

CROSS-ANALYSIS OF DATA COLLECTED ON KNOWLEDGE MANAGEMENT PRACTICES IN CANADIAN FORCES ENVIRONMENTS

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ABSTRACT

As the 21st century unfolds, a number of changes have already altered the character and conduct of military operations. Consequently, the military profession is subject to drastic transformations, which ones oriented our attention around questions such as “how is professional military expertise currently built, shared and transmitted in this ever-changing and unstable world?” Drawn on data collected from a recent research on Knowledge Management (KM) practices, namely on Knowledge Creation, Learning and Collaboration, the present work performs a detailed comparison of the states of these practices between the different military environments, with an emphasis on what distinguishes the Army from the others. This paper underlines the components that can be considered either as levers or constraints for the current Canadian Forces KM efforts, such as becoming a knowledge-based army, reaching acute situational awareness or accessing knowledge in the C4ISR context.

1. INTRODUCTION

The drastic changes currently taking place in the military *sphere* are rooted in a number of exceptionally recent events. The first one coming to mind is the well known Revolution in Military Affairs (RMA, 1990), but there are also the changing socio-economic-political context of the world nurtured by the proliferation of asymmetric threats, the rapid scientific and technological innovations, the world resources scarcities, to name a few. In addition, each incident that is taking place in the world is interconnected either directly or indirectly to other regions of the world. These connections happen at a pace never encountered in the past. Consequently, the world is even more unpredictable than ever; the number of intra-state conflicts increases daily, with no insurance that traditional inter-state conflicts will decrease (DLSC, 2003).

All these accelerating factors for change bring significant transformations in the military concepts of operations and organization as well as in the doctrine. For instance, along with all the efforts deployed to respond professionally to the full spectrum of operations,

our military personnel is asked to acquire new skills and learnings. Henceforth, the *military profession* at all levels of command is subject to a drastic transformation to integrate new technologies, organization structures, ethics, intelligence, collaboration, sharing and learning in order to gain an acute and real-time situational awareness and to collectively respond in an effective fashion. There is a recognized need to better learn from the lessons provided by the past but also to develop an environment enabling the emergence of adapted innovations. In parallel, to move forward, there is a definite need to comprehend the present situation and where our Canadian Forces (CF) stand today. Therefore, these elements oriented our attention around two key questions: how is professional military expertise currently built, shared and transmitted, either as an informal practice on the Theatre or as a formal discourse through doctrine and what does it mean to collaborate within this ever-changing and unstable world.

In a previous work, we used an ontology-based approach in order to understand the KM context in the military environment (Gauvin et al., 2004). We ran semi-structured interviews with military personnel to gather their appreciation of knowledge creation (k-creation), learning and collaboration in the context of their work, at the scales of the individual and the whole organisation. The present work performs additional analysis on the collected data to highlight the differences among the CF environments (Army, Navy, Air Force and Joint) with regard to these topics. We attempt to answer questions such as: “to which extent the meaning of collaboration, and its links to the creation of knowledge for instance, may vary from one environment to another?” or “what do those discrepancies imply in a context of interoperability?” Furthermore, we develop ontologies showing how these topics relate to each other in every environment, and we then compare them to illustrate their similarities and differences.

This paper first summarizes the methodology with regard to the survey protocol and the ontology-based representation, and explains the method used to perform the cross-analysis. It then presents the findings from the analysis of current and emerging Army practices in k-creation, collaboration and learning and compares them to the other environments. Subsequently, it presents the Army ontology and discusses the variations found within the

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other environments ontologies. This paper concludes by a synthesis stressing a number of components in the military practices that should be considered for the conduct of KM initiatives or projects. In particular, it highlights how some findings should be considered to meet the new military requirements faced in today's context.

