Draft Concept of Operations: Canadian Forces Readiness System

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DRDC CORA CR 2009-008
December 2009

Defence R&D Canada
Centre for Operational Research & Analysis

Strategic Joint Staff
ADM(S&T)

National Defence Défense nationale

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Defence R&D Canada – CORA

Contract Report
DRDC CORA CR 2009-008
December 2009

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This work was sponsored by DRDC DGSTO.

Defence R&D Canada – Centre for Operational Research and Analysis (CORA)

Abstract

This document has been written to capture the concept of how an Integrated Managed Readiness System might work. It is considered to be a preliminary concept paper and it is expected that Defence Research and Development Canada and Strategic Joint Staff (SJS) will utilize this document to develop a way forward and as a baseline for preparing the final concept. It leverages the requirements that were voiced by senior Canadian Forces (CF) executives regarding such a system and presents a vision of what could be developed and how it might be used. It is intended to bridge the gap between the operational user and the technology communities, and drive requirements for the system specification which will describe in technical terms what needs to be built and defines the detailed design.

In order to situate the concept of operations this document has provided details on the existing systems and the desired CF Readiness Framework. It has borrowed liberally from work performed by Calian Technology and from guidance provided by the SJS Director of Strategic Readiness.

Résumé

Ce document a été rédigé afin de capturer le concept de la façon dont un Système intégré de gestion de l'état de préparation pourrait fonctionner. Il est considéré comme un document de conception préliminaire et on s'attend à ce que Recherche et développement pour la défense Canada et l'État-major interarmées stratégique (EMIS) l'utilisent pour développer les étapes suivantes et comme base de référence pour la préparation du concept définitif. Il se fonde sur les besoins exprimés par les hauts dirigeants des Forces canadiennes (FC) concernant un tel système et il présente une vision de ce qui pourrait être développé et de la façon dont cela pourrait être utilisé. Il vise à combler l'écart entre l'utilisateur opérationnel et les communautés des technologies et à alimenter les besoins en ce qui concerne les caractéristiques du système qui décriront en termes techniques ce qui doit être bâti et qui définit la conception détaillée.

Afin de situer le concept des opérations, ce document fournit des détails sur les systèmes existants et le cadre souhaité de disponibilité opérationnelle des FC. Il s'inspire librement des travaux effectués par Calian Technology et des conseils du Directeur de l'état de préparation stratégique de l'EMIS.

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Executive summary

Draft Concept of Operations: Canadian Forces Readiness System:

Doug Hales; Dave Bowen; DRDC CORA CR 2009-008; Defence R&D Canada – CORA; December 2009.

Background: In 2008, the Strategic Joint Staff Director Strategic Readiness (SJS DSR) initiated research into the viability of a strategic level Canadian Forces (CF) Integrated Managed Readiness System (IMRS). The IMRS would consist of two related components: a CF Readiness Directive which provides the strategic readiness lexicon, standards and management process; and an automated tool to support the collection, collation and presentation of readiness information. SJS DSR requested the assistance of Defence Research and Development Canada (DRDC) to conduct a study of extant CF readiness systems and requirements, and to develop a draft concept of operations for the automated tool component of an IMRS.

Aim: This document captures the concept of how an IMRS tool might work. It is considered to be a preliminary concept paper and it is expected that DRDC and SJS will utilize this document to develop a way forward and as a baseline for preparing the final concept. It leverages the requirements that were voiced by senior CF executives regarding such a system and presents a vision of what could be developed and how it might be used. It is intended to bridge the gap between the operational user and the technology communities, and drive requirements for the system specification which will describe in technical terms what needs to be built and defines the detailed design.

Results: The automated tool envisioned would have several inherent functions. Firstly, there is a data entry function that must be easy to use and allows information to be captured with minimal user input. A monitoring function provides users with the ability to view the up-to-date status of all units (including people, training, material and equipment). Next is the planning function, which facilitates options and risk analysis and provides relevant information to decision makers. This includes a capability to project the future readiness status of units. A fourth administrative function is required to enable functions such as account and information management.

Four options for IMRS development were examined: purchasing and possibly modifying an existing government-off-the-shelf system; purchasing and modifying an existing commercial-off-the-shelf system; developing a tool in-house; and contracting out to industry. A technical requirements workshop was conducted to identify and examine issues and concerns associated with each option, and the options were rated against a series of evaluation criteria.

Way Ahead: This study followed recommended Institute of Electrical and Electronics Engineers (IEEE) processes. This report is the culmination of the first “Concept” stage. The next phase in the IEEE process focuses on development. As this “system” will involve integrating data feeds from a multitude of other systems, it can be characterized as a system of systems, and as such will require a more complex governance and management structure to oversee development, introduction into service and maintenance.

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Doug Hales; Dave Bowen; DRDC CORA CR 2009-008; R & D pour la défense Canada – CARO; Décembre 2009.

Contexte : En 2008, le Directeur – État de préparation stratégique – auprès de l'État-major interarmées stratégique (DEPS EMIS) a lancé une recherche concernant la viabilité d'un Système intégré de gestion de l'état de préparation (SIGEP) des Forces canadiennes (FC) au niveau stratégique. Le SIGEP comprendrait deux composantes liées : une directive sur l'État de préparation des FC qui fournirait le lexique, les normes et le processus de gestion concernant l'état de préparation stratégique; et un outil automatisé qui soutiendrait la collecte, le regroupement et la présentation des renseignements concernant l'état de préparation. Le DEPS EMIS a demandé l'aide de Recherche et développement pour la défense Canada (RDDC) afin de réaliser une étude sur les systèmes et les besoins existants en matière de disponibilité opérationnelle des FC en tant que première étape vers le développement d'un concept des opérations pour la composante d'outil automatisé d'un SIGEP.

Objectif : Ce document capture le concept de la façon dont un outil de SIGEP pourrait fonctionner. Il est considéré comme un document de conception préliminaire et on s'attend à ce que RDDC et l'EMIS utilisent ce document pour développer les étapes suivantes et comme base de référence pour la préparation du concept définitif. Il se fonde sur les besoins exprimés par les hauts dirigeants des FC concernant un tel système et il présente une vision de ce qui pourrait être développé et de la façon dont cela pourrait être utilisé. Il vise à combler l'écart entre l'utilisateur opérationnel et les communautés des technologies et à alimenter les besoins en ce qui concerne les caractéristiques du système qui décriront en termes techniques ce qui doit être bâti et qui définit la conception détaillée.

Résultats : L'outil automatisé imaginé aurait plusieurs fonctions inhérentes. Premièrement, une fonction d'entrée de données qui doit être facile à utiliser et qui permet de capturer des renseignements avec une intervention minimale de la part de l'utilisateur. Une fonction de surveillance offre aux utilisateurs la possibilité d'afficher l'état à jour de toutes les unités (y compris les effectifs, la formation, le matériel et l'équipement). Ensuite, une fonction de planification facilite l'analyse des options et des risques et fournit des renseignements pertinents aux décideurs. Cela inclut la possibilité de prévoir l'état de préparation futur des unités. Une quatrième fonction administrative est requise pour permettre des fonctions comme la gestion des comptes et des renseignements.

Quatre options pour le développement du SIGEP ont été examinées : acheter et probablement modifier un système gouvernemental standard existant; acheter et probablement modifier un système commercial standard existant; développer un outil à l'interne; et donner le projet en sous-traitance à l'industrie. Un atelier sur les exigences techniques a eu lieu afin de déterminer et d'examiner les questions et les préoccupations associées à chaque option, et les options ont été classées selon une série de critères d'évaluation.

Perspectives : Cette étude a suivi les processus recommandés par l'IEEE (Institute of Electrical and Electronics Engineers). Ce rapport est l'aboutissement de la première étape du « Concept ». La phase suivante du processus de l'IEEE se concentre sur le développement. Comme ce « système » impliquera l'intégration de flux de données en provenance d'une multitude d'autres systèmes, il peut être caractérisé comme un système de systèmes et, de ce fait, il demandera une gouvernance et une structure de gestion plus complexes pour la supervision du développement, de la mise en service et de la maintenance.

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1 Scope

1.1 Identification

This proposed draft Concept of Operations (CONOPS) is for an Integrated Managed Readiness System (IMRS) which is a component of the Canadian Forces (CF) Readiness Management Framework that is described in the Interim Directive – CF Readiness [1] approved by the Chief of Defence Staff (CDS) on 18 December 2008. It has been drafted by the Strategic Joint Staff (SJS), Defence Research and Development Canada (DRDC) operational research scientists and CAE Professional Services Canada. Insofar as possible, it reflects the CDS's vision and incorporates input from key stakeholders (e.g. Force Generators and Force Employers). Three fold objectives are to:

- Propose a target description of how the CF might manage readiness and how technology might support this target vision;
- Outline a road map to inform implementation in the longer term; and;
- Support the options assessment with the intent to help direct initial efforts to improve the capability of SJS to report on and plan with CF readiness data.

1.2 Document Overview

This document begins by providing an overview of the existing CF readiness processes and then establishes objectives for an integrated managed readiness system. Next, the document describes the overall desired attributes for such a system. Following this the document explores the four options available to SJS for implementing this capability: purchase either government or commercial off the shelf solutions; build a solution in house; or contract for a custom solution development. The document ends with an assessment of the options and guidance on the way forward. It assumes:

- The ability to non-invasively acquire the current readiness levels and associated data from each of the relevant Level 1 (L1) organizations;
- The provision of appropriate computer based tools to support analysis and planning; and,
- The ability to tailor perspectives based upon stakeholder roles and responsibilities, and to facilitate activity synchronization.

This concept of operations envisions that over time the capability for CF Readiness reporting will evolve towards the envisioned capability. This evolution will require significant effort and will have an impact (in the form of a requirement to support the capture of more information) on the Force Generators. This impact could also result in enhanced planning abilities for the Force Generators.

1.3 Overview

Preparedness is fundamental to operational effectiveness, and CF Readiness can be viewed as a system – a combination of interacting elements organized to achieve a stated objective.[1] Relevant and ready military forces, outfitted with the appropriate equipment and trained personnel capable of reacting in a timely manner, provide strategic influence to governments who possess them. Maintaining primed forces requires a comprehensive understanding of defence objectives and the resultant assignment of readiness levels to the standing organizational elements of the CF who will be called upon to execute the defence mission. A coherent readiness framework will both enable the CDS to provide the best possible advice to the Government of Canada (GoC) on the viability of military action, based on a detailed awareness of military capabilities and capacity, and provide direction to Force Generators and Force Employers. It is an important decision support aid and provides a means to align strategic intent and resource management.

[1] Based on INCOSE definition - System Engineering Handbook pg 1.5

2 Current Situation

2.1 Background

In August 2007, the Department of National Defence (DND) adopted the Defence Planning Directive Initiative as a means of aligning strategic defence intent, vision and priorities with resource management. This action revitalized the "Defence Plan on Line" which records defence tasks and assigns corresponding readiness and sustainment levels, and aligned it with the Department's Program Activity Architecture. Defence planning continues to evolve and a further revised Defence Plan will incorporate the requirement inputs of Commands and L1 Managers based on their part of the defence mission. CF Readiness will continue to be a key means for managing forces in response to the commitments and contingency operations identified in the Defence Plan. The difference now however, is the introduction of the Interim Directive and a CF Readiness Framework that works in parallel to defence planning to determine, approve, monitor and set/adjust readiness levels for operations.

As part of the post-transformation effort to revitalize doctrine and direction at the CF strategic level, the SJS is developing a CF Readiness Framework which will provide the CDS and senior management in DND with the tools to understand and to manage CF operational readiness. This framework will explain the procedures for determining, assessing, reporting and adjusting CF readiness, and eventually it is anticipated that the framework will lead to improvements in planning CF deployments and the long-term management of CF readiness.

2.2 The Strategic View

To date, there has been no framework or decision tool used at the strategic level to monitor and plan DND/CF readiness. Reporting of force generation / readiness issues has been as requested or as problems arise; however, at times the realization that a problem is present has occurred too late for effective and efficient management and decision making. This situation is not effective for risk management. The complexities of today's operations and the advance of technology has placed a need for more foresight than was required in the past to effectively manage the path from conception to planning to employment of a capability in response to forecasted tasks as well as un-forecasted tasks. The additional complexities of an evolving CF in force structure, equipment, and capabilities necessitate a methodology to manage the CF beyond 'looking at the status of today'. The reliance today on the Force Generators to provide regular reports on the status of their current progress on the road to readiness (an often time consuming and person effort intensive exercise) should be reduced. The status of the CF should be readily available and transparent to senior leaders with the caveat that this should not preclude the consultative approach to force apportionment and force employment. Thus the need for an Integrated Managed Readiness System.

2.3 The Linkage between Managed Readiness and CBP

Capability Based Planning (CBP) was adopted as a means to define requirements and inform force structure in the face of a posture of continual war. Enhanced agility was required, and task-

tailored mission packages integrating capabilities created in response to operational demands envisaged. In sum CBP embraces functional analysis of operational requirements in response to a broad range of circumstances and challenges.[2] It is intended to be concept led and top-down driven, to inculcate holistic (system-of-systems) thinking and foster innovation, and to challenge and supplant the existing Service focused culture. From a Force Development perspective the imperative was to convert from a platform centric culture to a functionally based, objectively-driven requirements appreciation.

