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A Knowledge Management Approach to the Creation and Sharing of Canadian Forces Lessons Learned

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or
Information superiority

A Knowledge Management Approach to the Creation and Sharing of Canadian Forces Lessons Learned

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Abstract

Lessons Learned (LL) constitute a fundamental Knowledge asset in any Command and Control organization. Past operations lessons convey important experiential knowledge (both about successes and failures) that can be learned, reused or avoided in future similar situations in a way to make best decisions. With the emerging of Information Technology, lessons learned systems were built, but not designed through a process that facilitates the sharing of their content and their reuse in subsequent decision-making. Therefore, we developed a knowledge management (KM) framework approach to support the lessons learned process. In this paper, we describe ongoing research initiatives dedicated to the building of knowledge-based lessons learned systems for the Canadian Forces. In particular, two initiatives are described; one to build an interactive Army Lessons Learned Knowledge Warehouse, and the other, to help support the Aviation LL process. In both initiatives, the main objective is to provide a web-based KM environment to facilitate lessons learned collection and sharing. Tools were developed to assist users in the LL sub-processes (lessons learned building, retrieval, and reusing). Finally, the impact of such approach on business rules and work layouts in the Canadian Forces LL cells is briefly discussed.

1. Introduction

The creation, sharing and reusing of Lessons Learned, as an embedded organizational process, tends to emerge among the best practices in many organizations. Organizations recognize the value-added of such best practices but at the same time, must assess the level of Business Process Reengineering (BPR) that its implementation may require. It is well known that, in the Command and Control world in particular, Lessons Learned have always been at the core of a fundamental knowledge asset. As part of its traditional culture, military people have continuously reported observations or lessons after operations or exercises. Past operations lessons convey important experiential knowledge (both about successes and failures) that can be learned, reused or avoided in future similar situations in a way to make the best decisions and undertake the best actions (e.g. preparation of future operations, selecting best course of actions,

etc.). Lessons Learned must be rapidly disseminated to the whole organization, and more importantly be easily accessed, created, shared, refined, etc.

With the emerging of Information Technology (IT) in the last decades, lessons learned systems were built and deployed. While these systems usually provide large repositories of lessons, they were not designed through a process that facilitates the sharing of their content and their reuse in subsequent decision-making. More advanced LL systems were developed. They promote a knowledge management (KM) approach for collecting, storing, disseminating and reusing experiential knowledge that, when applied, could benefit the organizational processes. However, whereas knowledge sharing and reusing is a central focus of KM, recent studies [Weber *et al.*, 2001] show that these lessons learned systems, in general, poorly serve their intended goal of knowledge sharing and reusing. The reasons are manifold. Representations of lessons are inadequate and hierarchical. Moreover, most lessons are described as a set of free-text fields. Consequently, search tools or dissemination techniques are unsatisfactory. Furthermore, Lessons Learned are not integrated into the decision-making process. For those reasons, today's LL repositories or standalone lessons learned systems are not effectively exploited.

The challenge to succeed resides in applying a knowledge management framework that complies with or enhances the Lessons Learned business processes and allows addressing the complete cycle of the lessons learned, from the request of capturing observations to the decisions and guidelines that are recommended. Moreover, attention needs to be paid on the conceptualization and modeling of the knowledge items (lessons learned, observations, comments, decisions, actions, etc.) in a way that allows efficient searches, various views and dynamic navigation throughout these items.

Through several projects, Defence Research & Development Canada – Valcartier and DMR Consulting have developed a knowledge management framework to support military processes. This paper presents the applicability of this framework approach to the lessons learned process used within the Canadian Forces. Although the LL process varies between the different service levels, we were able to extract some common generalities and to propose a common model. More specifically, two research initiatives are undertaken to experiment with the applicability of the approach to efficiently facilitate the practice of capturing, creating, sharing and reusing lessons learned. The first initiative is aimed at building an operational interactive Army Lessons Learned Warehouse and the second initiative, to help support the Air Force 1 Wing LL process. Issues to export this approach to the other service levels as well as at the Joint level are also discussed.

This paper reviews some terminology related to the lessons learned domain and exposes the Canadian Forces LL processes. It presents the knowledge management framework used to the structuring and sharing of the lessons-related knowledge. It describes the two LL initiatives under development. Finally, the paper concludes on challenges related to the implementation of the approach to the Canadian Forces and its impact on business processes and proposes avenues for further research advances.

2. The Lessons Learned Process

2.1 *Terminology*

Formalizing the lessons learned process has attracted a growing interest for several years within large organizations. For example, the US Department of Energy (DOE) Lessons Learned with the Society for Effective Lessons Learned Sharing organization (SELLS) organizes regularly meetings on Lessons Learned in order to develop a LL program and tools, resources and guidance documents for effectively sharing LL across DOE.

In a recent survey on Lessons Learned Systems, Weber and her colleagues [Weber *et al*., 2001] propose a definition of a lesson. They state that a lesson is a validated experiential knowledge from a work experience. It represents tacit knowledge, either positive or negative that can be reused (i.e. retrieved and applied during subsequent problem-solving) to improve a targeted organizational process by suggesting a relevant contribution to a work practice. An important aspect is that a lesson has to be validated for correctness and should impact organizational behaviour. Consequently, the lessons learned process is the knowledge management process that implements strategies for collecting, analyzing, storing, distributing and reusing a repository of lessons to continually support the organization goals.

