The Canadian Knowledge Management System (KMS) within the Land Force Command and Control Information Systems (LFC2IS)

Topic: Decision Making and Cognitive Analysis

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1. Abstract

This paper will present an overview of the Knowledge Management System (KMS) project history and the system functionalities. It will show how the KMS permits the Canadian Forces to synchronize lessons learned, doctrine and system help and to manage its knowledge and exploit it, either as a knowledge management process or as assets that can be used independently.

2. Introduction

The Knowledge Management System (KMS) is the result of substantial research and development efforts undertaken by the Department of National Defence (DND), DMR Consulting[1] and DRDC Valcartier regarding Knowledge Management, Lessons Learned Process, Electronic Task Support System (or EPSS, Electronic Performance Support System), Command and Control, Ontology, etc.

The KMS was deployed in October 2004 as "One System" of the Land Force Command and Control Information System (LFC2IS) to support specific requirements within a "System of Systems" development context where the challenge is to integrate different systems that were individually designed and developed into an infrastructure [Cantin, 2004]. The KMS encompasses two systems previously developed for the Canadian Forces (CF), the Army Lessons Learned Knowledge Warehouse (ALLKW)[2] [Champoux 2003] and the Electronic Task Support Framework (ETSF), aiming to enhance the capability to manage and generate more knowledge faster and more accurate in support of individuals, groups, teams and organizations; the aim being to gather/capture:
- What the individual knows;
- What others know;
- What the CF knows and how it can use this information and apply it in a more simple and efficient manner.

The main purpose of the KMS is to provide the Canadian Forces with a tool for managing Knowledge Assets and the Knowledge Management Process while remaining focused on business process (e.g. Doctrine, Lessons Learned). It also aims at focusing, providing, producing and managing information from different sources enabling a validation process of the information it supplies. The system may be foreseen as the Knowledge Management portion of an Enterprise Knowledge Portal [Firestone 1999], [Firestone, b 2003], [Collins, 2003].

The Army's intent is to use the KMS to standardize how system help is developed within a whole body of systems (e.g. LFC2IS) and to provide a tool to system help users, within the context of integrating declarative knowledge from Doctrine and Tactics, Techniques and Procedures (TTPs) as well as Procedural Knowledge from Standard Operating Procedures (SOPs) and System Procedures.

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[1] DMR Consulting, a division of Fujitsu Consulting.

[2] The system recently won the highest Canadian recognition in the IT domain (November 2004). Canadian Information Productivity Awards (CIPA) has awarded four prizes to the project, the Canadian IT project of the year, which are the Diamond Award of Excellence, the Silver and the Gold in the Efficiency & Operational Improvements category as well as the CIO of the year Award to Lieutenant Colonel Jacques Hamel. It had previously won an OCTAS (April 2004) from the Quebec Provincial IT industry in the E-learning and Knowledge Management category.
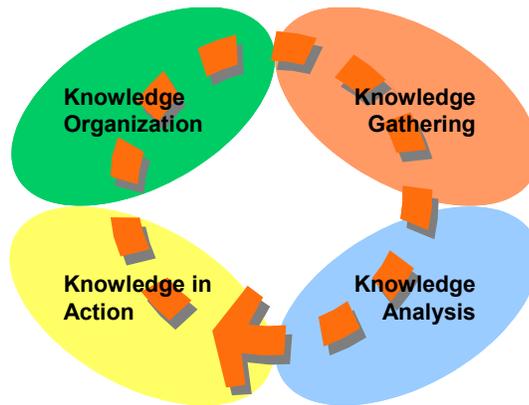
Figure 1. Knowledge Management Process

3.   KMS Overview

3.1 Origin of KMS

Managing assets and the Knowledge Process were embedded into the LLKW implemented in April 2003[2]. It mainly focused on supporting the entire Knowledge Management Process regarding Lessons Learned (LL) (Figure 1) [Bourry-Brisset, 2002], [Champoux, 2003]. The LL Process (LLP) is among the "Best Practices" in Knowledge Management [Davenport, 1998], [Weber, 2000], [Aha, 2001] and is a strategy to elicit, retrieve and re-use lessons acquired from experiential knowledge. The Army LLP was designed during the course of the project with the extensive participation of users [Maclean, 2005] in several Joint Application Development sessions (JAD) [Cantin, 2004]. The Canadian Forces agreed upon the composition of the LLP and is currently pursuing the development of a Canadian Forces Lessons Learned Knowledge Warehouse (CFLLKW) using KMS as a framework, leveraging the work undertaken by the Army and making it a multi-environment system where knowledge will be shared consequently enhancing a learning curve that will benefit everyone.

