survey Question 25
Survey Question 25: How do you learn from other members in your team?

Method	18-29		30-39		40-54		55 and over	
Collaboration	53	98%	72	95%	94	94%	38	97%
Storytelling	33	61%	42	55%	43	43%	10	26%
Occasional advice	45	83%	59	78%	65	65%	28	72%
Reports	32	59%	35	46%	51	51%	25	64%
Communities of Practice	16	30%	18	24%	15	15%	11	28%
Tech Briefs	12	22%	16	21%	25	25%	14	36%
Lessons Learned Presentations	7	13%	19	25%	21	21%	10	26%
I do not learn from other members	0	0%	1	1%	1	1%	0	0%
Other	2	4%	11	14%	7	7%	4	10%
Total responses	200		273		322		140	
Number of respondents	54		76		100		39	
Average number of selection per respondent	3.70		3.59		3.22		3.58	

Table A.XXIII. Inter-team learning and intra-team learning results comparison
Comparison of responses to Survey Question 26 and 25
Survey Question 26: How do you learn from other teams? (Please select all that apply)
Survey Question 25: How do you learn from other members in your team?

Method	Learning from other teams	Distribution	Learning intra-team	Distribution	Change
Collaboration	180	67%	257	96%	-28%
Occasional advice	155	58%	197	73%	-15%
Reports	152	57%	143	53%	4%
Tech Briefs	141	53%	67	25%	28%
Storytelling	94	35%	128	48%	-13%
Communities of Practice	66	25%	60	22%	2%
Lesson Learned Presentations	60	22%	57	21%	1%
Other	12	4%	24	9%	-4%
I do not learn from other members	8	3%	2	1%	2%
Total Responses	868		935		
Number of participants	268		269		
Average number of selection per participant	3.24		3.48		

Table A.XXIV. Results by age group to Survey Question 26
Survey Question 26: How do you learn from other teams? (Please select all that apply)

Method	18-29		30-39		40-54		55 and over	
Collaboration	36	67%	49	65%	70	70%	25	64%
Storytelling	23	43%	35	47%	30	30%	6	15%
Occasional advice	32	59%	52	69%	49	49%	22	56%
Reports	32	59%	41	55%	53	53%	26	67%
Communities of Practice	13	24%	18	24%	23	23%	12	31%
Tech Briefs	30	56%	34	45%	54	54%	23	59%
Lesson Learned Presentations	10	19%	22	29%	18	18%	10	26%
I do not learn from other members	1	2%	3	4%	3	3%	1	3%
Other	0	0%	5	7%	6	6%	1	3%
Total Responses	177		259		306	3.06	126	
Number of respondents	54		75		100		39	
Average number of selection per respondent	3.27		3.45		3.06		3.23	

Variable 11 related survey results.

Table A.XXV. Survey participants age distribution comparison to actual organization age distribution

Age group	Survey Participants	Survey Participants Age Distribution	G Number of Employees Actual from FY11 data	G Department FY11 Age Distribution	Approximated Age Group Participation
18 to 29	54	20%	157	20%	34%
30 to 39	76	28%	195	25%	39%
40 to 54	103	38%	342	43%	30%
55 and above	39	14%	98	12%	40%
Total Responses	272	Total Employees	792		34%

Variable 12 related survey results.

Table A.XXVI. Survey participants and G employees' years of service in NSWCDD comparison

Survey Question 4: What is your total years of service at NSWCDD?

Years of Service in NSWCDD	Survey Participants	Survey Participants NSWCDD Years of Service Group Distribution	Years of Service in the Government Actual Data as of FY11	Years of Service in the Government Distribution
< 5	94	35%	279	35%
5 to 9	67	25%	131	17%
10 to 14	39	14%	101	13%
15 to 19	9	3%	49	6%
20 to 29	42	16%	170	21%
30 to 34	10	4%	25	3%
35 to 39	7	3%	27	3%
40>	2	1%	10	1%
Total Responses	270		792	

Table A.XXVII. Survey participants years of service in G compared to years of service in NSWCDD

Comparison of results of Survey Question 4 and 5

Years of Service in G Group	Survey Participants	Survey Participants Years of Service in G Department Group Distribution	Survey Participants Years in NSWCDD	Survey Participants NSWCDD Years of Service Group Distribution	Difference
<5	124	46%	94	35%	11%
5 to 9	74	27%	67	25%	2%
20 to 29	28	10%	39	14%	-4%
10 to 14	26	10%	9	3%	6%
15 to 19	10	4%	42	16%	-12%
30 to 34	5	2%	10	4%	-2%
35 to 39	3	1%	7	3%	-1%
> 40	1	0%	2	1%	0%
Total Responses	271		270		

Variable 13 related survey results.

Table A.XXVIII. Results for current positions/performing roles
Survey Question 6: What is your current position/performing role?

Role	Survey Participants	
Mathematician	4	1%
Electrical Technician	4	1%
Software Engineer	7	3%
Computer Scientist	8	3%
Line Manager	9	3%
Aerospace Engineer	11	4%
Engineering Technician	12	4%
Principal for Safety (PFS)	13	5%
Program Manager	14	5%
Project Manager	21	8%
Test Engineer	21	8%
Scientist	22	8%
Safety/ESOH Engineer	25	9%
System Engineer	28	10%
Mechanical Engineer	33	12%
Other*	39	14%
Total Responses	271	

*software truncated additional roles, the number of participants were captured under "other"

Table A.XXIX. Results by age group for current positions/performing roles

Survey Question 6: What is your current position/performing role?

