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Front End Analysis toward a Demonstration of a Concept of ROSP

Concepts for Recognized Operational Support Picture (CoROSP) TDP

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Abstract

The Concepts for Recognized Operational Support Picture (CoROSP) project is a Technology Demonstration Project (TDP) to demonstrate technologies that will enhance operational support domain awareness, which is required by commanders and staff in their decision making. This document summarizes the results of the work executed to develop a sound understanding of the requirements associated with the use of a Recognized Operational Support Picture (ROSP) as well as existing tools/technologies/framework that can provide support to the development of operational support awareness. From these analyses, a set of ROSP concepts is being identified for demonstration purposes. This document also provides high level foundations for the design of a testbed environment to demonstrate and validate proposed ROSP concepts.

Résumé

Le projet de démonstration de technologies (PDT) sur les concepts pour une image du soutien opérationnel (CoROSP) vise à démontrer des technologies qui permettront d'améliorer la connaissance du domaine de soutien opérationnel, laquelle est requise par les commandants et les états-majors dans leur prise de décision. Ce document résume les résultats des travaux exécutés pour développer une bonne compréhension des exigences liées à l'utilisation d'une image de soutien opérationnel (ROSP) ainsi que les outils existants / technologies / cadres qui peuvent supporter le développement de l`éveil du soutien opérationnel. A partir de ces analyses, un ensemble de concepts ROSP sont identifiés à des fins de démonstration. Ce document fournit aussi les bases de haut niveau pour concevoir un environnement de banc d'essai pour démontrer et valider les concepts ROSP proposés.

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Executive summary

Front End Analysis toward a Demonstration of a Concept of ROSP: Concepts for Recognized Operational Support Picture (CoROSP) TDP

Micheline Bélanger; DRDC Valcartier TM 2013-305; Defence R&D Canada – Valcartier; January 2013.

Access to timely, accurate and integrated information about emerging sustainment requirements, material availability and support process status reports is essential to the success of military operations. Right now, most of this information is scattered across multiple partitioned information systems (different CF/DND Enterprise Resource Planning (ERP) applications and other legacy systems, as well as Allied and other external information sources respectively) and is thus difficult to access within the timelines required to support effective operational planning and decision-making. The concept of a Recognized Operational Support Picture (ROSP) capability is proposed to solve these issues. It is envisioned as an integrated information/knowledge sharing and decision support environment to assist commanders and staff in operational support planning, decision making and mission execution. ROSP should provide commanders, staff and operational support units with timely, accurate and integrated information about geographic locations of support installations, assets, unit and formation readiness status/trends (current and forecasted), courses of actions, transportation schedules, equipment maintenance status, and critical item supply status as well as transaction status.

DRDC has defined and put in place a Research and Development (R&D) project to support CANOSCOM in the identification of concepts that should be part of a ROSP. This project, called Concepts for Recognized Operational Support Picture (CoROSP), will look at enablers of the operational support domain awareness which are required by commanders and staff in decision-making. This document summarizes the results of the work executed to develop a sound understanding of the requirements associated with the use of a ROSP as well as existing tools/technologies/framework that can provide support to the development of operational support awareness. A review of existing commercial off the shelf technologies as well as open source materials, will be used to demonstrate a net-centric information sharing and decision support environment based on service-oriented architecture (SOA) allowing information integration (disparate data sources, services and applications). Considering that our main objective is to assist commanders and staff in decision making, a particular effort will be made to address information rendering support to different users' specific needs. We propose an operating picture approach defined by the User. Finally, we identify a list of existing technologies coming from the commercial, open source as well as the R&D worlds in order to demonstrate decision support functionalities.

Sommaire

Front End Analysis Toward a Demonstration of a Concept of ROSP: Concepts for Recognized Operational Support Picture (CoROSP) TDP

Micheline Bélanger ; DRDC Valcartier TM 2013-305 ; R & D pour la défense Canada – Valcartier; janvier 2013.

L'accès en temps opportun à de l'information précise et intégrée sur les besoins émergents de maintien des opérations, sur la disponibilité du matériel et l'état du processus de support aux opérations est essentiel au succès des opérations militaires. Présentement, la plupart de cette information est répartie à travers plusieurs systèmes d'information cloisonnés (différentes applications de planification de ressources d'entreprise des forces armées, des vieux systèmes hérités du passé, ainsi que des sources d'information provenant de nos alliés et d'ailleurs). Il est donc difficile d'accéder à cette information dans un temps acceptable pour la planification opérationnelle et la prise de décision. Le concept d'une capacité d'image du soutien opérationnel (ROSP) est proposé pour résoudre ces problèmes. Elle est envisagée comme un environnement intégré de partage d'information et de connaissance et d'aide à la décision afin d'aider les commandants et leur personnel dans la planification du soutien opérationnel, la prise de décision et l'exécution des missions. Le ROSP devrait fournir aux commandants, leur personnel et les unités de support opérationnel un accès en temps opportun à de l'information précise et intégrée sur les emplacements géographiques des installations de support aux opérations, les calendriers de transport, le statut des équipements de maintenance, le statut des items critiques d'approvisionnement ainsi que le statut des transactions.

RDDC a défini et mis en place un projet de démonstration de technologies (PDT) pour soutenir CANOSCOM dans l'identification des concepts sous-jacents au ROSP. Ce projet intitulé les concepts pour une image du soutien opérationnel (CoROSP) vise à démontrer des technologies qui permettront d'améliorer la connaissance du domaine de soutien opérationnel, laquelle est requise par les commandants et les états-majors dans leur prise de décision. Ce document résume le résultat des travaux exécutés pour développer une bonne compréhension des exigences liées à l'utilisation d'une image de soutien opérationnel (ROSP) ainsi que les outils/technologies/cadres existants qui peuvent supporter le développement de l`éveil du soutien opérationnel. Suite à une revue des technologies existantes, il est proposé de démontrer un environnement intégré d'information réseau-centrée de partage d'information et d'aide à la décision basé sur une architecture orientée-service permettant l'intégration d'information (dispersion de sources de données, services et applications). Comme notre objectif principal est d'aider les commandants et leur personnel dans la prise de décision, un effort particulier touchera la présentation des informations en fonction des besoins spécifiques de différents usagers. Une approche d'image opérationnelle définie par l'usager a été proposée. Finalement, des technologies existantes provenant du secteur commercial, du domaine ouvert ainsi que du monde de la recherche et développement ont été identifiées pour démontrer des fonctionnalités d'aide à la décision.

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1 Introduction

The increasingly complex security environment demands approaches that are comprehensive, integrated, networked and adaptive [1]. Such approaches will require operational support capabilities that are highly agile, adaptive and flexible, and able to contribute to multi-dimensional operations within a comprehensive approach framework [2]. Access to timely, accurate and integrated information about emerging sustainment requirements, material availability and support process status reports linked to Canadian Forces (CF) operations as well as comprehensive visibility of CF personnel and Department of National Defence (DND) employees will be invaluable to the success of operations. Right now, most of this information is scattered across multiple partitioned information systems (different CF/DND Enterprise Resource Planning (ERP) applications and other legacy systems, as well as Allied and other external information sources respectively) and is thus difficult to access within the timelines required to support effective operational planning and decision-making. In fact, one of the CF deficiencies documented in the Strategic Capability Roadmap 2008 version 1.0 (SCR v.1.0) [35] is the inability to obtain asset visibility information from a single point of access.

Canadian Operational Support Command (CANOSCOM) has identified that a possible solution to that gap would be a common representation of relevant operational support information that supports the development of commanders' Situational Awareness (SA) and that is shared with support organizations at all levels. This information should be drawn from recognized, authoritative sources and sensors and provides temporal, spatial, condition and support process transactional data about materiel and services in order to facilitate collaborative planning, decision-making and support service delivery. This concept has been given the title of Recognized Operational Support Picture (ROSP). It should serve as the operational support functional layer fully integrated with the future CF Common Operating Picture (COP) capability, and accordingly, must not exist as a separate entity in any way.

DRDC has defined and put in place a Research and Development (R&D) project to support CANOSCOM in the identification of concepts that can enable the operational support domain awareness required by commanders and staff in decision-making. This project, called Concepts for Recognized Operational Support Picture (CoROSP) involves the development of Recognized Operational Support Picture (ROSP) capability concepts envisioned as an integrated information/knowledge sharing and decision support environment to assist commanders and staff in operational support planning, decision making and mission execution. It will contribute to asset visibility by providing commanders, staff and operational support units with timely, accurate and integrated information about geographic locations of support installations, assets, unit and formation readiness status/trends (current and forecasted), courses of actions, transportation schedules, equipment maintenance status, and critical item supply status as well as transaction status. It will encompass relevant operational support information from other support functions, including general support engineering, military police and Communications Information Systems (CIS), as required. This information will be obtained from different CF/DND ERP applications, other legacy information systems and in future sensors, as well as Allied and other external information sources, respectively.

Considering the resources available for the project, the work primarily targets CANOSCOM operational command and relevant interacting organizational command environments. This

document summarizes the results of the work executed to develop a sound understanding of the requirements associated with the use of a ROSP as well as existing tools/technologies/framework that can provide support to the development of operational support awareness. It provides the high-level foundations for the design of a testbed environment to demonstrate and validate the proposed concepts of ROSP.

2 ROSP Requirements

The CANOSCOM portal on CF Command View (CV) provides the current operational support picture. Even if this capability has been iteratively improved in CANOSCOM's four years of operations, there is limited operational support information available. Furthermore, it is near its limits of utility. The generation of the future ROSP capability will require major development work to support the integration of the operational support information and to provide a suitable display to support the sharing of Operational Support information with other commands and Level 1 organizations.

In fact, it is part of the Joint Information and Intelligence Fusion Capability (JIIFC) project intention to deliver a solution that will address this deficiency. In recent years, JIIFC has defined a Battlespace Management capability that will provide: "A Joint, command-centric, information-based integrated operating environment that enables the optimization of the creative thinking and decision processes of the commanders and staff, resulting in improved synchronization of operational functions in the conduct of assigned missions". The capability will broaden the commanders' situation awareness through the process of collating, correlating, and integrating diverse elements of operational information into a holistic, shareable, scalable and context driven presentation of the commanders' battlespace. The Integrated Joint Battlespace Management (IJBM) capability to be delivered through JIIFC [6] shall provide commanders and staff with the ability to develop a Recognized Operational Support Picture. Following is the list of capabilities that the IJBM would like to address in order to enable the ROSP:

- Provide access to Enterprise Resource Planning (ERP) systems and other DND/CF legacy information systems data[1]
  - Defence Total Asset Visibility (DTAV)
  - Materiel Acquisition and Support Information System (MASIS)
  - Canadian Forces Supply System (CFSS)
  - Financial Management Accounting System (FMAS)
  - Human Resources Management System (HRMS)
  - National Movement and Distribution System (NMDS)
  - NATO Logistics Functional Area Services (LOGFAS)
  - Ammunition Inventory Management System (AIMS)
  - Integrated Managed Readiness (IMR)
- Provide data mining and computation capabilities;

[1] In addition to these systems, access would also be required to the Cancer and Mortality Study (CAMS: for Medical information), Automated Vehicle Inventory Management System (AVIMS: for Vehicle Movement), Fleet Management System (FMS: for the Vehicle Fleet) and Logistics, Operations and Management Information Systems (LOMIS: Plan Expert).

- Provide the ability to set up alerts and receive email notifications when trigger limits have been reached;
- Enable asset visibility throughout the supply chain;
- Provide a Watchboard capability:
  - Provide unit readiness status;
  - Provide resources readiness status;
  - Provide roll-up and drill down functionality;
- Provide the user with the ability to generate and display trend charts;
- Provide the ability to generate Logistics Lay down overlays, including but not limited to:
  - Theatre infrastructures and facilities;
  - seaport of disembarkation (SPODs) and airport of debarkation (APODs);
  - Lines of communication (including transportation nodes) and supply chain (supply location and status);
- Ability to integrate intelligent software agents employed to automatically detect change in the operating environment and initiate re-planning and other actions;
- Provide the ability to generate Logistics and other operational support related reports:
  - Integrate with multi-national coalition, and Other Government Department (OGD) reporting systems, e.g. NATO Logistic Reporting (NATO LOGREP);
  - Provide the ability to share operational support information with OGDs, International Organizations (IOs), Non-Governmental Organisations (NGOs) and Industry Partners.

While this requirement have been elicited in the recent past, it was considered appropriate to review the requirements associated with the development of operational support domain awareness by improving the understanding of CANOSCOM role and organisation. Accordingly, CANOSCOM initiated a business process analysis of CANOSCOM in the summer of 2010. Executed by Business Solutions, it provided a description of the roles and responsibilities of CANOSCOM members as well as their interactions in terms of input and output amongst themselves as well as with other organizations (e.g. Canada Command (CANADACOM), Canadian Expeditionary Force Command (CEFCOM) and Canadian Special Operations Forces Command (CANSOFCOM)) [3].

As mentioned in the Canadian Operation Support Command Concept of Operations [4], CANOSCOM is the organisation responsible for force development, force generation, and certain aspects of force employment of operational support capabilities. Operational support is defined as the action of a force, or portion thereof, which directly aids, protects, complements or sustains the operations of another force. Operational support [5] is provided by a supporting command either within a theatre of operations or along strategic lines of communication, consisting of delivering specialized support functions that have a routinely direct impact on CF operations planning, deployment, execution, redeployment and reconstitution either in Canada or abroad (not air, maritime, or land component command unique). As such, operational support includes

elements of military engineering, health services, military police, logistics (including transport, supply, food services, postal, and movements), equipment maintenance (primarily general land equipment), personnel support, financial operations, Communications Information Systems (CIS) support, and command and control (C2) for the support organization. Therefore the ROSP is not just limited to portraying logistics information.

In order to support the key CANOSCOM activities of planning, execution and monitoring, Business Solutions [3] identified 3 critical ROSP capability elements:

- An integrated picture enabling situational awareness, updated automatically from a variety of sources. It would be used to define the current operational support capabilities;
- The automatic generation of alerts to CANOSCOM staff, in the event of an inability to meet a current or future demand;
- The automated tracking and reporting of the status and location of critical equipment, so CANOSCOM staff can brief Command on location and expected time of arrival of needed equipment;

A Community of Interest Group was created to understand the perspectives that different members of operational support military communities might have. The first workshop with that group was conducted on the 12-13 January 2011 at StarTop Building (Annex C). It involved about 25 people from CANOSCOM, CANADACOM, Deputy Chief of Staff Materiel (DCOS (MAT)), Joint Information and Intelligence Fusion Capability (JIIFC), Chief of the Maritime (CMS), Director Land Requirements (DLR), Chief of Force Development (CFD), Assistant Deputy Minister, Information Management (ADM (IM)), University Laval, COMPUSULT (industry) as well as DRDC HQ, DRDC Centre for Operational Research and Analysis (CORA), DRDC Ottawa, DRDC Atlantic and DRDC Valcartier. The main findings of this workshop were:

- The concept of S&R logistics seems to be very promising for satisfying Canadian requirements related to operational support command and control;
- ROSP needs to cover the spectrum from strategic to tactical information;
- ROSP should be integrated as a sub-component of Palantir (Canadian Force COP);
- Access to information on Readiness need to be improved;
- Readiness assessment is not being normalized throughout the Canadian Forces, which may lead to inadequate interpretations;
- CANADACOM Northern Support Concepts is an area that is under definition and may require special attention;
- Support to Arctic Operations may be a challenge from a Canadian Force Maritime Environment perspective;
- Existing collaborative environments such as the Coalition Portal for Situational-Awareness (C-PORTS) would be worth demonstrating and assessing (e.g. Coalition Warrior Interoperability Demonstration (CWID));

A second workshop (Annex D) was conducted on the 13 June 2011, allowing the clarification of some of the expectations that CANOSCOM had regarding a ROSP:

- ROSP should be integrated in Palantir (JIIFC) BattleSpace Management capability
- ROSP should be linked to the new readiness and reporting process (under review)
- Strategic Joint staff to work on a revised readiness model
- Canada First Defence Strategy (CFDS) mission 5 would be a good scenario to use
- 2 main ERPs will need to be accessed: SAP for DRMIS and People soft for HF
- ISCoE will provide Canadian Forces with an information access tool, as well as Business Intelligence (BI) tools, etc. ROSP should leverage what these tools can provide
- CoROSP should cover the overall operational support area, not only the Logistics aspects
- LOGFAS will be added to the strategic baseline. ROSP should have access to the information managed by this tool
- Cross-Domain Exchange Network Architecture project (XENA which covers the security aspects) should be monitored. Considering the resources assigned to the CoROSP TDP, CoROSP cannot deal with the multi-level security problem as well.
- Capability Readiness (Cap RED) should be integrated with the ROSP