The first challenge to CBP is to articulate policy direction and establish Defence priorities and capability goals.[3] A traceable process and measurable goals are required to support the transition from policy narration to structural specification. The second challenge relates to integration. A number of elements combine to create a capability. It is difficult to assess objectively trade-offs between capability domains, and to relate CBP to organizational and governance structures (i.e. to force generation/capability production components, to business plans and resource distribution allocations and to performance management /accountability framework). Both challenges are germane to Readiness Management. Readiness is a key element of a capability goal; a timely/appropriate combination of people, materiel and process is key to generating a capability. This said, the obvious conclusion is that task lists and monitoring needs to be linked to the capability requirements of the strategic planning scenarios.

2.4 Description of the Current System or Situation

The Integrated Managed Readiness System is discussed in the Interim Directive - CF Readiness [1]. This directive defines the readiness framework, readiness levels, and the standing readiness planning cycle. A continuous readiness planning cycle provides for a constant review of readiness requirements and recommends force postures that deliver on readiness tasks delineated in the Defence Plan (Defence Tasks). Risk is managed by the CDS through conscious and informed approval of forces placed at readiness to achieve assigned tasks (multiple taskings). Force generators are responsible to deliver (on time and with approved operational capabilities) the ready forces as assigned. Flexibility for domestic (crisis) operations is achieved through the formal identification of forces that are available for immediate (crisis) employment (noting any limitations).

The Interim Directive defines CF Readiness as a measure of the ability of an element of the CF to undertake an approved task, and it distinguishes two components - Operational Capability and Response Time:

- Operational Capability (OC) refers to the actual capability of an element or asset of the CF to perform the mission for which it is organized or designed; and,

[2] CBP has been construed to 1) include requirements definition, options analysis and acquisition/capability generation and 2) describe the front-end goal characterization. Confusion can exist because the two interpretations are often used interchangeably.

[3] Policy analysts tend to write narrative papers relying on conceptual argument, limited reliance is on numerical or scientific analysis. Credence is linked to the reputation of the analyst. CBP aspires to complement policy analysis with quantifiable analysis.

- Response Time refers to the maximum time permitted for the designated CF element or asset, to assemble in a specified location possessing the allocated OC, and ready to undertake the assigned task.

2.5 The Strategic Readiness Management Framework

CF Readiness planning is based upon a four-step framework as shown in Figure 1. This framework supports general defence planning through the adoption of centrally directed defence tasks, but allows for a more dynamic and routine interaction by force developers, force generators and force employers in defining objectives and adjusting generation plans and activities. Monitoring of readiness levels allows constant vigilance and facilitates asset optimization and risk management. Finally the framework provides for a review mechanism whereby the CDS routinely sets and adjusts strategic readiness levels.

This extant Interim Directive establishes a coherent strategic readiness planning cycle and supports a monitoring process. It is intended to guide Commanders and staffs in CF readiness planning. Units and assets that have been allocated to Commands at designated readiness levels remain available to those Commands. Furthermore, Commanders delegated authority to change readiness levels, or elements thereof (such as notice to move) may continue to order changes without requesting authority of the CDS.

The CF structure is based upon formed units. Units form the building blocks of formations, task forces, groups and Commands. All members of the CF belong to a unit, and all DND/CF property is held against a unit account. Commanding Officers of units are responsible for managing three key aspects that contribute to CF Readiness: unit manning, the ability to execute individual or collective tasks, and serviceability of DND/CF property and materiel. CF readiness can be measured in these areas based on current unit-level information, as detailed below, staffed through the appropriate chain of command.

a. Organizational Strength. Every CF unit is structured for a specific mission or task. This organizational approach also applies to the creation of temporary forces, as temporary units, formations, task forces or task groups;

   i. Establishment. The establishment is the authorized personnel structure of an organization (unit) as approved by the Minister of National Defence;

   ii. Qualified. The Unit Qualification List states the unique qualification required for each established position. Personnel are assigned to billets based on the course/qualifications required for the billet; and

   iii. Deployable. Only personnel who have been screened may deploy. Units regularly conduct verification of the status of personnel ready for deployment based on assigned standards.

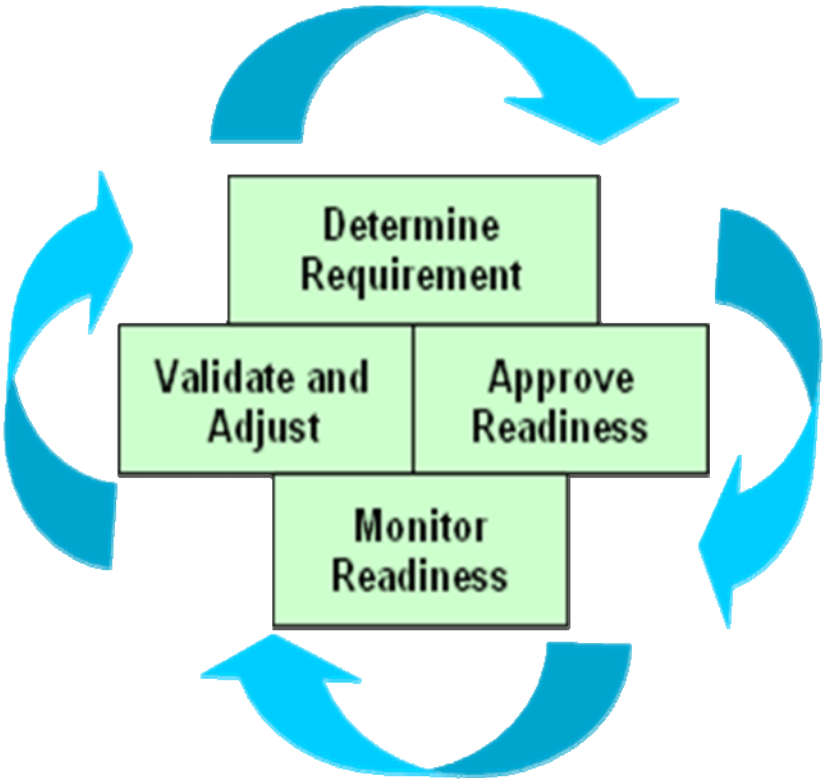

Figure 1: Four-step readiness planning framework.

b. Collective Training. Units conduct individual and collective training activities to acquire and maintain the requisite skill sets and unit cohesion to enable them to achieve assigned missions and tasks;

c. Materiel Readiness includes measurement of the tools required to complete assigned tasks. Materiel is measured using four categories: command and control systems, weapons, equipment, and vehicle/platforms. Measurement of readiness in the materiel domain is stated in terms of technical readiness to be maintained in each of the categories;

d. Supplies. Assets assigned to readiness tasks are provided an anticipated duration of task or "days for which the task must be sustained." The anticipated period of deployment, or the period for which the readiness asset is to be able to deploy for the task, is then measured in terms of specific scales of supplies. Measurement of supplies is broken into ten subcategories (Classes 1-10); and,

e. Measuring Response Time. The CF utilizes a successive series of Response Times, also known as Notice to Move. The Response Time provides units with a sense of the time available to assemble and be ready to undertake a task or contingency for which they have the requisite OC. CF Response Times have been rationalized with the NATO Response Time categories R1 through R10. In order to meet CF needs, two

additional categories of 24 hours and less than 12 hours have been added as I1 and I2, to the NATO categories.

2.6 Strategic Management Process

The CF Readiness framework is based upon the following steps:

a. Determine/Confirm Requirements. CF readiness is founded upon the generation of assets placed at various readiness levels in order to meet Government of Canada approved commitments. These commitments are broken down into defence tasks and assigned to Commands /Environmental Chiefs of Staff (ECS) /L1 through the DND/CF Business Plan and/or CDS Directives and Orders. In order to manage readiness the CF tracks DND commitments and/or defence readiness components by CF Readiness Task List Control Numbers;

b. Approved Readiness Levels. On an annual basis, the CDS, with the advice of subordinate Commanders and strategic level staffs, reviews and approves readiness levels as derived from the formal Strategic Readiness Review (SREDR). New readiness levels may be approved on other occasions, such as following any of the three informal SREDR or when operational necessity demands. Following CDS approval the task of generating assets to designated readiness levels is assigned to the appropriate Commands / ECS /L1;

c. Monitor Readiness. To facilitate Commander input to readiness reporting all Commands /ECS /L1 formally submit quarterly Command Readiness Reports (Comd REDREP) regarding Readiness Tasks for which they have a generate or employ responsibility. The Comd REDREP is one means that the Force Generators may use to inform others of issues regarding assigned readiness levels in the areas of manning, training and/or supplies; and,

d. Validate and Adjust Readiness. Established readiness levels are validated and adjusted by the CDS based on inputs from Comd REDREP. The validation of established readiness levels is integrated with the determination of new readiness requirements detailed above, thereby creating a continuous CF Readiness Review Cycle.

The process has been depicted in Figure 2: CF Readiness Framework Process Flow.

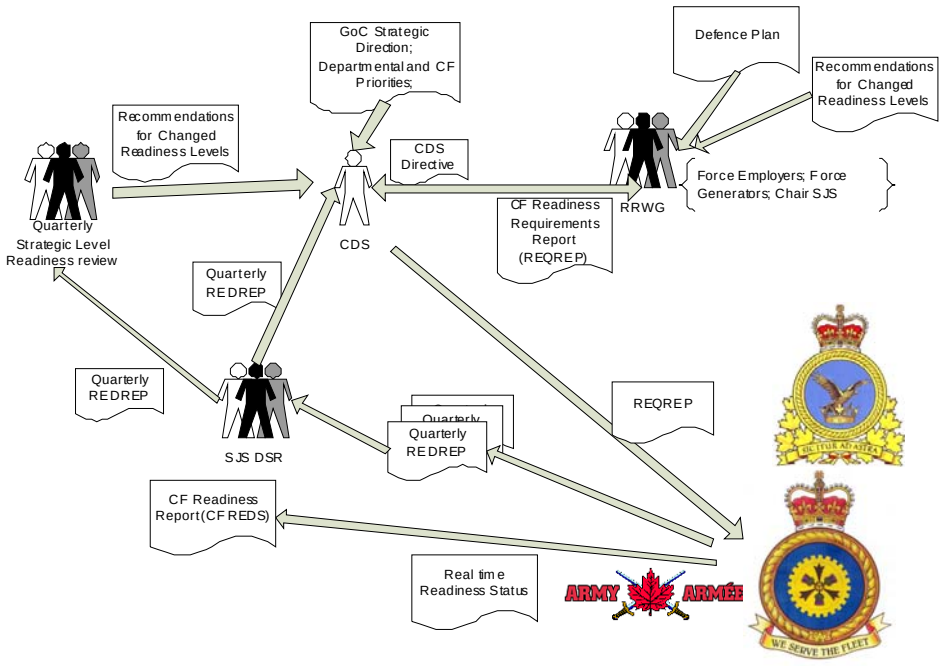

Figure 2: CF Readiness Framework Process Flow.

2.7 Strategic Management Tools

To date, there have been no dedicated tools developed or used to support strategic level decision support. Although it would be an exaggeration to describe the process as ad hoc, the reporting of force generation / readiness issues has been as requested or as problems arise. At times recognition has lagged development of a problem and been too late to inform and support strategic decision making. The need for tool support is becoming more urgent. The complexities of today's operations and the advance of technology has underscored the need for increased foresight and the intricacies of force generation call for enhanced management - an Integrated Managed Readiness System (IMRS).

2.8 The Force Generator Readiness Systems

Readiness management has two foci:

- Establishment of capability goals and promulgation of readiness policy and standards; and
- Oversight (monitoring and synchronization) of its development, generation and employment activities.

The CF Readiness Study conducted by Calian highlighted the five existing force generator readiness reporting systems. Given the key role played by the Environmental Chiefs, it is not surprising that these reflect tailored perspectives. The report concluded that while the five systems serve the needs of the individual stakeholders effort would be required to integrate the systems and support a more holistic view. Moreover existing force generator readiness management systems support differing philosophies (i.e. manning the equipment versus equipping the man). In sum, the current approach relies upon the Force Generator reporting and management systems to provide baseline readiness and planning data. These systems and the current situation have been summarised in the Calian report [2] and are discussed in chapter 3, and therefore will not be described here.

2.9 Readiness Levels

The CF employs a progressive series of readiness levels that are designed to create a coherent system understood throughout the CF that enables planning, selection and preparation of CF elements for assigned commitments and/or contingencies. Readiness levels enable:

a. A comprehensive, common and transparent understanding of CF readiness, informed by discrete measurable categories;

b. The immediate analysis of force availability to support Rapid Response Planning, particularly in the case of domestic crisis;

c. The development of rational and progressive force generation plans;

d. Informed decision-making regarding unit or asset selection based on a holistic understanding of second and third order impacts on operational plans and force generation activities;

e. Identification of emerging risk areas in time to mitigate; and,

f. Informed decision-making regarding strategic resource allocation that supports force development and force generation.