The Electronic Task Support Framework (ETSF), deployed in April 2004, provides tools to structure knowledge and manage explicit relations between objects that can be mapped to present the contextual help in relation to a system user performing a task. A study of how doctrine, TTPs and SOPs should be structured was undertaken in order to analyze the different schemas under which the declarative and the procedural knowledge are best represented or managed as distinct objects. Within the LFC2IS context, knowledge is organized in such a way that it provides the military personnel (operators) with easy access to knowledge and most importantly prompts them, upon request from a specific system, with what is truly relevant to their specific tasks while keeping in mind that time (both reaction and response time) is a sensitive issue in decision making. The system also allows users to navigate and search through the body of knowledge gathered either within or regardless of the domain.

As all LLKW functions, all ETSF functions are part of the KMS; the System Help domain is fully integrated and synchronized with the Doctrine domain (including TTPs and SOPs) offering the Canadian Forces a complete top-down view on knowledge as well as the right information in a timely fashion to the person requesting it. In order to facilitate learning and training within a sole system, the KMS offers a coherent and homogenous System Help framework to systems (e.g. LFC2IS) that were designed and developed on an individual basis.

3.2 Knowledge Domains

The KMS assists the CF throughout the Knowledge Management Process in managing several knowledge domains such as the Doctrine, Lessons Learned and System Help domains (Figure 2). Specific groups of Subject Matter Experts (SMEs) within organizations will structure and manage their knowledge by tracking the changes directly from military feedback, through issues determination and recommendation for action and by validating that the changes have made a difference. For instance, a specific CF organization may have the responsibility to manage a subset of Army Doctrine within the Doctrine domain; another may manage Lessons Learned from a tactical perspective within the Lessons Learned domain or manage all system helps related to a specific 'System of Systems', such as the LFC2IS within the System Help domain.
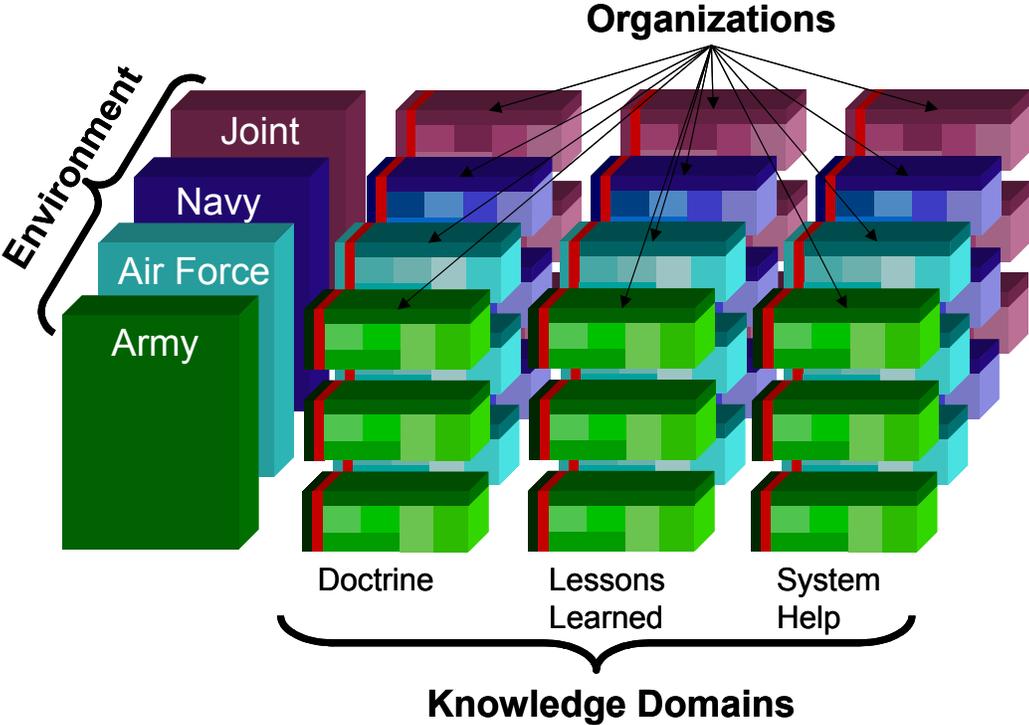
Figure 2. Organizations from Environments responsible of managing knowledge within a specific domain

