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An Analysis of Factors Affecting the Effective Use of Knowledge Management in Counter Improvised Explosive Device (C-IED) Operations

Umit Gencer
Old Dominion University

AN ANALYSIS OF FACTORS AFFECTING THE EFFECTIVE USE OF KNOWLEDGE MANAGEMENT IN COUNTER IMPROVISED EXPLOSIVE DEVICE (C-IED) OPERATIONS

by

Umit Gencer
B.S. August 1997, Military Academy, Turkey
M.S. March 2002, Naval Postgraduate School
M.A. July 2007, Army War College, Turkey

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Approved by:

Rafael E. Landaeta (Director)

Resit Unal (Member)

Ariel Pinto (Member)

Gokay Sursal (Member)

ABSTRACT

AN ANALYSIS OF FACTORS AFFECTING THE EFFECTIVE USE OF KNOWLEDGE MANAGEMENT IN COUNTER IMPROVISED EXPLOSIVE DEVICE (C-IED) OPERATIONS

Umit Gencer
Old Dominion University, 2012
Director: Dr. Rafael E. Landaeta

This dissertation investigates factors that influence effective use of Knowledge Management (KM) in Counter Improvised Explosive Device (C-IED) operations in the military.

The study suggests that effective KM program is determined by the interaction of three organizational capabilities: knowledge infrastructure, knowledge process, and leadership orientation.

A self-administrated survey was conducted on 300 NATO staff officers who have served in C-IED environments. A structural equation modeling technique was used to test a set of hypotheses using 118 completed responses collected from the survey.

The results suggest that out of the 11 constructs within the model; two are rated as `attribute needs immediate attention` (i.e. Culture and Traditional Leadership Capability), eight are rated as `attribute needs further enhancement` (i.e. Overall Organizational Capability, Knowledge Process, Knowledge Infrastructure, Acquisition, Transfer, Application, Structure and Transformational Leadership Capability) and one is rated as `attribute runs satisfactorily` (i.e. Technology).

Additionally, the study identified a set of factors that military leaders and commanders should consider before undertaking any KM programs. The results of this

research have particular value to engineering management researchers and practitioners operating in military domains because it proposes, empirically tests and justifies a conceptual model that explains KM in C-IED operations in the US military.

This dissertation is dedicated to my late father, Rahmi Gençer.
I know he would be proud!

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There are many people who have contributed to the successful completion of this dissertation.

First of all, I extend many, many thanks to my committee members, Dr. Sürsal, Dr. Pinto and Dr. Ünal for their patience and time. I thank my major advisor, Dr. Landaeta, whose untiring efforts deserves special recognition. Without his expertise and guidance, this dissertation would not have been completed.

I would especially like to thank my lovely wife, Banu, who has passionately supported and encouraged me without `ever` complaining. Within my 3 years of Ph.D. endeavor, she gave me a wonderful gift, my daughter, Zeynep Tuğba, and hopefully she will give me a second one, my graduation gift, my second son, right after the commencement ceremony.

Rahmi Fırat, my first son, sorry for not having played with you as much as I wanted. I hope I can make it up to you some day and I hope my perseverance in my study encourages you in your school life in the future; "No Pain, No Gain!"

I appreciate my loving mother's prayers and never-ending love and support throughout this endeavor.

I cannot thank my mother-in-law enough. She has been with us during my study and my wife's pregnancies. Without her, it would not have been possible to complete my chapters on time.

I am also so much obliged to my dearest friend and colleague, Doğan Öztürk, he has always been there for me and has motivated me continuously during our long, sleepless studies.

Last but absolutely not the least; I thank Turkish Armed Forces for granting me this opportunity to pursue Ph.D. degree so that I can better serve my country.

LIST OF ACRONYMS AND ABBREVIATIONS

AKO	Army Knowledge Online
C-IED	Counter Improvised Explosive Device
CJCS	Combined Joined Chief of Staffs
CoP	Community of Practice
DoD	Department of Defence
DON	Department of the Navy
HQ	Headquarter
IM	Information Management
IT	Information Technology
JIEDDO	Joint Improvised Explosive Device Defeat Organization
JKnIFE	JIEDDO Knowledge and Information Fusion Exchange
KM	Knowledge Management
KMT	Knowledge Management Technologies
NUPAN	NATO Unclassified Public Access Network
TRADOC	Training and Doctrine Command
TTP	Tactics, Techniques and Procedures

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CHAPTER 1

1. INTRODUCTION

"This is not a new war. Our enemies have been waging it for some time, and it will continue for the foreseeable future. As President Bush has stated, 'This is a different kind of war against a different kind of enemy.' It is a war we must win, a war for our very way of life."

General Peter J. Schoomaker,
Chief of Staff of the Army
Arrival Message, 1 August 2003

1.1 Background of the Study

"Drowning in information but starved for knowledge" (Naisbitt, 1984, p.17) is the plight of many of today's public and private organizations. Being one of the largest public organizations, military is not an exception. As society has transformed from the Industrial Age to the Knowledge Age, the evolution of computing technology has changed the landscape of the modern world and workplace. Unprecedented advances in information technology have allowed organizations to increase productivity, reduce cycle times, and expand operations. Simultaneously, however, this same technology has contributed to a proliferation of information that threatens to overwhelm humans. What has resulted is an increased awareness that it is "knowledge" and not "information" or "data" that is key to future organization success and innovation (Amidon, 1997).

1.1.1 The New Military Order

The need for agility, learning to create a capacity to adapt (on the personal and organizational level) is core characteristic of 21st century military operations (Ariely, 2006). The complexities of the operational environment require quantum leap abilities to adapt quickly, in an asymmetric, "flat" world (Friedman, 2005).

Complexity is extrapolated when militaries (which were tasked in the past with clear missions and adversaries, and clear alliances, like NATO) now needs to act in a spectrum of operations from epidemics or nature-disasters or Counter-Insurgency and Countering Improvised Explosive Device, yet remain capable to defend nations through maneuver warfare (Ariely, 2008).

All these demand a spectrum of competencies and capabilities which cannot be acquired by any single organization. This requires a new paradigm regarding knowledge and managing it.

1.1.2 The Improvised Explosive Device (IED) Challenge and US Response

The proliferation of Improvised Explosive Devices (IEDs) on the battlefield in both Iraq and Afghanistan has posed the most pervasive threat facing coalition forces in those theaters (Atkins, 2007). The persistent effectiveness of this threat has influenced unit operations, countries' policies, and public perception (Wilson, 2007). With the development of sufficiently powerful, stable, and accessible explosives, a preferred weapon of a terrorist is a bomb or IED. As a weapon, bombs are efficient as they allow a person or group to strike with great destructive effect. The sophistication of the device depends on the maker. They can range from being very simple to very complex with booby traps, anti-handling devices, and sophisticated electronic initiation devices to prevent disarming.

The IED has rapidly become the weapon of choice for the world's terrorist, insurgent, and criminal organizations. It is cheap, easy to construct, and can be emplaced (or driven) almost anywhere. It can be readily adapted to fit a wide variety of

circumstances and potential targets. With a sufficiently motivated adversary, the IED has evolved into an extremely sophisticated weapon. As US and coalition forces learn to counter various types of IEDs, insurgents adapt, create more sophisticated and different devices, and change their employment of Tactics, Techniques and Procedures (TTP) (Figure 1).

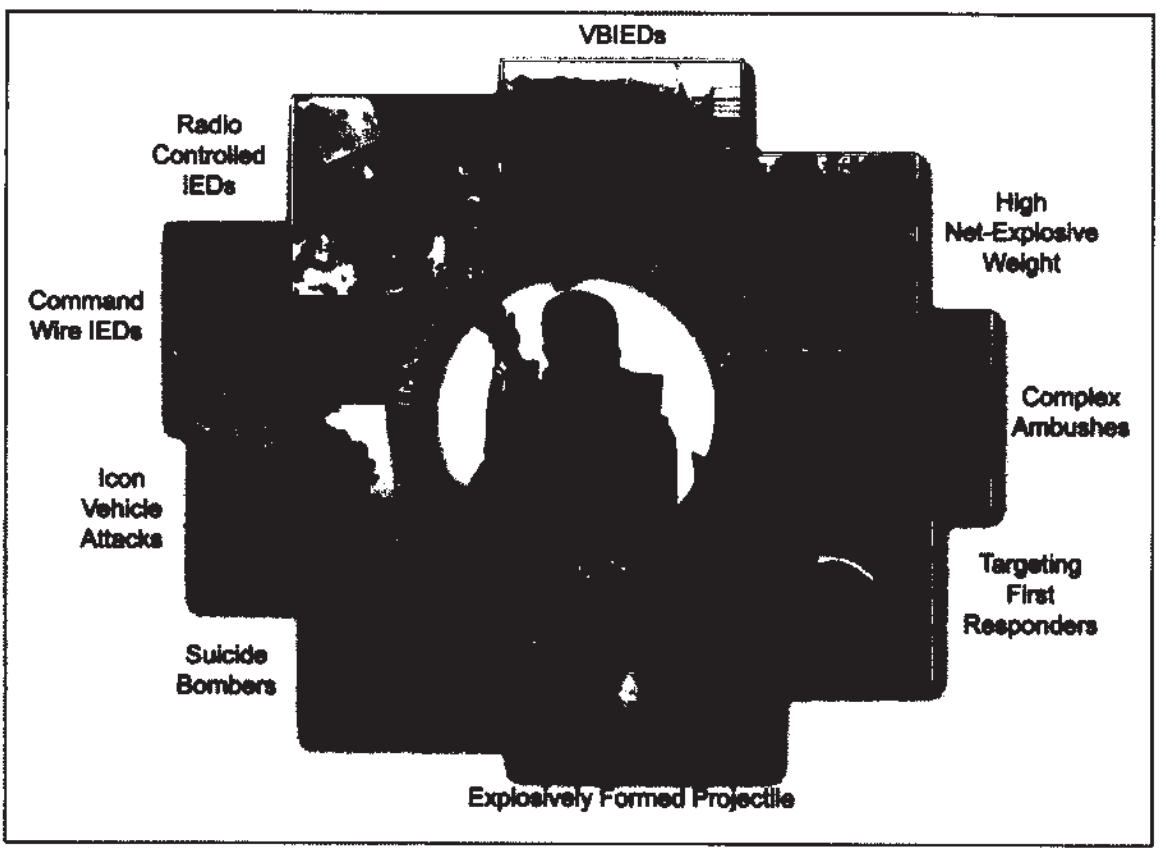

Figure 1. An Innovative, Agile, and Ruthless Enemy (Adapted from USJFCOM CIED, 2009)

The modern insurgents realize they do not possess the personnel, resources, or firepower to engage US or coalition forces in a more direct manner. Therefore, the adversary must adapt engagement criteria and employ asymmetric means, such as IEDs,

to "level the playing field," causing US and coalition forces casualties and increasing insurgent survivability (Hammes, 2005, p.23).

Improvised explosive devices have caused over 60% of all American combat casualties in Iraq and 50% of combat casualties in Afghanistan, both killed and wounded (DMDC Report, 2010).

The US Department of Defense, which has the largest contribution to NATO and Coalition Forces, is actively and aggressively searching for ways to defeat the IED. The United States government is spending billions of dollars searching for ways to defeat the insurgent's weapon of choice (Levine, 2006). The military's research and development assets, industry, and academia are all actively engaged in developing ways to mitigate the effects of this often simple and destructive weapon system.

In order to combat this, the U.S Department of Defense (DOD) established the Joint IED Defeat Organization (JIEDDO) to investigate countermeasures and to reduce the IED threat (Levine, 2006). It is essentially a Knowledge Management organization tasked to create a consistent framework so war fighters can innovate, evaluate alternate courses of actions within context of local conditions, and act agile, quickly and decisively. Most importantly, this KM organization will help preserve tacit and explicit knowledge and accelerate learning as units and personnel rotate in and out of theaters or organizations.

It also serves as grist for revised doctrine. Additionally, its Knowledge Management programs anchor knowledge management efforts as all-service-wide enterprise function. For example, if the 2nd Brigade Combat Team of 10th Mountain Division discovers new ways in which insurgents are triggering and deploying IEDs in

Afghanistan that the context-specific tacit and explicit knowledge is shared with soldiers and marines in Iraq, Philippines, Djibouti, Colombia and with soldiers in the U.S who will soon deploy (AKM Manual, 2005).

1.2 Statement of the Problem

IEDs are a weapon of choice and are likely to remain a major component of the Global War on Terrorism for the foreseeable future (Wilson, 2007).

As US and Coalition Forces learn to counter various types of IEDs, insurgents adapt, create more sophisticated and different devices, and change their employment of TTP. Thus, due to uncertainties and rapidly changing IED challenge, those who innovate, learn, rapidly adapt, and act decisively will prevail against adversaries and IEDs in C-IED environments.

Additionally, since the number one priority of the US Armed Forces is counterterrorism and specifically C-IED (Plummer, 2005), it is critical that gaps in knowledge transfer and training are quickly addressed in order to more effectively equip personnel to meet and counter IED threat. Ignoring these gaps has the potential to cause very negative implications on our forces. As terrorists continue to train daily to bring catastrophic harm to United States and Coalition Forces' citizens and interests worldwide, the US can no longer afford to be plagued by "recreating the wheel" (Nissen, 2006). Lessons learned through both formalized training and on-the-job experience must be quickly leveraged to aid broader sectors of the Armed Forces and partner communities in order to promote streamlined operations in combating IED while countering inefficient

knowledge management. Failing to achieve this goal makes US Armed Force efforts less effective.

As a result, the military must analyze the current KM programs in C-IED arena in order to maximize transfer of knowledge derived from experience and skill to staffs and finally to commanders.

1.3 Purpose of the Study

The purpose of this dissertation is to assess current KM practices across the DoD, especially in C-IED arena and ultimately to provide a definitional and empirical context for assessing key factors, that is, organizational capabilities that directly affect the military's impetus towards successful knowledge management. The aim is to determine the relationships amongst people, technology, processes and organization structure that may act as enablers/barriers to successful KM implementation in the military.

1.4 Research Questions

The main questions for this research are stated below. The questions are further refined through sub-questions.

1. What are key organizational capabilities for effective use of KM in military (especially in C-IED operations)?

2. How are these capabilities manifested for effective use of KM in C-IED environment?

3. How does the management (leadership) capability affect the use of KM in C-IED Operations?

The following research sub-questions are necessary in order to answer the above listed research questions:

IQ1: What is KM?

IQ2: Who has developed KM programs within DoD?

IQ3: How well does the military employ Knowledge Management in C-IED operations?

IQ4: What are the barriers and key enablers in KM areas?

IQ5: How does the military better utilize his KM programs to prepare more adequately a larger percentage of its workforce to address the C-IED threat?

1.5 Significance of the Study

With limited literature regarding the infusion of knowledge in the C-IED arena, this dissertation will propose a framework for identifying key factors that are necessary for successful implementation of KM program in C-IED environment in the military.

While this research is greatly aimed at strengthening the knowledge base within the US Armed Forces, it is only one stepping stone in a continuous effort to build capacities and partnerships to more effectively combat and dismantle the IED threat. As the C-IED arena is ever changing, it will be a good reference that documents existing material, offers viable solutions within the current environment, and provides a foundation for further research needed to meet evolving threats.

1.6 Research Contribution

The most significant contribution of this study is that it provides an understanding of factors that determine the effective use of KM program in C-IED environment in the military. Thus, this work enhances our understanding of knowledge management organizational capabilities. The findings of this work provide a context for development of new theories as well as a roadmap for military leaders seeking to develop organizational capabilities for effective knowledge management. Additionally, it analyzes the effect of leadership capability on the use of KM programs by dividing the leadership capabilities into two leadership styles (transformational and traditional leadership).

Finally, the study provides a checklist so that related military organization will be able to perform a self-check to determine the existing perception of KM program within the organization. The results will be able to help them to ensure essential factors are functioning as planned and to investigate any gaps that may exist between desired result and actual outcome.

This study is, to the best of researcher's knowledge, among the first empirical work to specifically examine the relationship between knowledge infrastructures, knowledge process and leadership capability for effective use of KM in C-IED arena in the military.

1.7 Research Methodology

The military environment was selected for two primary reasons; first of all, the author himself has been in this environment for more than fifteen years. He, on a first

hand, has experienced a couple of cases that closely match with the researches made in the C-IED environment.

Secondly, substantial literature exists in the knowledge management, yet the application of this literature within the military and particularly in C-IED arena remains largely new and unsubstantiated. Synthesizing this literature as it relates to C-IED efforts within the military, to identify and address existing gaps, will help maximize preparedness to effectively counter the threat.

This dissertation used data collected from a survey developed to identify effective use of KM programs in C-IED operations. Contributors were asked to indicate their opinions about their experience on a 7-point Likert scale about current status of KM program and its effectiveness.

1.8 High-Level Methodology

Research should address substantive issues (Punch, 2003). Research begins by addressing "what needs to be found" before addressing "how it should be accomplished." With this mindset, this research takes a top-down approach that moves from a general research question to evaluation of results (Creswell, 2003).

The methodology proceeds as follows:

1. Define the research problem and translate the problem into questions that are relevant to the military, the profession, and academia.

2. Understand the literature and determine what literature is needed to answer the research questions.

3. Generate ideas and develop conceptual models to address the research questions.

4. Develop and define the scope of the research to establish achievable research goals that address the needs of academia and practitioners.

5. Operationalize the research by defining the details of the research methodology. Determine the measures and measurement tools to achieve content and face validity.

6. Design the data-collection instrument by evaluating previous research and extend and improve previous research, while increasing content validity and face validity.

7. Implement the data collection plan on a selected sample developed during step 5.

8. Analyze the data using descriptive and inferential statistics.

9. Interpret and discuss the results of the analysis and generate research findings.

10. Produce the final report that states how the research results address the research question and recommend areas for future research.

The methodology is very similar to the social science research process proposed by Miller and Salkind (2002). A high level map of the research is shown in Figure 3.

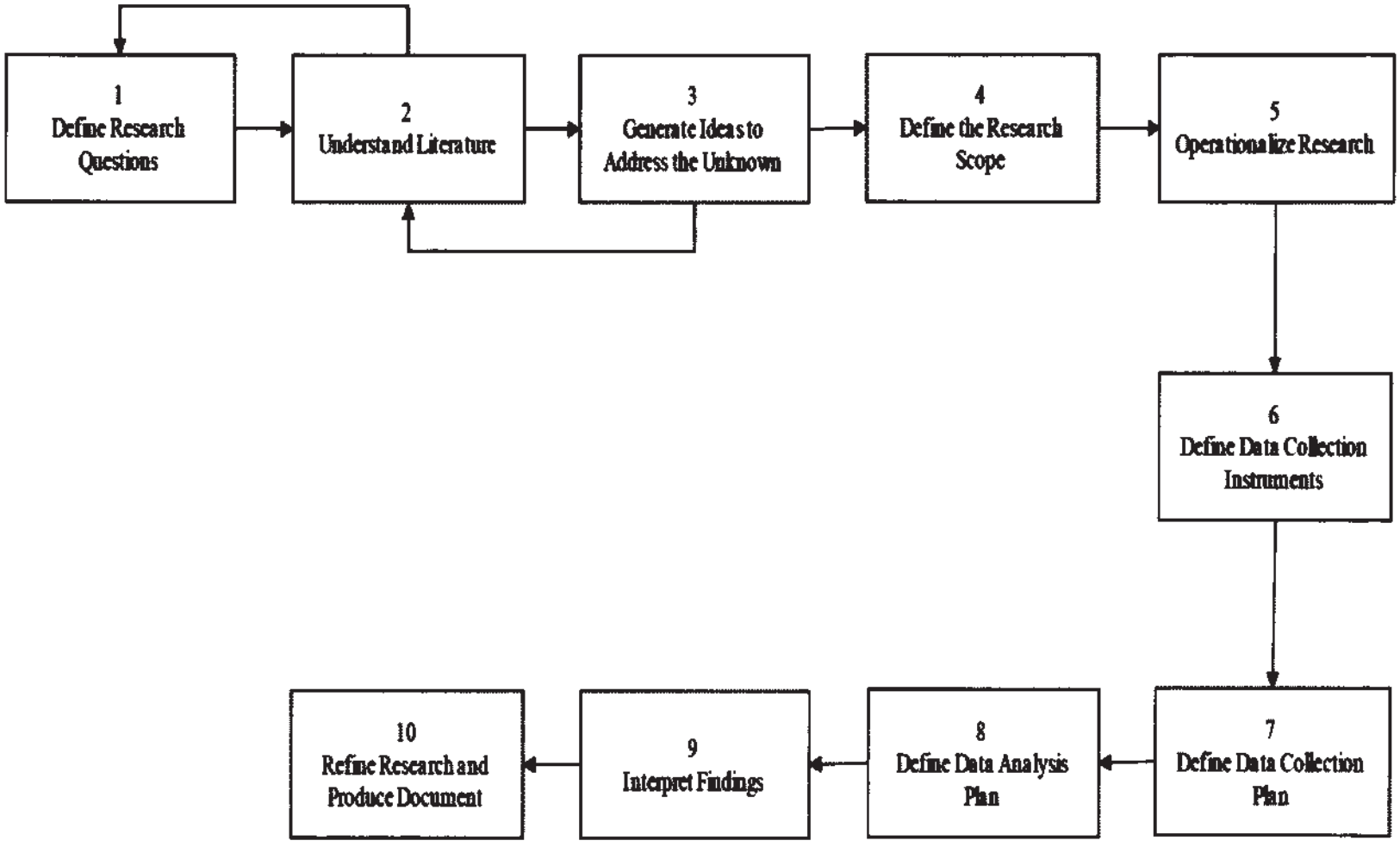

Figure 2. High-Level Methodology (Miller & Salkind, 2002)

1.9 Limitations

KM is implemented in a variety ways. Each organization's especially military implementation of a KM program is unique. The acceptance and use of KM tools and practices varies depending on the people involved. Thus, the findings may not be generalizable to other organizations.

Additionally, there is also the danger of having missing an important dimension of KM implementation in C-IED environment in the military that will not be captured by the survey instrument. The hypothesized model had only a selected number of variables and does not claim that all variables that affect KM implementation have been incorporated in the research model. The hypotheses tested in this study should be considered as tentative with the aim of presenting a conceptual model for the determinants of successful KM implementation in the military.

1.10 Organization of the Remainder of the Study

This dissertation is divided into five chapters including the introduction. So far, the introduction section has been provided in Chapter 1. The introduction contained a specific statement of purpose and identified specific research questions as they relate to the broader research questions of KM in military and C-IED environment.

Chapter 2 gives the summary of the literature relating to KM concepts and theories. This literature review is intended to point to possible deficiencies or gaps and areas for future research.

Chapter 3 includes methodological issues relating to the collection of information as well as those chosen models for the assessment of KM practices.

Chapter 4 deals with the processing of data and analysis of results for each of the hypotheses.

Chapter 5 presents a brief reflection on the main conclusions and recommendations, as well as limitations and some suggestions for future research.

Finally, for the sake of simplicity, rather than providing all the literature consulted, only studies that are directly related with the research has been selected and put in the references.

1.11 Definitions of Key Terms

Definitions of key terms used in this study are provided in this section. Several are unique to the environment in which this research was conducted, while others have multiple meanings, depending on the context in which they are used. The following are key terms and abbreviations that appear frequently in this study. An understanding of the intended meaning in the context of this study and of the environment that provides the context will greatly assist in understanding specific portions of the study and the study as a whole. In some cases, expanded definitions are discussed in Chapter 2, Literature Review.

Knowledge. Knowledge is defined differently in the literature. Knowledge is often differentiated from information and data. Knowledge is seen as personalized and context specific (Alavi &Leidner, 2001). Knowledge is the justified belief that increases an entity's capacity for effective action (Nonaka, 1994).

Knowledge Management. Knowledge management can be defined as the processes, tools, and techniques that make available the right knowledge to the right knowledge worker, at the right time (Landaeta, Pinto & Kotnour, 2009).

Explicit knowledge. Nonaka (1991) describes explicit knowledge as methodical, structured, and tangible which makes it easily communicated and shared because it exists in the form of books, publications, and other various hard and soft documents. Such explication of knowledge transforms knowledge to information.

Tacit knowledge. Tacit knowledge is more difficult to communicate and share because it is "highly personal and hard to formalized" (Nonaka, 1991). Nonaka (1991) further explained that tacit knowledge is ingrained into an individual's behavior, skills, and profession. As a result, tacit knowledge is difficult to identify and extract because it is "deeply rooted" in a person's "know-how" (Nonaka, 1991). Nonetheless, Davenport and Prusak (1998) assert that tacit and explicit knowledge are obtained and transferred through various channels such as casual conversation, person-to-person contacts, structured media, and business processes.

Organizational Capabilities. Organizational Capabilities have been defined as internal structures and processes that can be the source of a competitive advantage and most importantly, capabilities have been conceptualized as preconditions for effective knowledge management (Leonard-Barton, 1998; Vijayan, 2009; Von Krogh, 1998). The literature provides three capabilities within the knowledge management framework: leadership (management) capability, KM processes and KM infrastructure capability.

Knowledge Management Infrastructure Capabilities. Three key capabilities arise from the literature: *technology, structure and culture*.

- The *technology* within an organization determines how knowledge flows and is accessed (Leonard-Barton, 1998).
- *Structural capability* consists of the formal organizational structure. i.e. rules, policies, procedures, processes, hierarchical relationships, incentive systems and service boundaries that organize tasks within the military (Debowski, 2006).
- The *culture* capability also has multiple dimensions: the organization stresses the value of knowledge, the importance of interactions, conveys a clear vision and objectives and indicates that management is clearly supportive of knowledge related activities (Chang, Hung, Yen, & Tseng, 2009).

Knowledge Management Process Capabilities. The literature review provides three key capabilities as process capabilities; acquisition, transfer and application.

- *Acquisition* processes consist of multiple processes for generating new knowledge from existing knowledge, acquiring knowledge about products services, competition in the industry and identifying best practices or establishing benchmarks (Chaston, 2004).
- *Transfer* processes deal with making knowledge usable and consist of organizing, structuring, combining, integrating and identifying key sources of knowledge and filtering unimportant and replacing outdated knowledge (Lee &Yang, 2000).

- Application processes consist of applying organizational knowledge to learn from mistakes, solve problems, improve efficiency and deal with changing competitive needs (Takeuchi & Nonaka, 2004).

Transformational Leadership (Management). Transformational leadership lays the foundation for the development of organizational transformational culture that encourages knowledge exchange and innovation by having the proper reward structure and encouraging staff to experiment (Nissen, 2006).

Traditional (Conventional) Leadership (Management). Traditional leadership practiced in military is more top-down command and control. The reward system is based on compliance and efficient use of resources (McGrath & MacMillan, 2000).

Effectiveness. Effectiveness provides a measure of "how well" a system is performing usually in relation to a goal or a benchmark. In collaboration systems it generally addresses the value and accessibility of the content of a system. In most cases only the users of the system can ultimately determine or estimate its effectiveness (AR 25-1, 2005).

Component. One of the subordinate organizations that constitute a joint force. Normally a joint force is organized with a combination of Service and functional components (JP 1-02, 2004).

Joint. This term refers to "activities, operations, organizations, etc., in which elements of two or more Military Departments participate" (JP 1-02, 2004, p.25). An organization composed of Navy and Marine elements is not considered a joint organization, as they both come from the Department of the Navy.

Service Component Command. A command consisting of the Service component commander and all those Service forces, such as individuals, units, detachments, organizations, and installations under that command, including the support forces that have been assigned to a combatant command or further assigned to a subordinate unified command or joint task force.

Improvised Explosive Device. A device placed or fabricated in an improvised manner incorporating destructive, lethal, noxious, pyrotechnic, or incendiary chemicals and designed to destroy, incapacitate, harass or distract. It may incorporate military stores, but is normally devised from non-military components (JIEDDO Lexicon, 2007).

CHAPTER 2

2. LITERATURE REVIEW

Reviewing the collective knowledge about a situation is an important step in the early part of a research (Neuman, 2003). The literature review brings clarity to the research, and shows traces of issues and theory evolution of the research (Neuman, 2003).

Online and traditional sources supported the research into the literature. For the search included and used scholarly books, refereed journal articles, and research documents through library internet search engines, EBSCO host, ProQuest, and etc. Bibliographic and reference listings were used from appropriate titles for further literature searches through public libraries' interlibrary loan services.

The Literature Review is organized in eight major sections. These are knowledge, taxonomies of knowledge, knowledge flow theory, Knowledge Management (KM) and KM organizational capabilities (infrastructure, process and management), KM and organizational learning, KM and learning organizations, KM influences (barriers/enablers) in public/private sector and military environment. Figure 3 displays the outline of the literature review.

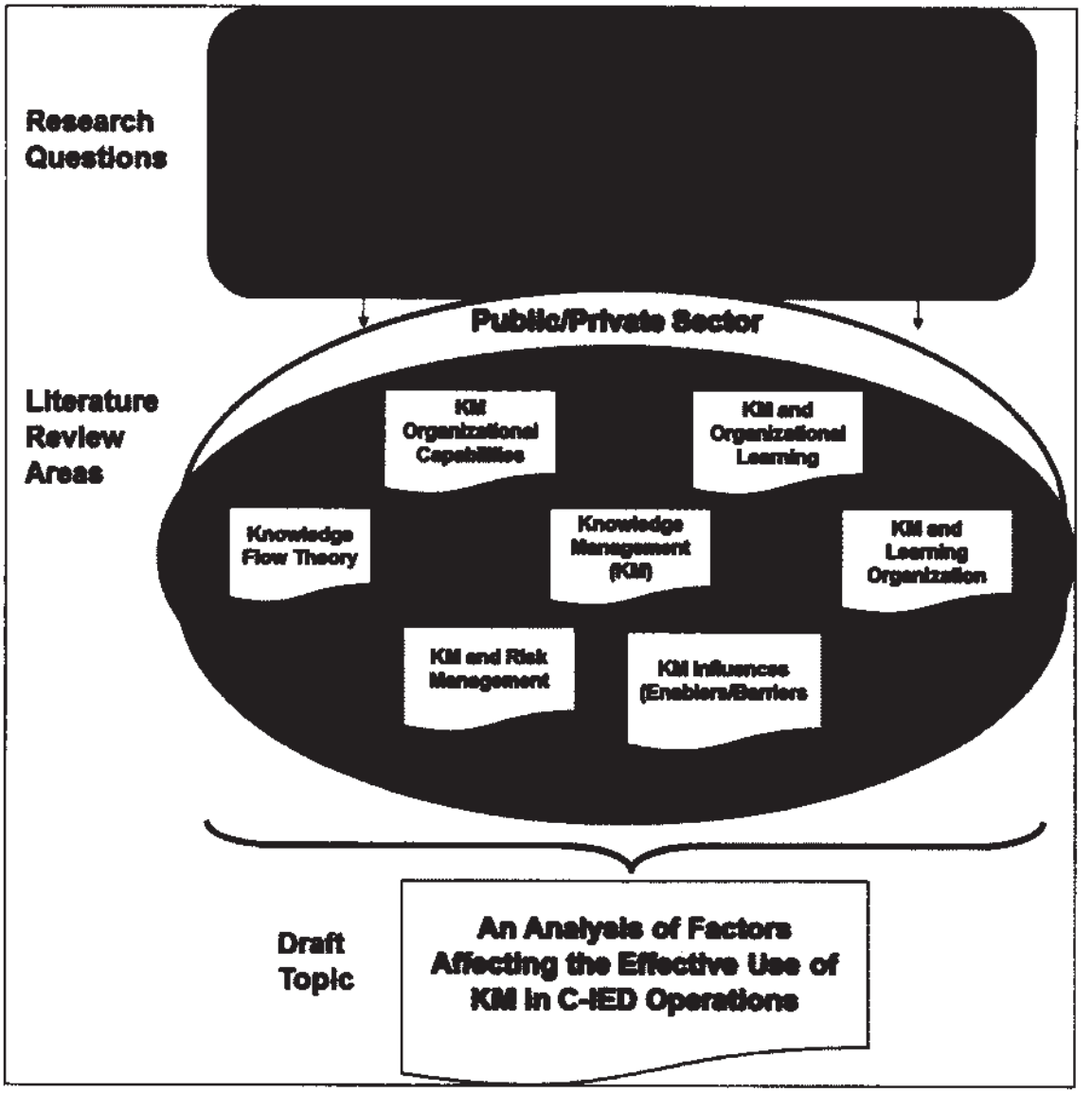

Figure 3. Literature Review Outline

2.1 Knowledge

In the prevailing business environment, where the only certainty is the uncertainty of the ever-changing business climate, the single certain source for sustainable competitive advantage is knowledge, according to Nonaka (1991). Ash (1998) similarly states that knowledge is an organization's most valuable and underused resource.

Knowledge has been suggested to be one of the strongest competitive advantages in modern markets (Davenport and Prusak, 1998; Drucker, 1993; Landaeta, 2008). Leibold, Probst and Gibbert (2005) also endorse the importance of knowledge and highlights the vitality of managing knowledge accordingly:

> "The new source of wealth is knowledge, not labor, land or financial capital. It is the intangible, intellectual assets that must be managed." (p.16)

Davenport and Prusak (1998) also defines knowledge as the fluid mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms (Ibid, 1998).

The concept of knowledge has over the years received numerous nuanced interpretations. In presenting alternative perspectives of knowledge, Alavi and Leidner (2001) define knowledge as information processed in the mind of individuals, where the information is personalized and related to facts, procedures, concepts, interpretations, ideas, observations and judgment. Dixon (2000) introduces the idea of "common knowledge" which is basically steps to translate experience into shared knowledge.

Despite the many definitions and interpretations of the term of knowledge, Fahey and Prusak (1998) state that it is crucial for every organization to develop a working definition of knowledge that is appropriate for its situation. Fahey and Prusak (1998) explain;

> The tendency to avoid grappling with what knowledge should not be surprising. There is little in the education, training or organizational

> experiences of managers that prepares them for the deep-seated reflection and understanding required by the concept of knowledge. Moreover, this situation is exacerbated by some recent popular management literature that directly advocates not making distinctions between these concepts. The argument advanced by these authors is that contemplation of such distinctions distracts managers from the necessary task of managing. However, upon reflection on concepts and the distinctions among and between them is the essence of the process of "knowing" or learning. (para.4)

The concept of knowledge is generally distinguished from the closely related aspects of information and data. Ajmal and Koskinen (2008) characterize data as "unprocessed raw facts" (p.23) while information is seen as "meaningful aggregations of data" (p.23). According to Kircher knowledge is created through the processing of information in the mind of individuals through the use of their own perception, skills, and experience. Similarly, Nonaka, et al. (2000) describes how information only becomes knowledge once it is interpreted and given a context by individuals and anchored in their beliefs and commitments. Ash (1998) concurrently emphasizes the limited value of raw data and information before it is processed by the human mind. Table 1 shows a simple military example of data becoming knowledge.

