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

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

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Abstract
Improvised Explosive Device (IED) is a weapon of choice and is likely to remain a major component of the Global War on Terrorism. It is critical that gaps in knowledge transfer are quickly addressed in order to more effectively equip personnel to counter IED (C-IED) threat. Therefore, the military must analyze the current Knowledge Management (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 study investigates the factors that influence effective use of KM in 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-administered 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), eight are rated as 'attribute needs further enhancement' (i.e. Overall Organizational Capability, Knowledge Process, Knowledge Infrastructure, Acquisition, Transfer, Application, Structure and Transformational Leadership) and one is rated as 'attribute runs satisfactorily' (i.e. Technology). 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 military.

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 theaters (Atkins, 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 Tactics, Techniques and Procedures (TTP).

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, 2010b).

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. It is critical that gaps in knowledge transfer are quickly addressed in order to more effectively equip personnel to counter IED (C-IED) threat. Therefore, the military must analyze the current Knowledge Management (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 study investigates the factors that influence effective use of KM in C-IED operations in the military.

Background and Hypothesis
Knowledge has been considered as the main source for creating organizational core capabilities, and as the basis for sustainable profitability (Grant, 1996). The term knowledge management (KM) 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). Capabilities have been defined as internal structures and processes that can be the source of a competitive advantage and most importantly, 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
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). Gold, Malhotra, and Segars (2001) identified three key building blocks of knowledge infrastructure capability: technology, structure, and culture.

Technology. Technology is one the most important enablers of the active knowledge management processes. Gold, Malhotra, and Segars stated that “Technology comprises a crucial element of the structural dimension needed to mobilize social capital for the creation of new knowledge” (2001, p.187). 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).

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). 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).

Culture. Every organization has its own culture that influences the way people work. Denison 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” (1990, p.45). 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.

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).

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.

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 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” (2007, 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, Von Krogh & Voelpel, 2006). The organization can acquire knowledge either externally or internally.

Transfer. Gold, Malhotra, and Segars (2001) described the knowledge conversion process as
making existing knowledge useful”. 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). 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.

Application. 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).

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

Leadership (Managerial) capability is the organization’s 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). Managerial (leadership) capabilities are essential to KM success. 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 traditional and transformational leadership approaches. Exhibit 1 summarizes the differences based on literature review.

Exhibit 1. Differences Between Traditional and Transformational Leadership Approaches (Adapted from Drucker, 1985; Edwards et al., 2003; Vijayan, 2009).

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Traditional Leadership Approach</th>
<th>Transformational Leadership Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to take calculated risk</td>
<td>Risks are to be avoided as it may affect the core business.</td>
<td>Risks are the challenges to be grasped in order not to miss opportunities.</td>
</tr>
<tr>
<td>Policies and Procedures</td>
<td>Enforce standard procedures to avoid mistakes. Rules must be strictly followed.</td>
<td>Since it is management that made the rule, they must change it according to changes in the environment.</td>
</tr>
<tr>
<td>Relationship with staff</td>
<td>Management has official/strict relationship with its employees.</td>
<td>People are the organization’s strength and team effort is always valued.</td>
</tr>
<tr>
<td>Initiative</td>
<td>Manage resources for efficiency and only initiatives that meet Return on Investment (ROI) are worth the effort.</td>
<td>All initiative should be considered and worth giving a chance.</td>
</tr>
<tr>
<td>Management style</td>
<td>Delegation: use of command control systems, procedures and manuals.</td>
<td>Empowerment, hand on, customized flexible procedures.</td>
</tr>
</tbody>
</table>
The Conceptual Model and Research Hypothesis

The conceptual model of this research, based on the literature review, was formulated and is shown in Exhibit 2. The theoretical model used in this thesis is a function of three 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)


The main questions for this research are stated below:
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?

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

H01: Knowledge Process Capability has significant impact on KM in C-IED Operations.
H02: Knowledge Infrastructure Capability has significant impact on KM in C-IED Operations.
H03: Traditional Leadership practices have significant impact on KM in C-IED Operations.
H04: Transformational Leadership practices have significant impact on KM in C-IED Operations.
H05: Traditional Leadership capability mediates the effect of Knowledge Process Capability on Organizational Capability.
H06: Transformational Leadership capability mediates the effect of Knowledge Process Capability on Organizational Capability.
H07: Traditional Leadership capability mediates the effect of Knowledge Infrastructure Capability on Organizational Capability.
H08: Transformational Leadership capability mediates the effect of Knowledge Infrastructure Capability on Organizational Capability.
H09: Knowledge Acquisition has direct effect on Knowledge Process Capability.
H10: Knowledge Transfer has direct effect on Knowledge Process Capability.
H11: Knowledge Application has direct effect on Knowledge Process Capability.
H12: Technology has direct effect on Knowledge Infrastructure Capability.
H13: Organizational Structure has direct effect on Knowledge Infrastructure Capability.
H14: Organizational Culture has direct effect on Knowledge Infrastructure Capability.