The three main Knowledge Domains of the KMS regroup knowledge in terms of business purposes within groups or organizations. They are defined as follows:

a. **Doctrine**. This domain manages knowledge regarding the "fundamental principles by which the military forces guide their actions in support of preset or current objectives."[AAP-6 NATO]. The doctrine in KMS is managed as a distinct knowledge object for each topic that can be shared and linked when needed, thus reducing knowledge redundancies that create inconsistencies. As a result, a specific topic may be defined once and re-used throughout the different Doctrine Knowledge Structures. The KMS manages knowledge objects instead of documents, however the concept of publications within the system allows the user the option to extract documents, as deemed appropriate.

b. **Lessons Learned**: This domain manages current and historical data gathered from activities such as Operations, Exercises, Experiments and Trials. Within this knowledge domain, observations and comments, considered as raw data, are gathered and organized through a set of Observation Structures (e.g. questionnaire). This domain aims at enabling the CF to profit from its own experiences thus avoiding the duplication of costly errors, particularly those pertaining to death or injuries. It will also help to achieve success and provide a consistent trend towards enhanced performance while favouring a better and permanent learning curve for the users.

c. **System Help**: This domain gathers and manages knowledge regarding "On-Line Help" for all LFC2IS applications and for KMS as a whole. This domain offers a coherent and homogenous framework for the development of System Helps of Systems. The different System Helps may be fully integrated and synchronized within the Doctrine domain, thus offering a complete top-down view on knowledge as well as the right information at the right time to the right person.

In order to address the CF priorities regarding Knowledge Management, many stakeholders (Figure 3) are involved in the development of the KMS and its content. The Canadian Forces Lessons Learned organizations involved are the Army Lessons Learned Centre, the 1 Canadian Air Division (1CAD), the J7 Operational Analysis and Lessons Learned and Lessons Learned Maritime Warfare Centre. From the System Help and Doctrine domain's perspective, the organizations involved are the Directorate Land Command Support Program Management (DLCSPM), the Directorate Army Doctrine (DAD) and the Army Digitization Office Kingston (ADOK) overlooking the management and the definition of Doctrine, TTPs, SOPs and System Helps.
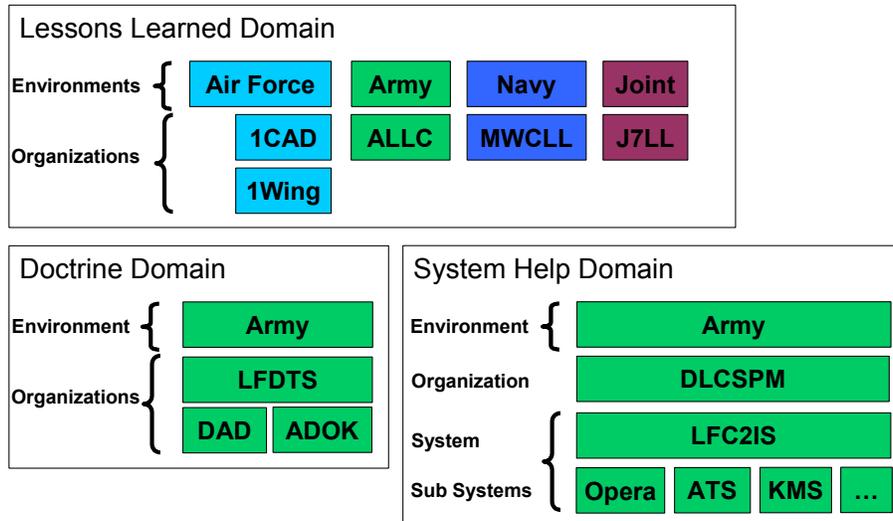
Figure 3. Stakeholders of the KMS Project

3.3 Knowledge Process and Assets

The KMS's main objective is to empower the Canadian Forces with a tool to create as many domains and sub-domains as required for groups or organizations that need to have control over knowledge assets and their own Knowledge Management Process enabling them to:

- Structure their body of knowledge more efficiently;
- Manage explicit relationships between knowledge objects;
- Share knowledge with one or many groups;
- Gather, receive and capture observations, comments and feedback from key participants on specific subjects or topics;
- Raise issues;
- Identify requirements or lessons;
- Track any action taken on issues;
- Validate that the lessons are learned and the effect of actions taken on outcomes.