Table 1. Example of Data Processed into Information and Knowledge

Data	100 T72 tanks	Unrelated symbols out of context
Information	100 T72 tanks at grid location AB271683	*Processing* places the symbols in the context of the terrain and friendly forces
Knowledge	100 T72 tanks at grid location AB271683 indicates the enemy has committed its reserve	*Cognition* based on experience, analysis, or study provides meaning to the information

For the purposes of this dissertation, Davenport and Prusak's (1998) definition of knowledge cited previously will be used. This definition encompasses the hierarchical view of data, information, and knowledge while acknowledging both the individual and organizational aspects of knowledge existence.

2.2 Taxonomies of Knowledge

Knowledge exists in many forms in an organization. Just as there are many definitions of knowledge, there are many types of knowledge. Each type of knowledge is developed and shared in different ways throughout the organization.

Two types of knowledge are consistently noted in the literature: tacit knowledge and explicit knowledge. Tacit knowledge is rooted in experience and involvement and has a specific context (Nonaka & Takeuchi, 1995). Tacit knowledge can be subdivided into cognitive tacit knowledge and technical tacit knowledge. Cognitive tacit knowledge refers to the mental routines or cause effect relationships in the individual's brain. Technical tacit is the know-how related to a specific type of task. Explicit knowledge is the other major type of knowledge. Explicit knowledge is generalized and articulated. Explicit knowledge can be stored and reused readily. Organizations and researchers agree that tacit knowledge is more valuable than explicit knowledge (Lesser & Storck, 2001; Nonaka, 1994). However, many organizations have invested greatly in technology to support explicit knowledge. Making tacit knowledge more accessible is a major quandary for organizations. It is worth noting that the majority of the knowledge debate focuses on the tacit and explicit dichotomy; however, there are other definitions of tacit knowledge.

Beyond tacit and explicit knowledge, there are other forms of knowledge such as individual, social, declarative, procedural, causal, conditional, relational, and practical (Alavi & Leidner, 2001). An organization's best practices and essential frameworks reside in practical knowledge (Alavi & Leidner, 2001; KPMG, 1999). While it is important to know these additional classifications exist, for the purposes of this dissertation the tacit/explicit dichotomy will be the core focus. The various types of knowledge and military examples on the research area are shown in Table 2.

The primary focus of military "knowledge" efforts is currently on explicit knowledge capture, transfer, and retrieval. Tacit knowledge capture, transfer, and retrieval, although acknowledged as critically important, is at this time a secondary focus. Because, military service knowledge focused programs are still in the early formation and implementation stages, more complex view of knowledge are inappropriate and sometimes confusing. In addition to the utility of the tacit/explicit dimension of knowledge, Alavi and Leidner's (2001) description of pragmatic knowledge best describes the military services' primary area of concern.

Table 2. Knowledge Types and Military Examples of Research Area (Adapted from Alavi & Leidner, 2011)

KNOWLEDGE TYPES	DEFINITIONS	MILITARY EXAMPLES ON RESEARCH AREA
Tacit	Knowledge is rooted in actions, experience, and involvement in specific context.	Insight into the best ways to deal with an IED.
Cognitive tacit	Models in the mind of the Individual.	Individual's understanding of causal relationships or general skills like carefully handling dangerous objects.
Technical tacit	Know-how applied to specific Work.	Automatic skills or mental models on how to detonate an IED.

Table 2. Continued

KNOWLEDGE TYPES	DEFINITIONS	MILITARY EXAMPLES ON THE RESEARCH AREA
Explicit	Knowledge that is articulated and generalized.	Knowledge map of the elements of a complex IED.
Individual	Created by and understood by the individual.	Insights gained from a completed C-IED event.
Social	Created and understood by a group.	Understanding how the group works together while countering a booby trap at the side of the road.
Declarative	Know-what—facts and information.	What method is appropriate on countering a radio controlled IED?
Procedural	Know-how—understand basic actions.	Steps needed to follow for suspicious device wired to the battery.
Causal	Know-why—understand the importance of the basic actions.	Understanding why jammer devices are used for radio controlled IEDs.
Conditional	Know-when—understand the timing of actions.	Understanding when a terrorist employs a tripwire, pressure mats or spring-loaded release IED systems.
Relational	Know-with—understand how one actions interacts with another.	Understanding how initiator, main charge, and power source interacts in an IED.
Practical	Useful knowledge, best ways to Operate.	Best practices, lessons learned, and useful techniques to improve performance at C-IED operations.

2.3 Knowledge Flow Theory

Nonaka and Takeuchi (1995) identified four distinct processes – *socialization, externalization, combination and internalization (SECI)* – by which new knowledge is created through conversion between tacit and explicit knowledge. Nonaka, Toyama, and Konno (2000) further extended the SECI process and proposed a more detailed framework consisting of two more elements, which explains how organizations create knowledge dynamically. These two elements are the shared context for knowledge

creation; and knowledge assets – the inputs, outputs, and moderator of the knowledge-creating process (Nonaka, et al., 2000).

According to Nonaka and Takeuchi (1995), an organization creates knowledge through interactions between explicit knowledge and tacit knowledge, and the interaction between the two types of knowledge is known as ''knowledge conversion''. The basic concept underlying the SECI process is that knowledge is first created within the individuals, which is then transmitted to the organization. The approach underlying Nonaka and Takeuchi's (1995) model is that knowledge conversion is a social interaction between individuals, and it is not confined within an individual. Figure 4 provides a conceptual diagram of the four modes of knowledge conversion. ''Socialization'' is a process where individuals share experiences with each other, which also includes creation and sharing of mental models, world views, and mutual trust (Nonaka and Konno, 1998; Nonaka and Takeuchi, 1995). Firms often acquire and take advantage of the tacit knowledge embedded in customers or suppliers by interacting with them (Bojnord and Afrazeh, 2006). ''Externalization'' characterizes the conversion of tacitly held knowledge, such as specialized knowledge held by customers or specialists, into an explicit, readily understandable form (Nonaka and Konno, 1998; Nonaka et al., 2000). The conversion of tacit knowledge into explicit knowledge helps it to be crystallized and shared by others, which becomes basis for creation of new knowledge (Byosiere and Luethge, 2004; Nonaka, et al., 2000). The successful conversion of tacit knowledge into explicit knowledge depends on the sequential use of metaphor, analogy, and model (Nonaka et al., 2000).

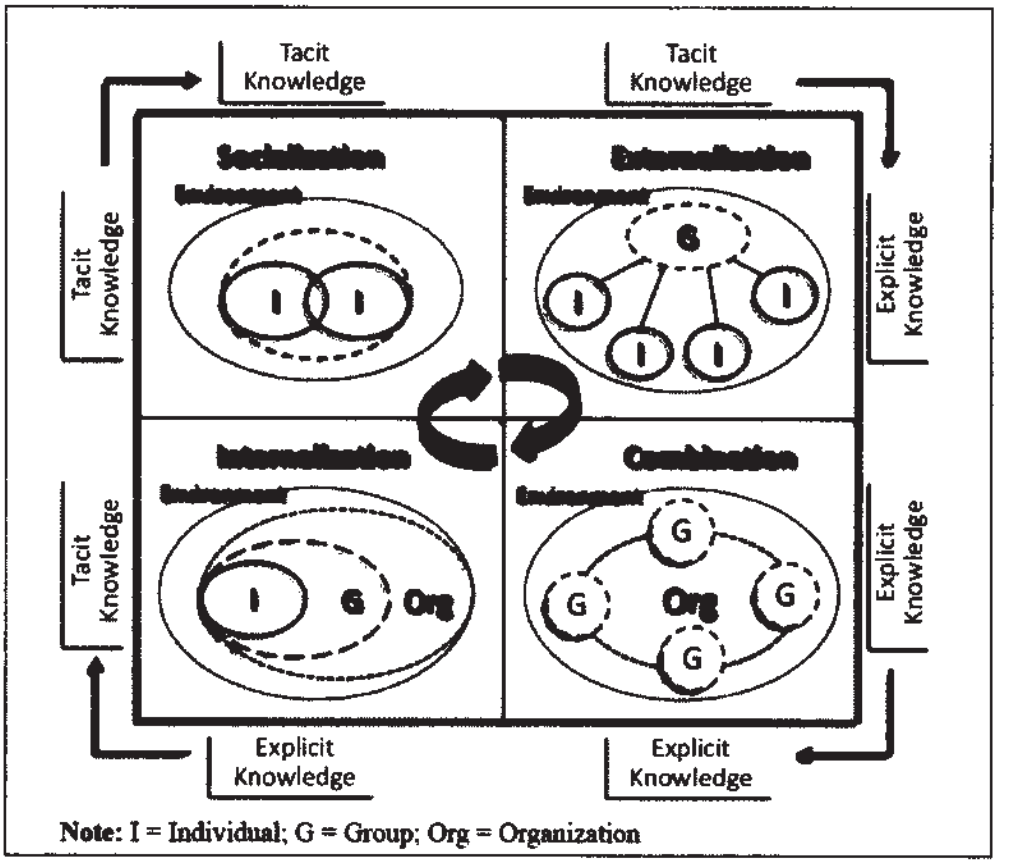

Figure 4. Conceptual Diagram of the SECI Process (Adapted from Nonaka &Takeuchi, 1995)

2.4 Knowledge Management

Knowledge Management (KM) is many things to many people. As Liebowitz (2000) indicates, it is a process intended to add value to an organization's intangible assets to leverage knowledge within and external to that organization. KM is concerned with creating, capturing, retrieving, coordinating and distributing not just bits and bites of information, but the knowledge that is inherent to an organization whether it is held within its people, its libraries or its electronic databases. The central idea is to create an environment whereby sharing knowledge, rather than preserving knowledge, is power

(Liebowitz, 2000). KM as described in this context offers a fundamentally different management approach than the traditional command and control, hierarchical approach to which the military is accustomed.

Conversely in military, KM is commonly defined as it is aptly stated in Landaeta, Pinto and Kotnour (2009) study as the processes, tools, and techniques that make available the right knowledge to the right knowledge worker, at the right time.

Since precise definition of knowledge management is indeed elusive, it would be valuable to show available definitions of knowledge management in current KM literature as shown in Table 3.

Table 3. Some Definitions of Knowledge Management

AUTHOR	DEFINITION
Drucker (1993, p.5)	"Knowledge is power, which is why people who had it in the past often tried to make a secret of it. In post-capitalism, power comes from transmitting information to make it productive, not from hiding it!"
Nonaka & Takeuchi (1995, p.45)	"The capability of an organization to create new knowledge, disseminate it throughout the organization and embody it in products, services and systems."
Skyrme & Amidon (1997, p.12)	"Knowledge management is the explicit and systematic management of vital knowledge and its associated processes of creating, gathering, organizing, diffusion, use and exploitation. It requires turning personal knowledge into corporate knowledge that can be widely shared throughout an organization and appropriately applied."
Kotnour (1998, p.56)	"A process for helping an organization continuously builds its capabilities to maintain and improve organizational performance."
Pan & Scarborough (1999, p.14)	"It is the capacity (or processes) within an organization to maintain or improve organizational performance based on experience and knowledge."
Kanter (1999, p.36)	"The process of turning data (raw material) to information (finished goods) and from there into knowledge (actionable goods)."
Tiwana (2000, p.23)	" …management of organizational knowledge for creating business value an generating a competitive advantage."

Table 3. Continued

AUTHOR	DEFINITION
Liebowitz (2000, p.26)	"A process intended to add value to an organization's intangible assets to leverage knowledge within and external to that organization."
Abell & Oxbrow (2001, p.11)	"The creation and subsequent management of an environment, which encourages knowledge to be created, shared, learnt, enhanced, organised and utilized for the benefit of the organisation and its customers."
Davenport & Prusak (1998, p.28)	"A comprehensive definition of KM has to incorporate the needs and attitudes of people with different temperaments and styles. A true definition has to satisfy everyone. The right approach to KM is a unified approach that is technological, social, and organizational, and which leads to economic value. Each temperament has to be represented."
Alavi & Leidner (2001, p.78)	"It is the process of identifying and leveraging the collective knowledge in an organization to help the organization to compete."
Prusak & Allerton (2003, p.90)	"The Darwin Executive Guide (guide.darwinmag.com) on knowledge management says there's no universal definition of KM and no agreement as to what constitutes knowledge in the first place. It likens knowledge workers to golf caddies: A good caddie does more than carry clubs; he or she gives advice on which club to use and how to hit the ball."
De Brun (2006, p.67)	"The capabilities by which communities within an organization capture the knowledge that is critical to them, constantly improve it, and make it available in the most effective manner to those people who need it, so that they can exploit it creatively to add value as a normal part of their work."
IBM	"Knowledge management is not about data, but about getting the right information to the right people at the right time for them to impact the bottom line."

2.5. Knowledge Management Organizational Capabilities

Knowledge has been considered as the main source for creating organizational core capabilities, and as the basis for sustainable profitability (Grant, 1996). The success of a knowledge-based organization depends hugely on how effectively the organization handles knowledge.

Organizational capability is "a firm's capacity to deploy resources, usually in combination, using organizational processes, to affect a desired end" (Amit & Schoemaker, 1993, p. 35). Grant (1996) maintained that "Capabilities involve complex patterns of coordination between people and between people and other resources" (p.34) and submitted that a capability is essentially a routine or a combination of interacting routines. An organizational routine is a regular and predictable pattern of coordinated actions, and the organization itself can be viewed as a huge network of routines. The term knowledge management capabilities refer to an organization's capabilities to recognize, create, transform, and distribute knowledge (Cho, 2011; Gold, et al., 2001).

Effective KM through the development of capabilities should contribute to key aspects of organizational performance (Anderson, 2009; Cho, 2011; Gold, Malhotra and Segar, 2001; Vijayan, 2009). Such contribution may include: improved ability to innovate, improved coordination of efforts and rapid reaction to adversaries' innovations. Other contributions may include: the ability to anticipate surprises/unknowns, responsiveness (i.e. application) to operational environment changes and reduced redundancy of information/knowledge. They provide a foundation for determining the relative contribution of KM to organizational effectiveness (Brown and Duguid, 1998; Vijayan, 2009). Capabilities have been defined as internal structures and processes that can be the source of a competitive advantage. Perhaps most importantly, capabilities have been conceptualized as preconditions for effective knowledge management (Vijayan, 2009; Von Krogh, 1998). Three broad dimensions can serve as the basis for model development within the knowledge management framework: *management capability, KM processes and KM infrastructure capability.* (Anderson, 2009; Cho, 2011; Gold,

Malhotra and Segar, 2001; Vijayan, 2009). Clearly, organizational capabilities are strategically important as a source of competitive advantage by establishing internal structures and processes to create competencies (Ulrich and Wiersema, 1989). These are rooted in an organization's value adding processes that captures transfers and uses knowledge to response to opportunities and threats in the marketplace. To support the knowledge process, an infrastructure must be in place that consists of organizational structure and technological to capture, store, transport, protect and monitor organization knowledge. In addition, the organizational culture must support the necessary social capital to enable knowledge creation through the process of combination and exchange that takes place through mutual acquaintance, contacts, connections and social status or reputations (Nonake, 1994).

Furthermore, a critical dimension that is often overlooked is the leadership capabilities (Vijayan, 2009). Although capabilities are strategically important, their dimensions are largely undefined. In summary, the creation of organizational knowledge relies on many systems, processes, structures, culture and management (leadership) that enable the maximization of social capital created through the process of combination and exchange.

2.5.1 Knowledge Infrastructure Capability

Knowledge infrastructure management provides the infrastructural environment, either IT or non-IT that supports knowledge-creation and sharing capabilities (Carrillo, Robinson, Anumba, & Al-Ghassani, 2003). Davenport, De Long, and Beers noted that organizations that built effective technical and organizational infrastructures were more

likely to implement successful knowledge management projects (1998). Gold, Malhotra, and Segars (2001) identified three key building blocks of knowledge infrastructure capability*: technology, structure, and culture*.

2.5.1.1 Technology

Technology is one the most important enablers of the active knowledge management processes. Gold, Malhotra, and Segars (2001) stated that "Technology comprises a crucial element of the structural dimension needed to mobilize social capital for the creation of new knowledge" (p.187) . The concept of social capital emphasizes that "Networks of relationships are valuable resources supporting any social affair by crediting all individuals with a collectively owned capital" (Vandaie, 2007, p.1). Although technology alone is not sufficient to directly affect knowledge management success, it is an essential foundation for the improvement of knowledge management capabilities (Cho, 2011; Iftikhar, 2003; Khalifa & Liu, 2003). It is clear that technology enables and supports core knowledge activities such as knowledge creation, knowledge sharing, knowledge distribution, and knowledge application (Gold, Malhotra, & Segars, 2001).

Examples of information technology are search and retrieval engines; internet, intranet, and web browsers; internal and external content repositories; content management systems; data warehouses; workflow systems; electronic news; real-time news feeds; automatic content classification; data mining; knowledge mapping; groupware; and collaboration tools. However, those tools are suboptimized if they are not supported by other knowledge management enablers such as organizational culture,

structure, and business strategy (Chong, et al., 2000; Hsu, 2008; Iftikhar, 2003; Sanchez, 2005).

2.5.1.2 Structure

Organizational structure is "the design of organizational work flow and processes," as well as "the pattern of interrelationships among key components of the system" (Senge, 1994, p. 90). The organizational structure usually takes the form of organizational norms, culture, communication methods, incentive systems, and corporate policies that affect individual behavior within an organization (Cho, 2011; Hansen, Nohria, &Tierne, 1999). Since the organizational structure can affect individual behavior, it should be designed to support effective knowledge flow and transfer (Casselman & Samson, 2007; Iftikhar, 2003; Walker, 2006). Additionally, the organizational structure attempts to divide tasks among members and arrange the coordination of their different task activities, and, during this process, knowledge is transferred, shared, and created (Nonaka, Von Krogh, & Voelpel, 2006; Vera & Crossan, 2004). The organizational structure should be strategically designed to support knowledge activities because unintended structural barriers exist that hinder knowledge creation and sharing (Suresh, 2002). There are two major structural barriers, multilevel structure and horizontal communication that occur when there are no economic and administrative links (Zeng, Lou, & Tam, 2007).

There is a tendency in contemporary organizations to transform their structures from traditional bureaucracies to more radical virtual corporations and hypertext organizations in which knowledge is an essential part of the organization (Suresh, 2002).

In the formal type of organizational structure, information and knowledge for making organizational decisions usually flow vertically. Often, the information and knowledge does not move horizontally; rather they go up to upper management and down to other horizontal sites. In the latter type of organizational structure, information and knowledge flow both vertically and horizontally (Iftikhar, 2003). It is important that the organizational structure be flexible enough to encourage sharing and collaboration across boundaries within the organization and across the supply chain (Gold, Malhotra, & Segars, 2001).

2.5.1.3 Culture

Every organization has its own culture that influences the way people work. Denison (1990) defined organizational culture as the "underlying values, beliefs and principles that serve as a foundation for the organization's management system, as well as the set of management practices and behaviors that both exemplify and reinforce those principles" (p. 12). Because the organizational culture includes values, norms, assumptions, and other observable behaviors, it is important to promote and modify organizational culture in order to affect desirable outcomes (Khan, 2005). The organizational culture has become critically important in contemporary organizations, and the transforming of that culture would be the most common form of organizational transformation. Buckman (2004) stated that installing hardware and software is absolutely not enough to support innovative and productive organizational changes, but doing so is necessary to bring about cultural changes.

In a knowledge-based economy, most organizations attempt to promote a knowledge-sharing culture so that they can react quickly to key issues and gain more competitive advantages (Chong, et al., 2000). De Long (1997) stated "Organizational knowledge and culture are intimately linked, and improvements in how a firm creates, transfers, and applies knowledge are rarely possible without simultaneously altering the culture to support new behaviors" (p. 28). Knowledge management is a particularly culturally dependent process (Cho, 2011; Gold, Malhotra, & Segars, 2001; Iftikhar, 2003). Cultural factors include corporate visions, mission statements, rewards, and information services, and they should be effectively aligned to facilitate a sharing culture (Chong, et al., 2000).

Organizational culture is one of the most powerful influences on behavior, and it can enable or hinder knowledge management (Cummings & Worley, 2005; Iftikhar, 2003). For example, a commonly shared culture can contribute significantly to an organization"s effectiveness under stable conditions, but in a fast-changing environment, a strong culture can inhibit organizational flexibilities and changes (Cummings & Worley, 2005). Additionally, since people recognize that knowledge is power, they might not be willing to give up or share power, so an organizational culture must promote the sharing rather than the hoarding of knowledge (Suresh, 2002).

2.5.2. Knowledge Process Capability

Knowledge process capability is essential to leverage the knowledge management infrastructure capability, and should be conducted frequently, consistently, and flexibly for optimizing knowledge management activities (Grant, 1996; Khalifa & Liu, 2003).

Knowledge management process capability not only includes obtaining necessary information and knowledge, but is also a tool for maintaining information and knowledge effectively to support employees" efforts to work better (Fan, et al., 2009). Knowledge process capability includes at least three sub-processes: *acquisition, transfer and application.*

2.5.2.1. Acquisition

The acquisition aspect of knowledge management relates to obtaining knowledge. Gold (2001) noted that the process of acquiring knowledge includes: seeking, generating, creating, capturing, and collaborating on knowledge. However, the main purpose is to acquire knowledge. Knowledge acquisition can be referred to as the creation of a knowledge base, which requires capturing knowledge from experts' minds (Milton, 2007). The knowledge base can be presented in various ways, such as a knowledge store, a knowledge repository, or an ontology, and recently, information technology. Milton (2007) defined knowledge acquisition as "the activity of capturing expertise from people (and other sources of knowledge) and creating a computerized store of this knowledge to be used to help an organization in some specified ways" (p. 17).

The organization learns when information is acquired outside the boundaries of the company and when individuals externalize tacit into explicit knowledge to be shared, and then integrates that into the existing knowledge base (Büchel & Probst, 2000; Nonaka, Krogh, Voelpel, 2006). The organization can acquire knowledge either externally or internally. External knowledge may be acquired from relationships with customers, suppliers, competitors, and partners. The organization can also buy external

knowledge by recruiting experts or through a merger and acquisition (Büchel & Probst, 2000). Meanwhile, individuals may acquire knowledge by observing, experiencing, imitating, practicing, and interacting with others. Internal knowledge acquisition could refer to finding hidden knowledge that is already within the organization, by capturing exporting it to other organizational members. Knowledge management must be designed to encourage members to participate in the knowledge acquisition processes, creating an opportunity for future business and competitive advantages.

2.5.2.2. Transfer

Gold, Malhotra, and Segars (2001) described the knowledge conversion process as "making existing knowledge useful" (p.191). One of the critical purposes of knowledge management is to exploit the knowledge inherent in the company in an effective manner (Iftikhar, 2003). The process should store, transform, and transport information throughout the organization, to enable the organization to capture, exploit, and transfer knowledge in an effective way (Gold, Malhotra, & Segars, 2001; Iftikhar, 2003; Nonaka, Toyama, & Konno, 2000).

Much useful knowledge is not revealed, and if it is not utilized, it will be wasted. Knowledge management should support the conversion of data to information and information to knowledge (Büchel & Probst, 2000; Sanchez, 2005). Chunks of data and information have little value if they are not reflected, interpreted, and learned by individuals based on their contextual situations (Alavi & Leidner, 2001; Cohen, 1998). However, an organization should not overly focus on the conversion process from data and information to knowledge, and neglect the process of conversion from knowledge to

information and information to data. The transfer (conversions) among data, information, and knowledge are cyclical and transitory (Bhatt, 2001, p.70). When knowledge is no longer valid in the existing context, the organization should transform it into information and data to store in its knowledge management system, or simply discard it.

Additionally, most knowledge in an organization remains in an individual's mind in the form of tacit knowledge. To be useful, it must be converted into explicit knowledge, available to share with those who need it (Von Krogh, 1998). Nonaka (1994) emphasized the knowledge conversion process between tacit and explicit knowledge, meaning it can be shared and used to create new knowledge. When individuals share, articulate, combine, and internalize tacit and explicit knowledge with others, new knowledge is created, and organizational members learn.

The development of information technology has accelerated knowledge conversion processes, tacit to explicit and explicit to tacit. Individuals understand and absorb explicit knowledge to create their own tacit knowledge, which makes explicit knowledge ready to use by the knowledge owner. Usually, knowledge about a particular subject may spread throughout the organization, so "combining or integrating this knowledge reduces redundancy, enhances consistent representation, and improves efficiency by eliminating excess volume" (Gold, Malhotra, & Segars, 2001, p. 191).

2.5.2.3 Application

Simply put, knowledge application denotes the actual use of knowledge within the organization. It involves making knowledge more active and relevant to create more value (Bhatt, 2001). Knowledge becomes useful to an organization only when it is

applied in action within an organization's processes, and otherwise it will be wasted (Sanchez, 2005). Knowledge management must ensure that knowledge is actually used and exploited in effective ways to create value. Sanchez (2005) stated that the basic goals of knowledge management practice are not just generating new knowledge but also assuring that new and existing knowledge is actually applied in all processes where the knowledge can be used throughout an organization. When knowledge is effectively applied, an organization can improve its efficiency and reduce costs (Davenport & Klahr, 1998). If an organization fails to locate the right knowledge to use in the right situations, it may lose its competitive advantage.

Major activities associated with the knowledge application are identification, storage, imitation, retrieval, application, dissemination, contribution, learning, sharing, and creation of knowledge (Bhatt, 2001; Cho, 2011; Gold, Malhotra, &Segars, 2001; Harris, 2003; Iftikhar, 2003; McElroy, 2000; Nonaka, 1994). The ultimate goal of knowledge management is not only to facilitate the creation of new knowledge but also to help the organization to apply it productively for its benefit (Büchel & Probst, 2000).

2.5.3. Knowledge Management Leadership Capability (Traditional vs. Transformational)

Due to the dynamic nature of KM, there is few empirical research to support the relationship between KM attributes and leadership practices (Vijayan, 2009). There is a need for management to create a climate in which sharing knowledge is encouraged, or even demanded. Lumpkin and Dess (1996) called for research that investigated how

managerial orientation moderated and mediated the implementation of knowledge management structures and processes.

Leadership (managerial) capability is the organizations strategic decision making orientation. Leadership is defined as the ability to influence and develop individuals and teams to achieve goals that have been set by the organization (Vijayan, 2009).

Scholars have attempted to explain performance by investigating a company's leadership (managerial) capabilities, that is, whether the capabilities are towards transformational or traditional (conventional) management.

Managerial capabilities provide a supportive infrastructure for resorting, decision making and innovative practices so that knowledge activities can be successfully pursued (Vijayan, 2009). Management provides leadership and the resources to enable organizations goals to be achieved. In knowledge incentive communities, the manager generally operates with the knowledge worker as both facilitator and partner, rather than as a controller of tasks and activities (Vijayan, 2009).

Although management intends to make the best use of resources, they may also hinder the pursuit of knowledge. 'Silo' mentalities can operate, encouraging the withholding of knowledge and information from some parts of the organization. Successful knowledge management requires an open management style which encourages sharing across the organization (Stock & Hill, 2000).

Managerial (leadership) capabilities are essential to KM's success. Leadership in general is important to both the organization and to every individual. Cooper, Markman and Niss (2000) specifically identified the first-level managers as the most important agents in a knowledge-based organization. They are in the best position to combine

abstract strategic information and action-oriented operational information and create new knowledge by actively resolving conflicts. Cooper, et al. (2000) state that the goal of leadership is to increase human capital. The teambuilding process must include constant attention to the building of greater levels of trust, not only between the leader and followers but among the collaborating employees as well. The knowledge management core team, which includes project, process, and product leaders, must constantly support the integrity of beliefs and values concerning knowledge (Ali &Yusof, 2004). Leaders must be the role models for learning and knowledge sharing. Ali and Yusof (2004) insist that for knowledge sharing to become reality you have to create a climate of trust in the organization. You cannot empower someone that you do not trust and who does not trust you (Ali &Yusof, 2004). Building trust and a knowledge-sharing culture must be the leader's responsibility. Without trust and a knowledge-sharing culture, a knowledge management initiative will fail.

It is important to select the style of leadership a particular KM effort needs. The Traditional Leadership (conventional) and Transformational Leadership have both an important implication for organizational leadership. They challenge organizational leaders to balance organizational needs with individual needs, in order to achieve the desired organizational behavior and to maximize human assets.

Traditional leadership uses of top-down command and control systems, enforced standard procedures and manuals whereas transformational leadership uses empowerment, customized flexible procedures.

There are distinct differences between in traditional and transformational leadership approaches. Table 4 summarizes the differences based on the literature review.

Table 4. Differences Between Traditional and Transformational Leadership Approaches (Adapted from Cooper, Markman &Niss, 2000; Drucker, 1985; Edwards, et al, 2003, Vijayan, 2009)

Attributes	Traditional Leadership Approach	Transformational Leadership Approach
Ability to take calculated risk	Risks are to be avoided as it may affect the core business.	Risks are the challenges to be grasped in order not to miss opportunities.
Creativity	Creativity is good, but it has to be fitted into the organization's vision and mission statement.	We live on creativity. It is niche to substantiate efforts to meet competition.
Policies and Procedures	Enforce standard procedures to avoid mistakes. Rules must be strictly followed.	Good rules should always be flexible. Since it is management that made the rule, they must change it according to changes in the environment.
Relationship with staff	Management has official/strict relationship with its employees.	People are the organization's strength and team effort is always valued.
Initiative	Manage resources for efficiency and only initiatives that meet Return on Investment (ROI) are worth the effort.	All initiative should be considered and worth giving a chance. Failure is only a word until initiative is completely tested.
Dealing with failure	Failure costs the company money and erodes confidence in ourselves.	Employees do not make mistakes intentionally and when they fail, it is an opportunity for us to learn from our mistakes.
Management style	Delegation: use of command control systems, procedures and manuals.	Empowerment, hand on, customised flexible procedures.
Organizational structure	Top-down command, hierarchical structure, segregation and compartmentalization.	360 degree integration, flat structure, synergy and borderless.

2.6. Knowledge Management and Organizational Learning

A leading theorist on organizational learning, Huber (1991) indicates that an entity learns if, through its processing of information, the range of its potential behaviours is changed (p.89). Huber's organizational learning theory focuses on explicit knowledge and consists of four distinct components: knowledge acquisition, information distribution, information utilization, and organizational memory. Elaborating Huber's (1991) work, Splender (1996) described an organizational learning process that links learning explicitly to organizational knowledge. He proposes three stages of learning that progress:

Acquisition: Development or creation of skills, insights, and relationships.

Disseminating: Sharing and disseminating what has been learned.

Utilization: Integrating knowledge so it is broadly available and can be generalized to new situations (Splendor, 1996).

Splender (1996) maintains that learning does not always occur in linear fashion as mentioned in the three stages of learning. It can take place through socialization and utilization. They hold that true knowledge is more than information: it includes the meaning or interpretation of the information.

Within this framework, the US military published "The Army Learning Concept" for 2015 (ALC 2015) in 2010. This concept proposes a learner-centric model that is built upon two underlying themes. First, is increasing the rigor, relevance, and effectiveness of face-to-face learning experiences in our schoolhouses through instructional strategies that maximize the effectiveness of limited resident learning time. The second theme expands the reach of the schoolhouse through the creation of a digitized learning environment that

blends the operational, institutional, and self-development domains to create a learner-centric, career-long learning capability. (ALC 2015, 2010)

2.7. Knowledge Management and Learning Organization

In general, an organization that seeks to generate change must do more than amend policies and direct that changes be implemented. There must be an education process where employees learn about the new challenges, systems, practices and procedures. Employees must also look inward and identify how they functioned in their former working construct and learn ways to alter their working habits to support the new way of doing business. Once the change initiatives are in place to promote a knowledge sharing culture, it is important to build in long-term learning and support. Liebowitz (2000) suggested that an organization that promotes continuous and supportive learning would increase the intelligence of the organization and contribute to the successful KM strategies of their organization. Senge, et al. (1999) indicated that learning results from profound change by linking the changes of their internal culture with the changes in their external organizational structures. Basically, they say that it is insufficient to change only the organizational structure without changing the underlying cultural thinking and beliefs.

In order for an organization to embrace change, it must evaluate its leadership approach and determine how it leverages the expertise of its workers. Vaill (1996) described a learning organization as having a transformational leadership style and personnel who are empowered to contribute and committed to learning, growing and evolving. This is in sharp contrast to the inflexible, stable and unchanging style of traditional bureaucratic organizations like educational institutions that are traditionally

managed with silo-like functions that make it difficult to implement cross-functional initiatives. KM provides an opportunity where educational institutions can gain a better understanding on how information can impact their organization (Petrides & Nguyen, 2006).

In military, integrating KM improves sharing of observations, insights, and lessons before, during, and after operations. KM processes organize lessons that have been incorporated into modified tactics, techniques, or procedures and disseminate them within the unit. KM processes also transfer these lessons to official lessons learned databases for others' use. KM tools help leaders to research doctrine more effectively for tactics, techniques, and procedures to help solve tactical problems. KM also connects operational units with subject matter experts and peers with relevant experience to obtain their assistance, both before and during an operation. It also includes access to the vast lessons learned databases at the Center for Lessons Learned and other repositories of data and knowledge products, such as JIEDDO Knowledge and Information Fusion Exchange (JKnife), Army Knowledge Online (AKO), etc. It expedites incorporation of this knowledge into plans and orders and contributes to accomplishing missions. Finally, KM allows units to contribute their learning and lessons to these repositories, thus increasing the military's institutional knowledge.

KM facilitates the transformation of Armed Forces into knowledge-based organizations. Those organizations integrate best practices—the most effective and efficient method of achieving any objective or task—into operations and training. Within organizations, KM improves knowledge flow, connecting those who need knowledge

with subject matter experts. Soldiers and leaders share lessons learned to prepare for both current and future operations (AR 25-1, 2005).

2.8 Knowledge Management (KM) and Risk Management (RM)

Knowledge Management and Risk Management (RM) are two domains that are taking root in the business management realm that deal directly with knowledge and identifying pitfalls (Haltiwanger, Landaeta, Pinto & Tolk, 2010). Kaplan and Garrick (1981) define risk as asking: "What can happen?", "How likely is that to happen?", and "If it does happen, what are the consequences? " (p.13). So, Risk Management can aptly be defined as planning, assessing, handling and monitoring of the risk (Conrow, 2005). There is a substantial relationship between RM and KM. Principles of RM are effectively being applied to enhance KM. Additionally, KM is being used as a tool to improve RM strategies. Furthermore, evidence exists that practices of the two can be combined in different ways to obtain a more holistic view (Haltiwanger, et al., 2010, p.289).