Role	18-29		30-39		40-54		55 and over	
Line Manager	0	0%	3	4%	4	4%	2	5%
Program Manager	0	0%	4	5%	7	7%	3	8%
Project Manager	1	2%	5	7%	15	15%	0	0%
System Engineer	3	6%	11	14%	11	11%	3	8%
Mechanical Engineer	14	26%	9	12%	7	7%	3	8%
Software Engineer	1	2%	3	4%	2	2%	1	3%
Computer Scientist	3	6%	1	1%	4	4%	0	0%
Aerospace Engineer	3	6%	4	5%	4	4%	0	0%
Test Engineer	8	15%	5	7%	7	7%	1	3%
Mathematician	1	2%	1	1%	1	1%	1	3%
Scientist	6	11%	5	7%	4	4%	7	18%
Principal for Safety (PFS)	1	2%	2	3%	7	7%	3	8%
Safety/ESOH Engineer	5	9%	8	11%	11	11%	1	3%
Engineering Technician	1	2%	3	4%	5	5%	3	8%
Electrical Technician	0	0%	0	0%	3	3%	1	3%
Other*	7	13%	12	16%	8	8%	9	24%
Participants	54		76		100		38	

*software truncated additional roles, the number of participants was captured under "other"

Table A.XXX. Results for Survey Question 7
Survey Question 7: What are your areas of competency or knowledge?
(Please indicate if never used or used: more than five years ago, between the last three to five years, or currently use.)

Competency Area	N/A	Never Used	Used > 5 years ago	Used within last 3-5 years	Currently Use	Total Respon-ses	% of current users	% of never used
Cost Estimation	37	47	15	34	138	271	51%	31%
Risk Management	31	49	16	38	135	269	50%	30%
Generate Requirements	27	51	18	40	133	269	49%	29%
System Integration	42	48	13	30	131	264	50%	34%
Project Management	41	60	14	29	127	271	47%	37%
Configuration Management	41	61	20	39	105	266	39%	38%
Fielding Systems	43	72	21	30	102	268	38%	43%
Procurement	44	77	20	26	100	267	37%	45%
Systems Engineering Management	48	89	16	23	89	265	34%	52%
Program Management	58	96	22	19	77	272	28%	57%
Cost Analysis	60	99	15	22	71	267	27%	60%
Quality Management	46	88	22	39	71	266	27%	50%
Develop Standards	43	95	26	32	67	263	25%	52%
Logistics	53	104	25	24	61	267	23%	59%
Architecture Engineering	80	116	14	22	32	264	12%	74%
Legal	77	132	10	15	30	264	11%	79%
Total Responses	771	1284	287	462	1469	4273		

Table A.XXXI. Results and distribution within age group for competency areas currently used

Competency Area	Currently Used Age Group			
	18-29	30-39	40-54	55 and over
Program Management	10	25	33	9
	19%	33%	32%	23%
Project Management	15	47	52	13
	28%	62%	51%	33%
Cost Estimation	24	39	60	14
	45%	52%	58%	36%
Generate Requirements	25	38	58	11
	47%	51%	57%	28%
Architecture Engineering	6	7	16	3
	11%	10%	16%	8%
System Integration	28	37	48	17
	53%	50%	48%	46%
Systems Engineering Management	11	33	39	6
	20%	45%	40%	16%
Cost Analysis	15	24	24	8
	28%	33%	24%	21%
Risk Management	23	39	59	13
	43%	52%	58%	34%
Configuration Management	24	33	39	9
	45%	45%	39%	24%
Quality Management	17	22	26	6
	32%	31%	26%	15%
Develop Standards	11	16	31	9
	21%	22%	31%	25%
Fielding Systems	18	30	42	12
	34%	40%	41%	32%
Procurement	17	27	40	16
	33%	36%	39%	42%
Logistics	10	20	26	5
	19%	27%	25%	13%
Legal	5	6	16	3
	9%	8%	16%	8%

Table A.XXXII. Results for Survey Question 8

Product	Never Used	Used > 5 years ago	Used within last 3 to 5 years	Currently Use	Total Responses	% of people that have used knowledge area	% current users	% never used
Ammunition	128	20	28	87	263	51%	33%	49%
Computing	155	15	18	76	264	41%	29%	59%
Ship Platforms	139	23	29	74	265	48%	28%	52%
Fire Control Systems	134	27	29	74	264	49%	28%	51%
Batteries	155	13	25	73	266	42%	27%	58%
Missiles	128	43	23	70	264	52%	27%	48%
Medium & Large Caliber Guns	140	25	30	69	264	47%	26%	53%
Launchers	132	37	25	69	263	50%	26%	50%
Targeting Systems	150	23	24	67	264	43%	25%	57%
Sensors (acoustic, infrared, vibration)	139	25	34	64	262	47%	24%	53%
Minor Caliber Guns	146	21	34	63	264	45%	24%	55%
Fuzing	145	24	31	63	263	45%	24%	55%
Explosives	155	30	18	61	264	41%	23%	59%
Weapon Mounts	146	19	36	60	261	44%	23%	56%
Vehicle Platforms	161	9	34	59	263	39%	22%	61%
Displays	161	23	24	57	265	39%	22%	61%
Warheads	152	27	27	55	261	42%	21%	58%
Propellants	157	24	28	54	263	40%	21%	60%
Tracking Systems	166	27	19	53	265	37%	20%	63%
Mortars	170	19	22	51	262	35%	19%	65%
Lasers	174	16	29	46	265	34%	17%	66%
Packaging	174	24	23	44	265	34%	17%	66%
Electro Optic Systems	185	13	21	44	263	30%	17%	70%
Power Systems	181	21	21	43	266	32%	16%	68%
Unmanned Systems (Ex. UAVs)	184	20	21	40	265	31%	15%	69%
Radars	165	35	27	39	266	38%	15%	62%
Imaging	191	22	10	39	262	27%	15%	73%
Rockets	180	23	22	38	263	32%	14%	68%
Autonomy Systems	200	14	11	38	263	24%	14%	76%
Guidance Systems	169	32	27	37	265	36%	14%	64%
Aircraft Platforms	193	16	23	34	266	27%	13%	73%
Non-lethal weapons	163	27	41	32	263	38%	12%	62%
Grenades, Flashbangs	181	26	22	32	261	31%	12%	69%
Fiber Optics	206	11	15	31	263	22%	12%	78%
Robotics	202	17	14	31	264	23%	12%	77%