A general information page is maintained on Defence Wide Area Network (DWAN) that provides unclassified readiness guidance information and points to the classified web site. Access to the unclassified Director Strategic Readiness web site is through the SJS / Director General Plans web site (http://sjs.mil.ca/sites/page-eng.asp?page=917).

3 Results of Requirements Analysis

3.1 Conclusions from the Calian Study

The *Requirements of a Strategic Readiness System* report [2] completed in December 2008 by Calian highlighted the five existing force generator readiness reporting systems. The primary conclusion is that the five systems appear to be pertinent for the principal environmental user; however, the feasibility for them to be combined and refined for use by an IMRS may be dubious with respect to high level depictions. This pertains to the two differing perspectives of manning the equipment versus equipping the man. This said, it is yet to be confirmed if the underlying raw data which feeds the individual systems could form a basis for the principal database for IMRS.

The scope of the report did not include some key reference systems used either as input into the force generator systems or as stand alone systems. Some of these include: Materiel Acquisition and Support Information System, and the Canadian Forces Tasks Plans and Operations application.

This said, there are some basic systematic limitations to readiness reporting in general and within the existing Force Generator systems, which would automatically migrate to the IMRS should a direct transfer be possible. Some of these are:

a. Data are not standardized among the Force Generator systems;

b. Data may be out-of-date or nonexistent for some units;

c. Data are maintained in multiple databases and are not synchronized across the databases;

d. Data represent a snapshot in time and do not signal impending changes in readiness;

e. Ratings may be misleading because they are based on broad measurements that can mask underlying problems;

f. Strategic users cannot rely on the systems to obtain authoritative unit status to assist in making time-sensitive decisions; and

g. The shear magnitude of readiness reporting from the sub-components of personnel, training, equipment and materials for the CF is daunting.

3.2 Description of Desired Changes

The results of the Calian interviews with the senior staff stakeholders resulted in the following key principles that should be considered when defining the desired capabilities to be provided by a future readiness system.

1. Defence Tasks. One of the keys discovered for unlocking the shackles of the current situation is the idea that Defence Tasks should not be "set in stone" for an indefinite number of years. Instead, it is suggested the Government sets a defence strategy and the Department then develops statements of the capabilities required to carry out the strategy. In effect, Defence Tasks become statements of military advice. While this advice would obviously not change frequently, it could be adjusted periodically as the demands of potential operations in the world change.

2. Capability Statements. Once a degree of flexibility is introduced into the concept of Defence Tasks, then these tasks can be profitably rewritten in terms of capabilities rather than specific lists of ships, aircraft, battalions and so on. Thus, the current task for a naval task group would become something more like "a maritime-centred force able to proceed to the other side of the world, be sustained, defend itself and project power". The greatest advantage of this approach is that it is broad enough to incorporate not just maritime or maritime air assets, but also all of the "strategic enablers" that underlie such a capability – forward logistic entities, staging bases, strategic communications, airlift, intelligence and so on. In the same manner, the infrastructure and schools that are the foundation of operational forces can also be tied to the readiness output. Thus, those entities that are crucial but previously unstated in terms of readiness can now be incorporated and their costs linked to operational capability. Equally, limitations to achieving a capability such as school capacity can be identified and reported. Implicit in this approach of capability statements is that the statements would come from the Force Employers or Joint Staff but it would be up to the Force Generators to decide what resources are needed to meet the capability ordered. Since the Capability Statements would now cross Environmental bounds, an Office of Primary Interest would have to be assigned for each Statement to corral its diverse components. In this way, what was a tactical-level system divided along Environmental lines can become a joint operational-level system.

3. The Future and Managing Risk. The current readiness systems are tactical-level snapshots. They start becoming out of date as soon as they are published. They may tell you what you have today in High Readiness forces but not what you will have tomorrow. Thus, a truly strategic system is a higher level system that worries about the big risks, that is, it looks into the future to see the risks coming in time to take action to mitigate them to an acceptable level. Today, the types of risks that might be considered are personnel trends, major equipment programmes and confluences of major tasks like Afghanistan and the Vancouver Olympics. Thus, this is not a simple extension of a current readiness system into the future, but a full shift in focus to the major factors that are expected to affect the production of the operational capabilities. The CDS will need to specify the type of information he is looking for to attune staffs to this different reporting stream. For such a predictive system, it is assessed that about three years is a realistic timeframe for adjusting readiness; any greater time is likely to be not readiness but force development. This look into the future is going to have to be reported in terms of quantified data so that the risk can be managed. Finally, by looking into the future in this way, a reporting system is no longer a solely military concern; its results will be of equal value and concern to the Deputy Minister.

4. Availability. Reporting based on the establishment of a unit for its personnel and equipment is of little value since that is axiomatically not the actual state. The manning of the unit and the number of pieces of equipment in place are equally misleading in a report. For accuracy,

the only measures that are effective are the availability of personnel for operations within the unit and the serviceability of the equipment. Thus, a ship may officially be well manned, but if enough people have been attach posted to a higher readiness ship that the original ship is now unable to sail, its readiness has obviously dropped significantly. Similarly, an Army unit that has given up equipment and personnel to a deploying task force no longer has the same capability and readiness level as before. It is proposed that a readiness reporting system should be sufficiently comprehensive that such changes are reported.

5. Standards. For a system to be coherent, it is clear that it must be based on common standards for evaluating readiness. This does not require, however, that everyone use the same methods of evaluation since there are peculiarities to each Environment, so long as there can be confidence that the standards are actually being attained. Some foreign forces with extensive reporting systems, the results of which figure prominently in personal advancement, have found that the veracity of reports becomes a concern. This is really a matter of ensuring accountability; transparency into the components of reports at the next higher level of command may be sufficient to the purpose.

6. Residual Capability. Availability and Standards lead in turn to the question of reporting the CF capability left after High Readiness forces have been removed from the equation. This is of direct concern in considering forces for domestic operations, but is also of value in bringing forth the impact of Force Employer requirements on units other than those deploying, as illustrated in the Maritime and Land examples suggested under Availability. The question then arises of what standard should be used to gauge the readiness of this residual capability in the CF. Standard or Normal Readiness is the obvious answer, but not as defined in the draft CF Readiness Framework where Standard Readiness is "generally used to indicate the next group of units/ assets that will be assigned operational or higher readiness tasks". Looking across the entire CF, there are many units that will only be required to be at Standard Readiness, or may be at that level for some months following a period of High Readiness. In other words, Standard Readiness in this broader context stands on its own as a readiness level and it is inappropriate to define materiel and other requirements in terms of a percentage of "the systems necessary to meet the operational capability for which the unit is preparing". Standard Readiness forces will require Capability Statements for Standard Readiness tasks, such as Domestic Operations.

7. Use of Information. One of the main concerns expressed by all the Environments was what SJS would do with detailed readiness information, especially if the intent was to provide readiness information at the company/squadron/ship level. Would they try to make decisions without consultation and would they try to micromanage the Force? Even in the present climate, the Environments felt that SJS was spending more time chasing what the "Corporals" were doing on the ground rather than looking at the strategic picture. The answer is simply that a reporting system that calls for more information will require a degree of faith initially, followed in time by a sense of trust built upon the appropriate use of the information.

8. Use of "Stoplight" Reporting. A majority of the people interviewed supported the stop light method of reporting the status of readiness. They felt that there is no need to drill down too deeply into the readiness information as they would not understand the nuances of the information presented. There should, however, be an area where the commander can provide input to the report, that is, after all the statistics are developed, there is still a role for a

Commander's qualitative assessment of whether a unit is truly ready. There were, however, a few individuals who felt that using the stop light system to indicate readiness was useless because it was too "ambiguous" and therefore, meaningless. They felt that readiness reporting had to be quantified to be of any value. This call for quantified data makes the most sense in terms of looking into the future as part of assessing risks. For current readiness, however, a good balance might be to use stoplight reporting in both the reporting of each element of readiness (personnel, equipment, etc) and for the components of those elements at the next level down (trials, ammunition, logistics, serviceability, etc). This would provide a good degree of information for the most senior levels without getting into counting people and vehicles. Of course, the success of such an approach will depend very much on the quality and comprehensiveness of the Capability Statements that drive the reporting.

9. Frequency and Process of Reporting. While perhaps obvious on reflection, the key point here is worth stating – the process cannot be too cumbersome or people will put minimal effort into the preparation. One ECS presented it as "Too much data and the system becomes onerous to maintain and eventually meaningless," while another senior officer stated "The greater the fidelity sought, the greater the chance of failure." Some staffs opined that the reviews and meetings in the draft CF Readiness Framework invoke that worry. Overall, the test for any system will be as much whether the staffs that develop the data see value in it as whether it is useful to senior leaders. The most senior officers also seemed to feel that quarterly reports were sufficiently frequent for their purposes.

The study also drew the following conclusions with respect to the senior staffs' envisioned purpose for the reporting system:

1. In the course of this study, it has become apparent that the type of system being considered is likely more than a classic readiness reporting system. There are three possible uses for the information being produced:

    a. Making decisions for current operations;

    b. Reviewing standing readiness levels of current forces against the demands of today's world, that is, that the Capability Statements are still current and correctly structured; and

    c. Using predictive data to look ahead for the major risks approaching.

2. The idea of three different purposes and that data for the third purpose will certainly be different from that for the first two is something to be kept in mind during system design.

The Calian report also identified that based upon the input from senior staff the readiness reports should contain the following:

1. Core Elements. The elements of the existing Force Generator readiness reports, that is, Personnel, Equipment and Training, are the standard for such reports and are recommended for continued use for current readiness. The only caveat is that personnel and equipment be considered in terms of availability to deploy for operations and serviceability, respectively.

2. Commander's Assessment. While these three elements should be on a statistical foundation, they will not provide a complete picture of readiness. It is certainly possible to carry out the required evolutions specified for a level of readiness and yet not be ready in the sense of such things as teamwork or ability to function under stress. Thus, there is always a role for the subjective assessment alongside the objective. The Commander's assessment of the readiness of his subordinate unit should be a fourth element of a reporting system.

3. Morale. In the course of the interviews, one other element was suggested – morale. The countering view was that morale is a factor at the unit level but not at aggregate levels. Even at the unit level, it is difficult to quantify and can be quite variable over even a short time. Thus, it is perhaps best left as one of the factors a Commander would consider for his portion of a report.

4. Logistic Support. An element that was mentioned by several people during the interviews was logistic support or sustainment. It is one of the "strategic enablers" and would be a key part of a Capability Statement, arguably the central element in knowing the "true" cost of an operational capability. Capturing all the aspects of sustainment, however, is not easy. It may seem relatively straight forward from the perspective of a front line unit but becomes increasingly complex as reports ascend the Command chain and additional elements such as usage rates, national stockpiles, re-equipment programmes and so on are added. The British are understood to be developing the concept of the Total Logistics Requirement to extend from training through deployment to operations so as to be able to assess the logistical aspects of readiness, including stockpile needs or what can be bought within the readiness time limits. The literature also suggests that while the information would be very useful, the British are finding it difficult to compile. Further investigation with the United Kingdom is recommended.

5. The Future. In contrast, for a report that looks into the future, it is difficult to specify what should be the elements beyond a statement of watching for "significant risks" to the organization. During the interviews, the risks mentioned ranged from demographics to the rate of usage of equipment in Afghanistan to the national economic situation. What this does suggest, therefore, is that reports of the future risks cannot be bottom-up, staff-driven efforts but rather must be the personal products of Commanders with the information and experience to identify such risks.

The Calian report concluded with the following recommendations for the IMRS concept of operation:

1. The overarching conclusion of this study is, as expressed by one senior officer, "A machine won't give us the answer; it will give us elements of a solution. Commanders will give the answer."

2. More specifically:

    a. The requirements demand more than a classic current readiness system. This does not mean, however, more detailed data, but rather a smarter system that covers all of the CF;

b. Different purposes require different data from different originators. In effect, the demand is for two reporting streams, one from Formations for current readiness and one from the national level for future risks;

c. Reporting only the present tactical-level readiness of units is inadequate. It needs to incorporate broader capabilities and predictive data;

d. Methods of measuring readiness will differ, but standards must be universal and processes for gauging readiness of a quality that withstands critical scrutiny;

e. "Keep it simple," by using something like a layered "stoplight" report for current readiness that includes a Commander's assessment and is only submitted quarterly. Equally, do not create a major staff process in the handling and evaluation of the reports;

f. The overall system should be a hierarchy of flexible Defence Tasks that are regarded as "military advice", Capability Statements that are not limited to one Environment and incorporate the appropriate "enablers", and reporting of all elements of the CF, including designated national stocks, in relation to assigned Statements and readiness levels; and

g. The core elements of a report should continue to be Personnel, Equipment and Training. Personnel and Equipment should be based on availability to deploy and serviceability, respectively. A Commander's assessment should be added. Further investigation should be conducted into how Logistic Support could also be incorporated.

Using the guidance resulting from the Calian Report the overall goal of this document is to guide the development of a readiness reporting tool that leverages data from existing and future systems to provide a monitoring capability for all levels of the organization and a planning tool for understanding the impact of new missions and developing trends in the 3 to 5 year time frame.

