Canadian Human View Handbook

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Abstract

With the rapid advancement of information technology and acquisition reform within Allied defence communities, enterprise architecture has emerged and become an effective approach to support the management of complex systems and their evolution over time. Architecture frameworks such as the Department of National Defence / Canadian Forces Architecture Framework (DNDAF) specify a common approach for development, presentation, and integration of architectural descriptions. While international architecture frameworks evolve to include new concepts in System Engineering, the portrayal of the human as a unique part of the system has not been well addressed. An architectural viewpoint is required to explicitly represent the human and document the unique implications humans bring into and impose on enterprise system design. To that end, the idea of a Human View (HV), which leverages Human Systems Integration (HSI) principles and practices, has emerged.

The purpose of HV is to capture human characteristics, their work requirements, and inform how they interact with technological systems to support enterprise objectives. This document defines a set of HV that was developed to enhance DNDAF, with a particular focus on supporting DND acquisition projects.

Résumé

Compte tenu de la poussée rapide de la technologie de l'information et de la réforme de l'acquisition au sein des collectivités de la défense des Alliés, l'architecture d'entreprise a fait son apparition et est devenue une démarche efficace pour appuyer la gestion de systèmes complexes et leur évolution au fil du temps. Les cadres d'architecture, comme le Cadre d'architecture du ministère de la Défense nationale et des Forces canadiennes (CA MDN), décrivent une démarche commune pour le développement, la présentation et l'intégration des descriptions architecturales. Bien que les cadres architecturaux internationaux évoluent pour inclure de nouveaux concepts en systémique, on n'a pas bien tenu compte de la représentation de l'être humain comme élément unique du système. Il faut un point de vue architectural pour représenter de façon explicite l'être humain et pour documenter les particularités que l'être humain apporte et impose à la conception du système d'entreprise. À cette fin, le concept de perspective humaine (PH), qui tire parti des principes et des pratiques de l'intégration des systèmes humaines (ISH), a fait surface.

La raison d'être de la PH est de saisir les caractéristiques des être humains, leurs exigences professionnelles, ainsi que de guider leur façon d'interagir avec les systèmes technologiques à l'appui des objectifs de l'entreprise. Le présent document définit un ensemble de PH qui a été élaboré afin d'améliorer le CA MDN, en mettant surtout l'accent sur le soutien aux projets d'acquisition du MDN.

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Executive summary

Canadian Human View Handbook:

Curtis Coates; Andrew Stewart; Wenbi Wang DRDC Toronto CR 2013-041; Defence R&D Canada – Toronto; July 2013.

Introduction or background: With the rapid advancement of information technology and acquisition reform within Allied defence communities, enterprise architecture has emerged and become an effective approach to support the management of complex systems and their evolution over time. Architecture frameworks such as the Department of National Defence / Canadian Forces Architecture Framework (DNDAF) specify a common approach for development, presentation, and integration of architectural descriptions. Architectural models based on DNDAF depict multiple, complementary aspects of a complex enterprise system. These models can be either used alone or integrated together to support stakeholder decision-making from various perspectives.

While international architecture frameworks evolve to include new concepts in System Engineering, the portrayal of the human as a unique part of the system has not been well addressed. An architectural viewpoint is required to explicitly represent the human dimension and document the unique implications humans bring into and impose on enterprise system design. To that end, the idea of a Human View (HV), which leverages Human Systems Integration (HSI) principles and practices, has emerged. The purpose of HV is to capture human characteristics, their work requirements, and inform how they interact with technological systems to support enterprise objectives.

Results: Based on the Department of National Defence (DND)'s requirements, the following set of ten sub-views was developed in this project, collectively regarded as the Canadian HV:

- HV-1 (Concept) provides a high level pictorial depiction of the human component in the enterprise.
- HV-2 (Establishment) provides a complete list of enterprise personnel based on the needs of the architecture project.
- HV-3 (Organization) is a chart diagram that depicts the organization of all individuals that are specified in the corresponding HV-2 model.
- HV-4 (Manpower projection) provides a forecast of manpower requirement for the modelled enterprise over a time line that is defined according to the purpose of architecture project.
- HV-5 (Personal characteristics) describes the personal characteristics for each individual, including physical, sensory, psychological, sociological attributes,
- HV-6 (Training needs) is a tabular summary of training and education gaps between an individual's qualification, skills, experience and those required by his/her jobs.

- HV-7 (System safety) summaries safety related management and engineering tasks that are required to identify prominent and foreseeable risks that may lead to potential accidents or mishaps and threaten the function of the enterprise.

- HV-8 (Health hazards) provides a summary of prominent and foreseeable factors that may cause reduced job performance, illness, injury, and disability for enterprise personnel.

- HV-9 (Human tasks) is a tabular description of the operator tasks that each individual needs to perform.

- HV-10 (Communications) is a graphical and/or tabular description of communication requirements for supporting team functions and performance.

This handbook explains each sub-view in detail and suggests development instructions that may be followed in the architecture modelling process.

Significance: HV enables a better representation of the human element in enterprise architectures and supports stakeholder decision-making by providing a structured linkage from enterprise requirements to manpower, personnel, training, and human factors engineering solutions. It provides a suitable mechanism to embed HSI considerations into the decision making processes in DND capital procurement projects and ensure the single greatest cost driver, people, is addressed 'up front'.

Future plans: The primary focus of future research is the incorporation of HV into DNDAF, which assists the integration of HSI practices into the mainstream system engineering processes and promotes user-centered engineering solutions.

Sommaire

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1 Background

With the rapid advancement of Information Technology (IT) and acquisition reform within Allied defence communities, enterprise architecture has emerged and become an effective approach to support the management of complex systems and their evolution over time. Architecture frameworks such as the Department of National Defence / Canadian Forces Architecture Framework (DNDAF) specify a common approach for development, presentation, and integration of architectural descriptions. Architectural models based on DNDAF depict multiple, complementary aspects of a complex enterprise system. These models can be either used alone or integrated together to support stakeholder decision-making from various perspectives. As an approach, enterprise architecture is most effective in supporting the design and management of large systems with complex integration and interoperability challenges. For example, many DND capital acquisition projects are highly complex and therefore are exemplar areas where enterprise architectural models can be applied.

While international architecture frameworks evolve to include new concepts in System Engineering, the portrayal of the human as a unique part of the system has not been well addressed. An architectural viewpoint is required to explicitly represent the human dimension and document the unique implications humans bring into and impose on enterprise system design. To that end, the idea of a Human View (HV), which leverages Human Systems Integration (HSI) principles and practices, has emerged. The purpose of HV is to capture human characteristics, their work requirements, and inform how they interact with technological systems to support enterprise objectives. HV enables a better description of the human's role in an enterprise and supports stakeholder decision-making by providing a structured linkage from enterprise requirements to manpower, personnel, training, and human factors engineering solutions. The incorporation of HV into DNDAF also assists the integration of HSI practices into the mainstream system engineering processes and promotes user-centered engineering solutions. The development of an HV model requires coordination between System Engineers and Human Factors practitioners. Such an architectural model allows enterprise stakeholders to examine personnel issues in a broader context that involves other enterprise factors such as technological infrastructure and business processes.

The intent of this handbook is to describe a Canadian HV framework that was developed by leveraging earlier research in this area, including:

- The Collaborative Capability Definition, Engineering and Management (CapDEM) Technology Demonstration Project (TDP);
- The proof-of-concept research conducted in the Human Centric Architecture Framework project; and
- The consolidation of the HV concepts performed by the Allied nations reported as the North Atlantic Treaty Organization (NATO) HV framework.

The Canadian HV framework was developed based on the NATO HV by tailoring a core set of it to support the DND/CF's project needs. While the framework can be applied in a broad range of DND/CF projects and programs, it was created in this study with a specific focus on major Crown acquisition projects so as to ensure the proposed sub-views are appropriate for addressing the HSI challenges faced by the acquisition community.

The handbook describes a notional set of HV architectural data products, i.e., sub-views. Each proposed sub-view is comprised of an architectural template based on which architectural models can be developed to address a specific set of human factors issues. Overall, the full set of HV provides a suitable mechanism to embed HSI considerations into the decision making processes in DND capital procurement projects and ensure the single greatest cost driver, people, is addressed 'up front'.

1.1 Enterprise architectural framework

As an approach to manage complex designs of IT infrastructure and acquisition reform, several Allied defence communities (e.g. the United States' Department of Defense (DoD), the United Kingdom's Ministry of Defence (MOD), and Canada's DND) have been applying an emerging and evolving concept of enterprise architecture in an effort to apply analytical rigour and improve traceability within a System-of-Systems construct to support capability based planning and system acquisition. This approach provides a structure for developing enterprise architecture models that are useful for addressing complex integration and interoperability challenges often encountered in large enterprise systems.

There are similarities between the allied defence communities' architecture frameworks, for example they share the same goal to define a common approach for development, presentation, and integration of architectural descriptions. However, the specific architectural viewpoints differ across countries: the DoD Architecture Framework (DoDAF) is organized into four architectural viewpoints: All View (AV), Operational View (OV), Systems View (SV), and the Technical Standards View (TV) [1]; the MOD Architecture Framework (MODAF) has extended DoDAF and included Strategic View (StV) and Acquisition View (AcV); the DNDAF has further customized the DoDAF framework and introduced Information View (IV) and Security View (SecV).

1.2 DND/CF Architecture Framework (DNDAF)

DNDAF is managed by the Directorate of Enterprise Architecture (DEA) within the Assistant Deputy Minister (Information Management) (ADM(IM)) Group. DNDAF is similar in form and function to both DoDAF and MODAF. The current version of DNDAF (i.e., version 1.8) is not yet mandated for use by DND projects and has not been widely applied outside the IT community.

As of now, DNDAF consists of eight architectural viewpoints and a total of thirty-seven sub-views. DNDAF products are stored in databases developed based on the Defence Architecture Data Model (DADM) which defines the elementary architecture data entities and their relationships. DADM provides a logical basis for creating a central repository to store architectural data. The current version of DADM, before integrating HVs, has 210 entities (i.e.,

data tables) and 1229 data attributes (i.e., fields). To assist the modelling effort, DEA is currently implementing DNDAF in Qualiware which is a commercial software tool for enterprise architecture development.

1.3 Human View (HV)

Through the development and use of the above mentioned architecture frameworks, there was a general acknowledgement that the human element was not well represented in the existing framework. Earlier attempt was made to characterize the human dimension as a part of operational requirements and use several OV sub-views to describe humans' role and their operational activities [1]. However to most Human Factors (HF) practitioners, such solutions are not comprehensive and do not represent the wide spectrum of human related issues that should be considered in enterprise architectural modeling. An independent architectural viewpoint, i.e., the HV, was recommended as a preferred solution and the notion triggered research interests from the HF communities from several allied nations including Canada.

The initial Canadian effort focused on personnel issues in Human Resources (HR) management and proposed four sub-views (i.e., Manpower Projection, Career Progression Roadmap, Individual Training Roadmap, and Establishment Inventory) to support common decisions faced by the HR community [8]. This set of sub-views was later integrated into the NATO HV framework which was created with an expanded goal to support a wider range of enterprise stakeholders including system designers and developers (e.g., HF engineers). The purpose of the current study was to Canadianize the NATO HV framework and customize a core set of HV based on DND/CF project needs.

1.4 NATO HV framework

The NATO HV was generated by the NATO Research and Technology Organization (RTO) Human Factors and Medicine (HFM) work panel 155. This research group took inputs from participating nations and established a set of HV sub-views by first grouping human characteristics into related themes, and then consolidate the themes into a manageable set of architectural constructs. The following set of eight sub-views was proposed. The readers are referred to the NATO HV handbook for more information [7].

- HV-A Concept
- HV-B Constraints
- HV-C Tasks
- HV-D Roles
- HV-E Human Network
- HV-F Training
- HV-G Metrics
- HV-H Human Dynamics

1.5 Approach to Tailoring the NATO HV

The NATO HV framework reflects a high-level conceptual outline that requires further customization by architecture modellers to select the form and format for architectural

descriptions. Such flexibility allows HF practitioners to create HV models for analyzing a plethora of HSI concepts and assisting decision-making in the lifecycle of system-of-systems engineering. On the other hand, the lack of specificity in the NATO HV framework makes it difficult to generate standardized architectural descriptions that are comparable across projects.

With a focus to support DND acquisition, this project took a pragmatic approach to create the Canadian HV. First, a user-centred approach was taken and stakeholder requirements were examined and utilized as the primary criterion for justifying the need for a particular sub-view. Second, the HV was closely aligned with the Canadian HSI framework that is characterized of five domains including manpower and personnel, training, system safety, health hazard, and human factors engineering. Third, project data from DND use cases were extensively used to support HV development decisions such as the form and format of architectural descriptions, levels of information granularity. For detailed account of the development principles and approaches, the readers are referred to a separate report previously published [1].

