Improve the Battlefield Situation Awareness Through an Effective IM/IX Framework

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ABSTRACT

Exploiting data and information effectively needs managing data and information effectively as well, therefore store data and information at the right place with the adequate level of classification, and allow only authorized users to access and manipulate it. This paper presents a new approach for the management of users and groups of users, workspaces and permissions which are important information management tasks that an Information Management Officer has to typically perform on a daily basis. This approach has been designed to be integrated to the Hyperion prototype, developed under Canadian Army G2 Capability Development. The Hyperion prototype proposes an integration framework for multi-sources in support to information management and information exploitation. The proposed approach, exploiting user experience best practices, offers a promising approach enhancing and strengthening the information management, and enables Information Management Officers to be efficient for the Army Intelligence function to deliver effective operations in an adaptive dispersed operations context.

1.0 BACKGROUND/ CONTEXT

Under the Canadian Army (CA) research and development projects Portfolio, Defence Research and Development Canada (DRDC) has formulated, and funds, a 5-year project, entitled *Land Tactical Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance/ Electronic Warfare* (aka LTC4ISR/EW) [1]. *Land Command Support System (LCSS) Intelligence, Surveillance and Reconnaissance Modernization* and *LCSS Tactical Command and Control Information Systems Modernization*, two main CA Capital Projects identified to address the business need for *LCSS Modernization*[1], are dependent on the outcome of the LTC4ISR/EW project. This dependence is on informing the identification and options analysis phase, and mainly the business case and the statements of requirements. The work presented in this paper is aligned with this dependency and has been realized in support of the Concepts of Operations (ConOps) document developed for LCSS Modernization in close collaboration with Director Land Command and Information (Capability Development), and to support the evolution of Information Management/ Information Exploitation (IM/IX) best practices in the CA as well.

[1] The Land Command Support System (LCSS) is the CA's operational command and control (C2) system and a part of the Canadian Armed Forces Integrated C2 Information System. Its purpose is to provide the CA with an integrated operational capability for C2, battlespace management, situational awareness and sensor integration, as well as interface to and interoperability with other systems and networks in Force Employment, Force Generation, and Force Management environments. LCSS is being modernised through 3 projects, collectively referred to as *LCSS Modernization*. LCSS Modernization aims at improving the capabilities of the systems comprising the LCSS, and systems enabling command, control, situational awareness, and intelligence functions for Land Forces 2021 and Adaptive Dispersed Operations.

More specifically, this paper aims to articulate and explain a first response to some IM challenges and/or deficiencies in the context of the Army Intelligence function.

2.0 INFORMATION MANAGEMENT CHALLENGE

As established in gaps and deficiencies analysis reports ([2] [3]), Army Intelligence has not really succeeded in developing effective IM/IX tools based on best practices. It has instead let its Intelligence function evolve in an ad-hoc manner by developing stove-piped tools designed to address specific issues. Identified IM gaps and deficiencies include, among others:

- low level of integration and coordination between IM tools/ systems;
- deficient or non-existing training;
- multiple disconnected networks (with air gaps between them) on which some IM tools/ systems, with redundant functionalities, are deployed;
- high level of Intelligence production duplication; and
- a lot of data/ information and document duplication.

In addition to the gaps and deficiencies described in [2] and [3], a number of challenges relating to current available IM tools and practices have been identified within the LTC4ISR/EW project by the way of elicitation [4] and through discussions with representatives of CA (details available in [5]). Despite the *Army IM Strategy* [6] and its main initiative which is the implementation [7] of Army Collaborative Information Management Services [8] on the Defence Wide Area Network, a number of gaps, deficiencies and challenges mentioned previously could not be addressed.

Thus, the *Hyperion* prototype, an integration framework in support to IM/IX, was designed under the CA G2 Capability Development to investigate options addressing key issues in order to enable Land Intelligence Modernization.

3.0 THE *HYPERION* PROTOTYPE

The *Hyperion* prototype aims to support the integration, alignment, management and exploitation of (1) data extracted from large amounts of documents (structured data) and (2) raw data (unstructured data) from many disparate external Intelligence Surveillance and Reconnaissance (ISR) sources. It is as well an exploratory platform for investigating, experimenting, testing and integrating new technologies in order to improve IM/IX for the Army Intelligence function. Furthermore, *Hyperion* aims to address the cognitive overload which is one of the ten hard problems outlined by the CA in their 2012 Army S&T Priorities document [9].