The IMRS needs to provide the CDS with reports on high readiness units as well as visibility on the rest of the CF to enable the CDS to understand what resources are available to call upon for other taskings. The IMRS should help identify causal impacts of decisions and support the risk management capability. The system needs to be linked to corporate management processes and the Program Activity Architecture. The information available will help senior staff with understanding how money is spent and providing better reporting to Treasury Board. The timely information should support the development of reports on plans and link to the Defence Plan Report. The Force Developers want to project future readiness and support exploratory analysis of future readiness.

The above implies that the IMRS system needs to enable the following:

a. A drill down ability to understand the details behind identified issues;

b. An ability to track progress and change;

c. An ability to raise “red flags” when there are problems emerging;

d. There should be support for Adaptive planning;

e. There must be a means to ensure the integrity and accountability of the information;

f. There should be minimal overhead for data capture;

g. A view into individual operational readiness; and

h. A view into the implication of sustainment on readiness.

The information required to feed the IMRS will be retrieved from a multitude of systems residing on both un-classified and classified networks; not all the systems required exist today and some data resides within units as spread sheets on local systems. As a result this system will need to develop through a series of incremental builds, i.e. a spiral development. In each cycle there will need to be changes in other systems within the CF System of Systems (SoS) to enable the collection of additional information; new systems may also need to be developed.

It is also recognized that the readiness system used by Special Operations Forces does not currently fit into the construct of IMRS and therefore inclusion of such reporting will need to be considered in future spirals.

3.3 Priorities for IMRS Implementation

A priority for the IMRS is to establish linkages (service level agreements) with existing systems within the CF infrastructure that provide relevant information to support the envisioned system functions. Relationships with these information providers will need to be established to influence their evolution to include the data capture of additional information necessary to support the monitoring and planning functions that the IMRS will provide. The first iteration of the IMRS should focus on providing a presentation of the information available in a format that supports the monitoring function. The development of a capability based Joint Task List is a high priority to enable much of the monitor function.

3.4 Capabilities not Included

The IMRS will not take on the task of tracking cost or providing planning tools related to the costs of readiness or operations. However, the capability based task framework could provide force generators and employers a framework for capturing costs. The IMRS will not handle external risk factors as that is not in the scope of what IMRS does. For the moment the civilian side of DND force readiness is not being looked at in this document.

4 Concepts for the Proposed System

The SJS assembled a team in December 2008 to review the status quo and analyse requirements for an IMRS. This chapter presents the results of this analysis and subsequent developments.

4.1 Scope

The IMRS will be a network of interdependent programs, processes, applications, and systems supported by directive and doctrine that enable and support readiness-related decision making. IMRS establishes the "framework" of architectures, databases, tools, networks, and information technologies that provide the backbone for the CF's readiness measurement, assessment, and reporting and readiness-related decision support.

The mission of IMRS is to provide a mission-focused, capabilities-based, common framework that provides the force employers, force generators and strategic leadership a data-driven environment and tools in which to evaluate the readiness and capability of the CF to carry out assigned tasks of today and potential tasks of tomorrow out to a time horizon of 3 – 5 years dependent on force employment data.

All this said, the tool developed for the IMRS will be an application or "system" that pulls together the information available in the five force generator readiness reporting systems (described in chapter 3) to report current readiness and predict future readiness.

4.2 Current Readiness Reporting System Needs

The IMRS should provide tools to enhance the following readiness reporting capabilities.

a. IMRS should allow users to retain the key functionality currently in the existing readiness systems which remain of value and useful to the respective force generators.

b. IMRS should facilitate deliberate planning efforts in peacetime and assist in deployment preparations through major contingency operations and Operational Plan execution.

c. IMRS should provide inputs and outputs to a variety of command levels: information providers can also be consumers of the readiness information through standard reports and ad hoc queries.

d. The aggregation of sustainment information from the building of force packages, and supporting units and agencies should enable the provision to commanders of a realistic picture of capabilities to execute a mission or plan.

e. IMRS should portray the readiness of forces to carry out actual missions and assigned tasks on an individual and collective plan basis.

f. IMRS should enable the broad sharing of information, and provide decision makers common access to the most up-to-date information possible, leading to shared situational awareness. The goal is to improve the efficiency of readiness reporting by merging previously unrelated stove-piped data environments and the various reporting assessment metrics into one authoritative source. IMRS design should strive to minimize demands on bandwidth in this net-centric approach.

g. IMRS should provide the capability to identify risks tied to specific resources by mission.

h. IMRS should provide readiness management capability to the CF strategic commanders and transparency to individual force generators and force providers.

i. Similar data resides in many locations in many different manual and automated systems. IMRS must be able to communicate and extract the data from the most accurate data source or in the case of multiple sources, depict what would be considered the most accurate data.

j. Data systems and force generation readiness systems already exist in some form within each of the Force Generator organizations. In developing and implementing IMRS, the development team will leverage existing capabilities as it incorporates a more joint and collaborative perspective and augments and enhances them with advanced information technologies.

The IMRS should allow commanders and planners to evaluate the readiness and capabilities of units, individually and collectively, and to identify capability gaps in near real-time. It should provide a framework for the development of plans for response to contingencies, independently, and in the context of other ongoing or required missions. IMRS should also provide decision makers the capability to conduct sensitivity analyses that test "what if" situations rapidly to help determine the viability of alternative courses of action. Collaboration techniques and technologies for the viewing, reporting, and management of readiness status are important and should be available within IMRS as well or be provided as broader system tools in the Consolidated Secret Network Infrastructure (CSNI).

4.3 Operational Policies and Constraints

By leveraging leading-edge technologies and methodologies (e.g., service-oriented architecture, Web services, intelligent agents, Common Extensible Mark-up Language Data Vocabulary), IMRS will provide high-quality readiness information to decision makers on demand, which will provide the time and capability to make more reasoned decisions. The Interim Directive establishes a common language of tasks, conditions, and standards to describe capabilities essential to the completion of every mission. IMRS data is to provide timely, accurate information for planning, readiness, and risk assessment purposes. Included in this data is the following:

a. Overall Mission Readiness / Individual Task Readiness;

b. The current Organizational / Hierarchical structure of the CF;

c. Personnel, Equipment, Training, and Supply Status Information; and

d. Availability and Current Location of Assets for Missions/Tasks (last reported).

The following guiding principles should apply to the design of the IMRS.

a. With the evolution of the CF Information Technology (IT) infrastructure the IMRS should be designed to transition to operations within a Service Oriented Architecture.

b. Every effort reasonable should be taken to minimize the impact on Force Generator readiness reporting systems.

c. The system should assume the data conversion and computational load within the IMRS.

d. A management board should be assembled to manage change and ensure compatibility across all systems. This includes the requirement to fit the system into the Integrated Capability Assessment Team structure of the capability development framework.

e. The IMRS should leverage standards-based leading-edge technologies.

f. As much as possible software developed to support the IRMS should be designed as reusable components (e.g., services).

g. The approach to this task should be to use the existing readiness reporting systems as a basis, rather than design a new, independent system.

h. User access controls must be implemented to allow Read & Write or Read-Only privileges as appropriate, as well as domain restrictions.

i. The role of the IMRS is a presentation and analysis service in the CF SoS.

j. DND Architectural Framework (DNDAF) could be employed in the formal requirements definition and systems analysis of the IMRS. (The use of the nascent Human Views could be examined given the key role of Chief of Military Personnel.)

4.4 Description of the Proposed System

The IMRS will reside on the classified network CSNI but will need to acquire information that resides on the unclassified DWAN as well as within the environmental enclaves within the CSNI. The following Figure 3: CF Systems and Information Flow for “as is”, presents this complex environment.

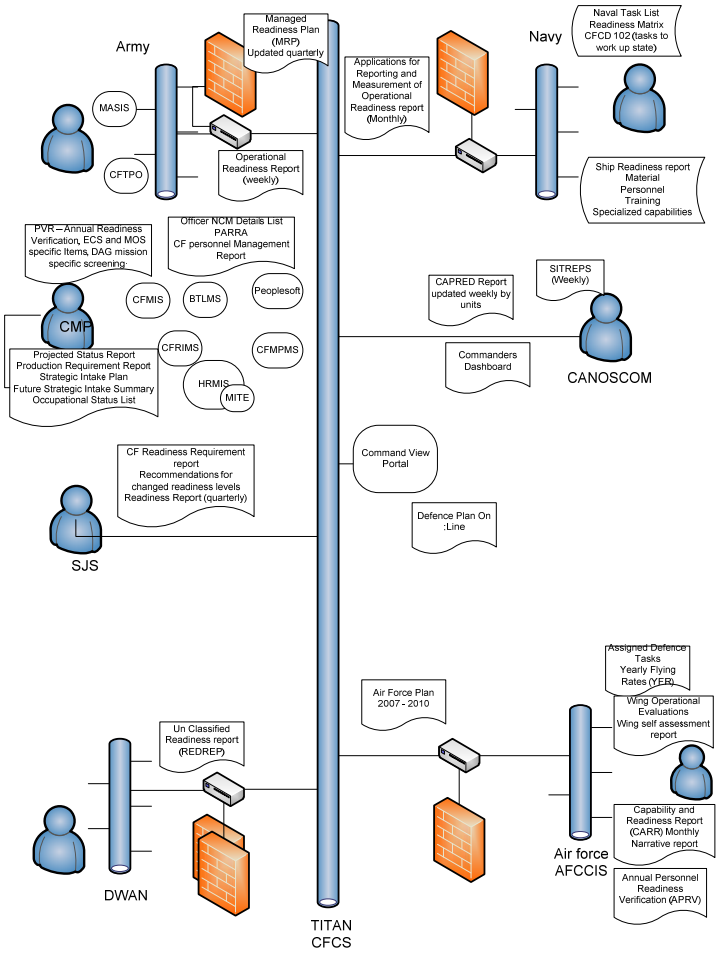

Figure 3: CF Systems and Information Flow for "as is".

The IMRS will principally be an information presentation and analysis service on the CF network. It will draw information from the systems-of-record for the underlying information required to Monitor and Plan readiness.

It is envisioned that there will be three categories of users of this system: those who perform data entry, monitor and plan, and administrative functions. Most data required will be automatically collected from systems of record; data entry for the remainder will be performed at the lowest level possible. With regards to unit and higher training the status would be entered by the staff of the organization responsible for certification. The users who are Monitoring and Planning (Research and Analysis) will use this system to respond to requests by the GoC for the CF to accept new taskings or to report to the CDS and/or Commanders on the progress being made with regards to being ready to fulfill CF commitments. The administrative user will set up accounts and organizational information required for the IMRS to function. The following sub-sections present more detail on the features available for each of these three functions.

When a user of the IMRS is on the "home page", a summary of the overall CF readiness posture should be presented. The user should have access to the data entry, monitoring and planning, and administration tools appropriate to their assigned roles on the system.

4.4.1 Data Entry Function

This is a major sub function of the system aimed at providing an easy tool for gathering information that is not available from existing systems. Over the life of IMRS the information being collected in this function should migrate to the appropriate systems of record which are then accessed automatically. Thus at some point this function could be removed from the readiness system.

This function should allow information to be captured with minimal user input. Thus, the IMRS interface should auto fill fields as much as possible and the user then only changes fields requiring updates. The use of pull down or pop up menus that provide the choices should be leveraged as much as possible. The information that will need to be captured by this function will not be known until the complete analysis of the information available in systems on the CSNI and DWAN has been completed. However, information that is currently captured at the unit level such as daily Parade state reports could be implemented as a web page and provide an export to IMRS feature to enable the units to maintain their existing processes with an "enter once" capability.

This function will also allow senior decision makers to review the readiness data regarding a unit and enter additional comments (i.e. qualitative assessments) to be attached to the readiness report. These comments will provide the commanders assessment of the impact of the unit readiness profile, expected changes, etc.

With regard to Data Entry, it is important that the following principle is enforced: for all data directly entered into the IMRS or extracted from other systems, the original source of the data must be recorded and all changes to the data must be traceable. (Ideally, this principle should be applied across all CF systems linked to by IMRS.)

4.4.2 The Monitor Function

The Monitor function provides the users with the ability to view the up-to-date status of the units (people, training, material and equipment) assigned to high readiness tasks as well as the status of all residual units currently not assigned to high readiness tasks. The system should be hierarchical in nature to allow a drill down capability to view readiness information down to the individual capability, task, unit and person level.

It is envisioned that there are six views of the underlying information that need to be available for presentation.

1. A view that allows the user to look at Readiness against:
    - Doctrinal and actual force structures;
    - Anticipated, assigned & outstanding tasks;

- Capabilities available to field versus fielded; and
- Assigned readiness levels.

2. A view that presents the readiness of the units assigned to execute the current and future assigned Tasks (capability).

3. A view that allows the user to look at units by their Readiness level.

4. A view that allows users to identify where CF assets are geographically, and to drill down on a location to identify the units and readiness status of assets at the location. This is the Geospatial view of tasks and force structures (using the geospatial capability of the existing Geographical Information Systems).

5. A view that allows users to look at historical patterns for units and taskings over time.

6. A means to develop and save Custom views. This view would allow the user to select a custom report by identifying the required data from a fixed set of fields. However there will be limits to the depth that the custom views will allow the user to specify (i.e. below a set-level information is not available from this system). There will be a maximum of three or four levels presented as a limited list of options to the user to select from. As the user selects an option there will be a sub list presented which will have options that are related to the earlier selection. Once a report has been defined the user can save the report and return to a refreshed version in the future. This custom view will need to provide an intuitive and user friendly interface.