2.9 Knowledge Management Influences (Enablers and Barriers)

Examples of KM influences can be found throughout KM literature where the influences are typically presented as either barriers or as enablers. For the purposes of this research, a complementary view of barriers and enablers is taken. Instead of treating the two as entirely separate of each other, both barriers and enablers will be considered as opposite effects of the same influence or as "two sides of the same coin" (Bartczak, 2002). Therefore, an identified influence that has a negative impact on KM implementation efforts represents a barrier, and an influence that has a positive impact on

KM implementation efforts represents an enabler (Bartczak, 2002). Throughout the literature there exists a broad range of KM implementation influences. Wong (2005) identifies influences such as *management leadership and support, culture, IT, strategy and purpose, measurement, organizational infrastructure, processes and activities, motivational aids, resources, training and education, and human resource management* (p.115). Skyrme and Amidon (1997) offer a strong link to a business imperative, a compelling vision and architecture, knowledge leadership, a knowledge creating and sharing culture, continuous learning, a well-developed technology infrastructure, and systematic organizational learning processes. Cho, Jerrell, and Landay (2000) identify influences as people, processes, and technology. Disterer (2001) separates influences into individual barriers and social barriers; offering loss of power, revelation, uncertainty, and motivation as individual barriers, and language, conflict avoidance, bureaucracy and hierarchy, and incoherent paradigms as social barriers. Liebowitz (2000) identified the following influences: *senior leadership support, a Chief Knowledge Officer (CKO) and a KM infrastructure, knowledge ontologies and repositories, KM systems and tools, incentives for KM sharing, a supportive culture* (p.34). As can be seen, a variety of influences are offered throughout the literature. While not all of the influences offered are labelled identically, many convey similar concepts. Some of these themes identified in the literature include concepts such as management and leadership, resources, culture, and external forces such as competition. Summary of the other enablers/barriers (influences) affecting the successful implementation of knowledge management is shown in Table 5.

Table 5. Summary of Influences Affecting the Successful Implementation of Knowledge Management

ENABLERS/BARRIERS	REFERENCES
Transparency, trust, and open culture	Akhavan, et al. (2006), Akhavan and Jafari (2006), APQC (1999), Davenport, et al. (1998), Egbu (2004), Hasanali (2002), Leibowitz (2000), Moffett, et al. (2003), Mooradian, et al. (2006), Skyrme & Amidon (1997), Tobin (2003),Wong (2005).
Data bases and technologic tools for knowledge search	Davenport and Probst (2002), and Leibowitz (1999).
Documentation	Davenport and Probst (2002), Leibowitz (1999), Skyrme and Amidon (1997), Tobin (2003).
Performance measurement	Barsky & Marchant (2000), Bassi & Ven Buren (1999), Martinez (1998), Moffett, et al. (2003), Pearson (1999).
Knowledge structure	Akhavan et al. (2006), Davenport & Klahr (1999), Hasanali (2002), Hickins (1999), Hsieh, et al. (2002), Moffett, et al. (2003).
Change management	Akhavan & Jafari (2006), Davenport et al. (1998), Tobin (2003).
Knowledge sharing	Akhavan, et al. (2006), Amidon (1997), Davenport, et al. (1998), Davenport & Probst (2002), Leibowitz (1999), Skyrme & Tobin (2003).
Company readiness for KM	Tobin (2003)
Strategy	Akhavan, et al. (2006), Akhavan & Jafari (2006), APQC (1999), Davenport and Probst (2002), Egbu (2004), Leibowitz (1999), Schneider (2007), Skyrme & Amidon (1997), Tobin (2003), Wong (2005).
Systematic approach to KM	Tobin (2003).
Knowledge metrics	Akhavan, et al. (2006), APQC (1999), Davenport & Probst (2002), Egbu (2004), Holsapple & Joshi (2000), Tobin (2003), Wong (2005).
Knowledge architecture	Akhavan, et al. (2006), Davenport (1998), Skyrme & Amidon (1997).
Continuous learning	Akhavan & Jafari (2006), Bixler (2002), Skyrme & Amidon (1997).
Knowledge repositories	Davenport & Probst (2002), Leibowitz (1999).
Job enrichment	Martinez (1998), Moffett, et al. (2003), Ulrich (1998), Verespej (1999), Ward (1997).
Team working and communities of practice (CoP)	Martinez (1998), Moffett, et al. (2003), Ulrich (1998).

Table 5. Continued

ENABLERS/BARRIERS	REFERENCES
IT infrastructure	Akhavan & Jafari (2006), APQC (1999), Bixler (2002), Davenport, et al. (1998), Davenport & Probst (2002), Egbu (2004), Moffett, et al. (2003), Paiva, et al. (2002), Tobin (2003), Wong (2005), Wang (2002).
Collaboration and communication	Egbu (2004), Holsapple & Joshi (2000), Tobin (2003).
Integration of KM and current systems	Akhavan et al. (2005), Egbu (2004).
Pilot	Akhavan, et al. (2005), Akhavan & Jafari (2006), Gartner Group (2002), Tobin (2003).
Job security	Egbu (2004).
Risk-taking climate in the organization	Egbu (2004), Ruggles (1998), Shirnir (2002), Wong (2005).
Human resources management and motivation	Akhavan, et al. (2006), Akhavan & Jafari (2006), Egbue (2004), Landaeta, et al. (2009).
Flexible and dynamic organizational structure	Akhavan, et al. (2005), Akhavan & Jafari (2006), Gartner Group (2002), Tobin (2003).
CEO support and commitment (leadership)	Bixler (2002), Davenport, et al. (1998), Egbu (2004), Holsapple & Joshi (2000), Moffett, et al. (2003), Skyrme & Amidon (1997), Tobin (2003), Van Buren (1998), Wong (2005),.
Awareness and employee's understanding	Akhavan, et al. (2005), Akhavan & Jafari (2006), McCune (1999), Moffett, et al. (2003), O'Brien & Crauise (1995), Tobin (2003), Wilson & Asay (1999).
Employees training and educations	Akhavan, et al. (2006), Davenport & Probst (2002), Moffett, et al. (2003), Tobin (2003), Wong (2005).
Team working for problem solving	Akhavan, et al. (2006), Martinez (1998), Moffett, et al. (2003), Verespej (1999).

2.10 Knowledge Management in the Public/Private Sector

Even though KM has been widely analyzed by many academics and industry professionals, research on KM in the public sector has been limited (Syed-Ikhsan & Rowland, 2004). Syed-Ikhsan and Rowland (2004) showed that public organizations have done benchmarking of KM, knowledge sharing, KM initiatives and KM practices. The

success of a public organization is increasingly related to how effectively it can collect, deposit, and retrieve knowledge sharing among employees at all government levels (Chang, Hung, Yen & Tseng, 2009). Liebowitz and Chen (2003) found that sharing of knowledge is difficult in typically hierarchical and bureaucratic organizations, which causes some unique challenges. They insisted that most employees in government agencies are reluctant to share knowledge because they have thought that having knowledge at their hands means having a power as they move through the ranks. Luen and Al-Hawamdeh (2001) discovered that many organizations in the public sector are knowledge-intensive organizations but high costs stem from poor knowledge management practices, including lost institutional memory, knowledge gaps, and poor decisions. They also noted that having realized that the public sectors also have high competition in funding and alternative services, it is turning to KM to gain competitiveness. Governmental policy has continuously changed depending on the organizational environment, so no public sectors can be said to have stable status even though they were born to have less competitiveness compared to the private sector.

Riege and Lindsay (2006) distinguished the difference in KM between the public and the private sector: the public sector focuses on information services and delivery related to stakeholder interests and involves multiple parties in the process, whereas the private sector, in general, is influenced by the external environment such as markets, products, etc., and is shareholder-dependent. Recently, knowledge-creating organizations like Korea Occupational Safety and Health Agency (KOSHA) have initiated KM as a tool to share knowledge through information services and to deliver knowledge to the public. When the KM was first introduced into KOSHA, the amount of knowledge

generated everyday was enormous, causing limitations in filtering all of it, which led to the unreliability of knowledge and its lack of connection to business processes.

2.11 Knowledge Management in the Military

Although military forces have performed knowledge management activities implicitly since military operations began, the term "Knowledge Management" has only recently been identified and used (AR 25-1, 2005). Throughout history it has been said that knowledge is power. But since 1980, it has become more evident that "knowledge shared" is power. The Knowledge Management doctrine has been developed to increase military advantages in conducting operations. It does this by providing systematic and explicit management of the US military's organizational knowledge and its soldiers' individual knowledge.

Military staff evolved as the need to provide knowledge to commanders and to subordinate and adjacent forces increased. Even in the time of the ancient Greeks and Romans, rudimentary staff existed to provide knowledge for commanders (Ibid, 2005). As the complexity of warfare increased, the size and functions of staffs expanded. However, all military staff continued to perform two major functions: First, they carried out functions for commanders that commanders could not perform alone or that required specialists, such as engineers, artillery, and logistics. Second, military staff developed and managed information. They gathered and organized information, analyzed it to create knowledge, and applied it in planning and decision-making. Staff also transferred information to the commander, other staff members, and higher, subordinate, and adjacent organizations.

The creation, organization, transfer of knowledge and application —in these examples and through the nineteenth century—were all performed manually and within individuals' minds (Ibid, 2005). Some collaboration took place, but usually those involved had to be in one place. Occasionally, commanders met in a formal council of war, but this did not necessarily result in collaboration as currently understood. Transfer of information could be accomplished with physical means, such as co-location, flags, sounds (bugle, drum, flute), and lights. However, transfer of knowledge depended on messengers. Often these messengers were high-ranking officers with authority to amend instructions to fit changes in the situation that occurred while they were traveling. Before the nineteenth century, commanders frequently reached decisions by synthesizing knowledge staff officers provided them. The nineteenth century brought the rise of formal staffs that began to formalize the creation, organization, application, and transfer of knowledge. New staff procedures allowed for more collaboration and synthesis of knowledge before it reached commanders for decision. Moreover, the formal delegation of authority to staff officers permitted them to direct functions that the commander no longer had the time or expertise to perform personally. During this period, the first non-manual information technologies were developed: among them, telegraph, telephone, radio, phonograph, and dictating machine. However, with few exceptions these devices could not store information, let alone knowledge products. The development of electronic information technology in the second half of the twentieth century brought new capabilities for the creation, organization, application, and transfer of knowledge. These capabilities enabled collection and storage of vastly greater quantities of information, making greater quantities of knowledge available to more users. That, in turn, led to the

development of Knowledge Management (KM) as a discipline, which the Department of Defense/US Armed Forces accepted in 2003.

In 2003, the Department of Defense (DoD) became interested in KM when it experienced a ten-year reduction in the department's workforce (Glennie & Hickok, 2003). The decrease in the DoD labor force resulted in, and still results in, a loss of valuable corporate knowledge (Glennie & Hickok, 2003). As a result, the DoD has realized it needs to retain, codify, and share the knowledge of its experts (Glennie & Hickok, 2003). Similarly, military leaders have recognized the added value of storing and sharing knowledge across the services to improve commander's decision-making ability (Department of Defense, 2004). Hence, Pentagon leaders have established joint policy, guidance, and procedures to facilitate the transformation of a U.S. Joint Forces to improve efficiency and effectiveness (Department of Defense, 2004). The Net-Centric Environment—Joint Functional Concept (2005) is a strategy for the U.S. Armed Services to exploit DoD resources to become an integrated military via shared knowledge and technical resources. The Net-Centric Environment—Joint Functional Concept (2005) is joint doctrine set forth by the Office of the Combined Joined Chief of Staffs (CJCS). Below is a brief explanation of the purpose for the Net-Centric Environment—Joint Functional Concept (2005a).

> "The central idea this concept proposes is that if the Joint Force fully exploits both shared knowledge and technical connectivity, then the resulting capabilities will dramatically increase mission effectiveness and efficiency." (Department of Defense, 2005a, p.v)

The need to share information and knowledge as a U.S. joint force is also noted in the Capstone Concept for Joint Operations (2005, p.28), which describes a need for the

services "to acquire, refine, and share knowledge" as a joint force (Ibid, 2005). It also states shared knowledge will provide joint force commanders (JFCs) the ability to "work within and across national and international sources to build and sustain the knowledge necessary to identify required actions and assess effects" (Department of Defense, 2005b). The Chairman of the Joint Chiefs of Staff, in 2005, stated his vision for a joint knowledge-based force:

> The better we understand our own forces and capabilities, the adversary and the environment, the better we can employ and integrate joint force actions to create decisive effects. Knowledge must be timely, relevant, and accurate to be of value, and it must be acquired, prioritized, refined, and shared vertically (strategic, operational, and tactical) and horizontally (within the joint force and among interagency and multinational partners). (Department of Defense, 2005a, p.13)

> Knowledge allows the joint force to see, understand, and act before operational needs go unmet in humanitarian crises. It is essential to the identification, creation and assessment of effects. (Department of Defense, 2005a, p.14)

Figure 5 shows the current state of knowledge sharing in the DoD and how the DoD sees knowledge sharing's role in a Net-Centric Operational Environment (NCOE).

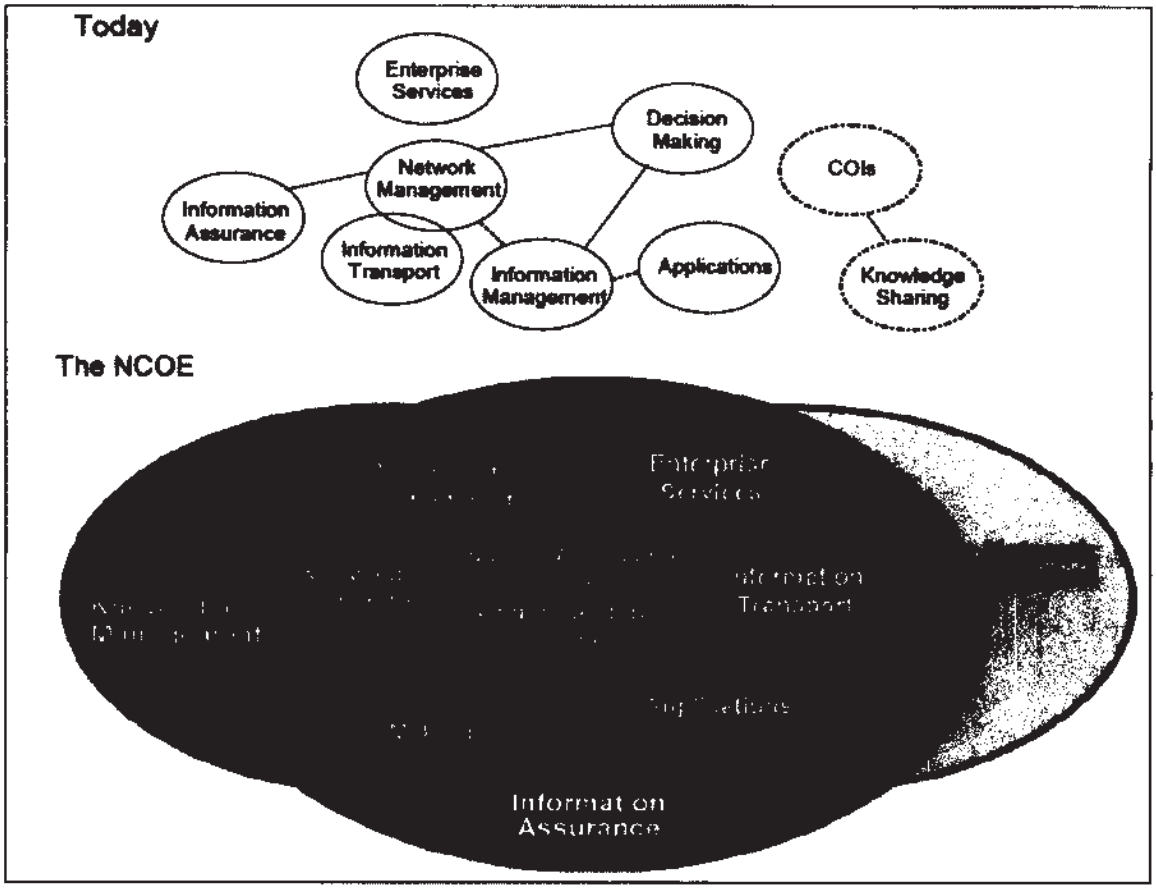

Figure 5. Transformation to the NCOE (DoD, 2005a)

Based on what is stated in the joint doctrine, KM will have a more active role in U.S. war-fighting capabilities in the global war on terrorism and modern conflicts in the future (Department of Defense, 2005a).

Additionally, Department of the Defense conducted a research in order to identify knowledge management technologies and key outcome metrics. Study reveals that Knowledge Management Technologies (KMTs) help improve performance through increased effectiveness, productivity, quality and innovation (Hanley, 2001). KMTs also increase the financial value of the enterprise by leveraging human capital. To measure these benefits, DoD KM framework included KMT system outcome metrics that indicate

the effectiveness, usefulness, functionality and responsiveness of knowledge management technologies (Hanley, 2001). Examples of each of the measures are summarized in Table 6.

Table 6. Knowledge Management Technologies and Key Outcome Metrics (Adapted from Hanley, 2001)

KNOWLEDGE MANAGEMENT TECHNOLOGIES	KEY OUTCOME MEASURES
Best practice directory	Time, money, or personnel time saved by implementing best practices, Number of groups certified in the use of the best practice, Rate of change in operating costs.
Lessons learned database	Time, money, or personnel time saved by applying lessons learned from others, Rate of change in operating costs.
Expert or expertise directory	Savings or improvement in organizational quality and efficiency, Time, money, or personnel time saved by leveraging expert's knowledge or expertise knowledge base.
Portal	Time, money, or personnel time saved as a result of portal use, Reduced training time or learning curve, Customer satisfaction.
Lead tracking system	Revenue and overhead costs, Customer demographics, Cost and time to produce proposals, Alignment of programs with strategic plans.
Collaborative systems	Reduced costs of product development, acquisition, or maintenance, Reduction in the number of delays, Faster response to proposals, Reduced learning curve for new employees.
Enterprise Yellow Pages	Time, money, or personnel time saved as a result of the use of yellow pages, Savings or quality and efficiency.
E-learning systems	Savings or improvement in organizational quality and efficiency, Improved employee satisfaction, Reduced training costs, Reduced learning curve.

As it can be easily seen, KM has been recognized as one of the tenets necessary to bridge the gap between the different departments of the military in an effort to cultivate a U.S. Joint Force and each service has embarked on methods to manage their service's knowledge resources. Examples are provided below.

The U.S. Army has a comprehensive KM strategy to become a network-centric, knowledge-based force (Cuviello, 2002). The Army has created an Army Knowledge Online KM portal that allows users around-the-clock access to Army knowledge, information, and services from anywhere in the world (Cuviello, 2002). Army Knowledge Online (AKO) is available to active duty, Army Reserve, Army National Guard, and Army retired personnel. The Army's comprehensive KM program provides personnel a static e-mail address they use throughout the duration of their career (Department of the Army, 2005a).

The Department of the Navy (DON) has implemented measures to harness the benefits of KM and has become a fundamental aspect of U.S. Naval operations (Lelic, 2005). The DON's KM initiatives include knowledge-based activities for Navy and Marine Corps personnel. The DON has developed a knowledge management portal, Navy Knowledge Online (NKO), which provides 24-hour access to training, educational tools, and professional development information (Walter, 2002). The U.S. Navy and the U.S. Marine Corps have formed the Navy Marine Corps Internet (NMCI) as a strategy for implementing network centric-warfare. The NMCI facilitates knowledge sharing and distance learning throughout the DON enterprise.

The Air Force has expressed a definite interest in KM and has a goal to "implement knowledge management practices and to assure knowledge is identified,

captured, and shared" (Rouse, 2002, p. 8). The Air Force Knowledge Now (AFKN) website is currently the tool used to store and transmit information and knowledge electronically to support collaboration, e-learning, and information sharing. The AFKN portal provides access to Communities of Practices (CoPs) and lessons learned for several Air Force specialties. As further proof of the Air Force's interest in KM, the Air Force held its first annual KM conference in the spring of 2005.

Evidence from the literature review suggests that each service has taken a different approach in developing their service-level KM programs. Some have focused on e-learning, while others have developed knowledge portals and CoPs. Although the office of the CJCS has set forth a strategy to exploit knowledge and technology as a joint force to improve efficiency and effectiveness, the particular mechanisms and processes each service has implemented to achieve this military-wide objective is unknown.

2.12 Knowledge Management in C-IED Operations

The proliferation of Improvised Explosive Devices (IEDs) on the battlefield in both Iraq and Afghanistan has posed the most pervasive threat facing Coalition Forces (CF) in those theaters (Atkins, 2007). The persistent effectiveness of this threat has influenced unit operations, countries' policies, and public perception (Wilson, 2007). Figure 6 displays the total number of IED casualties and provides comparisons for Iraq and Afghanistan for FY 2008, 2009, and 2010 (JIEDDO, 2010). The number of IED-related casualties for CF, host nation security forces, and civilians in Afghanistan increased 19 percent during FY 2010. In Iraq, the number of CF, host nation security force, and civilian IED casualties declined 29 percent.

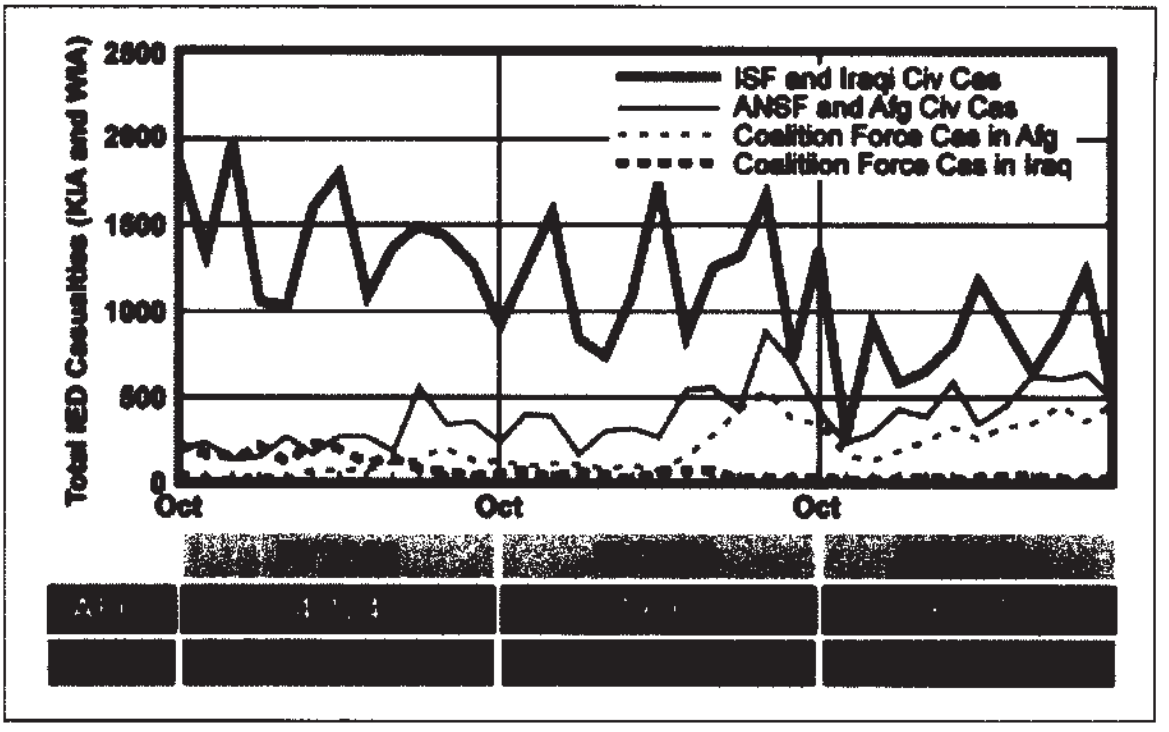

Figure 6. Total Number of IED Casualties in Iraq and Afghanistan for FY 2008, 2009, and 2010 (Adapted from JIEDDO, 2010)

Up to now, improvised explosive devices have caused over 60% of all American combat casualties in Iraq and 50% of combat casualties in Afghanistan, both killed and wounded (DMDC Report, 2010).

The US Department of Defense is actively and aggressively searching for ways to defeat the IED. The United States Government is spending billions of dollars searching for ways to defeat the insurgent's weapon of choice (Levine, 2006). The military's research and development assets, industry, and academia are all actively engaged in developing ways to mitigate the effects of this often simple and destructive weapon

system. In spite of many successes against this threat, the enemy continues to adapt and produce IEDs with readily available, inexpensive, and evolving commercial technologies.

Since IEDs will continue to be the weapon of choice for global insurgents and terrorists in foreseeable future, the U.S Department of Defense has established the Joint IED Defeat Organization (JIEDDO) to investigate countermeasures and to reduce the IED threat (Levine, 2006). It is essentially a Knowledge Management organization to create a consistent framework so war fighters can innovate, evaluate alternate courses of actions within context of local conditions, and act quickly and decisively. Most importantly, this KM organization will help preserve tacit and explicit knowledge and accelerate learning as units and personnel rotate in and out of theaters or organizations.

It also serves as grist for revised doctrine. Additionally, its Knowledge Management programs anchor Knowledge Management efforts as an all-service-wide enterprise function. For example, if the 2nd Brigade Combat Team of 10th Mountain Division discovers new ways in which insurgents are triggering and deploying IEDs in Afghanistan that the context-specific tacit and explicit knowledge is shared with soldiers and marines in Iraq, Philippines, Djibouti, Colombia and with soldiers in the U.S who will soon deploy (AKM Manual, 2005).

2.12.1 JIEDDO Mission and Organizational Structure

JIEDDO's mission is to focus (lead, advocate, coordinate) all DoD actions in support of the Combatant Commanders and their respective joint task forces' efforts to defeat IEDs as weapons of strategic influence. To accomplish this mission, JIEDDO has four specified mission areas: *strategic planning, rapid acquisition, information fusion,*

and operations and training support (JIEDDO, 2010, p.3). Figure 7 displays the current organizational structure.

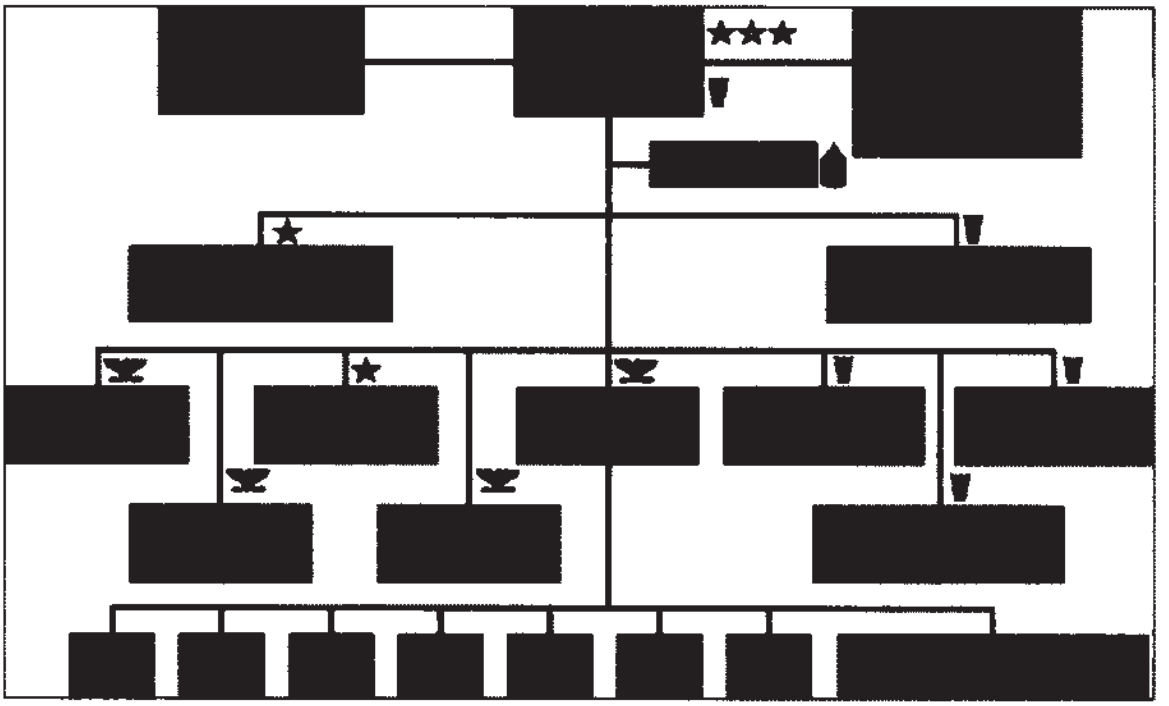

Figure 7. JIEDDO Organizational Structure (JIEDDO, 2010)

JIEDDO has three Lines of Operation (LOOs) to counter the IED threat: Attack the Network (AtN), Defeat the Device (DtD), and Train the Force (TtF).

Attack the Network. The AtN LOO activities aim to find and eliminate bomb makers and their supply sources prior to assembling and emplacing IEDs. JIEDDO's Counter-IED Operations Integration Center works diligently to respond to requests for information and support from theatre. Successes include Airborne Change Detection of IEDs, Airborne Radars for IED detection, and Analytical Support to C-IED.

Defeat the Device. The DtD LOO focuses on solutions that can detect IEDs, neutralize them prior to detonation, or mitigate the effects of detonation at the point of attack. Accomplishments include counter-mine detection system, mine rollers, and trace explosive detectors.

Train the Force. The TtF LOO prepares service members to recognize and protect themselves from IEDs. It also anticipates the evolving threat while merging AtN and DtD initiatives into the training base. Successes include *establishment of realistic home-station training, C-IED mobile assistance training teams, JIEDDO's Joint Center of Excellence, and up-to-date training tactics, techniques, and procedures and last but absolutely not the least JIEDDO Knowledge and Information Fusion Exchange (JKnIFE) management portal.*

2.12.2 JIEDDO Knowledge and Information Fusion Exchange (JKnIFE)

The JIEDDO Knowledge and Information Fusion Exchange (JKnIFE) is an enduring capability of the Joint IED Defeat Organization. JKnIFE consolidates current, relevant counter improvised explosive device (C-IED) data from numerous sources into a central web portal easily accessible by United States and Coalition warfighters.

JKnIFE provides warfighters and C-IED trainers a dynamic repository for *area of responsibility, specific C-IED situational awareness, C-IED training materials and C-IED references to enhance pre-deployment training and improve battlefield information sharing*. Additionally, JKnIFE provides support to warfighters by *maintaining a 24/7 Operations Center* to respond to individual/unit requests regarding IEDs.

JKnIFE consolidates *reports, best practices, and tactics, techniques, and procedures* (TTPs). JKnIFE also provides theater-specific training materials from JIEDDO enablers. Key Features of JKnIFE are stated below:

- Current and relevant C-IED information in support of the DoD communities of warfighters, training, intelligence, research, and development.
- Automated email updates on topics of interest delivered directly to the warfighter and C-IED Community of Practice (CoP).
- JKnIFE's new web portal provides data filtering based on key attributes such as geo-location and IED specifics. Warfighters can refine searches on the new portal to a specific geographical region throughout the world.
- Monthly newsletters highlighting the most current, relevant C-IED training materials available on the JKnIFE portals. Figure 8 shows the snapshot of JKnIFE KM portal.

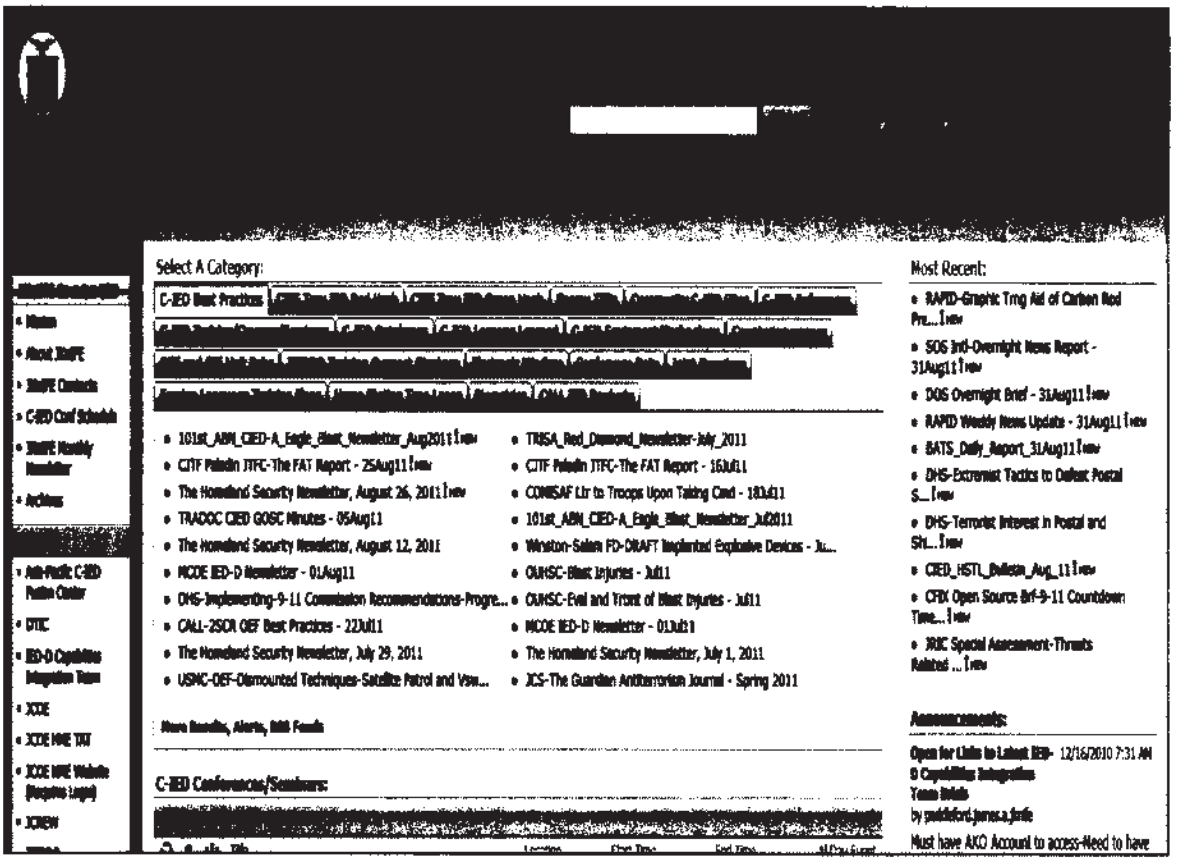

Figure 8. JKnIFE KM Portal

JKnIFE provides a great deal of metrics for the JIEDDO for Knowledge Management.