3.1 Operational Challenges and Deficiencies Addressed

The *Hyperion* prototype proposes to tackle as a first step the management of users/ groups of users, workspaces and permissions, while addressing the data/ information architecture, security, operational efficiency, and training. The proposed approach, based on best practices in terms of user experience design, offers a promising approach enhancing and strengthening the IM, and enable Information Management Officers (IMOs) to be efficient for the Army Intelligence function to deliver effective operations in an adaptive dispersed operations context. The IMO is a “staff function that has arisen in support of fielded information technologies” [10] [11].

3.2 Intent

In support to IM, the *Hyperion* prototype adopts an approach of "learning by experimentation" in order to facilitate the derivation of usability best practices; the derivation of engineering best practices in terms of system architecture and design; and to support the writing of the ConOps document developed for LCSS Modernization. The fundamental aspects considered for ensuring that IM activities are effective and successful are (1) user interfaces; (2) user system interactions; (3) architecture and design; (4) security; and (5) cognitive mapping. Addressed issues are related to:

- minimize training time by designing intuitive, visual and (mobile) touch-ready interface;
- facilitate data/information access and sharing, and promote collaboration;
- simplify permissions management by organising people into groups, and workspaces into hierarchies, and by optimizing inheritance;
- reduce the IMO's burden by delegating permissions; and
- deal with data overload by adequately exploiting big data processing and storage capability.

4.0 *HYPERION* PROTOTYPE DEVELOPMENT RESULTS

4.1 Technological Exploration for the Backend

Technological choices made while designing the *Hyperion* backend are in line with architecture and design identified by subject matter experts, mainly:

- no imposed data model or structure;
- service oriented ecosystem; and
- a system that leverages big data technologies.

The fundamental improvement offered by *Hyperion* is the flexibility it provides to users managing information as they see fit. Legacy systems suffer from schema rigidity or schema fragility. That is, once data relationships are set, they remain so and cannot easily be changed in conventional data management systems. Ontologies provide the flexibility and expressiveness required by the changing nature of military operations. They can represent data and models, segregate the information and also be combined to provide new semantics. In theory, ontologies provide solutions to many problems of the military client and that is why ontology concepts were selected to be the back bone of *Hyperion*. Using ontologies, Hyperion is sought to be an all-source information repository that can search and access seamlessly current and archived data, provide contextualized search, and import data from legacy systems.

4.2 Management Concepts

Concepts regarding users, groups of users, workspaces and permissions are defined in Table 1.

Table 1: *Hyperion* Core Users, Workspaces and Permissions Management Concepts

	Concept		Definition/ Description
Entities[2]	User		Is an individual person that has an access to *Hyperion*.
	Position		Has contact information, is assigned permission, and can be filled by multiple users who are granted the position's permission.
	Group		Is a labelled set of users and/or subgroups. Users & groups can be members of more than one group.
Entities Management Concepts	Workspaces Tree[3]		Is, for a user owning adequate permissions, the place to organize, configure and manage temporary digital storage areas. It is organised from root to leaves as a parent-child hierarchy. It contains four types of nodes: category, workspace, subworkspace and graph.
	Nodes Tree	Category	Is the high level division in the workspaces tree, has a label and is mainly used for organizing the workspaces and does not directly contain data, and can contain categories and workspaces.
		Workspace	Is a temporary digital storage area, is a subtree of the workspaces tree, has a label, can contain subworkspaces, data graphs and model graphs, and contains at least a data model graph and a data graph.
		Subworkspace	Is, as a workspace, a temporary digital storage area, a subtree, and has a label. It can contain subworkspaces and data graphs, and differs from a workspace in the sense that no data model graph is included.
	Graph		Is a *data container* such as Model (i.e. one or more than one data graph – ontology), Data (i.e. structured data), Document, Annotation, and Process. It is a leaf of the workspaces tree.
Permissions Management Concepts	Manage User Group Permission		Allows the user to make modifications to the target user/ group information and membership.
	Home Permission		Allows the user to organize (create/ remove) nodes under the target node in the workspaces tree structure. A user can be owner of more than one node home. This is not a permission per se, but is treated in a similar way.
	Owner Permission		Allows the user to configure & manage the target node. A user holding this permission acts as a sysadmin for the target node. Automatically includes read & write permissions.
	Read Permission		Allows the user to read information contained in the target node.
	Write Permission		Allows the user to read & modify information contained in the target node.