In addition to these views, other functionalities should be made available to users monitoring the readiness posture of the CF. The following list of additional desired functionalities is not exhaustive.

1. A drill down capability should be included in every view made available to the user, to enable access to readiness information down to the level of distinct capabilities, tasks, materiel assets, force structure elements (e.g. units) and individuals.

2. A search function allowing users to search for specific force structure elements (e.g. occupations, units), supplies, equipment, or geographic locations should be included. The result of the search should be a page displaying the readiness levels of the personnel and materiel assets selected.

3. The geographical view should be map based: users identify locations on a map rather than from text lists. When the user selects a location, a window should open showing details on the facility/unit(s) at that location and their readiness status.

4. Tools should be provided to enable users to see where potential break points are (e.g. in terms of operational tempo and sustainment) based upon current missions and resource allocations.

5. A reporting tool is required to allow users to create exportable reports; this should facilitate briefs to decision makers.

4.4.3 The Planning Function

As the IMRS is a decision support tool, not a decision making tool, the aim of the Planning function is to enable the provision of relevant information to decision makers. The IMRS should not be designed to provide 'optimized' solutions based on 'black box' algorithms that are not transparent to the user. While data collection and some analysis methodologies maybe automated within IMRS, the assessment and interpretation of the information should be conducted by the end users and decision makers in the relevant chain of command.

The Planning (Options and Risk Analysis) function should have the same set of six views identified in the Monitor function but provide new tools for Course of Action (COA) analysis (in the readiness context) and to identify issues and differences. The Operational Planning Process (OPP) and the associated tools are where the real resources and options are identified. Thus, there should be a link between the OPP tools and the readiness tools.

The six views and additional five functionalities envisioned for the Monitor function of IMRS (Section 4.4.2) also apply to the Planning function. A further set of functionalities that will be required to meet the unique requirements of the Planning function are listed below.

1. Tools that enable the user to respond to questions like "Can the CF do Tasks A, B , C in 6 months, 18 month, 24 months, etc".

2. Tools to display all assigned tasks over a give time horizon and the anticipated readiness status of the underlying force capabilities that are to fulfill the task (e.g. colour coded Gantt charts).

3. Tools that provide operational planning support by assisting in identifying:

    a. The number of units that are available for a given task at hand;

    b. If units are effective in a needed area. (A unit may only be at standard readiness and yet be fully capable of a mission such as "support to civil authority");

    c. Units and resources available for a task within a defined Geographic area;

    d. The availability of equipment/material for options;

    e. Forces that are committed and non-usable during the time frame being planned; and

    f. Where there are voids in capability for handling existing missions.

4. Tools that enable the planners to:

    a. Track people/equipment and supplies impacts that could degrade the CF's ability to provide or continue to provide a capability for executing an assigned task;

    b. Identify the potential tasks which the CF will not be in a position to undertake given current and planned commitments;

c. Identify the future availability (capability to release) of resources within the CF;

d. Assist in developing a common plan for rotations, refits, etc. within the desired operational tempo; and

e. Identify the required logistics tail for a unit when it is assigned to a task.

5. Tools that provide assistance in identifying and developing a COA for a specific task by enabling:

   a. Creation and entering of a new task in the system;

   b. Identification of units that have a capability to support the mission;

   c. Assessment of unit readiness and ability to perform a potential task(s) associated with a mission;

   d. Inputting the Commander's qualitative assessment of a unit's readiness status;

   e. The assignment of resources to tasks;

      - Identifying the impacts on readiness in the short, medium and longer term, of assigning specific resources to tasks (for example point out the potential to run out of resources for a rotation at a point in the future due to retention, and training length issues with respect to rotation schedule).

   f. The identification of tasks that need to be considered when developing a plan;

   g. Viewing the interrelationship of the different CF Taskings over a specified time frame;

   h. Identification of the resources available over a specified time frame;

   i. Identification of friction points and resource shortages within a plan or across all assigned tasks and a set of planned tasks;

   j. Identification of potential risks and lack of resources within a current course of action being developed for a task; and

   k. The performance of Historical Data Analyses to inform planning for future task allocations. Temporal analysis related to operational/personnel tempo and reallocation of resources to meet task requirements, as well as lessons learned could be used as appropriate to inform new plan development.

6. Simulation capabilities that allow the planner to run what-if scenarios for a given plan or set of plans, to examine the downstream impacts of potential COAs.

7. The capability to capture the start-state as well as the options being analysed for what-if and COA analyses. This start-state along with the options analysis shall be saved separately from the baseline readiness information.

In order to support this functionality the system must have access to all future planned taskings. The system must be able to flag when resources are utilized beyond their capacity and to flag issues that result from sudden change. When performing any of the analyses above, the system should provide the user with information on:

a. The impact(s) of the addition or subtraction of a task;

b. The impact(s) of the addition or subtraction of a resource;

c. The level of residual resources and the impacts on other tasks; and

d. Historical patterns (to facilitate trend analyses) such as

    i. Repetitive taskings

    ii. Resource consumption and failure rates

4.4.4 The Administration Function

The Administrative user will have a series of tools to enable: the management of accounts and users; information management functions; and the linkage of new CF tasks/capability packages to resources.

The typical account management tasks such as the creation, deletion, and management of user accounts and privileges will be available along with the ability to reset user passwords.

The information management tools will enable the operator to:

1. Review and analyse the data audit trail;

2. Update and encoding business rules;

3. Manage IMRS data archives (The information entered by a user of the system needs to be archived. Data from other systems are not archived.); and

4. Ensure the interface to existing systems (which should be an automated function), is working.

The ability to link new CF tasks/capability packages to resources is performed in response to a Commander's direction to reflect orders for resource assignment, changes in unit readiness status requirements, etc.

5 Projecting Readiness – Models and Simulation

An IMRS should have a capability to project readiness and to support exploratory analysis and planning. The four components of readiness are personnel, training, materiel and supplies. To effectively project the readiness posture of DND/CF, all four aspects of readiness must be addressed.

Again the intent should be to leverage prior work. The objective of this chapter is to identify the CF processes and process models (related to the management of personnel, training materiel and supplies) that could be leveraged by an IMRS to support readiness prediction. It is readily apparent that considerable leg work has been done (by DRDC/ Centre for Operational Research and Analysis (CORA) in particular) over the years to capture the relevant critical business processes, develop modeling & simulation tools and support analyses. The Operational Research studies cited below are illustrative, not necessarily exhaustive, and have been included as examples of how these processes have been modelled and are currently simulated. They are representative both of how the readiness projection capabilities might be expanded to support an IMRS and the requirement for model expansion and integration.

5.1 Personnel Readiness

A number of discrete models have been developed to examine specific aspects of personnel readiness management (e.g. recruitment and career progression).

The first of these is the Production and Strategic Intake Model (PSIM). It is an Excel-based tool developed to support the Annual Military Occupation Review process. Two separate versions have been developed - one for officers and one for Non-Commissioned Members and these are used to assist in the setting of production and recruiting targets. The PSIM model is populated with occupational specific data and provides customized military occupation perspectives. PSIM can:

- Project occupational attrition, Trained Effective Strength and manning gaps[4] for the next 10 years;
- Calculate annual recruitment targets (by entry plan) required to meet production targets; and
- Estimate the basic training and occupational specific course loading.

Whereas the focus of PSIM is on recruiting, the focus of the Production Management Tool (PMT) is on occupation specific training from recruitment to the operationally qualified point. The PMT models, in detail, occupation specific training pipelines. It is used to identify potential bottlenecks and to forecast the downstream effects of changes to the training system (e.g. the effects of increasing class size or cancelling a course). PMT is an event-based simulation tool and has three major components: an Arena-based simulation environment[5]; a database that contains

[4] An occupation's manning gap is the difference between the Preferred Manning Level and the Trained Effective Strength.

[5] Arena is a commercial, off-the-shelf modelling and simulation environment. It is often used for modelling industrial processes, although it also has applications in other areas, including human resources.

information required by and produced by the simulation (including information on past, present and planned courses as well as the training history for each individual in the pipeline); and a Graphical User Interface which includes a series of spreadsheet-based templates used for producing a variety of charts and reports. The outputs indicate anticipated course demands levels, and durations of each stage in the training pipeline given a specific simulation scenario – that is, what the future status of the training pipeline flow could be. Figure 4 is an example showing capacity and projected demand and attendance for the Basic Air Navigators Course. [6]

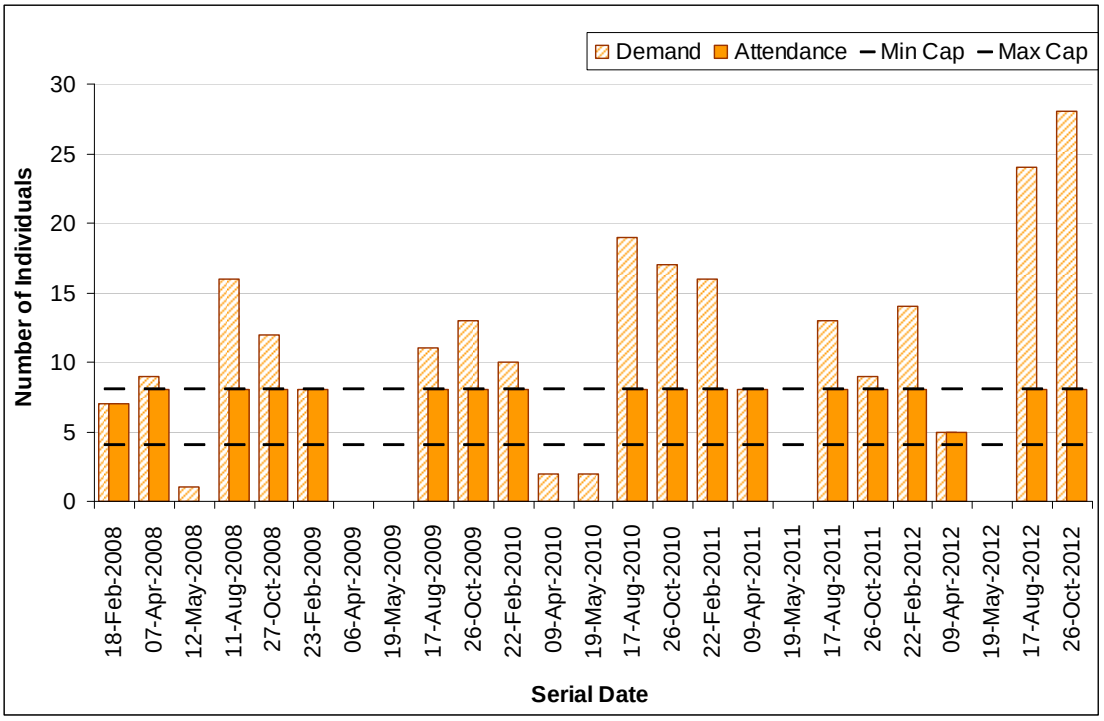

Figure 4: Demand and Attendance for Basic Air Navigators Course 14 Feb 08 – 13 Feb 13.

Using the PMT, existing or arising scheduling problems can be identified, and "what if" testing can be performed by adjusting pipeline parameters so that potential solutions to these problems can be explored. The aim of the PMT is to optimize training through put and accelerate production of operationally qualified personnel following recruitment. It complements the PSIM.

The Arena Career Modelling Environment Individual Training and Education (ACME IT&E) Projection Tool models IT&E within a rank-oriented career progression perspective. As a career progression modelling environment, it enables projections of the future demographics of the CF (number of personnel by occupation, rank, qualifications) up to 20 years into the future. In tandem with this capability, it provides projections of future yearly demand levels for career progression courses (the IT&E component).

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[6] Michelle Straver, Stephen Okazawa, Andrew Wind and Patricia Moorhead, Training Pipeline Modelling Using the Production Management Tool, NATO RTO-MP-SAS-073 Symposium, Paper 15, March 2009.