During the summer of 2011, CANOSCOM produced the first draft of a ROSP Statement of Capability Deficiency (SOCD). This document matured and in December 2011, version 2.1 [8] provided a list of 29 ROSP functional capabilities (Annex A) that can mainly be enabled by the following 5 key areas:

- Integration of Multiple Information Sources (I)
- Operational Support Information Management (IM)
- Decision Support (DS)
- Vizualisation (V)
- Collaboration. (C)

In February 2012, from the 29 functional capabilities identified in the SOCD, CANOSCOM identified those that would be most relevant to the CoROSP TDP. This list was provided to the CoROSP project in order of priority in March 2012:

Priority Order	Challenge#	Requirement
1.	C	The capability to share Operational Support (OS) information with C2 systems
2.	Q	Visibility of resources/capabilities> (e.g. units, platforms, systems, personnel, financial, equipment maintenance, communication and computer networks, etc.) readiness status (current and projected)

3.	L	The ability to fuse and analyze operational support transactional information/data from multiple sources, including Departmental Enterprise Resource Planning (ERP) systems and other official information sources of record, to determine the current status, predict an eventual situation or determine the potential causes leading to a situation
4.	B	The capability to present OS products (e.g. OS capability readiness reports) in forms that enable military and national decision-makers to understand the operational support environment
5.	P	End-to-end visibility of the supply chain and distribution management systems network from production, through procurement, storage and delivery to the warfighter
6.	M	The capability to synchronize and integrate the OS activities to meet the current and /or determine the feasibility of meeting future support and sustainment requirements of national and military decision-makers
7.	O	Efficient and shared resource management processes and tools for the identification, allocation and management of resources, including taskings, personnel, equipment and facilities, to operational tasks, e.g. Tables of Organizations and Equipment (TO&E), contingency plan data, deployment plans, transportation routing, maintenance status and schedule data
8.	I	The ability to control, monitor and adapt, as required, the execution of the Operational Plan, in particular the OS portions of the plan
9.	Y	Where appropriate, the capability to process and disseminate OS data, information and products location-referenced to a geospatial environment
10.	H	The capability to synchronize and integrate the OS activities to meet the support and sustainment requirements of national and military decision-makers

3 Current DND deficiencies

Current DND capability deficiencies have been documented in the Strategic Capability Roadmap 2008 [35] . Three of them are directly relevant to the requirements associated with a ROSP. They are:

- "(SCR2008 Cmd 6) Inadequate capacity and capability to provide a Common Operational Picture (COP) and Situational Awareness (SA) to facilitate managed readiness
  - The provision of timely and secure access to business information (Commander's Critical Information Requirements (CCIRs)).
  - The ability to conduct integrated, managed readiness through a DND/CF Common Operational Picture (COP).
  - The provision of total asset visibility.
  - The provision of timely, secure access to fused business information
- (SCR2008 Cmd 5) Inadequate capability to provide decision support processes to facilitate managed readiness
  - The creation of an integrated DND/CF managed readiness planning process.
  - The creation of an integrated process for Performance Measurement, transparent decision making and business planning within DND/CF.
  - The ability to share releasable operational intelligence (OI) and business intelligence (BI) with the public, either voluntarily or upon request (Access to Information and Privacy (ATIP)).
  - A process for the management of strategic reports, submissions to the Treasury Board, Memoranda of Understanding and other documents with other Government Departments (OGD).
  - The facilitation of appropriate information exchange between DND/CF and partners/vendors.
  - The ability to conduct asset management, and the visibility and tracking of material (RFID).
  - The creation of common processes for issuing and tracking direction across strategic, business planning and operational domains.
- (SCR2008 Sus 4) Inability to provide continuous, end-to-end Asset Visibility (AV) in real-time
  - Decision makers at all levels lack the capability to obtain timely, relevant asset visibility information about forces and materiel that will enable sound operational decision-making. First, there is a lack of continuous visibility of an asset throughout its Life Cycle (LC). There exist several AV Gaps throughout the LC of the asset which preclude DND from having continuous visibility, including real time visibility of domestic transport of ammo and other significant materiel. For the transport of

most assets, the current system only allows for time past point (i.e. no visibility of an asset from the time that it is dispatched until it is receipted at destination).

- The second deficiency is the inability to obtain AV information from a single point of access. The DND/CF currently uses over a dozen non-integrated Information Technology (IT) systems to perform the various functions of asset management including logistic support, which the operator must access separately to obtain all the desired AV information. This is a labour intensive and inefficient process. If this gap is not addressed, Commanders will be forced to make operational decisions without having all of the critical logistics information, which could impact on mission success."

Three initiatives were conducted to have a better understanding of some of the problems encountered by DND: the review of lessons learned, the participation in Human Factor 4 (HF4), the assessment of Mission Transition Task Force (MTTF) COP.

3.1 Lessons Learned

It was decided to have a look at the lessons learned of some operations in order to verify if more detailed deficiencies identified in past operations could be mitigated by a ROSP [7]. Only unclassified lessons learned available on Defence Wide Area Network (DWAN) on February 2011 were analysed for a sub-set of 15 operations (ARCHER, ARGONAULT, ATHENA, BOREAS, CENTRAL, DANACA, ECLIPSE, FORAGE, HALO, HESTIA, KINETIC, NANOOK, PODIUM, PONTOON, UNISON). Over 1000 total observations were gathered from a review of lessons learned (LL) documents. From these, 539 operational support observations were placed in a database and analyzed for their relevance to command and control (C2) and the development of a Recognized Operational Support Picture (ROSP). A total of 90 C2 related observations and 132 ROSP related observations were analyzed. The analysis identified 7 areas that ROSP should consider to be effective in operation. These areas, described in [7], are:

- Information Access
  - Any ROSP developed for employment in-theatre should consider the risk of lost connectivity
  - Cascading requirements can be collected and displayed in a ROSP through both integration with a planning system and discipline in the capture of requirements
- Personnel Management
  - The identification, achievement and tracking of secondary skills for operations should be maintained through a ROSP.
  - In addition to support for the managing of overall personnel requirements, the ROSP should be able to support the unit level to make sure that personnel preparing to deploy are properly kitted.
- Asset Tracking
  - Accessing required materiel during an operation can be assisted through improved request and tracking processes. Acquisition of Materiel, Often on Short Notice

- While subject matter expertise and Standard Operating Procedures (SOPs) can mitigate unloading challenges, an operation-specific equipment loading guidance tool may be of value in suggesting load/unload order
- Any system being used for asset tracking needs to have the means to support the introduction of new equipment

- Contingency Planning
  - As assets are reallocated, the knowledge of whether readiness levels are being met or will be in jeopardy in the near future are important decision points and should be assisted through integrated readiness monitoring. This involves setting up the requirements, minimum standards and readiness reporting mechanisms visible through a ROSP. It should also account for LL requirements of spare equipment such as laptops and medical supplies
  - Aggregated across operational types, a ROSP would be the central point of entry for viewing readiness and providing insight into the impact of a deficiency and could support decision-makers in selecting alternatives and addressing critical deficiencies.
  - Highlighting the risks and providing information on contingencies and mitigation options for operations would be of value for a ROSP. A ROSP could serve to address these characteristics if it can align with information from planning tools. Weather effects matrices, environmental overlays and other operational planning information needs to be associated with capability options early in the planning stage, particularly for contingency operations where timelines often need to be condensed.
- Forecasting
  - A ROSP with pre-developed templates with quick cost estimates for rough order of magnitude (ROM) budgeting of OS options could serve to aid in influencing the planning process, and can be tied into a greater Operational Planning Process (OPP) schedule management tool. The ability to exchange data between any tool used to produce an integrated Table of Organization and Equipment (TO&E) and the task force movement table (TFMT) is also required
  - As a single portal for knowledge, a ROSP would provide a natural mechanism to conduct the tracking of sustainability requirements
- Asset Reallocation
  - A ROSP should seek to provide capability (equipment and personnel) roll-up information on location, readiness and employment as a function of time, allowing decision-makers to view options easily when deciding between competing priorities. These factors should be considered both within Canada and in theatre. Further, the ROSP should seek to draw upon contingency plans and past operations to assist in the development of a draft set of requirements to increase readiness of potential assets. While immediate contingency operations will still be ad-hoc, a repository would allow pre-deployment and reallocation requests to be completed earlier
  - Though operational asset reallocation is conducted without need for use of a ROSP, tracking when a requirement was needed and for what can allow for adjustment in future ROTOs

While analyses of additional LL (including classified ones) could complete this set of recommendations related to how the concept of ROSP could support the operations, these findings represent a good initial set.

3.2 Human Factors (HF4)

HF4 was the fourth in the Human Factors experimental campaign.

- HF1: 16 to 27 February 2009, which considered integrating the Joint Automated Deep Operations Coordination System (JADOCS) into a brigade level fires support cell [10];
- HF2: 30 November to 11 December 2009, which looked at reviewing and validating the Joint Fires Support decision process [11]; and
- HF3/Coalition Attack Guidance Experiment (CAGE): 26 April to 14 May 2010, which looked at network centric warfare and network enable capabilities for improving coalition combined fires operations [12].

The Canadian Forces Warfare Centre (CFWC) conducted the HF4 experiment from 29 November to 16 December 2010 at the CFWC's Joint Battle Lab (JBL) facilities and Building 34 at Shirley's Bay, Ottawa, Ontario. This initiative was conducted in support of the Joint Information and Intelligence Fusion Capability (JIIFC) capital project to verify that the JIIFC project battlespace management capability could enhance the ability of the Operational Commands to conduct their operations. It also assisted the 1st Canadian Division (1st Cdn Div) in the development of processes and organizational structure for its deployable Headquarters (HQ), as well as determining how the HQ would interact with the operational commands. Additionally it assisted Chief of Defence Intelligence (CDI) in the development of intelligence tools and processes, as well as, Canadian Operational Support Command (CANOSCOM) and the Collaborative Operation Planning System (COPS) project in the exploration of logistic and operational planning tools, respectively. CANOSCOM (1 person) was one group along with 1st Cdn Div (19 people), All Source Intelligence Centre (ASIC) (3 people), CEFCOM (10 people) that were taking part of the experiment. The role of the CANOSCOM participant was: OS_LOG_MOV.

During the HF4 experiment, several information processing and communication tools were evaluated [13]. The information processing tools were Joint Automated Deep Operations Coordination System (JADOCS), Command View, Command Post of the Future (CPoF), Tool for Operational Planning, Force Activation and Simulation (TOPFAS), Logistics Functional Area Services (LOGFAS), ENDECA, Land Command Support System (LCSS), Battleview, Orion, CoALA, CASES, Command & Control PC (C2PC), Canadian Forces Task Planning and Operations (CFTPO) and Monitor Mass. From the communication side, the tools were VOIP, Email and Chat.

Email was the communication tool that was the most used during the experiment. It was used for the development of a general situational awareness as well as for discussions about operational support needs.

The quality and ease of use of Palantir, TOPFAS and LOGFAS were assessed based on the operators' feedback. The value-added of these systems was assessed through the comparison of

two conditions of use. More precisely, the information flow, frequency of communication, the operators' workload and situation awareness were used to compare the prototypes and the baseline systems. Between all the C2 (and other) tools, CPoF was the most used tool by the CANOSCOM operator during Condition 2 (17% of his time was spent on CpoF). ENDECA was the second most used tool during Condition 2 (9% of the operator's time). Both these tools had their own technical and usability issues. It is important to note that all the tools have been mostly evaluated positively (specifically for CpoF). However, it may be possible that the positive evaluation is influenced by the frequency of use (with extended use, participants become familiar with the tools and its capacities).

Potential improvements related to ROSP information requirements have been identified based on observations[14]. While they should be further validated, and are not considered exhaustive, they are worthwhile to consider when developing a ROSP capacity. They are:

- To facilitate the determination of the existence of an operational support need
  - Real-time information exchange mechanisms should allow continuous close communication between the different operational support staff members
  - Prediction of food, ammunition and POL (Petroleum, Oil, Lubricants) should be produced automatically based on upcoming events
  - Pattern detection of over use or under use of supplies.
- To support clarification of support request:
  - Improved awareness of the requesting authority's goals and objectives as well as his current operational state
  - Identification of alternate options for operational supply
  - Search functionalities to narrow down acceptable capabilities
- To support feasibility of operational support request
  - Real-time information about date, time and location of operational support supply
  - Search functionalities considering real-time information about date, time and location of operational support supply
  - Automated identification of transportation options
  - Functionalities for the assessment of supply transport times considering packing, loading, unloading

Details about analysis of the data collected can be found in [13] and [14].

3.3 Coalition Warrior Interoperability Demonstration (CWID)

The Coalition Warrior Interoperability Demonstration (CWID) is an annual event that assesses technologies geared to solving current operational challenges focused on Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) in a coalition environment [22]. The NATO counterpart to CWID is the NATO Coalition Warrior Interoperability eXploration, eXperimentation, eXamination eXercise (CWIX) which takes place

at the same time. CWID 2011 and NATO CWIX 2011 together engaged 20 countries and seven NATO commands, including different military services and Other Government Departments (OGD) in a single experimentation network using both a domestic homeland security scenario and a traditional military expeditionary scenario. Among the 37 Coalition interoperability trials conducted in CWID 2011, nine were from Canada. One of them, called The Coalition Portal for Situational-Awareness (C-PORTS) trial, was sponsored by CoROSP to demonstrate "near-real-time" access to and management of disparate sources of geo-referenced data and services via Compusult's underlying Web Entreprise Suite (WES) technology and its advanced Web-based geoportal interface.

C-PORTS operated on 5 different sites (US and Canadian). While the trial has not been executed as planned due to issues outside the C-PORTS area of influence (ex. continuous US network outages and lack of data feeds) [22], C-PORTS demonstrated interesting technical/interoperability such as data accessed from various simulated sensors and sources (ex. Global Command and Control System - Joint (GCCS-J) and the Satellite Simulator), compatibility with standard web browsers, creation of geospatial overlays onto various map clients (ex: WES Analyst, Google Earth, Google Maps, and Bing Maps). Furthermore, it is interesting to notice the following warfighter/observers' observations [23]:

- The ability to import live services and combine them with static data helps expand the SA picture over current products
- C-PORTS provides an operator with the advantage of combining the capabilities of several different C2 applications currently used by the CF and does so with a shallow learning curve.

While C-PORTS has some strong features, user interface processes would require refinement/improvement to increase operator popularity of the tool. This experiment confirms that the flexibility of adapting the interface on-the-spot is key to users' acceptance.

3.4 MTTF COP

MTTF COP is based on the information management platform SharePoint 2007, Enterprise. Following a request from the Brigadier-General Lamarre (chief of CF in Afghanistan) to assess MTTF COP, the CoROSP team developed a questionnaire to assess the utility of the MTTF COP as a tool to support future CANOSCOM Operational Support missions, from a tactical (in theatre) point of view. Interviews and the questionnaire administration were planned to be conducted in field. The objective of the interviews was to capture user assessment of MTTF COP in their tasks. The results of the analysis of MTTF COP can be found in [15].

MTTF COP has been assessed as a good information management tool supporting a deployed commander conducting a deliberate mission closure operation. From the integration of multiple information sources perspective, the tool has not been tested to accept real-time or non-real-time data from other systems. For example, information from NMDS had to be transfer manually into MTTF COP. From the information management perspective, MTTF COP has demonstrated functionalities to access, modify and disseminate operation support information. Furthermore, it provides easy customizable functionalities to present the information considering the preferences of the Commander. Report generation capabilities have not been demonstrated. From the

decision support perspective, MTTF COP has not demonstrated any functionality, other than visualizing the results of analysis executed in other tools such as Excel. From the visualization perspective, MTTF COP was only displaying graphs or charts produced by other tools. No geospatial capabilities were demonstrated. From the collaboration perspective, MTTF COP provided effective collaboration functionalities on data entry and review through the suite of tools provided by SharePoint. So, globally, MTTF COP provided satisfying functionalities. However, primary capabilities are missing in terms of geospatial mapping as well as decision support functionalities.