Product	Never Used	Used > 5 years ago	Used within last 3 to 5 years	Currently Use	Total Responses	% of people that have used knowledge area	% current users	% never used
Geographic Information Systems	203	18	13	27	261	22%	10%	78%
Night Vision Equipment	196	25	17	25	263	25%	10%	75%
Armor	192	25	25	21	263	27%	8%	73%
IEDs	212	16	17	20	265	20%	8%	80%
Directed Energy Systems	207	12	24	18	261	21%	7%	79%
Electromagnetic Launcher Systems	232	7	6	18	263	12%	7%	88%
Directed Energy Technologies	211	12	23	16	262	19%	6%	81%
Electronic Warfare	206	28	17	14	265	22%	5%	78%
Satellites	232	13	12	8	265	12%	3%	88%
Chemical & Biological detection systems	219	28	9	6	262	16%	2%	84%
Torpedoes	223	27	6	6	262	15%	2%	85%
Chemical & Biological hardware decontamination, personnel decontamination and medical systems	226	24	10	5	265	15%	2%	85%
Mines	222	27	10	5	264	16%	2%	84%

Variable 14 related survey results.

Table A.XXXIII. Results for Survey Question 15

Survey Question 15: How is the contractor's knowledge being captured and transferred to others? (Choose many)

Method	Survey Answers	Selection Rate
Interaction	73	46%
Reports	54	34%
Is not captured	45	29%
Mentoring	39	25%
Provides reviews	35	22%
Contributing to database	25	16%
Establishing processes	19	12%
Provides training	15	10%
Other	10	6%
Total responses	315	
Total participants	157	58%

Table A.XXXIV. Results for Survey Questions 33 and 35

Survey Question 33: The program I am involved with has a very high level of technological complexity.

Survey Question 35: In my experience, it is very difficult to find support in the area of expertise required by my project.

Survey Question	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree
33	96	88	49	21	3	7	2
	36%	33%	18%	8%	1%	3%	1%
35	30	28	41	61	38	56	12
	11%	11%	15%	23%	14%	21%	5%

Mean 33 = 5.84
Mean 35 = 4.00

Table A.XXXV. Results by age group for question 33
Survey Question 33: The program I am involved with has a very high level of technological complexity.

	18-29		30-39		40-54		55 and over	
Strongly Agree	12	23%	29	39%	39	39%	16	41%
Agree	21	40%	22	30%	33	33%	12	31%
Somewhat Agree	12	23%	13	18%	19	19%	5	13%
Neutral	5	9%	6	8%	8	8%	2	5%
Somewhat Disagree	1	2%	1	1%	0	0%	1	3%
Disagree	2	4%	2	3%	1	1%	2	5%
Strongly Disagree	0	0%	1	1%	0	0%	1	3%
Total Responses	53		74		100		39	
Mean	5.60		5.84		6.00		5.77	

Table A.XXXVI. Results by age group for question 35
Survey Question 35: In my experience, it is very difficult to find support in the area of expertise required by my project.

	18-29		30-39		40-54		55 and over	
Strongly Agree	1	2%	10	14%	17	17%	2	5%
Agree	3	6%	8	11%	14	14%	3	8%
Somewhat Agree	7	13%	12	16%	14	14%	8	21%
Neutral	15	28%	13	18%	25	25%	8	21%
Somewhat Disagree	8	15%	13	18%	11	11%	6	15%
Disagree	16	30%	16	22%	15	15%	9	23%
Strongly Disagree	3	6%	2	3%	4	4%	3	8%
Total Responses	53		74		100		39	
Mean	3.38		4.09		4.40		3.67	

Variable 15 related survey results.

Table A.XXXVII. Results for Survey Question 11
Survey Question 11: Have you worked for other Branches within G Department or for other Organizations outside G Department?

	G Responses	
Yes	197	73%
No	74	27%
Total Responses	271	

Table A.XXXVIII. Results by age group for question 11
Survey Question 11: Have you worked for other Branches within G Department or for other Organizations outside G Department?

	18-29		30-39		40-54		55 and over	
Yes	32	59%	62	82%	74	73%	29	74%
No	22	41%	14	18%	28	27%	10	26%
Total Participants	54		76		102		39	

Table A.XXXIX. Results for Survey Question 37
Survey Question 37: I am very familiar with the work my sponsoring organization performs.

Survey Question	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree	Total Responses
37	68	111	44	26	11	4	1	265
	26%	42%	17%	10%	4%	2%	0%	Mean 5.69

Table A.XL. Results by age group for question 37
Survey Question 37: I am very familiar with the work my sponsoring organization performs.

	18-29		30-39		40-54		55 and over	
Strongly Agree	10	19%	19	26%	27	27%	12	31%
Agree	19	36%	34	47%	41	41%	17	44%
Somewhat Agree	14	26%	9	12%	17	17%	4	10%
Neutral	4	8%	9	12%	8	8%	5	13%
Somewhat Disagree	1	2%	2	3%	7	7%	1	3%
Disagree	4	8%	0	0%	0	0%	0	0%
Strongly Disagree	1	2%	0	0%	0	0%	0	0%
Total Participants	53		73		100		39	
mean:	5.32		5.81		5.73		5.87	

Table A.XLI. Results to Survey Question 56

Survey Question 56: Do you know what expertise the members of your branch possess?

	G	
No	13	5%
Only members of my team	33	12%
Some of the branch	118	44%
Many of the branch	52	19%
Most of the branch	54	20%
Total Responses	270	

G mean=3.37; 18-29 mean=3.29; 30-39 mean=3.62; 40-54 mean=3.33; Over 55 mean =3.10; standard deviation for the sample means is .22

Table A.XLII. Results to Survey Questions 57 and 58

Survey Question 57: Are you aware of the programs your branch is working on?
Survey Question 58: Do you know who the sponsoring organizations are for the programs in your branch?