2.13 Gaps in Military Knowledge Management Literature

Organizations work to manage knowledge effectively. The ultimate goal is to improve firm performance. Organizations realize that knowledge is a critical factor in establishing and maintaining a competitive advantage (Drucker, 1993). KM is a discipline that addresses organizational challenges and improves organizational performance. Organizations recognize the effect that successful KM can have on the organization's performance. Through KM, individuals and organizations can create,

transfer, store, and apply best practices (Alavi & Leidner, 2001). Since KM approaches are becoming established in organizations, it is essential to develop measures and methods to influence performance and fill the gaps in the current KM literature.

Although research regarding Knowledge Management is growing at a fast pace, very little has yet focused exclusively on efforts in the military. More and more anecdotal information about military Knowledge Management is appearing in the popular press and on line, but formal research is still lacking. While there may be a variety reasons for this lack of research, the most significant reason is that the military services are just now beginning their KM efforts in earnest. KM projects have existed in each of the services for some years (OASD/C3I, 2000). Many such projects, however, have been limited in scope and in benefit. In the wake of budget cuts, personnel drawdowns, and increased mission taskings, the services are now realizing the necessity of enterprise-wide knowledge management programs for both their business and war-fighting processes. The Army is becoming increasingly recognized as a leader in military knowledge management as well as being touted as a good example for the private sector to follow (Computerworld, 2007). Although there are many military KM success stories, existing research (Bower, 2001; Johns, et al., 2000; Plant, 2000) raises the need to examine effective use of KM in the military, especially C-IED operations. Plant (2000) investigated KM in the Australian Defence Force and recognized that the military is a complex organization for KM implementation. Bower (2001) identified that cultural, technical, and structural aspects of the military organization require special consideration in making decisions regarding implementing knowledge management projects. Finally, Cho, et al. (2000) identified cultural, technical, and process barriers to sharing knowledge

in their investigation of KM in the DoD acquisition community. The gaps identified in the current KM literature are shown below:

1. There is a minimum empirical work on the description of knowledge management tools, methods, and outcomes (Alavi & Leidner, 2001; Kotnour, 1999).

2. There are few investigations on the application of KM in military (Bower, 2001; Johns, et al., 2000; Plant, 2000)

3. Organizations have experienced a high level of KM failure rates. Organizations have failed to address the KM elements that influence individuals to continue KM participation (Akhavan, et al., 2005).

4. Organizations have had a difficult time assessing the usefulness of KM on the individual, group, and organizational levels. Research is needed to develop methods to evaluate how individuals participate in KM (Lin & Tseng, 2005; Small & Sage, 2006).

5. Research has shown that measurement of complex constructs such as KM with only one indicator (single item approach) doesn't ensure optimal results. Modelling KM with multi-item approach leads to better results (Anderson, 2009).

6. Identification of preconditions for effective use of KM should take note of management capability towards successful organizational transformation (Sathe, 2003).

As such, the purpose of this research is to examine effective use of KM programs in C-IED operations. Such research will be beneficial in identifying influences that may aid the military in circumventing or overcoming barriers and, as a result, facilitate the implementation of KM practices. Table 7 highlights this gap and supports the investigation of the research question.

Table 7. Gap Analysis of the Literature on KM in C-IED Operations

TOPIC	AUTHOR	TYPE OF RESEARCH	HIGHLIGHTS	GAP IN KM
KM Processes	- Kotnour (1999) - Dixon (2000)	Survey and case studies	Create, apply, transfer, assimilate	**GAP** ***(There is no research on C-IED Operations)***
Knowledge Flow Theory	-Nonaka and Takeuchi (1995)	Survey and case studies	SECI, tacit and explicit knowledge	
KM Influences	- Akhavan, et al. (2006) - Akhavan and Jafari (2006) - APQC (1999) - Davenport et al. (1998) - Egbu (2004) - Hasanali (2002) - Leibowitz (1999) - Moffett, et al. (2003) - Mooradian, et al. (2006) - Skyrme and Amidon (1997) - Tobin (2003) - Wong (2005)	Case studies	KM infrastructure, knowledge ontologies and repositories, KM systems and tools, incentives for KM sharing, a supportive culture	
KM Technologies	Hanley, 2001	Case study	Reduced costs of product development, acquisition, or maintenance, Time saving	
KM Organizational Capabilities	- Anderson (2009) - Cho (2011) - Gold, Malhotra and Segar (2001) - Vijayan (2009)	Surveys	Infrastructure and Process capabilities	
KM in Military	-Bower (2001) -Johns et al. (2000) -Plant (2000)	Surveys and case studies	Best practices, Community of Practice	

2.14 The Conceptual Model and Research Hypothesis

The conceptual model of this dissertation, based on the literature review, was formulated and is shown in Figure 9. Most models of KM practices have included many of the same variables, but they have differed in their categorization of those variables and in their posited causal order (Anderson, 2009; Cho, 2011; Gold, Malhotra and Segar, 2001; Vijayan, 2009). The theoretical model used in this thesis is a function of 3 categories of constructs: *KM Infrastructure, KM Process, and Leadership (Managerial) Orientation*. The model used throughout the analysis is presented here in general form.

Effective Use of KM = f (KM Infrastructure, KM Process, and Leadership Orientation)

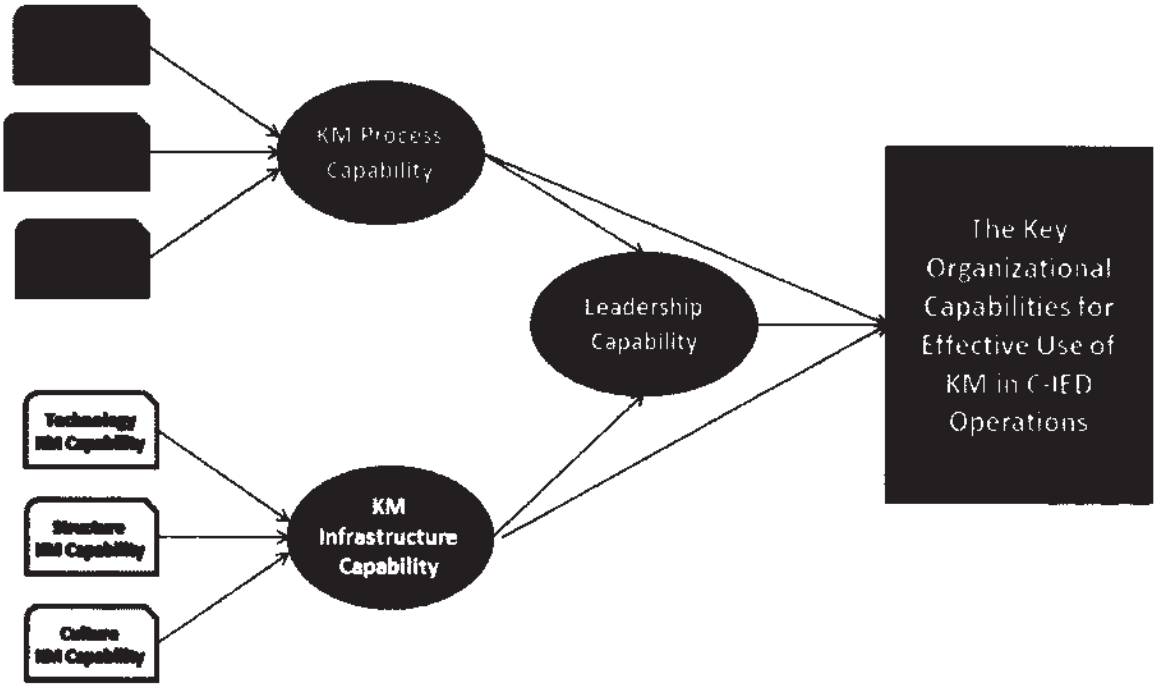

Figure 9. Conceptual Model of KM in C-IED Operations

Based on the research questions and literature review discussion, the following hypotheses will be tested.

1. *Hypothesis 1:*

   $H_0$1: Knowledge Process Capability has a significant impact on KM in C-IED Operations.

   H_A1: Knowledge Process Capability does not have a significant impact on KM in C-IED Operations.

2. *Hypothesis 2:*

   $H_0$2: Knowledge Infrastructure Capability has a significant impact on KM in C-IED Operations.

   H_A2: Knowledge Infrastructure Capability does not have a significant impact on KM in C-IED Operations.

3. *Hypothesis 3:*

   $H_0$3: Traditional Leadership practices have a significant impact on KM in C-IED Operations.

   H_A3: Traditional Leadership practices do not have a significant impact on KM in C-IED Operations.

4. *Hypothesis 4:*

   $H_0$4: Transformational Leadership practices have a significant impact on KM in C-IED Operations.

   H_A4: Transformational Leadership practices do not have a significant impact on KM in C-IED Operations.

5. *Hypothesis 5:*

$H_0$5: Traditional Leadership capability mediates the effect of Knowledge Process Capability on Organizational Capability.

H_A5: Traditional Leadership capability does not mediate the effect of Knowledge Process Capability on Organizational Capability.

6. *Hypothesis 6:*

$H_0$6: Transformational Leadership capability mediates the effect of Knowledge Process Capability on Organizational Capability.

H_A6: Transformational Leadership capability does not mediate the effect of Knowledge Process Capability on Organizational Capability.

7. *Hypothesis 7:*

$H_0$7: Traditional Leadership capability mediates the effect of Knowledge Infrastructure Capability on Organizational Capability.

H_A7: Traditional Leadership capability does not mediate the effect of Knowledge Infrastructure Capability on Organizational Capability.

8. *Hypothesis 8:*

$H_0$8: Transformational Leadership capability mediates the effect of Knowledge Infrastructure Capability on Organizational Capability.

H_A8: Transformational Leadership capability does not mediate the effect of Knowledge Infrastructure Capability on Organizational Capability.

9. *Hypothesis 9:*

$H_0$9: Knowledge Acquisition has a direct effect on Knowledge Process Capability.

H_A9: Knowledge Acquisition does not have a direct effect on Knowledge Process Capability.

10. Hypothesis 10:

$H_0 10$: Knowledge Transfer has a direct effect on Knowledge Process Capability.

$H_A 10$: Knowledge Transfer does not have a direct effect on Knowledge Process Capability.

11. Hypothesis 11:

$H_0 11$: Knowledge Application has a direct effect on Knowledge Process Capability.

$H_A 11$: Knowledge Application does not have a direct effect on Knowledge Process Capability.

12. Hypothesis 12:

$H_0 12$: Technology has a direct effect on Knowledge Infrastructure Capability.

$H_A 12$: Technology does not have a direct effect on Knowledge Infrastructure Capability.

13. Hypothesis 13:

$H_0 13$: Organizational Structure has a direct effect on Knowledge Infrastructure Capability.

$H_A 13$: Organizational Structure does not have a direct effect on Knowledge Infrastructure Capability.

14. Hypothesis 14:

$H_0 14$: Organizational Culture has a direct effect on Knowledge Infrastructure Capability.

H_A14 Organizational Culture does not have a direct effect on Knowledge Infrastructure Capability.

CHAPTER 3

3. METHODOLOGY

3.1 Introduction and Defined Requirements

This chapter provides a data collection and analysis framework for the research. The requirements defined by Creswell (2003) are also presented below, so that connections between the literature and theory can be drawn. A properly defined line of research must be established and supported by a methodology that meets the defined requirements:

- To integrate the multiple themes and perspectives on knowledge management currently available into a unified capabilities perspective,
- To enhance the understanding of a complex organizational phenomena from a military KM perspective,
- To expand the current body of empirical research on KM in C-IED arena in the military,
- To refine the conceptualization of knowledge management capabilities to include not only general organizational capabilities, but also various dimensions addressed separately in the literature including process dimensions, structural dimensions and the effect of leadership (managerial) capabilities, So, the research problem is specified in terms of larger constructs that are broken down into smaller constructs. The smaller constructs provide the opportunity for evaluation.
- To test the theory with the evaluation of a questionnaire that extracts the required information and enables the testing of the stated hypotheses.

- Finally, to provide a framework for identifying the factors that are indispensable for effective use of KM in C-IED operations.

3.2 Research Methodology

Research should address substantive issues (Punch, 2003). Research begins by addressing "what needs to be found" before addressing "how it should be accomplished." With this mind-set, this research takes a top-down approach that moves from a general research question to evaluation of results (Creswell, 2003).

The methodology proceeds as follows:

1. Define the research problem and translate the problem into questions that are relevant to the military, the profession, and academia.

2. Understand the literature and determine what literature is needed to answer the research questions.

3. Generate ideas and develop conceptual models to address the research questions.

4. Develop and define the scope of the research to establish achievable research goals that address the needs of academia and practitioners.

5. Operationalize the research by defining the details of the research methodology. Determine the measures and measurement tools to achieve content and face validity.

6. Design the data-collection instrument by evaluating previous research. Extend and improve previous research, while increasing content validity and face validity.

7. Implement the data-collection plan on a selected sample developed during step 5.

8. Analyse the data using descriptive and inferential statistics.

9. Interpret and discuss the results of the analysis and generate research findings.

10. Produce the final report that states how the research results address the research question. Recommend areas for future research.

The research methodology used in this dissertation is very similar to the social science research process proposed by Miller and Salkind (2002). A high level methodology map of the research is shown in Figure 10.

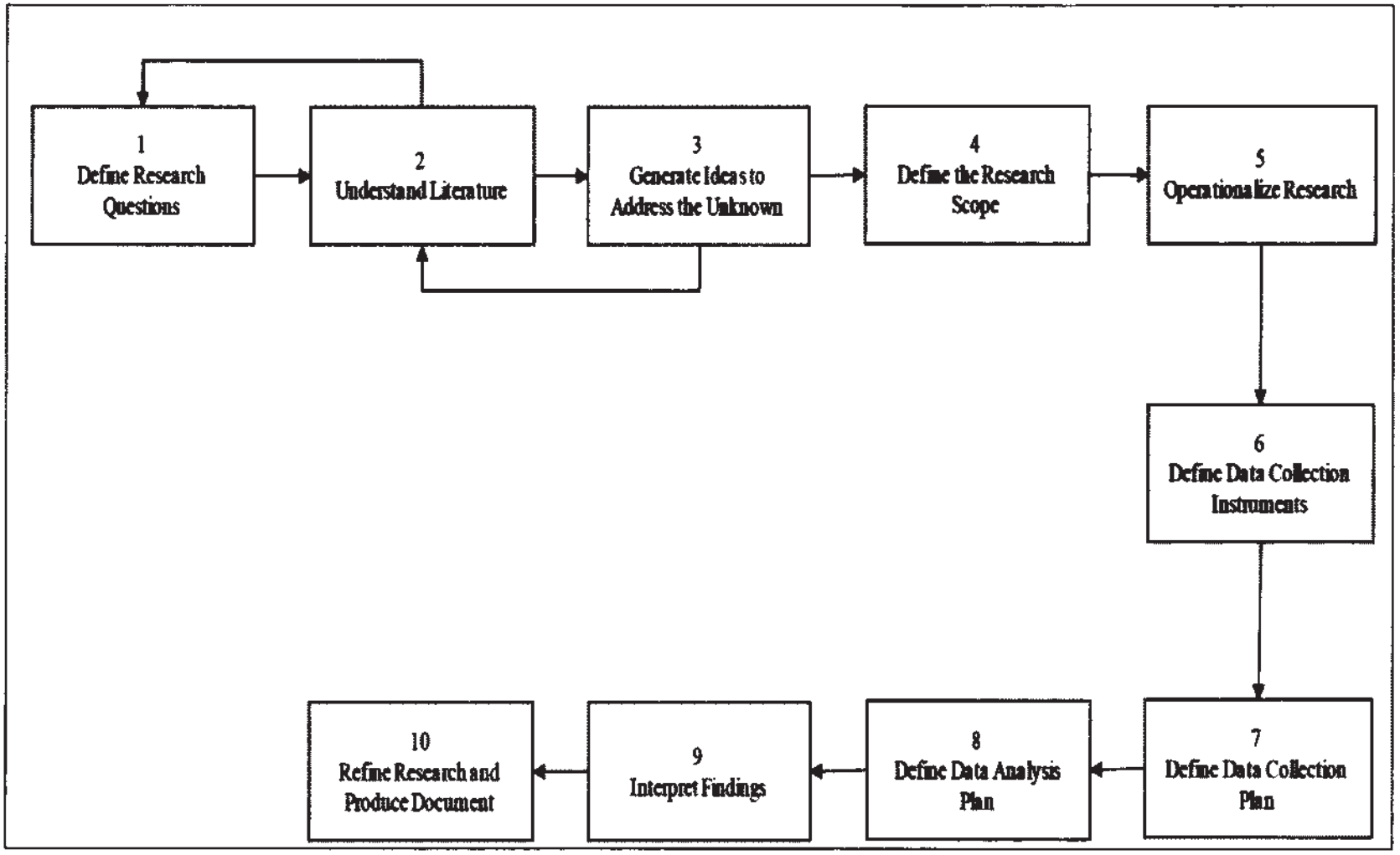

Figure 10. High-Level Methodology (Miller & Salkind, 2002)

3.2.1 Define Research Questions

The objective of this step is to understand the environment and to develop questions that help understand the environment in a clearer manner. The main questions for this research are stated below. The questions are further refined through sub-questions.

1. What are the key organizational capabilities for effective use of KM in military (especially in C-IED operations)?

2. How are these capabilities manifested for effective use of KM in C-IED environment?

3. How does the management (leadership) capability affect the use of KM in C-IED Operations?

3.2.2 Understand the Literature

In order to understand whether the problem of interest is unique, it is necessary to understand the literature of KM. Specifically, this phase focus on understands what is known and what is unknown (Landaeta, 2003). The result is a set of refined questions and an understanding of the phenomena of interest. The gaps identified in the current KM literature are shown below:

1. There is a minimum empirical work on the description of knowledge management organizational capabilities and outcomes (Alavi & Leidner, 2001; Kotnour, 1999).

2. There are few investigations on the application of KM in military (Bower, 2001; Johns et al., 2000; Plant, 2000).

3. Organizations have experienced a high level of KM failure rates. Organizations have failed to address the KM elements that influence individuals to continue KM participation (Akhavan, et al., 2005).

4. Organizations have had a difficult time assessing the usefulness of KM on the individual, group, and organizational levels. Research is needed to develop methods to evaluate how individuals participate in KM (Lin & Tseng, 2005; Small & Sage, 2006).

5. Research has shown that measurement of complex constructs such as KM with only one indicator (single item approach) does not ensure optimal results. Modelling KM with multi-item approach leads to better results (Anderson, 2009).

6. Identification of preconditions for effective use of KM should take note of management capability towards successful organizational transformation (Sathe, 2003).

3.2.3 Generate Ideas to Address the Unknown

The objective of this phase is to generate a conceptual model. The conceptual model needs to include the elements that will be investigated in the study. Methods for generating ideas include analogies, inductive reasoning, and combine ideas collected through the literature. The conceptual model for this dissertation is shown in Figure 11.

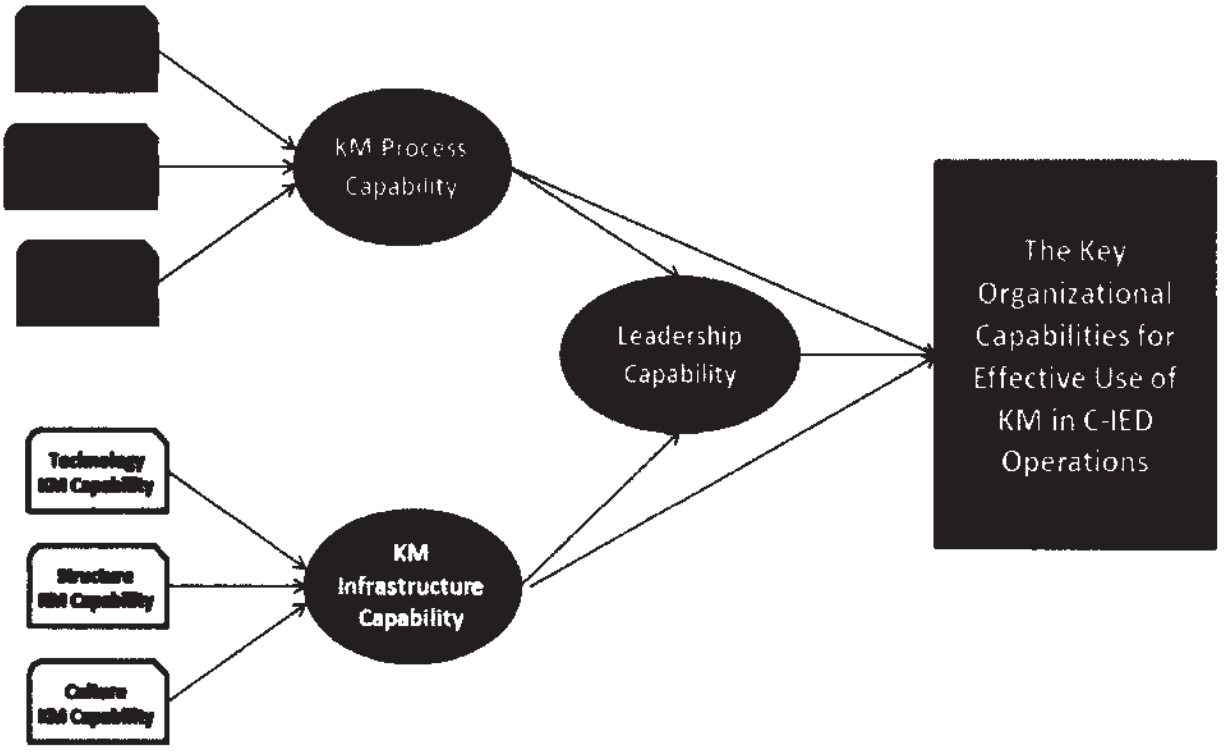

Figure 11. Conceptual Model of KM in C-IED Operations

3.2.4 Define Research Scope

The research scope provides a boundary for the project. The goal of this boundary is to provide a manageable framework that focuses on the topic and addresses the research question in a coherent manner.

3.2.5 Operationalize Research

The conceptual model translates into an operational research model in which key constructs are identified by multiple item measures (Ahire & Devaraj, 2001). The operational constructs translate into measurable behaviours or methods. The measures must be clear and precise to describe the construct adequately.

Operational definition of a variable is the process whereby the research explains a construct's meaning in measurement terms by specifying the activities or operations necessary to measure it (Sekaran, 2003). Since constructs that have direct and indirect effect on KM cannot be directly observed or measured, researchers attempt to indirectly measure the effects through operationalization of their components (indicators).

Operational definitions of variables and terms used throughout this research are provided below (Figure 12). Interpretations and meanings for the variables used in the hypotheses are depicted in Table 8.

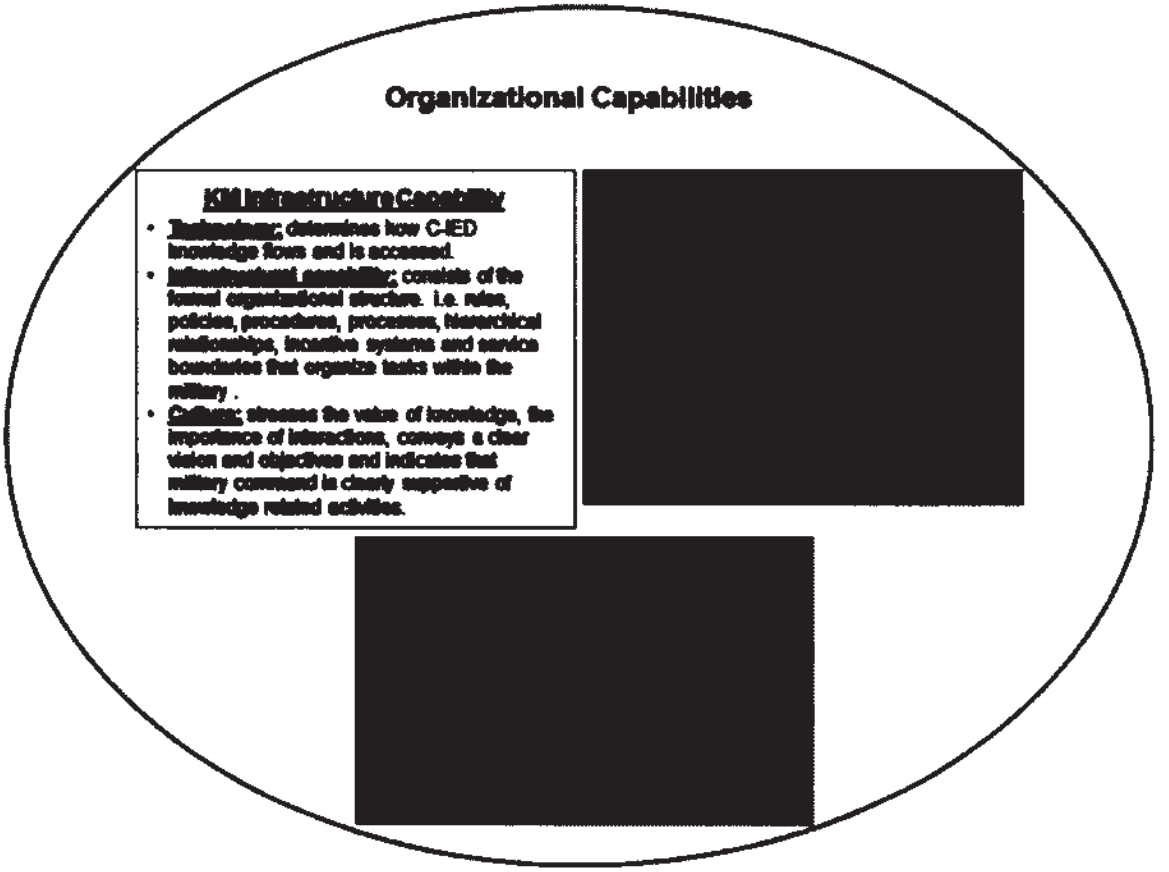

Figure 12. Operational Definitions of the Constructs

Table 8. Operational Definitions of the Constructs and Variables of the Research Model

CONSTRUCT		Q#	VARIABLE DESCRIPTION
Organizational capabilities for Effective use of KM in C-IED Operations/Arena. - *KM Infrastructure, KM Process, and Leadership Orientation* have direct effect on effective use of KM in C-IED Operations.		1	The military processes that use knowledge to create products, services and countermeasures in accordance with the C-IED threat.
		2	The military structural and technological capabilities to track, capture and disseminate knowledge existing in different services of the military.
		3	The military's culture encourages the sharing of knowledge through social interactions with service personnel.
		4	The military encourages commands to practice knowledge management as it is the key to learn, adapt and innovate faster and creation of sustainable competitive advantage over insurgent/terrorist capabilities.
KM INFRASTRUCTURE CAPABILITY	**Technology Infrastructure** - Technology has direct effect on KM Infrastructure Capability.	5	Technology that is used to exchange knowledge with other military personnel/servicemen.
		6	Technology that is used to monitor insurgent/terrorist activities and changes in the C-IED arena.
		7	Technology that is used to search for new knowledge (example: Internet access, data mining, electronic libraries).
	Organizational Structure - Organizational Structure has direct effect on KM Infrastructure Capability.	8	The military organization structure that permits the sharing of knowledge to improve service offerings through innovation.
		9	The staff/military personnel performance appraisal system that rewards knowledge sharing and contribution.
		10	The military 'hybrid' type of structure that combines the benefits of a formal organization and a non-hierarchical structure
	Culture - Organizational culture has direct effect on KM Infrastructure Capability.	11	The military regards its personnel as the most valuable asset and every effort is made to break down invisible barriers that prevent them from sharing their knowledge.
		12	Military personnel are encouraged to experiment with new ideas and if failure happens, the first response is not to assign blame but that they learn from mistakes.
		13	The military promotes lifelong learning to encourage the free exchange of knowledge for success in C-IED operations.

Table 8. Continued

CONSTRUCT		Q#	VARIABLE DESCRIPTION
KM PROCESS CAPABILITY	**Knowledge Acquisition** - Knowledge acquisition has direct effect on KM Process Capability.	14	The military organization regularly obtains feedback from its personnel to ensure services developed are what military personnel want.
		15	The military continuously identifies excellent practices in C-IED and performs knowledge gap analysis to benchmark its knowledge and skill set.
		16	The military policy on cross-functional collaboration for the generation of new ideas that can lead to the innovation of new products and services in C-IED environment.
	Knowledge Transfer - Knowledge transfer has direct effect on KM Process Capability.	17	Important events related to C-IED environment changes are shared with all related military personnel within a short period.
		18	Cross-functional teaming is encouraged to exchange and replace outdated knowledge.
		19	The military encourages the sharing of knowledge by providing mechanisms to convert knowledge held by individuals into organizational knowledge.
	Knowledge Application - Knowledge application process has direct effect on KM Process Capability.	20	The military has processes for transferring lessons learned from previous activities to build a database of knowledge to assist current staff/military personnel to solve current and new challenges.
		21	The military organization has processes for using existing and new knowledge to response immediately, if an insurgent/terrorist was to launch an innovative IED targeted at our military personnel.
		22	The military is oriented to exploring all available knowledge to serve the soldiers in the field and be perceived as 'best in classes".

Table 8. Continued

CONSTRUCT		Q#	VARIABLE DESCRIPTION
LEADERSHIP CAPABILITY	**Transformational Leadership Practices** - Transformational leadership (management) orientation has a direct effect on effective use of KM in C-IED Operations.	23	The higher command in military believes that the ultimate goal of KM is to lay the foundation for the development of organizational transformational culture that propagates innovation and sustainable competitive advantage over insurgents/terrorists.
		24	Reward systems exist to motivate the exchange and creation of knowledge within the military.
		25	The military believes that innovation is the key to sustainable competitive advantage, hence, military personnel are encouraged to experiment and develop new products & services even though the initial results may be insignificant.
	Traditional (Conventional) Leadership Practices - Conventional leadership (management) orientation has a direct effect on effective use of KM in C-IED Operations.	26	The military rigid top-down command and control hierarchal structure and commanders are very protective of their knowledge/skills.
		27	Reward systems are based on compliance and do not tolerate mistakes.
		28	Only new products and services that meet minimum Return on Investment (ROI) are permitted for further research and development.

Table 8. Continued

CONSTRUCT		Q#	VARIABLE DESCRIPTION
ORGANIZATIONAL CAPABILITY	**KM Infrastructure Capability** - KM Infrastructure Capability has a direct effect on effective use of KM in C-IED Operations.	29	Assessment of intellectual capital is part of the overall military personnel performance evaluation and reward process.
		30	The military approach is to better serve in C-IED arena is through knowledge management and innovation.
		31	The military uses technology as an enabler to capture, store and exchange knowledge across the organization regardless of distance
		32	The military actively promotes a culture of trust and openness through its vision statement and value systems.
	KM Process Capability - KM Process Capability has a direct effect on effective use of KM in C-IED Operations.	33	The military uses knowledge mapping to track the source, flow, constraint and loss of knowledge within the services to sustain corporate/institutional knowledge.
		34	Cross-functional teams are involved in the creation, maintenance and continuous improvement of the knowledge processes for merging mechanistic and organic (hybrid) practices.
		35	Security policies and processes are in place to protect knowledge from inappropriate use.

The conceptual model depicted in Figure 11 was restated as the *Hypothesised Model,* as shown in Figure 13. To test the Hypothesised Model, 5 research propositions based on the three research questions were taken and developed as the research hypotheses **(H.1.1 to H.3.6.)** as summarised in Table 9. The model treats each construct, *(acquisition, transfer, application, technology, structure, culture, process capability, infrastructure capability, transformational leadership practices and traditional leadership practices)* as latent variables with multiple indicator measures.

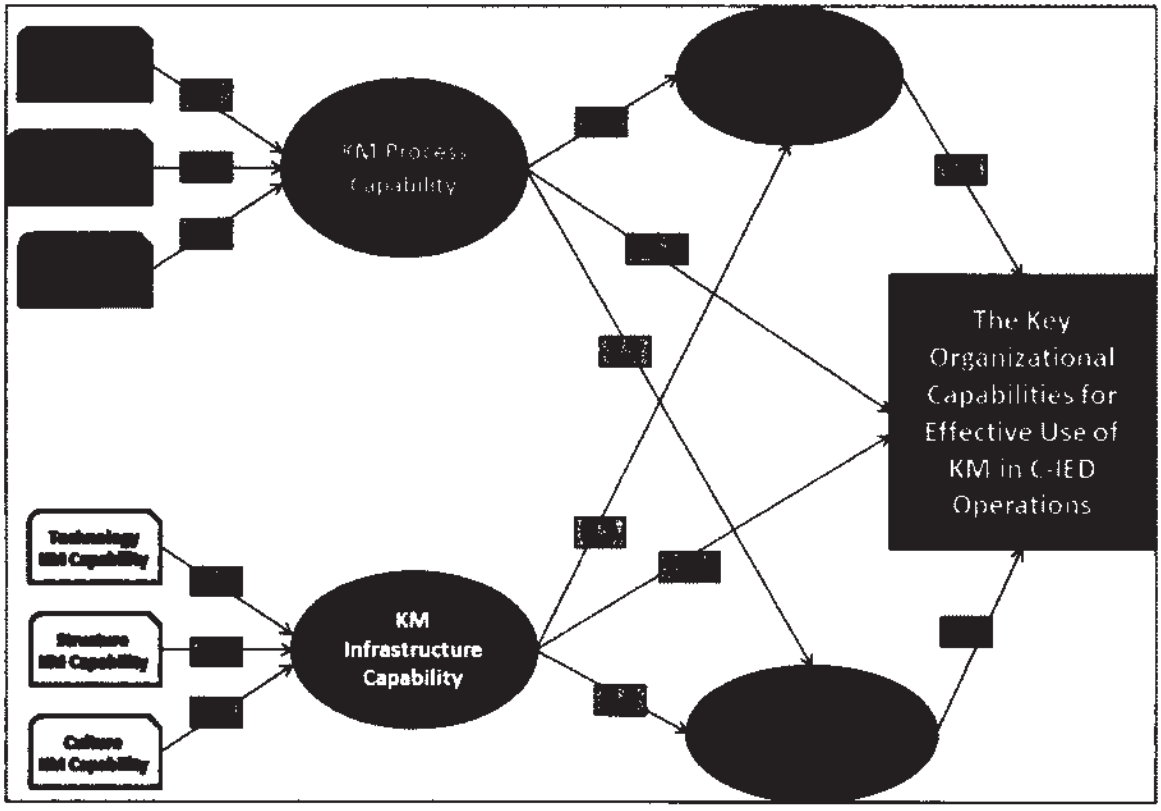

Figure 13. Hypothesized Model of KM in C-IED Operations

Table 9. Summary of Research Questions, Prepositions and Hypothesis

#	RESEARCH QUESTIONS	RESEARCH PREPOSITIONS	RESEARCH HYPOTHESIS (IMPORTANCE FOR KNOWLEDGE MANAGERS)
1	What are the key organizational capabilities for effective use of KM in military (especially in C-IED operations)?	**RP.1** The effective use of KM in military is determined by its organizational capabilities which consist of three constructs: *KM Infrastructure, KM Processes, and Leadership (Transformational/Traditional) capability.*	**H.1.1.** Knowledge Process Capability has significant impact on KM in C-IED Operations.
			H.1.2. Knowledge Infrastructure Capability has significant impact on KM in C-IED Operations.
			H.1.3. Conventional Leadership practices have significant impact on KM in C-IED Operations.
			H.1.4. Transformational Leadership practices have significant impact on KM in C-IED Operations.
2	How does the leadership (managarial) capability affect the use of KM in C-IED Operations?	**RP.2** Leadership capability mediates the effect of Knowledge Process Capability on Organizational Capability for the effective use of KM in C-IED operations.	**H.2.1.** Conventional Leadership capability mediates the effect of Knowledge Process Capability on Organizational Capability.
			H.2.2. Transformational Leadership capability mediates the effect of Knowledge Process Capability on Organizational Capability.
		RP.3 Leadership capability mediates the effect of Knowledge Infrastructure Capability on Organizational Capability for the effective use of KM in C-IED operations.	**H.2.3.** Conventional Leadership capability mediates the effect of Knowledge Infrastructure Capability on Organizational Capability.
			H.2.4. Transformational Leadership capability mediates the effect of Knowledge Infrastructure Capability on Organizational Capability.
3	How are these capabilities manifested for effective use of KM in C-IED environment?	**RP.4** Knowledge Process Capability is a weighted function of three process factors: *Acquisition, Transfer and Application*	**H.3.1.** Knowledge Acquisition has direct effect on Knowledge Process Capability.
			H.3.2. Knowledge Transfer has direct effect on Knowledge Process Capability.
			H.3.3. Knowledge Application has direct effect on Knowledge Process Capability.
		RP.5 Knowledge Infrastructure Capability is a weighted function of three infrastructure factors: *Technology, Structure, and Culture.*	**H.3.4.** Technology has direct effect on Knowledge Infrastructure Capability.
			H.3.5. Organizational Structure has direct effect on Knowledge Infrastructure Capability.
			H.3.6. Organizational Culture has direct effect on Knowledge Infrastructure Capability.