1.6 Alignment between Canadian HV and HSI framework

The authors suggested a close alignment of the Canadian HV with the HSI framework was critical for promoting the adoption of enterprise architecture as a method among HF practitioners. The concept of HSI arose from a general recognition of the importance of Human Factors in system effectiveness. As noted in the conclusion of the 1983 NATO Defence Research Group (DRG) Symposium on *Man as the Limiting Element in Military Systems*, human was identified as a critical system component and technological solutions alone wouldn't be able to solve our defence problems [9]. In the domain of Materiel Acquisition and Support (MA&S), the gist of HSI is to consider human performance factors together with system effectiveness measures while managing MA&S activities to seek an improvement in overall system performance. In general, HSI can contribute to system effectiveness in many areas including operability, safety, reliability, maintainability, availability and survivability.

Figure 1: Conceptual illustration of Canadian HSI.

Within the DND, HSI is defined as *the technical process of integrating the five HSI domains, Human Factors Engineering, Manpower and Personnel, Training, System Safety, and Health*

Hazards, with a materiel system to ensure safe, effective operability and supportability [10]. The five HSI domains are illustrated in Figure 1. A successful HSI program ensures that human factors are properly considered in system engineering processes that encompass system design, development, operations and disposal. In this project, the Canadian HSI framework was used as a basis for developing the HV. A brief overview of each HSI domain is provided below.

Manpower and Personnel. Within the HSI framework, the manpower sub-domain looks at numbers of positions and people. It addresses the number of military and civilian personnel required, and potentially available, to operate, maintain, sustain, and provide training for a complex military system. It deals with the number of personnel spaces (required or authorized positions) and available people (operating strength), and considers these requirements for peacetime, conflict, and low intensity operations. Current and projected constraints on the total size of the CF/organization/unit are also examined. The scope of the personnel sub-domain encompasses cognitive, physical characteristics and capabilities required to train for, operate, maintain, and sustain materiel and information systems. In the military context, personnel capabilities are sometimes reflected as Knowledge, Skills, and Abilities (KSAs).

Training. The training domain is concerned with the instruction or education (on-the-job or unit training) required to provide personnel with the essential job skills, knowledge, values and attitudes, as well as any constraints on such training.

Systems Safety. The domain focuses on safety risks occurring within a system's lifecycle, including its set-up, use, transport, maintenance, and decommissioning. It is within the scope of Systems Safety domain to examine a system's design features and/or its operating characteristics to minimize the potential for human or machine failures that cause injurious accidents.

Health Hazards. The domain is concerned with short or long term hazards to health occurring as a result of normal operation of the system. It focuses on design features and operating characteristics of a system that create significant risks of bodily injury or death. Along with safety hazards, an assessment of health hazards is necessary to determine risk reduction or mitigation.

Human Factors Engineering. The general goal of this domain is to maximize the ability of an individual or crew to operate and maintain a system at required performance levels by generating engineering solutions based on a comprehensive examination of the user's characteristics (i.e., capabilities and limitations) to eliminate design-induced difficulties and errors.

A set of ten sub-views were proposed for the Canadian HV. They were developed to align with the priorities reflected in the HSI framework. Table 1 provides a reference chart between the five Canadian HSI domains (including key areas of interest in each domain), the proposed Canadian HV and the NATO HV. Notably the naming of Canadian HV sub-views was modified to follow the DNDAF convention.

Table 1: Human View Reference Chart.

HSI Domain	Areas of interest	Canadian HV	NATO HV
		HV-1 Concept	HV-A Concept
Manpower and Personnel	Force structure	HV-2 Establishment	HV-D Roles
	Human Interaction	HV-3 Organization	HV-E Human network
	Availability	HV-4 Manpower projection	HV-B1 Manpower projections
	Previous experience and training	Not applicable	HV-B2 Career progression
	Cognitive and physical personnel factors	HV-5 Personal Characteristics	HV-D Roles and HV-B6 Human characteristics
	Recruitment, retention, advancement	Not applicable [1]	HV-B4 Personnel policy
Training	Training	HV-6 Training needs	HV-F Training
System Safety	Systems Safety	HV-7 System safety	HV-B5 Health hazards
Health Hazards	Health Hazards	HV-8 Health hazards	HV-B5 Health hazards
Human Factors Engineering	Operator roles, functions, and tasks	HV-9 Human tasks	HV-C Tasks
	Operator roles, functions, and tasks	HV-10 Communications	HV-E Human network
	Environment	Not applicable	Not applicable
	Workload	Not applicable	HV-H Human dynamics [2]

Note 1: Several NATO HV are addressed within DND by Military Policy, Doctrine, Occupational Structure, and Job Descriptions which are all legal descriptions governing both Military and Civilian employees of the Department of National Defence, and are not considered applicable as Canadian HVs.

Note 2: The NATO description, and intent, for HV-H (Human dynamics) identifies it as a place to perform dynamic analysis, using data from various other HV, typically executed using tools external to the architecture framework. Thus the Human Dynamics View represents the possibilities brought to bear by completing good Human Factors analysis, however, this analysis and the reporting of results are best served by being maintained outside the confines of an architecture framework.

2 The Canadian Human View

The proposed Canadian HV framework is comprised of ten sub-views. Section 2 provides a detailed description for each sub-view, following a similar structure that was used in DADAF user's guide for defining other architectural viewpoints. More specifically, each sub-view is described from the following four aspects:

1. The *purpose* sub-section explains the intended utilities for the sub-view, including DND/CF stakeholders that can be identified as potential users of the sub-view;

2. The *prerequisite* sub-section attempts to describe the inter-dependency, at the architectural data element level, among different sub-views;

3. The *instruction* sub-section explains basic data elements proposed for the sub-view, and suggests a set of common steps that can be followed in a typical modeling effort; and

4. The *representation* sub-section provides one or more examples of architectural models developed based on the sub-view.

Most sample models provided in this section were obtained from past DND use case studies, particularly the conceptual design of a Virtual-Combined Aerospace Operations Centre (V-CAOC). It is useful to note that the models are reported for illustrative purposes, and the data have not been endorsed by DND. Additionally, most sample models are self-explanatory. In a few cases where contextual information is needed for interpreting the models, brief commentaries are provided.

2.1 HV-1 Concept

HV-1 (Concept) is a high-level pictorial depiction of the human element in an enterprise architectural model. It serves as a single point of reference to illustrate key HSI concepts, e.g., the HF design challenges and/or solutions, that the HV architecture models are created to support.

2.1.1 Purpose

The purpose of HV-1 is to provide a conceptual overview of the human dimension in the enterprise. Similar to the utility of OV-1 (High-level operational concept diagram), HV-1 is useful for presentation and discussion purposes. For example, a practical usage of HV-1 is in project briefings where an HV-1 model can be inserted into a standard DND project update quad-chart presentation to describe the HSI concept to various stakeholders.

Generally speaking, the sub-view should highlight the human element and its interdependent relationship with other enterprise factors such as technology, infrastructure and business processes. Ideally, the content of HV-1 should be tailored to indicate key HSI concerns for the architecture modeling project. As such it is typically up to the architecture developer to determine the specific messages to be conveyed in this sub-view. One example is to use HV-1 for depicting

HSI concepts in relation to operational demands and system solutions that are captured in the associated OV and SV models respectively.

2.1.2 Prerequisite

If OV-1 (High-Level Operational Concept Graph) is available, it should be reviewed before the development of an HV-1 model. OV-1 depicts the Concept of Operations for the enterprise of interest, based on which an HV-1 model can be generated to further highlight those concepts where the key enabler is people.

2.1.3 Instruction

The "look and feel" of an HV-1 model depends on the architect's creativity. As a general rule of thumb, it is recommended that the following steps should be considered in the model construction process.

1. Determine key HSI concepts that are applicable to the enterprise of interest. This can be performed by reviewing the OV-1 model (if it is available) to identify operational concepts where the enabler is the human factors;
2. Construct pictorial representations of the HSI concepts, and if possible, provide a visual reference to connect HV-1 and OV-1 models.

Multiple versions of HV-1 may be developed for an architecture project. As an enterprise evolves, so are its HSI concerns. Consequently the HV-1 should be modified to reflect the current areas of focus so as to continually support enterprise design and problem-solving.

2.1.4 Representation

Examples of HV-1 are shown in Figure 2, 3 and 4, reflecting models developed in two different projects. It is useful to note that a common solution was adopted in the examples by inserting a graphical reference to the Canadian HSI framework, at the top right corner, and accentuating the domains that were deemed relevant to the intended use of the architectural models.

Figure 2 was obtained from a Royal Canadian Navy (RCN) use case [2] in which the goal of HV models was to support crewing analysis. In this example, the architect used an HV-1 model for illustrating HSI concerns in the area of ship manning, that is, to determine the type and number of naval personnel required across major ship functions.

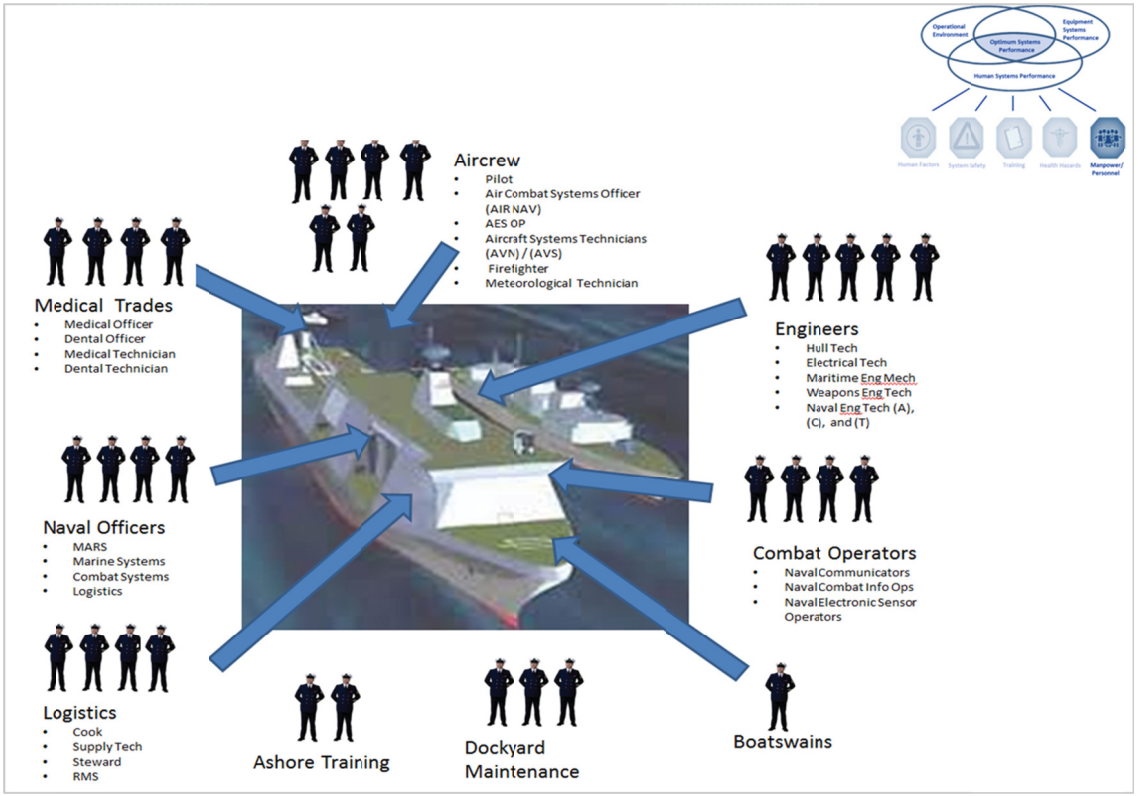

Figure 2: An HV-1 (Concept) model for RCN ship crewing analysis.

Figure 3 and 4 are examples of HV-1 models developed for a Royal Canadian Air Force (RCAF) study on its Combined Aerospace Operations Centre (CAOC). Figure 3 is a baseline (i.e., as-is) architecture model of the existing CAOC, whereas Figure 4 reflects a target (i.e., to-be) architecture model of a forward deployed Virtual CAOC (V-CAOC) unit that can be set up to enhance the global reach of the existing CAOC [3]. In this case, since the associated OV-1 model of CAOC was available (see Figure 5), it was reviewed prior to the development of corresponding HV-1 models and common graphical elements were adopted in the HV-1 models to enhance the association between HSI concerns and operational concepts.