The KMS may be considered as a tool that supports a Knowledge Management Framework [Gorelick 2004, Firestone a 2003] addressing knowledge as a process (Figure 4 A) and as a multitude of assets (i.e. stock or entity) (Figure 3 C) but most importantly it is a tool permitting knowledge management in both aspects.

Sharing is one of the most important factors of success of any KM initiatives and in that regard, the KMS allows any CF personnel to give 'Feedback' (Figure 4 B) on any asset of any domain. Feedback may take many forms, comments or suggestions, covering various subjects such as enhancement purposes, new functionalities, and examples or best practices. For instance, it may be additional information on a specific Exercise that was overseen.

The first priority of the Canadian Forces regarding Knowledge content concerns Activities (e.g. Operations, Exercises) as well as System Help and SOPs for LFC2IS and secondly comes Doctrine and TTPs, which are already in progress. The actual content of the KMS consists of the following:

- Observations and comments gathered through the Chain of Command for each specific activity pertaining to Operations/Rotations, Exercises and Experiments/Trials.
- Doctrine where "fundamental principles, by which the military forces guide their actions in support of objectives"[AAP 6, NATO] are defined for guidance;
- Tactics, Techniques and Procedures that prescribes in more detail how military activities are planned and executed.
- Standard Operation Procedures that define "a set of instructions covering features of operations which lend themselves to a definite or standardized procedure without loss of effectiveness. The procedure is applicable unless ordered otherwise" [AAP 6, NATO].
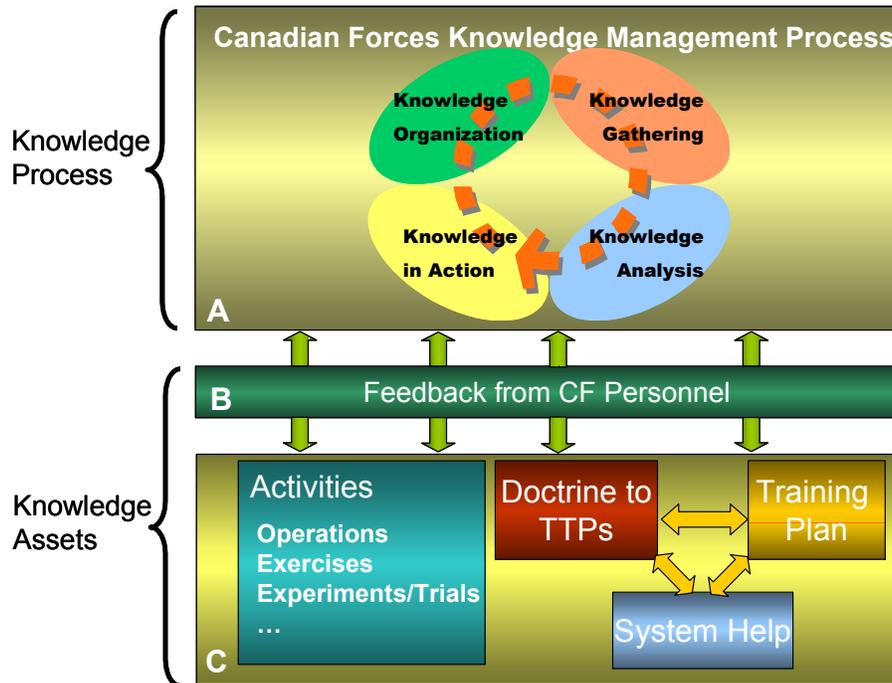- System Procedures that support the SOP's related to specific military tasks.

Figure 4. Knowledge Management as Process and Assets

3.4 KMS usage within the LFC2IS context

The KMS also provides to users of systems, such as LFC2IS, an access to a standardized help within specific knowledge from Doctrine, TTPs and System Procedure, which is linked and presented to LFC2IS users to address their tasks.