2. CROSS-ANALYSIS METHODOLOGY

2.1 Data Collection

This paper performs a cross-analysis on data that were collected from a recent survey with sixty-nine (69) military personnel representing a balance sample of high-level senior managers, experienced and junior-ranked practitioners. Furthermore, the samples were uniformly distributed to represent the four CF environments. Each respondent was questioned on either one of the three elements of the study (k-creation, collaboration and learning), with again a uniform distribution in each sample. The research protocol and the ontology-based representation used to consolidate the data gathered from the interviews are fully documented in Gauvin et al. (Gauvin et al., 2004) and are summarized in the next subsection.

personnel and the relationship with other elements. The model uses two levels of abstraction, a *concept card* and a *network of concepts*, which one is also simply referred to as an *ontology*. The card contains a description of all dimensions of a concept¹ and the ontology illustrates the relationships between the different concepts. In the survey, we produced sixty-nine (69) concept cards, each one corresponding to an interview.

2.3 Cross-Analysis Method

The first phase of the cross-analysis work consisted in regrouping the cards per environment and per concept. In each group, a preliminary analysis was conducted to extract generalities and to trace a global portrait of the environment context with regard to the concept at hand. Despite the limited number of respondents in each group, the balanced distribution among hierarchical levels and organisations allowed the extraction of valuable indicators and insights of the CF setting. Figure 1 shows an example of a consolidated card. It depicts how k-creation is generally experienced in the Army. In total, twelve (12) similar consolidated cards were produced. The second phase consisted in performing for each concept a comparison between the CF environments. All dimensions of the concepts were examined to extract similarities and

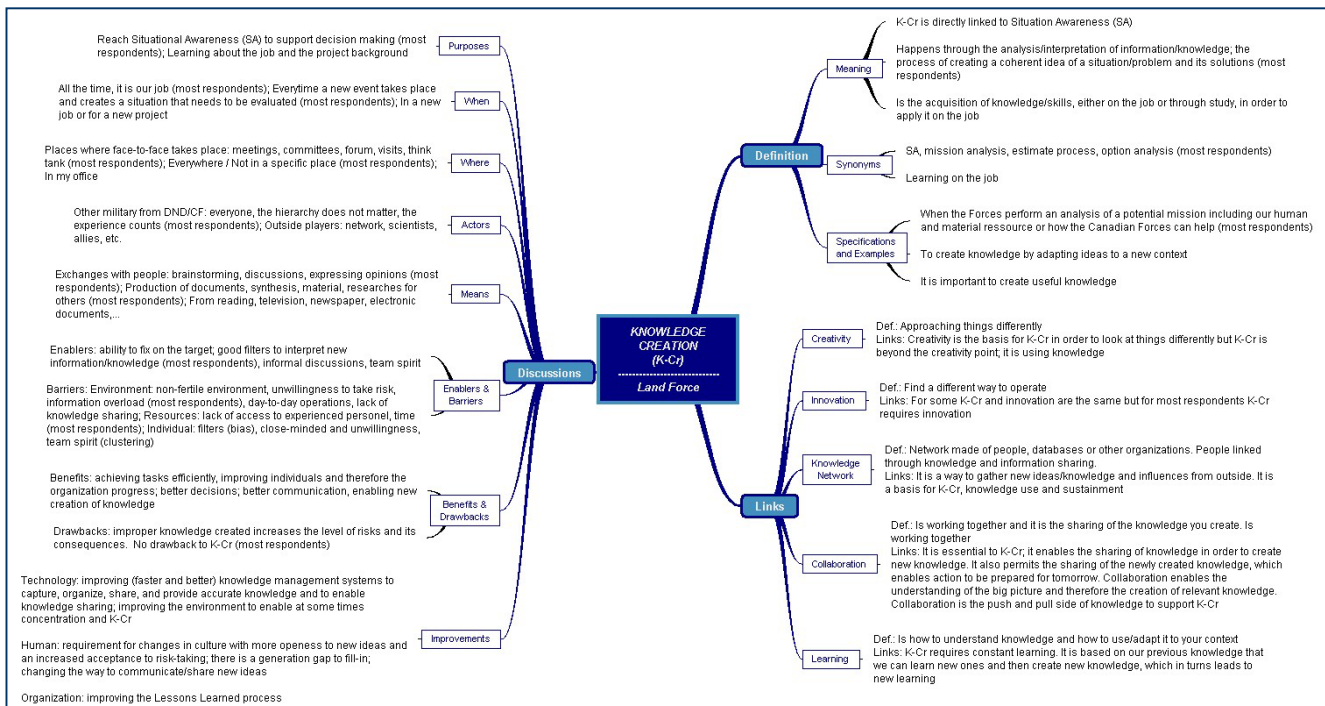


Fig. 1 - Consolidated card example for the Army

2.2 Ontology-Based Representation

An ontology-based representation was chosen to illustrate the meaning, the value and the relevance of the selected KM practices in the work of our military

differences. The third and last phase consisted in producing for each environment an ontology showing the