A generic LL process [Weber & Aha, 2001] consists of different sub-processes: collect, verify, store, disseminate and reuse. *Collect* consists of capturing lessons either after missions (*passive* or *after action* collection) by using standardized forms or proactively during problem-solving. *Verify* is performed by experts in order to validate lessons for correctness, redundancy, consistency, and relevance. *Store* addresses the representation and indexing of lessons in a lessons repository. *Disseminate* aims at lessons reusing. It is passive when users retrieve lessons by using a search engine, and active when lessons are broadcasted to potential users with respect to their interests or by sending CD-ROMs containing lessons. More advanced approaches disseminate lessons in the context of users decision-making processes. *Reuse* aims at taking into account recommendations from a lesson in a new situation. The outcome of reusing a lesson can help determine its utility.

Finally, lessons can be incorporated directly into the doctrine, which defines the processes to be employed by members of the organization.

2.2 *The Canadian Forces Lessons Learned Processes*

At the present time, there is no standardized Lessons Learned business process within the Canadian Forces (CF) but each service level (Joint, Army, Navy, Air force) has its own standardized procedures, particularities and culture. In each case, the ultimate objective of the process is the same. It is to collect and analyze observations from Canadian and allied operations and from training exercises, and disseminate them as well as their interpretation as lessons learned for future reuse. However, the degree of efficiency in achieving the objective varies. Some LL cells are currently proactive in improving their LL business processes and capabilities; others are demonstrating a strong willingness to undertake such project. For instance, the managing of corrective actions, which is not yet implemented as an established practice, is foreseen to be part of a LL business process reengineering.

Some commonalities between the current and targeted processes were found, which has lead to the specification of a generic Lessons Learned process for the Canadian Forces. The process

occurs in a specific LL cell and takes place into six cyclic stages as illustrated in Figure 1: mission-reporting requirements, knowledge gathering, knowledge analysis, lessons determination, actions follow-up and impact analysis. (figure 1).

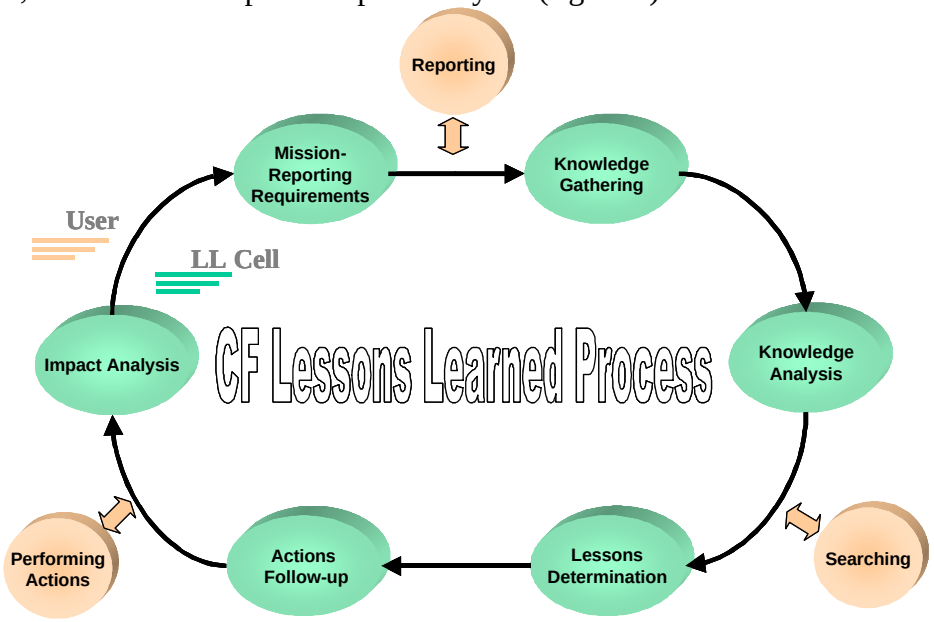

Figure 1. The Generic Canadian Forces Lessons Learned Process

The six cyclic stages are:

- *Mission-reporting requirements*: The LL cell identifies pertinent questions for a specific mission based on information requirements or on refinement of issues raised in the last stage of the preceding cycle: impact analysis. It creates a questionnaire or adapts an existing one to be filled in during an operation or an exercise or yet, states pre-mission particulars.
- *Knowledge gathering*: The LL cell gathers knowledge received from various sources and documents upon operations, exercises or deployments. Observations are gathered from the Post Operation Reports (POR) and Post Exercise Reports (PXR) in both Army and 1Wing LL cells, from the Post Deployment Report (PDR) in the Navy, and from individual observations and comments in the Air Force and Joint staff LL cells.
- *Knowledge analysis*: The LL cell studies in detail the knowledge extracted from the previous stage. Significant facts are interpreted. This leads to the identification of issues.
- *Lessons determination*: The LL cell considers possible solutions to resolve issues and submits recommendations. The pair of issue-recommendation constitutes a lesson.
- *Actions follow-up*: Once issues have been identified, recommendations given and lessons determined, the Office of Principal Interests (OPI) adds its comments, prescribes appropriate actions and states directives. This stage also includes the follow-up on these actions.
- *Impact analysis*: The LL cell analyses subsequent POR/PXR/PDR and reported observations to verify if the lesson was indeed learned and the actions were appropriate to solve the issues that were raised. If it is positive, the lesson can be assimilated in the doctrine and be disseminated for future reuse as a lesson learned. If

not, remedial actions are prescribed and new information requirements are stated to collect additional observations on the issues to eventually refine the lesson. The original questions could also be rephrased to refine the search as to target the real cause that raised the issues. Lessons learned are used to be disseminated through regular publishing of a CD-ROM, but with the targeted capabilities, lessons learned will be available through direct web-access to shared repositories.