Also, the critical aspect in the evolution of any fundamental theory in any research is data quality, in particular, the development of good measures to assess the generalizability, validity and the reliability of constructs (Bartczak, 2002). Without establishing generalizability, validity and the reliability, it would be difficult to standardize the measurement scales and establish whether the sample truly measures what they are intended to measure and are representative of the population. The various data quality assessment strategies that have been used in this dissertation are summarized in Table 10. The literature suggests that the best solution to the problem reliability and validity is to verify research findings by quantitative techniques such as structural equation modelling (Tabachnick & Fidell, 2001).

Table 10. Data Quality Assessment Strategies

Method	Description	Assessment Strategy
Research Topic Validity	The extent to which the investigation's objectives address current literature gaps and practitioners' concerns/challenges.	- Gap analysis table. - Other authors support of the research objectives.
Research Model Validity	The degree to which the research model and the research method seem to be able to achieve the research objectives.	Alignment of the research model and the research method with the research objectives.
Face Validity	The extent to which the measurement instrument appears to measure what it is supposed to measure (Kerlinger & Lee, 2000).	Pilot study use.
Content Validity	The degree to which the measurement instrument covers the domain of the concept (Kitchenham & Pfleeger, 2002).	Literature review, expert opinion, pretesting survey.
Construct Validity	The extent to which indicators are associated with each other represent a single concept (Tabachnick & Fidell, 2001).	Factor analysis.
Nomological Validity	The extent to which the proposed relationship between the validity constructs is true (Ahire & Davaraj, 2001).	Structural Equation Modelling.

Table 10. Continued

Method	Description	Assessment Strategy
Reliability	The degree of consistency or stability of a scale (Sekeran, 2003).	- Clear instructions and questions. - Pretesting of questionnaire.
Generalizability	The degree to which research based on a sample applies to population as a whole (Forster, 2000).	Systematic sampling techniques.

3.2.6 Data Collection Instrument

The literature review indicates that the survey (questionnaire) approach was the most preferred data collection methodology for KM research mainly due to the following reasons (Johnson, et al, 2001).

- The ability to accommodate large sample sizes and increase the generalizability of the results.

- Ability to distinguish small difference.

- Ease of administering and recording questions and answers.

- Capabilities of using advanced statistical analysis such as structural equation modelling used in this research.

- Abilities of tapping into factors and relationships not directly measurable (Hair, Bush & Ortinau, 2003).

However, using the survey may also have some drawbacks as it is aptly stated by Hair, Bush and Ortinau (2003).

- Difficulty in developing accurate survey instruments.

- Limits to the in-depth detail of data structure.

- Lack of control over timeliness and potential low response rates.

- Difficulties in determining whether respondents are responding truthfully.

The following topics were taken into consideration while developing the research survey.

- It was consulted to NATO C-IED subject matter experts to achieve content validity.
- It was conducted a small focus group from military KM experts to achieve face validity.
- The former KM research questionnaires were used and incorporated to the study to increase content validity. The questionnaires used in the study are Gold, Malhotra and Segar (2001) organizational capabilities perspective analysis, Vijayan's (2009) organizational capabilities assessment, Garland's (2007) KM in e-learning environment.

3.2.7 Data Collection and Analysis Plan

The objective of the data collection and analysis plan is to identify the group actions that could lead to a better use of the study's resources.

The main purpose of the survey (See Appendix A-Questionnaire) is to collect meaningful raw data to test the hypotheses. The design of the questionnaire involves a number of steps. The initial step was determining the specific information needed for the research and where or how to obtain such information. Subsequent steps included: determining the survey method, operational definitions, developing and evaluating the questionnaire, developing the measurement scale, general issues in drafting the

questionnaire and pretesting the final questionnaire before administering the questionnaires to NATO military personnel for data collection.

Permission to conduct the pilot study and follow-on study was obtained through the NATO and ODU Institutional Review Board process (Appendix B) in order to meet ethical conditions of the study (See Appendix C Recruitment Letter). Additionally, the researcher completed training modules before conducting the survey (See Appendix D Responsible Conduct of Research for Engineers Curriculum Completion Report).

In this study, the distribution of the survey questionnaires were based on a self-administered questionnaire using the NATO Unclassified Public Access Network (NUPAN). Being one of the 564 military personnel of the NATO Allied Command Transformation (ACT) Headquarter, research assistant has access to NATO personnel listing to assist in the selection of the necessary sample for the survey. The questionnaire was uploaded to NUPAN and the link was emailed to all NATO military personnel. The staff completed the surveys, clicking the link and filling in the questions. There was no identifiable private information - all questionnaires were anonymous and none of the information could be traced back to any individual directly or through identifiers.

The purpose of conducting the KM survey is to ascribe order to issues and magnitude to the variables that effect KM in C-IED Operations in the military. These two goals require scalar questions as opposed to open-ended questions.

Three types of measurement scales were used in designing the questions to measure the objective and subjective characteristics of respondents in this research. These are *nominal, ordinal and interval* scales. Both nominal and ordinal scales were used to measure the objective characteristics of a respondent in Part One of the questionnaire

(See Appendix A-Questionnaire). Nominal scales were used for identification purposes because they have no numeric value, i.e., the request for staff to identify which military armed forces they are currently employed. Ordinal scales were used, for example, to rank the number of years of the military has been using the KM program. Interval scales were used to design questions in Part Two of the questionnaire to measure the respondent's attitude and behaviour relating to KM in military. In behavioral research, it is common for attitudinal and opinion judgements to be treated as interval data because they allow the respondents to respond in varying degrees to each item that described the construct (Kerlinger & Lee). Moreover, behavioural studies have shown multi-item measures to be more reliable compared with single item counterparts (Miller & Salkind, 2002).

Many researchers have treated the Likert scale format as an ordinary interval scale and determined that it is best suited to research designs that use self-administered surveys (Hair, et al., 2003). Furthermore, Likert scales have been widely used in business research and extensively tested in the social sciences (Neuman, 2003). Hence, for this research Likert scales are adopted as the Likert scale method yields higher reliability coefficients with fewer items than the scale developed using other methods (Neuman, 2003).

Once data were collected, they were analyzed in a manner that brought significance to the research. Data analysis was performed on the collected data utilizing statistical methods in an objective, quantitative evaluation. The steps used in data collection and analysis plan for this research study is summarized in Figure 14.

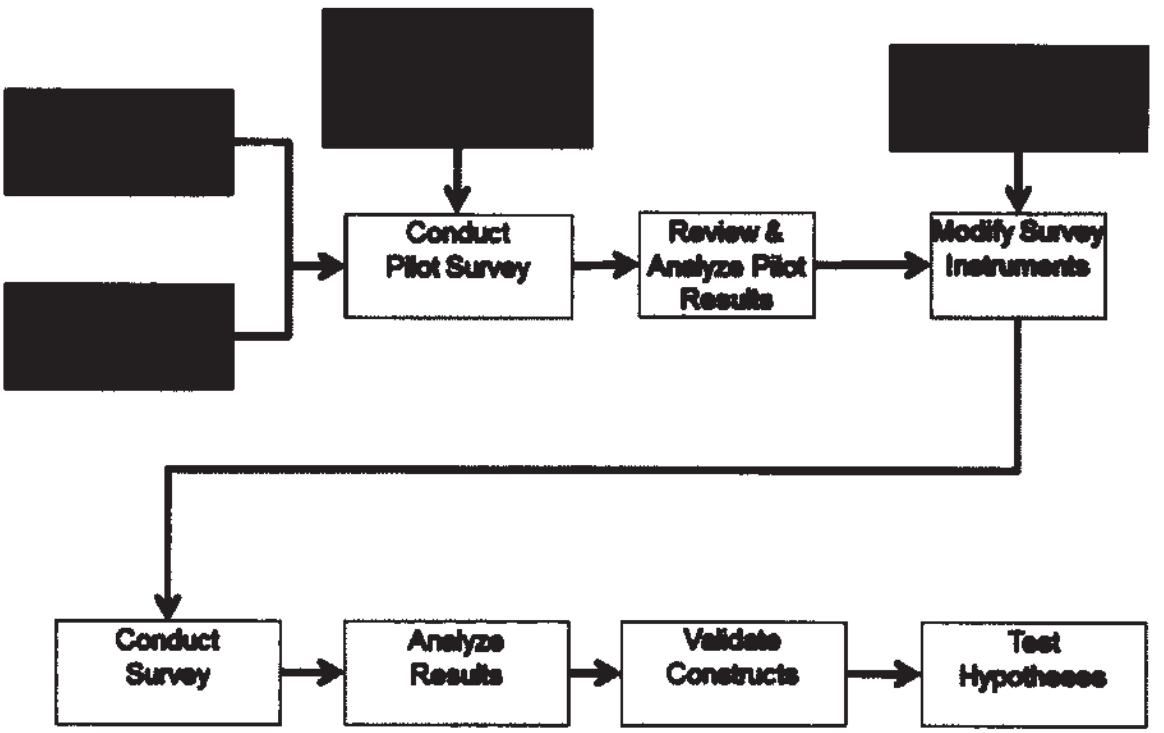

Figure 14. Data Collection and Analysis Plan for the Research

3.2.8 Interpret findings

The objective of interpretation is to determine the extent to which a hypothesis can be accepted/rejected and the implications of the research findings. This phase is achieved through the execution of four groups of actions: conduct inductive reasoning, share results with experts, share results with respondents or organizations, and review of the literature.

3.2.9 Refine and produce final research results

The final goal is to produce a final report. Careful data collection and analysis will be made for the production of the report. The final report must balance the needs of academia and practicing managers to be relevant. Subject feedback and expert opinion of

the analysis are needed to produce the final document. Conclusions, limitations, and suggestions for improvement are the core topic of the final research document. The conceptual model, research model, hypotheses, and data collection lead to the analysis and final conclusions. Suggestions for future research are also included.

CHAPTER 4

4. DATA ANALYSIS AND PRESENTATION OF FINDINGS

4.1 Introduction

The main objective of the current study is to examine the relationship between knowledge management organizational capabilities and organizational effectiveness. The framework of organizational capabilities (Gold, Malhotra, & Segar, 2001; Vijayan, 2009) was used to measure knowledge management organizational capabilities and its effectiveness. This chapter describes discussion of *the relevant/target population, pilot study, sample frame, response rate, model data description, descriptive data analysis, and inferential analysis (Structural Equation Modeling-SEM)* with highlighting the key points. The implications of the results are discussed in Chapter 5.

4.2 Relevant Population

Population is defined as all members of any well-defined class of people, or even objects and it refers to all items of interest (Ary, Jacobs & Razavieh, 2002). In NATO, there are total 28 nations. These 28 nations, targeted for this research are calculated to employ a total population of approximately 11,188[1] military staff in the entire NATO Commands and Headquarters.

[1] NATO Unclassified MC 215/38, NATO Annual Manpower Plan 2012-2016, dated 05 May 2011.

4.3 Target Population

The target population is a collection of individuals or regions that are to be investigated in a statistical study, or it is the group of people that the researcher wants to study (Ary, et al., 2002). In any research, once the target population is well defined, the researcher selects a suitable sampling procedure to obtain an impartial and representative sample. For this research, the target population consisted of NATO HQ Supreme Allied Command Transformation (SACT) with a total of approximately 564[2] official military staff in all 28 NATO nations. Part of the NATO staff was involved in the C-IED environment before (served in Afghanistan, Iraq, etc.) and have familiarized themselves in KM programs before they deployed to C-IED environment.

4.4 Pilot Study

A pilot test was conducted to check the validity and reliability of the research questionnaire. The pilot test is a very important step in developing a survey questionnaire; the pilot study makes a distinction between the validity and reliability tests by identifying aspects of the study design, and the pilot study is seen as a miniaturized "walk-through" of the entire study design (Babbie, 1973). Additionally, a pilot study is undertaken because it provides the researcher with a full review of the questionnaire, the respondents, and the actual test processes (Balian, 1994). Rationale is used to ensure the reliability and validity of the data. The pilot study for this research was conducted using a selection of NATO staff officers who have been to C-IED environment before (10 respondents) who were representative of the population being considered. Participants

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[2] NATO Unclassified MC 215/38, NATO Annual Manpower Plan 2012-2016, dated 05 May 2011.

were instructed to provide all thoughts and comments (both favourable and unfavourable) about any of the questions as they completed the online survey. This information was manually recorded, and the names of participants in the pilot survey remained anonymous in the final documentation of the results. Then, the suggestions and comments from the pilot study respondents were evaluated, and those found to be valid were incorporated into the survey or test design prior to the actual study. As a consequence of the pilot study, a few questions were rephrased to make them easier to understand.

4.5 Sample Frame

There were many techniques that could have been used to determine the sample frame. For this study, the criteria that were used for estimating the sample size are as follows: a precision rate of (+/-) 5%, a 95% confidence level, and a 50% degree of variability. According to Cohen (1988), the larger the sample size, the smaller the error and the greater precision of the result. Since the sample frame population of SACT HQ is 446 military personnel (who are eligible to serve in C-IED operations) in total, the calculated sample size with a precision rate of (+/-) 5%, a 95% confidence level, and a 50% degree of variability, using the Raosoft sample size calculator, is approximately 207.

$$x = Z(^{c}/_{100})^{2} r(100-r)$$

$$n = {}^{Nx}/_{((N-1)E^{2} + x)}$$

$$E = \mathrm{Sqrt}[{}^{(N-n)x}/_{n(N-1)}]$$

n: The sample size,
N: The population size,
E: Margin of error,
r: The fraction of responses,
Z(*c*/100): The critical value for the confidence level *c*

To compensate for non-responses and poor responses, a total number of 300 potential participants was obtained, which was larger than the calculated number required for the desired precision rate, confidence level, and degree of variability. The expected return rate for the survey questionnaire was approximately 50% of the potential participants, that is, about 150 participants.

Additionally, the general rule of thumb for minimum sample size in Structural Equation Model (SEM) studies is 200 (Jackson, 2003). However, there are typically four factors that are used to determine sample size in SEM: model specification, model size, departures from normality and estimation procedure. Using the guidelines for number of model parameters and ability to account for non-normal data, the minimum sample size for this study should be 75. However, if the most common estimation procedure is used, maximum likelihood estimation (MLE), then the minimum sample size should be 100 to 150 (Hair, et al., 1998). Additionally, Loehlin (1992) reports that when using this class of model with two to four factors, the investigator should plan on collecting at least 100 cases, with 200 being ideal (if possible).

4.6 Response Rate

Even though 300 sets of questionnaires were distributed to 28 nations' staff officers in NATO SACT HQ, only 170 sets of questionnaires were successfully collected. The (weighted) response rate was 56.67%, which is typical for small-scale surveys of DoD military personnel (DMDC report, 2010). Among the 170 (56.67%) sets of questionnaires that were returned successfully, only 160 (53.33%) copies were completely answered. The remaining 10 sets (3.33%) of questionnaires that were returned

were not included in the study due to incomplete data or poor responses. Table 11 shows the valid staff response rate.

Table 11. Response Rate of HQ SACT Staff from all NATO Nations (n=160)

	Frequency	Percent
Albania (ALB)	1	0,6%
Belgium (BEL)	-	-
Bulgaria (BGR)	1	0,6%
Canada (CAN)	2	1,3%
Croatia (HRV)	-	-
Czech Republic (CZE)	1	0,6%
Denmark (DNK)	1	0,6%
Estonia (EST)	1	0,6%
France (FRA)	-	-
Germany (DEU)	3	1,9%
Greece (GRC)	1	0,6%
Hungary (HUN)	-	-
Iceland (ISL)	-	-
Italy (ITA)	3	1,9%
Latvia (LVA)	1	0,6%
Lithuania (LTU)	1	0,6%
Luxembourg (LUX)	-	-
Netherlands (NLD)	2	1,3%
Norway (NOR)	4	2,5%
Poland (POL)	-	-
Portugal (PRT)	-	-
Romania (ROU)	-	-
Slovakia (SVK)	-	-
Slovenia (SVN)	-	-
Spain (ESP)	3	1,9%
Turkey (TUR)	13	10%
United Kingdom (GBR)	4	2,5%
United States (USA)	118	73.75%
TOTAL	**160**	**100%**

4.7 Model Data Description

The focus of the research is NATO military staff officers who have served in C-IED environment before. However, the response rate for all NATO nations except USA is not enough for conducting a thorough analysis and cannot be representative of related nation due to the fact that they do not meet the `generalizability` criteria of the study.

Additionally, since the USA is the driving and the most contributing nation of the NATO, as it is aptly stated in the literature review, it would be statistically significant to omit the other NATO nations' responses and narrow the focus of the study on USA only.

Finally, respondents (10 sets) who did not provide valid responses for items essential to the analysis were eliminated from the data set.

4.8 Descriptive Analysis of the Data

The descriptive analysis was performed using Statistical Package for the Social Sciences (SPSS) 19 program. Frequency distributions of the survey questions were calculated based on the 118 valid responses and shown as charts in Figures 15 to 29. Relevant remarks to note from the analysis of the data are also discussed below.

Figure 15 displays the bar chart and frequency distribution of service of the military officers. Army military officers who have served in C-IED environment before has the highest frequency (79.7%).

Service	Frequency	Percent
Army	94	79.7
Navy	14	11.9
Air Force	10	8.5
Total	118	100

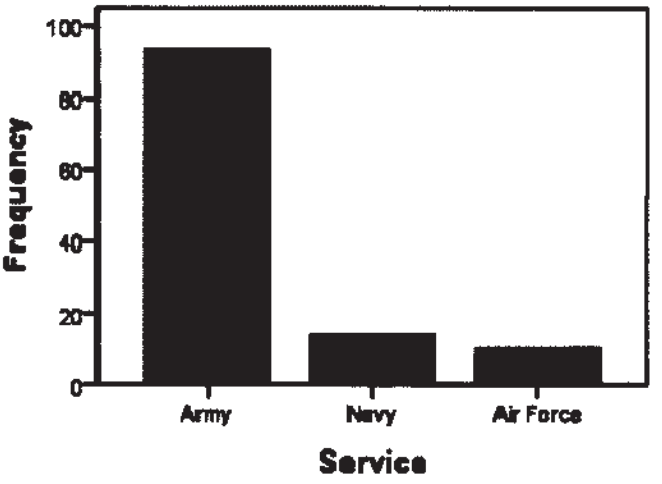

Figure 15. The Chart and Frequency Distribution of Service of US Military Officers

Figure 16 displays the bar chart and frequency distribution of military personnel's rank. Majors (or Lieutenant Commanders in Navy) have the highest frequency (66.9%).

Rank	Frequency	Percent
MAJ /LCDR	79	66.9
LTC/CDR	37	31.4
COL/CAPT	2	1.7
Total	118	100

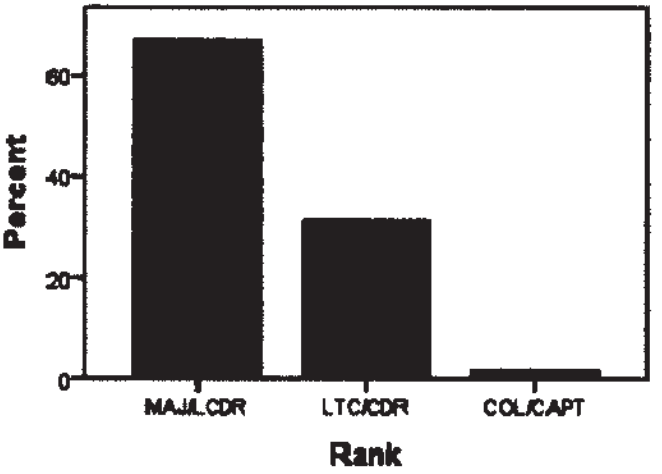

Figure 16. The Chart and Frequency Distribution of Military Personnel's Rank

Figure 17 displays the bar chart and frequency distribution of military personnel's active duty service. Personnel with 10-15 years of active duty service have the highest frequency (47.5%).

Active Duty Service	Frequency	Percent
10-15 Years of Service	56	47.5
16-20 Years of Service	46	39.0
More Than 20 Years of Service	16	13.6
Total	118	100

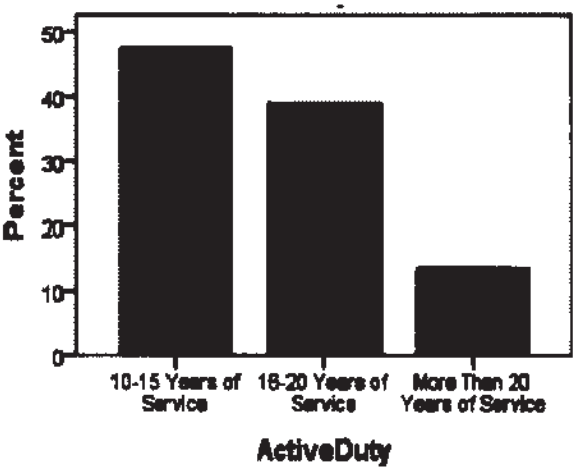

Figure 17. The Chart and Frequency Distribution of Active Duty Service of Military Personnel

Figure 18 displays the bar chart and frequency distribution of military personnel's job types served in C-IED environment before. Most of the personnel have completed staff jobs (serving in HQs) rather than field duties with 51.7%.

Job Type	Frequency	Percent
Staff Job	61	51.7
Field Job	53	44.9
Both Staff and Field Jobs	4	3.4
Total	118	100

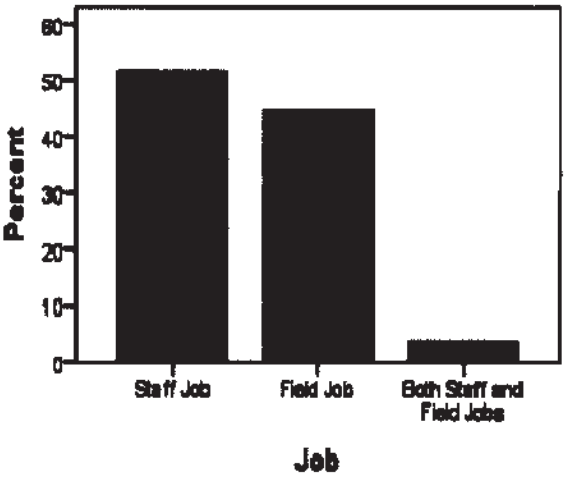

Figure 18. The Chart and Frequency Distribution of Military Personnel's Job Types Served In C-IED Environment

On a scale of 1 (lowest) to 10 (highest), military staff rates that the US military KM programs are ready with 65.3% (rating 6 to 10). Figure 19 displays the bar chart and frequency distribution of status of the KM program in military particularly in C-IED operations. Most of the personnel believe the military already has KM in place with the highest frequency of 48.3%.

KM program status	Frequency	Percent
Do not know	6	5.1
Military is not considering KM program	16	13.6
Military is examining the need for KM program	19	16.1
Military is setting up a KM program	20	16.9
Military already has KM in place	57	48.3
Total	118	100

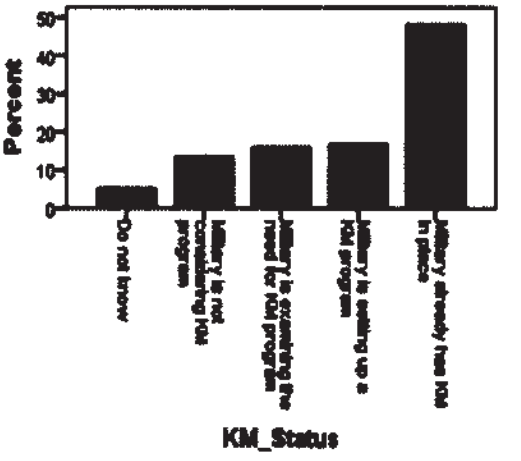

Figure 19. The Chart and Frequency Distribution of Status of the KM Program

In terms of maturity of KM programme, 55.9 % of military staff believe that military has KM programs on C-IED more than 5 years (Figure 20). And the majority of respondents (53.4%) stated that KM programs are effective (Figure 21).

KM Maturity	Frequency	Percent
Do not know	35	29.7
Less than 1 year	5	4.2
More than 1 year	5	4.2
More than 2 years	7	5.9
More than 5 years	66	55.9
Total	118	100

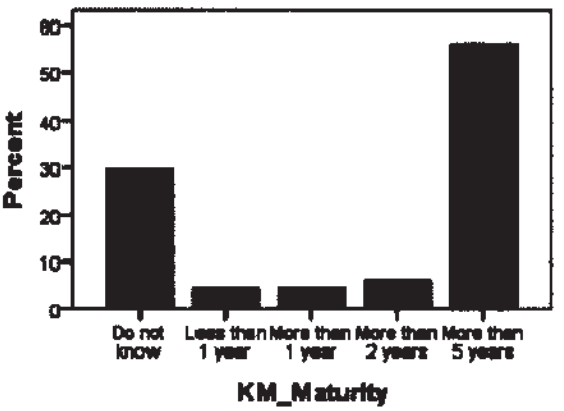

Figure 20. The Chart and Frequency Distribution of Maturity of KM Programs in C-IED Operations

KM Effectiveness	Frequency	Percent
Do not know	26	22.0
Not effective	13	11.0
Too early to tell	16	13.6
Moderately effective	30	25.4
Effective	33	28.0
Total	118	100

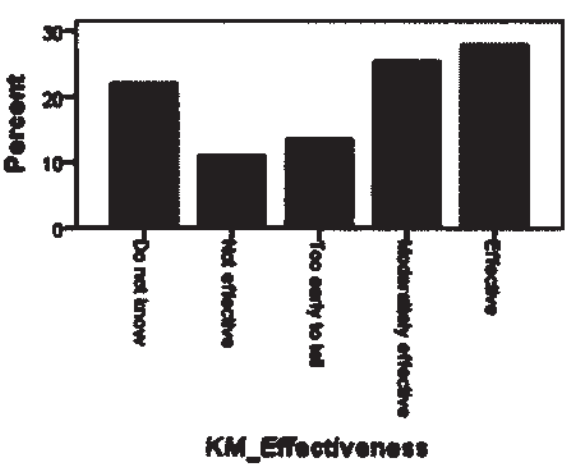

Figure 21. The Chart and Frequency Distribution of Effectiveness of KM Programs in C-IED Operations

When respondents were asked to rank the military's key priorities in C-IED, 47% ranked "defeat the device" projects as the most important; followed by "train the force" (29%), and "attack the terrorist network" at 18%, and knowledge transfer (6%) (Figure 22).

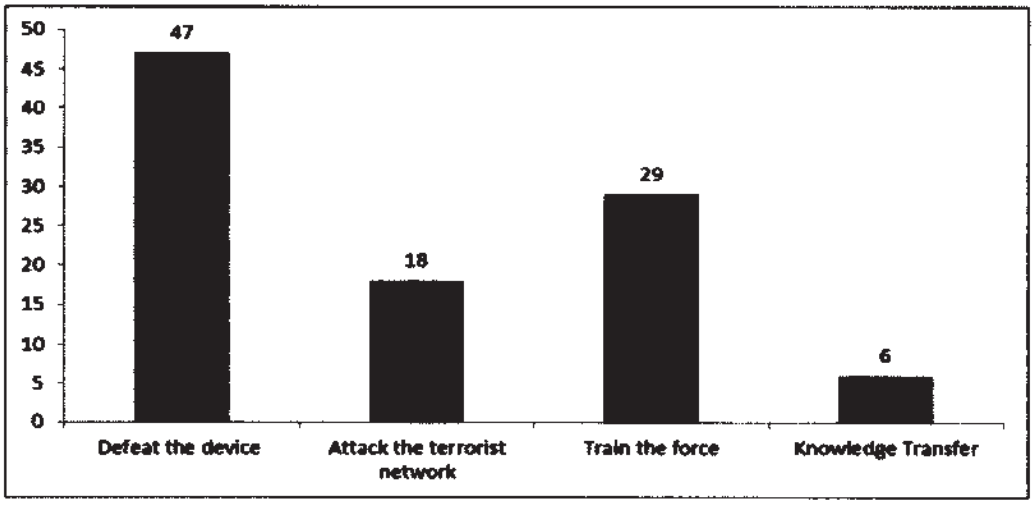

Figure 22. The Chart of Military's Key Priorities in C-IED (%)

Respondents indicated that the main drivers of interest in KM in C-IED operations was to improve knowledge sharing (45%) and improve C-IED/IED database (29%) and knowledge is key for leadership (17%). Disappointingly, only 8% stated that KM is Risk Management (Figure 23).

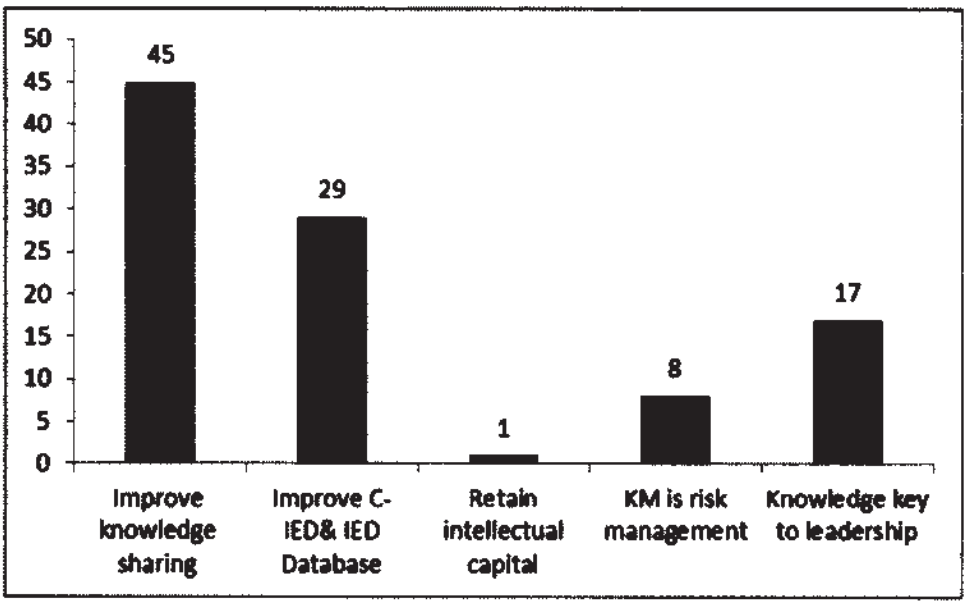

Figure 23. The Chart of the Main Drivers of Interest in KM in C-IED Operations (%)

The respondents cited that "lack of incentives" was the main barrier to sharing knowledge (39%) (Figure 24).

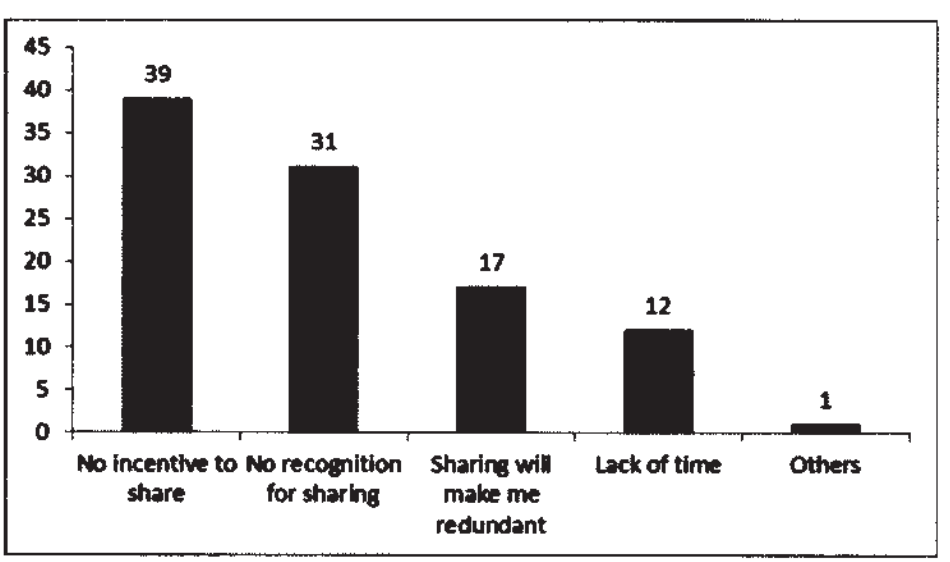

Figure 24. The Chart of Reasons for Not Sharing Knowledge in Military (%)

42% of the respondents indicated that the C-IED knowledge is stored in emails-shareable electronic repository and next in printed document (35%) and then the staff's head/brain (16%) (Figure 25).