From a system users perspective, the KMS supports and enhances users' performance by providing them with the body of knowledge required by the task they are actually performing at the time of the request (just in time). As a result, the user has access to the most appropriate knowledge to address his task, which is embedded into KMS (e.g. Doctrine, TTPs, System Procedures). This knowledge delivery has strategic implications in the training and in its subsequent adaptability to changes. It is recognized in the scientific literature that when the user of a system is adequately guided by the system itself towards the knowledge he needs to accomplish the task, the main result is a significant reduction in training requirements [Cole, 1997], [McGraw 1997].

From a system development perspective, the KMS provides an integrated framework for the development of System Help whereby systems developers and Subject Matter Experts capture and integrate knowledge from a system's perspective such as system procedures and steps and from a business perspective such as Business Process, Sub-Process and Task. Most importantly they are managing explicit relationships within the body of knowledge of the KMS (e.g. doctrine, Lessons). The KMS offers a single point of entry to access System Help of a 'System of Systems' such as the Land Force Command and Control Information System (LFC2IS).

4.   Knowledge Management Process within the KMS

The Knowledge Management Process (KMP) supported by KMS is composed of four main phases: Knowledge Organization, Knowledge Gathering, Knowledge Analysis and Knowledge in Action (Figure 5), under which several sub-processes manage different knowledge assets and aspects of the system. Some assets may be associated to one or more phases of the KMP such as the issue raised by Knowledge Analysts are determined in the Knowledge Analysis phase and are conducted in the Knowledge in Action phase. Figure 5 presents the KMS Assets in light of the KM Process.
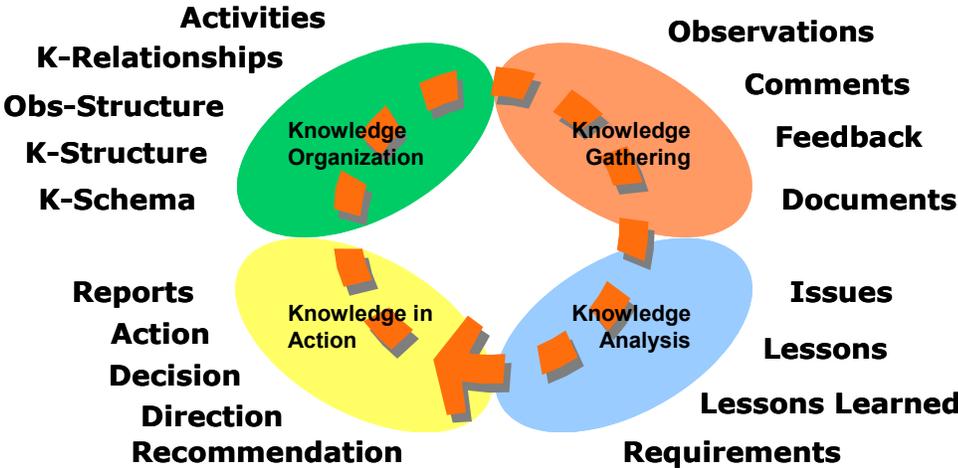

Figure 5. KMS Knowledge Assets in relation with the Knowledge Management Process

All domains and sub-domains follow the KMP in light of their respective knowledge assets responsibilities. As a result, the KMP involves many users that have specific roles. With the use of application roles (Figure 6), the KMS facilitates the management of accessing and editing rights to knowledge within a domain or a sub-domain.
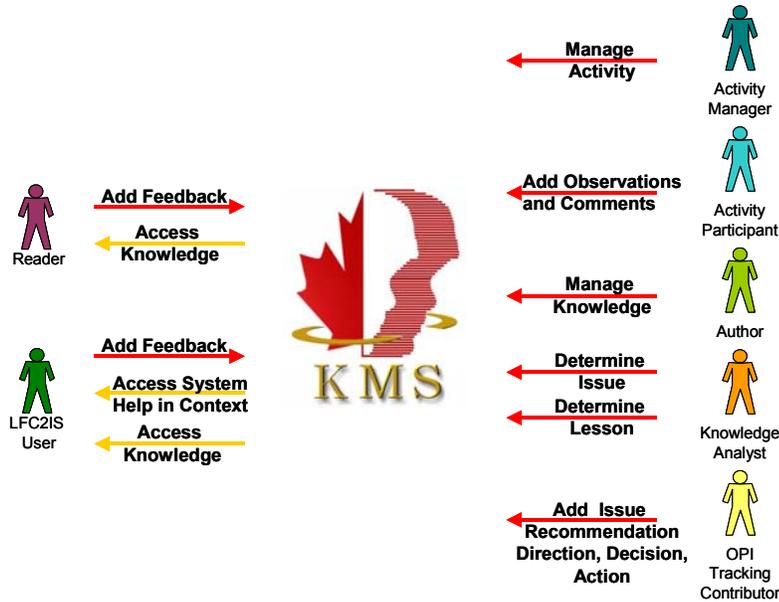