External to this process, activities are performed by people from the community of users who must interact with the process. In particular, these activities are:

- the reporting of observations and their sending to the LL cell;
- the searches of lessons learned from repositories; and
- the application of the recommended actions in current situations.

3. **Knowledge Management Approach**

The definition of Knowledge Management as defined by the Gartner Group[1] states that: "Knowledge Management promotes an integrated approach to identifying, capturing, retrieving, sharing, and evaluating an enterprise's information assets. These information assets may include databases, documents, policies, procedures, as well as the un-captured tacit expertise and experience stored in individual's heads". T. Davenport and his colleague [Davenport and Prusak, 1998] describe four objectives for KM: create knowledge repositories, improve knowledge access, enhance the knowledge environment, and manage knowledge as an asset. In particular, the building of corporate or organizational memories that incorporate relevant knowledge assets in an organization in order to make them available to knowledge workers is one of the main challenges of KM to promote knowledge collection, sharing and reusing.

A *learning organization* refers to an organization's capability to gain insight and understanding from experience through experimentation, observation, analysis, and a willingness to examine both successes and failures. Dalkir [Dalkir, 2002] gave a practical definition of KM that emphasizes the learning angle: "Knowledge Management can be defined as the process of applying a systematic approach to the capture, structuring, management and dissemination of knowledge throughout the organization to work faster, reuse best practices, and reduce costly rework from project to project". The benefits of a KM approach to promote the corporative value-added of efficiently exploiting experiential knowledge in the organization are obvious. Lessons learned need to be included in the corporate memory. The knowledge gained from experience must be captured and made readily available during the work of others. This way, the overall efficiency of the whole enterprise is improved.

With this in mind, three different perspectives must be considered to meet Knowledge Management goals of the enterprise:

- *Management Perspective*: Focusing on determining, organizing, facilitating, and acquiring knowledge.
- *Application* Perspective: Focusing on effective retrieval of relevant content through advanced searches and mining to conduct knowledge-related work and tasks.
- *People Perspective*: Focusing on cultural change to encourage learning, thinking, sharing and collaborating.

[1] www.gartner.com

Although people are part of all perspectives, either as "producers" of background knowledge or as "consumers" of knowledge respectively in management and application perspectives, it is within the people perspective that their contribution to the enterprise's corporate memory is maximized and where knowledge management takes its complete sense. Traditional IT systems, in counterpart, usually don't include the people perspective as described here. Information is managed and tools/services are made available for its exploitation, but no retro-feedback on the information is performed.

Knowledge Management activities occur in a cyclic process across the span of these perspectives. Various descriptions of this cycle were given in the literature, but a consensus is starting to emerge. DRDC-Valcartier and DMR were also active in this area through their work in various KM projects and specified a KM cycle notation that complies with the trends in the literature. The notation is: capture/acquire, organize, access/search/disseminate, use/discover, share/learn and create [DMR Consulting, 1999].

3.1 *Mapping of the Lesson Learned Process to the KM Approach*

As stated earlier, the proposed generic CF lessons learned process is, by definition, a knowledge management process. It is possible to relate the LL process to the KM cycle to demonstrate its tangible applications. The mapping between these processes is illustrated in Figure 2. The top portion of the figure (whether from a LL or KM perspective) aims at capturing, organizing and recording knowledge. The knowledge is made available and distributed for people to use in order to make discoveries (right portion of figure). Findings can be shared and learned to create new facts (left portion of the figure).