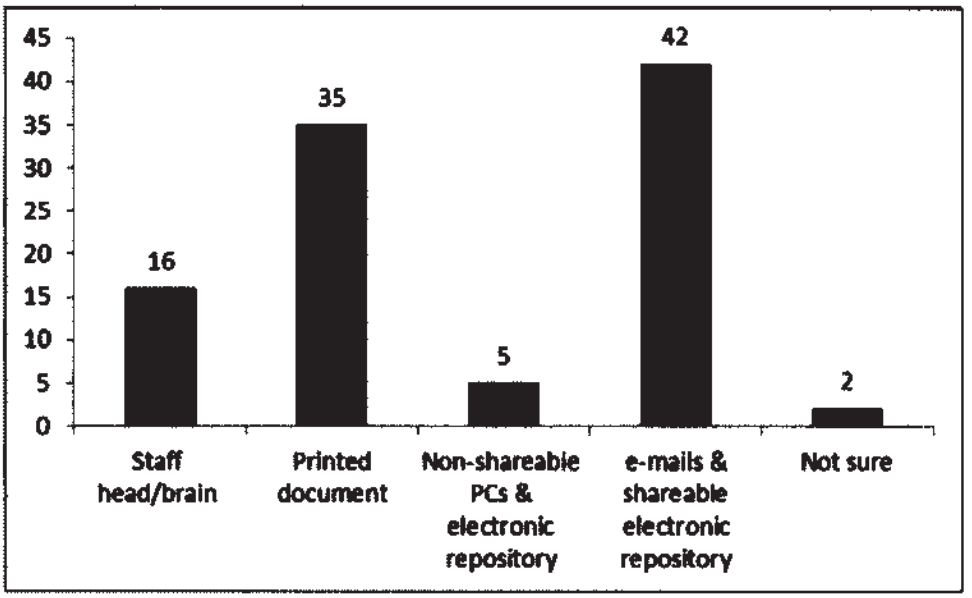

Figure 25. The Chart of C-IED Knowledge Store Locations (%)

Respondents indicated that the most important C-IED knowledge to the military is "Adversary IED tactics and techniques" with 52%, followed by terrorist/insurgent information (35%) (Figure 26).

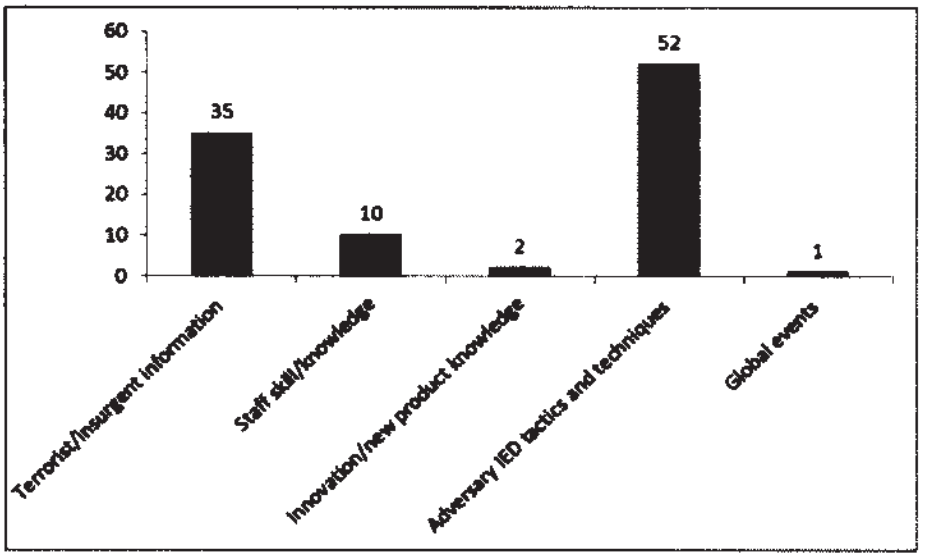

Figure 26. The Chart of Most Important C-IED Knowledge to the Military (%)

Respondents also ranked "experienced military personnel" as the highest main source of IED/C-IED knowledge (41%) (Figure 27).

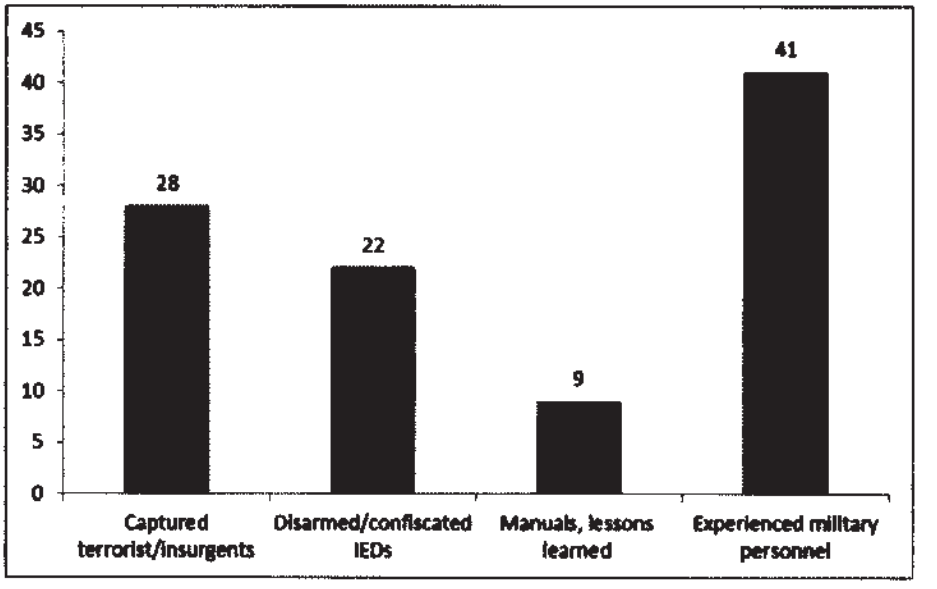

Figure 27. The Chart of the Main Source of IED/C-IED Knowledge (%)

The main barriers to KM implementation cited by respondents are the following: poor appreciation of the benefits derived from KM (40%), lack of training (27%), distrust (23%) and the complexity of KM technology (10%) (Figure 28).

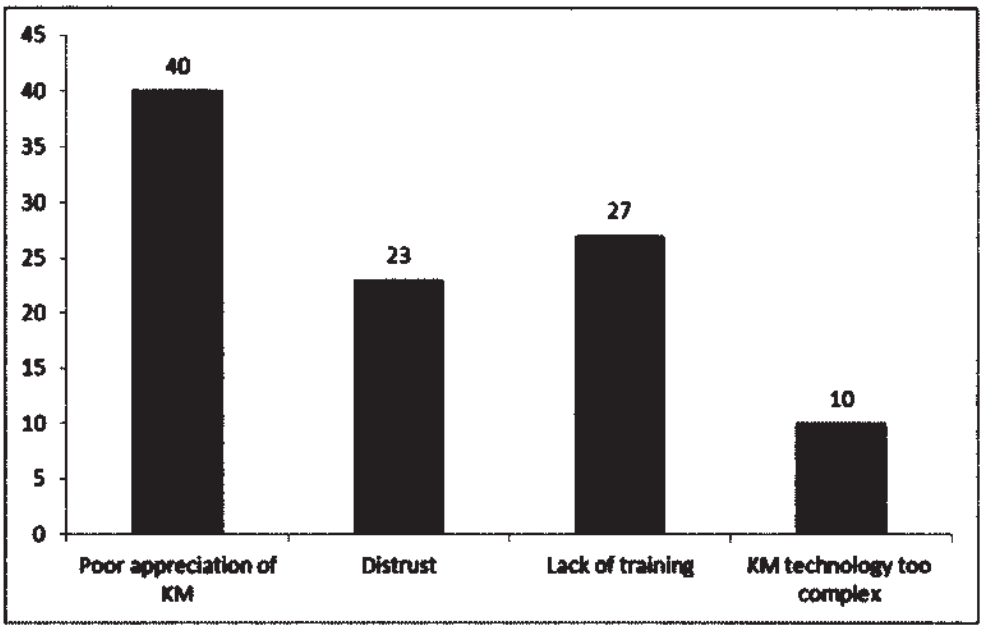

Figure 28. The Chart of Main Barriers to KM Implementation in Military (%)

The main benefits expected from military's KM programs on C-IED are said to be to decrease casualties (42%), defeat the adversaries (25%), innovate, learn and act agile (16%) and increase knowledge transfer between personnel (11%) (Figure 29).

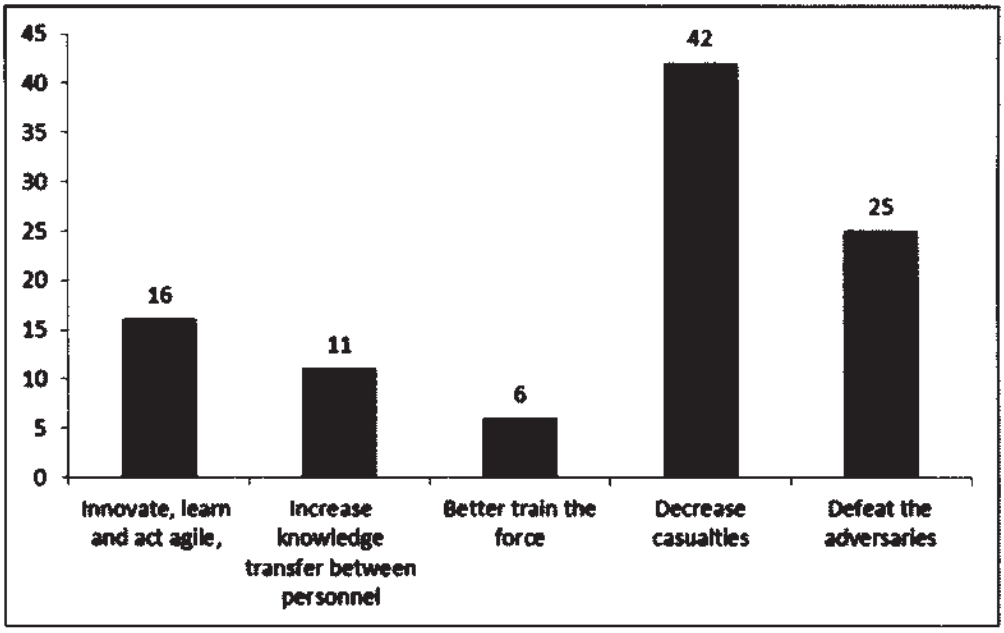

Figure 29. The Chart of Main Benefits Expected from KM programs on C-IED

Table 12 displays the descriptive analysis of all 35 variables.

Table 12. Descriptive Statistics of Variables (n= 118)

Q#	Variable Name *(Legend)*	Mean	S.D	Variance	Skewness	Kurtosis
1	Effective process *(Process)*	4.45	1.238	1.532	-.280	-.290
2	Effective capability *(Structure)*	4.41	1.440	2.072	-.081	-.834
3	Effective culture *(Culture)*	4.93	1.332	1.773	-.183	-.684
4	Effective management *(Management)*	4.71	1.359	1.848	-.188	-.879
5	Technology for exchanging Knowledge *(Tecj_Exchange)*	4.73	1.610	2.592	-.648	-.465
6	Technology for monitoring adversaries *(Tech_Monitor)*	4.86	1.530	2.340	-.671	-.280
7	Technology for search new knowledge *(Tech_NewIdeas)*	4.97	1.684	2.836	-.688	-.566
8	Structure permits sharing knowledge *(Permit_Sharing)*	4.07	1.523	2.320	-.205	-.713
9	Reward for sharing knowledge *(Reward_Sharing)*	3.85	1.545	2.387	-.080	-.756
10	Hybrid organization structure *(Hybrid)*	3.97	1.467	2.153	.060	-.910

Table 12. Continued

Q#	Variable Name *(Legend)*	Mean	S.D	Variance	Skewness	Kurtosis
11	Breakdown invisible barriers *(ValuableAsset)*	4.24	1.350	1.824	-.231	-.368
12	Experiment with new ideas *(Encorurage_Expt)*	3.90	1.532	2.349	.029	-1.121
13	Promote lifelong learning *(LifelongLearning)*	4.27	1.406	1.977	-.346	-.498
14	Obtaining feedback from personnel *(Feedback)*	4.27	1.477	2.182	-.157	-.724
15	Perform gap analysis and benchmarking *(Benchmarking)*	4.24	1.529	2.336	-.263	-.821
16	Collaborate for new ideas *(Collaboration)*	4.22	1.397	1.951	.095	-.533
17	Rapid sharing *(RapidTransfer)*	4.49	1.351	1.825	.061	-.647
18	Update knowledge *(Update)*	4.24	1.400	1.960	-.091	-.902
19	Mechanism to convert knowledge *(Mechanism)*	4.44	1.298	1.684	-.058	-.530
20	Processes for lessons learned *(LessonsLearned)*	4.90	1.290	1.665	-.536	.226
21	Agile reaction to insurgents new TTPs *(AgileResponse)*	4.90	1.290	1.665	-.633	-.117
22	Best in class in military *(BestinClass)*	4.90	1.303	1.699	-.374	-.221
23	Transformational leadership structure *(Trans_Leadership)*	4.61	1.281	1.642	-.175	-.708
24	Transformational reward system *(Trans_Reward)*	3.76	1.647	2.712	.155	-.937
25	Transformational approach to experiment *(Trans_Experiment)*	4.29	1.457	2.121	.024	-.816
26	Traditional leadership structure *(Trad_Leadership)*	5.14	1.473	2.169	-.859	.024
27	Reward system based on compliance *(Reward_Compliance)*	4.95	1.425	2.032	-.486	-.442
28	Traditional approach to ROI *(ROI)*	4.61	1.384	1.915	-.134	-.677
29	Performance evaluation component *(Perf_Evaluation)*	4.34	1.262	1.594	-.355	-.735
30	Innovation *(Innovation)*	4.51	1.413	1.996	-.517	-.488
31	Technology is enabler *(Tech_Enabler)*	4.83	1.270	1.612	-.287	-.691
32	Trust and openness culture *(Trust)*	4.49	1.425	2.030	-.452	-.157
33	Knowledge mapping *(KnowledgeMapping)*	4.14	1.247	1.554	.169	-.399
34	Cross-functional teams *(CrossFunctional)*	4.07	1.382	1.910	-.005	-.942
35	Security policies for knowledge protection *(Security)*	5.27	1.210	1.464	-.362	-.797

4.9 Inferential Analysis (Structural Equation Modeling-SEM)

In this study, knowledge management organizational capabilities are categorized into three capabilities: knowledge infrastructure capability, which includes three variables (i.e., technology, structure and culture), knowledge process capability, which includes three variables (i.e., acquisition, transfer and application), and leadership orientation, which includes two variables (i.e., transformational and traditional leadership capabilities).

The main research model of this study (Figure 13) was comprised of combinations of unobserved variables (i.e., knowledge infrastructure, knowledge process capabilities, and leadership orientation) and observed variables (i.e., technology, structure, culture, acquisition, transfer, application, traditional leadership, transformational leadership), and attempted to identify structural relationships among these combinations. Observed variables are those that can be directly observed, whereas latent variables cannot be directly observed, but are comprised of several observed variables.

Structural equation modelling (SEM) is mostly used to describe causal relationships among unobserved and observed variables (Schumacker & Lomax, 2010). Therefore, a SEM is appropriate for studies where there are several unobservable variables that are measured by observed values from survey instruments. The SEM takes into account all of the different observed values that are used to measure the unobservable variables (Byrne, 2001).

The SEM is a statistical procedure that is similar to the multiple regression procedure, where several independent variables can be fit into the model at the same

time. However, when SEM is compared to the multiple regression procedure, it can be a more powerful process because it is possible to account for interactions, nonlinearities, correlated independents, measurement error, correlated error terms, and multiple latent independents (Raykov & Marcoulides, 2006). Latent variables, also called factors, are those which comprise a combination of unobserved variables. For the current study, the latent variables included the three different knowledge management organizational capabilities. In this research, SPSS 19 Analysis of Moment Structures (AMOS) software program was used for SEM analysis.

Observed variables are represented by square or rectangular shaped boxes, whereas those that are unobserved are represented by elliptical shaped objects. In SEM, the relationships between the observed and unobserved variables are represented by a one-way arrow from the unobserved to the observed variable. The one-way arrow indicates that the unobserved variable is measured or comprised of the observed variables in which the arrows are connected. For the study, there were observed variables taken from the survey instrument to measure the latent variables. The model for this study was created to illustrate the relationships between the independent and dependent variables. The independent variables (knowledge infrastructure, process capabilities, and leadership orientation) in the model were those assumed to predict or impact a dependent variable (effective use of KM in C-IED operations). The relationship between the independent and dependent variables were accomplished by connecting them through paths (Byrne, 2001). The basic diagrams relations between observed variables, latent variables, and errors. The factors might be correlated, and were represented by curved arrows; the straight arrows represented regression coefficients. The latent variables were assumed to be causes of the

observed variables, and this was represented by a straight arrow with a single head. The direction of a single head meant the direction of cause to effect. Once the models were created, the analysis provided information regarding the relationships between the eight different knowledge management capabilities.

4.10 SEM Model

The model used for SEM analysis in this research is recursive. Recursive models are the straightest forward because their disturbances are independent and no variable is both a cause and an effect of another variable. In contrast, non-recursive models have feedback loops and may have a disturbance correlation. Thus, problems such as identification are more likely to occur in the analysis of a non-recursive model than in a recursive model (Bryne, 2001; Kline, 2005). Kline (2005) reported that there are relatively few non-recursive models in the social science literature. In brief, since there were no theoretical reasons to justify not using recursive models in this research, the recursive model conceptualised for this research was acceptable (Schumacker & Lomax 2004).

4.10.1 SEM Model Estimation Approach

The SEM model can be divided into two sub-models: a measurement model and a structural model. The measurement model defines relations between the observed and the unobserved (latent or indicator) variables. In contrast, the structural model defines relations among the unobserved variables. So, in this study, at the first phase, a confirmatory factor model (i.e. the measurement model) was used to measure the fit

between the theorized model and the observed variable. At the second phase, the results of the measurement model were used to create a path-analytic model to investigate the relationships hypothesized in this research.

4.11 Measurement Model Analysis

The best-known statistical procedure for investigating relations between sets of observed and latent variables is factor analysis (Byrne, 2001). There are two basic types of factor analysis: exploratory factor analysis (EFA) and confirmatory factor analysis (EFA). In EFA, the researcher has limited or no prior knowledge what the variables do and is designed for situations where links between the observed and latent variables are unknown or uncertain. Whereas, in CFA the researcher has some knowledge of the underlying latent variables structure (Kline, 2005).

Factor analysis by specification search technique available in AMOS 5 (Arbuckle, 2003) was applied to the whole 11 dimensions of the measurement model (Figure 30) consisting of three-indicator and four-indicator sub-models with the following constructs: *Acquisition, Transfer, Application, Technology, Structure, Culture, KM Process Capability, KM Infrastructure Capability, Traditional Leadership Orientation, Transformational Leadership Orientation, Organisational Capabilities.*

The purpose of the specification search was to obtain guidance as to which subset of single headed arrows are essential to the model to determine the most optimum combination and to access the reliability and validity of the multi-item measures in the model (Arbuckle 2003; Schumacker & Lomax 2004).

Table 13 shows the standard factor loadings, the standard error (S.E.) and critical ratio (C.R.) values of the various indicator variables of Figure 30. The S.E. of the coefficient represents the expected variation of the estimated coefficient and is an index of the 'efficiency' of the exogenous or observed variables, the smaller the S.E. the more efficient the observed variable. The C.R. is a test of the significance of the regression coefficient. The C.R. test was obtained by dividing the parameter estimates by their respective standard errors and it is distributed approximately as z. As such, a critical ratio more extreme than ± 1.96 or ± 2.56 indicates a significant path ($p<0.05$) and ($p<0.01$) respectively. The C.R. for all the item measures In the CFA exceeded 2.56 indicating each path was significant.

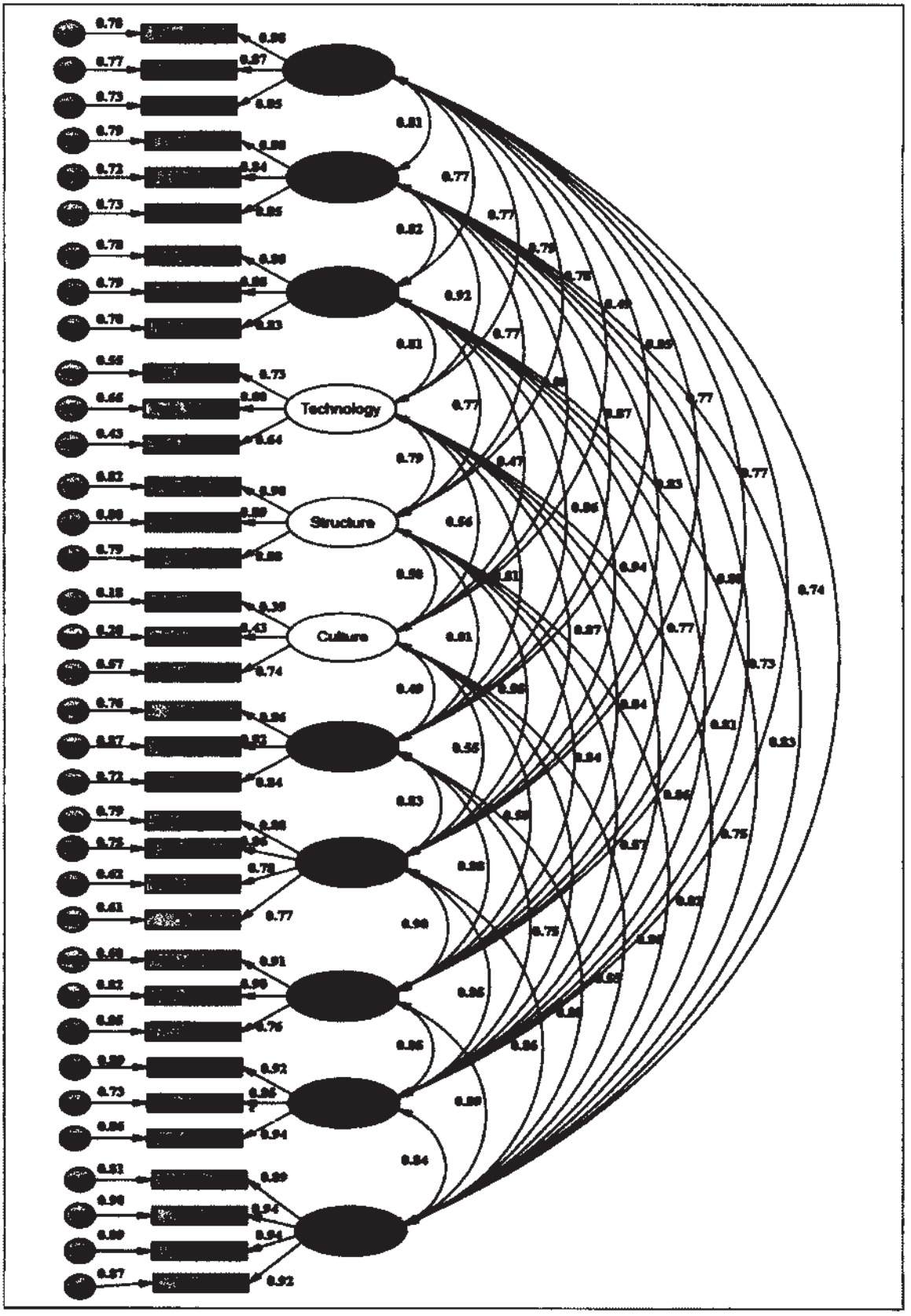

Figure 30. Confirmatory Factor Analysis of Measurement Model in KM in C-IED

Table 13. Standard Factor Loading and z Values of the Model

Q#	Variable	Constructs	SF Loadings	S.E	C.R. $(z)^2$	p
1	Process	Organizational Capabilities	**0.92**	0.037	**5.391**	0.001
2	Structure		**0.94**	0.032	**5.341**	0.001
3	Culture		**0.94**	0.036	**5.408**	0.001
4	Management		**0.89**	0.054	**9.301**	0.001
5	Tech_Exchange	Technology	**0.73**	0.065	**4.980**	0.001
6	Tech_Monitor		**0.80**	0.026	**5.925**	0.001
7	Tech_NewIdeas		**0.64**	0.037	**5.731**	0.001
8	Permit_Sharing	Structure	**0.90**	0.034	**5.090**	0.001
9	Reward_Sharing		**0.89**	0.045	**7.878**	0.001
10	Hybrid		**0.88**	0.038	**5.628**	0.001
11	ValaubleAsset	Culture	**0.39**	0.086	**4.880**	0.001
12	Encourage_Expt		**0.43**	0.078	**4.666**	0.001
13	LifelongLearning		**0.74**	0.047	**4.948**	0.001
14	Feedback	Acquisition	**0.88**	0.028	**6.090**	0.001
15	Benchmarking		**0.87**	0.054	**5.885**	0.001
16	Collaboration		**0.85**	0.031	**4.746**	0.001
17	Rapid_Transfer	Transfer	**0.88**	0.033	**4.367**	0.001
18	Update		**0.84**	0.047	**4.084**	0.001
19	Mechanism		**0.85**	0.056	**4.536**	0.001
20	LessonsLearned	Application	**0.88**	0.028	**4.941**	0.001
21	AgileResponse		**0.88**	0.029	**4.677**	0.001
22	BestinClass		**0.83**	0.032	**4.560**	0.001
23	Trans_Leadership	Transformational Leadership Orientation	**0.92**	0.034	**9.572**	0.001
24	Trans_Reward		**0.85**	0.054	**5.094**	0.001
25	Trans_Experiment		**0.94**	0.045	**5.294**	0.001
26	Trad_Leadership	Traditional Leadership Orientation	**0.91**	0.048	**4.707**	0.001
27	Trad_Reward		**0.90**	0.049	**5.855**	0.001
28	ROI		**0.76**	0.067	**7.587**	0.001
29	Perf_Evaluation	KM Infrastructure Capability	**0.88**	0.086	**6.249**	0.001
30	Innovation		**0.86**	0.053	**8.739**	0.001
31	Tech_Enabler		**0.78**	0.032	**11.391**	0.001
32	Trust		**0.77**	0.029	**8.541**	0.001
33	Knowledge Mapping	KM Process Capability	**0.86**	0.046	**19.108**	0.001
34	CrossFunctional		**0.92**	0.048	**23.190**	0.001
35	Security		**0.84**	0.084	**24.560**	0.001

z values exceeding ± 2.56 ($p<0.01$) are significant.

4.12 Reliability and Validity Analysis of the Constructs

4.12.1 Reliability

Reliability refers to the accuracy of a measurement scale, and validity refers to the extent to which the scale measures the theoretical construct. In this study, construct validity was established through an extensive review of the literature, which is a common practice in quantitative research (Wainer & Braun, 1998). Cronbach's Coefficient alpha (symbolized as α) is commonly used to test for reliability of multi-item scales as it refers to whether items are sufficiently interrelated and estimates the reliability of internal scale consistency (Cooper & Emory, 1995). For the alpha values to be acceptable as indicators of internal consistency, they must meet the threshold of 0.70, as suggested in the literature (Gefen, Straub, & Boudreau, 2000; Hair, et al., 1995).

The alpha values for all the latent constructs in this research for the research model (Figure 30) are shown in Table 14 and exceeded the minimum reliability coefficient requirement of 0.70, thereby demonstrating that all the various dimensions are internally consistent and have acceptable reliability values in their original form.

However, some researchers have even suggested minimum values of 0.30 or less depending on the type of the research (Kline, 2005; Tabachnick & Fidell, 2001; Vijayan, 2009). As this research is considered the first attempt to develop model to explain determinants of effective knowledge management in C-IED operations in military, aforementioned suggestions were adopted for the rest of this study:

- *Values **0.20 and less** have negligible effect/support,*
- *Values **0.21 to 0.40** have weak effect/support,*
- *Values between **0.41 to 0.60** have moderate effect/support,*

- *Values between **0.61 to 0.80** have significant effect/support and*
- *Values above **0.80** have very significant effect/support.*

Table 14. Reliability Analysis of the Research

Q#	Constructs	Cronbach's Alpha (α)	Q#	Constructs	Cronbach's Alpha (α)
Q1	Organizational Capabilities	.962	Q20	Application	.920
Q2			Q21		
Q3			Q22		
Q4			Q23	Transformational Leadership Orientation	.917
Q5	Technology	.908	Q24		
Q6			Q25		
Q7			Q26	Traditional Leadership Orientation	.962
Q8	Structure	.949	Q27		
Q9			Q28		
Q10			Q29	KM Infrastructure Capability	.951
Q11	Culture	.905	Q30		
Q12			Q31		
Q13			Q32		
Q14	Acquisition	.942	Q33	KM Process Capability	.924
Q15			Q34		
Q16			Q35		
Q17	Transfer	.958			
Q18					
Q19					
Reliability Coefficients (α) = 0.9524 for the whole survey **Number of cases = 118 in the whole survey** **Number of items = 35 in the whole survey**					

4.12.2 Unidimensionality

The construct validity and reliability checking is the unidimensionality of the measure (Anderson and Gerbing, 1991). And, unidimensionality is assessed by the

implementation of a confirmatory factor analysis (Ahire & Davaraj, 2001). So, to test whether the indicator items where measuring the same construct (convergent validity) and to drop those items that were cross loading (that is, loading on more than one factor) and items that were highly correlated (multicollinearity), a confirmatory factor analysis was performed on the measurement model. Additionally, the indicators that measure the same construct should exhibit convergent validity that is, they should be at least moderately correlated and indicators of different constructs should not be so highly correlated (Kline, 2005; Sekaran, 2003). Appendix E lists the correlation relationships among the variables for this research and the results indicate that the analysis does not include sign and statistical significance of the correlation.

4.12.3 Face Validity

Face validity is the extent to which the measurement instrument appears to measure what it is supposed to measure (Kerlinger and Lee, 2000). In face validity, one looks at the measure and sees whether "on its face" it seems a good reflection of the construct. Although it is the weakest way of demonstrating construct validity, a researcher also relies on subjective judgement and hence has its usefulness. The face validation of study constructs was confirmed by a group of military KM experts before conducting the survey.

4.12.4 Content Validity

Content validity is the degree to which the measurement instrument covers the domain of the concept (Kitchenham & Pfleeger, 2002). The evaluation of content validity

is not a statistical matter but based on expert opinions. The instrument used in this research has been developed based on a detailed analysis of literature. Additionally, study was pretested with a focus group and subject matter experts in C-IED and KM in military. Their input was incorporated to the survey final construction; such as short and brief questions, asking no negative questions, etc.

4.12.5 Convergent Validity

Convergent validity involves the evaluation of measures against one another instead of against an external criterion. When there is a high correlation between a measure and other measures that are believed to measure the same construct, convergent evidence for validity is obtained (Kaplan & Sacuzzo, 1993). For the study, correlations are lower than 0.80 and significant, ($p<0.01$); suggesting that the variables do not measure the same construct and display no evidence of convergent validity.

4.12.6 Nomological Validity

Nomological validity is the extent to which the proposed relationship between the validity constructs is true (Ahire & Davaraj, 2001). It is measured by chi-square and degrees of freedom, the p-value of which should be above 0.05 for significance. The nomological validity of the variables in the model can be explored by observing the correlations between constructs. The correlation matrix of constructs involved in the model appears in Appendix E. Specifically, the direction of all the relationships hypothesized in the model was supported, providing strong evidence of nomological validity.

4.13 "Goodness of Fit" Analysis

The model was first tested by using SEM procedures to determine whether it was a good fit, often called as goodness-of-fit test, which is a statistical test to find whether a model fits a set of data, whether it matches a theoretical expectation (Vogt, 2005). A hypothesized model that has a good fit indicates that the model adequately describes the sample data. There are a few criteria for checking the model fit, but this study adopted six criteria: *the chi-square, the chi-square dividing by the degree of freedom (CMIN/DF), Goodness of Fit Index (GFI), Comparative Fit Index (CFI), Root Mean square Residual (RMR), and Root Mean Square Error of Approximation (RMSEA).*

4.13.1 The chi-square and the chi-square dividing by the degree of freedom (CMIN/DF)

One of the most basic measures of absolute fit is the likelihood ratio measure with Chi-square test (χ^2) (Hair et al. 1998). The χ^2 statistics value relative to degrees of freedom is said to be significantly different from zero ($p<0.05$ or $p<0.01$) when there is a difference between the population covariance matrix and the implied covariance matrix (Shumacker & Lomax 2004). However, its use is limited by its sensitivity to the sample size (Anderson & Gerhing, 1988; Hair, et al., 1998). That is, when the sample size is large, the χ^2 statistics may be significant even though the difference between observed and model implied covariances is minor. One of the first fit statistics to address the Chi-square test (χ^2) limitation was to divide its value by the degrees of freedom (χ^2 / df) to reduce the sensitivity of χ^2 the sample size. This normed chi-square test ratio (χ^2 / df) is regarded as a measure of absolute fit and model complexity in SEM literature because it

is unaffected by the sample size. So for this study, $1.0 < \chi^2 / df < 3.0$ range is adopted for this research. (Byrne, 2001; Kline, 2005; Vijayan, 2009).

4.13.2 Goodness of Fit Index (GFI)

The GFI is based on the ratio of the sum of the squared differences between the observed and reproduced matrices to the observed variances (Schumacker & Lomax, 2010). It ranges from zero to 1.0; a value close to 1.0 indicates a good fit. Generally, when a GFI is more than 0.9, it indicates that the model is relatively good-fitting (Byrne, 2001).

4.13.3 Comparative Fit Index (CFI)

The CFI measures the relative improved fit in the researcher"s model when compared to the baseline model (Kline, 2005). The CFI value has a range from 0 to 1, where a CFI of 1 indicates that the chi-square statistic that assesses the fit of the model is less than the degrees of freedom, not that the model resulted in a perfect fit. In general, a CFI of approximately 0.95 indicates that the model is relatively good-fitting (Byrne, 2001).

4.13.4 Root Mean square Residual (RMR), and Root Mean Square Error of Approximation (RMSEA)

The RMR is the average residual value derived from the fitting of the variance-covariance matrix for the hypothesized model to the variance-covariance matrix of the sample data (Byrne, 2001). The smaller the RMR, the better the model. An RMR of zero

indicates that the model is a perfect fit. In general, when a RMR is smaller than 0.05, it indicates that the model is relatively good-fitting.

The RMSEA is another fit index that assesses how well the proposed model fits the data. The RMSEA statistic takes into account the error of approximation in the population (Byrne, 2001). It then assesses how well the model fits the population covariance matrix if the population covariance matrix was available. Values of the RMSEA that are around 0.05 or less indicate that the model provides a quality fit. On the other hand, an RMSEA of around 0.08 to 0.10 indicates that the fit of the model is questionable, while an RMSEA greater than 0.10 indicates a poor-fitting model. Each of these fit indices was used to assess the fit of the model for the internal relationship within eight different knowledge management capabilities aspects.