Specific shortcomings from a ROSP perspective were identified [15] as:

- The capability to obtain and aggregate relevant sensor products (e.g. maintenance sensors, consumption data, convoy tracks, consignment and asset tracking data) in near-real time – (I);
- The ability to evaluate and compare courses of action (COA) for Operational Plan validation from an OS perspective – (DS);
- The ability to control, monitor and adapt, as required, the execution of the Operational Plan, in particular the OS portions of the plan – (I, IM, DS);
- The ability to identify and capture OS focused lessons learned at all phases of operations – (IM);
- The ability to discover and institutionalize lessons learned from current and/or previous similar operations, both in terms of capability and environment, applicable to issues resolution and/or operational planning scenarios – (IM);
- The ability to fuse and analyze operational support transactional information/data from multiple sources, including Departmental Enterprise Resource Planning (ERP) systems and other official information sources of record, to determine the current status, predict an eventual or determine the potential causes leading to a situation – (I, IM);
- Efficient processes and tools for the determination of resource requirements to operational tasks – (I, IM);
- Efficient and shared resource management processes and tools for the identification, allocation and management of resources, including taskings, personnel, equipment and facilities, to operational tasks, e.g. Tables of Organizations and Equipment (TO&E), contingency plan data, deployment plans, transportation routing, maintenance status and schedule data – (I, IM, DS);
- Sufficient and effective ability to quickly detect, react to, control and monitor significant resource utilization/demand fluctuations caused by activity changes, consumption surges and attrition – (I, DS, V);
- Incidents, threats and vulnerabilities identification, promulgation, resolution management and monitoring tools – (I, IM, DS, V, C);
- Electronic tools to support, as a minimum, COA, geospatial and timeline analysis – (DS, V);
- Where appropriate, the capability to process and disseminate OS data, information and products location-referenced to a geospatial environment – (IM, V);

- The capability to discover, access, disseminate and/or share specific OS data sets/products at all security classification levels and/or caveats – (I, IM, C);
- It is essential that the ROSP capability, while not dependent on the Battlespace Management Capability to be delivered by JIIFC, integrates with the DND/CF Battlespace Management Capability – (I, DS, C).

3.5 Discussion

Based on the requirements identified in Section 2 and the deficiencies identified in Section 3, an initial list of capability concepts to be demonstrated in the CoROSP project have been identified [9]. They are:

- For Integration of Multiple Information Sources (I):
  - Single point of access
    - There is only one point of access to any information required for operational support operations.
  - Transparent data access
    - End user should have access to any information required for operational support operations without any awareness of the individual DND ERP systems where the data reside.
  - Access to structure as well as unstructured information
- For Operational Support Information Management (IM)
  - Easy information search
    - End user should easily search for any information required for operational support operations, no matter if it stores in a structure or an unstructured way.
  - Efficient information retrieval
    - Result of a search should be provided to the end user in a timely manner.
  - Interoperability
    - Information can be exchanged amongst systems (military or non-military, national or international)
- For Decision Support (DS)
  - Analysis functionalities
    - Asset readiness should be uniform from strategic to operational to tactical perspectives
    - Estimation of current operational support option status should be provided to decision-makers
    - Risk analysis of operational support plans should be provided

        - End user should be able to do what-if analysis in order to identify appropriate operational support options
    - Forecasting functionalities
        - Estimation of future asset status, location, quantities should be identified considering the evolution of the situation as well as existing operational plans
    - Monitoring functionalities
        - End user should be notified of any deviation of operational support plan
        - End user should be notified of asset over-used or under-used
        - End user should be able to identify the event associated with notification mechanisms
- For Visualization (V)
    - Tailored personalized near real-time view of any information required for operational support operations should be provided to the end user
    - Visual representation of the information (textual, charts, graphical, geospatial, overlays) should be available to the end user
    - Customized production of reports should be automated
    - Customized view summarizing all the information required to develop a good awareness of the operational support situation should always be available
- Collaboration (C)
    - Different communities can be defined for different needs
    - Information can be shared amongst one of multiple communities
    - Specific display of information can be shared amongst one of multiple communities
    - Outputs can be shared amongst one of multiple communities

4 Review of Relevant Technologies

A state-of-the-art review has been conducted by the Canada Institute for Scientific and Technical Information (CISTI) from National Research Council (NRC), surveying existing and available similar systems and operational support picture frameworks anywhere in the world. More than 1700 scientific publications were analysed based on text analysis and the co-occurrence of words in the metadata of the documents, to identify important research fronts in the domain of military logistics, with emphasis on decision support, predictive analytics, search and retrieval, visual analytics and user interfaces [18]. Several large global firms such as SAP, Lockheed Martin, IBM, and Oracle control the majority of market share and it appears that many logistics systems developed for commercial markets are being adapted for military purposes since these Commercial of the Shelf (COTS) solutions do not often have the full functionality required by military applications.

The data clearly show that decision making, decision support tools and predictive analytics are significant research thrusts within this domain, and that modeling and simulation techniques and tools are key enabling technologies in this area. On the visualization side, key enabling technologies are geographic information systems and mapping capabilities to show assets in transit as well as battle space visualizations within a geographic context

A set of commercial systems were reviewed [19] for their capabilities. These systems are:

- Commercial Systems:
  - SAP: NetWeaver, Business Objects, Supply Chain Management (SCM), Sybase
  - IBM: Cognos, WebSphere, InfoSphere, Sterling
  - Oracle: SOA Suite, Data Integrator Suite, Business Intelligence Suite, WebLogic, CEP Suite, Supply Chain Management, Essbase, Hyperion, Crystal Ball, Map Viewer
- Military Systems:
  - Mincom: Ellipse, Critical Inventory Optimization
  - Miro: GoldESP
- Specialized Systems
    - Sitscape (Specialized in Visualisation and Collaboration)
    - FasseTrak
    - Metatomix MetaStudio (Specialized in Information Integration)

This initial assessment allowed the level of maturity of required ROSP functionalities to be identified.

Very Mature:

- analysis (asset readiness, identification of trends, statistics, what-if analysis)

- history, rollback and traceability
- standard forecasting techniques
- integration of business processes
- integration of legacy databases
- Graphic User Interface (GUI) and Graphic Information System (GIS): merging including visualization with drill-down functionalities (and dashboards and watchboards)

Mature:

- Hardware/ software for monitoring including SCADA systems
- Inventory management
- Distribution/ transportation network performance monitoring (travel times, delays, repairs)
- MRO (maintenance, repair, and overhaul)

Immature:

- Forecasting for military operations and logistics (expert input, Course of Action (COA), qualitative forecasting)
- Operations management:
    - Dynamic distribution management
    - Dynamic routing and scheduling
    - Forecasting demand → proactive order planning → inventory replenishment scheduling (some aspects exist at MRO systems)
    - Integration with real-time feeds (updates) or near-real-time feeds of
        - Legacy systems/ databases
        - External systems
        - Monitoring/ SCADA systems

Furthermore, a similar exercise has been conducted on the open source domain [21]. A subset of open source tools has been further investigated and identified having the capabilities to provide functionalities of interest for the context of a ROSP. These tools, described in [21], are:

- Data access – Teiid
- Information integration – Teiid and Drools
- Visualization – Jaspersoft and Pentaho
- Collaboration (limited) – Drools
- Forecasting (limited) – SimPy and SphinxSD
- Analysis (what-if, risk) – SimPy and SphinxSD, and BI (Jaspersoft and Pentaho)

These open systems appear to be very promising in term of capabilities for data access, integration, visualization, collaboration. Functionalities such as decision trees, Bayesian networks, Monte-Carlo simulation, system dynamics, neural networks and the Dempster-Shaffer theory of evidence can be used for decision support functionalities of analysis and forecasting but it would require significant effort to adapt them to support ROSP requirements.

As mentioned previously, a lot of work has been done related to visualisation of information for a panoply of applications. Mode of visualisation include using different hardware or technologies such as 3 dimensions, augmented reality, desktop workstation, flexible displays, head-mounted displays, holographic presence, immersive displays, large group displays (Wall displays), Multimodal interface, multiple screens, personal digital assistant, portable computer, smartphone, tabletop systems, tablet PC, and virtual reality. A review of the strengths and weaknesses of each mode has been documented in [25] . Subsequently a list of existing visualization tools has been identified to support the presentation of:

- data related to resources, assets, infrastructure, task, mission and operations,
- information which is the result of data aggregation/fusion
- tools for analysis, such as what-if, forecasting, etc.
- monitoring of plans, mission or operations from different perspectives
- adaptive user's tailored visualisation

In parallel to the studies identified earlier, a 2-day workshop (20-21 September 2010) was conducted in Valcartier to discuss current and past R&D activities that were related to operational support. This workshop (Annex B) involved scientists from the different labs (DRDC Valcartier, CORA, DRDC Ottawa, DRDC Atlantic). From this workshop a subset of prototypes, in the areas considered not as mature as commercial tools, were identified as relevant to the TDP.

Based on the results of these initial studies, a list of potential tools to be considered for the demonstration was identified, taking into consideration the following aspects:

- For ROSP requirements that have been considered matured, consider commercial tools that DND have bought licences
- For ROSP requirements that have been considered immature, consider prototypes owned or easily accessible by DRDC
- Open source technologies providing some of the ROSP functionalities should be considered next
- Commercial tools providing some of the ROSP functionalities but for which DND does not have licences should be considered last

Based on the knowledge that has been developed on the functionalities provided by commercial, open source and prototypes, and considering the previous guidelines, the CoROSP team has made the following selection:

- For Integration of Multiple Information Sources (I):
  - Single point of access: ISCoE/Informatica

- Transparent data access : ISCoE/Informatica
- Access to structure as well as unstructured information: Autonomy

- For Operational Support Information Management (IM)
  - Easy information search : Autonomy
  - Efficient information retrieval : Autonomy
  - Interoperability : MDE
- For Decision Support (DS)
  - Analysis functionalities : ISCoE/BI, Endeca Latitude, SAP, Digital Cockpit, Risk management tool from COPlanS
  - Forecasting functionalities : TRV
  - Monitoring functionalities: EMPA
- For Visualization (V)
  - Tailored personalized near real-time view of any information required for operational support operations should be provided to the end user: Endeca
  - Visual representation of the information (textual, charts, graphical, geospatial, overlays) should be available to the end user: Endeca, EMPA, TRV
  - Customized production of reports should be automated : Endeca, COPlanS automated generation of reports/briefings
  - Customized view summarizing all the information required to develop a good awareness of the operational support situation should always be available: Endeca, Digital Cockpit, CHESS
- For Collaboration (C)
  - ISCoE reference architecture, Advanced Command Portal

While these choices do not cover all the requirements that have been identified in the SOCD, they would demonstrate a good potential for ROSP. The following section contains a short description of these systems/prototypes:

4.1 Information Sharing Centre of Excellence (ISCoE) reference architecture

Information Sharing Centre of Excellence (ISCoE) should provide organizational information technology governance within the Department of National Defence (DND), to ensure the integrity and effectiveness of the organization's architectures. Key objectives of this architecture are to provide information sharing capability and services to the enterprise that:

- Sustains and expands core reusable information sharing infrastructure;
- Builds integration & sharing solutions for new and existing information systems;

- Provides a development team capable of undertaking selected data, information and application integration activities and projects within the Department.

In line with those objectives, ISCoE proposed a Reference Architecture that:

- Provides a foundation of generic services and functions;
- Defines the list of standards and specifications to be observed

An analysis of the ISCoE reference architecture [16] has identified that, considering that it is based on open standard, this architecture is flexible enough to support the CoROSP TDP architecture.

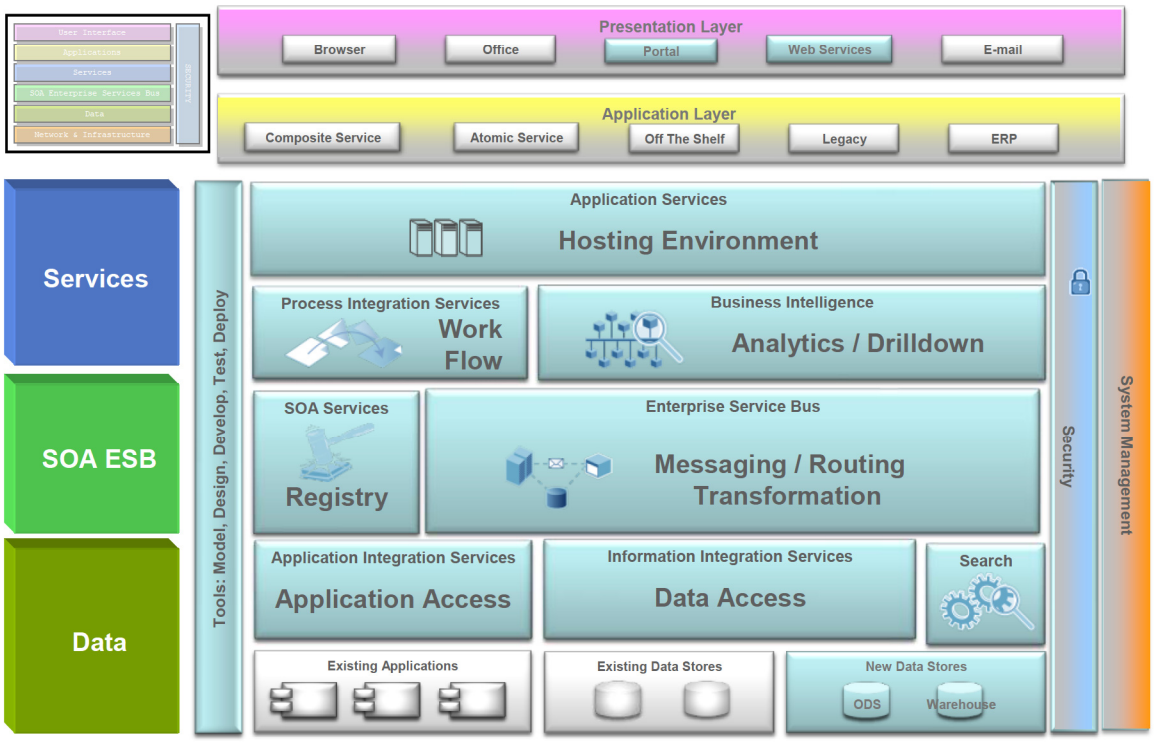

Figure 1: ISCoE architecture.

4.2 Informatica PowerCenter Standard Edition tool

An important building block of ISCoE architecture responsibility is to provide data warehouse management capability. A key function of this activity is to store enterprise strategic data for subsequent analysis. This work is commonly supported by an Extract, Transform and Load (ETL) process. ADM (IM) has selected Informatica Power Center to perform this task.

The analysis made of the PowerCenter Standard tool suite [16] demonstrated a very strong ability to provide ETL capability. Accordingly, it is recommended that these functionalities be exploited for the CoROSP TDP.

Notice that while the Informatica whitepaper mentions that some of the Informatica tools allow data virtualization capability and real-time processing, these capabilities are not part of the version currently acquired by ADM (IM). This is an aspect that will have to be further investigated.

4.3 ISCOE Business Intelligence tool

ISCOE was in the process of selecting a business intelligence (BI) tool that would be part of the information sharing environment. However, at the time of the front end analysis, the name of the tool selected was not made public. It would be worthwhile to assess this tool before any implementation of a CoROSP testbed.

4.4 SAP

In their ERP strategy for the future, ADM(IM) foresee that there will be only 2 ERPs [17]: SAP and PeopleSoft. Defence Resource Management Information System (DRMIS) has already initiated activities to integrate all systems related to material, I&E and finance using SAP. PeopleSoft will handle all information about human resources.

SAP, which stands for "Systems, Applications, and Products in Data Processing", has a set of solutions that would be of interest from a ROSP perspective. In addition to a set of applications supporting information access, SAP also offers tools providing decision support functionalities that would be of interest from a ROSP perspective.

- For monitoring: SAP Enterprise Resource Planning (ERP) and SAP Supply Chain Management (SCM)
- For analysis: Business Obects Analysis, NetWeaver Analysis, BusinessObjects Readiness Assessment, SAP Business Planning and Simulation (SEM-BPS), SAP Supply Network Traceability
- For forecasting: SAP Business Planning and Simulation (SEM-BPS), SAF
- For operations management: SAP Supply Chain Management (SCM)

As we can see, SAP has a wide set of functionalities that would be of interest to use. However, here again DND does not have access to all these functionalities. So it would be appropriate to look first at the ISCOE BI tool selected by DND, and, if appropriate, look at SAP functionalities that could complement them.