Survey Question	No	I only know my program	A few programs	Some programs (around 1/2)	Most or all of the programs	Most of current and future programs	Total Responses
57	7	3	80	74	84	21	269
	3%	1%	30%	28%	31%	8%	
58	27	29	91	58	51	13	269
	10%	11%	34%	22%	19%	5%	

Results of questions 57
G mean=4.07; 18-29 mean=3.90; 30-39 mean=4.09; 40-54 mean=4.18; Over 55 mean =3.94; Standard deviation for the sample means is .12
Results of questions 58
G mean= 3.43; 18-29 mean=3.12; 30-39 mean=3.53; 40-54 mean=3.56; Over 55 mean =3.3; Standard deviation for the sample means is .20

Structural Capital Variables

Variable 21 related survey results.

Table A.XLIII. Results to Survey Question 36
Survey Question 36: In my experience, it is very easy to collaborate with others within: (my branch, my division, my department, NSWCDD)

	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree	Total Responses
My Branch	107	109	26	15	4	2	2	265
	40%	41%	10%	6%	2%	1%	1%	
My Division	49	112	53	36	8	4	4	266
	18%	42%	20%	14%	3%	2%	2%	
My Department	33	75	76	54	13	10	5	266
	12%	28%	29%	20%	5%	4%	2%	
NSWCDD (outside of my Department)	27	89	70	58	9	5	7	265
	10%	34%	26%	22%	3%	2%	3%	

Relational Capital Variables

Variable 25 related survey results.

Table A.XLIV. Results to Survey Question 28
Survey Question 28: How often do you or your team regularly collaborate with organizations outside of your: Branch, Division, Department, Command (NSWCDD)

Organization Level	Always	Almost Always	Often	Sometimes	Seldom	Almost Never	Never	Total Responses
Branch	123	51	39	30	12	8	2	265
	46%	19%	15%	11%	5%	3%	1%	
Division	94	41	59	40	12	10	8	264
	36%	16%	22%	15%	5%	4%	3%	
Department	72	37	53	58	24	11	9	264
	27%	14%	20%	22%	9%	4%	3%	
NSWCDD	71	35	69	51	18	8	13	265
	27%	13%	26%	19%	7%	3%	5%	

Variable 27 related survey results.

Table A.XLV. Results to Survey Question 13

Survey Question 13: If members of your team are contractors, what is the role of the contractor member? (Please select all that apply. Skip if your team does not consist of any contract personnel.)

Role/Position	Responses
System Engineer	40
Safety/ESOH Engineer	36
Mechanical Technician	34
Software Engineer	32
Electrical Technician	25
Electrical Engineer	22
Mechanical Engineer	21
Test Engineer	21
Computer Scientist	18
Machinist	9
Scientist	8
Project Manager	7
Aerospace Engineer	2
Mathematician	0
Principal for Safety (PFS)/PESOH	0
Total Responses	275

Table A.XLVI. Results to Survey Question 14

Survey Question 14: What skills or knowledge does the contractor team member bring to the team? (Please select all that apply. Skip if your team does not consist of contract personnel.)

Skills/Knowledge	Reponses
Configuration Management	40
Systems Integration	39
Risk Management	31
Generate Requirements	27
Project Management	22
System Engineering Management	22
Cost Estimation	21
Logistics	20
Cost Analysis	17
Fielding Systems	16
Quality Management	14
Procurement	13
Develop Standards	11
Program Management	10
Architecture Engineering	9
Total Responses	312

Variable 28 related survey results.

Table A.XLVII. Results by age group to Survey Question 30

Survey Question 30: How often do you communicate with the sponsor?

Frequency	18-29		30-39		40-54		55 and over	
Daily or more often	8	15%	13	17%	23	23%	9	24%
Weekly	20	37%	25	33%	37	36%	13	34%
Monthly	9	17%	25	33%	17	17%	6	16%
Never	17	31%	12	16%	25	25%	10	26%
Total Responses	54		75		102		38	

Table A.XLVIII. Results by division group to Survey Question 30

Survey Question 30: How often do you communicate with the sponsor?

Frequency	G20		G30		G60		G70		G80	
Daily or more often	7	14%	15	27%	9	26%	13	20%	8	15%
Weekly	10	20%	15	27%	17	50%	24	36%	25	46%
Monthly	17	35%	12	21%	1	3%	14	21%	12	22%
Never	15	31%	14	25%	7	21%	15	23%	9	17%
Total Responses	49		56		34		66		54	

Table A.XLIX. Results by age group to Survey Question 31

Survey Question 31: To your understanding, how often does the project manager communicate with the sponsor?

Frequency	18-29		30-39		40-54		55 and over	
Daily or more often	22	41%	27	36%	45	45%	19	49%
Weekly	14	26%	37	49%	30	30%	9	23%
Monthly	3	6%	2	3%	8	8%	3	8%
Never	0	0%	1	1%	1	1%	0	0%
I do not know	15	28%	8	11%	17	17%	8	21%
Total Responses	54		75		101		39	

Table A.L. Results by division to Survey Question 31

Survey Question 31: To your understanding, how often does the project manager communicate with the sponsor?

Frequency	G20		G30		G60		G70		G80	
Daily or more often	13	27%	35	63%	12	35%	21	31%	27	51%
Weekly	21	43%	15	27%	9	26%	21	31%	23	43%
Monthly	5	10%	3	5%	1	3%	5	7%	2	4%
Never	0	0%	0	0%	2	6%	0	0%	0	0%
I do not know	10	20%	3	5%	10	29%	20	30%	1	2%
Total Responses	49	1	56	1	34	1	67	1	53	0

Table A.LI. Result for Survey Questions 37, 38 and 39

Survey Question 37: I am very familiar with the work my sponsoring organization performs.
Survey Question 38: I have a very good relationship with the POC of my sponsoring organization.
Survey Question 39: The PM of my project has a very good relationship with the POC in the sponsoring organization.