Goodness-of-fit statistics for the research model was displayed in Table 15. Based on this criterion, the research model indicates 'good fit' and the finding suggested that the model fitted the sample data well and is significant at $p<0.001$.

Table 15. Goodness of Fit Results (CFA Measurement Model)

AMOS Fit Measures	Acceptable Criteria	Model Fit Results
Probability value (p)	$p < 0.05$	0.001
The chi-square dividing by the degree of freedom(χ^2 / df)	$1.0 < \chi^2 / df < 3.0$	2.25
Goodness of Fit Index (GFI)	$0.9 \leq$ GFI	0.92
Comparative Fit Index (CFI)	$0.95 \leq$ CFI	0.95
Root Mean Square Residual (RMSR)	RMSR < 0.05	0.043
Root Mean Square Error of Approximation (RMSEA)	RMSEA around 0.05	0.057

4.14 Hypothesized Model (Structured Model) Analysis

This section examines the hypotheses stated earlier in Table 9 and illustrated in AMOS notation in Figure 31 to determine the relationship between Knowledge Process Capability, Knowledge Infrastructure Capability, Leadership Orientation and Organisational Effectiveness of KM based on the integrated framework discussed in earlier. As the objective of the study was to determine the factors that contribute towards the effective use of KM program in C-IED operations in the military, Maximum Likelihood Estimation was applied to the hypothesised research model to obtain the goodness of fit statistics. The regression paths are also shown in Figure 31. The fit indices for the hypothesised model are summarised in Tables 16.

The fit measures were at the acceptable level indicating high degree of fit in the hypothesised model. It can be stated that research model could explain 87 % of the factors that affect the effective use of KM in C-IED operations.

Table 16. Goodness of Fit Results (Hypothesized Model)

AMOS Fit Measures	Acceptable Criteria	Model Fit Results
Probability value (p)	$p < 0.05$	0.001
The chi-square dividing by the degree of freedom(χ^2 / df)	$1.0 < \chi^2 / df < 3.0$	2.12
Goodness of Fit Index (GFI)	$0.9 \leq$ GFI	0.93
Comparative Fit Index (CFI)	$0.95 \leq$ CFI	0.95
Root Mean Square Residual (RMSR)	RMSR < 0.05	0.039
Root Mean Square Error of Approximation (RMSEA)	RMSEA around 0.05	0.055
R^2: Organizational capabilities for effective use of KM in C-IED Operations	The higher the value of R^2, the greater the explanatory power of the regression model	0.87

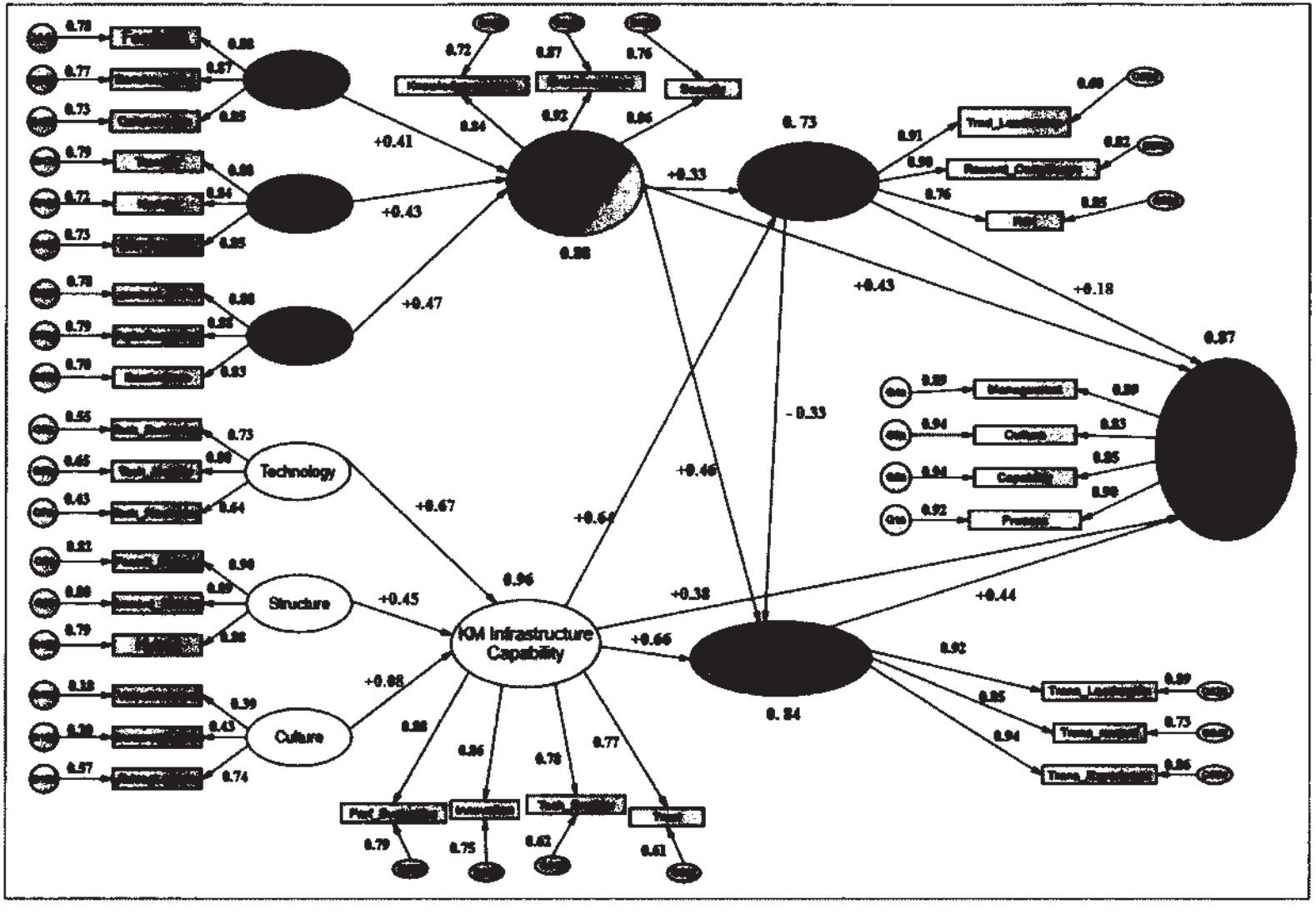

Figure 31. Hypothesized Model in AMOS Notation

Insignificant regression weights of hypothesized Model (Figure 31) are shown at Table 17. Their regression paths have a factor loading of less than 0.30. Based on the reliability analysis criteria, they don't have significant effect on the effective use of KM in C-IED operations.

Table 17. Insignificant Regression Weights of Hypothesized Model

Regression Weights			Standard Estimates	S.E	C.R. $(z)^2$	p
Culture	→	KM Infrastructure Capability	0.08	0.097	1.391	0.001
Traditional Leadership Orientation	→	Organizational capabilities of effective use of KM in C-IED Operations	0.18	0.093	1.341	0.001

4.15 Results of Hypotheses Tests

The research questions and related hypotheses were examined by assessing the path coefficients in the SEM structural models. For each path, the critical ratio of the unstandardized path coefficient, regression weights, standard error, and probability level were calculated. The results of the hypotheses are shown at Table 18.

Table 18. Summary of Research Hypothesis Test Results

#	RESEARCH QUESTIONS	RESEARCH PREPOSITIONS	RESEARCH HYPOTHESIS	R	SE	CR	*p*	RESULT/ MAGNITUDE OF EFFECT
1	What are the key organizational capabilities for effective use of KM in military (especially in C-IED operations)?	**RP.1** The effective use of KM in military is determined by its organizational capabilities which consist of three constructs: *KM Infrastructure, KM Processes, and Leadership (Transformational/ Traditional) capability.*	**H.1.1.** Knowledge Process Capability has significant impact on KM in C-IED Operations.	0.43	-	-	0.001	Supported/ Moderate effect
			H.1.2. Knowledge Infrastructure Capability has significant impact on KM in C-IED Operations.	0.38	-	-	0.001	Supported/ Weak effect
			H.1.3. Traditional Leadership practices have significant impact on KM in C-IED Operations.	0.18	-	-	-	**Not Supported**
			H.1.4. Transformational Leadership practices have significant impact on KM in C-IED Operations.	0.44	0.083	6.45	0.001	Supported/ Moderate effect

Table 18. Continued

#	RESEARCH QUESTIONS	RESEARCH PREPOSITIONS	RESEARCH HYPOTHESIS	R	SE	CR	*p*	RESULT/ MAGNITUDE OF EFFECT
2	How does the leadership capability affect the use of KM in C-IED Operations?	RP.2 Leadership capability mediates the effect of Knowledge Process Capability on Organizational Capability for the effective use of KM in C-IED operations. RP.3 Leadership capability mediates the effect of Knowledge Infrastructure Capability on Organizational Capability for the effective use of KM in C-IED operations.	H.2.1. Traditional Leadership capability mediates the effect of Knowledge Process Capability on Organizational Capability.	0.33	0.079	3.34	0.001	Supported/ Weak effect
			H.2.2. Transformational Leadership capability mediates the effect of Knowledge Process Capability on Organizational Capability.	0.46	0.058	7.78	0.001	Supported/ Moderate effect
			H.2.3. Traditional Leadership capability mediates the effect of Knowledge Infrastructure Capability on Organizational Capability.	0.64	0.087	13.89	0.001	Supported/ Significant effect
			H.2.4. Transformational Leadership capability mediates the effect of Knowledge Infrastructure Capability on Organizational Capability.	0.66	0.077	21.56	0.001	Supported/ Significant effect

Table 18. Continued

#	RESEARCH QUESTIONS	RESEARCH PREPOSITIONS	RESEARCH HYPOTHESIS	R	SE	CR	*p*	RESULT/ MAGNITUDE OF EFFECT
3	How are these capabilities manifested for effective use of KM in C-IED environment?	RP.4 Knowledge Process Capability is a weighted function of three process factors: Acquisition, Transfer and Application.	H.3.1. Knowledge Acquisition has direct effect on Knowledge Process Capability.	0.41	0.068	4.67	0.001	Supported/ Moderate effect
			H.3.2. Knowledge Transfer has direct effect on Knowledge Process Capability.	0.43	0.074	5.89	0.001	Supported/ Moderate effect
			H.3.3. Knowledge Application has direct effect on Knowledge Process Capability.	0.47	0.065	6.59	0.001	Supported/ Moderate effect
		RP.5 Knowledge Infrastructure Capability is a weighted function of three infrastructure factors: Technology, Structure, and Culture.	H.3.4. Technology has direct effect on Knowledge Infrastructure Capability.	0.67	0.089	11.03	0.001	Supported/ Significant effect
			H.3.5. Organizational Structure has direct effect on Knowledge Infrastructure Capability.	0.45	0.065	6.78	0.001	Supported/ Moderate effect
			H.3.6. Organizational Culture has direct effect on Knowledge Infrastructure Capability.	0.08	-	-	-	**Not Supported**

CHAPTER 5

5. CONCLUSIONS AND RECOMMENDATIONS

This chapter discusses the implications of the results, conclusions and recommendations of the dissertation.

5.1 Introduction

IEDs are a weapon of choice and are likely to remain a major component of the Global War on Terrorism for the foreseeable future (Wilson, 2007).

As US and coalition forces learn to counter various types of IEDs, insurgents adapt, create more sophisticated and different devices, and change their employment of TTP.

Thus, due to uncertainties and rapidly changing IED challenge, those who innovate, learn, rapidly adapt, and act decisively will prevail against adversaries and IEDs in C-IED environments.

Counterterrorism and specifically C-IED is the number one priority of the US Armed Forces. It is very critical that gaps in knowledge transfer and training are quickly addressed in order to more effectively equip personnel to meet and counter IED threat. Therefore, the military must analyze the current KM programs in C-IED arena in order to maximize transfer of knowledge derived from experience and skill to staffs and finally to commanders.

This main objective of this dissertation was to identify the connection between Knowledge Process Capability, Knowledge Infrastructure Capability, Leadership Orientation and Organization Capability for effective use of KM programs in C-IED

operations in the military. The purpose of the study was to assist military leaders and commanders in finding a solution for the question below:

What are the essential organizational capabilities for the effective use of KM in military especially in C-IED operations?

In order to address this issue, the following research questions were presented:

1. What are the key organizational capabilities for effective use of KM in military (especially in C-IED operations)?

2. How are these capabilities manifested for effective use of KM in C-IED environment?

3. How does the management (leadership) capability affect the use of KM in C-IED Operations?

Chapter 1 outlined the justification for this research. With limited literature regarding the infusion of knowledge in the C-IED arena, this dissertation proposes a framework for identifying the key factors that are necessary for successful implementation of KM program in C-IED environment in the military.

Chapter 2 brought clarity to the research, and showed traces of issues and theory evolution of the research and main principles of Knowledge Management. Specifically, knowledge, taxonomies of knowledge, knowledge flow theory, knowledge management and KM organizational capabilities, KM and organizational learning, KM and learning organizations, KM influences (barriers/enablers) in public/private sector and military environment are elaborately presented and concluded that there are gaps in knowledge and a lack of empirical examination of KM models in military .

Chapter 3 described the research methodology, design and hypotheses, construction of the survey instrument, data collection methodology and data analysis strategy that were used to determine the variables and collect the data to analyze the three research questions.

Chapter 4 described the discussion of the relevant/target population, pilot study, sample frame, response rate, model data description, descriptive data analysis, and inferential analysis (Structural Equation Modeling-SEM) with highlighting the key points. Hypotheses were examined using structural equation model and the results were summarized in Table 17 and 18.

Finally, Chapter 5 outlined the details the findings of the research problem, research contributions, implications for theory and practice, limitations and recommendations for future studies.

5.2 Research Findings

The survey based on 118 completed responses reflects the general state of KM in military in C-IED operations. From the descriptive analysis of the respondents, the following may be summarized:

- Army military officers and Majors (or Lieutenant Commanders in Navy) have served in C-IED environment before has the highest frequency with the percent of 79.7% and 66.9% respectively (Figure 15 and 16).

- Most of the personnel have completed staff jobs (serving in HQs) rather than field duties with 51.7% (Figure 18).

- Most of the personnel believe that the military already has KM in place with the highest frequency of 48.3% (Figure 19) and rates on a scale of 1 (lowest) to 10 (highest) that the US military KM programs are ready with 65.3% (rating 6 to 10).

- In terms of maturity of KM program, 55.9 % of military staff believe that military has KM programs on C-IED for more than five years (Figure 20). And the majority of respondents (53.4%) stated that KM programs are effective (combining effective and moderately effective responses) (Figure 21).

- When respondents were asked to rank the military's key priorities in C-IED, 47% ranked "defeat the device" projects as the most important; followed by "train the force" (29%), and "attack the terrorist network" at 18%, and knowledge transfer (6%) (Figure 22).

- Respondents indicated that the main drivers of interest in KM in C-IED operations was to improve knowledge sharing (45%) and improve C-IED/IED database (29%) and knowledge is key for leadership (17%). Disappointingly, only 8% stated that KM is Risk Management (Figure 23).

- The respondents cited that "lack of incentives" was the main barrier to sharing knowledge (39%) (Figure 24).

- 42 % of the respondents indicated that the C-IED knowledge is stored in emails-shareable electronic repository and next in printed document (35%) and then staff head/brain (16%) (Figure 25).

- Respondents indicated that the most important C-IED knowledge to the military is "adversaries' IED tactics and techniques" with 52%, followed by terrorist/insurgent information (35%) (Figure 26).

- Respondents also ranked "experienced military personnel" as the highest main source of IED/C-IED knowledge (41%) (Figure 27).

- The main barriers to KM implementation cited by respondents are the following: `poor appreciation of the benefits derived from KM` (40%), `lack of training` (27%), `distrust` (23%) and `the complexity of KM technology` (10%) (Figure 28).

- The main benefits expected from military's KM programs on C-IED are said to be to `decrease casualties (42%)`, `defeat the adversaries (25%)`, `innovate, learn and act agile (16%)` and `increase knowledge transfer between personnel (11%)` (Figure 29).

The descriptive analysis of the survey indicated that military staff knowledge and KM are important in the military. To address the shortcomings, it is suggested that military leaders/commanders should study and develop appropriate reward system (monetary and/or recognition) to increase the exchange of knowledge. Military leadership needs to be transformational and initiate and nurture the development of a culture that propagates innovation and sustainable competitive advantage over insurgents/terrorists.

Additionally, they should also provide the necessary training to enhance the competence of the military staff in the use of KM programs. The benefits of achieving these goals will reduce the casualties in C-IED operations and enable the military personnel to innovate, learn and act agile to the adversaries' threats.

The main research model of this study (Figure 13) was comprised of combinations of unobserved (latent) variables *(i.e., knowledge infrastructure, knowledge process capabilities, and leadership orientation)* and observed variables *(i.e., technology, structure, culture, acquisition, transfer, application, traditional leadership, transformational leadership)*, and attempted to identify structural relationships among these combinations.

Structural equation modelling (SEM) was used to describe causal relationships among unobserved (latent) and observed variables.

The results of the hypothesized KM model in C-IED operations based on the research hypotheses is shown in Figure 31 and summarized in Table 18. Absolute values of 0.70 or more are recommended but some researchers have even suggested minimum values of 0.30 or less depending on the type of the research (Kline, 2005; Tabachnick & Fidell, 2001; Vijayan, 2009). As this research is considered the first attempt to develop model to explain determinants of effective knowledge management in C-IED operations in military, aforementioned suggestions were adopted for the rest of this study (Table 18):

- *Values **0.20 and less** have negligible effect/support,*
- *Values **0.21 to 0.40** have weak effect/support,*
- *Values between **0.41 to 0.60** have moderate effect/support,*
- *Values between **0.61 to 0.80** have significant effect/support and*
- *Values above **0.80** have very significant effect/support.*

The research used the squared multiple correlation (R^2) value as the model fit criterion in multiple regression analysis. R^2 is an index of the proportion of the variance of the endogenous variable that is accounted for by the exogenous or indicator variables.

It can be assumed that the higher the value of R^2, the greater the explanatory power of the regression model and therefore the better the prediction of the independent variables (Arbuckle, 2003; Schumaker & Lomax, 2004). The fit measures of the data were at the acceptable level indicating high degree of fit in the hypothesised model. Thus, it can be stated that research model could explain 87 % of the factors that affect the effective use of KM in C-IED operations.

This research has contributed towards KM in military particularly in C-IED operations by empirically demonstrating the relationships of each of the latent constructs in the conceptual model. Out of the fourteen hypotheses specified in the research model (Figure 30), twelve hypotheses were significant (Table 18).

Table 19 displays the path coefficient and KM effective status (rating). Based on the rating status, recommendations for each KM attributes were presented.

Table 19. Prescriptive Recommendation Based on Empirical Results (Adapted from Tabacknick & Fidell, 2001; Vijayan, 2009)

Research Path Coefficients	**Rating (KM Status)**	**Recommendation to Command/Control**
Coefficients values **0.20 and less** have negligible effect/support	Critical	Attribute needs immediate attention
Coefficients values **0.21 to 0.40** have weak effect/support		
Coefficients values between **0.41 to 0.60** have moderate effect/support	Inadequate	Attribute needs further enhancement
Coefficients values between **0.61 to 0.80** have significant effect/support	Adequate	Attribute is operating at a satisfactory level
Coefficients values above **0.80** have very significant effect/support.	Superior	Best in Class

The KM Status rating was determined by the Path coefficient computed by AMOS. The path coefficient ranging 0 to 0.40 was rated as 'Critical'. This rating also applied to the individual attributes that compose the construct. Attributes rated as 'Critical' was recommended as needs immediate attention for effective functioning of KM in the military. The path coefficient ranging 0.41 to 0.60 was rated as 'Inadequate' and recommendation to command/control was these attributes need further enhancement for effective KM implementation. The path coefficient above 0.61 to 0.80 was rated as 'Adequate' and indicated the attributes are operating satisfactorily for effective KM implementation. Finally, the path coefficient above 0.80 was rated as 'Superior' and can be classified as 'Best in Class' (Table 19).

5.2.1 KM Organizational Capability

The hypothesized model empirically demonstrated the following level of support for the hypotheses summarized in Table 18.

The research has demonstrated that the effective use of KM programs in C-IED operations in military is directly dependent on its Knowledge Process, Infrastructure and Transformational Leadership Capability. Furthermore, the results empirically demonstrated that within military, Transformational Leadership has a greater effect than Traditional Leadership on Organizational Capability for effective use of the KM program. This can be observed in the research model (Figure 31) which shows that Transformational Leadership has a moderate effect (0.44) and Traditional Leadership has a negligible effect (0.18) on Organizational Capability. Knowledge Process Capability

has moderate effect where Knowledge Infrastructure Capability has also weak effect on Organizational Capability, 0.43 and 0.38, respectively.

The high R^2 of 0.87 for the construct organizational Capabilities indicate that 87% of the factors effecting Organization Capabilities for Effective use of KM in C-IED operations can be explained by the KM Process, Infrastructure and Leadership Capability dimensions.

Table 20 summarizes the key attributes operationalized for the construct Organization Capability in the hypothesized Model. AMOS computed the total effect of all construct as 0.43. The implication is that the total significant and insignificant effects of all the constructs within the model on Organizational Capability construct is presently 'inadequate' for effective implementation of KM in C-IED operations. The research recommends the attributes identified need further enhancement.

5.2.2 KM Leadership Capability

The hypothesized model empirically demonstrated the following level of support for the hypotheses summarized in Table 18.

Knowledge Process Capability has a weak effect (0.33) on Traditional Leadership and has moderate effect (0.46) on Transformational Leadership. On the other hand, Knowledge Infrastructure Capability has significant effect on both Traditional and Transformational Leadership capability with the values of 0.64 and 0.66 respectively.

The high R^2 0.73 on Traditional Leadership Orientation indicates that in C-IED arena, both Knowledge Process Capability and Knowledge Infrastructure Capability presently can account for 73% of the effect on Traditional Leadership (and significant

effect on Organizational Capability). On the other hand, Transformational Leadership has high R^2 of 0.84 indicating that Knowledge Process Capability and Knowledge Infrastructure Capability can account for 84% of the effect on Transformational Leadership (and significant effect on Organizational Capability).

An examination of the indicator variables operationalized as the attributes of each the two constructs, Traditional and Transformational Leadership indicate that the loadings are all in a fairly narrow range, suggesting each variable are relatively equally importance attributes.

AMOS rated the attributes that operationalized Leadership Capability as follows: Transformational Leadership 'inadequate' (0.44) and Traditional Leadership 'critical (0.18) for effective use of KM in military. The research recommends that traditional leadership attributes immediate attention whereas transformational leadership attributes need further enhancement.

However, there is evidence that the effect of transformational leadership (0.44) is greater than that of traditional leadership (0.18) on organizational capability for effective KM programs. It appears that currently military leaders/commanders practice a mixture of both traditional and transformational leadership style but with a greater propensity towards the transformational leadership orientation than the traditional one. The presence of the Transformational Leadership construct in the hypothesized model is beneficial as it provides empirical evidence that military leaders/commanders appreciate the necessity to adopt transformational leadership style than solely relying on the traditional style of leadership in the current dynamic and agile military environment.

5.2.3 KM Process Capability

The hypothesized model empirically demonstrated the following level of support for the hypotheses summarized in Table 18. This study has contributed towards knowledge management in C-IED operations in the military by empirically demonstrating that currently the following constructs: Knowledge Acquisition, Knowledge Transfer and Knowledge Application. All indicate positive effect on Knowledge Process Capability with moderate effect.

The high R^2 of 0.88 on Knowledge Process Capability indicates that the three dimensions Knowledge Acquisition, Knowledge Transfer and Knowledge Application are critical dimensions and can account for 88% of the overall effect on the construct Knowledge Process Capability. However, the effect of the dimensions Knowledge Acquisition (0.41), Knowledge Transfer (0.43) and Knowledge Application (0.47) on Knowledge Process Capability is moderate as clearly seen by their respective path coefficients (regressing factor loadings). As mentioned previously, Knowledge Process Capability has direct effect on Organization Capability and Transformational Leadership.

An examination of the indicator variables for each of the constructs, Knowledge Process Capability, Knowledge Acquisition, Knowledge Transfer and Knowledge Application indicate the indicator variable loadings are all in a fairly narrow range, suggesting they are each relatively equally importance attributes.

The hypothesized model rated the Knowledge Process Capability, including its attributes with the antecedent constructs, Knowledge Acquisition, Knowledge Transfer and Knowledge Application, as 'inadequate' for effective use of KM in C-IED operations

in the military (Table 19). The research recommends the related attributes need further enhancement.

The implications are the current efforts in military's KM program in regard to Process Capability and its antecedent are inadequate and greater effort is required to develop the acquisition, transfer and application knowledge process capabilities for effective use of KM. Appropriate mechanisms need to be in place in order to ensure that KM processes are addressed in a systematic manner. Coordination of the KM processes is crucial and should be incorporated into military personnel's daily work activities so that they become common practices in C-IED operations.

Additionally, it is crucial to have an -at least adequate- KM process capability in order to be successful in KM implementation in the military. Because, through efficient and effective process capability, the military will have the ability to acquire and transfer more of their best practices, skills and knowledge into processes that transform inputs into better, cheaper and agile solutions that prevail against adversaries.

5.2.4 KM Infrastructure Capability

The hypothesized model empirically demonstrated the following level of support for the hypotheses summarized in Table 18.

The Knowledge Infrastructure Capability dimension consists of three key capabilities: technology, infrastructure and culture. However, the hypothesized model only provides support for two dimensions - Technology and Structure. The research has empirically demonstrated that in military, Technology (0.67) has significant effect and Structure (0.45) has moderate effect on Knowledge Infrastructure Capability. However,

based on empirical evidence the present organization culture has negative impact on KM implementation and was completely rejected in the model. The strength of the relationships between the antecedent factors, Technology (0.67) and Structure (0.45) and the construct, Knowledge Infrastructure Capability was rated as strong and moderate respectively. Furthermore, the high R^2 of 0.96 on Knowledge Infrastructure Capability indicates that the two dimensions Technology and Structure are critical dimensions and account for 96% of the overall effect on Knowledge Infrastructure Capability.

The present military culture is dysfunctional and has negative effect in the use of KM programs. Knowledge Infrastructure Capability has a significant direct effect on both Traditional and Transformational Leadership Capability with 0.64 and 0.66 values respectively. However, it has weak direct effect (0.38) on Organizational Capability.

Examining of the factor loading of each indicator variables for each of the constructs, Knowledge Infrastructure, Knowledge Technology, Knowledge Structure and Knowledge Culture indicated that no single variable seems to be more important than any other, i.e., the loadings all have fairly equal effect size, suggesting they are each relatively equally important attributes.

So, the hypothesized model rated each of the constructs as follows: Knowledge infrastructure Capability 'inadequate' (0.59), Technology - 'adequate' (0.67), Structure - 'inadequate' (0.45) and Culture - 'critical' (0.08, negligible and rejected by the model). The research identified that the attributes identified for Overall Knowledge Infrastructure Capability and Technology are satisfactory. However, the research recommends that Structure Capability needs further enhancement and Culture needs immediate attention for effective KM program.

Many empirical studies on KM have indicated that culture is the most ignored aspect of KM and is the reason for KM projects not yielding their intended results. No matter what technology base or organization structure is established, without a supportive culture that believes in the positive contribution of using that technology and the structure to military and the individual, success rates remain low (Gold, Malhotra & Segar 2001; Vijayan, 2009). The research has empirically demonstrated that in US military, Organizational Culture is not a contributing dimension in the effective use of KM programs. This clearly indicates that command and control in the military must address the present dysfunctional organizational culture and weak structure immediately for successful KM program.

5.3 Implications for Theory

Based on 118 sample data obtained from US military personnel who have been to C-IED operations before and by applying SEM techniques, the research built a hypothesized model and identified a set of attributes that are crucial/key to successful KM programs in C-IED operations in the military.

When assessing the effect of capabilities, it is necessary to consider the magnitude (effect) as well as the existence of the relationship (path coefficient) between the various constructs and variables in the model because aspects of capabilities may exist, but may not be significant to define all the capabilities.

Overall, the findings and contribution of this research have several implications for theory about modeling KM for C-IED operations in US military. It should be noted

that the findings of this research refer only to US military and whether these findings can apply to other NATO nations and its militaries have to be proven with further studies.

Figure 32 represents the current state of C-IED KM in US military and illustrates diagrammatically the research contribution. Constructs that are green are adequate and contribute towards successful KM use. Constructs that are yellow require further enhancement. Constructs that are red needs immediate urgent attention to address the current weakness exhibited by the existing US military KM model. The model identified that out of the 11 constructs within the model; two were rated as `needs immediate attention` *(i.e. Culture and Traditional Leadership Capability)*, eight were rated as `needed further enhancement` *(i.e. Overall Organizational Capability, Overall Infrastructure Capability, Knowledge Process Capability, Acquisition, Transfer, Application, Structure and Transformational Leadership Capability*) and one was rated as `attribute runs satisfactorily` t *(i.e. Technology)*. The military commanders/leaders need to put in place the suggestions made in this research to close the gap for the effective use of KM in C-IED operations. Through the preceding discussion, it is apparent that this dissertation has made some significant accomplishments and made significant contributions to the present theory and literature.

Additionally, the study identified a set of factors that military leaders and commanders should focus on before undertaking any KM programs. These results are tabulated in checklist form in Table 20.

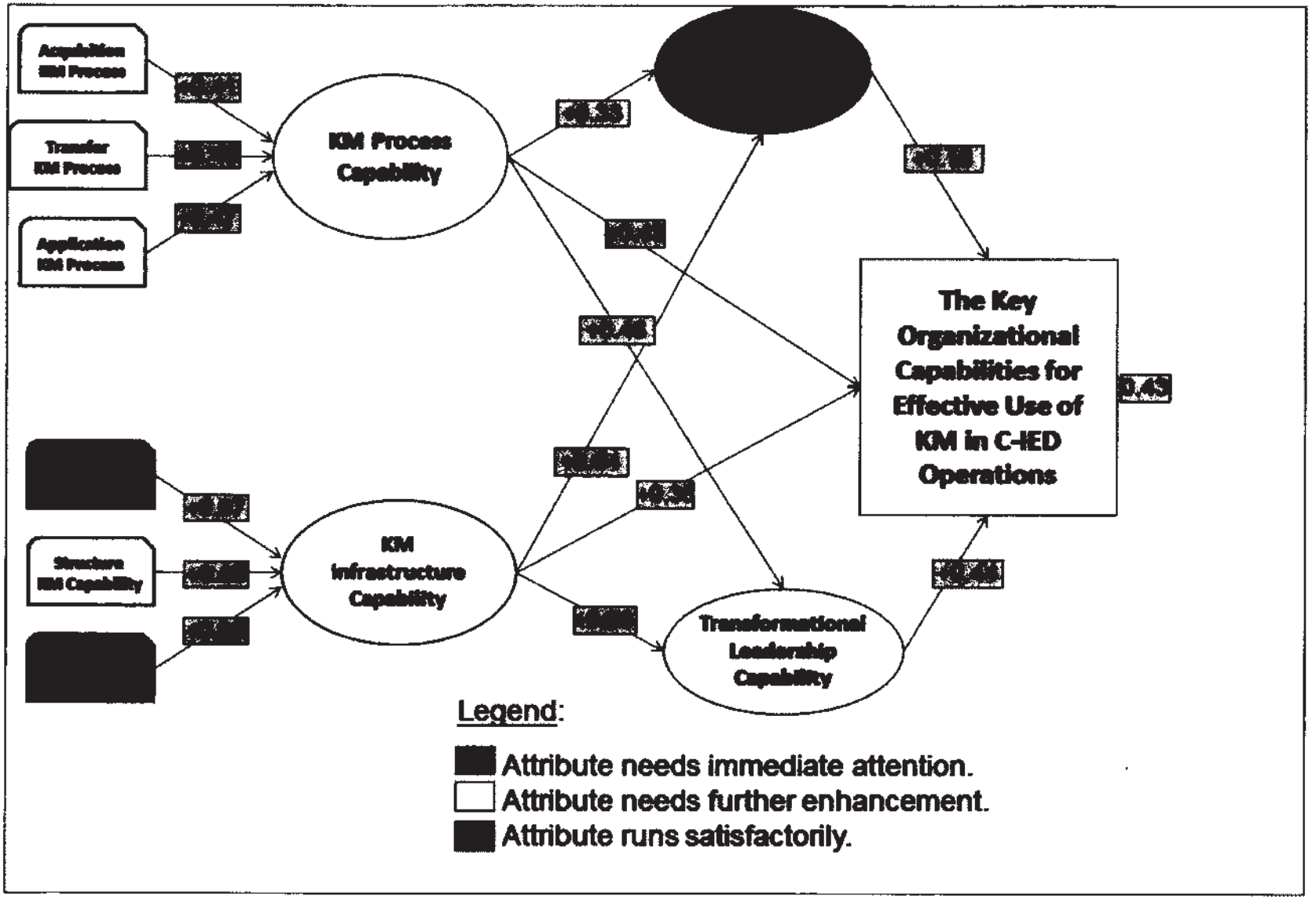

Figure 32. Dissertation Contribution: Present Status of KM in C-IED Operations in US Military

Table 20. Checklist for Effective KM in C-IED Operations

#	ATTRIBUTE	☑
	Organizational Effectiveness	
1	The military has processes that use knowledge to create products and services in accordance with the military personnel's desire.	
2	The military has capabilities to track, capture and disseminate knowledge existing in different services of the military.	
3	The military's culture encourages the sharing of knowledge through social interactions with colleagues.	
4	The military encourages commands to practice knowledge management as it is the key to learn, adapt and innovate faster and creation of sustainable competitive advantage over insurgent/terrorist capabilities.	
	Technology	
5	Technology is used to exchange knowledge with other military personnel.	
6	Technology is used to monitor insurgent/terrorist activities and changes in the C-IED arena.	
7	Technology is used to search for new knowledge (example: Internet access, data mining, electronic libraries).	
	Structure	
8	The military organization structure permits the sharing of knowledge to improve service offerings through innovation.	
9	The staff/military personnel performance appraisal system rewards knowledge sharing and contribution.	
10	The military adopts a 'hybrid' type of structure that combines the benefits of a formal organisation and a non-hierarchical structure.	
	Culture	
11	The military regards its personnel as the most valuable asset and every effort is made to break down invisible barriers that prevent them from sharing their knowledge.	
12	Military personnel are encouraged to experiment with new ideas and if failure happens, the first response is not to assign blame but that they learn from mistakes.	
13	The military promotes lifelong learning to encourage the free exchange of knowledge for success in C-IED operations.	
	Acquisition Process	
14	The military organization regularly obtains feedback from its personnel to ensure services developed are what military personnel want.	
15	The military continuously identifies excellent practices and performs knowledge gap analysis to benchmark its knowledge and skill set.	
16	The military has clear policy on cross-functional collaboration for the generation of new ideas that can lead to the innovation of new products and services in C-IED environment.	