4.5 Endeca Latitude

The Director Capability and Structure Analysis Support (DCSAS) 5 Developmental Lab is currently building a Center of Excellence (CoE) on Endeca Latitude expertise. Endeca Latitude is

a complete platform for the agile BI of an enterprise. Analysis of Endeca Latitude [16] definitely demonstrate useful capabilities to manipulate data and metadata in a way that aids information discovery. It has highly capable graphic components to support the visualization and very flexible guided navigation. The combination of the Latitude Query Language (LQL) with the drill down and filtering capabilities provides the user with a very agile means analyze the data.

It is important to mention that Oracle has recently acquired the Endeca company and all their related tools and has renamed it Oracle Endeca Information Discovery. Considering that Oracle has its own solutions for some of the components of Endeca Latitude, like Oracle Data Integrator as ETL tool, it is natural to question the evolution of the Endeca suite and added risk in investing in the current form of the technology solution.

4.6 Total Resource Visibility Tool (TRV)

Total Resource Visibility Tool (TRV) [26],[27] is a decision support prototype developed by DRDC. It demonstrates near real-time resource visibility, offering the ability to know the identity, location, status, and condition of assets in the logistics chain at the operational level. This prototype includes:

- Application and services to support assets monitoring (identity, location, status and condition of assets)
- Analysis tools of resources employment and usage, readiness and availability
- GIS visualization
- Data sources integration services.

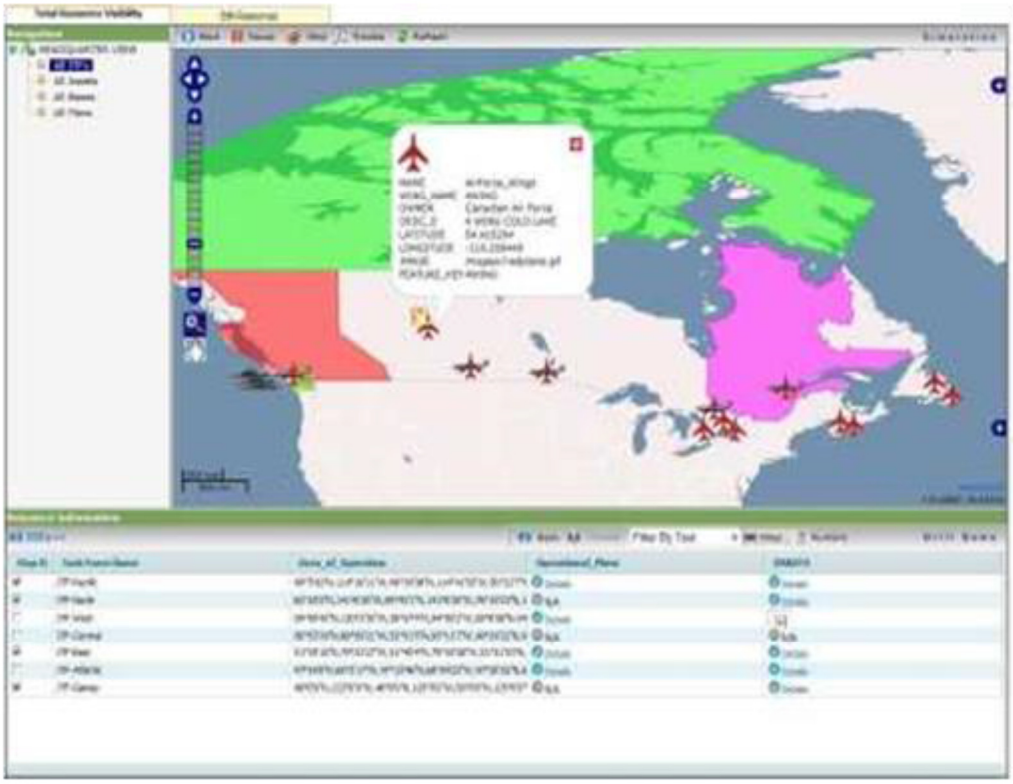

Figure 2: TRV

4.7 Execution and Operation Management (EMPA)

Execution Management and Plan Adaptation (EMPA) [28] is a prototype developed by DRDC. It demonstrates functionalities of distributed and multi-layered real-time monitoring of plan execution, automated change detection, decision aid for plan repair and continuous forecasting. This prototype includes:

- Distributed, multi-layered execution management services
- Automated execution monitoring algorithms
- Scheduler viewer tasks synchronization / assets availability / asset viewer / mission viewer
- Plan monitoring vs asset monitoring

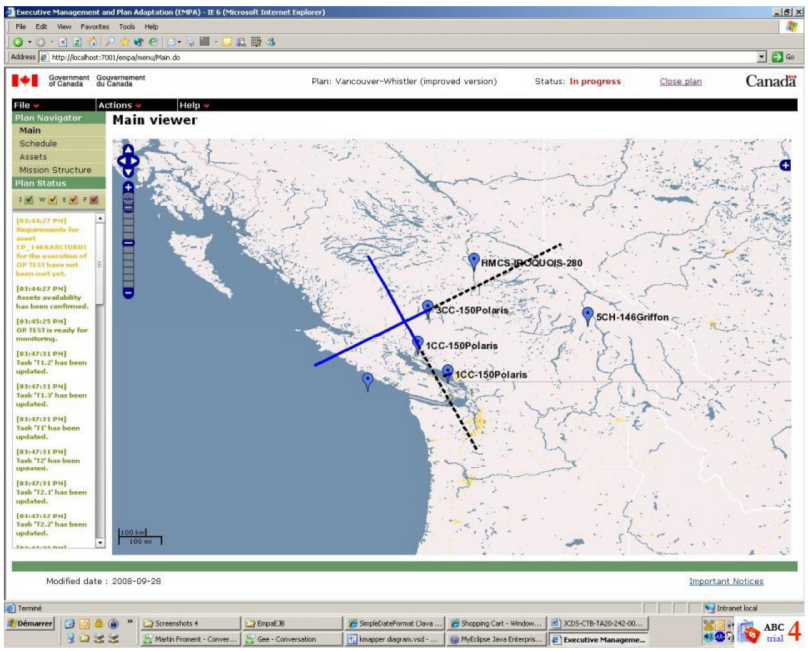

Figure 3: EMPA- main view

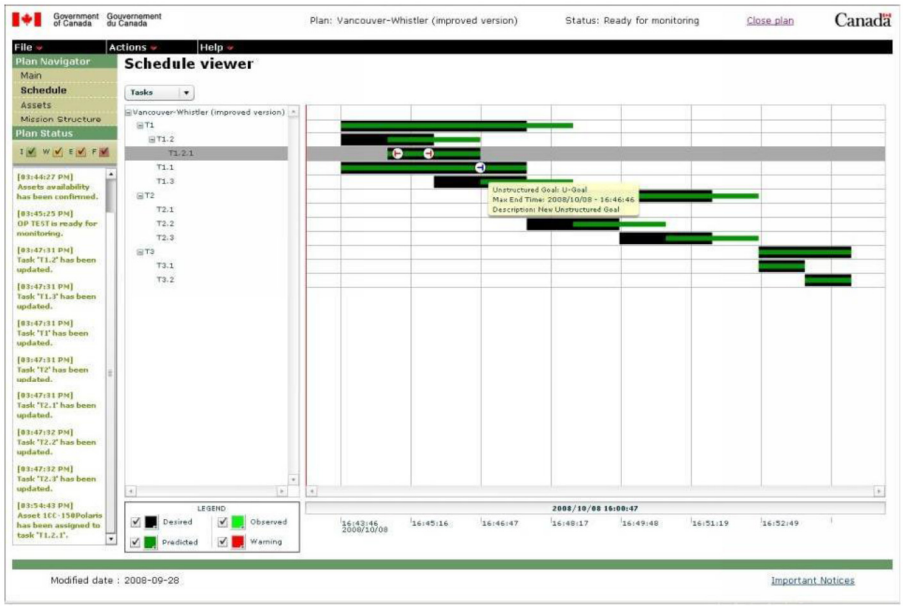

Figure 4: EMPA- schedule view

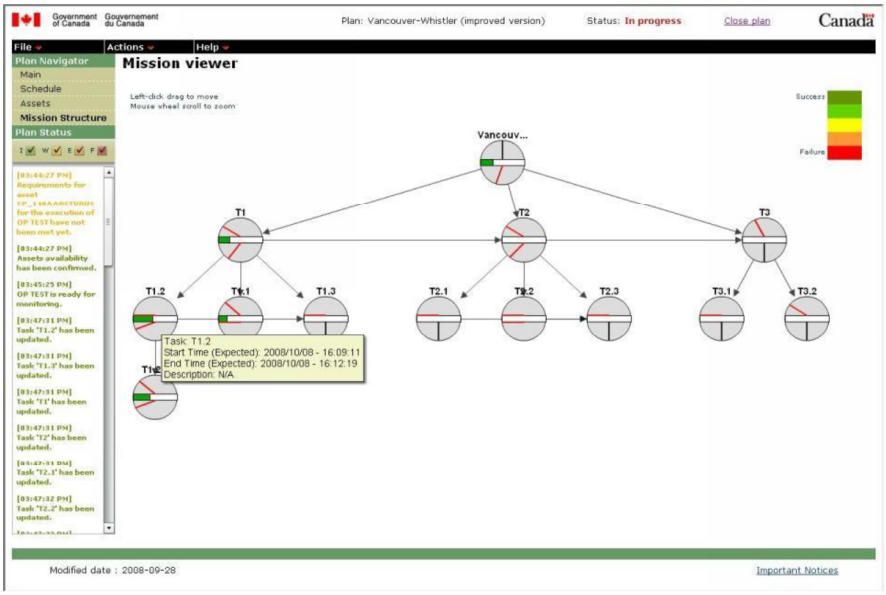

Figure 5: EMPA- mission view

4.8 Commander HandhEld Support System (CHESS)

Commander HandhEld Support System (CHESS) [31] is a prototype developed by DRDC. This prototype demonstrates real-time exchange of information with key DND systems through a wireless handheld device. It includes:

- Multi-Networks Communication
- Limited bandwidth and unstable connectivity information delivery services
- Notification and alerts
- Electronic documents management services
- Access to CommandView and Collaborative Operations Planning System (COPlanS)

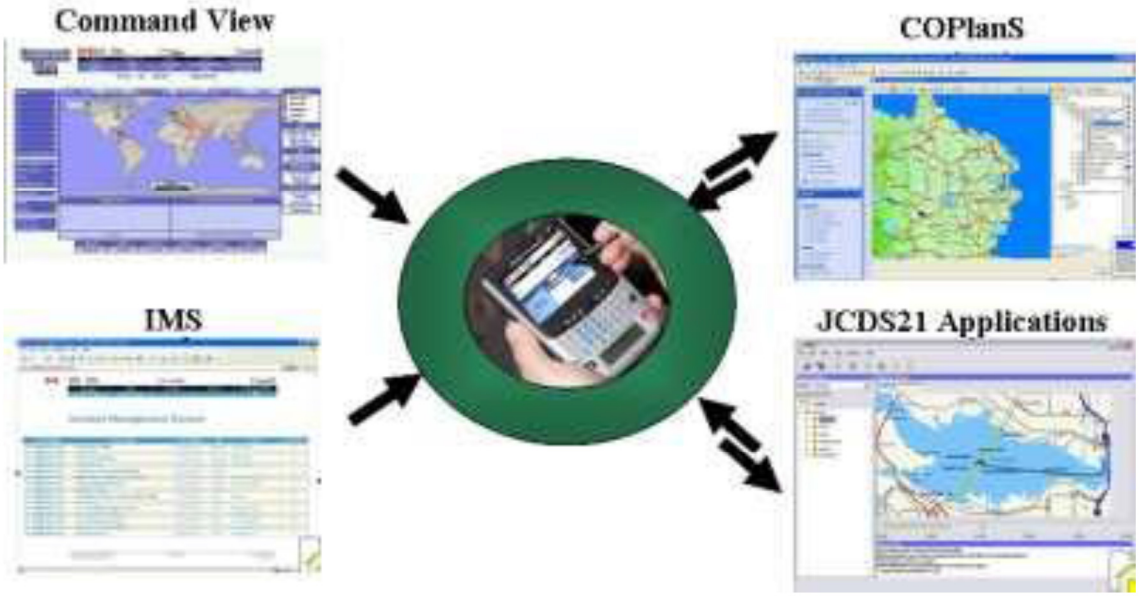

Figure 6: CHESS

4.9 Emergency Logistic Decision Support (ELDS)

Emergency Logistic Decision Support (ELDS) [29] is a DRDC prototype developed under the collaboration program of PROMPT. The intent was to investigate the optimization of resources deployment in a Logistics Network for emergency management. During an emergency, ELDS will help emergency logistic Decision Makers make better decisions. The main functionalities are:

- Critical infrastructure inventory and their capability
- Representation of the demand on a map
- Creation of the disaster area which can be subdivided in disaster zones in accordance with population concentration, damage to the area or area accessibility
- Optimisation algorithms for
- Localisation of Humanitarian Aid Distribution Centers
- Vehicle Routing Problem
- Presentation of different options with metrics for comparison
- Possibility for decision makers to adjust the proposed solutions
- Readiness Monitoring

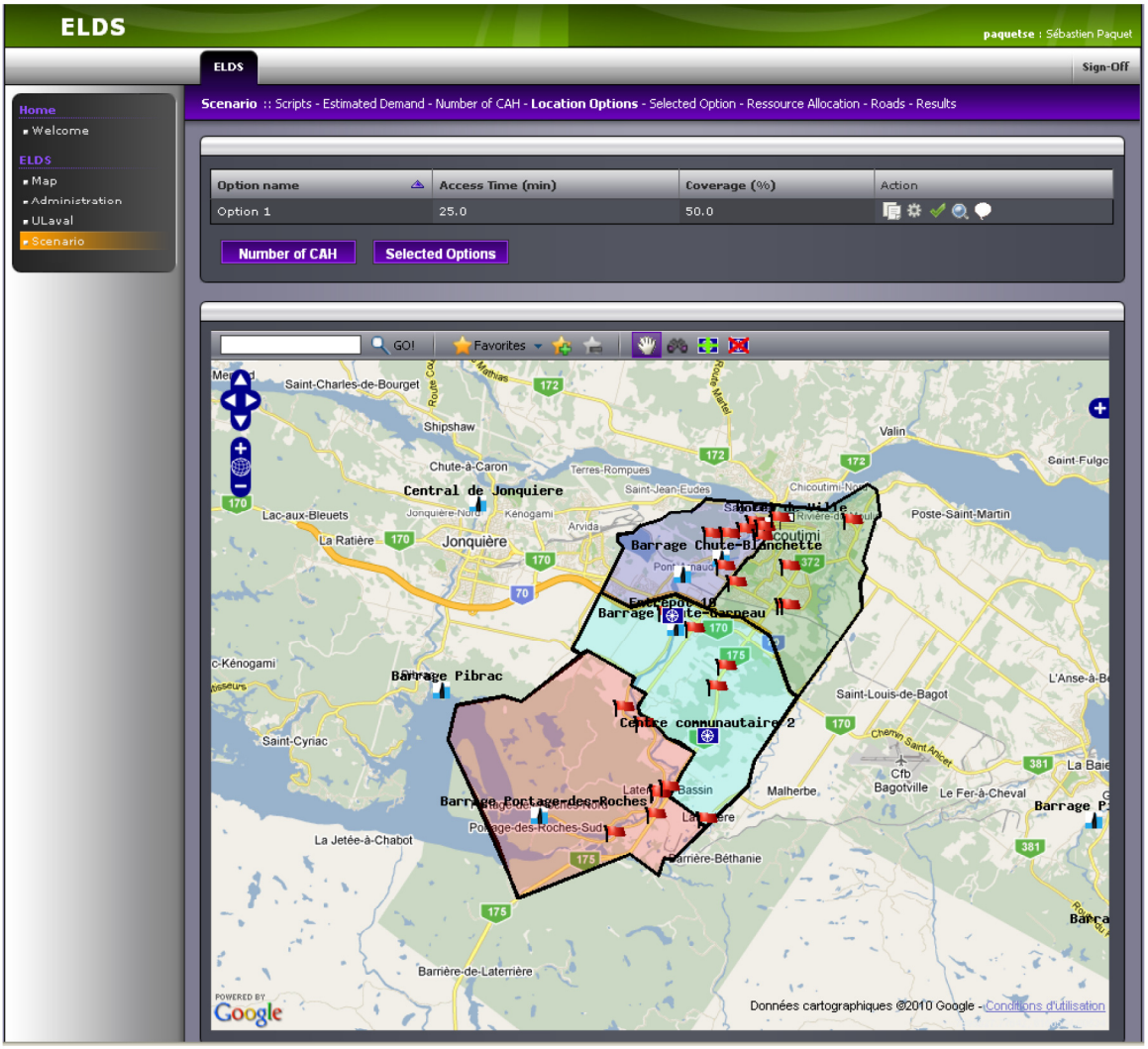

Figure 7: ELDS

4.10 Advanced Command Portal / Autonomy

Advanced Command Portal [30] is a prototype developed by DRDC. It demonstrates the foundation for a Command and Control Collaborative Environment, supporting shared situation awareness, information management, systems integration and collaborative work. The prototype includes:

- Information and Knowledge Management services
- User-centric environment based on context and user-role management
- Collaborative environment that facilitates information sharing and collaborative work

Furthermore, advanced search services were provided through the use of Autonomy.