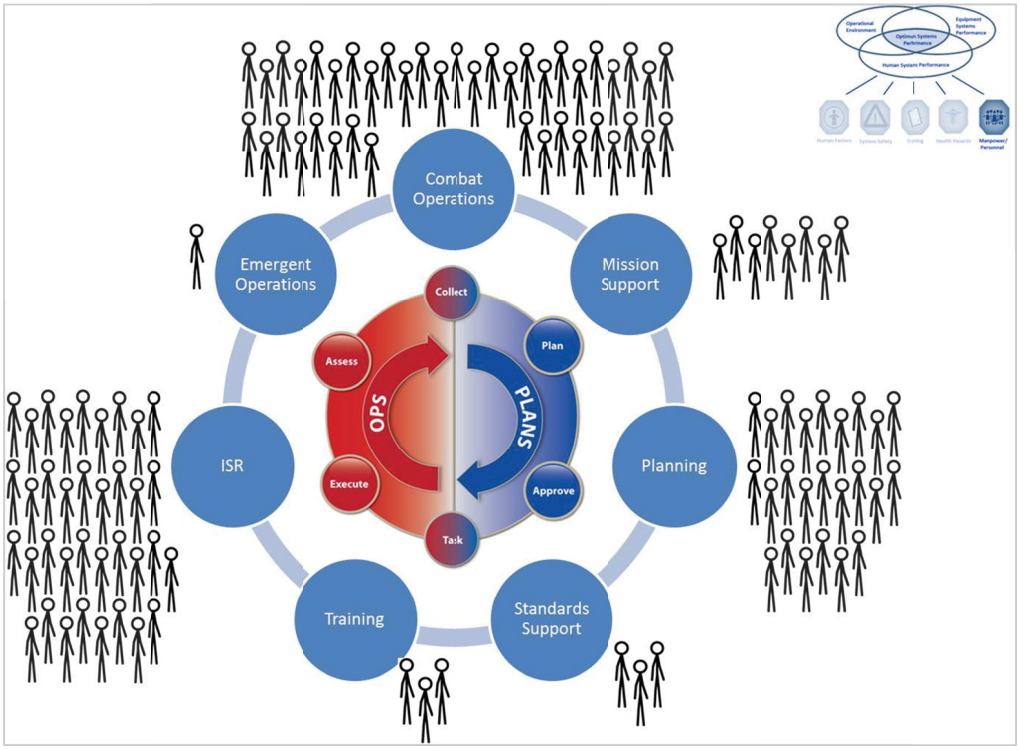

Figure 3: A sample HV-1 (Concept) model of the existing RCAF CAOC.

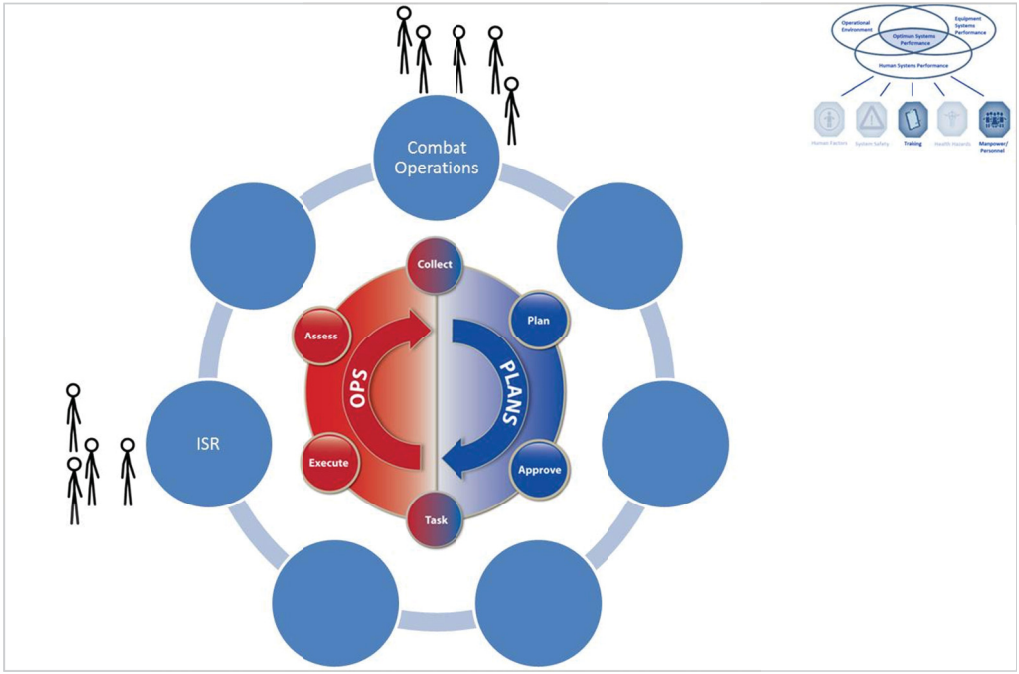

Figure 4: A sample HV-1 (Concept) model of V-CAOC.

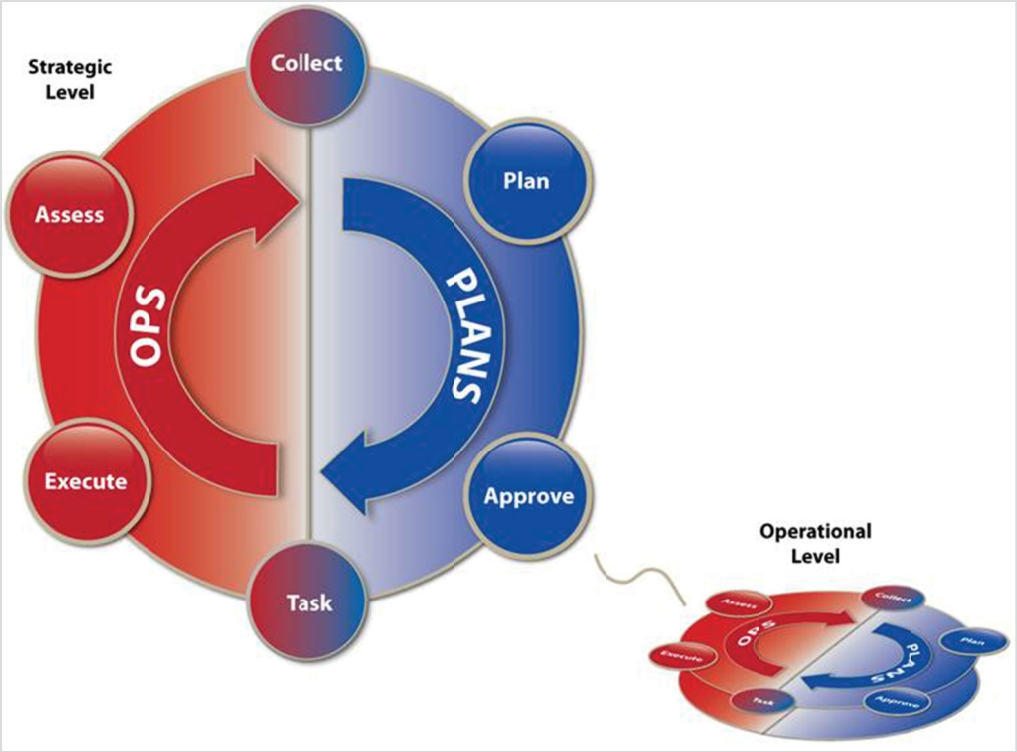

Figure 5: An OV-1 (High-level operational concept graph) model of CAOC (Adapted from [4]).

2.2 HV-2 Establishment

HV-2 (Establishment) provides a complete list of personnel that needs to be considered in the enterprise architecture model, including for example operators, maintainers, trainers, and any other types of primary and supportive staff required for enterprise operations.

2.2.1 Purpose

If one considers an enterprise as a socio-technical system, the purpose of HV-2 is to describe the basic element of the social aspect of the enterprise, i.e., individuals, and document "*who these individuals are*" in an enterprise. The sub-view provides a complete list of enterprise personnel, with basic descriptions of their occupations and qualification levels.

Essentially a nominal roll, an HV-2 model is useful for any enterprise stakeholder who wants to understand the personnel composition of the enterprise.

2.2.2 Prerequisite

There are no prerequisite sub-views for HV-2, since the construction of a HV-2 model does not directly require architectural data from other sub-views. However, it is recommended that the logical process to determine enterprise manning should start with an examination of human tasks.

2.2.3 Instruction

A definition of key architectural data elements in the HV-2 is provided below:

- **Establishment**: A listing of the people who work in a structured (e.g., hierarchical) organization to support shared enterprise objectives.
- **Position**: The smallest part of a personnel establishment that requires the work of one individual. A position exists whether it is occupied or vacant and is the basic accounting unit for personnel planning and control activities.
- **Occupation**: An occupation is the fundamental grouping of personnel used for the Human Resources cycle of activities. Each occupation comprises a grouping of related jobs having similar duties / tasks and requiring similar competencies. A job is defined as the work performed by a position incumbent, or by those in a group of similar positions requiring the incumbent(s) to successfully perform a similar set of tasks with their associated knowledge, skills, and abilities (KSA).
- **Qualification Level (QL) and Rank**: QL is a description of the minimum knowledge and skills a CF member must possess before becoming eligible to progress to the next higher rank level. QL reflects the level of formal training expected to hold the designated position. In the CF, the QL and Rank are closely related. As an example a Naval Combat Information Operator (NCIOP) QL5A is a mandatory requirement for promotion to Leading Seaman (LS) and QL6A is required for promotion to Petty Officer Second Class (PO2).

  Note: civilian organizations often have similar structures, typically denoted as classification levels (e.g., Engineer Level 4), to group individuals with similar KSA.

The following steps are suggested for creating an HV-2 model:

1. Based on the scope of architecture project, determine who should be represented in this sub-view model. For example, address questions such as whether it is necessary to include the second or third order manpower requirements (i.e., maintainers, trainers, and other supporting staff) in the model;
2. Supply a list of positions required to support the enterprise functions;
3. For each position, assign a basic set of core attributes such as Rank, MOSID, and QL. For civilian positions, a corresponding set of attributes like classification and level are used instead.

2.2.4 Representation

The HV-2 is envisioned to use a tabular representation in which a list of personnel is presented in a data table. Three examples of HV-2 models were obtained from RCAF's V-CAOC study to reflect three V-CAOC configurations with different personnel footprint, as shown in Table 2, 3 and 4 respectively. For this analysis, it was determined that the scope of HV-2 was limited to the forward deployed V-CAOC team, excluding the existing CAOC personnel that are responsible for carrying out regular CAOC functions.

Table 2: A sample HV-2 (Establishment) model for V-CAOC (Minimum manning)

ID #	Position	Rank	Occupation (MOSID)
1	V-CAOC Director	LCol	Any Air Occupation Officer
2	Chief Operations	Maj	Any Air Occupation Officer
3	Combat SO Ops 1	Capt/Maj	Any Air Occupation NCM
4	Combat Ops Sup	Capt	Any Air Occupation Officer
5	SODT Lead	Capt	Any Air Occupation Officer
6	ATO Production	MCpl/Cpl	Any Air Occupation NCM
7	ISRD	Capt	00213 Intelligence Officer
8	Analysis and Production	MCpl/Cpl	00099 Intelligence Operator
9	Analysis and Production	MCpl/Cpl	00099 Intelligence Operator
10	ISR Ops	Capt	00213 Intelligence Officer

Table 3: A sample HV-2 (Establishment) model for V-CAOC (Medium manning)

ID #	Position	Rank	Occupation (MOSID)
1	V-CAOC Director	LCol	Any Air Occupation Officer
2	V-CAOC Deputy Director	Maj	Any Air Occupation Officer
3	Chief Operations	Maj	Any Air Occupation Officer
4	Plan A3/A5	Capt	Any Air Occupation Officer
5	Plan A3/A5	Capt	Any Air Occupation Officer
6	Combat Ops Sup	Capt/Maj	Any Air Occupation Officer
7	SODT Lead	Capt	Any Air Occupation Officer
8	ATO Production	MCpl/Cpl	Any Air Occupation NCM
9	ISRD	Capt/Maj	00213 Intelligence Officer
10	Analysis and Production	MCpl/Cpl	00099 Intelligence Operator
11	Analysis and Production	MCpl/Cpl	00099 Intelligence Operator
12	ISR Ops	Capt	00213 Intelligence Officer
13	ISR Ops	Capt	00213 Intelligence Officer
14	Chief Mission Support	Maj	00328 Logistics
15	Logistics Suport	Capt	00328 Logistics
16	Admin Support	Capt	00328 Logistics
17	Information System Support	Capt/Maj	00340 Communications and Electronics Engineering - Air

Table 4: A sample HV-2 (Establishment) model for V-CAOC (Maximum manning)

ID #	Position	Rank	Occupation (MOSID)
1	V-CAOC Director	LCol	Any Air Occupation Officer
2	V-CAOC Deputy Director	Maj	Any Air Occupation Officer
3	CAOC LO	Capt	Any Air Occupation Officer
4	CAOC NAPPIC/ATO	MCpl/Cpl	Any Air Occupation NCM
5	D/ACCEs	Maj/Capt	Any Air Occupation Officer
6	D/ACCEs	Maj/Capt	Any Air Occupation Officer
7	Airspace Coord	Maj/Capt	00184 Aerospace Control
8	Plan A3/A5	Capt	Any Air Occupation Officer
9	Plan A3/A5	Capt	Any Air Occupation Officer
10	Plan A3/A5	Capt	Any Air Occupation Officer
11	Plan A3/A5	Capt	Any Air Occupation Officer
12	Plan A3/A5	Capt	Any Air Occupation Officer
13	ISRD	Capt/Maj	00213 Intelligence Officer
14	Collator	MCpl/Cpl	00099 Intelligence Operator
15	Collator	MCpl/Cpl	00099 Intelligence Operator
16	ISR Ops	Capt	00213 Intelligence Officer
17	ISR Ops	Capt	00213 Intelligence Officer
18	Chief Mission Support	Maj	00328 Logistics
19	Logistics Suport	Capt	00328 Logistics
20	Finance Support	Capt	00328 Logistics
21	Personnel Support	Capt	00328 Logistics
22	CE Support	Capt	00189 Airfield Engineering
23	Information System Support	Capt/Maj	00340 Communications and Electronics Engineering - Air
24	Technical Information Support (TIS)	WO	00109 Aerospace Telecommunications Technician

2.3 HV-3 Organization

HV-3 (Organization) depicts the organization of all individuals (as specified in HV-2) in the enterprise of interest. It describes the formal organizational reporting structure, from which information such as chain-of-command and organizational grouping can be obtained.