Figure 6. KMS Knowledge Application Roles

4.1 Knowledge Organization

The aim of this phase is to organize and structure knowledge for each knowledge domain and sub-domain in such way that it can be easily visualised, searched and managed. The KMS supports two ways of accessing the knowledge of a specific domain:

- By navigating through different Knowledge Structure; or
- By searching within the domain.

A Knowledge Structure (Figure 7) provides a hierarchical display of knowledge that may be characterized as a subject, a topic, a process, a task, a procedure, a step, etc. For example, within the Doctrine domain there is a breakdown of processes that will present all processes, sub-processes, tasks and procedures.
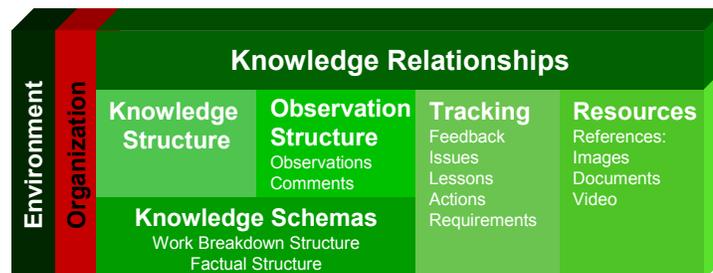

Figure 7. Knowledge Component of a Domain or sub-domain managed by an organization

A Knowledge Structure follows a set of rules that is referred to as a Knowledge Schema (Figure 7) defining:

- How knowledge is characterized (e.g. topic, process);
- How it is organized within a hierarchy (e.g. process may task or sub-process);
- The possible relations within the schema, between schemas and with other knowledge objects such as lessons, issues or recommendations.

The KMS support multiple schemas shared between domains and sub-domains. Within the KMS the declarative knowledge (e.g. Doctrine) are regroup under Knowledge Structures as the observations and comments gathered from participants of specific activity are linked to Observations Structures (Figure 7).

The KMS allows the use of multiple Observations Structures that may be based on questionnaires schema (or other) for different categories of activities (e.g. International Operations, Domestic Exercises).

The KMS also manages explicit relationships (Figure 7) between assets such as documents, issues or lessons may be linked to activities: Operation, Exercise, etc.

4.2 Knowledge Gathering

The main objective of this phase within a domain or a sub-domain is to manage observations, comments and feedback in relation to activities. This phase is the entry point of the military personnel (participants) involved in this activity.

The participants of Operations or Exercises are able to capture their observations and comments "on-line" following a specific Chain of Command and attached specific documents related to the activities. These are considered by the Canadian Forces as "Official Reports" that are approved by the Chain of Command. Observations and comments are captured on-line by contributors and approved by the Commanding Officer for each organization associated to a specific Reporting Level. The distinction between observations and comments allows users to easily visualize and follow a discussion on a particular subject within the context of an operation or an exercise. The sequence of observations and comments follow the Chain of Command from the Unit level up to the higher level. One of the benefits of the on-line capture of knowledge is the possibility to access observations and comments as soon as the Commanding Officer has approved his knowledge acquisition.

The KMS also allows any military users to add feedback on any particular assets. For instance, a user may want to add an observation regarding an Experiment, Doctrine or a system procedure.

4.3 Knowledge Analysis

The next two phases are part of the Tracking Knowledge Mechanisms that foresee the validation and dissemination of information within the KMS.