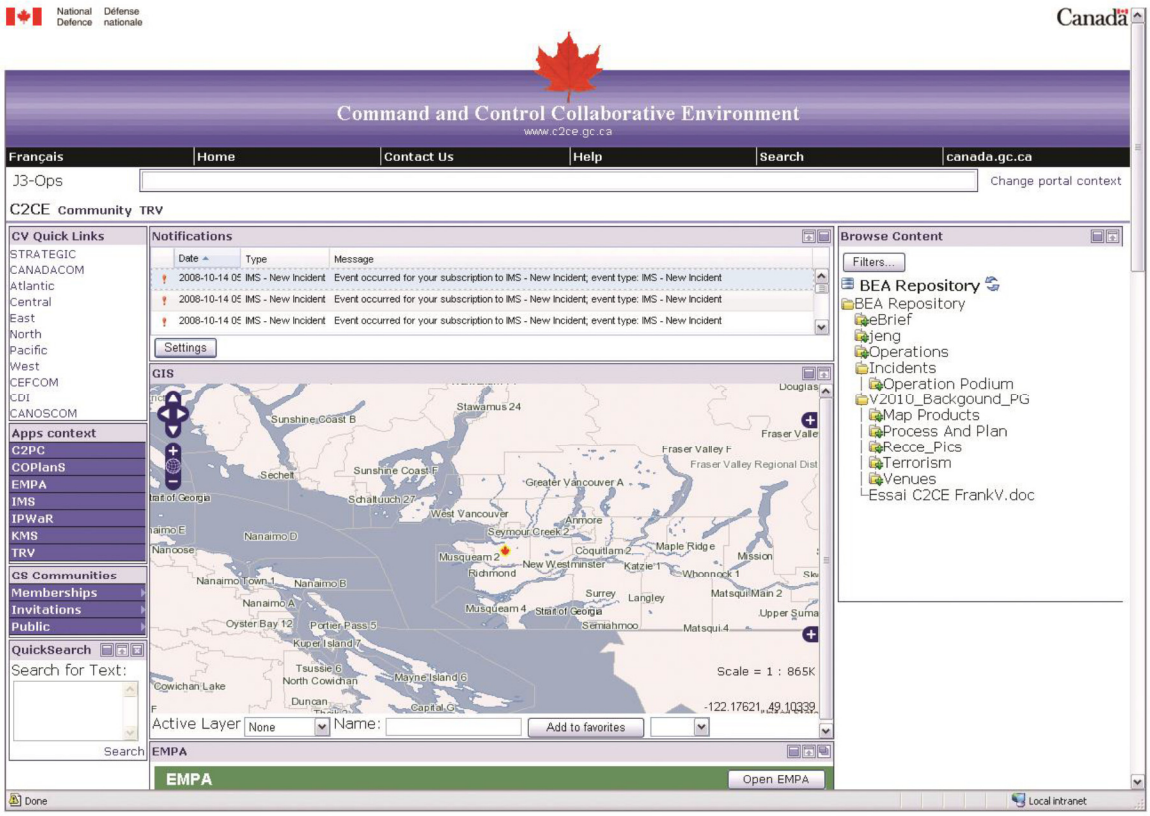

Figure 8: Advanced Command Portal

4.11 Digital Cockpit

Digital Cockpit [32] is a DRDC prototype. It demonstrates solutions to support collaboration between the intelligence, operations planning and logistics planning through scalable and customizable web-based applications integrating data from diverse DND sources. The prototype includes:

- Data integration of ADAM, Mission Management Application (MMA), Air Operations Database (AODB from TBMCS) requests
- Asset visibility for an integrated air picture
- SOA-based mission dashboard for Air Domain

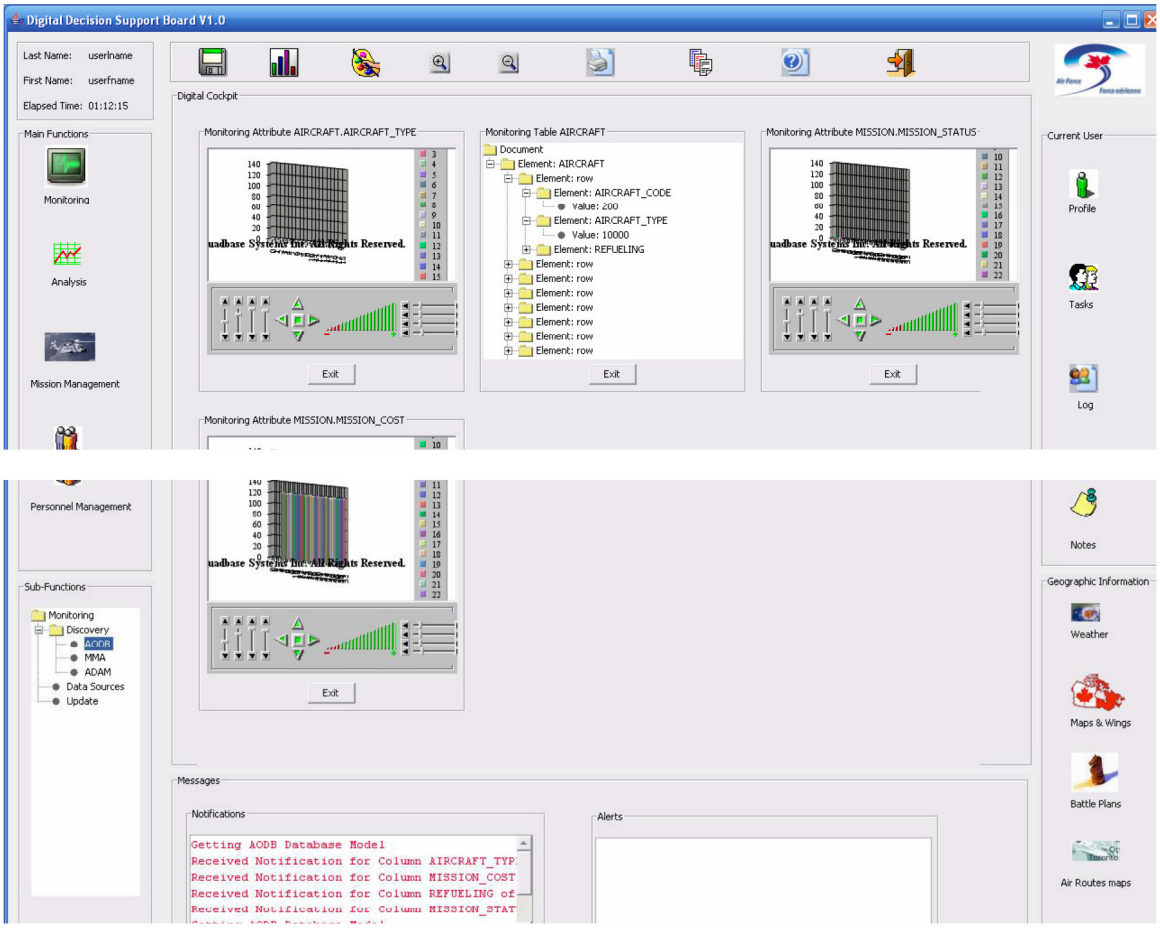

Figure 9: Digital Cockpit – Display of the monitored component in the free space

4.12 Integrated Information Dashboard – IID

Integrated Information Dashboard (IID) is a DRDC prototype. It demonstrates integration of information towards a dashboard. Providing a 'big picture' of the operations theatre and allowing visual inspection, simulation of mission related information in a network centric environment, it offers a flexible user interface allowing data sources for exploration and mission visualization on a geographic information system (GIS). The prototype includes:

- Mission Explorer: Mission explorer plug-in aims to collect, gather, consolidate and aggregate data, coming from several databases. The framework issues real-time notification to data changes subscribed by the users offering almost real-time situational awareness.
- Mission Visualization: The mission visualization plug-in takes missions described in air tasking orders (ATO) and Airspace Control Order (ACO) files, filters and projects them graphically on a Geographic Information System (GIS). Other geo-reference data sources can be displayed on top of the mission visualization as weather and airfield status.

IID Capabilities includes:

- Visual inspection, update, filtering and graphical presentation of database information in a network centric environment in a report format;
- Active connectivity with the central server from where it can retrieve and/or update mission related information stored in MMA and AODB databases (2008) / FlightPro (2009);
- Monitoring capability whereby the application is notified and updated upon any changes performed by other clients on the server databases related to the mission application;
- Geographic Information System providing an overview of mission details, etc.;
- Usage of web services for uploading/downloading mission related information in the form of ATO/ACO files;
- Usage of web service for retrieving information about the geographical location and weather patterns corresponding to the missions' legs and path-points.
-

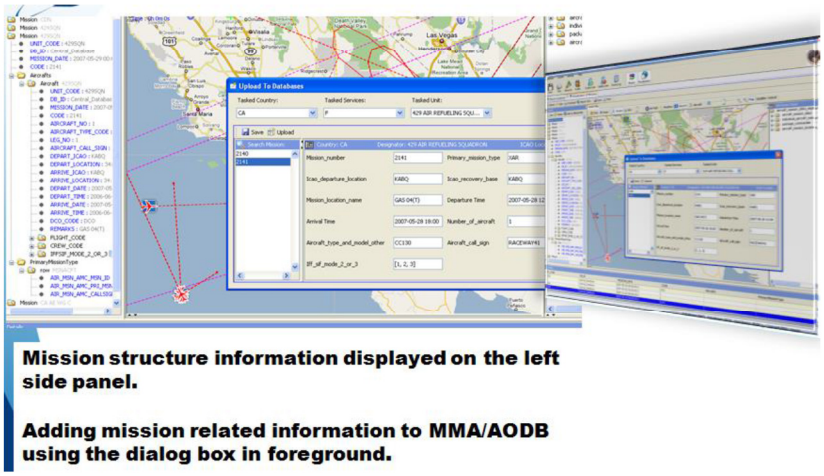

Figure 10: Display of Mission Structure by IID

4.13 Vital Planning and Analysis (VIPA)

Through The Technical Cooperation Program (TTCP) COMMAND, CONTROL, COMMUNICATIONS AND INFORMATION SYSTEMS (C3I) – Technical Panel 4 (TP4): Planning and Scheduling, CoROSP team had access to information about the Australian logistics tool suite operational level joint analysis called VIPA. While we did not have a copy of the tool for further assessment, the information we had allowed us to identify some functionalities that would be of interest from a ROSP perspective.

Through its different tools, VIPA provides information about:

- generic organisation and equipment
- Bottlenecks and associated recommendations
- Timelines of activities and phases
- Sustainment and support requirements
- Operational visibility period (OVP)
- Movement assessment for deployment and redeployment
- Estimation of Deployment loads
- Estimation of Sustainment loads
- Medical casualty estimates
- Sustainment requirements over a period of time
- "demand" required at various locations
- Provisioning stock levels at each of the locations
- Suitable frequency of resupply and Transport type
- Rough estimates of comparing a heavy OVP (late supply chain) vs a light OVP (earlier supply chain)
- Supply chain dependencies and the impact on interim stage bases
- Distribution chain assessment by identifying supply items sourced in theatre
- Feasibility assessment of a particular distribution plan and use of movement assets
- Simulation of "unavailability" of transportation assets (temporarily and for the rest of the plan)
- Assessment of bottlenecks in user's distribution plan
- Recommendations on what can be done about these vulnerabilities

5 CoROSP High–Level Concepts

As mentioned previously, the ROSP can be envisioned as providing functionalities of information access and discovery, information management, decision support and decision aids, while providing advanced visualisation and presentation mechanisms that will be adjusted to each end user based on his needs. This combination of functionalities would be in line with a user-defined operating picture approach.

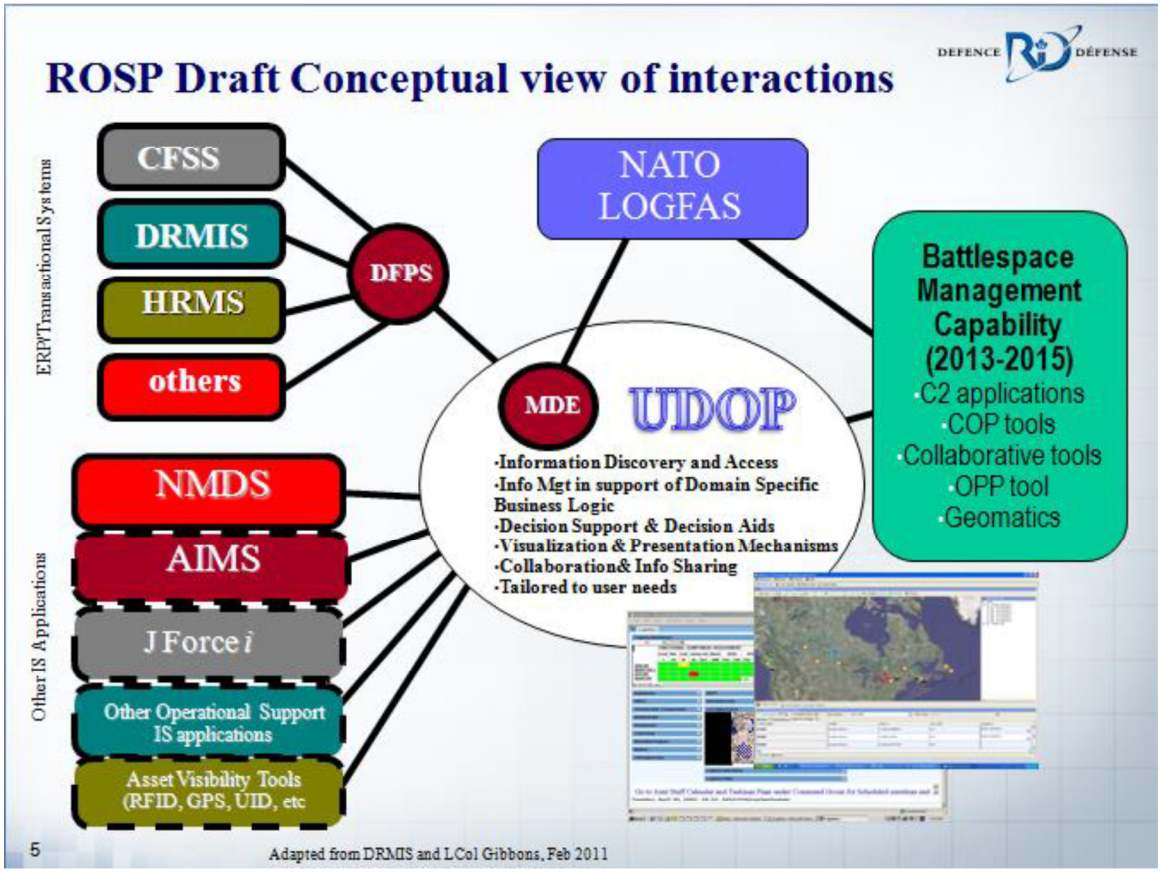

Figure 11: ROSP concept

While this capability is not currently available, it is recommended to demonstrate a ROSP capability based on User Defined Operating Picture (UDOP) approach while being linked to the COP tool being in used in the CF, i.e. Command View (CV) (Figure 11). CV is the CF Joint web-based information portal aimed at providing a single point of access to current information about the status of Canadian military operations. CV provides links to various CF organizations

and allows information to be posted and disseminated easily. The main CV tool is deployed on a Canadian classified network and displays information relevant to the Joint Staff and CF Headquarters. Variants of CV have been put in service at the operational headquarters (e.g., Maritime Forces Atlantic and Maritime Forces Pacific), with a focus on their own regional views (Eastern and Western Canada); these can be linked to the Strategic CV. An unclassified version of CV is also available on the DWAN and provides links with OGDs.