4.3 Front End Design and Initial Implementation

DRDC Team collaborated closely with CA G2 Capability Development to design the users/ groups of users, workspaces and permissions management web user interface for the initial implementation of *Hyperion*. This interface was implemented using web technologies in order to leverage touch-ready and display resizing capabilities, as well as speeding up interface development. Tables 2–5 describe how development based on user experience centered design principles led to innovations identified from initial tests and user evaluations of the *Hyperion* prototype.

[2] Entities are related to *military structure* or *military hierarchy*.

[3] Data structure

Table 2: Groups Perspective

Principles	Innovation/ Benefit
▪ Operations centered on selected users and/or groups are allowed; and ▪ Put users together into a group and then manage its permissions as a single entity greatly reduces the number of operations required to grant similar permissions to a large group.	▪ Organise users in a way that reproduces a military organisational units and work groups (reduced cognitive overload); ▪ Assign a user to multiple positions and as a member of multiple groups (increased flexibility); ▪ Assign multiple users to the same position (increased flexibility); ▪ Change who is assigned to a specific position, thereby granting the newly assigned user the position's permission on relevant workspaces for that position; ▪ Rapidly see what a user or group has access to; ▪ Rapidly see positions and groups that a user belongs to; ▪ Enable/ disable a user at any time; and ▪ Assign contact information to a user or a position.

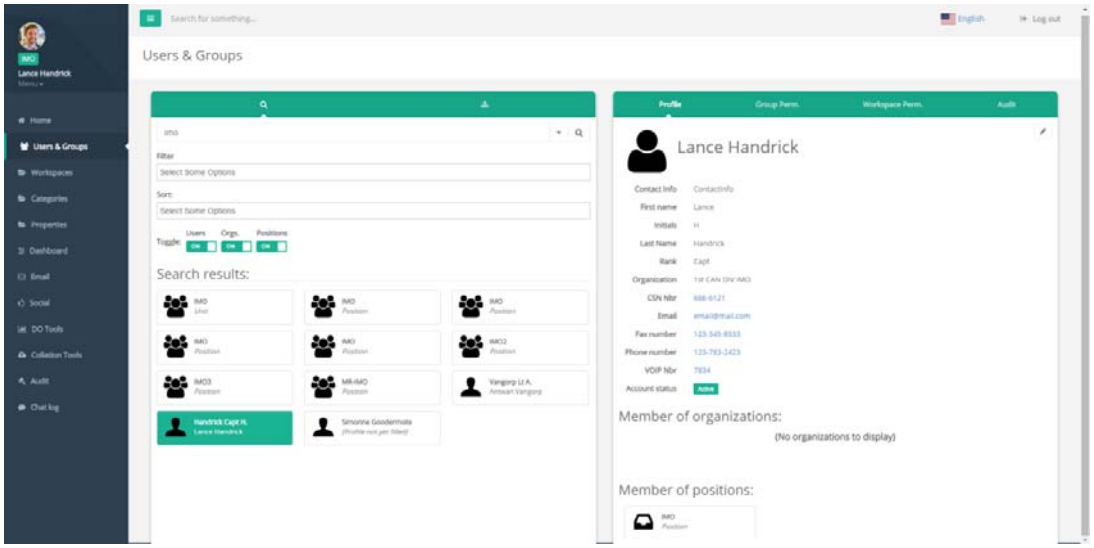

Figure 1: Groups Perspective – Allow operations centered on selected users and/or groups

Table 3: Workspaces Perspective

Principles	Innovation/ Benefit
▪ Operations centered on selected users and/or groups are allowed.	▪ Let the user to create a new workspace/ subworkspace based on an existing one, to allow faster reuse of the already defined relevant concepts. Moreover, because anyone can create a subworkspace, this facilitates the creation of sandboxes that users or groups can use without having to wait for an IMO. It provides a greater agility to teams; ▪ Organise workspaces around operations (reduced cognitive overload); ▪ Work with multiple operations in parallel; ▪ Rapidly create an ad-hoc shared workspace for collaboration without having to resort to IMOs (increased efficiency and flexibility); ▪ Rapidly see who has access to specific workspaces; and ▪ Rapidly clone or transfer data models and content for a new operation.