¹ In the military context, concepts such as k-creation, collaboration and learning are often discussed in terms of practices or processes.

relationship between the KM concepts and any other relevant elements that were mentioned as related. Again, a comparison was performed between the environments' ontologies.

3. FINDINGS: AT THE CONCEPT LEVEL

Using the consolidated cards, we performed a cross-analysis of the current and emerging practices in k-creation, learning and collaboration between the CF environments. Table I shows a subset of this analysis on some key dimensions of the concepts, namely purposes, enablers, barriers, benefits and drawbacks. We are presenting in this section the findings that are specifically related to the Army and the similarities and differences found with the other environments.

3.1 Knowledge Creation

From the results of this survey, *k-creation* is comprehended within the CF as the gathering, analysis, interpretation and adaptation of information to cope with

new situation.

Army Specificities

In the Army, the practices and understanding of k-creation refers strongly to the one of Situation Awareness (SA). K-creation is the interpretation and understanding of contextual information in order to bring awareness about the situation. Reaching SA, in turn, leads to the proposition of solutions and their resulting decisions.

K-creation is made possible by the sharing of knowledge through formal and informal interactions with colleagues. However, the true process of creating new knowledge, takes place subsequently when the different pieces of knowledge are set in context, organized, linked to one another and compared to the individuals' previous experiences. Moreover, for the Army, most of these k-creation activities happen when collaborating with other military personnel, internal or external to the organization.

Table I-a: Cross-environment fractional analysis on k-creation, learning and collaboration

CONCEPT	KNOWLEDGE-CREATION	LEARNING	COLLABORATION
Purposes			
Army Specificities	Reach SA to support decision-making (Frequent); Learn the job/project	Job/operational efficiency (Frequent); Improve abilities/skills; Solve problems; Adapte to changes; More/better decision-making; Recognition (peers, international)	Achieve objective/organizational goal (Frequent); Efficiency/better resources usage; Reach SA; Work in an informed network of people; Improve operations; Eliminate frictions
Environments Similarities	Efficiency; Optimize resources usage; Improve decision-making	Adapt to changes; Efficiency; Solve problems; Personal achievement/satisfaction; Recognition; Improve decision-making	Achieve objective/goal; Efficiency; Optimize resources usage; Nurture information/knowledge sharing
Environments Specificities	Army: Reach SA Air: Teach Navy: K-transfer, ensure continuation Joint: Organization advancement/growth	Army: Support SA Air: Career path/ensure employability Navy: Provide advices Joint: Think outside the box/enhance intuition faculty/close a knowledge gap	Army: Eliminate frictions Air: Make a change happen Navy: Create group cohesion/synergy Joint: Seek consensus
Enablers			
Army Specificities	Ability to fix on the target; Good filters to interpret new info/knowledge (frequent); Informal discussions; Team spirit	Time/energy spent on it; Rotations; Previous knowledge/learning; Structured environment; Team work; Experiencing; Communication skills; Motivation/ willingness; Feed-backs; Chocks; Clear objectives; Achievable results	Trust built with previous experience; Leadership; Meeting face-to-face; Common goal; Insufficient resources (incentive)
Environments Similarities	Ability to focus/fix target; Capacity to link to the job/interpret; Good communications; Understanding the big picture (vision)	Willingness/motivation, Rewards; Feed-backs; Environment adapted to learning styles; Relationships, interactions; Management flexibility and culture	Trust/Leadership; Common goal/interests; Availability; Structure; Communications; Have information/ knowledge to share; Technology
Environments Specificities	Army: Informal discussions, team spirit Air: Freedom to ask questions Navy: Open-minded people, good teachers Joint: Knowledge sharing environment, right amount of stress	Army: Time/energy spent on it, rotations, teamwork, previous learning/knowledge Air: Crisis/stressful situations Navy: People you learn with, leadership style, experienced colleagues Joint: Available resources, allowing mistakes/risks, equal level of knowledge	Army: face-to-face interactions, lack of resources (incentive) Air: autonomy, people thinking "outside-the-box" Navy: participants' willingness, chain of command/military culture Joint: rotations