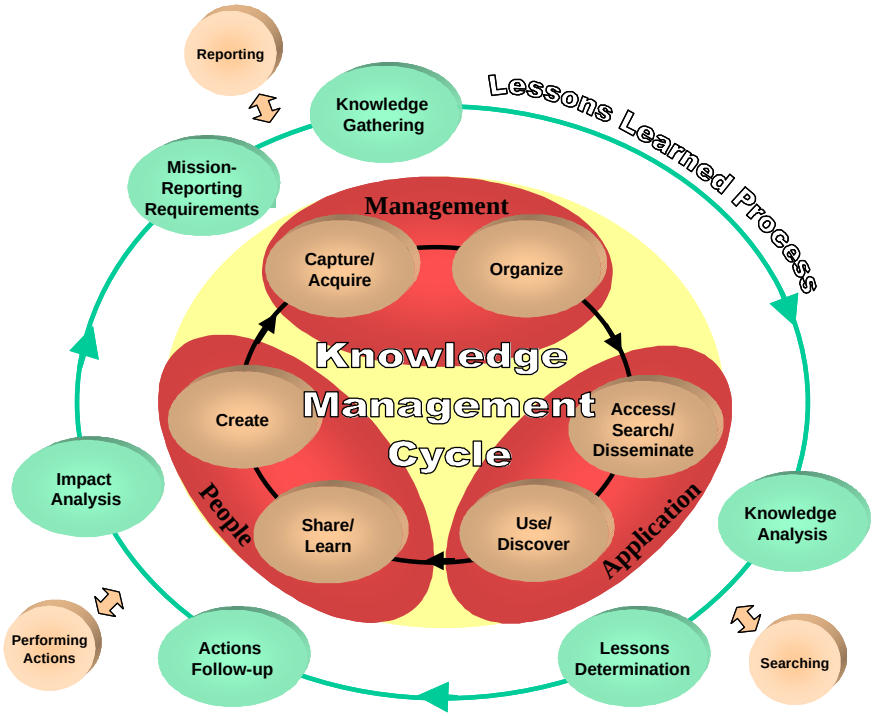

Figure 2. Mapping of the LL process to the KM cycle

4. **Lessons Learned Research Initiatives**

A pressing requirement from the Army to significantly improve their lessons learned process is at the origin of a research activity that started at the spring of 2001. The Army expresses the needs to extract more quickly and more efficiently their lessons learned when preparing new deployments. To this, a revision of the whole business processes and a shift towards becoming a *learning organization* was identified as a pre-requisite. Consequently, a strategy based on a knowledge management approach was identified, particularly to ensure that the re-introduction of experiential knowledge from the lessons learned and from the application of the prescribed actions is continually pushed in the corporate memory as new observations. From this, a research initiative started and a technology KM framework adapted to the LL process was developed. A proof-of-concept was built on it and delivered as a first operational capability to the Army Lessons Learned Centre (ALLC). Activities are now undertaken to develop it further and to deliver a final operational capability.

At the same time, a research initiative driven by the DRDC's technology investment strategy was set to explore means of efficiently exploiting knowledge content in support of the Air Force decision-making processes. The focus was put on Lessons Learned and their exploitation. More particularly, the emphasis was put on assisting analysts in detecting issues among reported observations and providing views to organize lessons among several dimensions. A prototype to support the LL process of the 1Wing LL cell, built on the same technology KM framework as the one developed for the Army, was demonstrated. Activities are now undertaken to deliver to 1Wing a LL desk.

Finally, a research initiative is starting-up at Joint level to evaluate the applicability of the technology KM framework to their needs and to the ones of other service levels. A gap analysis must be performed as well as a study to evaluate the impact on business processes and work layouts. The establishment of a lessons learned program is also part of the initiative.

Details on the two first initiatives are presented hereafter.

4.1 ***Army Lessons Learned Research Initiative***

As stated earlier, the aim of this research initiative was to help the Army in meeting their new requirements in their quest to become an efficient *learning organization*. The method is in three stages:

- First: to develop a technology KM framework;
- Second: to experiment its appropriateness by developing a proof-of-concept; and
- Third: to deliver operational capabilities.

In addition to providing ALLC with capabilities, more specific research objectives were to experiment and advance further the KM approach, which should eventually help establish new KM best practices in the user community.

Role of ALLC

The role of the Army Lessons Learned Center (ALLC) is to collect and analyze Canadian and allied operational and training experiences for the dissemination of lessons learned that serve to improve the overall operational capability of the Army. The goals are to consistently improve their performance and to avoid the duplication of costly errors. The process complies with the

one expressed in Section 2.2. In particular, ALLC provides direction to assimilate Lessons into the doctrine, during training and acquisition of equipment, etc. Lessons are then archived and disseminated. The Army learning culture provides feedback and follow-up on lessons.

Guiding Principles to the development of a technology KM framework

Given that a KM strategy was identified as a means to support the overall LL process, some guiding principles were established to develop a technology knowledge warehouse (KW) framework. These were:

- To develop an architecture that takes into account all activities of the KM cycle as well as all elements of the LL process: internal as well as external activities.
- To ensure proper handling of the external interaction with communities of users (such as *producers – consumers – retro-actors*) as well as the internal interaction with the LL staff (analysts and decision-makers).
- To ensure that the framework will support knowledge creation, retrieval, sharing and reusing.
- To ensure that the cycle "- questions – observations – lessons – action/decision -" is embedded in the framework philosophy.
- To provide a software environment compliant with the technology in the Army, which offers a knowledge-based engine supporting the construction and maintenance of dynamic links between knowledge items and allows simultaneous entry points to reach observations, lessons learned, etc.
- To provide a user-friendly web-environment facilitating knowledge access, searching and sharing.

The framework was named: Interactive Lessons Learned Knowledge Warehouse (LLKW) and the selected technology to support it is:

- The Teximus Expertise tool as the Knowledge Content System [Teximus];
- SQL Server as the database;
- Internet Explorer as the browser;
- Resin as the web -server.

Development of a Proof-of-Concept – Interim Operational Capability

In order to verify the applicability of the technology framework to support the LL process, a proof-of concept was developed and delivered as the Interim Operational Capability (IOC) of the future interactive Army Lessons Learned Knowledge Warehouse (ALLKW). The targeted group of users for this IOC was the larger one, that is the *consumers'* group who are principally interested to access, browse, retrieve and search for lessons learned. They usually consult Post Operation and Exercise Reports (PORs and PXRs) for this purpose. These reports contain questions and observations that are presented along an *Infomap* and *Operation-Rotation* structure respectively. The *Infomap* structure consists of a series of questions that are linked, regrouped and presented under the hierarchy of phases, themes and subjects, while the *Operation-Rotation* structure consists of a series of observations and comments that are the answers to the questions retrieved from the Infomap Structure.