Compared with the current DNDAF, HV-3 overlaps significantly with OV-4a (Organizational Relationship Chart). Both are intended to display the organizational relationships in an enterprise. One distinction can be made based on how the personnel element is defined in the graphical representation. HV-3 specifies each individual should be represented in this sub-view, whereas it is acceptable in OV-4a to describe the organizational configuration at the functional grouping level (i.e., divisions or units). The authors recognize such a distinction is rather minor and it is feasible to merge these two sub-views while integrating the HV into DNDAF. In this handbook, HV-3 is explicitly proposed for the sake of completeness when presenting the HV framework.

2.3.1 Purpose

The purpose of HV-3 is to depict the structure and organization of all personnel specified in the associated HV-2 model. In other words, individuals presented in HV-3 can be directly traced to the positions defined in the corresponding HV-2 model. This sub-view facilitates an understanding of formal functional groupings of people in the enterprise and the hierarchical inter-relationships among the individuals. Numerical indicators are also suggested in this sub-view to describe the size of different organizational groupings.

2.3.2 Prerequisite

HV-2 (Establishment) is a prerequisite sub-view for HV-3. It provides the complete list of personnel that needs to be represented in the HV-3 organizational diagram.

OV-4a (Organizational Relationship Chart) should be reviewed if the model is available. The development of a HV-3 model can be considered as an extension of OV-4a to the individual level.

2.3.3 Instruction

The basic information required for an HV-3 model includes the organizational structure of the enterprise and personnel assignment in this structure. To depict such a structure in a HV-3 model, four graphical elements are suggested, as illustrated in Figure 6:

- A diamond shaped element that indicates the overall enterprise;
- A hexagonal element that represents a subdivision or organizational grouping within the enterprise. A numeric value in the bottom right corner of the hexagon indicates the total number of personnel in the this organizational group;
- A rectangular shape represents a single individual in the enterprise. The labeling of each individual can use the unique identification available in the associated HV-2 model, such as the position descriptor or the identification number.
- A stacked rectangular shape represents multiple individuals with the same work assignment. A numeric indicator at the bottom right corner shows the number of people that shares the same duties and responsibilities.

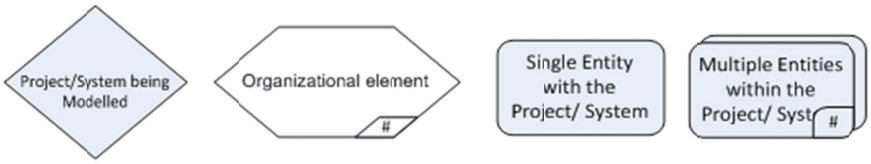

Figure 6: Suggested graphical elements for depicting an HV-3 (Organization) model.

Figure 7 illustrates how these graphical elements manifest themselves in the CAOC modeling study. Specifically, the enterprise of interest in this case is the CAOC; its Mission Support division is comprised of eight members; Construction Engineer Mission Support (CE Msn Spt) is

an individual (within the Mission Support division); and Logistics Mission Support (Log Msn Spt) consists of two persons.

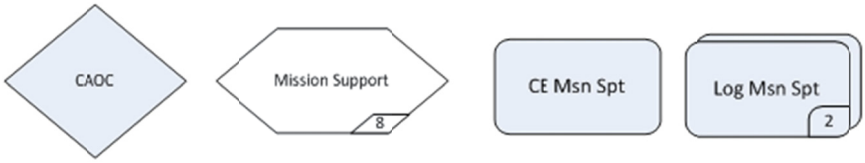

Figure 7: The HV-3 graphical elements, as manifested in a DND use case study.

The following steps are suggested for creating an HV-3 model:

1. Obtain functional groupings of the organization from the corresponding OV-4a model;
2. Obtain personnel positions from the corresponding HV-2 model;
3. Assign personnel positions to each of the functional groupings; and
4. Create a chart diagram using the suggested graphical elements to represent the organizational structure of the enterprise.

2.3.4 Representation

HV-3 is envisioned to use a graphical representation. Two examples are presented in Figure 8 and Figure 9 to show models developed for the CAOC analysis. Specifically, Figure 8 reflect a reduced 'as-is' HV-3 model of the existing CAOC, and Figure 9 is one of the "to-be" models that indicate the minimal manning configuration for the forward deployed V-CAOC team. By contrasting these two models, it is possible to analyze the functional interfacing between CAOC and the forward deployed team.

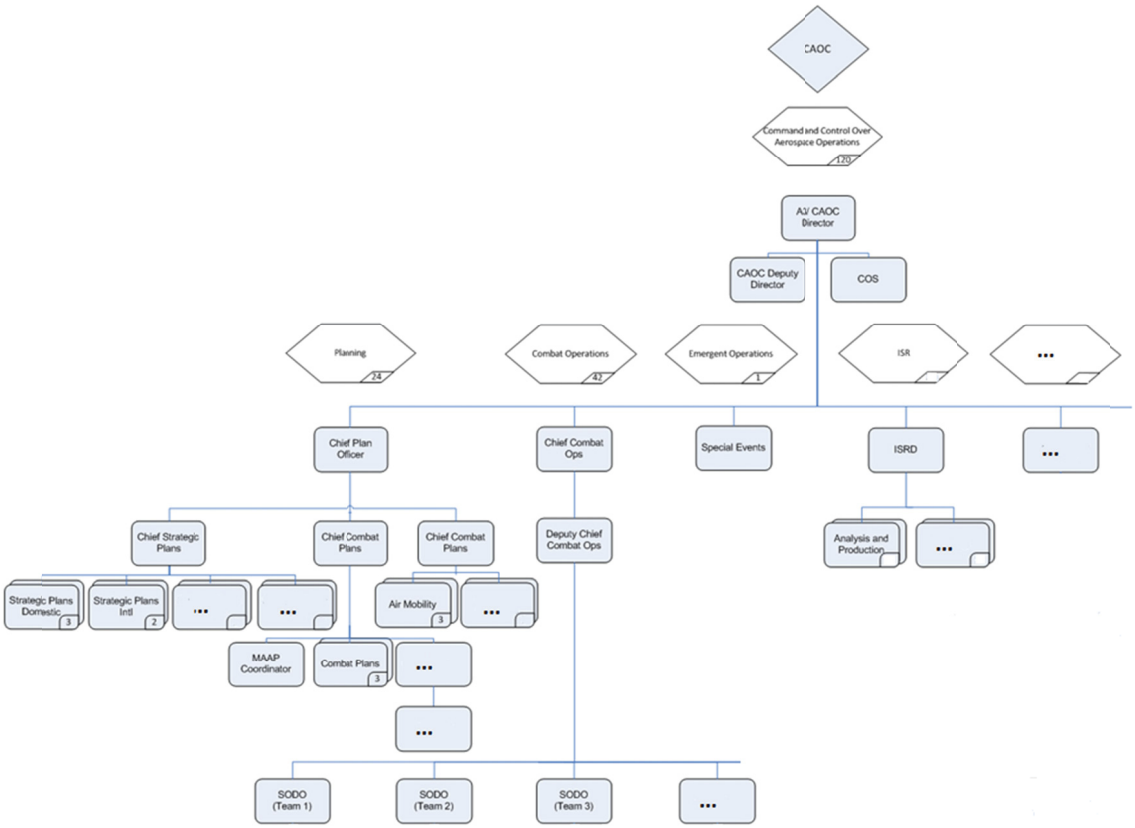

Figure 8: A sample HV-3 (Organization) model for CAOC (the reduced as-is model).

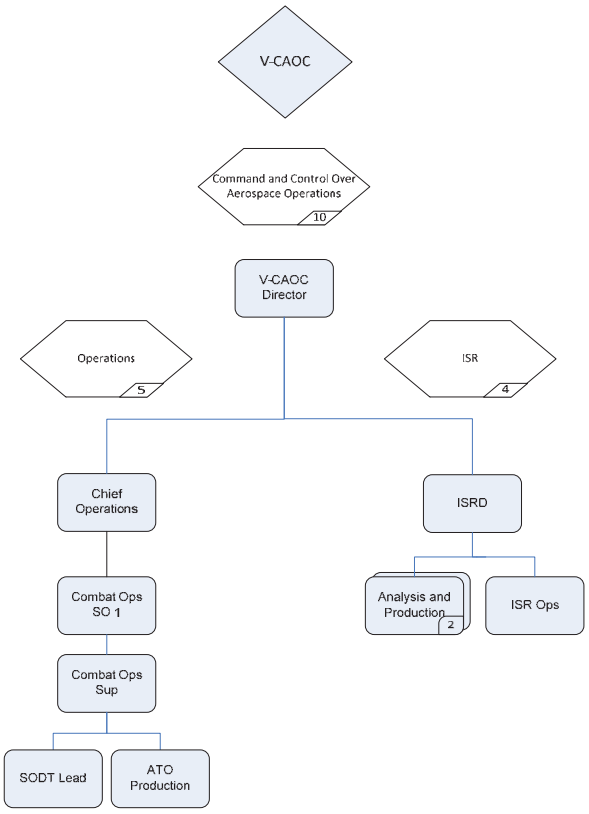

Figure 9: A sample HV-3 (Organization) for V-CAOC (the to-be model for the minimal manning configuration).

2.4 HV-4 Manpower projection

HV-4 (Manpower projection) provides a forecast of manpower requirement for the modelled enterprise over a time line that is defined according to the purpose of architecture project. While HV-2 reflects a manpower prediction based on the enterprise functional requirements, HV-4 provides more detail by projecting such requirements along a time horizon and describes when the personnel resources will be required and how the demand will fluctuate as the enterprise goes through different phases. An extreme example of the projection time line is the entire life cycle of an enterprise. Together these two sub-views supply essential architectural data for enterprise crewing analysis.

2.4.1 Purpose

The purpose of HV-4 is to provide a temporal forecast of personnel requirements for an enterprise based on anticipated operational demands. The sub-view is important for stakeholders that are involved in HR planning activities such as recruiting, training, professional development, personnel assignment and management.

2.4.2 Prerequisite

HV-2 (Establishment) is a prerequisite sub-view for HV-4 and supplies a repository of personnel required by the enterprise.

CapV-1 (Capability Taxonomy) provides useful information for constructing the timeline for manpower forecast. CapV-1 describes important enterprise capability states, such as Initial Operational Capability (IOC), Full Operational Capability (FOC), and System Disposal. These capability states reflect major milestones in an enterprise's life-cycle and often have specific implications on manpower demand. One solution for HV-4 is to align manpower forecast with these capability states. It is useful to note however that other types of milestones can also be adopted (e.g., specific operations and exercises) as long as these events lead to a change of personnel requirements.

2.4.3 Instruction

The proposed architecture data elements for HV-4 include:

- Enterprise state descriptor, e.g., capability milestones that cause a significant change of manpower requirements;
- Timing information for each enterprise state, which describes when a change of manpower requirement are expected; and
- Manpower requirements associated with each enterprise state.

Currently in this sub-view, the forecast is made at the individual level. The information can be aggregated to infer the number of people required for specific personnel types (e.g., MOSID and QL).

The following steps are suggested for creating an HV-4 model:

1. Identify enterprise states against which manpower forecast is required. Use information from CapV-1 if enterprise capability states are accepted as preferred state descriptors;
2. Provide a start (and optionally, an end) date for each enterprise state; and
3. Based on the personnel repository that is defined in the corresponding HV-2 model, specify the type and number of personnel required for each enterprise state.

2.4.4 Representation

HV-4 is envisioned to use a tabular representation. A sample model is provided in Table 5 that illustrates manpower projection for a V-CAOC team during the period between 2013 and 2014. This example shows personnel requirements, described in terms of occupation and rank, in this time frame based on the RCAF's operation requirements that serve as capability states driving the manning demand.

The numerical indicator in each cell reflects the number of personnel required for the associated time period. As an example, the row – '00213 Intelligence Officer', 'Captain' – indicates a requirement for four such officers during the third quarter of 2013.

