KNOWLEDGE MAPPING IN EMERGENCY OPERATIONS

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The Coalition's military Forces as well as "the Canadian Forces are now facing, to a greater extend than ever, challenging operating environments"[1]. The Armed Forces have to operate in more complex environments, which requires "Forces that are combat-effective, but also highly mobile, adaptive, networked, sustainable and capable of operating in a Joint, Interagency, Multinational and Public (JIMP) context."[2] These complex operating environments generate corollaries such as complexified technological solutions or overloads of knowledge/information. Moreover, they require also more sophisticated common operating pictures where these different pieces of knowledge/information – called in this paper, knowledge assets (KAs) – are being held by numerous distinct groups and organizations. Therefore, to attain mission success, Commanders at all levels have to compose with those different military and non-military organizations which are an intrinsic part of the complex situation being faced. Some of those KAs, hold by organizations, are considered key by the commander and the soldier to first fully understand the situation at hand and to then make effective and accurate decisions. Unfortunately, as the number of involved organization increases, it is also undeniably more difficult to identify what organization holds which critical KA. In order for the military personnel to adequately exploit situational KAs, these ones need first to be identified, located and made available.

During the last few years, the Department of National Defence and the Canadian Forces have started to investigate the field of knowledge-mapping (k-mapping) as one of the solutions to solve KAs discovery and localisation. The key output of the research is to develop a dynamic knowledge management capability in order to enhance sense-making of the situation, to improve knowledge understanding and decision making, and to increase internal and external collaboration. This paper presents an alpha prototype k-mapping application called *"KMapper"* along with its leading concepts, underlying multidimensional approach and technological features. In the light of the preliminary results from the alpha prototype demonstration in a national/public security surrounding, the paper examines how k-mapping can similarly support coalition operations.

In the context of this research, the k-mapping application draws on scientific bases[3] converging towards a proposed novel multidimensional k-mapping approach. From the literature, as well as from the field of practice, k-mapping is usually articulated along one of three main categories of approaches namely the conceptual approaches, the procedural approaches, and the social approaches. Unfortunately, when times come to undertake a k-mapping project, practitioners only consider k-mapping in the light of one of those approaches. Consequently the results of such projects tend to be disappointing as only limited values of k-mapping are considered or even worst the perspective/approach embraced is inappropriate to the pursued project objectives. The novelty of Defence R&D Canada's k-mapping research resides in the fact that it combines the value of each one of those three categories of approaches into a single one called the *"Multidimensional K-Mapping*

[1] Defence R&D Canada – Defence S&T Strategy - Science and Technology for a Secure Canada - December 2006
[2] DND/CF – Land Operations 2021 - Adaptive Dispersed Operations – 2007
[3] Lecocq, R. – Knowledge Mapping: A Conceptual Model – DRDC – TR2006-118 – 2006

Balanced Approach"; moreover, a fourth approach named *"Knowledge Artefacts"* was added in order to support some information management requirements. One of the main outputs of the developed k-mapping application is to provide end-users with a contextualized visualisation of the discovered KAs as well as the links existing between them. As the application aims at pointing to the identified KAs as opposed to presenting the knowledge itself, a specific capability was developed in order to provide end-user with metadata attached to the KAs. This metadata capability fulfill two main roles. First it provides information on the KA itself in order to increase its understanding and the level of relevancy of the KA. Secondly, whenever possible and deemed necessary, it enables a direct access to the KA in order to ease the accomplishment of end-user specific activities such as for instance contacting identified key stakeholders in order to start coordinating their respective actions. It stands to reason that the k-mapping application mirrors the multidimensional approach with its four key dimensions. The first two dimensions are the *"Social Dimension"* and the *"Knowledge Artefacts Dimension"*; they basically represent the two types of general categories under which KAs are being automatically identified from data sources, gathered and organized in the KMapper. The *"Social Dimension"* identifies KAs that are, for instance, experienced or knowledgeable individuals or else specialized groups and organizations. The *"Knowledge Artefacts Dimension"* represents sets of KAs that can be considered as explicit knowledge such as documents, incident logs, e-mails, lessons learned, databases or websites. As the application focuses on helping commanders at all levels to discover meaningful KAs in the context of the specific situation being faced; once the two main categories of KAs identified and located they are organized and displayed to the user around the other two dimensions, namely the *"Concept Dimension"* and the *"Process Dimension"*. This type of display first allows the users to comprehend the KAs within a meaningful context but also provides new knowledge to the user by highlighting meaningful links between concepts and specific KAs.

In terms of the k-mapping alpha application being developed and demonstrated, there are several specificities worth to note. First the application is dynamic and almost fully automated in its identification, localization and mapping of KAs. Secondly it is an ontology-based system where the application's backbone is built around a domain-specific ontology as well as a KMapper specific ontology. As an example, where trying to map the world would be a useless activity, the domain-specific ontology supports the search engines in order to retrieve information about KAs relevant to the end-user in the context of the situation being faced. This situation-focused activity provides military end-users – accomplishing different tasks – with a shared context for common actions. The ontology structure and content also feed the *"Knowledge Inference"* service. This service with its set of rules is essential to discover and gain new relevant pieces of knowledge based on the ones already accumulated. The third application specificity is to be built along a service-oriented architecture where the encapsulated services can be tapped by other applications and reciprocally.

The paper explains the knowledge mapping concepts and approach but also the specificities of the alpha prototype being developed as for instance how the ontologies are key elements of the application. Also, based on the demonstration's results within a national/public security and JIMP contexts, it is realistic to infer some of the k-mapping added values to similar characteristics of coalition operations such as multiple parties involved or requirements for shared situation, awareness as well as information/knowledge exchange. Finally, the paper expands on some of the challenges and future work in the domain.