Survey Question	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree	Total Responses
37	68	111	44	26	11	4	1	265
	26%	42%	17%	10%	4%	2%	0%	Mean 5.69
38	71	90	36	51	8	8	2	266
	27%	34%	14%	19%	3%	3%	1%	Mean 5.5
39	75	116	29	39	4	1	0	264
	28%	44%	11%	15%	2%	0%	0%	Mean 5.81

Variable 29 related survey results.

Table A.LII. Results for Survey Question 24

Survey Question 24: Please indicate what organizations your team members belong to. (Select all that apply)

Organization	Responses	
Branch	176	66%
G Department	163	61%
Division	86	32%
Contractor at NSWCDD	85	32%
NSWCDD (other than G Department)	80	30%
Other Government Organization (external to NSWCDD)	77	29%
Contractor external to NSWCDD	66	25%
Other, please specify:	5	2%
Does not apply (answered no to question 2)	0	0%
Number of Participants	267	

Table A.LIII. Results by age group for Survey Question 40

Survey Question 40: I have a very good relationship with all the members of my team.

	18-29		30-39		40-54		55 and over	
Strongly Agree	19	36%	34	46%	24	24%	11	28%
Agree	27	51%	26	35%	54	54%	21	54%
Somewhat Agree	6	11%	11	15%	10	10%	5	13%
Neutral	1	2%	3	4%	10	10%	1	3%
Somewhat Disagree	0	0%	0	0%	0	0%	1	3%
Disagree	0	0%	0	0%	1	1%	0	0%
Strongly Disagree	0	0%	0	0%	1	1%	0	0%
	53		74		100		39	

Table A.LIV. Results by age group for Survey Question 41a

Survey Question 41a: Most of my team members feel free to talk during meetings if they disagree with something being said

	18-29		30-39		40-54		55 and over	
Strongly Agree	19	36%	37	50%	33	33%	16	41%
Agree	23	43%	23	31%	48	48%	18	46%
Somewhat Agree	8	15%	7	9%	7	7%	0	0%
Neutral	2	4%	3	4%	7	7%	1	3%
Somewhat Disagree	1	2%	2	3%	1	1%	2	5%
Disagree	0	0%	1	1%	1	1%	1	3%
Strongly Disagree	0	0%	1	1%	3	3%	1	3%
Total Responses	53		74		100		39	

Table A.LV. Results for Survey Question 41b

41b. On Average, what percentage of the team members talk to make contributions during team meetings?

Contributions	Responses	
>75%	110	41%
50-75%	91	34%
25-50%	45	17%
< 25%	20	8%
Total Responses	266	

Table A.LVI. Results by division for Survey Question 41b

41b. On average, what percentage of the team members talk to make contributions during team meetings?

41B	G20		G30		G60		G70		G80	
< 25%	3	6%	2	4%	5	15%	3	5%	6	11%
25-50%	8	16%	9	16%	4	12%	16	25%	5	9%
50-75%	14	29%	20	36%	12	35%	24	37%	17	32%
>75%	24	49%	24	44%	13	38%	22	34%	25	47%
	49		55		34		65		53	

Table A.LVII. Results by age group for Survey Question 41b

41b. On average, what percentage of the team members talk to make contributions during team meetings?

41B	18-29		30-39		40-54		55 and over	
< 25%	3	6%	1	1%	12	12%	4	10%
25-50%	7	13%	15	20%	17	17%	6	15%
50-75%	26	49%	32	43%	26	26%	7	18%
>75%	17	32%	27	36%	44	44%	22	56%
	53		75		99		39	

Variable 30 related survey results.

Table A.LVIII. Results for Survey Question 23

Survey Question 23: How many members are in your team:

Team Size	Responses	
1	3	1%
2-7	129	48%
8-15	82	31%
16-25	12	4%
> 25	42	16%
Total Responses	268	

Table A.LIX. Results by age group for Survey Question 23

Survey Question 23: How many members are in your team:

Team Size	18-29		30-39		40-54		55 and over	
1	2	4%	0	0%	1	1%	0	0%
2-7	28	52%	31	41%	49	49%	21	54%
8-15	20	37%	26	35%	23	23%	13	33%
16-25	1	2%	2	3%	6	6%	3	8%
> 25	3	6%	16	21%	21	21%	2	5%
Total Responses	54		75		100		39	

Variable 32 related survey results.

Table A.LX. Results for Survey Question 32
Survey Question 32: My team member's roles and responsibilities are clearly defined.

Survey Question	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree	Total Responses
32	57	104	60	20	15	5	6	267
	21%	39%	22%	7%	6%	2%	2%	Mean=5.48

Table A.LXI. Results by age group for Survey Question 32
Survey Question 32: My team member's roles and responsibilities are clearly defined.

	18-29		30-39		40-54		55 and over	
Strongly Agree	6	11%	20	27%	20	20%	11	28%
Agree	19	36%	27	36%	40	40%	18	46%
Somewhat Agree	18	34%	11	15%	25	25%	6	15%
Neutral	2	4%	6	8%	11	11%	1	3%
Somewhat Disagree	6	11%	6	8%	3	3%	0	0%
Disagree	1	2%	1	1%	2	2%	1	3%
Strongly Disagree	1	2%	3	4%	0	0%	2	5%
Total Responses	53		74		101		39	
mean	5.19		5.46		5.56		5.72	

Variable 33 related survey results.

Table A.LXII. Results for Survey Questions 42, 43, and 44

Survey Question 42: All of my team members provide high quality work with minimal supervision.
Survey Question 43: I feel very confident all my team members will complete their tasks in the time agreed.
Survey Question 44: I provide critical and useful feedback to other team members about their work performance.