Table 5: A sample HV-4 (Manpower projection) model for V-CAOC analysis.

Virtual - Combined Aerospace Operations Centre		2013				2014			
Operational Demand							Min. - Op 5		
							Min. - Op 4		
						Max. - Op 3			
			Med. - Op 2						
		Min. - Op 1							
Occupation	Rank	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
00183 Pilot	LCol	1	2	2	1	2	3	2	1
00183 Pilot	Maj		2	2	2	3	1	1	
00184 Aerospace Control	Maj/Capt					1	1	1	
Any Air Occupation Officer	Maj/Capt	2	3	3	1	3	6	4	2
Any Air Occupation Officer	Capt	2	5	5	3	9	10	8	2
00213 Intelligence Officer	Maj/Capt		1	1	1	2	1	1	
00213 Intelligence Officer	Capt	2	4	4	2	4	6	4	2
00328 Logistics	Maj		1	1	1	2	1	1	
00328 Logistics	Capt		2	2	2	5	3	3	
00340 Communications and Electronics Engineering - Air	Maj/Capt		1	1	1	2	1	1	
00189 Airfield Engineering	Capt					1	1	1	
00099 Intelligence Operator	MCpl/Cpl	2	4	4	2	4	6	4	2
00109 Aerospace Telecommunications Technician	WO					1	1	1	
Any Air Occupation NCM	MCpl/Cpl	1	2	2	1	2	3	2	1

2.5 HV-5 Personal characteristics

HV-5 describes the personal characteristics for each individual in the enterprise. Such information is useful for a wide variety of purposes such as personnel selection, system interface design, as well as training/education planning. The proposed characteristics to be considered in this sub-view include physical (including anthropometric), sensory, psychological, sociological attributes, as well as KSAs that are required by the roles to which these individuals are assigned. In the context of CF, many such personal characteristics have been captured by each member's occupational specification. For example, based on a CF member's occupation and qualification level (e.g., MOSID and Rank), it is feasible to obtain a list of generic and baseline requirements from the Military Occupational Specification (MOS) on the individual's physical, sensory, psychological characteristics, as well as KSAs. The intent of HV-5 is to describe personal characteristics beyond those available from occupational specifications. The need for such a sub-view often arises either because a particular personal characteristic is very specific and is not included in the standard MOS or because its assessment criteria is different from (i.e., often higher than) the occupational baseline level.

It is useful to note that an HV-5 model is analogous to a Target Audience Description (TAD) that has been widely used in DND/CF. In a nutshell, TAD is commonly used in acquisition projects to document personal characteristics of a future system's intended users that include both operational users and maintenance personnel. The incorporation of HV-5 in the HV framework ensures such data are represented in the architectural models.

2.5.1 Purpose

The purpose of HV-5 is to specify personal characteristics, beyond those derivable from military occupational specifications, based on each individual's job performance requirements. Such characteristics can be classified into the following categories:

- Physical Characteristics, that is, physical and psychomotor skills (e.g., speed of typing, response time to visual and auditory signals, manual dexterity skills), anthropometric and medical traits (e.g., strength, body size, weight, health), biomechanical attributes (e.g., mechanical properties of joints; human posture).
- Physiological/psychological characteristics, such as fitness levels, heat tolerance, lung capacity, working memory capacity, cognitive skills.
- Sensory characteristics, including visual and auditory abilities such as field of vision, visual response to colour, and hearing sensitivity.
- Knowledge, skills and abilities, such as communication skills, managerial skills, emotional stability, multi-tasking skills, generic and technical qualifications (e.g., computer literacy).

It is important to note that the list of characteristics is not exhaustive, other personal attributes can be added based on the needs of a specific architecture project. As an example, personality traits or demographic information (such as gender, age) can be incorporated into this sub-view if they are deemed important for enterprise decision-making. Additionally it is typical that a subset of the abovementioned characteristics is useful for a particular architecture modeling project, therefore we suggest it is the responsibility of the architect to determine and select the relevant attributes for inclusion in an HV-5 model.

2.5.2 Prerequisite

Information required for modelling HV-5 can be obtained from the following sub-view models:

- HV-2 (Establishment) provides the list of enterprise personnel whose personal characteristics need to be specified;
- HV-9 (Human tasks) supplies information regarding each individual's task assignments, based on which personal characteristic requirements can be derived.

2.5.3 Instruction

Personal characteristics can be described in a variety of ways. Some can be measured using a ratio scale while others are better assessed categorically. Table 6 provides an example how assessment criteria can be created to focus on requirements beyond those specified by an individual's MOS. Following this scheme, personal characteristics can be evaluated using a binary (yes/no) response.

Table 6: Sample data elements, including personal characteristics and their assessment criteria, for modeling an HV-5 (Personal characteristics).

Attribute	Criteria
Position	The name of the position in the system being analyzed.
Rank	The rank level of the position.
Occupation (e.g., MOSID)	The Military Occupational Structure Identification Code.
Strength	Does the position require strength beyond that expected of the MOSID and rank designated for the position?
Fitness	Does the position require a fitness level beyond that expected of the MOSID and rank designated for the position?
Endurance	Does the position require endurance beyond that expected of the MOSID and rank designated for the position?
Confined spaces	Will the position be expected to operate in a confined space?
Right handedness	Does the position require the operator / maintainer to be right handed?
Visual acuity	Does the position require visual acuity beyond that expected of the MOSID and rank designated for the position?
Colour vision	Does the position require colour vision beyond that expected of the MOSID and rank designated for the position?
Auditory acuity	Does the position require auditory acuity beyond that expected of the MOSID and rank designated for the position?
Decision making	Does the position require decision making capabilities beyond that expected of the MOSID and rank designated for the position?
Concentration	Does the position require concentration capabilities beyond that expected of the MOSID and rank designated for the position?
Attitude	Does the position require an attitude beyond that expected of the MOSID and rank designated for the position?
Sociability	Does the position require sociability skills beyond that expected of the MOSID and rank designated for the position?
Language abilities	Does the position require language capabilities (written, oral or both) beyond that expected of the MOSID and rank designated for the position?

The following steps are suggested for creating an HV-5 model:

1. Identify a list of personal characteristics that are relevant to the architecture project;
2. Determine how each characteristic should be measured in the model, for example, whether a categorical binary response (yes/no) is sufficient or numerical rating scales are needed;
3. Identify a list of personnel (i.e., positions) from the associated HV-2 model for whom detailed personal characterization is required;
4. For each individual, specify the characteristic requirement for each attribute defined in Step 1 using the rating scale decided in Step 2.

2.5.4 Representation

HV-5 is envisioned to use a tabular representation. Table 7 shows a sample HV-5 model for describing personal characteristic requirements (as defined in Table 6) for all personnel in the

minimal manning configuration of a V-CAOC team. An additional 'Remark' field was added for storing any commentary note that the architect supplied for each position.

Table 7: A sample HV-5 (Personal Characteristics) model for V-CAOC analysis (the Minimal manning configuration).

Position	Rank	MOSID	Physical Characteristics					Sensory Characteristics			Psychological Characteristics					Remark
			Strength	Fitness	Endurance	Confined Space	Right Handedness	Visual Acuity	Colour Vision	Auditory	Decision Making	Concentration	Attitude	Sociability	Language Ability	
V-CAOC Director	LCol	Air Ops	No	No	Yes	No	No	No	No	No	Yes	No	No	Yes	No	Long hours. Will need to socialize with Joint Staff.
Chief Operations	Maj	Air Ops	No	No	Yes	No	No	No	No	No	No	No	No	No	No	Long hours
Combat SO Ops 1	Capt/ Maj	Air Ops	No	No	Yes	No	No	No	No	No	No	No	No	No	No	Long hours
Combat Ops Sup	Capt	Air Ops	No	No	Yes	No	No	No	No	No	No	No	No	No	No	Long hours. Small team will require enhanced responsibility.
SODT Lead	Capt	Air Ops	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No	No	Heavy workload and long hours
ATO Production	Cpl	Air Ops	No	No	Yes	No	No	No	No	No	No	No	Yes	No	No	Heavy workload and long hours
ISRD	Capt	00213 Intel	No	No	Yes	No	No	No	Yes	No	Yes	No	Yes	No	No	Heavy workload and long hours Coloured intelligence products
Analysis and Production	Cpl	00099 Intel	No	No	Yes	No	No	No	Yes	No	Yes	No	Yes	No	No	Long hours. Small team will require enhanced responsibility. Coloured intelligence products
Analysis and Production	Cpl	00099 Intel	No	No	Yes	No	No	No	Yes	No	Yes	No	Yes	No	No	Long hours. Small team will require

																enhanced responsibility. Coloured intelligence products
ISR Ops	Capt	00213 Intel	No	No	Yes	No	No	No	No	No	No	No	Yes	No	No	Heavy workload and long hours
Note: The characteristics that are selected as 'yes' represent those items that are beyond or exceed those expected for the Ranks and MOSID designated for the position.																

2.6 HV-6 Training needs

Within DND/CF, the Chief of Military Personnel (CMP) and Human Resources Civilian (HR-Civ) provide functional direction and guidance on all personnel management matters, including training. Policy manuals such as the Canadian Forces Individual Training and Education System (CFITES) describe the model and processes for managing individual training and education issues. In practice, such issues are commonly handled by career managers and occupational advisors in these organizations. According to CFITES, training issues are commonly handled within the framework of military occupations. For example, Occupational Specification Validation Board (OSVB) is often set up to manage the analysis of task and performance requirements for each military occupation. The output is presented in Job Based Occupation Specification (JBOS), which provides a baseline for generating training requirements. An introduction of novel tasks into an occupation or a change of task performance requirements typically will trigger assessment on training needs and the follow-up generation of training plans. The full process is well defined in CFITES, and OSVB has their specialized methods and tools to support its work. The intent of HV-6 is not to modify the existing management framework, rather it is to raise the visibility of this important HSI domain in enterprise architecture and ensure the perspective from such stakeholders as training officers is well represented in enterprise planning and problem-solving.

2.6.1 Purpose

The purpose for HV-6 is to identify gaps between an individual's qualification, skills, experience and those required by his/her jobs. The focus of this sub-view is to document requirements beyond those specified in an individual's occupational specification, such as, those caused by assignment of novel tasks due to the use of new equipment and/or higher performance requirements. Such information can be fed into future Training Needs Analysis and JBOS processes.

2.6.2 Prerequisite

Information required for modelling HV-6 can be obtained from the following sub-view models:

- HV-2 (Establishment) provides the list of enterprise personnel whose training needs should be assessed;

- HV-9 (Human tasks) supplies information regarding each individual's task assignments, based on which task and performance requirements can be derived.

2.6.3 Instruction

Table 8 provides a list of the basic data elements for modeling HV-6.

Table 8: A list of data elements for an HV-6 (Training needs) model.

Data element	Description
Position	The name of the position in the enterprise being analyzed. The information is available from the corresponding HV-2 model.
Rank/level	The required rank level of the position. The information is available from the corresponding HV-2 model.
Occupation (e.g., MOSID)	The Military Occupational Structure Identification Code. The information is available from the corresponding HV-2 model.
Tasks/Sub-Tasks	A list of the tasks a position incumbent is expected to conduct. The mapping between positions and tasks are available from the HV-9 model.
Qualification	Any unique qualifications that are required to perform the tasks expected of the position. These can be written in either plain text by the analyst or they can be captured as either the military occupational qualifications (e.g., ADFR for a MARS Officer, MOSID 00207) or occupational specialty specifications (e.g., AEEG – Surface Ship Command).
Skill	Any unique skills that will be required to perform the roles/tasks expected of the position beyond those expected for a person of the Rank/QL and MOSID.
Experience	Any unique experience that will be required to perform the roles/tasks expected of the position beyond those expected for a person of the Rank/QL and MOSID.

The following steps are suggested for creating an HV-6 model:

1. Identify positions from the corresponding HV-2 model that new training needs assessment may be required;
2. Examine the associated HV-9 model, collate all task and sub-task requirements for each position; and
3. Specify qualification, skills and experience requirements for each position.

2.6.4 Representation

HV-6 is envisioned to use a tabular representation. A sample model is shown in Table 9 that depicts the qualification, skill and experience requirement for each position identified in a forward deployed V-CAOC team.

Table 9: An HV-6 (Training needs) model for V-CAOC analysis.