5.1 UDOP

As stated by Mulgund and Landsman (2007): "the purpose of the UDOP capability is to create, visualize, and share decision-focused views of the operational environment for decision-makers to support accurate situation awareness and timely decision-making in a distributed net-centric C2 environment."

A Workshop on "User Defined Operating Picture" was conducted in Valcartier, Québec, Canada from 8-10 February 2012 (Annex E). The workshop brought together Canadian military stakeholders and scientists with expertise in information management, military intelligence, decision support and logistics, to identify different requirements to support the concepts of a UDOP. The results of this workshop contributed to the categorization of different UDOP implementations and the specification of the required UDOP services.

The main outcomes from the workshop were the following [24]:

- Refinement of UDOP pillars. The proposed refined UDOP pillars as presented in Figure 12 were agreed to by the workshop participants.
- UDOP: a tool for a large audience. A UDOP is intended to be used by a large community (not only specialists). Accordingly, the system must be user friendly and intuitive otherwise it will not be used.
- Information discovery. Customizable crawlers should facilitate information discovery. Such tools should consider users' profiles to determine relevant information (removing noise and using reliability of information sources based on users' preferences). Furthermore, intelligent searches should look for similarities that make sense to the user based on the tasks that need to be done.
- Learning capabilities. Capability of learning user's information access and manipulation processes should allow automated reproduction of sequences of UDOP commands as required. Accordingly, required end products can easily be reproduced.
- Information fusion. Information fusion within a UDOP should only tackle information integration. More advanced functionalities of information fusion should be handled by specialized tools.
- Authoritative sources. Information management should be tightly coupled with the notion of authoritative sources.
- Adaptive visualization approaches. The UDOP should provide capabilities to automatically select visualization approaches based on the type of information to be presented and based on the user's profile. This would also include automated adaptation of transformations.

- Social networking approach. The UDOP should support up-to-date communities of interest tools such as Facebook.
- Interactive briefing. The UDOP should allow briefing from the information environment using dynamic and interactive approaches such as storytelling. This requires a paradigm shift from "work to brief" to "briefing work".
- User's profile. Users' models need to include information about users' expertise, roles/tasks, context of execution as well as users' preferences. Users' preferences (in terms of human system interaction, reliability of sources of information, measures of similarities) should be set manually or learned based on previous use of the tool by the user. This concept will require strong governance.

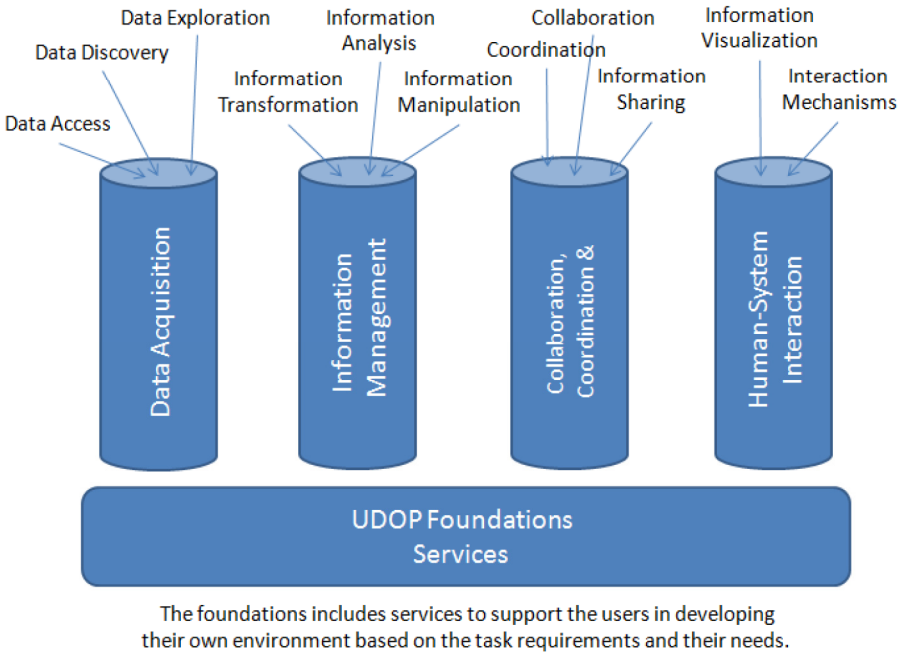

Figure 12: UDOP pillars

5.2 CoROSP testbed high level architecture

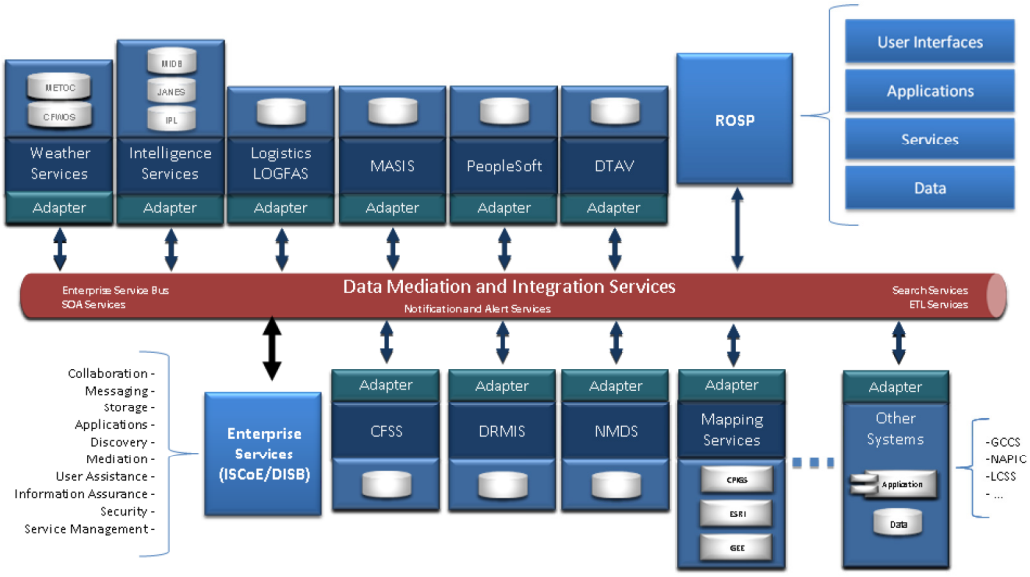

Figure 13: Possible integration of ROSP into ISCoE architecture.

While it is expected that ISCoE architecture could support the majority of the functionalities required to perform the tasks that may be related to scenarios of ROSP, a few potential issues require further investigation [33]:

- Classified and Unclassified information synchronization;
- Enterprise Service Bus adds configuration and maintenance overhead;
- Enterprise Service Bus can diminish the network responsiveness and slow down the processes;
- High dependency on the network quality of service;
- No specific solution to integrate information from other agencies, industry or nations information systems.

Based on the ISCoE target architecture, the ROSP solution should be designed as a system exploiting existing ISCoE services and components, like Informatica PowerCenter and BI/Analytics tools chosen by DND, and offering a new range of services covering the operational support domain, such as unique graphical components and advanced decision-aid services, to the enterprise (Figure 13). Promoting services and components reusability as well as information sharing is key to this new approach. Accordingly, the ROSP integration, as illustrated by Figure 14, should take advantage of the Enterprise Service Bus to access enterprise operational system data and services but also to share its own data, services and graphical components with the entire enterprise. It is also envisioned that ROSP information layer should be considered as an additional information layer for other systems like Command View and CPOF.

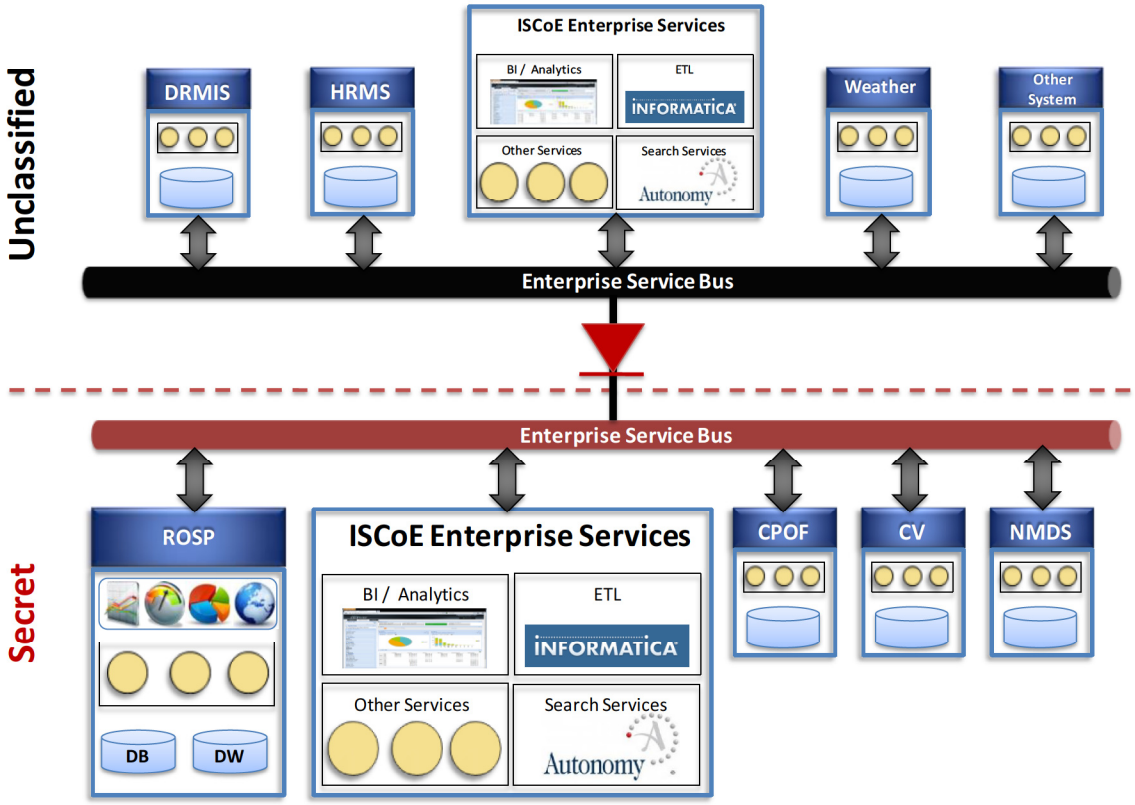

Figure 14: ROSP Operational System View

Accordingly, it is proposed that CoROSP testbed architecture [16] leverages the ISCOE architecture as described in the Figure 15. It is recommended to assume that all sources of information reside on the same level of security, i.e. secret. This would permit effort to be invested in demonstrating the CoROSP functionalities instead of solving the multi-level security problems, which should be solved by other DND initiatives. For example, it is expected that projects like DRMIS will allow the flow of information from a network of lower-level of security to higher-level network using Informatica PowerCenter ETL through a data diode as proposed by ISCoE architecture.

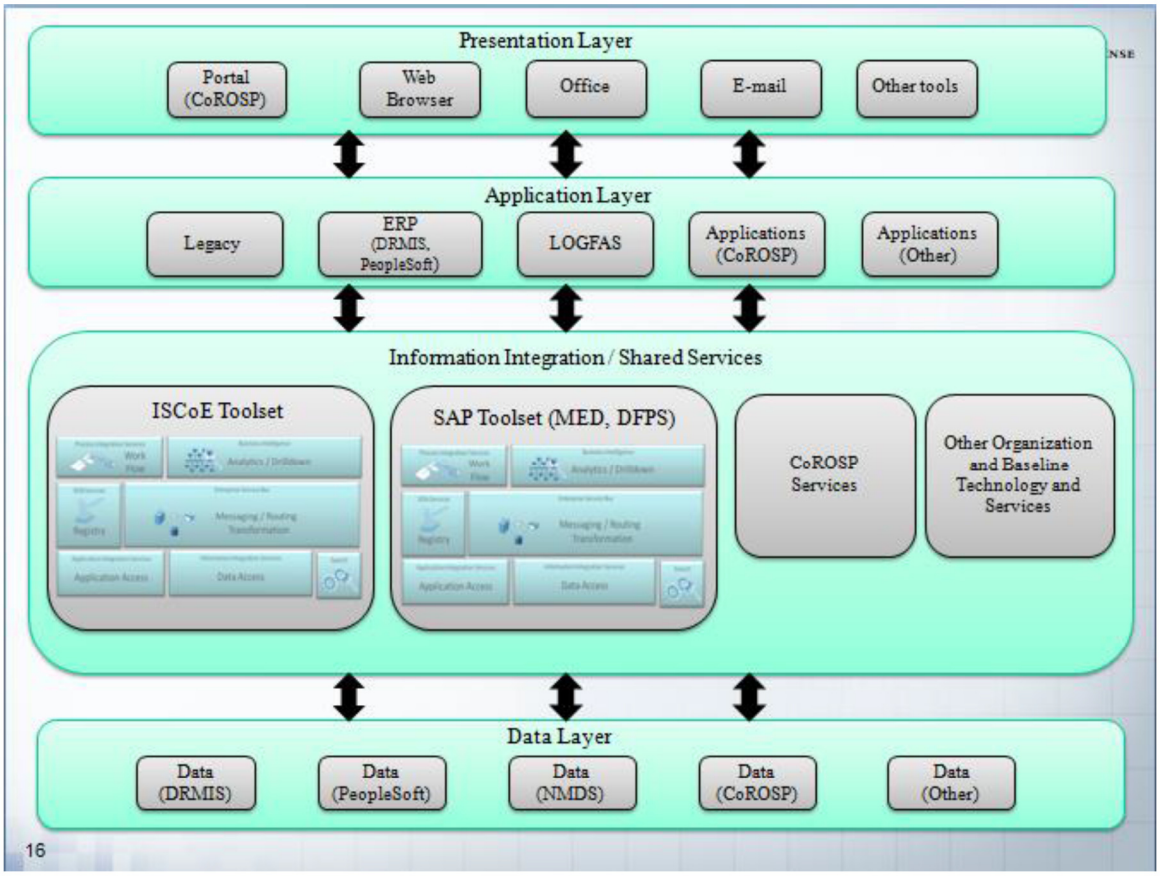

Figure 15: CoROSP testbed architecture

6 Conclusion

This document summarizes the results of the work executed to develop a sound understanding of the requirements associated with the use of a ROSP as well as existing tools/technologies/framework that can provide support to the development of operational support awareness. Considering that a core aspect of this TDP is to demonstrate the integration of a wide range of distributed information sources, a net-centric information sharing and decision support environment based on service-oriented architecture (SOA) is proposed. To assist commanders and staff in decision making, this environment will allow to the demonstration of key transactional data functions such as data/information query, filtering/abstraction, extraction/retrieval, search/navigation (guided/free), fusion and management of uncertainty information resulting from information integration.

Furthermore, this environment could support the demonstration of decision support functions and capabilities enhancing operation support situational awareness of past, current and future operations through the exploitation of integrated information sources. Some analysis functionalities supporting the understanding of operation support domain awareness such as readiness analysis, cost estimate, risk analysis, what-if analysis, and identification of trends should be considered for demonstration as well as concepts of asset monitoring, resource state projection given current plan, planned and potential future courses of action, and plan deviation detection.

To fulfill the overall objective of the TDP to assist commanders and staff in decision making, particular effort will be required to address information that supports different user's specific needs. A user-defined operating picture approach should therefore be considered.

Twenty-three published documents describe different aspects of the front end analysis. The list of these documents can be found in the bibliography. Some are intended to improve understanding of ROSP requirements and deficiencies while others look at existing technologies and how they could be applied to the concept of ROSP.