Table 1-b: Cross-environment fractional analysis on k-creation, learning and collaboration

CONCEPT	KNOWLEDGE-CREATION	LEARNING	COLLABORATION
Barriers			
Army Specificities	Environment: information overload (frequent), non-fertile environment, Risk level, day-to-day tasks, lack of k-sharing; Resources: lack of availability of experienced personnel, time (frequent) Individuals: filters' biases, close-mind/unwillingness, misgi	Environment: generation gap, systems coexistence (legacy+new), no opportunities to experience the learning; constrains (time, money, security, risk-taking inacceptance) Individuals: basic needs (fatigue, medication) Organizational: disparity of learning p	Environment: lack of common goal, stovepipe structure (Some), ranks, geographical dispersion, cultural differences Individuals: close-mindness/unwillingness Organization: time and resources as well as all elements impacting a mission
Environments Similarities	Lack of resources; unwillingness (political and individual); information/knowledge overload (or difficulty to locate); rigidity of the structure, chain of command, non-fertile environment; reactive organization rather than proactive; people's biases	Generation gap; heavy workload; uneasy access to information and/or technology; lack of resources	Stovepipe structure; personality conflicts; unwillingness/ negativism; lack of resources (people, time, money); cultural differences (including intergenerational); resistance to change
Environments Specificities	Army: day-to-day operations, team spirit (clustering); Air: pressure/stress, poor communications Navy: lack of adequate IT/common processes, rotations Joint: none	Army: disparity of learning processes, conflicting priorities Air: none Navy: rotations, stovepipe structure Joint: immaturity of organization, non-adequate mentor/teacher	Army: geographical dispersion Air: absence of follow-up/feed-back Navy: chain of command, poor working relationships, unwanted postings Joint: military takes so long vs. technology moves so fast
Benefits			
Army Force description	Tasks efficiency, improved individuals and therefore organizational progress, better decision, help to communicate	Organization: organizational memory, better knowledge application, increased effectiveness, less cost/time, common understanding, saving life's Individual: improved skill/professionalism, personal satisfaction	Reduce unforeseen situations, more resources to use, building more knowledge, achieve tasks or missions more efficiently, create common vision
Environments Similarities	Successful missions/operations; efficiency; better decision-making; better understanding; allowing the organization to progress and adapt	Increase effectiveness; common understanding; personal satisfaction, recognition; faster reactions, better decision-making;	More/better resources; shared vision, buy-in; understanding the big picture; information/knowledge sharing; tasks/missions efficiency; better results; personal satisfaction; work duplication reduction
Environments Specificities	Army: Better communications Air: Not repeating errors Navy: Reduction of frustration/rework/cost, less stovepipe Joint: none	Army: Better knowledge application Air: Increased adaptation to change Navy: Improved problems solving Joint: Career progress, intellectual stimulation	Army: Reduce unforeseen situations Air: Consensus, innovation Navy: Good external image Joint: Opportunity to learn; Canada recognition
Drawbacks			
Army Specificities	Improper knowledge increases the level of risks; No drawbacks (Frequent)	Time/money cost, questioning orders, trade-off personal life, be stubborn, wrong learning impacts the job done	Time consuming, delays decisions, dwindle people's autonomy
Environments Similarities	Knowledge overload; improper knowledge increases risks; absence of focus increases work redundancy	Time/energy/cost consuming	Time consuming; possibility of overload; no drawback
Environments Specificities	Army: No drawback Air: Thinking that knowledge can replace experience Navy: Money/resources investment Joint: Negative impact when improper knowledge release (time/style)	Army: Wrong learning impacts the job Air: Fast-learning creates superficial learning; climate of uncertainty (changes) Navy: Distance from family; too many requests for expert Joint: none	Army: Delays decisions Air: Chain of command lack of efficiency Navy: Risk of failure if too many people/poor leadership Joint: Wrong collaboration goes against general interest