Position	Rank	MOSID	Tasks	Qualifications	Skills	Experience
ACCE Director	LCol	Air Ops	Command Operations Intelligence Planning	AJGM – Joint Command and Staff Programme	Adaptability, Operational Planning, Strong Leadership, Decisiveness	Post-Command, Operational Planning Process, recent deployed operation, understanding of RCAF doctrine
Deputy ACCE Director (Churchill)	Maj	Air Ops	Operations Intelligence		Adaptability, Operational Planning, Strong Leadership, Decisiveness, Flying Supervisor Qualification	Wing Ops, RJTF ACCE, deployed HQ
Deputy ACCE Director (Inuvik)	Maj	Air Ops	Operations Intelligence		Adaptability, Operational Planning, Strong Leadership, Decisiveness, Flying Supervisor Qualification	Wing Ops, RJTF ACCE, deployed HQ
ACCE A2	Capt	Air	Intelligence Planning	ACC Training, AEUU, AEUX	Good verbal comms, Adaptability, Operational Planning,	Wing Ops Centre
ACCE A2 Collator	Cpl	Air	Intelligence		Adaptability, motivated, attention to detail	
ACCE A3	Capt/Maj	Air Ops 00183 or 00182	Operations Planning ATO Production		Operational & Tactical Planning, Building Air Tasking Orders (ATO)	Air Operations, Flying Supervisor Position, CAOC, Recent Deployed Operation
ACCE A3/A5 (ACC)	Capt	Air Ops 00183 or 00183	Planning ATO Production		Operational & Tactical Planning, Building Air Tasking Orders (ATO)	Air Operations, Flying Supervisor Position, CAOC, Recent Deployed Operation
ACCE A3/A5 (Churchill)	Capt	Air Ops 00183 or 00184	Planning ATO Production		Operational & Tactical Planning, Building Air Tasking Orders (ATO)	Air Operations, Flying Supervisor Position, CAOC, Recent Deployed Operation
ACCE A3/A5 (Inuvik)	Capt	Air Ops 00183 or 00185	Planning ATO Production		Operational & Tactical Planning, Building Air Tasking Orders (ATO)	Air Operations, Flying Supervisor Position, CAOC, Recent Deployed Operation

2.7 HV-7 System safety

HV-7 summaries safety related management and engineering tasks that are required to identify prominent and foreseeable risks that may lead to potential accidents or mishaps and threaten the function of the enterprise. Within DND/CF, the Director General Safety (D Safe G) provides oversight on System Safety issues. D Safe G is responsible for developing and administering a General Safety Program which meets the legislated requirements of the Canada Labour Code Part II and provides guidance and direction to reduce accidents, minimize personal suffering and financial losses, and contribute to the morale and well-being of all personnel. In an acquisition effort, System Safety concerns are important in design trade-off considerations. The development of HV-7 is to ensure such concerns are dealt with systematically and safety domain experts are engaged in the decision-making process.

2.7.1 Purpose

The purpose of HV-7 is to highlight critical system safety concerns in enterprise architecture and ensures these issues will be reviewed and assessed by safety domain experts in the enterprise development process. Since system safety management activities are often project-specific and the associated method and approach are well defined by DND/CF policy documents such as the General Safety Program, the intent of HV-7 is not to change existing practices or prescribe safety management solutions, rather to inform decision-makers where specialized system safety analyses are required. The development of an HV-7 model requires domain experts to identify System Safety analyses that are applicable to the project. The model also provides a tracking mechanism that allows the status of each System Safety task to be updated.

The utility of HV-7 is similar to the sub-view TV-2 (Standards Forecast). While TV-2 provides a list of technical standards applicable to the enterprise project, HV-7 is created with a focus to support reporting and tracking functions for System Safety related effort.

2.7.2 Prerequisite

There are no prerequisite sub-views for HV-7

2.7.3 Instruction

HV-7 specifies a list of System Safety tasks that are applicable to the enterprise. Table 10 shows a list of suggested data elements for describing each task. A complete list of System Safety tasks and their definitions are available in MIL-STD-882E: Department of Defense Standard Practice: System Safety [12].

Table 10: Suggested data elements for describing System Safety tasks in HV-7 (System safety).

Data element	Description
System Safety Task	The specific task related to system safety.

OPI	Officer of Principle Interest. The individual or group responsible for the specific system safety task.
Date Started	The start date of the task.
Dated Completed	The completion date of the task.
Remarks	Any remarks or comments related to the specific task. This can also contain a link to the completed or draft document.

The following steps are suggested for creating an HV-7 model:

1. Identify System Safety tasks that are applicable to the enterprise;
2. Specify an OPI for each task;
3. Schedule a planned start date for each task; and
4. Update the model with task completion date and remarks as required.

2.7.4 Representation

HV-7 is envisioned to use a tabular representation. A sample HV-7 model template is shown in Table 11 that illustrates a non-exhaustive list of System Safety tasks for a generic acquisition project.

Table 11: A sample HV-7 (System Safety) model template for a generic acquisition project.

System Safety Task	OPI	Date		Remarks
		Start	Complete	
System Safety Program Plan				
Hazard Management Plan				
Hazardous Materials Management Plan				
Preliminary Hazard List				
Preliminary Hazard Analysis				
Functional Hazard Analysis				
Preliminary System Safety Assessment				
Operating and Support Hazard Analysis				
Health Hazard Analysis				
Health Hazard Assessment				
Personnel Impact Assessment Report				
System Safety Case				
System Hazard Analysis				
Safety Compliance Assessment Report				
Hazard Management Assessment Report				
Explosives Hazard Classification Data				

2.8 HV-8 Health hazards

HV-8 provides a summary of prominent and foreseeable factors that may cause reduced job performance, illness, injury, and disability for enterprise personnel. The sub-view highlights health hazard concerns in enterprise architecture and ensures these issues will be reviewed and assessed by health hazard domain experts in the enterprise decision-making process. The proposed sub-view identifies health hazards and their link to operator tasks, as well as the associated equipment systems. As a decision-support aid, the sub-view points out whether dedicated Health Hazard Assessment (HHA) is needed.

Within DND, D Safe G is the authority on issues related to health hazards and workplace safety. Two documents, the General Safety Program [15] and A DND/CF Hazardous Occurrence Investigator's Guide [16], were used as the primary reference materials for the creation of HV-8.

2.8.1 Purpose

The purpose of HV-8 is to identify health hazards and their association with operator tasks and equipment systems. The sub-view supports HHA to achieve the goal of minimizing or mitigating both short and long term hazards to health that occur as a result of system operation, maintenance and support.

2.8.2 Prerequisite

HV-9 (Human tasks) contains information regarding operator tasks and supportive systems, and is a prerequisite sub-view for developing an HV-8 model.

2.8.3 Instruction

Table 12 shows the recommended data elements for HV-8. Hazard risks are classified into physical, chemical, electrical, biological, radiological, and environmental hazards, according to the *General Safety Program* and *A DND/CF Hazardous Occurrence Investigator's Guide.* Assessment of each hazard is performed by examining both the frequency and the severity of hazard exposure. A set of commonly used assessment criteria is provided in Table 13. A risk assessment matrix is shown in Table 14, based on which different risk reduction strategies can be developed.

Table 12 : A description of the basic data elements for HV-8 (Health hazards)

Data element	Description
Task / Activity	The task or activity that causes operator exposure to a health hazard. The information is available from the associated HV-9 model.
Equipment / System	The required equipment or system for supporting the operator task/activity. The information is available from the associated HV-9 model.
Physical Hazard	Collision, caught in or between equipment, falls, slips, trips,

Data element	Description
	submersion, acoustical energy such as steady-state noise, impulse noise and blast over pressure, explosion, vibration, heat or cold stress, optical hazards, shock, repetitive strain and trauma.
Chemical hazards	Hazardous materials that are flammable, explosive, corrosive, toxic, carcinogens or suspected carcinogens, systemic poisons, asphysxiants including oxygen deficiencies and respiratory irritants.
Electrical Hazards	Electro static discharge, electrical fires, power loss, shock, short circuit and electromagnetic.
Biological hazards	Pathogenic micro-organisms or bacteria.
Radiological Hazards	Ionizing and non-ionizing radiation, lasers.
Environmental Hazards	Fire/heat, poor lighting, extreme temperatures, and weather phenomena such as snow, wind, ice, lightening, tornados and floods.
Hazard Severity	The effect of a hazard to cause injury, damage or impact on the environment.
Hazard Exposure	The likelihood that a hazard will occur.
Risk Ranking	Hazard assessment based on the assessment matrix (i.e., Table 14)
Analysis Required	An indicator whether additional analyses are required.

Table 13 : Definition of risk assesssment criteria.

Assessment criteria		Definition
Exposure	Frequent	Certain to contribute to an occurrence at least once during the next 30 days.
	Probable	Likely to contribute to an occurrence at least once during the next 6 months.
	Occasional	Likely to contribute to an occurrence at least once during the next 12 months.
	Seldom	Likely to contribute to an occurrence at least once during the next 5 years.
	Unlikely	Unlikely to contribute to an occurrence in the foreseeable future.
Severity	Catastrophic	May cause death of personnel, destruction of equipment or property or severe environmental damage.
	Critical	May cause serious injury of illness, major damage to equipment or property or serious environmental damage.
	Significant	May cause minor injury of illness, substantial damage to equipment, property or the environmental.
	Negligible	May cause personnel injury requiring first aid or damage to equipment or property or the environment.

Theoretically health hazard assessment can be performed for all operator tasks that have been identified in the associated HV-9 (human tasks) model. In practice however, it is suggested that the HV-8 model focuses primarily on novel operator tasks for which previous HHA has not been performed. Often these are tasks associated with the use of new material, equipment or systems. The intent for HV-8 is not to replace the existing framework for health hazard management. By fixating on novel operator tasks, HV-8 models better support enterprise level decision-making which focuses on trade-offs among the selection of material, equipment and/or systems. As an example, in the context of military acquisition, most new systems are comprised of a mixture of existing and new technology. It is recommended that the HV-8 model, developed to support the acquisition effort, should focus on health hazard risks imposed by the new technology. This however does not suggest the risks associated with existing technologies should be overlooked. It

is just that such risks are comparatively better understood and likely does not require further HHA investigations.

Table 14 : A risk assessment matrix

Severity / Exposure	Catastrophic	Critical	Significant	Negligable
Frequent	1A	2A	3A	4A
Probable	1B	2B	3B	4B
Occasional	1C	2C	3C	4C
Seldom	1D	2D	3D	4D
Unlikely	1E	2E	3E	4E

Definition of the colour coding used in the matrix:

- Red: Normally unacceptable. Immediate risk reduction must occur.
- Yellow: Undesirable. Reduction of risk should occur.
- Green: May be acceptable. Further risk reduction may be required.
- Blue: May be acceptable. Further risk reduction desirable.

The following steps are suggested for creating an HV-8 model:

1. Review the associated HV-9 (Human tasks) model, and identify novel operator tasks that may impose health hazard risks;
2. Supply equipment or system information for the identified operator tasks;
3. Classify the type(s) of the hazard;
4. Specify the frequency and the severity of hazard exposure and assess the risk level; and
5. Determine if detailed HHA is required.

2.8.4 Representation

HV-8 is envisioned to use a tabular representation. A full model has not been completed in the past use case studies. Table 15 provides a sample model that illustrates the data structure for HV-

8 and a hypothetical hazard risk assessment for a naval activity (e.g., Replenishment At Sea) due to the use of new automated equipment (e.g., reeling machine).

Table 15: A sample HV-8 (Health hazards) model.

Task/Activity	Equipment	Hazards						Risk			Analysis Required
		Physical	Chemical	Electrical	Biological	Radiological	Environmental	Severity	Exposure	Ranking	
Replenishment at Sea	automated reeling machine	Yes	No	No	No	No	Yes	Critical	Frequent	2A	Yes
…	…	…									

2.9 HV-9 Human tasks

HV-9 (Human tasks) describes enterprise tasks that are allocated to human operators, in other words, the sub-view explains "*what people do*". Such information is the foundation for addressing many human-related design considerations, including personnel selection, training, user interface design, and workload assessment. Ultimately a common goal shared by these design considerations is to ensure successful performance of all human tasks, which in turn is aligned with the general objectives of an enterprise.

2.9.1 Purpose

The purpose of HV-9 is to capture how enterprise functions are decomposed into tasks, how tasks are assigned to operators, and the assistive technologies required for supporting these tasks. The sub-view provides a summary of key outputs from a typical Human Factors task analysis, and the model is useful for engineering designers (e.g., Human Factors practitioner) to develop and evaluate design options and ensure successful Human-Systems Integration. The inclusion of such a sub-view promotes a user-centered design principle that put user needs, for which task performance is a core component, as an important driver for generating system solutions.

2.9.2 Prerequisite

The prerequisite sub-views for HV-9 include OV-5a (Functional Model), SV-5 (Operational Activity to System Function Traceability Matrix), and HV-2 (Establishment).

OV-5a describes "what must be done" by defining enterprise functions and their relationships. SV-5 explains "how it is to be done" by mapping these enterprise functions to system functions. HV-9 explains "who will do it" by decomposing enterprise functions into operational tasks, assign the tasks to operators (as identified in the associated HV-2 model), and connect the human task with system solutions.