The basic requirements for the IOC were:

- To facilitate access of the Knowledge Warehouse through the use of a web-browser;
- To enable discussions in the capture of observations, comments, lessons learned, decisions and actions;
- To minimize human intervention in loading POR/PXR into the knowledge base;
- To facilitate the search of relevant content through the use of knowledge retrieval techniques and tools, in particular the search from previous Operations, exercises and Lessons Learned;
- To support the main LL and the Staff Action Directives processes; and
- To maintain the Post Operation Report and Exercise functions from the previous CD-released system and translate them into the new knowledge base structure. Thus, the searching through the *Infomap* and *Operation-Rotation* structure must be preserved.

The main functionalities that were implemented are:

- Navigation through the Infomap structure or the Operation-rotation structure;
- Basic filters on operations, organizations and material used in conjunction with the Infomap or the Operation-rotation structures;
- Basic search capabilities;
- Tools such as a Frequently-Asked-Questions (FAQ), a Discussion Forum and a Glossary.

The proof-of-concept was deployed at Kingston as an interim operational capability. Figure 3 shows a mapping of the IOC functionalities against the knowledge cycle and Figure 4 shows a screenshot of the main IOC menu.

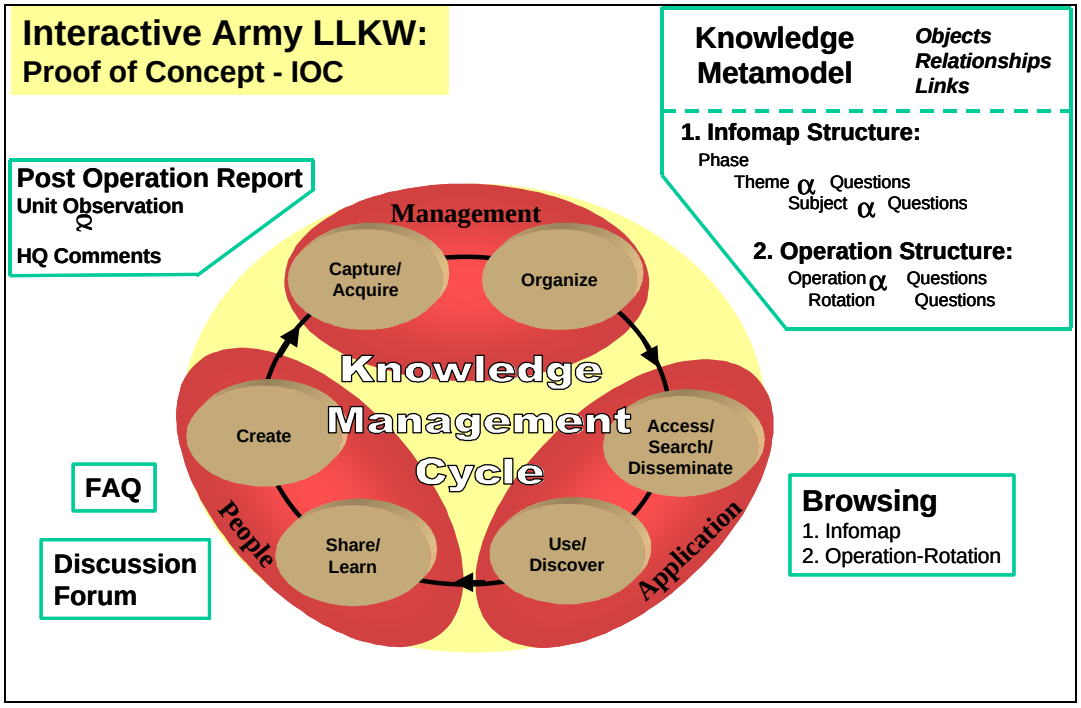

Figure 3. Interim Operational Capability : Main implemented functionalities in relation to the KM cycle