Comparison Between the CF Environments

The pursued objectives of creating knowledge are the same for all environments. It is to improve efficiency and to allow the growth of knowledge and experience of the human capital. Both Joint and Army soundly stressed the importance to improve the decision-making process as the ultimate purpose aimed by k-creation. In addition, the Air Force and Joint conceive k-creation as a key component to support the Forces transformations required within the present RMA or for the C4ISR purpose. Changes and external significant events strengthen creativity in order to adapt or increase the range of options to be considered as potential solutions. This sparks k-creation and allows innovation.

All environments place the accent on the criticality of transforming knowledge into a logical and tangible package that can be actionable by others. The usage and re-usage of created knowledge is even considered as a direct measurement of k-creation.

It is to be noted that people network is considered as the enabler by excellence for the gathering of knowledge as well as the sharing of newly created knowledge. In the same idea, the Army identified the element of “Team Spirit” as an enabler to k-creation but also specified that it could be a barrier as it creates frontiers between groups that are difficult to overcome. In the Air Force, the use of formal training and education is as important as people network in order to gain knowledge. The Joint environment has a different list of specific enablers to trigger the creation and sharing of new knowledge. These are the necessity for a clear understanding of organisational objectives and directions as well as for efficient and timely communication channels. For the Navy, k-creation is based on a cycle supported by human interactions and technology and it is gained through the experience taken on the job or, for instance, through the lessons learned.

Among the barriers to k-creation mentioned by the respondents of all environments, are human filters, the lack of time and resources (human and funding) and information overload. A human filter refers to the notion of judgment or intuition that needs to be applied to the circumstantial information and knowledge in order to create new one. If inadequate filters are being applied, erroneous knowledge might be created, which can lead to errors and risks for the organization. The lack of human resource impacts negatively k-creation and leads to a reactive mode vs. a pro-active one for the organization. Finally the barrier of information overload is also closely related to the difficulty of locating current knowledge already existing within the organization.

3.2 Learning

The general definition of learning for the Canadian Forces relates to the gain of knowledge and acquisition of new competencies and skills. Also, it refers to understanding from past experience and expanding on individual's experience.

Army Specificities

For the Army, learning requires the moderation of the acquired knowledge through experience to finally adapt it or create new learning applicable to the mission. Therefore, education, training, professional development, and experience are learning foundations. Education is considered as the component providing the context understanding, which enables problem solving.

The type of things people in the Army seek to learn, on top of the tactics, strategies or body of knowledge, concern elements directly linked to their understanding of the battlefield. These include the cultural and historical aspect of local populations as well as the overall Canadians' military and society history. They learn from their colleagues, from experts as well as from people of other nations or government departments. Consequently their main mean of learning is through formal or informal people interaction. Therefore, rotation opportunities are perceived as a good enabler to access these other individual's knowledge.

In terms of learning barriers, the Army stressed some organizational aspect (such as generation gap, risk-taking opposition and security constraints) and individual aspects (such as people's willingness to learn and work overload).

Comparison Between the CF Environments

In all environments, learning aims to improve operational efficiency through better decisions and better adaptation to the constantly changing surroundings. While the benefits are the ability to build a common understanding and react faster to events, the costs are the time and money required for learning. The Army also mentioned the risks of having individuals questioning orders and the risks of erroneous learning that could have disastrous impact on operations. The notion of learning to better understand and adapt to new situations is slightly different in the environments. In the Air Force, the notion relates more to the learning about people and organizational culture aspects as they are often tasked to support other environments. The Army are more interested in the history or societal cultures as they have to deal closely with them. The Joint Force is the environment stressing the most, the critical role played by external organizations. The essential components are the societal/ cultural/ organizational/ geopolitical changes and issues. While the Navy needs definitively to learn on the

surroundings and external scenes, the notion of learning is concentrated on the individual process of discovering knowledge through his/her group of peers and superiors. It refers to the amalgamation and transformation of acquired knowledge and past experience into skills in order to perform specific tasks.