2.9.3 Instruction

The following steps are suggested for creating an HV-9 model:

1. Obtain information about enterprise operational activities from the associated OV-5a model;
2. Decompose operational activities into human tasks and sub-tasks. Such task decomposition can be carried out iteratively, as seen in many hierarchical task analyses. General speaking, the granularity of task representation should support the needs of the architecture project and allow for the desired analysis. As a general rule of thumb, a stopping rule is recommended for HV-9 to terminate task breakdown when further decomposition will not affect the task's operator assignment.
3. Assign operators (e.g., using the positions obtained from the associated HV-2 model) to the human tasks; and
4. Identify supportive systems (information available from SV-5) to each task.

Additional task characteristics (e.g., workload ratings) may be added into this sub-view. But generally, this level of detail is not needed for enterprise decision-making such as those conducted by acquisition project staff.

2.9.4 Representation

HV-9 is envisioned to use a tabular representation. Table 16 provides a sample model obtained from the CAOC study in which the operational activity, the production of a Master Air Action Plan (MAAP), was analyzed. The model shows that two levels of task decomposition are sufficient in this analysis to identify individual operators for task assignment.

Table 16: A sample HV-9 (Human tasks) model.

Operational Activity	Tasks		Sub Tasks		Positions	Systems
1 Develop MAAP	1.1	MAAP Collect	1.1.1	Collect and Collate Weekly RFEs	MAAP Production	
			1.1.2	Publish Draft MAAP	MAAP Production; Combat Plans Chief	Email
	1.2	MAAP Plan	1.2.1	Review/Update Draft MAAP and Weekly RFEs	MAAP Production; FELPs	Email Telecom
			1.2.2	Review/Update Weekly Special Events	MAAP Production; Air Mobility 2;	Email Telecom

Operational Activity	Tasks		Sub Tasks		Positions	Systems
					Air Mobility 3	
			1.2.3	Review Mission Support Requirements	MAAP; TIS; CE; Air Maintenance; Logistics	Email Telecom
			1.2.4	Prepare Recommended MAAP	MAAP Production	NAPPIC
			1.2.5	Prepare Mission Support Brief and Tasking Order	MAAP Production	Email
	1.3	MAAP Approve	1.3.1	Review / Approve Recommended MAAP and Mission Support Plan	MAAP Production; Mission Support; Director CAOC	
			1.3.2	Distribute MAAP	MAAP Production	NAPPIC
			1.3.3	Distribute Mission Support Plan	MAAP Production	Email
	1.4	MAAP Task / Execute / Assess		Currently not supported in CAOC		

2.10 HV-10 Communications

HV-10 (Communications) describes inter-operator communication requirements for supporting team functions. While HV-9 provides a comprehensive model of all human tasks, HV-10 focuses on a sub-set of the human tasks, that is, the teamwork, and depicts task requirements for information exchange among operators.

The scope of HV-10 overlaps with that of OV-3 (Operational Information Exchange Matrix) and SV-2 (Systems Communications Description). However, there are significant differences between these sub-views.

HV-10 is specifically designed to capture inter-personnel communication requirements at the individual level, whereas SV-2 describes connectivity links among organizational nodes and emphasizes the hardware and software infrastructure that facilitates the exchange of information among the organizational nodes. Like the rest of the SVs, SV-2 provides an architectural model of the system solutions. In contrast, HV-10 focuses on operational requirements and describes why a communication link is needed by identifying the human task that demands it.

The differences between HV-10 and OV-3 are more subtle. Both are intended to provide traceable evidences to justify the needed for information exchange among operators. The utility of an OV-3 model is to identify, develop, or evaluate communication systems and infrastructures. For HV-10, its purpose is to support collaborative work and enhance teamwork performance. As a result, the attributes suggested in OV-3 mainly focus on those factors external to an individual whereas HV-10 attempts to capture the human characteristics such as the sensory channel through which information is transmitted.

2.10.1 Purpose

The purpose of HV-10 is to capture the existing or projected human to human communication patterns within collocated or distributed teams. The sub-view facilitates a better understanding of inter-personnel communication, which is needed in the following types of activities:

- Transmitting data;
- Sharing (access to) information;
- Retrieving or accessing data and information;
- Conversations and dialogues;
- Shared coordination activities; and
- Mutual/shared awareness-building.

An HV-10 model describes the intent of information flow and the sensory channels required for information transmission. It supports the analysis of many HF issues including collaborative work design, teamwork effectiveness, and workspace room layout.

2.10.2 Prerequisite

The HV-9 (Human tasks) is a prerequisite for this sub-view. The development of an HV-10 model starts with an identification of team tasks in the corresponding HV-9 model.

OV-2 (Operational Node Connectivity Description), OV-3 (Operational Information Exchange Matrix), and SV-2 (Systems Communications Description) are optional sub-views that assist the construction of an HV-10 model. Together these sub views provide a comprehensive model of the communication network by describing both its technological and human characteristics.

2.10.3 Instruction

Table 17 provides an overview of key data elements recommended for HV-10. Berlo's model was used as the underlying framework for describing the human characteristics in inter-operator communications [13].

Table 17: Key data elements for HV-10 (Communications)

Data element	Description
Operational Activity	The operational activity that generates teamwork requirements. The information is available from the associated OV-5a or HV-9 models.
Task	The teamwork tasks required to support operational activities. The information is available in the associated HV-9 model.
Sub-task	(Optional) decomposition of the teamwork task. The information is available in the associated HV-9 model.
Originator	The communication originator, i.e., the person who has a message to be transmitted.
Receiver	The communication receiver, i.e., the person on the receiving end of the transmission.
Channel	The human sensory channel required for processing the transmitted message.
Criticality	How important is the communication, reflecting the severity of communication failure. A categorical response (e.g., Low, Medium, High) is suggested which can be further

	defined by the architect.
Frequency	How often information exchange takes place. Generally speaking, frequency is context dependant and therefore is relative to the project being defined by the architecture. Sample categories for frequency are: Seldom, Occasional, Often, Frequent, and Very Frequent.
Synchronicity	Whether successful information exchange requires the presence of both originator and receiver when transmission occurs.
Feedback	Whether explicit acknowledgements are needed to confirm the successful receiving of the message.
Co-location requirement	Whether the originator and receiver need to be co-located based on characteristics of their communication requirements. Two operators are considered co-located when they are in a close proximity and assistive technologies are not needed to facilitate their communication.

A dual (tabular and/or graphical) representation is proposed for HV-10. The tabular representation reflects a comprehensive model of the communication requirements. Using a data table, the full list of attributes (e.g., as specified in Table 17) can be adopted for describing each communication link. An accompanying graphical representation can also be created to enhance the visualization of the communication requirements. A common format is a network diagram in which circular nodes and connecting lines are used to depict operators and communication links respectively. The connecting line can be graphically coded to represent different communication attributes. Two forms of the graphical representation are supported: an individual-centric depiction that shows the communication needs for each individual across all his/her tasks, and an activity-centric depiction that shows the team members involved in an operational activity and the required information exchanges among them.

The following steps are suggested for creating an HV-10 model:

1. From the associated HV-9 (Human tasks) model, identify team tasks that require exchanges of information among operators;
2. For each team task, specify the communication link by identifying the communication originator and receiver;
3. Determine the relevant communication attributes based on the architecture project's needs, and specify the attributes for each communication link.
4. If needed, generate a graphical depiction of the communication patterns to facilitate better visualization.

2.10.4 Representation

Table 18 provides a sample tabular representation of an HV-10 model, and the corresponding graphical representation is available in Figure 10. In this example, the models describe communication requirements for the production of the Total Air Resource Management (TARM) in the national CAOC.

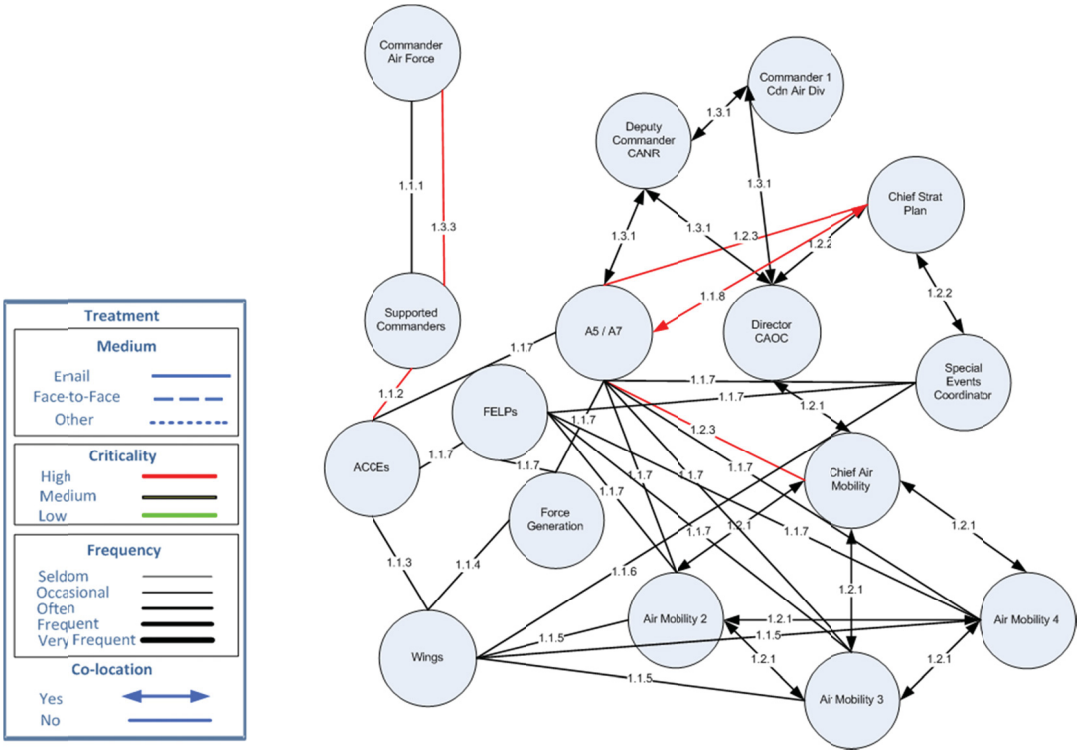

Figure 10: A sample graphical HV-10 (Communications) model for CAOC analysis (i.e., TARM production)

Table 18: A sample tabular HV-10 (Communications) model for CAOC analysis (i.e., TARM production)

Operational Activity	Tasks	Sub Tasks	Originator	Receiver	Criticality	Frequency	Synchronicity	Feed-back	Channel
1 Develop TARM	1.1 TARM Collect	1.1.1 Issue Call Letter	CAF	Supported Commanders	Medium	Occasional	Asynchronous	Yes	Visual
		1.1.2 Forward to ACCEs	Supported Commanders	ACCEs	Critical	Occasional	Asynchronous	Yes	Visual
		1.1.3 Collect and Collate Yearly RFEs	Wings	ACCEs	Medium	Occasional	Asynchronous	No	Visual
		1.1.4 Collate Force Generation RFEs	Wings	Force Generation	Medium	Occasional	Asynchronous	No	Visual
		1.1.5 Collect and Collate Yearly Air Mobility RFEs	Wings	Air Mobility 2 Air Mobility 3 Air Mobility 4	Medium	Occasional	Asynchronous	No	Visual
		1.1.6 Collect and Collate Yearly Special Events RFEs	Wings	Special Event Coord	Medium	Occasional	Asynchronous	No	Visual
		1.1.7 Collect and Collate Yearly FE and FG RFEs	ACCEs Force Generation Air Mobility 2 Air Mobility 3 Air Mobility 4 Special Event Coord	A5 / A7 FELPS	Medium	Occasional	Asynchronous	No	Visual
		1.1.8 Collect and Collate Yearly Unconstrained Demands	A5 / A7	Chief Strat Plan	Critical	Occasional	Synchronous	Yes	Visual and Auditory
	1.2 TARM Plan	1.2.1 Assess Air Mobility Constraints	Air Mobility 2 Air Mobility 3 Air Mobility 4	Chief Air Mobilty Air Mobility 2 Air Mobility 3 Air Mobility 4	Medium	Occasional	Synchronous	Yes	Visual and Auditory
			Chief Air Mobility	Director CAOC	Medium	Occasional	Synchronous	Yes	Visual and Auditory

	1.2.2 Assess Special Events Constraints	Special Event Coordinator	Chief Strat Plan	Medium	Occasional	Synchronous	Yes	Visual and Auditory
		Chief Strat Plan	Director CAOC	Medium	Occasional	Synchronous	Yes	Visual and Auditory
	1.2.3 Draft YAOP	A5 / A7	Chief Air Mobility Chief Strat Plan	Critical	Occasional	Asynchronous	No	Visual
1.3 TARM Approve	1.3.1 Review Draft YAOP	A3/CAOC/Deputy Commander CANR	Director CAOC A5 / A7	Medium	Occasional	Synchronous	Yes	Visual and Auditory
		1 Cdn Air Div/CANR HQ Commander	Director CAOC	Medium	Occasional	Synchronous	Yes	Visual and Auditory
	1.3.2 Approve YAOP	CAF	1 Cdn Air Div/CANR HQ Commander		Occasional	Asynchronous	No	Visual
	1.3.3 Publish YAOP	CAF	Supported Commanders	Critical	Occasional	Asynchronous	No	Visual
1.4 TARM Assess	1.4.1 Receive Feedback 1.4.2 Solicit Feedback 1.4.3 Review Feedback 1.4.4 Make Assessment	(note, currently the tasks are not performed in the CAOC)						

3 Further discussions

The proposed Canadian HV framework is aligned with HSI domains. The ten sub-views highlight key HSI concerns and assist their consideration in enterprise architecture models. However, given the complexity of enterprise systems and the vast scope of HSI practices, the authors are aware the proposed HV may need to be adjusted to suit each architecture project's needs. Such customization can be achieved in two ways. Within each proposed sub-view, architectural data elements can be adjusted by the architect, by removing or adding data attributes according to the needs of the specific architecture project. Alternatively the notion of fit-for-purpose sub-views is supported that allows the architect to generate tailored architectural representations by manipulating the architectural data that are captured by the existing HV framework. Section 3.1 elaborates on this concept by providing a sample rank structure sub-view.