ACME IT&E can accommodate up to 50 "basic" Qualifying Level courses required for promotion and 50 specialty courses. The output charts generated provide occupational years of service, time in rank, release, and course enrolment profiles plus confidence interval analysis of course demand and risk assessments. An example is provided below (Figure 5).[7]

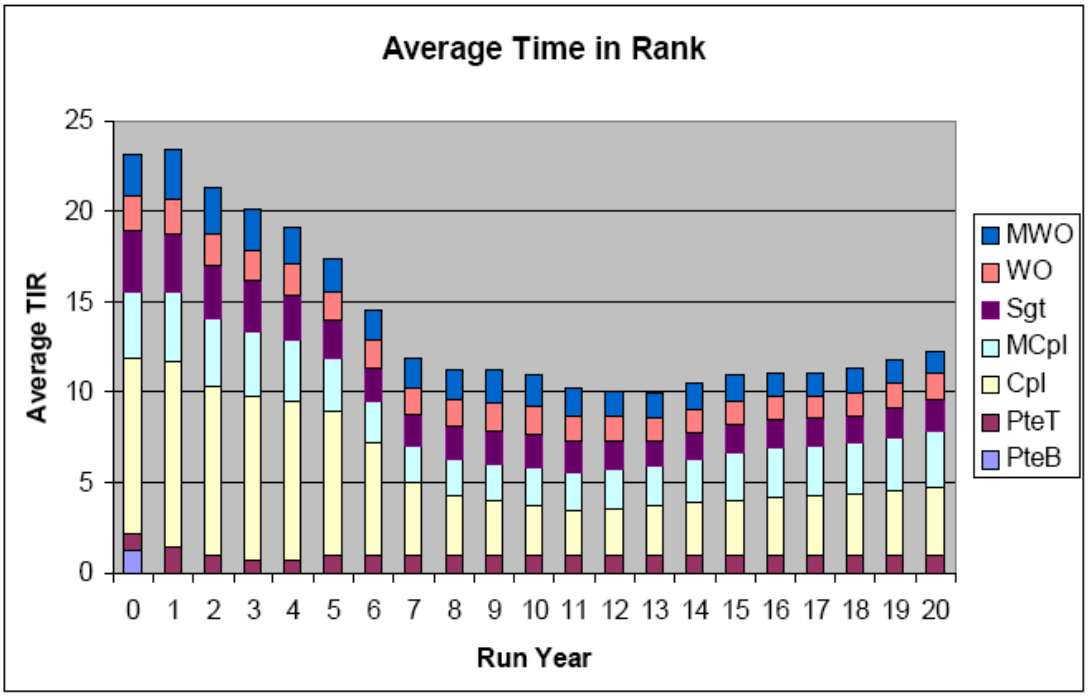

Figure 5: Average Time in Rank, by Rank.

Personnel readiness is concerned with tracking and projecting capacity and capability issues. Both are inextricably linked to recruiting and retention and to individual training and education respectively. The models described above provide the genesis of an integrated predictive model for personnel readiness. The second core element in readiness relates to equipment.

5.2 Materiel Readiness

A number of studies have been conducted and models developed to forecast servicing requirements and equipment availability. These tend to be fleet specific. The following are, again, illustrative rather than exhaustive examples of the types of analysis conducted.

The CH 149 Cormorants are dedicated Search & Rescue helicopters operating from dispersed Main Operating Bases. After a few years of operation, the observed aircraft availability was less

[7] Stan Isbrandt and Antony Zegers, The Arena Career Modelling Environment Individual Training and Education (ACME IT&E) Projection Tool, DRDC CORA TR 2006-03, March 2006.

than predicted. A study was conducted by the Material Group Operational Research Team[8] to forecast the availability of the fleet and determine the appropriate number of aircraft required at each main operating base. An Autoregressive Integrated Moving Average model, utilizing historical availability data, was developed to project CH 149 fleet availability over a 4 year horizon. These projections were compared to the minimum requirements detailed in the initial statement of requirements. Sensitivity analyses were conducted which highlighted the impact small changes in availability can have on the number of aircraft required.

A simulation model was also developed using the Arena software package, to determine the number of aircraft that would be available at each base at any given time[9]. The results confirmed that targets could not be met even given ideal spares support – the maintenance demands need to be reduced or aircraft numbers increased to meet performance objectives. It also demonstrated, as might be anticipated, that reductions in inspection durations had a significant impact on availability and the number of aircraft required. These modelling efforts are significant as they provided a link between monitoring and planning activities.

A second relevant study is in support of the Medium Support Vehicle System (MSVS) Project. This project will purchase 1,500 standard military pattern vehicles. Two variants – a 4.5 ton cargo vehicle and an 8 ton Load Handling System - will be used transport stores and equipment. The aim of the study was to determine an optimal mix of the MSVS variants for resupply of deployed forces.[10] The daily supply requirement for the deployed task force modelled was calculated using standard planning consumption rates and pallet weights for NATO classes of supply. Multiple fleet configurations were considered and an integer linear program used to determine the minimum vehicle requirements. Next, replenishment concepts for different fleet configurations were examined and a simulation model constructed incorporating factors such as loading times, reliability, convoy speeds and equipment availability. Finally, multi-criteria decision analysis was exploited to determine the optimal mix of MSVS vehicles. The MSVS study provides an excellent example of the effectiveness of operational research in defining requirements and supporting procurement programs. More significantly for an IRMS, this methodology could be readily imported and used to assist in mission analysis and fleet “sizing”.

5.3 Operational Readiness

There are fewer examples of training and sustainability models. These must be, by definition, integrated and there is obvious overlap with some of the simulation models previously described.

The Managed Readiness Simulator (MARS) was developed to assist in sustaining a prescribed readiness posture and in evaluating Land Force policy, supply and demand related options. It was designed with a number of objectives in mind:

- To support gap analysis between supply and demand based on proposed demands and existing "Managed Readiness" processes;

[8] Raman Pall, On Forecasting the Availability of the CH149 Cormorant Fleet, DRDC CORA TR 2007-20, December 2007.
[9] Raman Pall, On the Availability of the CH149 Fleet, DMGOR Project Volume I-08. May 2008.
[10] Bohdan Kaluzny and Adrian Erkelens, The Optimal MSVS Fleet for First-Line Replenishment. DRDC CORA TR 2006-026. December 2006.

- To provide a means to anticipate and appreciate sustainability issues (e.g. operational capability, resource utilization costs, training and maintenance efforts, and the ultimate quality of forces fielded);
- To facilitate the development, validation and testing of new and different Force Generation, Human Resource and Material Support strategies (e.g. resource allocation, activity scheduling, unit synchronization, and functional management); and
- To assess potential force structure/establishment changes.

MARS is composed of four basic components:

a. A graphical interface that facilitates the creation and management of scenarios;

b. A discrete event simulation kernel;

c. A relational database that stores scenario input and output data; and

d. A graphical interface that provides access to a series of post-processing routines for analysis and interpretation of simulation results.

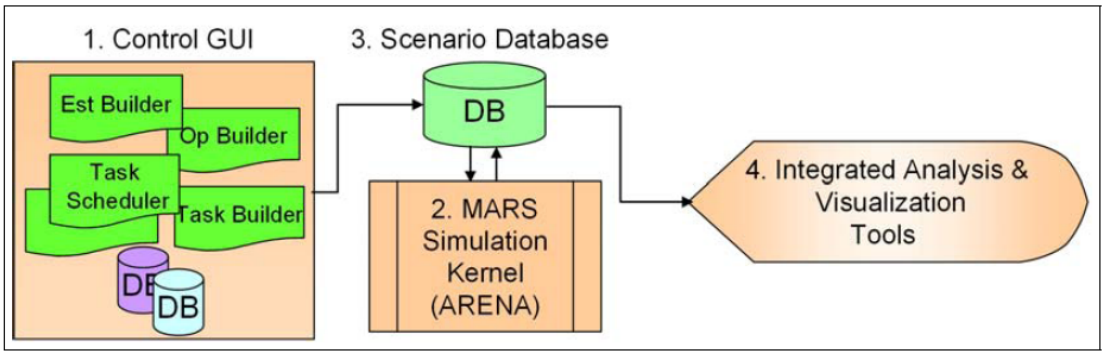

Figure 6: Basic MARS Architecture & Data Flow.[11]

The focus of the initial effort has been the development of a "proof of concept", and a prototype has been constructed. A number of areas ripe for further development have been identified (tracking human resources, costing, prescriptive scheduling, in situ analysis, resources, capability matching, generic constructs, quality and data collection) and are described in more detail in a CORA Technical Memorandum[12]. A number of observations are noteworthy. MARS is an ambitious project - it endeavours to model repetitive, concurrent and/or random taskings, represent the associated competition for resources and forecast overall (interrelated) implications: in short, to support dynamic "what if?" analyses.

[11] Chad Young, Raman Pall and Mike Ormrod, A Framework & Prototype for Modelling Army Force Generation, DRDC CORA TM 2007-54, December 2007.
[12] Ibid.

From an IRMS point of view, MARS is “poised to integrate data that is not currently integrated with other analysis tools”. It might provide a departure point for development of an in house IRMS. Equally important, integrated systems such as MARS facilitate shared awareness incorporating both force employment force generation perspectives. There are several Allied efforts also converging and attempting to address this shortfall.

5.4 Allied Models

A brief survey has been conducted of models and simulation in use with Allied Forces. Common responsibilities include elements of policy formulation, strategic planning and implementation monitoring responsibilities and common challenges related to increasing interdependency, compressed decision cycles and transition towards continuous, adaptive planning. Nonetheless the review would suggest that there are not many holistic readiness reporting systems in use capable of supporting readiness projection functions. It is noteworthy that the two systems that have been identified have been developed specifically for military use. They are presented, again as illustrative representations.

5.4.1 MAPS

The Manpower Analysis Planning Systems (MAPS) Defence Suite is a commercially developed application developed to support Capability Management. It is currently in use the United Kingdom, Australia and Singapore. MAPS incorporates feeds from personnel, equipment and financial databases to support Force Planning, Force Preparation and Force Generation. It is the former function which has specific IMRS forecasting application; MAPS can be used to explore alternative futures and model force structure options. It attempts to optimize capability (supply) to requirement (demand) matching by creating a schedule of future commitments and evaluating the ability of plans to satisfy requirements. The Force Preparation and Force Generation are complementary functions which include consideration of readiness phasing, coordination of training and nomination of units, down to and including individual training and augmentation. An attractive analytical feature is the ability to look across planned operations and identify potential problems such as vacant positions and/or competency shortfalls. Figure 7 depicts an illustrative screen shot – a Gantt chart representation of the training and operational commitments for selected units.

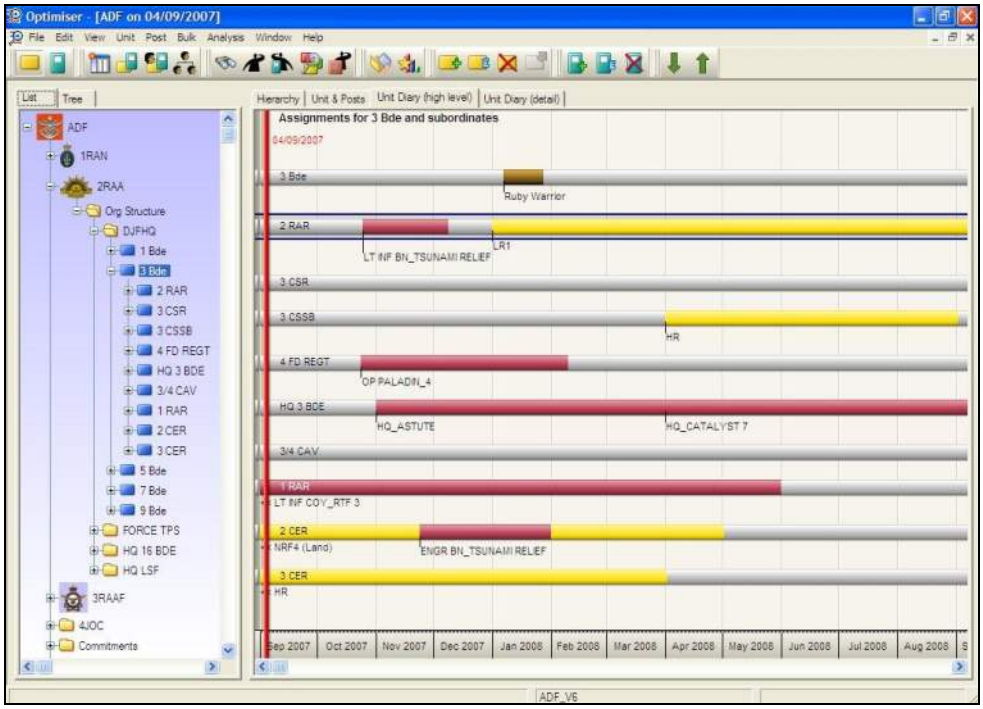

Figure 7: MAPS Diary View of Selected Force Elements.[13]

MAPS is representative of a commercial off-the-shelf (COTS) product. As the name of the software supplier suggests (Manpower Software) and moniker (right people, right place, right time) its departure point is personnel availability and training,

5.4.2 DRRS

The readiness reporting system in use in the United States is representative of a government off-the-shelf (GOTS) solution. It has many of the same objectives as MAPS but takes a slightly different tack.

The Defense Readiness Reporting System (DRRS) also offers a suite of applications to support force mangers. Requirements are defined using a Joint Mission Essential Task List. DRRS provides the "framework of architectures, databases, tool, networks and information technologies that provide the backbone for the Department of Defense's readiness measurement, assessment, and reporting and readiness-related decision support".[14] Commitments (core tasks, major war plans and directed current operations) are expressed in terms of hierarchical Mission Essential Tasks (MET) with prescribed standards and these form the basis for assessing unit readiness. Strategic planning and risk assessment is accomplished through relating MET demands to the detailed information on individual and organizational readiness resident in the Enhanced Status of Resources and Training System (ESORTS). The tools will identify units capable of supplying the

[13] Manpower Software, Defence Capability Management Overview: MAPS Defence Suite 6, July 2008.
[14] Office of the Secretary of Defense, DRRS Concept of Operations, 2 December 2004.

mandated capability and highlight multiple apportionments and high risk areas. An example of ESORTS Mission Assessments is shown in Figure 8: ESORTS Mission Assessment.