Methodology

The main objective of the study was 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. The data collection effort was primarily based on survey, although focus groups of C-IED and KM experts were conducted. The research approach consisted of six phases: literature review and hypotheses setting, initial validation of the research model, development of the questionnaire, identification of the research sample, administration and evaluation of the questionnaire, and hypotheses testing and conclusions.

Target Population. For this research, the target population consisted of NATO HQ Supreme Allied Command Transformation (SACT) with a total of approximately 564 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.

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.

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.

Response rate and model data description. Even though 300 sets of questionnaires were distributed to 28 nations' staff officers in NATO SACT HQ, only 128 sets of questionnaires were successfully collected. The (weighted) response rate was 42.67%, which is typical for small-scale surveys of DoD military personnel (DMDC report, 2010a). Among the 128 (42.67%) sets of questionnaires that were returned successfully, only 118 (39.33%) 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.

Reliability and Validity Analysis. 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). For the face validation of study, constructs was confirmed by a group of military KM experts before conducting the survey. Additionally, the study was pretested with a focus group and subject matter experts in C-IED and KM in military for the evaluation of content validity. 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). The alpha values for all the latent constructs in this research for the research model (Exhibit 2) 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.

Descriptive Analysis. The survey based on 118 completed responses reflects the general state of KM in military in C-IED operations. The descriptive analysis was performed using Statistical Package for the Social Sciences (SPSS) 19 program. From the descriptive analysis of the respondents, the following may be summarized:

• Most of the personnel believe that the military already has KM in place with the highest frequency of 48.3% and rates on a scale of 1 (lowest) to 10 (highest) that the 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. And the majority of respondents (53.4%) stated that KM programs are effective (combining effective and moderately effective responses).

• 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%). Only 8% stated that KM is Risk Management.

• The respondents cited that “lack of incentives” was the main barrier to sharing knowledge (39%).

• 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%).

• 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%).

• Respondents also ranked “experienced military personnel” as the highest main source of IED/C-IED knowledge (41%).

• 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%).

• 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%)’.

Inferential Analysis. The main research model of this study (Exhibit 2) 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 modeling (SEM) was used to describe causal relationships among unobserved (latent) and observed variables (Arbuckle, 2003). In this research, SPSS 19 Analysis of Moment Structures (AMOS) software program was used for SEM 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. The fit indices for the hypothesized model are summarized in Exhibit 3.

**Exhibit 3. Goodness of Fit Results.**

<table>
<thead>
<tr>
<th>AMOS Fit Measures</th>
<th>Acceptable Criteria</th>
<th>Model Fit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability value (p)</td>
<td>p &lt; 0.05</td>
<td>0.001</td>
</tr>
<tr>
<td>The chi-square dividing by the degree of freedom (χ² / df)</td>
<td>1.0 &lt; χ² / df &lt; 3.0</td>
<td>2.12</td>
</tr>
<tr>
<td>Goodness of Fit Index (GFI)</td>
<td>0.9 ≤ GFI</td>
<td>0.93</td>
</tr>
<tr>
<td>Comparative Fit Index (CFI)</td>
<td>0.95 ≤ CFI</td>
<td>0.95</td>
</tr>
<tr>
<td>Root Mean Square Residual (RMSR)</td>
<td>RMSR &lt; 0.05</td>
<td>0.039</td>
</tr>
<tr>
<td>Root Mean Square Error of Approximation (RMSEA)</td>
<td>RMSEA around 0.05</td>
<td>0.055</td>
</tr>
</tbody>
</table>

The fit measures were at the acceptable level indicating high degree of fit in the hypothesized 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.

Additionally, in SEM analysis, absolute values (coefficients) 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, below mentioned suggestions were adopted for the rest of this study (Exhibit 4).

**Exhibit 4. Prescriptive Recommendations Based on Empirical Results.**

<table>
<thead>
<tr>
<th>Research Path Coefficients</th>
<th>Rating (KM Status)</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficients values 0.20 and less have negligible effect.</td>
<td>Critical immediate attention</td>
<td>Attribute needs immediate attention</td>
</tr>
<tr>
<td>Coefficients values 0.21 to 0.40 have weak effect.</td>
<td>Inadequate further enhancement</td>
<td>Attribute needs further enhancement</td>
</tr>
<tr>
<td>Coefficients values between 0.41 to 0.60 have moderate effect.</td>
<td>Adequate satisfactory level</td>
<td>Attribute is operating at a satisfactory level</td>
</tr>
<tr>
<td>Coefficients values between 0.61 to 0.80 have significant effect.</td>
<td>Superior Best in Class</td>
<td>Best in Class</td>
</tr>
<tr>
<td>Coefficients values above 0.80 have very significant effect.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The results of the hypothesized KM model in C-IED operations based on the research hypotheses is shown in Exhibit 5 and summarized in Exhibit 6.

**Exhibit 5. Present Status of KM in C-IED Operations in the Military.**

The higher the value of R², the greater the explanatory power of the regression model.
Exhibit 6. Summary of Research Hypothesis Test Results.