Table 20. Continued

#	ATTRIBUTE	☑
	Transfer Process	
17	Important events related to C-IED environment changes are shared with all related military personnel within a short period.	
18	Cross-functional teaming is encouraged to exchange and replace outdated knowledge.	
19	The military encourages the sharing of knowledge by providing mechanisms to convert knowledge held by individuals into organizational knowledge.	
	Application Process	
20	The military has processes for transferring lessons learned from previous activities to build a database of knowledge to assist current staff/military personnel to solve current and new challenges.	
21	If an insurgent/terrorist was to launch an innovative IED targeted at our military personnel, the military organization has processes for using existing and new knowledge to response immediately.	
22	The military is oriented to exploring all available knowledge to serve the soldiers in the field and be perceived as 'best in class'.	
	Transformational Leadership Orientation	
23	Command and Control believes that the ultimate goal of KM is to lay the foundation for the development of organizational leadership culture that propagates innovation	
24	Reward system exists to motivate the exchange and creation of knowledge within the military.	
25	The military believes that innovation is the key to sustainable competitive advantage, hence, military personnel are encouraged to experiment & develop new products & services even though the initial results may be insignificant.	
	Traditional Leadership Orientation	
26	The military has rigid top-down command and control hierarchal structure and commanders are very protective of their knowledge/skills.	
27	The reward system is based on compliance and does not tolerate mistakes.	
28	Only new products and services that meet minimum Return on Investment (ROI) are permitted for further research and development.	
	Overall Knowledge Infrastructure	
29	Assessment of intellectual capital is part of the overall military personnel performance evaluation and reward process.	
30	The military's approach is to better serve in C-IED arena is through knowledge management and innovation.	
31	The military uses technology as an enabler to capture, store and exchange knowledge across the organization regardless of distance	
32	The military actively promotes a culture of trust and openness through its vision statement and value systems.	

Table 20. Continued

#	ATTRIBUTE	☑
	Overall Knowledge Process	
33	The military uses knowledge mapping to track the source, flow, constraint and loss of knowledge within the services to sustain corporate/institutional knowledge.	
34	Cross-functional teams are involved in the creation, maintenance and continuous improvement of the knowledge processes for merging mechanistic and organic (hybrid) practices.	
35	Security policies and processes are in place to protect knowledge from inappropriate use.	

5.3.1 Leadership Orientation Is Crucial For Successful KM in Military

Based on the data collected and the methods used to analyze them, the results of this research empirically confirmed that the effect of Knowledge Process Capability and Knowledge Infrastructure Capability on Organization Capability is linear (direct) and mediated through leadership. It means successful use of KM is dependent on the leadership orientation the commanders adopt, particularly either Transformational or Traditional Leadership style.

Prior to this study, to the best of our knowledge, there was no empirical support the relationship between leadership capability and knowledge management within the context of C-IED operations in the military. Traditionally, military is top-down hierarchical organization and leaders/commanders tend to orient towards a traditional leadership orientation which favored a custodial approach to KM that focused almost exclusively on the packaging of existing knowledge with little effort devoted to creating the additional expertise needed to innovate. This study confirmed that transformational

leadership is crucial for effective use of KM in military. So, military leaders/ commanders need to adopt transformational approach to knowledge management.

5.3.2 Culture Attribute Needs Immediate Attention in KM

Based on the data collected and the methods used to analyze them, the results of this research empirically demonstrated that within US military, the organization culture is presently needs immediate attention for effective use of KM in C-IED operations.

However, early studies show that KM programs should focus especially on the cultural aspects of the discipline since staff involvement is an essential prerequisite of any KM process. Moreover, based on the survey respondents, around half of the respondents indicated that organizational culture in military does not support openness and the sharing of expertise. Additionally, distrust is one of the most challenging barriers hindering KM adoption in military as people do not trust each other and share the knowledge that they each possess.

So, in order to overcome barriers to organizational culture, military leaders and commanders establish incentives, give recognition and include knowledge sharing in performance appraisal system and reward creativity during all phase of C-IED operations.

5.4 Implications for Practice

5.4.1 Assessment of Organizational Capabilities

Based on the data collected and the methods used to analyze them, the results of this research suggest that US military must first assess the organizational capabilities of the C-IED operations, i.e. leadership, process and infrastructure before setting milestones

and expectations for KM program. Two knowledge related aspects are crucial for success, i.e. knowledge assets that must be applied, preserved and used by individuals and knowledge-related processes to create, build, compile, organize and safeguard the knowledge assets.

Additionally, based on the data collected and the methods used to analyze them, the results of this research empirically indicated that the leadership orientation of the US military was tending towards transformational style rather than traditional one. This new paradigm change in the military is the result of new military order and the complex adaptive systems in which the military has been operating. Rapid changes in the operation environment, asymmetric threats, and spectrum of operations from epidemics or nature-disasters, or Counter-Insurgency and Countering Improvised Explosive Device force military leaders to possess transformational attributes to adapt, act agile and practice proactive decision making, foster creativity and take calculated risk to address the ever changing operation conditions. So, military leaders/commanders seeking to establish effective KM programs in C-IED operations must apply their transformational traits to balance both the content of the military's tacit and explicit knowledge as well as its capabilities to leverage knowledge infrastructure and process to sustain competitive advantage or superiority over adversaries.

Military leaders and commanders must align the military's organizational capabilities and knowledge content for successful KM initiative. The greater the transformational leadership capability, the greater will be its effect on exploiting knowledge content and organization capability for effective use of KM in C-IED operations that prevail towards adversaries.

Sustainable competitive advantage/superiority requires a transformational capability that emphasizes the creation of value by bringing together a unique combination of resources and processes to exploit opportunities.

So, transformational leaders can help the military to construct knowledge maps and formulate knowledge creation, innovation and exploitation policies that lay the foundation for the development of organizational transformation culture, substantial differentiation and competitive advantage towards adversaries.

5.4.2 Research Analysis Tools

Researchers/analysts are using correlations and regression and tend toward the use of averages, which produce isolated answers. In trying to solve complex business problems, such as determining the effective use of knowledge management programs in military, the military organization needs more than the narrow view offered by averages. In situations where leaders/commanders are seeking to understand complex relationships, such as the relationship between organizational capabilities and knowledge management effectiveness in C-IED operations, it is critical that they apply the right analytics. Instead of using averages, managers should utilize SEM.

The risk of looking at variable pairs in isolation is that critical nuances in the data could be missed. The value of SEM is that it not only looks at pairs of variables, it looks at all measures simultaneously providing a broader view of the observations that would have been otherwise lost.

5.5 Limitation of the Study

KM is implemented in a variety ways. Each organization's especially military implementation of a KM program is unique. The acceptance and use of KM tools and practices varies depending on the people involved. Thus, the findings may not be generalizable to other organizations.

Additionally, there is also the danger of having missing an important dimension of KM implementation in C-IED environment in the military that will not be captured by the survey instrument. The hypothesized model had only a selected number of variables and does not claim that all variables that affect KM implementation have been incorporated in the research model. The hypotheses tested in this study should be considered as tentative with the aim of presenting a conceptual model for the determinants of successful KM implementation in the military.

The data collected from some respondents may not have been totally accurate due to the fact that some of the respondents might have felt that the information about the military and their views should be kept confidential and private.

Lastly, statistics and statistical tools with all their wide application in every sphere of human activity have their own limitations. These include statistics not being suitable to the study of qualitative phenomenon. Since statistics is basically a science and deals with a set of numerical data, it is applicable to the study of only these subjects of enquiry, which can be expressed in terms of quantitative measurements. In this study, qualitative phenomena like culture, leadership, etc. cannot be expressed numerically and any statistical analysis cannot be directly applied on this qualitative phenomenon. Nevertheless, statistical techniques may be applied indirectly by first reducing the

qualitative expressions to accurate quantitative terms. Additionally, statistical tools such as correlation analysis, or SEM have their own measurement errors that no one can claim that the results are the actual representation of the current status.

5.6 Recommendations for Future Studies

The results of this study suggest that there is a significant relationship between organizational capabilities and effective use of knowledge management programs in C-IED operations. However, there are several unexplored questions to be answered.

First, this study was not designed to distinguish the differences between tacit and explicit knowledge. Tacit knowledge is difficult to articulate in formal language and to transfer to others in terms of subjective insight, intuitions, and hunches; whereas, explicit knowledge is codified and can be easily transmitted to others. This research did not deal with the two dimensions of knowledge. Identifying how knowledge management in C-IED operations is involved in the processes of managing tacit and explicit knowledge would be a topic for further research.

Second, a potential useful area of future research is to conduct similar research on other 28 NATO nations and perform a comparative analysis to establish empirical standards. Such knowledge could provide a road map for other nations' armed forces to initiate a successful use of KM in C-IED operations.

Last but absolutely not the least, even though this dissertation did not find any direct correlations between Culture and Infrastructure, further investigation should be conducted due to its relative importance of its effect on successful use of KM.

Longitudinal research design should be employed as well to explore the relative effect of KM programs in the military and particularly in C-IED operations over time.

5.7 Conclusion

The most important conclusion of this research is that it provides a framework for identifying the key factors for effective use of KM program in the military specifically in C-IED operations. Thus, this work enhances our understanding of knowledge management organizational capabilities. The findings of this work provide a context for development of new theory as well as a roadmap for military leaders seeking to develop organizational capabilities for effective knowledge management.

Additionally, it analyzes the effect of management capability on the use of KM programs by dividing the leadership capabilities into two leadership styles (transformational and traditional leadership).

Finally, by using the checklist in Table 20, the military leaders/commanders can perform a self-check to determine the existing perception of KM program within the organization. The results will be able to help them to ensure essential factors are functioning as planned and to investigate any gaps that may exist between desired result and actual outcome.

This study is –to the best of researcher's knowledge – among the first empirical work to specifically examine the relationship between knowledge infrastructures, knowledge process and leadership capability for effective use KM in C-IED arena in the military.

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APPENDICES

APPENDIX-A QUESTIONNAIRE

This survey only requires about 15 minutes of your time. You are not required to identify yourself and all responses will be treated in strict confidence.

INTRODUCTION

The proliferation of Improvised Explosive Devices (IEDs) on the battlefield in both Iraq and Afghanistan has posed the most pervasive threat facing coalition forces in those theatres. Improvised explosive devices have caused over 60% of all American combat casualties in Iraq and 50% of combat casualties in Afghanistan, both killed and wounded (DMDC Report, 2010).

NATO and particularly all nations Department of Defenses are actively and aggressively searching for ways to defeat the IED. Most of them established Knowledge Management (KM) organizations (such as JIEDDO and JKniFE) to create a consistent framework so war fighters can innovate, evaluate alternate courses of actions within context of local conditions, and act agile, quickly and decisively. This KM organization can help preserve tacit and explicit knowledge and accelerate learning as units and personnel rotate in and out of theatres or organizations. Also, it serves as grist for revised doctrine.

So, the purpose of this survey is to analyze the current KM programs in C-IED arena in the military in order to maximize transfer of knowledge derived from experience and skill to staffs and finally to commanders. Survey analysis will be used at the Ph.D dissertation and your responses will not be released without your expressed permission.

There is no identifiable private information - all questionnaire is anonymous and none of the information can be traced back to any individual directly or through identifiers. Any disclosure of the human subjects' responses outside the research could not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

We cordially invite you to voluntarily participate in our survey to assist us better understand how military manage knowledge management in C-IED operations/environment. There is no "RIGHT" or "WRONG" answers. Kindly complete this questionnaire by placing a tick (✓) on the appropriate scale, ① to ⑦, as shown in the example below. Please provide only ONE answer to each question.

EXAMPLE: **KM in C-IED operations is vain.**	*Strongly disagree*	①	✓	③	④	⑤	⑥	⑦	**Strongly agree**

Thank you for participating in our study!

MAJ Umit Gencer is a Ph.D. Candidate under the supervision of Dr. Rafael E. Landaeta at the Old Dominion University, Norfolk, VA USA. Tel: +1 757 892 0361. e-mail: umit.gencer@act.nato.int

PART I

1. What is your gender? ……Female ……Male
2. What country are you from? ……
3. What service are you in?

☐	**Army**	☐	**Marine**
☐	**Navy**	☐	**Coast Guard**
☐	**Air force**		

4. What is your current Pay grade/Rank? ……
5. How many years of active duty service have you completed? …….
6. Have you served in any C-IED environment (Such as Iraq, Afghanistan, etc.) before? …..
7. If yes, what kind of job have you completed? (Staff or field)……..
8. On a scale of 1 (lowest) to 10 (highest), how would you rate your military in terms of KM readiness?

1	2	3	4	5	6	7	8	9	10

9. What is the status of the KM program in your military particularly in C-IED operations?

☐	**Do not know**	☐	**Military setting up a KM program**
☐	**Military is not considering KM program**	☐	**Military already has KM program in place**
☐	**Military is examining the need for KM program**		

10. How mature is the KM program in the military?

☐	**Do not know**	☐	**More than 1 year**
☐	**More than 5 years**	☐	**Less than 1 year**
☐	**More than 2 years**		

11. How effective is the KM initiative in the military?

- ☐ **Do not know**
- ☐ **Too early to tell**
- ☐ **Not effective**
- ☐ **Moderately effective**
- ☐ **Effective**

PLEASE RANK ON A SCALE FROM 1 (LOWEST) to 5 (HIGHEST) THE FOLLOWING QUESTIONS

12. Currently, which of the following are the military's priorities in countering IEDs? (Please rank 1 to 5)

- ☐ **Attack the terrorist network**
- ☐ **Defeat the device**
- ☐ .....
- ☐ **Train the force**
- ☐ **Knowledge Transfer**

13. What are the main drivers of interest in KM in the C-IED operations? (Please rank 1 to 5)

- ☐ **Improve knowledge sharing**
- ☐ **Improve C-IED& IED Database**
- ☐ **Retain intellectual capital**
- ☐ **KM is risk management**
- ☐ **Knowledge is crucial to leadership**

14. What are the reasons for not sharing knowledge or knowledge transfer in military (Please rank 1 to 5)

- ☐ **No incentive to share**
- ☐ **No recognition for sharing**
- ☐ **Sharing will make me redundant**
- ☐ **Lack of time**
- ☐ **Others**

15. Where is C-IED knowledge stored in your military? (Please rank 1 to 5)

- ☐ **Staff head/brain**
- ☐ **Printed document**
- ☐ **Non-shareable PCs & electronic repository**
- ☐ **e-mails & shareable electronic repository**
- ☐ **Not sure**

16. What are the types of C-IED knowledge most important to the military? (Please rank 1 to 5)

☐	**Terrorist/insurgent information**	☐	**Terrorist/insurgent IED tactics and techniqu**
☐	**Staff skill/knowledge**	☐	**Global events**
☐	**Innovation/new product knowledge**		

17. What are the main sources of IED/C-IED knowledge? (Please rank 1 to 5)

☐	**Captured terrorist/insurgents**	☐	**Other (Such as…..)**
☐	**Disarmed/confiscated IEDs**	☐	**Experienced military personnel**
☐	**Manuals, lessons learned**		

18. What are the main barriers to KM implementation in the military? (Please rank 1 to 5)

☐	**Distrust**	☐	**KM technology too complex**
☐	**Lack of training**	☐	**Others**
☐	**Poor appreciation of KM**		

19. What are the benefits expected from the military's KM program on C-IED? (Please rank 1 to 6)

☐	**Do not know**	☐	**Defeat the adversaries**
☐	**Innovate, learn and act agile,**	☐	**Better train the force**
☐	**Increase knowledge transfer between personnel**	☐	**Decrease casualties**

PART 2

Organizational Effectiveness

01	The military has processes that use knowledge to create products and services in accordance with the military personnel's desire.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
02	The military has capabilities to track, capture and disseminate knowledge existing in different services of the military.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
03	The military's culture encourages the sharing of knowledge through social interactions with	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree

	colleagues.									
04	The military encourages commands to practice knowledge management as it is the key to learn, adapt and innovate faster and creation of sustainable competitive advantage over insurgent/terrorist capabilities.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
B	Technology									
05	Technology is used to exchange knowledge with other military personnel.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
06	Technology is used to monitor insurgent/terrorist activities and changes in the C-IED arena.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
07	Technology is used to search for new knowledge (example: Internet access, data mining, electronic libraries).	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
C	Structure									
08	The military organization structure permits the sharing of knowledge to improve service offerings through innovation.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
09	The staff/military personnel performance appraisal system rewards knowledge sharing and contribution.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
10	The military adopts a 'hybrid' type of structure that combines the benefits of a formal organisation and a non-hierarchical structure.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
D	Culture									
11	The military regards its personnel as the most valuable asset and every effort is made to break down invisible barriers that prevent them from sharing their knowledge.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
12	Military personnel are encouraged to experiment with new ideas and if failure happens, the first response is not to assign blame but that they learn from mistakes.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
13	The military promotes lifelong learning to encourage the free exchange of knowledge for success in C-IED operations.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
E	Acquisition Process									
14	The military organization regularly obtains feedback from its personnel to ensure services developed are what military personnel want.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
15	The military continuously identifies excellent practices and performs knowledge gap analysis to benchmark its knowledge and skill set.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree

16	The military has clear policy on cross-functional collaboration for the generation of new ideas that can lead to the innovation of new products and services in C-IED environment.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
I	Transfer Process									
17	Important events related to C-IED environment changes are shared with all related military personnel within a short period.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
18	Cross-functional teaming is encouraged to exchange and replace outdated knowledge.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
19	The military encourages the sharing of knowledge by providing mechanisms to convert knowledge held by individuals into organizational knowledge.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
G	Application Process									
20	The military has processes for transferring lessons learned from previous activities to build a database of knowledge to assist current staff/military personnel to solve current and new challenges.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
21	If an insurgent/terrorist was to launch a innovative IED targeted at our military personnel, the military organization has processes for using existing and new knowledge to response immediately.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
22	The military is oriented to exploring all available knowledge to serve the soldiers in the field and be perceived as 'best in class'.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
H	Transformational Leadership Orientation									
23	Command & Control believes that the ultimate goal of KM is to lay the foundation for the development of organizational leadership culture that propagates innovation and sustainable competitive advantage over insurgents/terrorists.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
24	Reward system exists to motivate the exchange and creation of knowledge within the military.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
25	The military believes that innovation is the key to sustainable competitive advantage, hence, military personnel are encouraged to experiment & develop new products & services even though the initial results may be insignificant.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree

I	Traditional Leadership Orientation									
26	The military has rigid top-down command and control hierarchal structure and commanders are very protective of their knowledge/skills.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
27	Reward system is based on compliance and does not tolerate mistakes.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
28	Only new products and services that meet minimum Return on Investment (ROI) are permitted for further research and development.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
J	Overall Knowledge Infrastructure Capability									
29	Assessment of intellectual capital is part of the overall military personnel performance evaluation and reward process.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
30	Military approach to better serve in C-IED arena is through knowledge management and innovation.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
31	Military uses technology as an enabler to capture, store and exchange knowledge across the organization regardless of distance.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
32	The military actively promotes a culture of trust and openness through its vision statement and value systems.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
K	Overall Knowledge Process Capability									
33	The military uses knowledge mapping to track the source, flow, constraint and loss of knowledge within the services to sustain corporate/institutional knowledge.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
34	Cross-functional teams are involved in the creation, maintenance and continuous improvement of the knowledge processes for merging mechanistic and organic (hybrid) practices.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree
35	Security policies and processes are in place to protect knowledge from inappropriate use.	Strongly disagree	①	②	③	④	⑤	⑥	⑦	Strongly agree

We would like to thank you for completing this questionnaire.

APPENDIX-B LETTERS OF APPROVAL FROM ODU IRB AND NATO

No.: 11-201

OLD DOMINION UNIVERSITY
HUMAN SUBJECTS INSTITUTIONAL REVIEW BOARD
RESEARCH PROPOSAL REVIEW NOTIFICATION FORM

TO: **Rafael Landaeta** *Responsible Project Investigator*
DATE: February 16, 2012 *IRB Decision Date*

An Analysis of Effective Use of Knowledge Management in Counter Improvised Explosive Device (C-IED) Operations
Name of Project

Please be informed that your research protocol has received approval by the Institutional Review Board. Your research protocol is:

__ Approved
___ Tabled/Disapproved
_X__ Approved, contingent on making the changes below*

Kirsten C. Waitheder — **February 16, 2012**
IRB Chairperson's Signature *date*

Contact the IRB for clarification of the terms of your research, or if you wish to make ANY change to your research protocol.

The approval expires one year from the IRB decision date. You must submit a Progress Report and seek re-approval if you wish to continue data collection or analysis beyond that date, or a Close-out report. You must report adverse events experienced by subjects to the IRB chair in a timely manner (see university policy).

---

* Approval of your research is CONTINGENT upon the satisfactory completion of the following changes and attestation to those changes by the chairperson of the Institutional Review Board. Research may not begin until after this attestation.

***In the Informed Consent:**

- Change the Informed Consent document to that of a Notification Statement. At the end of the statement, in place of the witness and investigators' signature block, construct a statement that says, "If you agree to participate in this study, please click on the following site which should link you to the survey." In this way, the participants may remain anonymous while taking the survey which is on-line.
- In the letter to potential participants, 2nd sentence-change 'a online survey' to 'an online survey'. Correct the spelling of the word 'analyse' to 'analyze'. In the 3rd Paragraph- 1st sentence- Change the line to 'to assist us in the better understanding of...'
- In the paragraph after the italics, Replace first sentence with, 'The research study has been reviewed and approved by the University Institutional Review Board of the Old Dominion University.

Attestation

As directed by the Institutional Review Board, the Responsible Project Investigator made the above changes. Research may begin.

Kirsten C. Waitheder — **February 27, 2012**
IRB Chairperson's Signature *date*

NORTH ATLANTIC TREATY ORGANISATION
ORGANISATION DU TRAITÉ DE L'ATLANTIQUE NORD
HEADQUARTERS, SUPREME ALLIED COMMANDER TRANSFORMATION
7857 BLANDY ROAD, SUITE 100
NORFOLK, VIRGINIA, 23551-2490

17 December 2011

Maj Umit Gencer
Staff Officer, NATO ACT HQ
Norfolk, VA 23551

SUBJECT: Request to conduct C-IED Knowledge Management Survey in NATO

Major Gencer,

We reviewed your proposed study on analysis of factors for effective use of Knowledge Management in C-IED arena in NATO and concluded that the survey was low risk and hereby grant you authority to commence with your study.

With my best wishes for your study and a continued professional success.

Kurt PEDERSEN
Brigadier General, Norwegian Air Force
ACOS Joint Education, Training and Exercises

APPENDIX-C RECRUITMENT LETTER TO SURVEY RESPONDENTS

Date

Dear Colleague,

I am working at NATO Allied Command Transformation (ACT) HQ, Norfolk and studying Ph.D (Engineering Management & Systems Engineering) at Old Dominion University. Currently, I am conducting an online survey under the supervision of Dr. Rafael Landaeta on identification of effective use of Knowledge Management in Counter Improvised Explosive Device (C-IED) Operations.

The purpose of this study is to analyze the current KM programs in C-IED arena in the military in order to maximize transfer of knowledge derived from experience and skill to staffs and finally to commanders. Survey analysis will be used at the Ph.D dissertation.

We cordially invite you to voluntarily participate in our survey to assist us in the better understanding of how military manage knowledge management in C-IED operations/environment. There is no "RIGHT" or "WRONG" answers. And, you can discontinue anytime as you wish.

Please click on the following link if you wish to participate:
www.act.nato.int/ciedsurvey

There is no identifiable private information - all questionnaire is anonymous and none of the information can be traced back to any individual directly or through identifiers. Any disclosure of the human subjects' responses outside the research could not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

The researcher will not have access to survey database. Web page administrator of ACT HQ will receive responses and put them in data analysis sheet and deliver the report as aggregate to the researcher. All individual survey responses will be deleted by survey web page administrator after copying them to data analysis report.

The research study has been reviewed and approved by the University Institutional Review Board of the Old Dominion University. However, the final decision about participation is yours. Should you have comments or concerns resulting from your participation in this study, please contact Dr. George Maihafer, the current IRB chair, at 757-683-4520, or the Old Dominion University Office of Research, at 757-683-3460.

If you have any questions later on, then the researchers should be able to answer them:

MAJ Umit Gencer, Tel: +1 757 892 0361. e-mail: umit.gencer@act.nato.int or

Dr. Rafael Landaeta, Tel: +1 757 683 6224. Email: rlandaet@odu.edu

Thank you in advance for your interest in this project.

Yours sincerely,

Umit Gencer
Ph.D. Student (The researcher), Old Dominion University
Engineering Management and Systems Engineering
Tel: +1 757 892 0361
Email: ugenc001@odu.edu

APPENDIX-D RESPONSIBLE CONDUCT OF RESEARCH FOR ENGINEERS CURRICULUM COMPLETION REPORT

CITI Collaborative Institutional Training Initiative

LEARNER: UMIT GENCER
INSTITUTION: OLD DOMINION UNIVERSITY

Responsible Conduct of Research for Engineers:

Stage 1. Basic Course Passed on 12/01/11 (Ref# 7102228)

Elective Modules	Date Completed	Score
Introduction to RCR for Engineers	12/01/11	no quiz
Completing the RCR for Engineers Course	12/01/11	no quiz
Research Misconduct	12/01/11	5/5 (100%)
Responsible Authorship in Engineering	12/01/11	3/4 (75%)
Ethical Issues in Peer Review and Publication in Engineering Research	12/01/11	4/4 (100%)
Conflicts of Interest in Engineering Research	12/01/11	4/5 (80%)
The Ethics of Mentoring	12/01/11	5/7 (71%)
Ethical Issues in the Management of Data in Engineering Research	12/01/11	8/9 (89%)
Collaborative Research in Engineering Fields	12/01/11	5/7 (71%)
Introduction to the Responsible Conduct of Research	12/01/11	no quiz
The CITI RCR Course Completion Page	12/01/11	no quiz

For this Completion Report to be valid, the learner listed above must be affiliated with a CITI participating institution. Falsified information and unauthorized use of the CITI course site is unethical, and may be considered scientific misconduct by your institution.

Paul Braunschweiger Ph.D.
Professor, University of Miami
Director Office of Research Education CITI Course Coordinator

APPENDIX-E CORRELATION MATRIX OF VARIABLES

Variable	Process	Structure	Culture	Management	Exchange	Monitor	Novidess	Sharing	Reward	Hybrid	Asset	Experiment	Learning	Feedback	Benchmarking	Collaboration	Rapid	Update	Mechanism	LessonsLearned	Agile	BestInClass	Trans_Leader	Trans_Reward	Trans_Expt	Trad_Leader	Trad_Reward	ROI	Evaluation	Innovation	Enabler	Trust	Mapping	C-Functional	Security
Process	1.000																																		
Structure	0.570	1.000																																	
Culture	0.000	-0.004	1.000																																
Management	0.125	0.294	-0.305	1.000																															
Exchange	0.148	0.486	0.412	0.940	1.000																														
Monitor	0.357	0.129	0.294	0.945	0.112	1.000																													
Novidess	0.467	0.884	0.412	0.457	0.904	-0.202	1.000																												
Sharing	-0.125	0.004	0.940	0.598	0.901	-0.902	0.012	1.000																											
Reward	0.304	0.586	-0.545	0.304	0.486	0.486	0.202	0.486	1.000																										
Hybrid	0.488	0.571	0.529	-0.400	0.529	0.576	0.216	0.206	0.300	1.000																									
Asset	0.304	0.298	0.527	0.304	0.305	0.454	0.521	0.522	0.484	0.457	1.000																								
Experiment	0.501	0.489	-0.522	0.501	0.486	0.412	0.940	0.545	0.540	0.486	0.480	1.000																							
Learning	0.488	0.589	-0.476	0.486	0.216	0.644	-0.521	0.521	0.504	0.138	0.304	0.504	1.000																						
Feedback	0.000	0.577	0.570	0.515	0.457	0.504	0.480	0.479	0.502	0.045	0.442	0.204	0.504	1.000																					
Benchmarking	0.548	0.572	0.545	0.545	0.412	0.484	0.521	0.522	0.484	0.457	0.589	0.529	0.501	0.502	1.000																				
Collaboration	0.488	0.578	0.488	0.488	0.204	0.486	0.116	0.206	0.504	0.216	0.052	0.227	0.488	0.442	0.412	1.000																			
Rapid	0.216	0.574	0.304	0.216	0.412	0.504	0.546	0.000	0.529	0.257	0.457	0.522	0.000	0.504	0.436	0.486	1.000																		
Update	0.257	0.000	0.402	0.504	0.949	0.711	0.504	0.498	0.429	0.000	0.000	0.000	0.250	0.548	0.949	0.504	0.000	0.229	1.000																
Mechanism	0.613	0.504	0.949	0.401	0.113	0.527	0.501	0.486	0.522	0.504	0.504	0.502	0.486	0.957	0.505	0.505	0.722	0.404	1.000																
LessonsLearned	0.504	0.512	0.545	0.486	0.501	0.550	0.486	0.516	0.208	0.249	0.245	0.502	0.548	0.504	0.572	0.485	0.256	0.548	0.572	1.000															
Agile	0.248	0.504	-0.129	0.486	0.529	0.504	0.513	0.517	0.202	0.449	0.486	0.486	0.521	0.527	0.548	0.716	0.202	0.504	0.179	0.716	1.000														
BestInClass	0.048	0.000	-0.445	0.245	0.257	0.400	0.948	0.504	0.502	0.242	0.256	0.052	0.457	0.500	0.529	0.502	0.501	0.000	0.152	0.502	0.400	1.000													
Trans_Leader	0.242	0.400	0.957	0.485	0.522	0.504	0.486	0.504	0.486	0.245	0.504	0.486	0.486	0.755	0.425	0.529	0.852	0.404	0.805	0.244	0.504	0.504	1.000												
Trans_Reward	0.404	0.500	-0.457	0.416	0.208	0.402	0.256	0.400	0.152	0.245	0.401	0.256	0.548	0.578	0.504	0.400	0.527	0.544	0.504	0.442	0.504	0.529	0.527	1.000											
Trans_Expt	0.257	0.502	0.294	0.457	0.202	0.402	0.529	0.548	0.402	0.112	0.404	0.257	0.000	0.504	0.400	0.504	0.501	0.529	0.512	0.546	0.486	0.256	0.429	0.481	1.000										
Trad_Leader	0.529	0.504	0.154	-0.527	0.502	0.548	0.421	0.529	-0.504	0.486	0.548	-0.502	0.486	0.000	0.948	0.486	0.256	0.250	0.514	0.486	-0.294	-0.486	-0.256	-0.504	-0.521	1.000									
Trad_Reward	-0.529	0.504	-0.945	-0.804	-0.486	-0.202	-0.480	-0.504	-0.547	-0.529	-0.548	-0.948	0.548	-0.516	0.504	-0.480	0.486	0.294	0.500	0.256	-0.412	0.404	-0.548	-0.542	-0.548	0.716	1.000								
ROI	0.422	0.486	0.219	-0.440	0.502	0.504	0.512	0.486	0.500	0.486	0.579	-0.512	0.457	0.234	0.557	0.542	0.548	0.250	0.480	0.250	0.501	0.504	-0.548	-0.440	-0.529	0.157	0.156	1.000							
Evaluation	0.308	0.957	0.486	0.948	0.598	0.548	0.572	0.548	0.545	0.542	0.484	0.521	0.522	0.494	0.457	0.500	0.535	0.501	0.501	0.480	0.542	0.501	0.486	0.412	0.480	0.504	-0.254	0.504	1.000						
Innovation	0.250	0.957	0.216	0.500	0.557	0.504	0.500	0.557	0.502	0.545	0.412	0.204	0.504	0.548	0.486	0.716	0.504	0.401	0.488	0.500	0.486	0.486	0.716	0.544	0.521	0.754	0.504	0.548	0.598	1.000					
Enabler	0.500	0.598	0.550	0.504	0.480	0.504	0.500	0.486	0.650	0.548	0.457	0.216	0.570	0.521	0.504	0.548	0.648	0.542	0.484	0.544	0.535	0.270	0.500	0.550	0.502	0.502	0.486	0.502	0.512	0.484	1.000				
Trust	0.488	0.501	0.504	0.257	0.544	0.208	0.486	0.557	0.512	0.548	0.250	0.251	0.484	0.521	0.512	0.484	0.457	0.500	0.535	0.501	0.480	0.504	0.500	0.486	0.428	0.545	0.457	0.216	0.598	0.542	0.544	1.000			
Mapping	0.552	0.500	0.500	0.122	0.642	0.257	0.505	0.642	0.504	0.548	0.545	0.229	0.571	0.670	0.504	0.480	0.157	0.521	0.216	0.680	0.484	0.545	0.505	0.525	0.457	0.544	0.642	0.486	0.642	0.548	1.000				
C-Functional	0.488	0.501	0.516	0.250	0.500	0.504	0.480	0.504	0.551	0.480	0.548	0.548	0.486	0.216	0.504	0.401	0.486	0.501	0.486	0.486	0.536	0.217	0.501	0.504	0.480	-0.548	0.500	0.525	0.540	0.216	0.646	0.521	0.179	1.000	
Security	0.484	0.486	0.254	0.274	0.504	0.216	0.412	0.254	0.545	0.150	0.525	0.257	0.457	0.502	0.500	0.504	0.277	0.504	0.545	0.484	0.521	0.404	0.484	0.457	0.577	0.578	0.510	0.557	0.504	0.480	0.527	0.502	0.716	0.010	1.000

VITA

Umit Gencer
4401 St Mark Rd Virginia Beach, VA 23455
(757) 892 0361

Education:

M.S. in National and International Security Strategies Management & Leadership, Turkish Army War College, Istanbul, Turkey, 2007

M.S. in Manpower Systems Analysis, Naval Postgraduate School, Monterey, CA, 2002

B.S. in System Engineering, Turkish Military Academy, Ankara, Turkey, 1997

Professional Experience:

Supreme Allied Command Transformation HQ Norfolk/VA, NATO Exercises Planning & Programming Staff Officer, 2009-2012

Brigade, Chief of Operations and Training Branch, 2008-2009

Brigade, Chief of Logistics Branch, 2007-2008

Manpower Analyst, Turkish General Staff HQ, Personnel Systems Management Division, 2002-2005

Tank Platoon Leader and Company Commander, 1998-2000