Survey Question	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree	Total Responses
42	65	102	56	13	15	11	3	265
	25%	38%	21%	5%	6%	4%	1%	mean 5.54
43	60	97	58	19	19	8	4	265
	23%	37%	22%	7%	7%	3%	2%	mean 5.45
44	57	99	53	37	15	3	1	265
	22%	37%	20%	14%	6%	1%	0%	mean 5.50

Table A.LXIII. Results by age group for Survey Question 42

Survey Question 42: All of my team members provide high quality work with minimal supervision.

	18-29		30-39		40-54		55 and over	
Strongly Agree	14	26%	21	28%	22	22%	8	21%
Agree	19	36%	25	34%	39	39%	19	49%
Somewhat Agree	10	19%	18	24%	22	22%	6	15%
Neutral	4	8%	4	5%	5	5%	0	0%
Somewhat Disagree	1	2%	4	5%	7	7%	3	8%
Disagree	5	9%	2	3%	3	3%	1	3%
Strongly Disagree	0	0%	0	0%	1	1%	2	5%
Total Responses	53		74		99		39	
Mean	5.49		5.66		5.52		5.46	

Table A.LXIV. Results by age group for Survey Question 43

Survey Question 43: I feel very confident all my team members will complete their tasks in the time agreed.

	18-29		30-39		40-54		55 and over	
Strongly Agree	14	26%	17	23%	21	21%	8	21%
Agree	18	34%	28	38%	37	37%	14	36%
Somewhat Agree	11	21%	15	20%	22	22%	10	26%
Neutral	3	6%	8	11%	7	7%	1	3%
Somewhat Disagree	5	9%	3	4%	8	8%	3	8%
Disagree	1	2%	3	4%	3	3%	1	3%
Strongly Disagree	1	2%	0	0%	1	1%	2	5%
Total Responses	53		74		99		39	
Mean	5.49		5.53		5.43		5.31	

Table A.LXV. Results by age group for Survey Question 44

Survey Question 44: I provide critical and useful feedback to other team members about their work performance.

	18-29		30-39		40-54		55 and over	
Strongly Agree	8	15%	26	35%	16	16%	7	18%
Agree	14	26%	24	32%	48	48%	13	33%
Somewhat Agree	13	25%	14	19%	19	19%	7	18%
Neutral	12	23%	6	8%	11	11%	8	21%
Somewhat Disagree	3	6%	4	5%	4	4%	4	10%
Disagree	2	4%	0	0%	1	1%	0	0%
Strongly Disagree	1	2%	0	0%	0	0%	0	0%
Total Responses	53		74		99		39	
Mean	5.04		5.84		5.59		5.28	

Variable 34 related survey results.

Table A.LXVI. Results for Survey Questions 45, 46, 47, and 48
Survey Question 44: I provide critical and useful feedback to other team members about their work performance.
Survey Question 45: I provide feedback only when requested.
Survey Question 46: I receive feedback about my performance only when requested. (excluding mid-year and year-end reviews)
Survey Question 47: My team members provide critical and useful feedback about my work performance. (excluding mid-year and year-end reviews)
Survey Question 48: My team members provide critical feedback to other team members about their performance.

Survey Question	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree	Total Responses
44	57	99	53	37	15	3	1	265
	22%	37%	20%	14%	6%	1%	0%	Mean 5.50
45	13	40	43	42	52	55	20	265
	5%	15%	16%	16%	20%	21%	8%	Mean 3.77
46	26	58	45	41	49	38	7	264
	10%	22%	17%	16%	19%	14%	3%	Mean 4.35
47	25	67	53	52	38	21	9	265
	9%	25%	20%	20%	14%	8%	3%	Mean 4.58
48	21	58	54	78	30	19	4	264
	8%	22%	20%	30%	11%	7%	2%	Mean 4.58

Table A.LXVII. Results by age group for Survey Question 45

Survey Question 45: I provide feedback only when requested.

	18-29		30-39		40-54		55 and over	
Strongly Agree	3	6%	5	7%	4	4%	1	3%
Agree	10	19%	9	12%	18	18%	3	8%
Somewhat Agree	15	28%	8	11%	16	16%	4	10%
Neutral	8	15%	14	19%	12	12%	8	21%
Somewhat Disagree	10	19%	14	19%	21	21%	7	18%
Disagree	5	9%	19	26%	19	19%	12	31%
Strongly Disagree	2	4%	5	7%	9	9%	4	10%
Total Responses	53		74		99		39	
Mean	4.34		3.65		3.78		3.23	

Table A.LXVIII. Results by age group for Survey Question 46

Survey Question 46: I receive feedback about my performance only when requested. (excluding mid-year and year-end reviews)

	18-29		30-39		40-54		55 and over	
Strongly Agree	5	9%	9	12%	9	9%	3	8%
Agree	9	17%	16	22%	24	24%	9	23%
Somewhat Agree	15	28%	11	15%	14	14%	5	13%
Neutral	6	11%	9	12%	19	19%	7	18%
Somewhat Disagree	10	19%	17	23%	16	16%	6	15%
Disagree	8	15%	10	14%	13	13%	7	18%
Strongly Disagree	0	0%	2	3%	3	3%	2	5%
Total Responses	53		74		98		39	
Mean	4.42		4.36		4.39		4.15	

Table A.LXIX. Results by age group for Survey Question 47

Survey Question 47: My team members provide critical and useful feedback about my work performance. (excluding mid-year and year-end reviews)

	18-29		30-39		40-54		55 and over	
Strongly Agree	5	9%	11	15%	7	7%	2	5%
Agree	18	34%	16	22%	23	23%	10	26%
Somewhat Agree	12	23%	16	22%	17	17%	8	21%
Neutral	6	11%	13	18%	25	25%	8	21%
Somewhat Disagree	6	11%	13	18%	16	16%	3	8%
Disagree	4	8%	3	4%	10	10%	4	10%
Strongly Disagree	2	4%	2	3%	1	1%	4	10%
Total Responses	53		74		99		39	
Mean	4.81		4.76		4.45		4.28	

Table A.LXX. Mean comparison by age group for Survey Questions 44, 47 and 48

	18-29	30-39	40-54	55 and over
Mean 44	5.04	5.84	5.59	5.28
Mean 47	4.81	4.76	4.45	4.28
Mean 48	4.74	4.65	4.56	4.28

Table A.LXXI. Results by age group for Survey Question 48

Survey Question 48: My team members provide critical feedback to other team members about their performance.