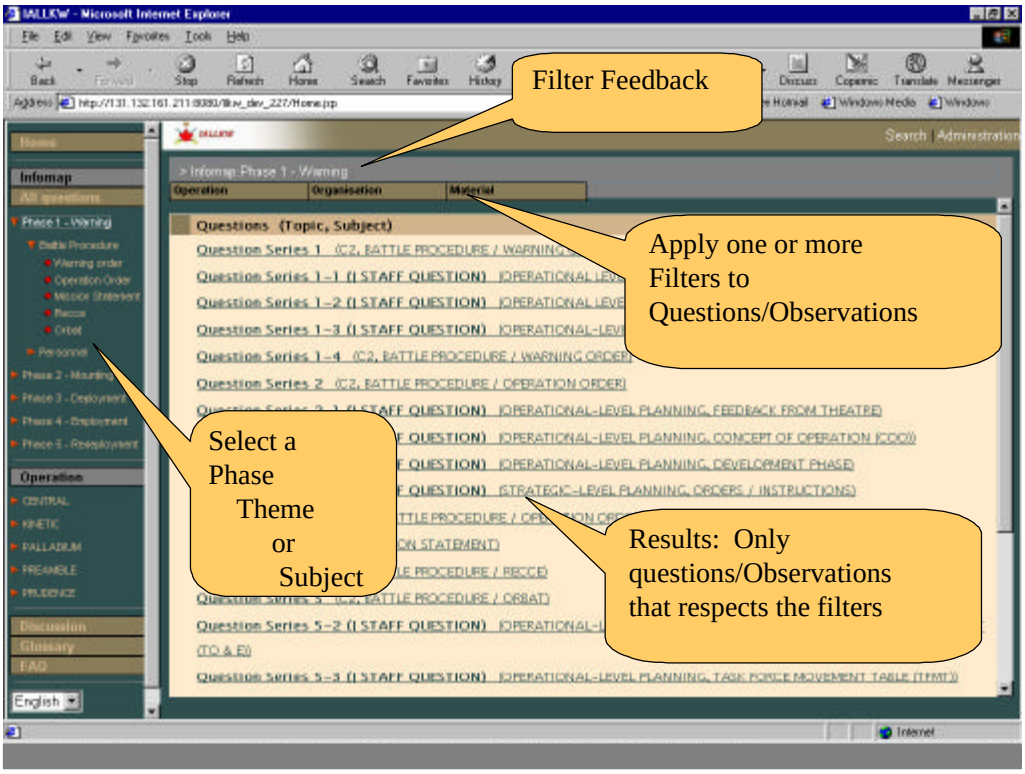

Figure 4. Main menu of the LL Knowledge Warehouse Prototype

Future development – Final Operational Capability

The IOC was used to elicit from the Army Personal the functional requirements to undertake the development of the Final Operational Capability (FOC). The detailed requirements are:

- To provide the main functionalities to all ALLC staff and all communities of users;
- To provide customized views for analysts, trainers, researchers and military personal;
- To create and manage links between knowledge objects (e.g. equipment and observation) and documents (historic);
- To collaborate in the capture of any newly uncovered observation;
- To perform analysis among reported observations and comments;
- To detect issues and build relevant lessons;
- To track down recommendations and actions and to navigate and search into the knowledge warehouse when dealing with operations and training.

The Interactive Army Lessons Learned Knowledge Warehouse, which is based on the e-learning model, will help in formulating and learning doctrine.

4.2 *Air Force 1Wing Lessons Learned Research Initiative*

As stated earlier, the aim of this research initiative was to exploit Lessons Learned in support to the Air Force decision-making process. Given that Air Force Lessons Learned at the 1CAD (Canadian Air Division) LL Cell are classified, 1Wing, an Air Force Aviation unit working in support of the Army, was chosen for the experimentation of the ideas exposed hereafter.

LL research activities for the Aviation aim at supporting some LL sub-processes: the *knowledge gathering and analysis* processes are concerned with tools to assist LL analysts to detect issues among reported observations and build relevant lessons accordingly. The approach to support *organize* and *access/store/disseminate* from the knowledge cycle consists of organizing observations and lessons using several dimensions (e.g. task structure, operation-rotation, domain ontology or concept map). This facilitates both lessons categorisation and lesson retrieval by end-users for further reuse.

The main long-term objectives of this project are to investigate:

- The use of a task-oriented structure to provide a different view on the LL knowledge base, in addition to the usual operation-rotation structure or the phase-theme structure.
- The use of knowledge extraction concepts and tools to help identify issues and build lessons from recorded observations.
- The exploitation of an ontology or taxonomy in order to structure observations or lessons and to facilitate searching along this dimension;
- The development of tools and techniques to facilitate search and retrieval of relevant content.

Below are the main concepts that are proposed and implemented in a first prototype, i.e. a structured task-oriented viewer and knowledge extraction capabilities.

Multiple Views on the LL Knowledge Base

Multiple views on a knowledge base facilitate searching for information under different perspectives. In our context, relating observations to specific tasks in addition to other structures may be useful for users to retrieve information. For example, the US Joint Center for Lessons Learned makes use of the Universal Joint Task List when recording lessons [Lucas and Aha, 2000].

The Battle Task Standard (BTS) consists of a hierarchy of tasks description that constitutes relevant doctrine information for the 1Wing environment. Therefore, observations were linked to the BTS tasks within the prototype in order to present observations and comments related to specific tasks. A subset of the doctrine linked to the BTS is implemented in the prototype. For a given task, users can simultaneously visualize the doctrine and all of the links to observations/comments from an Operation-Rotation (Figure 5). Conversely, an operation-rotation presents all tasks that are related together with a link to the corresponding observations.

Managing multiple links on LL knowledge components is possible using the Teximus Expertise content management system supporting by a knowledge base. Using this approach, users can browse the knowledge base through different structures, thus facilitating the search for specific information.

Another avenue is to provide an ontology or taxonomy of terms to organize observations and lessons. For example, 1CAD provides some categories that could serve as a baseline. Again, this would facilitate searching based on concepts.