<table>
<thead>
<tr>
<th>RESEARCH QUESTIONS</th>
<th>RESEARCH HYPOTHESIS</th>
<th>R</th>
<th>SE</th>
<th>CR</th>
<th>p</th>
<th>RESULT/ MAGNITUDE OF EFFECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What are the key organizational capabilities for effective use of KM in military (especially in C-IED operations)?</td>
<td>H.1.1. Knowledge Process Capability has significant impact on KM in C-IED Operations.</td>
<td>0.43</td>
<td>-</td>
<td>-</td>
<td>0.001</td>
<td>Supported/ Moderate effect</td>
</tr>
<tr>
<td></td>
<td>H.1.2. Knowledge Infrastructure Capability has significant impact on KM in C-IED Operations.</td>
<td>0.38</td>
<td>-</td>
<td>-</td>
<td>0.001</td>
<td>Supported/ Weak effect</td>
</tr>
<tr>
<td></td>
<td>H.1.3. Traditional Leadership practices have significant impact on KM in C-IED Operations.</td>
<td>0.18</td>
<td>-</td>
<td>-</td>
<td></td>
<td>Not Supported</td>
</tr>
<tr>
<td></td>
<td>H.1.4. Transformational Leadership practices have significant impact on KM in C-IED Operations.</td>
<td>0.44</td>
<td>0.083</td>
<td>6.45</td>
<td>0.001</td>
<td>Supported/ Moderate effect</td>
</tr>
<tr>
<td>2. How does the leadership capability affect the use of KM in C-IED Operations?</td>
<td>H.2.1. Traditional Leadership capability mediates the effect of Knowledge Process Capability on Organizational Capability.</td>
<td>0.33</td>
<td>0.079</td>
<td>3.34</td>
<td>0.001</td>
<td>Supported/ Weak effect</td>
</tr>
<tr>
<td></td>
<td>H.2.2. Transformational Leadership capability mediates the effect of Knowledge Process Capability on Organizational Capability.</td>
<td>0.46</td>
<td>0.058</td>
<td>7.78</td>
<td>0.001</td>
<td>Supported/ Moderate effect</td>
</tr>
<tr>
<td></td>
<td>H.2.3. Traditional Leadership capability mediates the effect of Knowledge Infrastructure Capability on Organizational Capability.</td>
<td>0.64</td>
<td>0.087</td>
<td>13.89</td>
<td>0.001</td>
<td>Supported/ Significant effect</td>
</tr>
<tr>
<td></td>
<td>H.2.4. Transformational Leadership capability mediates the effect of Knowledge Infrastructure Capability on Organizational Capability.</td>
<td>0.66</td>
<td>0.077</td>
<td>21.56</td>
<td>0.001</td>
<td>Supported/ Significant effect</td>
</tr>
<tr>
<td>3. How are these capabilities manifested for effective use of KM in C-IED environment?</td>
<td>H.3.1. Knowledge Acquisition has direct effect on Knowledge Process Capability.</td>
<td>0.41</td>
<td>0.068</td>
<td>4.67</td>
<td>0.001</td>
<td>Supported/ Moderate effect</td>
</tr>
<tr>
<td></td>
<td>H.3.2. Knowledge Transfer has direct effect on Knowledge Process Capability.</td>
<td>0.43</td>
<td>0.074</td>
<td>5.89</td>
<td>0.001</td>
<td>Supported/ Moderate effect</td>
</tr>
<tr>
<td></td>
<td>H.3.3. Knowledge Application has direct effect on Knowledge Process Capability.</td>
<td>0.47</td>
<td>0.065</td>
<td>6.59</td>
<td>0.001</td>
<td>Supported/ Moderate effect</td>
</tr>
<tr>
<td></td>
<td>H.3.4. Technology has direct effect on Knowledge Infrastructure Capability.</td>
<td>0.67</td>
<td>0.089</td>
<td>11.03</td>
<td>0.001</td>
<td>Supported/ Significant effect</td>
</tr>
<tr>
<td></td>
<td>H.3.5. Organizational Structure has direct effect on Knowledge Infrastructure Capability.</td>
<td>0.45</td>
<td>0.065</td>
<td>6.78</td>
<td>0.001</td>
<td>Supported/ Moderate effect</td>
</tr>
<tr>
<td></td>
<td>H.3.6. Organizational Culture has direct effect on Knowledge Infrastructure Capability.</td>
<td>0.08</td>
<td>-</td>
<td>-</td>
<td></td>
<td>Not Supported</td>
</tr>
</tbody>
</table>

Conclusions

The main objective of this study 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 "What are the essential organizational capabilities for the effective use of KM in military especially in C-IED operations?".

Based on 118 sample data obtained from NATO 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.

Exhibit 5 represents the current state of C-IED KM in the 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 need immediate urgent attention to address the current weakness exhibited by the existing 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' (i.e. Technology).

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. Transformational approach can initiate and nurture the development of a culture that propagates innovation and sustainable competitive advantage over insurgents/terrorists. Also, it is suggested that military leaders/commanders should study and develop appropriate reward system (monetary and/or recognition) to increase the exchange of knowledge.

Additionally, the results of this research empirically demonstrated that within the 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.

Consequently, 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.

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.

**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, even though this study 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.

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