References

[1] The Integrated Capstone Concept, VCDS/CFD, 30 June 2009

[2] Chief of Force Development, Capability Domain Concept: Sustain Capability Domain, draft version 3.4, 22 Jan 2008

[3] Business Solutions, Recognized Operational Support Picture – High Level Joint Requirement Definition (Task 1 Report), 26 November 2010

[4] CANOSCOM, Canadian Operational Support Command Concept of Operations, 1 February 2006

[5] CF Joint Publication 01 Canadian Military Doctrine, dated April 2009

[6] JIIFC, Integrated Joint Battlespace Management capability – Operational Requirements

[7] Race, P., Appleton, A., Analysis of Operational Support Lessons Learned, DRDC Valcartier CR 2011-246, September 2011.

[8] CANOSCOM, Recognized Operational Support Picture Statement of Capability Deficiency, version 2.1, December 2011

[9] Berger, J., Bélanger, M., Allouche, M., Breton, R., Concepts for a Recognized Operational Support Picture (CoROSP) – Preliminary Gap Analysis, TM, Date, 42 pages, (2012). (under publication process)

[10] Allen, D. and Lichacz, F. (2010), Joint Fires Support Human Factor Experiment 1 – Analysis Report (U), (DRDC CORA TR 2010-004) Defence R&D Canada – CORA

[11] Allen, D. et al. (2011), Joint Fires Support Human Factors Experiment 2: Final Analysis Report (U), (DRDC CORA) Defence R&D Canada – CORA

[12] Allen, D. et al. (2011), Joint Fires Support HF3/CAGE Experiment: Final Analysis Report (U), (DRDC CORA) Defence R&D Canada – CORA

[13] Allen, D., Hill, A., Breton, R., Jeffrey, A., & Lichacz, F. Initial Analysis of Human Factors 4 Experiment. Defence Research and Development Canada-CORA, DRDC TM 2011-110, July 2011, 99 pages.

[14] Rehak, L. A., CANOSCOM Human factors 4 experiment observations: SIGNIFICANT ACHIEVEMENTS and issues, Joint Fires Support Task Authorization #17, January 2011.

[15] de Boer, C. et al. , REPORT ON THE UTILITY OF THE MTTF COP TOOL FOR USE IN FUTURE OPERATIONAL SUPPORT MISSIONS, CANOSCOM document, December 2011.

[16] Pageau, N. et al., Reference Architecture Front End Analysis, DRDC Valcartier TM- (under review)

[17] ADM(IM), Defence ERP Strategy, presentation made at CoROSP workshop, 13 June 2011.

[18] Brady, B. and Keating, T., Concepts for Recognized Operational Support Picture (CoROSP) – Literature Survey, NRC – Canada Institute for Scientific and Technical Information. Survey, DRDC Valcartier CR-2011-625, March 2011

[19] Allouche, M., Boukhtouta, A., Investigation of Military and Commercial Decision Support Systems for Recognized Operational Support Picture, DRDC Valcartier

[20] Berger, J., Boukhtouta, Mitrovic-Minic, S. and Conrad J. Decision Support Capability for In-Theatre Logistics Planning and Sustain Missions – Problem Definition, UNCLASSIFIED, TM 2012-?, December 2012

[21] Mitrovic Minic, S., Thomson, D., Wang, A., Reedel, G., (2012), Investigation of Open Source and Visualization Technologies for ROSP Decision Support and Information Access and Integration, DRDC Valcartier, November 2012.

[22] Canadian CWID Project Management Team, CWID 2011 Canadian final report, November 2011.

[23] Coalition Warrior Interoperability Demonstration Joint Management Office, CWID 2011 Final Report Assessment Briefs, Hampton, VA, September 2011

[24] Gouin, D., Bélanger, M., Breton, R., Proceedings of the Workshop on User Defined Operating Picture Held at DRDC Valcartier Québec Canada (8-10 February 2012), TR-C3I-1-2012 , Québec, June 2012.

[25] Thales, State-of-the-art on Innovative Techniques and Tools in support of Planning, March 2012

[26] TrustSeer Corporation, SOFTWARE INTERFACE DESIGN DESCRIPTION (SIDD) FOR TOTAL RESOURCE VISIBILITY (TRV) PROJECT, Document control number: JCDS-CTB-310-181, W7701-5-3182, December 2008

[27] TrustSeer Corporation, SOFTWARE ARCHITECTURE DOCUMENT (SAD) FOR TOTAL RESOURCE VISIBILITY (TRV) PROJECT, JCDS-CTB-242-0166, W7701-5-3182, December 2008

[28] Allouche, M., Chow, R., Execution Management and Plan Adaptation System, DRDC Valcartier , January 2013.

[29] Fujitsu Consulting (Canada) Inc, OPTIMIZATION OF RESOURCES DEPLOYMENT IN AN EMERGENCY LOGISTICS DECISION SUPPORT (ELDS), JCDS-CTB-118-0379, December 2010.

[30] Fujitsu Consulting (Canada) Inc , SOFTWARE ARCHITECTURE DOCUMENT (SAD) FOR THE COMMAND & CONTROL COLLABORATIVE ENVIRONMENT PORTAL, JCDS-CTB-242-0256, February 2009

[31] Bélanger, M., Pageau, N., CHESS: Commander HandhEld Support System, UNCLASSIFIED, 15th International Command and Control Research and Technology Symposium (ICCRTS), Santa Monica CA, 22-24 June 2010

[32] TrustSeer Corporation, Deliverable 4: On the Integration of Web Services in the Integrated Air Picture, 2006

[33] Fujitsu (2011), Information Sharing Center of Excellence Architecture Analysis, DRDC Valcartier CR 2012-044, May 2011.

[34] Cinq-Mars, P., Open Architecture Analysis – Endeca Latitude Software Integration Analysis, DRDC Valcartier CR-, 30 April 2012

[35] Strategic Capability Roadmap 2008 version 1.0 (SCR v.1.0)

Annex A SOCD

The Recognized Operational Support Picture Statement of Capability Deficiency[8] provides the following list of 29 ROSP functional capabilities

a. The ability to provide shared OS situation awareness to the supported Command and other OS information stakeholders – (I, C);

b. The capability to present OS products (e.g. OS capability readiness reports) in forms that enable military and national decision-makers to understand the operational support environment – (IM, V);

c. The capability to share OS information with C2 systems e.g. see the JFS scenario at Annex B (DS, C);

d. The capability to obtain and aggregate relevant sensor products (e.g. maintenance sensors, consumption data, convoy tracks, consignment and asset tracking data) in near-real time – (I);

e. The capability to effectively communicate the Commanders' vision, intent, plans and orders – (I);

f. The capability to synchronize and integrate the OS activities to meet the support and sustainment requirements of national and military decision-makers – (IM, C);

g. The integration of OS factors and lessons learned for consideration into a shared collaborative planning process between the operational and support communities – (I, DS, C);

h. The ability to evaluate and compare courses of action (COA) for Operational Plan validation from an OS perspective – (DS);

i. The ability to control, monitor and adapt, as required, the execution of the Operational Plan, in particular the OS portions of the plan – (I, IM, DS);

j. The ability to identify and capture OS focused lessons learned at all phases of operations – (IM);

k. The ability to discover and institutionalize lessons learned from current and/or previous similar operations, both in terms of capability and environment, applicable to issues resolution and/or operational planning scenarios – (IM);

l. The ability to fuse and analyze operational support transactional information/data from multiple sources, including Departmental Enterprise Resource Planning (ERP) systems and other official information sources of record, to determine the current status, predict an eventual or determine the potential causes leading to a situation, e.g. see the EDD at Annex B – (I, IM);

m. The capability to synchronize and integrate the OS activities to meet the current and /or determine the feasibility of meeting future support and sustainment requirements of national and military decision-makers – (IM, DS, C);

n. Efficient processes and tools for the determination of resource requirements to operational tasks – (I, IM);

o. Efficient and shared resource management processes and tools for the identification, allocation and management of resources, including taskings, personnel, equipment and facilities, to operational tasks, e.g. Tables of Organizations and Equipment (TO&E), contingency plan data, deployment plans, transportation routing, maintenance status and schedule data – (I, IM, DS);

p. End-to-end visibility of the supply chain and distribution management systems network from production, through procurement, storage and delivery to the warfighter – (I, DS, V);

q. Visibility of resources/capabilities' (e.g. units, platforms, systems, personnel, financial, equipment maintenance, communication and computer networks, etc.) readiness status (current and projected) – (I, DS, V);

r. Sufficient and effective ability to quickly detect, react to, control and monitor significant resource utilization/demand fluctuations caused by activity changes, consumption surges and attrition – (I, DS, V);

s. Performance measurement and monitoring of the supply chain management and distribution networks, OS related contracts and other OS processes – (I, DS, V);

t. Incidents, threats and vulnerabilities identification, promulgation, resolution management and monitoring tools – (I, IM, DS, V, C);

u. A national coalition interoperable process and OS capability readiness status reporting capability, including the ability to effectively and efficiently roll up or expand (drill down) into operational support reports, e.g. section, company, unit/formation, Forward Operating Base (FOB), theatre of operations, operational or strategic levels – (I, IM, DS, V, C);

v. The capability to manage (author, publish, discover, search, and receive notification of) OS data across the enterprise such that holdings are authoritative, common and shared – (IM);

w. The capability to transform OS data and information into formats suitable for further retrieval, analysis, action and/or dissemination – (IM, DS);

x. Electronic tools to support, as a minimum, COA, geospatial and timeline analysis – (DS, V);

y. Where appropriate, the capability to process and disseminate OS data, information and products location-referenced to a geospatial environment – (IM, V);

z. The capability to discover, access, disseminate and/or share specific OS data sets/products at all security classification levels and/or caveats – (I, IM, C);

aa. The capability to extend the OS network to remote locations both domestically and deployed – I;

bb. Common to many of these capabilities is the requirement to increase automated processing of data in order to reduce the burden on manpower – (IM, DS); and

cc. It is essential that the ROSP capability, while not dependent on the Battlespace Management Capability to be delivered by JIIFC, integrates with the DND/CF Battlespace Management Capability – (I, DS, C).

Where

- I = Integration
- DS = Decision Support
- C = Collaboration
- V = Visualization
- IM = Information Management

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Annex B CoROSP Workshop Agenda

AGENDA

CoROSP Workshop

20-21 September 2010

DRDC-Valcartier, Valcartier, Quebec.

Workshop Objectives:

- Day 1 – 20 September 2010:
  1. Review DRDC projects/initiatives that CoROSP could leverage from;
  2. Discussions on leveraging on HF4
  3. Discussions on CoROSP workplan
- Day 2 – 21 September 2010:
  1. Review of R&D activities related to C2 Operational Support (separate agenda)

20 September 2010, CoROSP Workshop Day 1

TIME	SUBJECT	Speaker
08:30	Introduction/Opening Remarks	Micheline Bélanger
08:45	Plan Monitoring & Resource Availability	Mohamad Allouche
09:15	Integrated Information Dashboard – (IID)	Abdeslem Boukhtouta
09:45	EBB	Jean-Claude St-Jacques
10:15	BREAK	Cafeteria
10:45	MOE/MOP for JCDS21 (Lessons Learned)	Richard Breton
11:15	Requirement Analysis Approach used in SATAC	Richard Breton
11:45	Net-Centric Decision Support	Jean Berger
12:15	LUNCH	Cafeteria
13:30	HF 4 Update	David Allen
14:00	HF 4 Discussion	Richard Breton/ Micheline Bélanger
15:00	BREAK	Cafeteria

15:30	CoROSP Work Plan Discussions	Micheline Bélanger
16:30	Adjournment	

AGENDA

DRDC Workshop on R&D activities related to C2 Operational Support

21 September 2010,

Auditorium 1, DRDC-Valcartier, Quebec.

Workshop Objectives:

- Review past and current DRDC projects/initiatives related to the logistics support;
- Obtain a comprehensive overview of logistics requirements already identified, related logistics projects;
- Identify relationships between different activities and avoid effort duplication.

TIME	SUBJECT	Speaker
08:00	Introduction/Opening Remarks	Pierre Lessard
8:15	TDP Scoping Study	Jean Berger
8:45	Capability Domain Concept - Sustain Capability Domain	Dave Allen
9:15	CANOSCOM OR activities	Ahmed Ghanmi
9:45	International collaboration activities : UK-Canada, Canada-Aus, etc	Ahmed Ghanmi, Abdeslem Bouhktouta
10:00	Break	Cafeteria
10:30	Requirements of a CF Readiness system	Patricia Moorhead
11:00	MAPS Defence Suite – Results from discussion with Autralians	Patricia Moorhead
11:30	RFID initiatives and efforts in CF/DRDC	Qinghan Xiao
12:00	Lunch	Cafeteria
13:00	TRV- Total Resource Visibility for JCDS 21	Abdeslem Boukhtouta
13:30	Net-Centric logistic activities: DRESNET, PROMPT,..	Abdeslem Boukhtouta
14:00	CoROSP TDP	Micheline Bélanger
14:15	CANOSCOM Business Process	Jean Berger
14:30	Land Tactical Sustain Sensing Technologies and Concepts (LTSSTC) - Scoping Study Results	Nezih Mrad
15:00	Sustain Sensing Technologies and Concepts Roadmap Development– DRDC Atlantic	Nezih Mrad
15:15	Break	Cafeteria

16:00	Scoping Study on Decision Support Capability for Tactical Logistics Planning and Sustain Missions	Abdeslem Boukhtouta
16:30	Wrap Up	Abdeslem Boukhtouta
17:00	Adjournment	

Annex C Workshop on Operational and Tactical CF Operations Support Requirements – A C2 Perspective

AGENDA

Workshop on Operational and Tactical CF Operations Support Requirements

- A C2 Perspective

CANOSCOM – 1600 Star Top Road, Ottawa, Ontario
Room N-100/S-200, 12-13 January 2011

Workshop Objectives: Obtain a comprehensive overview of CF logistics requirements

12 January 2011: Room N-100

TIME	SUBJECT	Speaker
9:00	Introduction/Opening Remarks	LCol Gibbons, Mrs. Bélanger
9:05	A CANOSCOM perspective on Sense and Respond Logistics (S&RL)	LCol Gibbons, CANOSCOM
9:45	ROSP requirements	CANOSCOM COST Br C4ISR Team Representative
10:30	**Break**	
10:45	Readiness Framework Ref: 3000-1 S/S DSR. Interim Directive – CF Readiness. December 2008.	Mr. Wheaton and LCol Spaan
11:30	Readiness Requirements – challenges and related systems (e.g. NMDS)	Maj. Glockling (CANOSCOM)
12:15	**LUNCH**	
13:00		
13:45	CANADACOM Northern Support Concepts	LCol Allan Hoey J Engr, CANADACOM
14:30	Challenges and lessons learned for HESTIA mission	Not Confirmed
15:15	**Break**	
15:30	Design of Robust and Effective Supply Network (DRESNET) for Overseas Military Operations	Prof. Martel University Laval, QC
16:45	Adjournment	

AGENDA

Workshop on Operational and Tactical CF Operations Support Requirements

- A C2 Perspective

CANOSCOM - Ottawa, Ontario
Room S-200, 12-13 January 2011

Workshop Objectives: Obtain a comprehensive overview of CF logistics requirements

13 January 2011: Room S-200

TIME	SUBJECT	Speaker
9:00	Introduction/Opening Remarks	LCol Gibbons, Mrs. Bélanger
9:05	R&D Exploitation Perspectives	Mr. Wagner DST C4ISR
9:30	Requirements related to Joint Task Force Support Component (JTFSC) Concept	LCol Gibbons CANOSCOM
10:15	Break	
10:30	Requirements for CF Supply Chain Network	Captain Campbell CANOSCOM
11:15	Tactical logistics requirements (current and short term)	Maj Mills DLR/DBRT 6-4
12:00	LUNCH	
13:00	Support to Arctic Ops	Cdr JGL Morin CMS/DMMOS
13:45	C-PORTS demonstration to CWID 2011	Mr. P. Mitten COMPUSULT
14:30	Information Retrieval Technology	Mr. Alder ENDECA
15:15	Wrap Up	LCol Gibbons Mrs Bélanger
15:30	Adjournment	

Annex D Workshop on Operating Concepts for Recognized Operational Support Picture

AGENDA

Workshop on Operating Concepts for of Recognized Operational Support Picture

CANOSCOM – 1600 Star Top Road, Ottawa, Ontario
Room S130, 13 June 2011

Workshop Objectives:

- Develop shared awareness on operational support requirements
- Discuss concepts of operations for ROSP

13 June 2011

TIME	SUBJECT	Speaker
10:00	Introduction/Opening Remarks	Mrs. Bélanger (DRDC Valcartier)
10:10	Review of Lessons Learned analysis of operations from a C2 and an operational support perspective (30 min + discussion)	CAE
10:45	HF4 – Identification of Potential ROSP Information Requirement	Richard Breton DRDC Valcartier
11:15	Update on SOCD	Marc Lessard CANOSCOM
11:45	Approaches to develop a Concept of Operations (20 minutes)	CAE
12:00	**LUNCH**	
13:00	ERP – Today and Tomorrow (40 min)	Scott Taylor (DGEAS)
13:45	ROSP – Preliminary gap analysis – a DRDC perspective	Jean B. (DRDC Valcartier)
14:15	ROSP – CANOSCOM Perspective related to ROSP concept of operations - Scenarios of interest - Military Positions of interest - Functions of interest - Enabling Capabilities - …	LCol Gibbons CANOSCOM
14:45	**Break**	
15:00	Discussions	All
16:45	Wrap Up	All
17:00	Adjournment	All

Annex E UDOP Workshop

Agenda

The UDOP workshop will start on Wednesday February 8, 2012 in the afternoon. However, for those interested, some presentations of interest to the COROSP project will be given in the morning of the 8th, as well as a visit of some DRDC facilities.