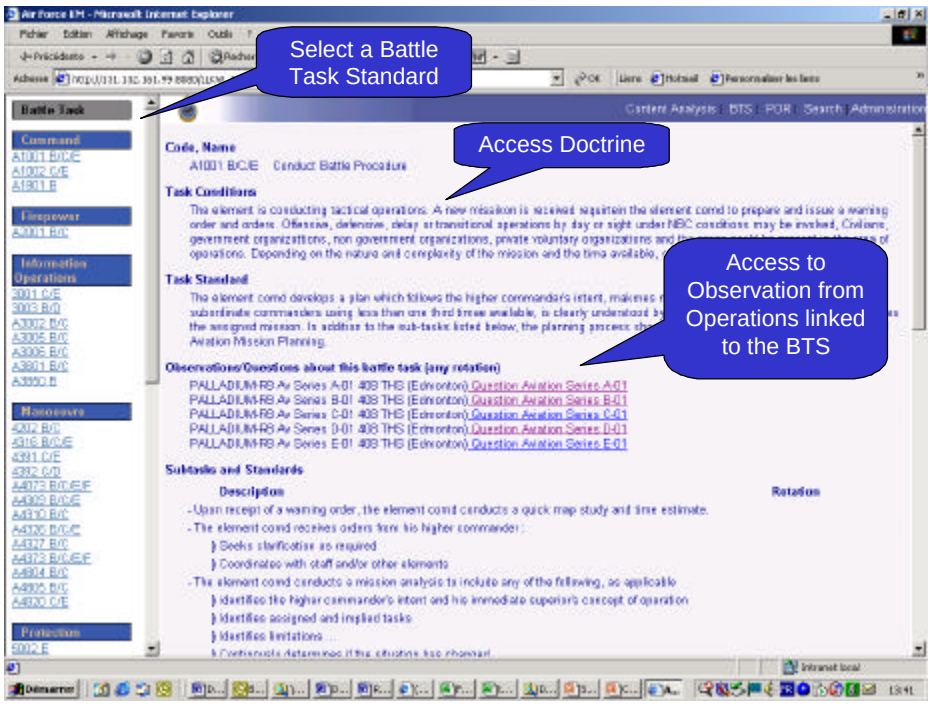

Figure 5. Air Force 1Wing Prototype: main view of the Battle Task Standard

Knowledge Extraction to Support the Analysis Process

The objective is to investigate how knowledge extraction techniques could be exploited to support LL analysts in the analysis of observations in order to detect specific issues and build lessons from these ones.

The proposed method consists of extracting the main relevant terms from a document corpus in order to detect some patterns or particular concepts that could be informative to the LL analyst in order to analyze observations. Oracle9i Text [Oracle] provides indexing capabilities that have been investigated elsewhere [Alpha *et al.*, 2001]. They were used to index documents and to get the more significant terms appearing within documents. Knowledge extraction can be applied to a subset of the knowledge base (e.g. a particular mission) or the whole knowledge base, as illustrated in Figure 6. Significant terms that are extracted can then be searched within the knowledge base.

In the near future, an ontology or thesaurus of the domain should be used to remove poorly meaningful concepts to better take into account the semantic content of documents and improve the results. This technique could also be exploited to detect redundancies and/or contradictions across documents (as proposed in [Everett *et al.*, 2002]), which is a frequent and problematic aspect in LL knowledge bases.

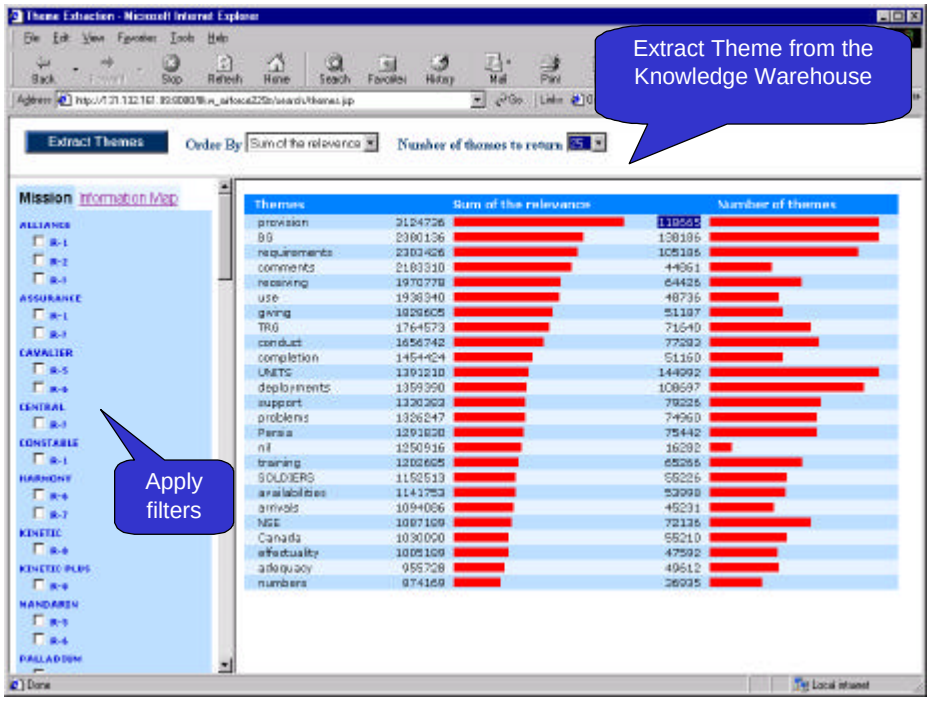

Figure 6. Theme extraction view from the Air Force Prototype

The Air Force 1Wing prototype under development is based on the Army Lessons Learned Knowledge Warehouse prototype, with additional profiles linked to different interfaces. The main functionalities being implemented are as follows:

- Navigation capabilities based on the Aviation Battle Task Standard;
- Use of filters based on operations, organization (from the Army and 1Wing) or other materials in conjunction with the Infomap structure or the Operation-rotation structure;
- Knowledge extraction and search capabilities using different techniques to enable better and more relevant content retrieval.