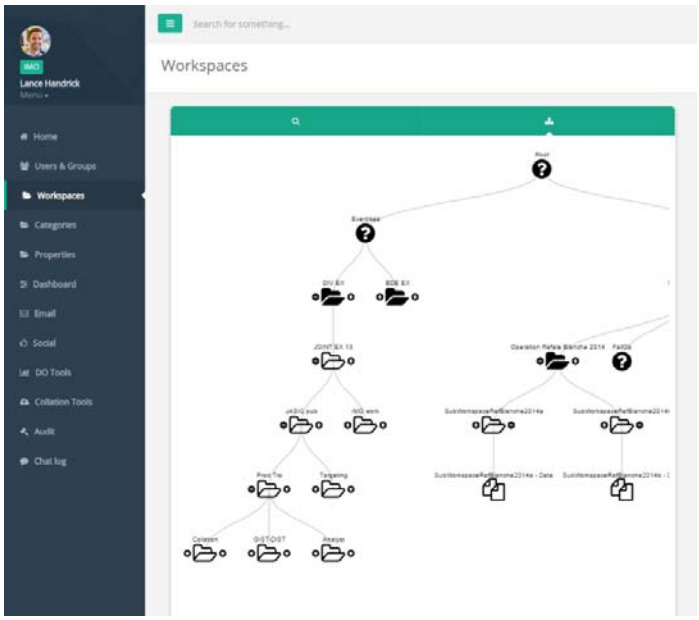

Figure 2: Workspaces Perspective – Allow operations centered on selected categories, workspaces, subworkspaces or graphs

Table 4: Permissions Management Approach

Principles	Innovation/ Benefit
▪ Permissions over groups and workspaces can be managed under either the groups or the workspaces perspective because some permission management operations are more efficient while focusing on specific users/ groups while others require fewer steps when adopting a workspaces centric view; and ▪ Viewing the permissions for a workspaces perspective quickly allows one to know who has access to this workspace. The same applies to when one wants to know what a specific user has access to. This can be summarized in a single view for each case (see Figure 3 and Figure 4).	▪ Delegate his/her permissions to other users/ groups for a specific time interval without having to resort to IMOs; ▪ Manage permissions of other users/ groups on a workspace that you own without having to resort to IMOs or system administrators; ▪ Grant or revoke permissions on a category/ workspace/ subworkspace to multiple users in a single operation; ▪ Access a log of all groups, workspaces and permissions management operations and see who performed (see Figure 6) (audit ready); ▪ Use permission boxes to enable simple drag and drop operations to grant or retract permissions (see Figure 3); and ▪ Delegate permissions to another user as a single operation from the radial menu (see Figure 5). Highly desirable feature not yet provided in operational systems.