All environments are facing a transition from a passive learning mode to an active learning mode. Passive learning was described either as unexpected learning happening to the individual or learning decided by others. Traditional learning (formal education, training and experience), a form of passive learning, is still valued and encouraged in all environments. Active learning, in the other hand, relates to individual's willingness to learn and the way to pro-actively seek to acquire knowledge and learning.

Learning is recognized in all environments as being a continuous on-going process. Learning occurs in daily duties, all the time. For instance, people interaction is perceived as a way to learn from the experience of others and to provide feedback to validate ideas. Surprisingly, learning is also described as being experienced when significant external events impact the organisation or the individual. In this case, learning is associated with transformation.

Among the enablers shared by all environments was to encouragement for learning from the high-management. On the other hand, barriers dealt with the lack of resources impeding formal learning and the generation gap hindering knowledge transfer. Army and Joint Force specifically mentioned the barriers due to the difficulty to access experienced individuals and needed information residing within the organization.

3.3 Collaboration

Among the different environments, collaboration is understood as working together, either formally or informally to achieve a common goal.

Army Specificities

In the Army, collaboration happens through the mutual exchange of knowledge and experience. Either virtually or not, sharing creates the required synergy to reach SA or accomplish a task. Collaboration also enables a group to deal with complex situations where no single individual would have the required knowledge, expertise or authority to solve the issue. Finally, collaboration tends to eliminate friction due to communications and the creation of a common understanding of the situation and a common goal. The Army perceived benefits of collaboration were the creation of more and better-adapted knowledge and an increased efficiency in achieving missions. The

drawbacks mentioned by the Army were the risk for a group of being stigmatized due to selected collaborations.

There are many barriers to collaboration but most of them relate to elements hindering people interactions like cultural differences, stove piped organization, geographical dispersion, close minded people or people resisting to change as well as to knowledge sharing.

Comparison Between the CF Environments

Overall, with respect to collaboration, more commonalities than differences were collected throughout the Canadian Forces environments. Actually, collaboration is perceived by the Canadian Forces as such a critical activity that it is considered as a part of the military culture. They share the same purposes for collaboration, that is, to improve efficiency and optimize human resources usage. Nevertheless, the Army sets these objectives directly in the context of operations, for instance, to reduce the number of unforeseen situations. The Air Force, in its case, links it more to enabling learning, leveraged by the mutual aid of participants. For the Navy, collaboration refers more to a way of working that enables the buy-in from people to work toward a long-term development of visions and strategies. In the Joint Force, the practice of collaboration is very similar to the planning activities and the coordination of staff and efforts.