	18-29		30-39		40-54		55 and over	
Strongly Agree	5	9%	8	11%	6	6%	2	5%
Agree	14	26%	14	19%	22	22%	8	21%
Somewhat Agree	13	25%	19	26%	17	17%	5	13%
Neutral	10	19%	17	23%	36	37%	15	38%
Somewhat Disagree	5	9%	11	15%	10	10%	4	10%
Disagree	6	11%	3	4%	7	7%	3	8%
Strongly Disagree	0	0%	2	3%	0	0%	2	5%
Total Responses	53		74		98		39	
Mean	4.74		4.65		4.56		4.28	

Variable 35 related survey results.

Table A.LXXII. Results for Survey Question 49

Survey Question 49: Having team members participating in telework has NOT affected the performance of my team.

Survey Question	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree	N/A	Total Responses
49	71	77	22	33	10	13	8	29	263
	27%	29%	8%	13%	4%	5%	3%	11%	Mean 5.41

Table A.LXXIII. Results by age group to Survey Question 49

Survey Question 49: Having team members participating in telework has NOT affected the performance of my team.

	18-29		30-39		40-54		55 and over	
Strongly Agree	16	31%	22	30%	24	24%	9	24%
Agree	15	29%	22	30%	31	31%	9	24%
Somewhat Agree	5	10%	7	9%	6	6%	4	11%
Neutral	6	12%	10	14%	14	14%	3	8%
Somewhat Disagree	3	6%	2	3%	2	2%	3	8%
Disagree	2	4%	3	4%	5	5%	3	8%
Strongly Disagree	0	0%	1	1%	4	4%	3	8%
Not Applicable	5	10%	7	9%	13	13%	4	11%
Total Responses	52		74		99		38	
Mean	5.62		5.58		5.35		4.91	

Variable 36 related survey results.

Table A.LXXIV. Result for Survey Questions 50 and 51

Survey Question 50: Having a mentor within my branch has been very beneficial in my professional development.

Survey Question 51: Having a mentor within my division has been very beneficial in my professional development.

Survey Question	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree	N/A	Total Responses
50	56	42	19	37	10	2	2	95	263
	21%	16%	7%	14%	4%	1%	1%	36%	Mean 5.49
51	42	29	17	57	5	7	5	101	263
	16%	11%	6%	22%	2%	3%	2%	38%	Mean 5.03

Table A.LXXV. Result by age group for Survey Questions 50

	18-29		30-39		40-54		55 and over	
Strongly Agree	19	37%	24	32%	10	10%	3	8%
Agree	8	15%	10	14%	21	21%	3	8%
Somewhat Agree	5	10%	4	5%	8	8%	2	5%
Neutral	7	13%	8	11%	16	16%	6	16%
Somewhat Disagree	1	2%	3	4%	2	2%	4	11%
Disagree	0	0%	1	1%	0	0%	1	3%
Strongly Disagree	0	0%	1	1%	1	1%	0	0%
Not Applicable	12	23%	23	31%	41	41%	19	50%
mean	5.93		5.73		5.29		4.58	

Table A.LXXVI. Result by age group for Survey Questions 51

	18-29		30-39		40-54		55 and over	
Strongly Agree	13	25%	17	23%	9	9%	3	8%
Agree	5	10%	8	11%	15	15%	1	3%
Somewhat Agree	4	8%	5	7%	8	8%	0	0%
Neutral	12	23%	12	16%	22	22%	11	29%
Somewhat Disagree	0	0%	2	3%	1	1%	2	5%
Disagree	2	4%	2	3%	1	1%	2	5%
Strongly Disagree	0	0%	3	4%	2	2%	0	0%
Not Applicable	16	31%	25	34%	41	41%	19	50%
mean	5.36		5.16		4.97		4.26	

Table A.LXXVII. Results for Survey Questions 52, 53, 54 and 55

Survey Question 52: I consciously make an effort to share my knowledge with others in my team.

Survey Question 53: I am unable to share my knowledge with members of my team because I do not have time.

Survey Question 54: I like to share my knowledge with members of my team but I feel they are not interested in what I have to say.

Survey Question 55: If I were to retire or move to another position in the next two years, the time I have spent transferring knowledge to others has been adequate to ensure that my key experience is retained within the organization.

Survey Question	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree	Total Responses
52	108	108	35	10	3	1	0	265
	41%	41%	13%	4%	1%	0%	0%	Mean 6.15
53	6	12	32	29	46	82	57	264
	2%	5%	12%	11%	17%	31%	22%	Mean 2.83
54	13	9	26	38	45	98	36	265
	5%	3%	10%	14%	17%	37%	14%	Mean 3.00
55	25	54	59	42	41	24	19	264
	9%	20%	22%	16%	16%	9%	7%	Mean 4.36

Table A.LXXVIII. Results by age group for Survey Question 55

Survey Question 55: If I were to retire or move to another position in the next two years, the time I have spent transferring knowledge to others has been adequate to ensure that my key experience is retained within the organization.