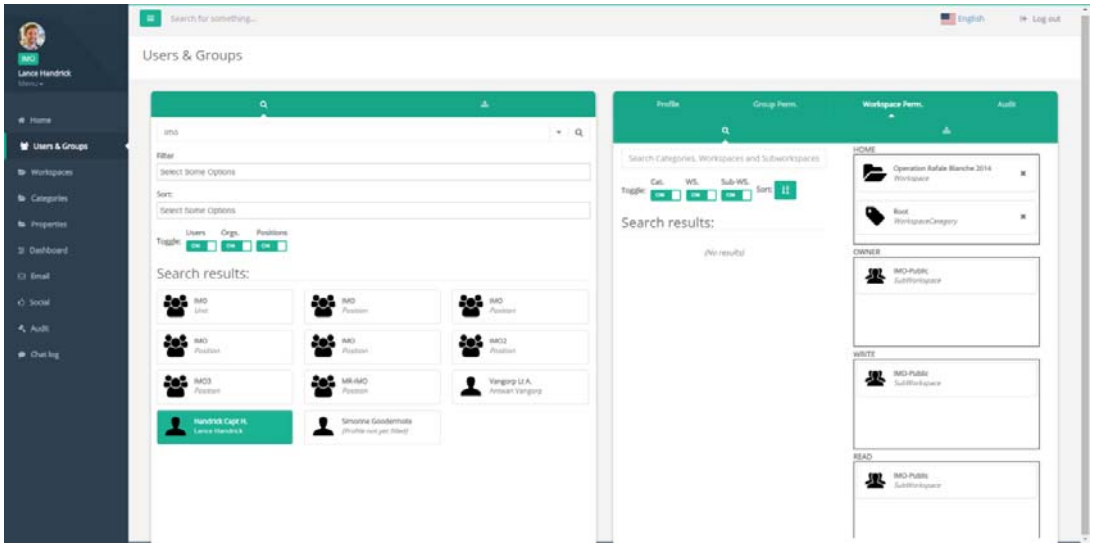

Figure 3: View of a User's Permissions

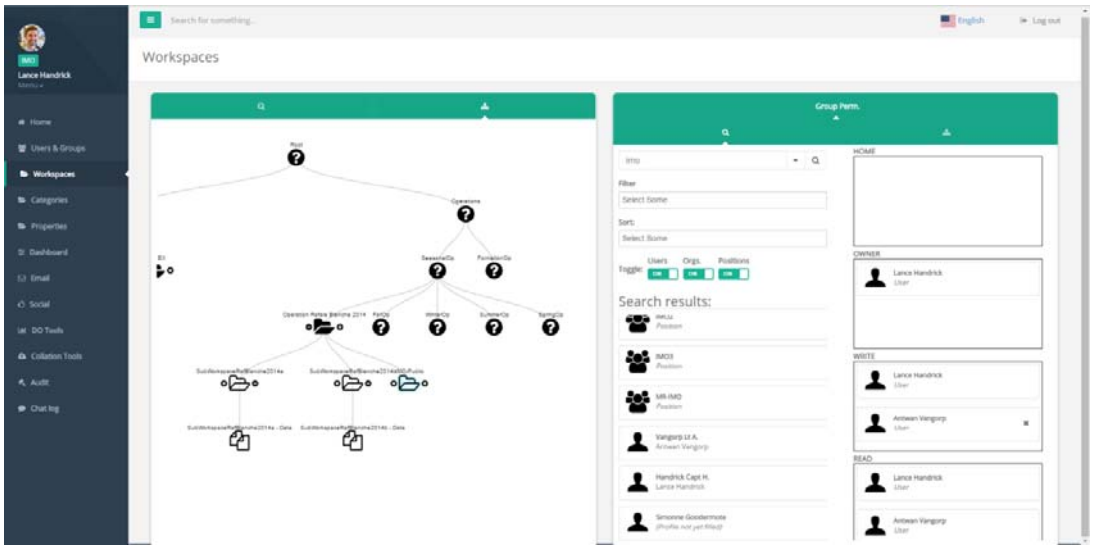

Figure 4: View of Permissions Related to a Specific Workspace – Permission boxes appear in the right pane and allow the user to grant a permission using a drag and drop interaction