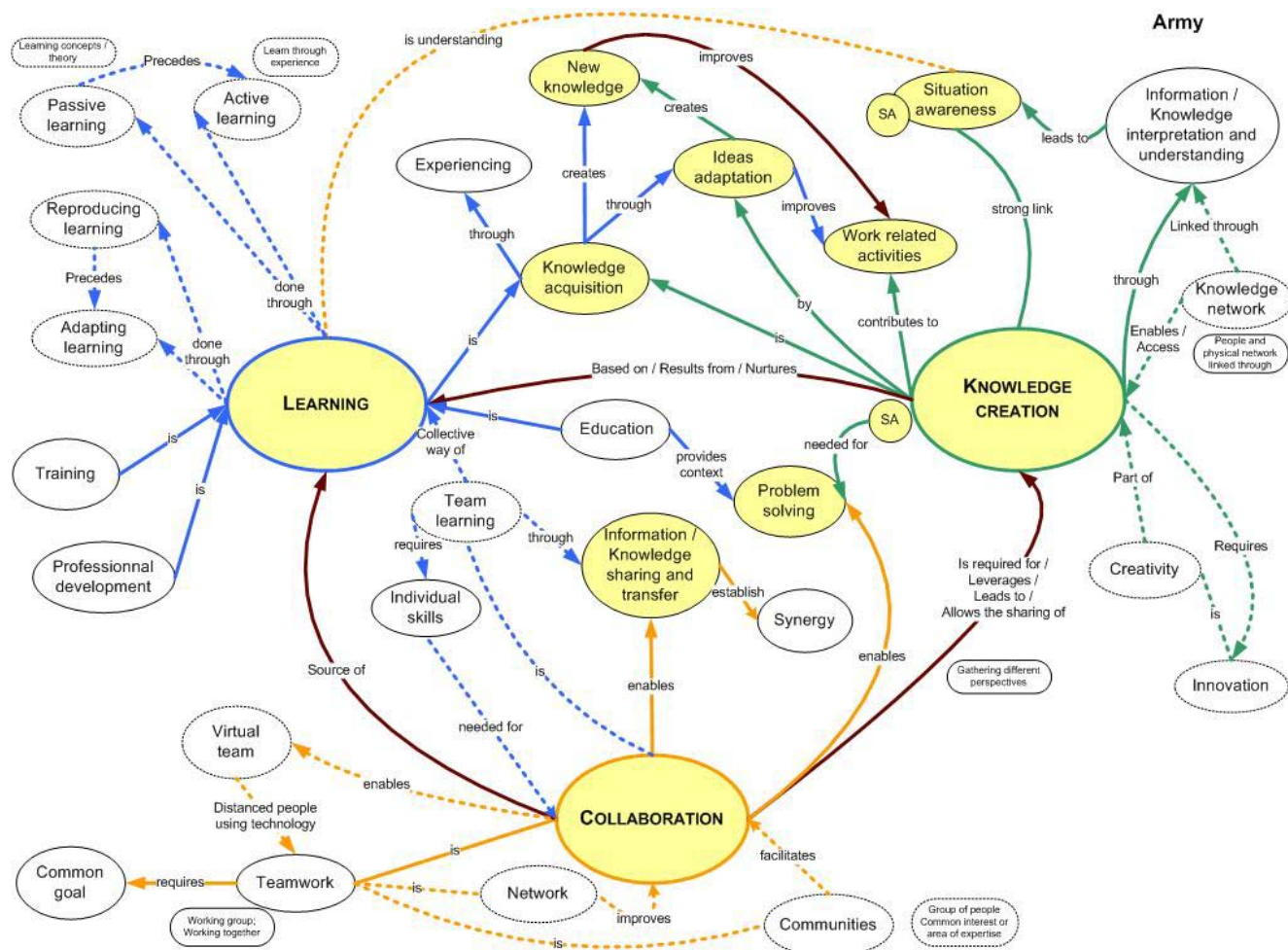
In terms of enablers for all environments, leadership plays numerous roles in collaboration like facilitating communications, ensuring common understanding or also defining the priorities. Also, it is very important to establish good relationships and trust with others, particularly since the resources scarcities (money, time and human resources) are a challenge for the Forces. It is worth to note that in the case of the Army, resources scarcities were also perceived as an incentive for collaboration. The common drawbacks to all environments were the time and energy consuming aspects as well as the personnel's overload due to the number of collaborations taking place. An additional drawback identified by the Army was the risk of slowing down the decision-making process.

4. FINDINGS: AT THE ONTOLOGY LEVEL

This section presents the findings from the construction of the ontologies, which describe the relationship between *k-creation*, *learning*, *collaboration* and any other related elements. In particular, we are discussing the ontology for the Army and the findings from the comparison between the ontologies of the other environments.

4.1 The Ontology for the Army

Figure 2 illustrates the ontology built for the Army. The shaded concepts are the ones that were spontaneously



mentioned by the respondents of at least two sample groups. For instance, a reference to the concept of knowledge acquisition was made during the interviews about *learning* and *k-creation*.