The main objective of the Knowledge Analysis phase is to seek knowledge on different topics, validate issues and enhance learning while performing activities (e.g. operations, exercises). This phase is the entry point of a wide range of users that are interested in learning about previous experiences and increase their state of preparedness for operations or training.

The Officers of Primary Interest (OPI) of a specific knowledge domain manages all feedback or observations (i.e. through questionnaires) ensuring that all are addressed, analysed, and that each relevant issues is raised and sent through the Chain of Command. They are also responsible to identify lesson.

The Subject Matter Experts (Knowledge Analyst) of each domain decide which explicit relationships between assets from different domains need to be managed, shared and pursued throughout the environments, as deemed appropriate. The KMS offers different views of the same knowledge without duplicating it so that multiple knowledge structure schemas can be used to organize the knowledge in light of the user's perspective for either learning, training on current applications or to support activities such as operations or exercises.

The KMS is a unique collaborative environment where military personnel can manage and share their knowledge among different domains as well as domains of different environments. The system enables the users to find rapidly and easily what is required, it may prompt knowledge in context of a given task and allow the user to add their own feedback taking into account their valuable experience and expertise.

4.4 Knowledge in Action

The main objective of the Knowledge in Action phase is to gather recommendations and decisions from staff authorities, ensuring that proper actions are taken and lessons are learned. This phase is the entry point of the stakeholder, OPI, Staff, Commander and Lessons Learned Organization Staff whose main concern is to follow up on actions but also contribute to the KMS by adding their comments, recommendations or decisions on issues that falls under their command.

The Follow-up on action is required to validate changes, to verify if a lesson has been learned or to simply correct/modify or change specific topics of the doctrine.

Therefore, KMS enables domain OPIs to track action taken upon issues. The KMS allows:
- OPIs (Tracking Contributor) to capture "on-line" their recommendation, direction or decision on specific issues.
- Knowledge Analyst to create and manage multiple Status Reports regrouping several issues of a specific domain.

5. Impacts of KMS

This whole process did not happen overnight. It took time to convince a lot of people at different levels that what was developed had a purpose and a very important one indeed. This "vision" had to be presented, acknowledged and eventually shared among many participants before it became a "System of Systems" type of project. Again, time was a sensitive issue.

The way of doing things have changed over time, thanks to the e-tools that are offered on the market but also because, ultimately, time should be considered a valuable issue/asset in decision making. Our workforce is aging rapidly and their knowledge needs to be captured so that the next generation will not have to repeat the same process of errors, results, lessons learned and change of attitude towards problems that they will encounter. Our learning curve needs to adapt rapidly to changes and we feel that the KMS will provide a valuable solution for the next generation, ultimately enabling us to save lives by making the right decision at the right time. As groups may evolve throughout the acquisition of a KMS, whatever the development and direction it should take, keep in mind that both reaction and response time are sensitive issues and that they, from an economical point of view, have a strong monetary impact on the outcome, much stronger than the costs involved in implementing such an approach.

The fact that the new generation is much more familiar with computers is a plus that needs to be exploited for the benefits of organizations. Contrary to some beliefs, the "old ways of doing things" will not be jeopardized by the acquisition of a KMS System of Systems: it is more likely to be the opposite as the value of the knowledge embedded within each individual will be captured in the System, thus challenging those who have put this information in to "push the envelope further." This is called innovation; it should not be scary: it should stimulate creativity within groups. It may also enable people to discover within Forces, a group of individuals that are starving to "make it happen" as was seen within the CF.

6. Conclusion

KMS is a tool that enables organizations to centralize their knowledge. Yet it also compartmentalizes it in terms of ownership facilitating its management and its use from different perspectives according to who uses it. The information in KMS comes full circle since the CF exploits it as part of its knowledge management process. However, it need not stop there, and it doesn't, since each bit of information can also be exploited as a stand-alone. By linking one bit of information to another, which does not necessarily follow one another in the KM process, a better idea of what the situation is can be given. Creating those links and adding additional relationships between chunks of information draw a clear picture of the real world. You need only go back to it to remember how it was, how it is now or to see what is planned for the future.

This project was born from the passion of dedicated individuals. As you have noticed over the years, passion is a driving force if you want to make a success of what you implement. More importantly, to be a winner you need to surround yourself with what is necessary to be the best, especially when being on top of your game can save lives!

7. Acknowledgement

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