One key application area for enterprise architecture modeling is to support project planning in large capital acquisition effort. Section 3.2 briefly explains DND's project management process and discusses the alignment of different HV sub-views with key decision points in the acquisition process.

3.1 Fit-For-Purpose Sub-Views

In a nutshell, a fit-for-purpose sub-view refers to a customized architectural sub-view that is created locally by architects based on a project's needs [14]. Such a sub-view relies on architectural data that are defined in DADM but adopts a representation that differs from the standard sub-views. Technically fit-for-purpose sub-views can be created by querying existing DNDAF database based on user-defined criteria. The concept reflects a shift of trend in architecture framework development from a 'view-centric' to a 'data-centric' approach. While the view-centric approach focuses on the definition of architectural representation for each sub-view, a data-centric solution emphasizes the underlying architectural data elements and allows an architect to determine the form and format of the architectural descriptions.

To better illustrate the concept, we provide a sample fit-for-purpose sub-view (i.e., rank structure sub-view) that was developed based on HV-2 (Establishment). The sub-view describes the rank distribution across military occupations for all personnel in an organization using a tabular format. Such information is useful in the context of ship crewing analysis. A rank structure sub-view can be created by aggregating the relevant architectural data (e.g., rank and MOS specifications for each position) captured in the corresponding HV-2 model and then summarizing the results in a tabular format.

Table 19 shows a sample model developed for a RCN use case study in which crewing solutions for a new naval platform were analyzed.

Table 19: A sample fit-for-purpose (Rank structure) sub-view model for a naval crewing analysis.

Officers	13	Officers					Senior NCOs					Enlisted				
Senior NCMs	39															
Enlisted	113	Cdr	LCdr	Lt(N)	SLt	Tot	CPO1	CPO2	PO1	PO2	Tot	MS	LS	AB	OS	Tot
Total	**165**	1	2	8	2	13	1	6	14	18	39	32	64	15	2	113
Command/Executive																
MARS	2	1	1			2										
Any Naval	1						1				1					
Med Tech-PA	1							1			1					
Med Tech	1											1				1
Totals	5	1	1			2	1	1			2	1				1
Combat																
MARS	6			4	2	6										
Any Combat	2							1			1			1		1
NavComm	9								1	1	2	2	4	1		7
NCIOp	12								1	2	3	4	3	2		9
NESOp	7								1	2	3	2	2			4
Met Tech	1								1		1					
Totals	37			4	2	6		1	4	5	10	8	9	4		21
MSE																
MS Eng	1			1		1										
Any Eng	3							1			1		2			2
Mar Eng Tech	17								2	2	4	4	9			13
E Tech	10								1	1	2	2	5	1		8
H Tech	15								1	1	2	4	6	3		13
Totals	46			1		1		1	4	4	9	10	22	4		36
Deck																
MARS	2			2		2										
Bos'n	29							1	1	4	6	5	11	5	2	23
Totals	31			2		2		1	1	4	6	5	11	5	2	23
CSE																
NCS Eng	1			1		1										
Any CSE	1							1			1					
W Eng Tech	17								1	2	3	4	8	2		14
Totals	19			1		1		1	1	2	4	4	8	2		14

Logistics																
Sea Log	1		1			1										
Any Log	1							1			1					
Cook	7								1		1	1	5			6
RMS	5								1	1	2		3			3
Steward	6								1	1	2	1	3			4
Sup Tech	7								1	1	2	2	3			5
Totals	27		1			1		1	4	3	8	4	14			18

3.2 Application of the HV in the Acquisition Process

According to DNDAF, enterprise architecture models support DND/CF acquisition process by facilitating options analysis. The models ensure that acquisitions are aligned with the DND/CF's strategic objectives and help to identify common needs so that resources can be pooled and existing assets can be managed to avoid unnecessary procurement.

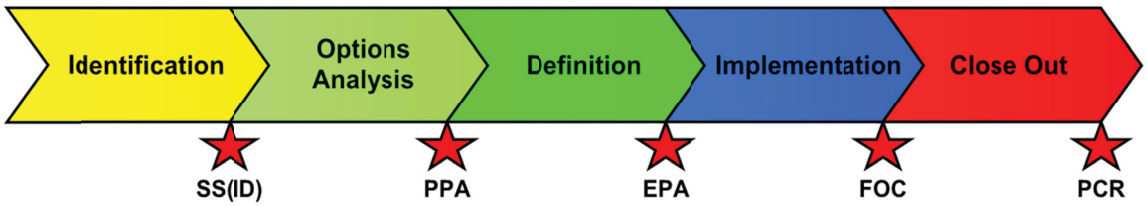

Figure 11: Project management phases (note, SS(ID) = Synopsis Sheet (Identification); PPA=Preliminary Project Approval; EPA=Effective Project Approval; FOC=Full Operational Capability; PRC=Project Completion Report).

Figure 11 was adapted from the DNDAF manual (Volume 2) and illustrates project management phases, as well as the associated key decision points identified in the DND/CF Project Approval Directive (PAD) [17]. The manual also recommends a minimum set of DNDAF sub-views for supporting acquisition projects, as shown in Table 20. The recommendation provides a baseline for the architectural development progress of new architecture activities through different project management phases. In this study, Table 20 is extended with an additional column to indicate an association of HV sub-views with project management phases.

Table 20: Recommended association of DNDAF and HV sub-views with project management phases (note, the information regarding DNDAF sub-views is adapted from [11]).

PAD Document	Associated DNDAF sub-view	Associated HV sub-view
SS(ID)	The following sub-views will aid in presenting Key Activity results in the Identification Phase:	HV-1 (Concept)

PAD Document	Associated DNDAF sub-view	Associated HV sub-view
	CV-1 (Overview and summary information), OV-1 (High-level operational concept graphic), IV-1 (Strategic information model), StratV-1 (Business strategy and motivation), CapV-1 (Capability taxonomy), and SecV-1 (Risk assessment).	
SS(PPA)	In addition to the sub-views identified in SS(ID), the following sub-views will aid in presenting Key Activity results in the Options Analysis Phase (Note, more than one set of any sub-view may be used to define various options.) OV-1 (High-level operational concept graphic), OV-2 (Operational node connectivity description), OV-4a (Organizational relationship chart), OV-5a (Functional model), CapV-3 (Capability to operational activities mapping), SV-1 (Systems interface description), SV-5 (Operational activity to systems functions traceability matrix), SV-7 (Systems performance parameters matrix), and TV-1 (Standards profile).	HV-2 (Establishment), HV-5 (Personal characteristics), HV-6 (Training needs), HV-7 (System safety), HV-9 (Human tasks)
SS(EPA)	In addition to the views identified in SS(PPA), the following sub-views will aid in presenting Key Activity results in the Definition Phase: CV-2 (Integrated data dictionary), OV-3 (Operational information exchange matrix), OV4b (Organization to role/skill matrix), OV-5b (Operational process model), OV-6a (Operational rules model), OV-6c (Operational event-trace description), SV-2 (Systems communications description), and TV-2 (Standards forecast).	HV-3 (Organization), HV-8 (Health hazards), HV-10 (Communications)
FOC	In addition to final updates to the selected sub-views identified in SS(EPA), any additional sub-views developed will aid in presenting the results of the Key Activities results in the Implementation Phase.	HV-4 (Manpower projection)
PCR	All the completed sub-views with a final updated CV-1will aid in presenting the Key Activity results in the Close Out Phase.	HV-4 (Manpower projection)

While Table 20 provides useful guidance on when to develop and employ DNDAF and HV sub-views in acquisition processes, it is useful to note that the scope of the architecture modeling effort differs across projects. Ultimately it is the architect's decision to select specific sub-views and decide an implementation strategy that considers model re-use, redundancy or duplication and fits the architecture project's needs.

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List of symbols/abbreviations/acronyms/initialisms

ACCE	Air Component Coordination Element
AcV	Acquisition View
ADM(IM)	Assistant Deputy Minister (Information Management)
AV	All View
CAOC	Combined Aerospace Operations Centre
CapDEM	Collaborative Capability Definition, Engineering and Management
Capt	Captain
CapV-1	Capability Taxanomy
CFITES	Canadian Forces Individual Training and Education System
CMP	Chief of Military Personnel
Cpl	Coporal
DADM	Defence Architecture Data Model
DEA	Directorate of Enterprise Architecture
DNDAF	Department of National Defence / Canadian Forces Architecture Framework
DoD	Department of Defense
DoDAF	Department of Defense Architecture Framework
DRG	Defence Research Group
FOC	Full Operational Capability
HF	Human Factors
HRCiv	Human Resources Civil
HSI	Human System Integration
HV	Human View
IOC	Initial Operational Capability
IV	Information View
JBOS	Job Based Occupation Specification
KSAs	Knowledge, Skills, and Abilities
LCol	Lieutenant Colonel
Log Msn Spt	Logistics Mission Support
LS	Leading Seaman
MA&S	Materiel Acquisition and Support
MAAP	Master Air Action Plan
Maj	Major
MCpl	Master Coporal
MoD	Ministry of Defence
MoDAF	Ministry of Defence Architecture Framework
MOS	Military Occupational Specification
MOSID	Military Occupational Specification Identification
NATO	North Atlantic Treaty Organization
NCIOP	Naval Combat Information Operator
OSVB	Occupational Specification Validation Board
OV	Operational View
OV-1	High-Level Operational Concept Graph
OV-2	Operational Node Connectivity Description
OV-3	Operational Information Exchange Matrix

OV-4a	Organizational Relationship Chart
PO2	Petty Officer Second Class
QL	Qualification Level
RCAF	Royal Canadian Air Force
RCN	Royal Canadian Navy
SecV	Security View
StV	Strategic View
SV	System View
SV-2	Systems Communications Description
TAD	Target Audience Description
TDP	Technology Demonstration Project
TIS	Technical Information Support
TV	Technical and Standards View
TV-2	Standards Forecast
WO	Warrant Officer

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As a result of information technology and acquisition reform within Allied defence communities architectural approaches have emerged and are evolving as a structure for the development of a systems architecture or enterprise architecture. While international architecture frameworks evolve to include new concepts in System Engineering, the portrayal of the human as a unique part of the system has not been addressed. A Human View is required to explicitly represent the human and to document the unique implications humans bring to and impose on the system design. To that end, the idea of Human Views, which leverages Human System Integration principles, has emerged. The purpose of the Human View is to capture the human requirements and to cater to and inform on how the human interacts in the system. This report defines the Human Views that are applicable to the Department of National Defence / Canadian Forces Architecture Framework (DNDAF).

Compte tenu de la poussée rapide de la technologie de l'information et de la réforme de l'acquisition au sein des collectivités de la défense des Alliés, l'architecture d'entreprise a fait son apparition et est devenue une démarche efficace pour appuyer la gestion de systèmes complexes et leur évolution au fil du temps. Les cadres d'architecture, comme le Cadre d'architecture du ministère de la Défense nationale et des Forces canadiennes (CA MDN), décrivent une démarche commune pour le développement, la présentation et l'intégration des descriptions architecturales. Bien que les cadres architecturaux internationaux évoluent pour inclure de nouveaux concepts en systémique, on n'a pas bien tenu compte de la représentation de l'être humain comme élément unique du système. Il faut un point de vue architectural pour représenter de façon explicite l'être humain et pour documenter les particularités que l'être humain apporte et impose à la conception du système d'entreprise. À cette fin, le concept de perspective humaine (PH), qui tire parti des principes et des pratiques de l'intégration des systèmes humaines (ISH), a fait surface.

La raison d'être de la PH est de saisir les caractéristiques des être humains, leurs exigences professionnelles, ainsi que de guider leur façon d'interagir avec les systèmes technologiques à l'appui des objectifs de l'entreprise. Le présent document définit un ensemble de PH qui a été élaboré afin d'améliorer le CA MDN, en mettant surtout l'accent sur le soutien aux projets d'acquisition du MDN.

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