5. **Related work**

Many Lessons Learned Systems have been proposed and described in the literature, in particular in the context of a recent Workshop on intelligent lessons learned systems [Aha and Weber, 2000]. Among the projects described, some present a traditional IT approach to support LL processes whereas others investigate more sophisticated techniques, in particular from the Artificial Intelligence domain.

Among the concepts and techniques proposed, some are worth noting:

- Latent semantic analysis helps extract information from texts by using statistical methods in [Straits and Haynes, 2000];
- Ontologies serve as a basis to structure and search for information [Eilerts and Ourston, 2000];
- Case-Based Reasoning (CBR) is exploited to retrieve and reuse lessons from lessons repositories. Textual CBR is more appropriate when “cases” are expressed in textual

form. In [Ashley, 2000], textual CBR and information extraction techniques are used to assist in constructing LLS.

- Advanced search engines are implemented to retrieve relevant information. [Free, 2000] provides different types of searches.

Moreover, some researchers promote the integration of lesson distribution with other organizational activities or decision processes. The ALDS system (Active Lessons Delivery System) [Aha *et al*., 2001] brings lessons to the attention of users when applicable to the user's current decision-making task under similar conditions by using Case-Based Reasoning. The ACPA (Air Campaign Planning Advisor) system [Johnson *et al.*, 2000] is composed of a corporate memory (containing video-clips in which experts relate their experience) linked to a performance support tool through a model-based task tracking system. The approach allows providing users with contextual help.

6. **Change Management Issues**

6.1 ***Technology and Security Issues***

The focus of the present paper is not to provide a detailed review of technological and security issues related to the development of the knowledge warehouses. However, number of key factors need to be considered at the time of providing fully operational LL capabilities to the Canadian Forces, notably:

- the flexibility to facilitate the integration of new technology;
- the insurance towards integrity, prioritization and evolution of the "organizational knowledge memory";
- the maintenance of the operational LL knowledge warehouse systems;
- the vacuum to preserve security issues; and
- the fundamentals of access rights.

6.2 ***Organizational Issues***

The implementation of the KM approach proposed in this paper to support the whole CF lessons requires a major culture change. The present processes are quasi motionless (lessons learned being published at fixed interval) and does not include a dynamic re-introduction of experiential knowledge at the experimentation of prescribed actions nor does it support the push of remedial actions. Consequently a significant BPR would be required and work layouts might have to be importantly modified.

Some of the key factors to help achieve the required change management and avoid the failure of the organizational adaptation to the new culture need to be considered. These are:

- A strong commitment from high-level Commanders towards the new approach;
- Promotion of the approach aimed at ensuring wide acceptance;
- Establishment of incentives to contribute to the corporate experiential memory and to exploit and refine it;
- Establishment of a rigorous and systematic implementation method;
- Leadership, skill and expertise in the implementation of a KM approach;
- Assignment of a *pilot* role to monitor and ensure integrity of the corporate memory;

- Setting up mechanisms at technology, human and managerial levels to instigate the reuse of lessons [Weber *et al*., 2001].

7. **Future Research Work**

Some further work is necessary to enhance the envisioned advanced functions of the knowledge warehouse. These are:

- To extend search engine capabilities in order to offer better performance and more relevant content retrieval results.
- To further explore the use of a taxonomy or a thesaurus in conjunction with different knowledge structures such as the Infomap or the Canadian Joint Task List.
- To better define Tools to assist the Lessons Learned analysts or the Trainers in order to facilitate the search of lessons or specific issues.
- To provide intelligent tools to organize and retrieve relevant content.
- To find solutions to tackle with information redundancy within LL repositories.

In order to complement the LL approach and to move towards the field of e-learning, it will be important to perform a survey to understand the different means used in learning in the Canadian Forces at each service level. What will be the proportion of learning (1) from procedures and doctrinal information, (2) from mentoring and (3) from lessons learned? This survey could ensure that relevant BPR will be performed.

8. **Conclusion**

This paper aimed at presenting a knowledge management approach to the creation and sharing of Canadian Forces Lessons Learned and at illustrating it with two LL prototypes under development for the Canadian Forces.

The benefit of a KM approach to promote the corporate value-added of efficiently exploiting experiential knowledge within the Canadian Forces was demonstrated. In particular, the implementation of this approach with an appropriate technology knowledge warehouse framework has positive impacts:

- it enables the electronic sharing of lessons learned;
- it allows to manage the whole spectrum of lessons learned, from the collection of observations to the prescription of corrective actions;
- it allows a continuous and more dynamic access, re-use and refinement of lessons learned;
- it improves the effectiveness of training, particularly for complex missions; and
- it allows to move towards the goal of becoming a learning organization.

Organisational issues to reach these ambitious goals were also discussed. Some of the Lessons Learned cells are already moving along this path. However, if the CF wishes to become a learning organization in its entirety, the vision must be shared, consented and implemented at all service levels. A strategy to this is to set up a CF lessons learned program where a discussion space between all service levels could lead to the specification of agreed orientations, including foundations, policies, procedures, common terminology and expectations. This will help formulating a learning doctrine for the Canadian Forces.

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