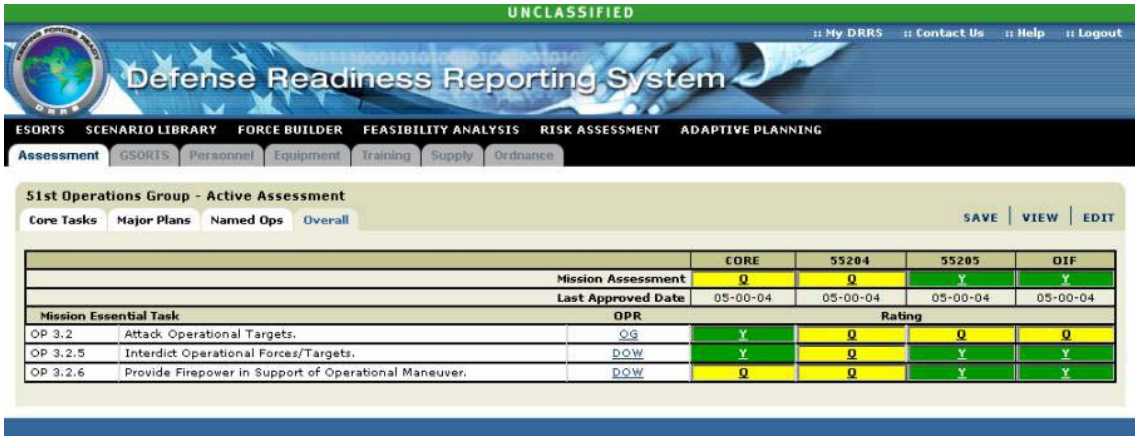

Figure 8: ESORTS Mission Assessment.

MAPS and DRRS are representative of existing IRMS incorporating strategic planning functionality. Both are capability focused (although they adopt different approaches – MAPS views capability from a human resource and "key battle winning equipment" perspective and DRRS from a mission essential task list perspective) and are designed to support distributed team collaboration. Each has substantive strengths and weaknesses, as well as advantages and disadvantages relating to the associated procurement approach. A Technical Review Workshop was convened in 3-5 February to consider these options; the next section summarizes the results of this review.

6 Options for the IMRS Development

6.1 Benefits from and Challenges to IMRS Development

The following key improvements have been identified and should accrue if an IMRS is adopted:

a. The ability to present to CDS and senior management a recognized, holistic depiction of current CF readiness (e.g. an overview of the readiness posture of all CF units, not just those on High Readiness);

b. The ability to both aggregate or to disaggregate (drill down) information and to offer interactive, tailored views (e.g. unit, platform/equipment and individual competency perspectives);

c. The ability to empower strategic management linking Force generation, Force preparation and Force employment planning;

d. The ability to improve staff assessments of the impact of new tasks; and

e. The ability to project: the status of current tasks; impact of assigned resources and unassigned resources and conduct exploratory options analysis.

The IMRS envisaged is dependent on the availability, currency and integrity of the data contained in existing systems. This poses technical and personnel challenges – both of which lie beyond the SJS/IMRS staff's ability to resolve – although they can inform. The development and introduction into service of an IMRS is a "nested" challenge and dependent on the breadth and pace of enterprise wide integration and system specific migration. There may be a requirement to collect some more data or alter the information structure. Already much of the data entry is done as a secondary duty i.e. the system offers little incentive to transform particularly if change is not championed throughout the chain of command.

6.2 Alternatives and Trade-Offs Considered

There are several options for acquiring this IMRS capability:

Option 1: Purchase an Existing GOTS System

The US Armed Forces has developed a very advanced system that could be purchased by Foreign Military Sale. Modifications would be required and scalability of this system could be an issue.

Option 2: Purchase and Modify Existing COTS System

The UK MAPS (MAnPower Software suite) is one example of a COTS solution. Some modifications would be required to implement such a system for the CF.

Option 3: Integrate existing systems and develop an In-House Solution

This allows a staged development in which the operational requirements are implemented incrementally. This could be merged into the planned evolution of the CSNI and designed to exploit the services available on the network.

Option4: Contract Out – Request For Proposals

A system could be developed by Industry. It is likely that much of the system would need to be developed from scratch and/or by exploiting modules within various existing commercial tools.

In an effort to provide an informed assessment of these options, the CF held a 3-day workshop. The results of this workshop have been presented in the report titled "CF Integrated Managed Readiness System Technical Review Workshop" [3].

6.3 Evaluation Criteria

As a result of the workshop held during 3-5 Feb 2009 the evaluation criteria have been examined and the Suggested Evaluation Criteria are summarized in Table 1: Evaluation Criteria for the eventual system. The focus for the automated system is threefold: report current readiness, project future readiness and interface to existing CF data resources.

Table 1: Evaluation Criteria for the eventual system.

Main Criteria	Sub Criteria
Operational requirement	business outcomes
	Scalability
	Adaptability
	interoperability with DND/CF systems
	user friendly / ease of use
	meet user requirements
Institutional Requirements	alignment with Information Management strategy
	Treasury Board common look & feel
	application accreditation
	defence Enterprise Resource Planning tools
Procurement	level of effort (include process cost)
	Timelines
	procurement management
Development	programme management
	Timelines
	Cost

Main Criteria	Sub Criteria
Implementation	level of effort (integration, compliance, accreditation, modifications, etc)
	programme management
	time to Initial Operating Capability
	cost (includes purchase cost)
Sustainment	robustness (custom modifications)
	Costs
	Management level of effort
	Configuration (ease of modifications)
	data entry load
	alignment with future capabilities
	PRICIE (Personnel & Training, R&D, Infrastructure, Concepts/Doctrine, IT infrastructure, equip/supplies/services) elements

6.3.1 Option 1 GOTS

Several key issues were identified. This included concerns that:

a. Functionality: the system offered could have far greater capability than Canadian operators require/would use;

b. Customization: accommodation of Canadian requirements might be afforded lower priority than those of the host foreign government – particularly in the case of the US where scale might also moderate CF influence;

c. Fit: embedded doctrine and process would not suit the CF culture;

d. Alignment with Information Management (IM) Group Policy: institutional requirements may prove difficult to satisfy if an imported system does not support them from the outset. Adjusting to align with Government of Canada and Departmental IM policy guidelines might be problematic; and

e. Configuration: Configuration control is unlikely to be shared. Ultimately, as the system evolves, national needs might diverge from those of the foreign government and the CF could end up with an orphan configuration or drawn into following an evolutionary path determined by others.

6.3.2 Option 2 COTS

The COTs option offered several advantages. It was felt that the Department would be able to exercise greater control than under a GOTS option. A commercial company would likely be more responsive to customization requests and the solution scaled to satisfy DND/CF requirements. Additionally it was felt that system purchase would afford some influence to ensure that it met the IM/IT strategy specifications and that, depending on the size of the

company and the product market, CF users would have a somewhat easier time having Canadian derived features integrated into the baseline configuration. One concern that was raised related to security accreditation. As the system is targeted for the CSNI network (Can/US eyes only), foreign suppliers might have issues with contracting to Canadian affiliates capable of integrating the system into the CSNI network.

6.3.3 Option 3 In House Development

The third option was to develop an IMRS in house. This would likely include exploiting standing contracts and involve some managerial overhead. This option would allow DND/CF to adopt an incremental/spiral approach and provide a tailored system to satisfy operational requirements. Customization and configuration risks would be eliminated. Concerns revolved around internal governance challenges and the potential for priorities to change which could result in lost momentum and delays. Resource related issues - skills availability and sustainment and evolution of the system – were also tabled as a risk.

6.3.4 Option 4 Contract for Custom Development

It was concluded that this option would deliver a solution that meets stated requirements. The concerns noted related to the possibility of protracted contracting and development timelines and the ability to effectively manage emergent specifications and avoid costly amendments and to delays in achieving Initial Operating Capability. Finally it was also felt that the overhead for this option would likely be the largest of the four options.

6.4 Summary of Impact

The requirements and a rudimentary Concept of Operations have been laid out. The requirement for an IMRS has been acknowledged as recently reflected in the Strategic Capability Roadmap. The efficient management of military resources is key to Departmental stewardship and CF effectiveness. Current tools and processes do not provide adequate insight and decision coherence. It follows that introduction of an IMRS will impact existing capabilities.

6.4.1 Operational Impacts

The most immediate impact relates to strategic planning and operations. An IMRS would allow the CDS and senior management to monitor and project the readiness of all CF units, not just those at high readiness. It would foster a shared appreciation of supply and demand, strengthen vertical and horizontal staff collaboration and enable continuous, adaptive planning. Trust is tied to data integrity and greater transparency. An IMRS will promote information assurance and provide enhanced visibility and tacit appreciation of Command Intent. Perhaps most importantly, an IMRS will enable the CDS and senior executives to better respond to the GoC and new task requirements.

The long term impact will be to improve the planning for force preparation and generation.

6.4.2 Organization Impacts

An IMRS will have two distinct organizational impacts. Although the initial system should require minimal user training, an IMRS will, as alluded to earlier, have cultural implications. Planning doctrine – particularly at the Operational level is well established and documented; introduction of an IMRS will enhance application/instantiation of the OPP. It is envisaged that an IMRS will facilitate discharge of current roles and responsibilities, not stimulate realignment. It will also promote the development and increase the utility of communities of interest. An IMRS system will require that information that is currently maintained and stored on local networks or individual workstations to be: 1) converted to a format accessible by the IMRS or 2) entered into a new tool provided to the units for data entry. Every effort should be made to ensure the data is only entered once to minimize the work load increase. Governance will need to be addressed on an enterprise level i.e. structured to address both operator and IM/IT communities' perspectives and both customization and configuration demands. As an IMRS will reside on the CSNI network and draw information from systems of record, an important element of governance will relate to alignment with and integration into Departmental IM/IT plans.

An incremental approach to development is likely to be preferred to cater to emergent requirements and opportunities. As the IMRS evolves increased emphasis will be placed on technology exploitation and application development. A users group might be established. Tailored training and additional calls on Operational Research support may be necessary.

6.4.3 Impact During Development

System development should have minimal impact on the operational units. Most of the information required to support an IMRS is being collected in some form and distributed to some users. There will be a requirement for a transition to capture this data (residing currently at the unit level and often made available to higher levels of command) and disseminate it more widely. Issues to be addressed include concerns that unit level entries may be inappropriate and/or subject to misinterpretation and, hence, should provide for review and filtering. Patience, sensitivity to such issues and continued, open dialogue will be needed to establish both Standard Operating Procedures and trust. Development of a formal risk mitigation strategy might be useful – and the development process as valuable as the product.

6.5 Further Investigation and Mitigation

The following section looks at the way forward from a systems engineering and a system of systems perspective. It provides a high level road map followed by the identification of risks and issues that will confront the evolution of the project.

A typical system progresses through a common series of stages where it is conceptualized, developed, produced, utilized, supported and retired. The representative system life cycle model shown in Figure 9: Representative life cycle model, illustrates this passage.

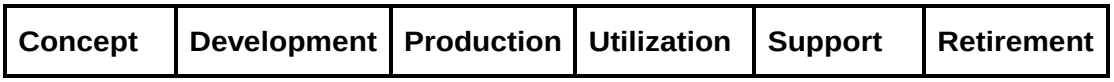

Figure 9: Representative life cycle model.

The following Table 2: An example of stages, their purposes and major decisions gates presents each of these lifecycle stages with a description of the purpose of the stage and the major issues that influence the transition from one stage to the next.

Table 2: An example of stages, their purposes and major decisions gates.

LIFE CYCLE STAGES	PURPOSE	DECISION GATES
CONCEPT	Identify stakeholders' needs Explore concepts Propose viable solutions	Decision Options: - Execute next stage - Continue this stage - Go to a preceding stage - Hold project activity - Terminate project
DEVELOPMENT	Refine system requirements Create solution description Build system Verify and validate system	
PRODUCTION	Produce systems Inspect and test	
UTILIZATION	Operate system to satisfy users' needs	
SUPPORT	Provide sustained system capability	
RETIREMENT	Store, archive or dispose of the system	

7 The Way Ahead

An effort has been made to follow recommended Institute of Electrical and Electronics Engineers (IEEE) processes. This report is the culmination of the first "Concept" stage. The next phase in the IEEE process focuses on development. As this "system" will involve integrating data feeds from a multitude of other systems, it can be characterized as a SoS and as such will require a more complex governance and management structure to oversee development, introduction into service and maintenance.

Understanding these systems and relationships will involve integrating a number of different dimensions. Typically in this area, system functionality is defined first; i.e. how data is shared. However relationships are also very important in modelling and analysing a SoS. There are:

a. Operational relationships (how do the systems work together in the operational environment);

b. Organizational relationships among the systems (who is responsible for management and oversight of the systems);

c. Resource relationships (who is responsible for funding which aspects of the systems and how are they related to the SoS funding authorities);

d. Stakeholder relationships;

e. Planning relationships among the development processes, plans of the systems, and the SoS (waterfall, incremental, agile development approaches, timing and scheduled events);

f. Technical interfaces among the systems (what communications linkages exist among the systems) and

g. Requirements (what is the relationship between the requirements of individual systems and the SoS).