8 February 2012

- 8h15 – 8h30 : Arrival
- 8h30 – 10h30 : Tools presentation
- 10h30 – 12h00 : Tour of the labs
- 12h00 – 13h00 : Lunch (cafeteria)
- 13h00 – 13h30 :Welcome and UDOP workshop introduction
- 13h30 – 15h00 : UDOP Context, concepts and examples
- 15h00 – 15h15 : Break
- 15h15 – 16h00 : Workshop Directives and scenario
- 16h00 – 16h15 : Wrap Up

9 February 2012

- 8h45 – 9h00 : Arrival
- 9h00 – 9h15 : Introduction
- 9h15 – 11h00 : Theme 1 (Data Acquisition)
- 11h00 – 12h30: Theme 2 (Information Management)
- 12h30 – 13h30 : Lunch (cafeteria)
- 13h30 – 15h00 : Theme 3 (Human-System Interaction)
- 15h00 – 15h15: Break
- 15h15 – 16h45 : Theme 4 (Collaboration and Coordination)
- 16h45 – 17h00 : Wrap Up

10 February 2012

- 8h45 – 9h00 : Arrival
- 9h00 – 9h15 : Introduction
- 9h15 – 10h15 : Theme 5 (UDOP Foundations)
- 10h15 – 10h30 : Break
- 10h30 – 11h00 : Theme 5 (continued)
- 11h00 – 12h00: Wrap Up
- 12h00 : Departure

Annex F Areas of Responsibility – CoROSP team

Area of Responsibility	PD RW	PM MJM	ScAut MB	DPM MBl	EM Maj PK	LSc1 JB	LSc2 AB	LSc3 MA	LSc4 RB	LSc5 DA	LSc6 AG	LSc7 NP
Project Management												
Project Management Activities	S	**R**	S									
Project Completion Report	S	**R**	S		S	S	S	S	S	S	S	S
Contractual Strategy	S	**R**	S	S								
Prime Contract – PM Deliverables		**R**	S									
Prime Contract – Technical Deliverables		S	**R**			S	S	S	S	S	S	S
Prime Contract Management		S	S	**R**		S	S	S	S	S	S	S
Liaison												
Liaison with CANOSCOM	S		S								**R**	
Liaison with CFWC	S		S						S	**R**		
Liaison with ADM(IM)	S		S									**R**
Activities												
Definition of Technical Requirements	S	**S**	**R**		S	S	S	S	S	S	S	S
Technical Development/Execution	S	S	**R**		S	S	S	S	S	S	S	S
Exploitation												
Exploitation strategy	S	S	S		R	S	S	S	S	S	S	S
Exploitation plan	S	S	S		R	S	S	S	S	S	S	S
Major areas of work												
ROSP Requirement Analysis			S			**R**	S	S	S	S	S	S
CoROSP Concept of Operations							R					
CoROSP Information Integration			S			S	S	**R**	S	S	S	S
CoROSP Decision Support			S			S	**S**	R	S	S	S	S
CoROSP User's Tailored Visualization			**R**			S	S	S	S	S	S	S
CoROSP Development			S			S	S	S	S	S	S	**R**
CoROSP Experimentation Design			S			S	S	S	**R**	S	S	S
CoROSP Experimentation Technical Set Up and Execution			S			S	S	S	S	S	S	**R**

Bibliography

This is the list of documents that has been produced during the execution of this work. Some of these documents are intended to improve understanding of ROSP requirements and deficiencies. Those references are:

- Berger, J., Canadian Forces Operational Support Situational Awareness, DRDC Valcartier TM 2011-450, December 2011, UNCLASSIFIED.
- Berger, J., Bélanger, M., Allouche, M., Breton, R., Concepts for a Recognized Operational Support Picture (CoROSP) – Preliminary Gap Analysis, DRDC Valcartier TM-, Date, 42 pages, (2012). (under publication process)
- Allen, D., Hill, A., Breton, R., Jeffrey, A., & Lichacz, F. Initial Analysis of Human Factors 4 Experiment. Defence Research and Development Canada-CORA, DRDC TM 2011-110, July 2011.
- Rehak, L. A., CANOSCOM Human factors 4 experiment observations: SIGNIFICANT ACHIEVEMENTS and issues, Joint Fires Support Task Authorization #17, January 2011.
- de Boer, C., Dolsen , D. , Maupin, P. , REPORT ON THE UTILITY OF THE MTTF COP TOOL FOR USE IN FUTURE OPERATIONAL SUPPORT MISSIONS, CANOSCOM document, December 2011.
- Gouin, D., Bélanger, M., Breton, R., Proceedings of the Workshop on User Defined Operating Picture Held at DRDC Valcartier Québec Canada (8-10 February 2012), TR-C3I-1-2012 , Québec, June 2012.
- Racc, P., Applcton, A., ANALYSIS OF OPERATIONAL SUPPORT LESSONS LEARNED, DRDC Valcartier CR 2011-246, September 2011.
- MDA, Issues and Challenges Related to the Tactical and Operational Logistics, DRDC Valcartier CR 2011-067

Some of these documents are intended to look at existing technologies and how they could be applied to a concept of ROSP. They are:

- Pageau, N. and Bélanger, M., Reference Architecture Front End Analysis, DRDC Valcartier TM- (under review)
- Allouche, M., Boukhtouta, A., Investigation of Military and Commercial Decision Support Systems for Recognized Operational Support Picture, DRDC Valcartier
- Brcton, R., CoROSP initial cxpcrimcntation ovcrvicw, DRDC working documcnt, December 2012.
- Mitrovic Minic, S., Boukhtouta, A., Allouche, M., Belanger, M., Berger, J., Thomson, D. and Wang, A., A comparison of decision support technologies for operational logistics, Proceedings of the 4th International Conference on Information Systems, Logistics and Supply Chain CREATIVE LOGISTICS FOR AN UNCERTAIN WORLD, ILS 2012 – Quebec (Canada), August 26-29 2012.

- Sebbah, S., Ghanmi, A., Boukhtouta, A. Modeling and Simulation of Military Tactical Logistics Distribution, Proceedings of the 2011 Winter Simulation Conference, Phoenix, Arizona, 10-15 December 2011.
- Fujitsu (2011), Information Sharing Center of Excellence Architecture Analysis, DRDC Valcartier CR 2012-044, May 2011.
- TrustSeer Corporation, Task 10: Final Report on installation, features & performance analysis of Informatica Power Center, March 2012.
- Cinq-Mars, P., Open Architecture Analysis – Endeca Latitude Software Integration Analysis, DRDC Valcartier CR-2013-315, 30 April 2012.
- Brady, B. and Keating, T., Concepts for Recognized Operational Support Picture (CoROSP) – Literature Survey, NRC – Canada Institute for Scientific and Technical Information. Survey, DRDC Valcartier CR-2011-625, March 2011
- Mitrovic-Minic, S., Thomson, D., Wang, A., Reedel, G., Conrad, J., Decision Support and Information Access and Integration for Operational Support Situational Awareness Final Report, DRDC Valcartier CR-2013-310 , April 2012.
- Berger, J. , Boukhtouta. A. Mitrovic-Minic, S. and Conrad J. Decision Support Capability for In-Theatre Logistics Planning and Sustain Missions – Problem Definition, UNCLASSIFIED, TM 2012-?, December 2012.
- Mitrovic-Minic, S., Thomson, D., Wang, A., Reedel, G., Investigation of Open Source and Visualization Technologies for ROSP Decision Support and Information Access and Integration – Final Report, DRDC Valcartier CR-2013-371 ,November 2012
- Tremblay, S., Rioux, F., Rousseau, R., Requirements Analysis and Initial Prototyping of Tactical Planning and Execution Management Decision Aids – State-of-the-Art on Innovative Visualization Techniques and Tools in Support of Planning, DRDC Valcartier CR-2013-311 ,June 2012
- Appleton, A., Lamoureux, T., Identification of Operational Support Picture Concepts, DRDC Valcartier CR-2013-406, January 2012
- Canadian CWID Project Management Team, CWID 2011 Canadian final report, November 2011.
- Coalition Warrior Interoperability Demonstration Joint Management Office, CWID 2011 Final Report Assessment Briefs, Hampton, VA, September 2011.

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List of symbols/abbreviations/acronyms/initialisms

AIMS	Ammunition Inventory Management System
ACO	Airspace Control Order
ADAMS	Allied Deployment and Movement System
ADM(IM)	Assistant Deputy Minister, Information Management
AODB	Air Operations Database
APOD	Airport of debarkation
ASIC	All Source Intelligence Centre
ATIP	Access to Information and Privacy
ATO	Air Tasking Order
AV	Asset Visibility
AVIMS	Automated Vehicle Inventory Management System
BI	Business Intelligence
C	Collaboration
CCIR	Commander's Critical Information Requirements
C-PORTS	Coalition Portal for Situational-Awareness
C2	Command and Control
C2PC	Command & Control PC
C3I	COMMAND, CONTROL, COMMUNICATIONS AND INFORMATION SYSTEMS
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CAMS	Cancer and Mortality Study
CANADACOM	Canada Command
CANOSCOM	Canadian Operational Support Command
CANSOFCOM	Canadian Special Operations Forces Command
Cap RED	Capability Readiness
CCIRs	Commander's Critical Information Requirements
CDI	Chief of Defence Intelligence
CEFCOM	Canadian Expeditionary Force Command

CF	Canadian Forces
CFD	Chief of Force Development
CFDS	Canada First Defence Strategy
CFS	Coalition Fire Support
CFSS	Canadian Forces Supply System
CFTPO	Canadian Forces Task Planning and Operations
CHESS	Commander HandhEld Support System
CIS	Communications Information Systems
CISTI	Canada Institute for Scientific and Technical Information
CORA	Centre for Operational Research and Analysis
COA	Course of Action
CoE	Center of Excellence
COO	Concept of Operations
COP	Common Operating Picture
COPlanS	Collaborative Operations Planning System
COPS	Collaborative Operation Planning System
CoROSP	Concepts for Recognized Operational Support Picture
COTS	Commercial of the Shelf
CMS	Chief of the Maritime
CPoF	Command Post of the Future
CV	Command View
CWID	Coalition Warrior Interoperability Demonstration
CWIX	Coalition Warrior Interoperability eXploration, eXperimentation, eXamination eXercise
DCOS (MAT)	Deputy Chief of Staff Materiel
DCSAS	Director Capability and Structure Analysis Support
DLR	Director Land Requirements
DND	Department of National Defence
DRDC	Defence Research & Development Canada
DRDKIM	Director Research and Development Knowledge and Information Management
DRMIS	Defence Resource Management Information System
DRP	Distribution Resource Planning

DS	Decision Support
DTAV	Defence Total Asset Visibility
DWAN	Defence Wide Area Network
ELDS	Emergency Logistic Decision Support
EMPA	Execution Management and Plan Adaptation
ERP	Enterprise Resource Planning
FMAS	Financial Management Accounting System
FMS	Fleet Management System
GCCS-J	Global Command and Control System – Joint
GIS	Graphic Information System
GUI	Graphic User Interface
HF4	Human Factor 4
HQ	Headquarter
HRMS	Human Resources Management System
I	Integration of Multiple Information Sources
IID	Integrated Information Dashboard
IJBM	Integrated Joint Battlespace Management
IM	Operational Support Information Management
IMR	Integrated Managed Readiness
IMS	Incident Management System
IO	International Organisation
ISCoE	Information-Sharing Center of Excellence
IT	Information Technology
JADOCS	Joint Automated Deep Operations Coordination System
JFS	Joint Fire Support
JIIFC	Joint Information and Intelligence Fusion Capability
LCSS	Land Command Support System
LL	Lessons Learned
LOGFAS	Logistics Functional Area Services
LOMIS	Logistics, Operations and Management Information Systems
LQL	Latitude Query Language
MASC3	Metrics for Assessing Cognition in Command and Control

MASIS	Materiel Acquisition and Support Information System
MMA	Mission Management Application
MRO	Maintenance, Repair, and Overhaul
MTTF	Mission Transition Task Force
NATO	North Atlantic Treaty Organisation
NATO LOGREP	NATO Logistic Reporting
NGO	None Governmental Organisation
NMDS	National Movement and Distribution System
NSE	National Support Element
NRC	National Research Council
OI	Operational Intelligence
OGD	Other Government Departments
OPP	Operational Planning Process
OS	Operational Support
OVP	Operational Visibility Period
PROMPT	Partenariats de recherche orientée en microélectronique, photonique et télécommunications
R&D	Research and Development
ROM	Rough Order of Magnitude
ROSP	Recognized Operational Support Picture
S&RL	Sense and Respond Logistics
SA	Situational Awareness
SATAC	Situation Analysis for Tactical Commanders
SCM	SAP Supply Chain Management
SCR	Strategic Capability Roadmap
SEM-BPS	SAP Business Planning and Simulation
SIV	Staff Inspection Visit
SOA	Service Oriented Architecture
SOCD	Statement of Capability Deficiency
SOPs	Standard Operating Procedures
SPOD	Seaport of Disembarkation
SLA	Statement Level Agreement

TBMCS	Theater Battle Management Core Systems
TDP	Technology Demonstration Project
TFMT	Task Force Movement Table
TO&E	Table of Organization and Equipment
TOPFAS	Tool for Operational Planning, Force Activation and Simulation
TP4	Technical Panel 4
TRV	Total Resource Visibility
TTCP	The Technical Cooperation Program
UDOP	User Defined Operating Picture
UOR	Unforecasted Operational Requirement
V	Vizualisation
VIPA	Vital Planning and Analysis
WES	Web Entreprise Suite
XENA	Cross-Domain Exchange Network Architecture

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The Concepts for Recognized Operational Support Picture (CoROSP) project is a Technology Demonstration Project (TDP) to demonstrate technologies that will enhance operational support domain awareness, which is required by commanders and staff in their decision making. This document summarizes the results of the work executed to develop a sound understanding of the requirements associated with the use of a Recognized Operational Support Picture (ROSP) as well as existing tools/technologies/framework that can provide support to the development of operational support awareness. From these analyses, a set of ROSP concepts is being identified for demonstration purposes. This document also provides high level foundations for the design of a testbed environment to demonstrate and validate proposed ROSP concepts.

Le projet de démonstration de technologies (PDT) sur les concepts pour une image du soutien opérationnel (CoROSP) vise à démontrer des technologies qui permettront d'améliorer la connaissance du domaine de soutien opérationnel, laquelle est requise par les commandants et les états-majors dans leur prise de décision. Ce document résume les résultats des travaux exécutés pour développer une bonne compréhension des exigences liées à l'utilisation d'une image de soutien opérationnel (ROSP) ainsi que les outils existants / technologies / cadres qui peuvent supporter le développement de l`éveil du soutien opérationnel. A partir de ces analyses, un ensemble de concepts ROSP sont identifiés à des fins de démonstration. Ce document fournit aussi les bases de haut niveau pour concevoir un environnement de banc d'essai pour démontrer et valider les concepts ROSP proposés.

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logistics; decision support; CANOSCOM; data integration; ROSP

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