	18-29		30-39		40-54		55 and over	
Strongly Agree	2	4%	14	19%	6	6%	3	8%
Agree	12	23%	11	15%	20	20%	11	28%
Somewhat Agree	12	23%	17	23%	23	23%	7	18%
Neutral	10	19%	8	11%	20	20%	4	10%
Somewhat Disagree	10	19%	15	21%	13	13%	3	8%
Disagree	3	6%	6	8%	8	8%	7	18%
Strongly Disagree	4	8%	2	3%	9	9%	4	10%
Total Responses	53		73		99		39	
Mean	4.26		4.66		4.25		4.23	

10.3 Letter of Approval to Conduct Study in G Department

DEPARTMENT OF THE NAVY
NAVAL SURFACE WARFARE CENTER
DAHLGREN DIVISION
6440 WELSH ROAD SUITE 300
DAHLGREN VIRGINIA 22448-5130

IN REPLY REFER TO
12000
Ser G31/002
MAR 2 7 2012

From: Commander, Dahlgren Division, Naval Surface Warfare Center
To: Old Dominion University, Department of Engineering
Management & Systems Engineering (Rafael E. Landaeta,
Associate Professor), 241 Kaufman Hall, Norfolk, VA 23529

Subj: LETTER OF APPROVAL TO CONDUCT STUDY

1. The purpose of this letter is to authorize Luis J. Rodriguez to
conduct his Doctor of Engineering Project Study, "Naval Surface
Warfare Center Dahlgren Division Engagement Systems (G) Department
Development of a Plan to Maintain, Expand, and Create Corporate
Knowledge," in the Engagement Systems Department. The study will
include:

    a. Survey - the survey will be administered to all G
Department employees. G Department will allow the subjects to
complete the survey during working hours.

    b. Interviews - subjects are G Department line managers or
Knowledge Management Systems managers. G Department will allow
subjects to participate in the study during working hours.

2. Questions may be addressed to Mr. Luis Rodriguez, 540-284-0687,
18106 Phalanx Drive, Suite 220, Dahlgren, VA 22485-5123.

MICHAEL A. TILL
By direction

10.4   NSWCDD IRB Consent to Conduct Study in G Department

From: Simulcik, Michael J CIV NSWCDD, CX8
To: Rodriguez, Luis J CIV NSWCDD, G31
Cc: Regan, Allyson A CIV NSWCDD, CXP
Subject: RE: Rodriguez Study IRB Approval
Date: Wednesday, March 21, 2012 14:11:22

Luis,

Thanks for the information provided. As stated in our conversation, you are working under ODU's IRB, who has a DoD Navy Addendum. I see no issues/concerns in regards to NSWCDD's IRB.
Please feel free to proceed with your work.

Good luck.

r/
Mike

Mike Simulcik, CIH
NSWCDD-CX8
17483 Dahlgren Rd Suite 104
Dahlgren, VA 22448-5119
Phone: 540-653-2036
Mobile: 540-376-2777
Fax: 540-653-7965

-----Original Message-----
From: Rodriguez, Luis J CIV NSWCDL, G31
Sent: Tuesday, March 20, 2012 12:55
To: Simulcik, Michael J CIV NSWCDD, CX8
Cc: Regan, Allyson A CIV NSWCDD, CXPL
Subject: Rodriguez_Study_IRB Approval
Importance: High

Mr. Simulcik,

With this e-mail I seek to obtain NSWCDD IRB approval, if necessary, to conduct a study in G department. I have G department approval, currently a letter of approval is in the line management signature process for written evidence. This study will only to be conducted in G department to government civilians 18 years old or older. Also, I'm coordinating with Ms. Allyson Regan to crate and conduct the survey online using ActiveSurvey by Allegiance. The data collection is expected to start in April 2012.

I obtained approval from Old Dominion University (ODU) IRB to conduct the study. Please find attached all the documents submitted to the ODU IRB. The statement below was extracted from the email attached, were Dr. George Maihafer indicates my project was approved by the ODU IRB; all the required revisions have been made.

"14.   Rafael Landaeta's proposal, "NSWCDD Engagement Systems Department (G) Development for a Plan to Maintain, Expand, and Create Corporate Knowledge", (ODU IRB # 12-020), Department of Engineering Management, Frank Batten College of Engineering and Technology was approved as amended (6-0) with the following revisions required:"

Please let me know if you need any further information or clarification. Thanks for your time.

Respectfully,

11.VITA

Luis J. Rodriguez

- **Education**

  Master of Engineering Management (M.E.M.), Old Dominion University, 2008, Norfolk, VA

  B.S., Mechanical Engineering, University of Puerto Rico, Mayagüez Campus, 2004, Mayagüez, PR

- **Work Experience**

  Lead Engineer (2004 to present)
  Naval Surface Warfare Center Dahlgren Division, Dahlgren, VA
  - Managed technical projects including budgeting, task planning, tracking and execution, and resource management.

- **Training and Certifications**

  - Systems Planning, Research, Development and Engineering Level III certified, Defense Acquisition University
  - Passed the Fundamentals of Engineering (FE) exam (2004)

- **Technical Reports**

  - Rodriguez et al. (2012), NSWCDD/TR-12/253 "Test Report for EFSS M1103 120mm Smoke Cartridge Temperature Analysis for Safe Firing Procedures"

  - Rodriguez et al. (2006), NSWCDD/MP-06/10 *"Reconfigurable Target System"*

- **Patents**

  - (pending) Co-inventor in two patent applications Navy Case 101243 and 101244: (1) Fixed Optic for Boresight (FOB) and (2) the Boresight Verification Device (BVD) respectively. (2011)

- **Publications and Presentations**

  - Rodriguez, L.J. (2012), "Conceptual Model for the Development of a Plan to Maintain, Expand, and Create Corporate Knowledge in a Technical Organization", *Proceedings of the International Annual Conference of the American Society for Engineering Management*

  - Rodriguez, L.J. (2007), "Minor Caliber Insensitive Munitions Reaction Mitigation Implementation", *National Defense Industrial Association Insensitive Munitions and Energetic Materials Symposium, October, Miami, FL*

- **Presentations**

  - **"Container Modifications For The 120MM HE Mortar Ammunition To Improve Reactions When Subjected To The Fast Cook Off Test"**
    National Defense Industrial Association Insensitive Munitions and Energetic Materials Symposium
    October 2010 Munich, Germany