We notice that *collaboration*, with its sharing and transfer of information/knowledge, acts as a bridge between concepts. *Collaboration* leads to *k-creation* through the gathering of different perspectives. It also allows the sharing and management of the newly created knowledge. Indeed, it is through collaboration that new knowledge can circulate and be applied throughout the organization. Similarly, as *collaboration* is considered as a synonym to *team learning*, it is perceived as a collective way of learning enabled by the sharing of participant's knowledge, information and experiences. On the other hand, if *collaboration* is perceived as a source of *learning*, this latter concept is the instrument that ensures that all participants possess the individual skills and abilities required to alleviate the collaborative process.

Problem solving activity is frequent within the

Forces and naturally within the Army. *K-creation* happens through the interpretation and understanding of information/knowledge shared through *collaboration*. The newly created knowledge leads to *SA*. In this cycle, *learning* provides, through education, the context required to help understand the problematic at hand.

In the same realm, *learning* and *k-creation* are both related to *knowledge acquisition* respectively through *experiencing* and *adapting ideas*. In both cases, the newly acquired knowledge supports the improvement of the work related to the activities to bring awareness of the situation. This latter one is considered as the ultimate objective of *k-creation*.

4.2 Comparison between Environments' Ontologies

The Army shares with the Navy, the tenet that *collaboration* is an enabler for sharing and broadcasting newly created knowledge. Other environments also mentioned the role of collaboration as a feedback mechanism either to validate created knowledge or to confirm the acquired learning.

In all environments, *collaboration* is a key source for learning. It is even considered as a strong learning accelerator within the Joint Force. While all environments stressed the strong links between *SA* and *k-creation*, the Army was the only one to link it directly and simultaneously to *collaboration* and *learning*. For the Army, *SA* seemed to be the central node or “raison d’être” of all other components regardless of the investigated concept.

Overall, the main difference with the other environments resides in the number of links between the practices of *k-creation*, *collaboration* and *learning*. The Army is experiencing very strong interconnections between the three practices and the other related elements. As well, the interconnected concepts are not always the same in all environments. For instance, the concept of *problem solving* does not appear as such in the other environments.

5. DISCUSSION AND CONCLUSION

In this work, we used an ontology-base approach to perform a detailed comparison of the current and emerging practices of *k-creation*, *learning* and *collaboration* between the different CF environments and we focussed on what distinguishes the Army from the others. The results offer many interesting insights into the specificities encountered in each environment and a better understanding of the current and emerging KM practices in the Canadian Forces.

The ultimate aim of the present work is to provide support to KM related activities, initiatives, and programs that are taking place in the Department of National Defence (DND). Some focus more specifically on KM while others only recognize the role that KM should play. For instance, from the analysis of the Joint sample related to *k-creation*, respondents prioritized some of the interconnected elements. It would be worthwhile to use these findings to help establish the scope and issues right at the offset of new C4ISR initiatives. Other DND on-going activities are the NEOps initiatives (Babcock, 2004), the Canadian Forces Strategic Operating Concept (DND/CF, 2004), the Joint Interagency Multinational and Public framework, and a starting-up Departmental KM program.

The results of the research demonstrated that there exist very strong links between *k-creation*, *learning* and *collaboration* in every environment. Therefore any KM initiative should consider them from a systemic point of view. A number of closely related elements were also listed and discussed. Examples are *SA*, *lessons learned*, *team spirit*. In this latter case, it appears to play a double edge role. It can be an enabler or a barrier in the same environment. Any initiatives should then take all these

elements into account to maximize its chance of success and to reduce risks.

Finally, the results of this paper underline the importance of the specific military culture pertaining to each environment in their ways of defining their practices. In most cases, respondents of a same environment selected the same elements to describe the way they learn, create knowledge and collaborate, whether they refer to knowledge sharing, education, feedbacks or experiences. However, if this particularity can sometime be considered as a positive factor, and it is, it also appears to create some challenges. As a matter of fact, the environments not only consider different relationships between these elements but they also structured and prioritized them in different ways. These differences are strongly tinted by each environment’s *raison d’être* and culture, which bring and also justify compartmentalized approaches.

This research was very productive in many ways due to the richness of the data collected on the subject. Other similar cross-analyses are currently taking place to highlight this time the differences between the hierarchical levels of respondents.

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