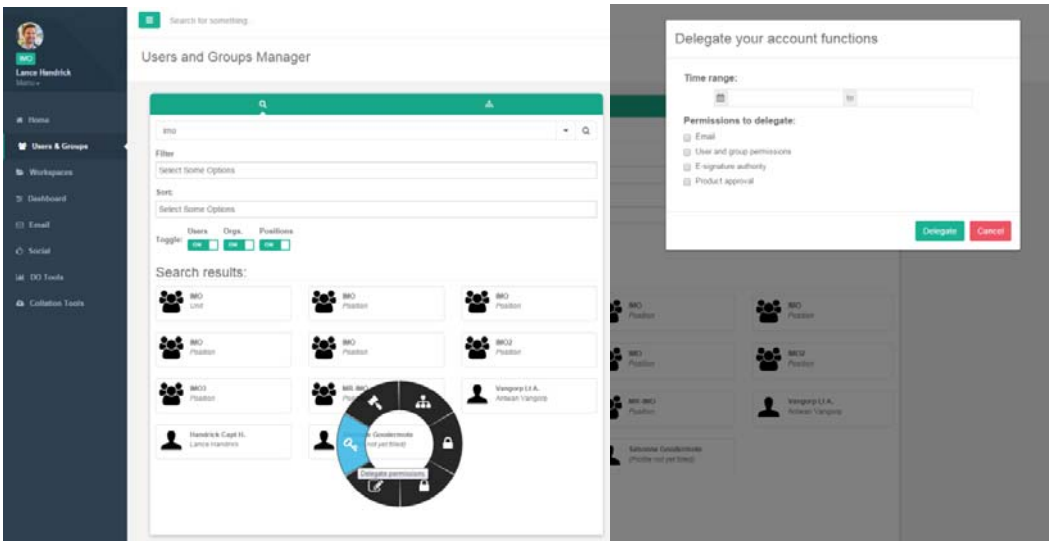

Figure 5: Delegate Permissions to another User

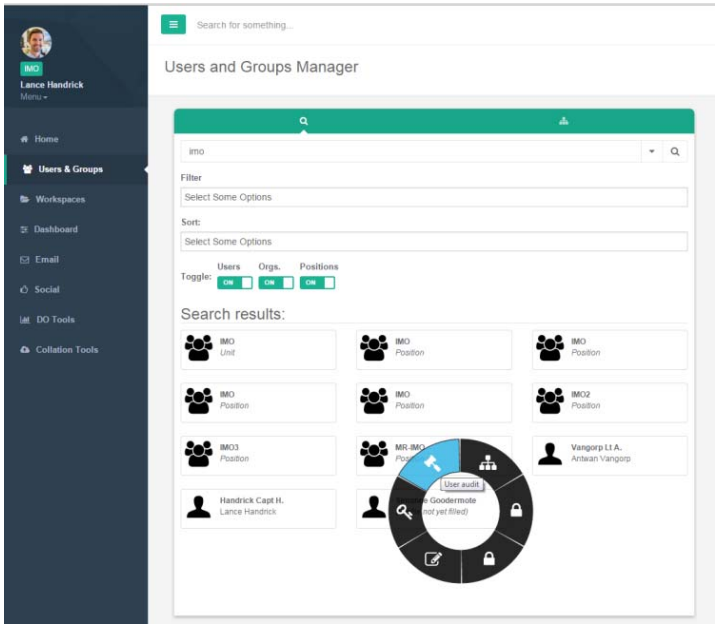

Figure 6: Accessing a User's Audit Trail

Table 5: User Interface Panels Design

Principles	Innovation
▪ Organization of the user interface around coordinated panels offering specific perspective into the users/ groups, workspaces and permissions management processes; ▪ Possibility to alternate between a *list* and a *tree* representation of the information (only one exception : the *user information* panel which allows the edition of user information that cannot be represented as a tree); ▪ Possibility to easily perform simple operations in a single panel (e.g. performing modifications on the tree structure or changing simple element properties); and ▪ Performing an operation requiring two panels means that the *left* panel is always considered as the *selection* panel and the *right* panel is where the *action of modifying* the information takes place.	▪ Ensure interaction consistency and facilitate features learning and knowledge transfer between similar functionalities by repetition of the same representation and interaction designs through all the different panels; ▪ Transfer knowledge within the prototype and necessitate lower training requirements according to consistent user interface visual component and interaction mechanisms; and ▪ Reduced software development costs.

5.0 CONCLUSION

Achieving efficient IM practices is a key focus for CA as it is a key focus for many organisations, across both the private and public sectors. This is being driven by several factors, comprising: a need to improve efficiency of processes; demands of compliance with legal and policy obligations; and the desire to deliver new and effective products/ services. Unfortunately, IM is often narrowly interpreted as deploying new technology solutions (e.g. content and document management systems, portal applications), which leads frequently to disappointing results, and the inability to provide an integrated IM environment. Within all organisations, IM is an umbrella term that encompasses processes and systems for the creation and exploitation of information. IM encompasses more than just technology. IM is about the processes and practices supporting the exploitation and creation of information. IM is as well about the information itself (i.e. its architecture, its content, its quality, etc.).

From an Army Intelligence perspective, IM challenges are numerous but effective IM is difficult. Thus to tackle a piece of the whole challenge, the *Hyperion* prototype has been designed to investigate options addressing key issues for enabling Land Intelligence Modernization. The first issue is related to information architecture and its associated users, groups, workspaces and permissions management. The proposed methodology, based on best practices in terms of user experience design, offers a promising approach for enhancing and strengthening IM, and enabling IMOs to be efficient for the Army Intelligence function to deliver effective operations in an Adaptive Dispersed Operations context. This methodology is aligned with the wish “to be oriented towards commanders at all levels and people who create, manage, analyse, and consume information, be they in an expeditionary, training, or garrison environment” as expressed in [12].

6.0 REFERENCES

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