A key part of the SoS engineering process is to establish a persistent technical framework for addressing the mutation of the SoS to satisfy evolving user needs, including possible emergent changes in individual system's functionality, performance or interfaces. This framework is essentially a high level design of the SoS, often referred to as the 'architecture' for the SoS. This overarching framework does not address the design details within the individual systems but rather, defines the way the systems interface to satisfy user needs and the functionality each system contributes to the overall SoS. It addresses the implementation of individual systems when the functionality is key to crosscutting issues of the SoS.

The next step in the systems engineering process, for IMRS, is to develop this overarching framework. The architecture articulates and augments the CONOPs. The business processes associated with the information management and governance for each system needs to be captured. Where information exists in multiple systems the relationship between this information

needs to be established to ensure that the authoritative information or process is exploited in the architecture. Architectures provide the means to address complexities, to structure relationships, discipline engineering and enforce consistency.

Once an architecture has been completed, options analysis can proceed and the four options can be evaluated objectively. A gap analysis (performance of “as is” versus “target” architectures), cost and schedule assessment will then provide the information necessary to inform option selection. It will also allow work packages to be described for the individual systems and the interfaces defined for the portion of the system to be developed/procured this will allow service level agreements to be implemented with the authority for each of the existing systems.

There are a number of methodologies and standards for representing this information that have been developed over the years. Two potential mechanisms are the Department of Defense Architectural Framework (DoDAF) [5] and the Zachman Framework [4]. The CF has selected DoDAF and modified it slightly by adding additional products and called it DNDAF. Annex B presents the various engineering products that are recommended by DoDAF. The developers of the IMRS could exploit the relevant views from this list to provide a sufficient architectural description of the SoS to assist in its development.

8 Conclusion

The objective of this study was to support development of a Concept of Operations for an Integrated Managed Readiness System. It leveraged the Calian study [2], commissioned by DRDC, that provided a précis of the current readiness reporting systems used by CF Force Generators. The approach has been to follow established systems engineering process and the IEEE layout for a CONOPS. Both provided useful direction and should continue to guide similar efforts. The initial workshop helped to define principles, characterize users, refine requirements and identify data sources. A survey of recent Operational Research tools and of Allied systems highlighted state-of-the-art technological opportunities that could be exploited by IMRS developers. The second workshop provided the opportunity to engage the broader community and consider options.

This Draft CONOPS captures current thinking on the automated tool envisioned in the Interim Directive – CF Readiness [1]. The requirement for an IMRS has been established and there is increasing recognition of the importance and urgency of delivering the system.

References

[1] Interim Directive – CF Readiness, 18 Dec 2008. 3000-1 SJS DSR.

[2] Requirements of a Strategic Readiness System, 8 Dec 2008. Calian Technologies

[3] CF Integrated Managed Readiness System Technical Review Workshop, Feb 2009. CAE Professional Services Canada.

[4] The Zachman Framework. J.A. Zachman. www.zachmaninternational.com/index.php/the-zachman-framework .

[5] Department of Defense Architectural Framework. www.architectureframework.com/dodaf .

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Annex A Information Requirements for IMRS

This Annex outlines in point form the information that should be available to the user through the interface defined earlier. This was prepared in the December IMRS workshop and is an initial estimate.

Table A- 3: Force Structure Data Requirements.

Force Structure	Current size		
	Organization structure		
	For each unit	Location	
		Parent Unit	
		Number of Personnel	
		Unit Training Status	
	For each person in unit	Name of person	
		Trade	
		Qualification	
			When Qualification received
			Requalification requirements
			duration of qualification
		Health	
		Availability Status	
	Expected Equipment in Unit	Number of pieces if fully equipped	
		Number in unit	
		Number operational	
		For each piece of equipment	
			operational status
			time to overhaul
			time to repair
	Stockpile of Material	Expected Material on hand	
		For each type of material	
			expected quantity
			actual quantity
			Expected delivery for short fall
	Commanders Comments		

Table A- 4: Capability/Task Data Requirements.

Task/capability	Name			
	Duration of task			
	Phases	Preparation	Start / End dates	
		Performance	Start / End dates	
		Disband	Start / End dates	
	Required readiness level			
	Rotations required			
		Number of personnel required per rotation		
	Skills required			
	Equipment Required			
	Material Required			
		Readiness level required for each unit		
		Allocation of Units to Sub Tasks		
		Expected resources from Unit		
		Personnel		
		Skills (training - both collective and individual qualifications)		
		Material		
		Equipment		
		Phases	Preparation	Start / End dates
			Performance	Start / End dates
			Disband	Start / End dates
		Assigned AOR		

Annex B DODAF Views

This Annex presents the various engineering products that are recommended by DoDAF. The developers of the IMRS could exploit the relevant views from this list to provide a sufficient architectural description of the SoS to assist in its development.

Table B- 5: DoDAF Views.

Applicable View	Framework Product	Framework Product Name	General Description
All Views	AV-1	Overview and Summary Information	Scope, purpose, intended users, environment depicted, analytical findings
All Views	AV-2	Integrated Dictionary	Architecture data repository with definitions of all terms used in all products
Operational	OV-1	High-Level Operational Concept Graphic	High-level graphical/textual description of operational concept
Operational	OV-2	Operational Node Connectivity Description	Operational nodes, connectivity, and information exchange needlines between nodes
Operational	OV-3	Operational Information Exchange Matrix	Information exchanged between nodes and the relevant attributes of that exchange
Operational	OV-4	Organizational Relationships Chart	Organizational, role, or other relationships among organizations
Operational	OV-5	Operational Activity Model	Capabilities, operational activities, relationships among activities, inputs, and outputs; overlays can show cost, performing nodes, or other pertinent information
Operational	OV-6a	Operational Rules Model	One of three products used to describe operational activity—identifies business rules that constrain operation
Operational	OV-6b	Operational State Transition Description	One of three products used to describe operational activity—identifies business process responses to events
Operational	OV-6c	Operational Event-Trace Description	One of three products used to describe operational activity—traces actions in a scenario or sequence of events
Operational	OV-7	Logical Data Model	Documentation of the system data requirements and structural business process rules of the Operational View
Systems	SV-1	Systems Interface Description	Identification of systems nodes, systems, and system items and their interconnections, within and between nodes
Systems	SV-2	Systems Communications Description	Systems nodes, systems, and system items, and their related communications lay-downs
Systems	SV-3	Systems-Systems Matrix	Relationships among systems in a given architecture; can be designed to show relationships of interest, e.g., system-type interfaces, planned vs. existing interfaces, etc.
Systems	SV-4	Systems Functionality Description	Functions performed by systems and the system data flows among system functions
Systems	SV-5	Operational Activity to Systems Function Traceability Matrix	Mapping of systems back to capabilities or of system functions back to operational activities
Systems	SV-6	Systems Data Exchange Matrix	Provides details of system data elements being exchanged between systems and the attributes of that exchange
Systems	SV-7	Systems Performance Parameters Matrix	Performance characteristics of Systems View elements for the appropriate time frame(s)

Systems	SV-8	Systems Evolution Description	Planned incremental steps toward migrating a suite of systems to a more efficient suite, or toward evolving a current system to a future implementation
Systems	SV-9	Systems Technology Forecast	Emerging technologies and software/hardware products that are expected to be available in a given set of time frames and that will affect future development of the architecture
Systems	SV-10a	Systems Rules Model	One of three products used to describe system functionality—identifies constraints that are imposed on systems functionality due to some aspect of systems design or implementation
Systems	SV-10b	Systems State Transition Description	One of three products used to describe system functionality—identifies responses of a system to events
Systems	SV-10c	Systems Event-Trace Description	One of three products used to describe system functionality—identifies system-specific refinements of critical sequences of events described in the Operational View
Systems	SV-11	Physical Schema	Physical implementation of the Logical Data Model entities, e.g., message formats, file structures, physical schema
Technical	TV-1	Technical Standards Profile	Listing of standards that apply to Systems View elements in a given architecture
Technical	TV-2	Technical Standards Forecast	Description of emerging standards and potential impact on current Systems View elements, within a set of time frames

Annex C Further Reading

Defence Planning Directive Initiative

Maritime Command Readiness Reporting

- CFCD 129 (Naval Readiness and Sustainment Policy) (Draft)
- Maritime Command Orders (MARCORDS) 2-12 (Readiness Support Programme - Ships)
- CFCD 102 (Maritime Command Combat Readiness Requirements) – Training
- MARCORD G-03 (Operational Deficiency Reporting) for materiel,
- MARLANTORD 59-7/ MARPACORD 59-3 for personnel shortages, and
- other reports such as logistics inspections, audits, and physical fitness testing results

Land Command Readiness Reporting

- Managed Readiness System (MRS)
- Managed Readiness Plan (MRP)
- 3350-1 (DLFR) Nov 05 Annex A-Managed Readiness System
- B. 3350-1 (DLFR) Nov 05 Annex B-Managed Readiness Plan
- Land Operations Collective Training Management Framework
- Land Force Individual Training Management Framework (collectively referred to as the Land Force Training Management Framework),
- Force Employment and Generation concepts,
- Land Force Service Support (which includes ASR and Whole Fleet Management), and
- Army Reserve Managed Readiness Plan. (Note: The Army Reserve Managed Readiness Plan is under development; the ensuing Army Reserve CTMF

Aero Space Command Readiness Reporting

- Air Force Plan (AFP)

CANOSCOM Readiness Reporting

- CANOSCOM's Concept of Operations (COO)

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List of abbreviations/acronyms

ACME	Arena Career Modelling Environment
CBP	Capability Based Planning
CDS	Chief of Defence Staff
CF	Canadian Forces
COA	Course of Action
CONOPS	Concept of Operations
CORA	Centre for Operational Research and Analysis
COTS	Commercial off the shelf
CSNI	Consolidated Secret Network Infrastructure
DGSTO	Director General Science and Technology Operations
DND	Department of National Defence
DNDAF	Department of National Defence Architectural Framework
DoDAF	Department of Defense Architectural Framework
DRDC	Defence Research & Development Canada
DRDKIM	Director Research and Development Knowledge and Information Management
DRRS	Defense Readiness Reporting System
DWAN	Defence Wide Area Network
ECS	Environmental Chief of Staff
ESORTS	Enhanced Status of Resources and Training System
GoC	Government of Canada
GOTS	Government off the shelf
IEEE	Institute of Electrical and Electronics Engineers
IM	Information Management
IMRS	Integrated Managed Readiness System
IT	Information Technology
IT&E	Individual Training and Education
L1	Level 1
MAPS	Manpower Analysis Planning Systems

MARS	Managed Readiness Simulator
MSVS	Medium Support Vehicle System
NATO	North Atlantic Treaty Organization
OC	Operational Capability
OPP	Operational Planning Process
PMT	Production Management Tool
PSIM	Production and Strategic Intake Model
R&D	Research & Development
REDREP	Readiness Report
SJS	Strategic Joint Staff
SoS	System of Systems
SREDR	Strategic Readiness Review

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2. SECURITY CLASSIFICATION (Overall security classification of the document including special warning terms if applicable.)

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3. TITLE (The complete document title as indicated on the title page. Its classification should be indicated by the appropriate abbreviation (S, C or U) in parentheses after the title.)

Draft Concept of Operations: Canadian Forces Readiness System:

4. AUTHORS (last name, followed by initials – ranks, titles, etc. not to be used)

Hales, D.; Bowen, D.

5. DATE OF PUBLICATION (Month and year of publication of document.)

December 2009

6a. NO. OF PAGES (Total containing information, including Annexes, Appendices, etc.)

66

6b. NO. OF REFS (Total cited in document.)

5

7. DESCRIPTIVE NOTES (The category of the document, e.g. technical report, technical note or memorandum. If appropriate, enter the type of report, e.g. interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered.)

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8. SPONSORING ACTIVITY (The name of the department project office or laboratory sponsoring the research and development – include address.)

Defence R&D Canada
305 Rideau Street
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9a. PROJECT OR GRANT NO. (If appropriate, the applicable research and development project or grant number under which the document was written. Please specify whether project or grant.)

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W7701-054996/001/QCL

10a. ORIGINATOR'S DOCUMENT NUMBER (The official document number by which the document is identified by the originating activity. This number must be unique to this document.)

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This document has been written to capture the concept of how an Integrated Managed Readiness System might work. It is considered to be a preliminary concept paper and it is expected that Defence Research and Development Canada and Strategic Joint Staff (SJS) will utilize this document to develop a way forward and as a baseline for preparing the final concept. It leverages the requirements that were voiced by senior Canadian Forces (CF) executives regarding such a system and presents a vision of what could be developed and how it might be used. It is intended to bridge the gap between the operational user and the technology communities, and drive requirements for the system specification which will describe in technical terms what needs to be built and defines the detailed design.
In order to situate the concept of operations this document has provided details on the existing systems and the desired CF Readiness Framework. It has borrowed liberally from work performed by Calian Technology and from guidance provided by the SJS Director of Strategic Readiness.

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