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Command and Control for the Transformed Canadian Forces
A Grand Strategy

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Abbreviations

AFCCIS	Air Force Command and Control System
C4ISR	Command, Control, Communications, Computers, Intelligence, Search and Reconnaissance
CANOSCOM	Canadian Operational Support Command
CANSOFCOM	Canadian Special Operations Force Command
CBA	Canadian Border Agency
CBS	Canadian Blood Services
CCG	Canadian Coast Guard
CCIS	Command and Control Information System
CDS	Chief of the Defence Staff
CEFCOM	Canadian Expeditionary Force Command
CF	Canadian Forces
CFCS	Canadian Forces Command System
CFSS	Canadian Forces Supply System
CIDA	Canadian International Development Agency
CIN	Canadian Information Network
CSIS	Canadian Security Intelligence Service
DND	Department of National Defence
DPSEP	Department of Public Safety and Emergency Preparedness
FAC	Foreign Affairs Canada
FINTRAC	Financial Transaction and Reports Analysis Centre of Canada
FMIS	Financial Management and Information System
FOC	Fisheries and Oceans Canada
GCCS	Global Command Control System
IAASP	International Association of Airport and Seaport Police
IC2S	Integrated Command and Control System
IPS	International Policy Statement
JIIFC	Joint Information Intelligence and Fusion Capability
JIMP	Joint Interagency Multinational Public
JST	Joint Support Team
LFC2IS	Land Forces Command and Control Information System
MASIS	Material Acquisition and Support Information System
MCOIN	Maritime Command and Information Network
MSOC	Maritime Security Operations Centre
NATO	North America Treaty Organization
NCW	Network Centric Warfare
NEC	Network Enabled Capability
NEO	Network Enabled Operation
NGO	Non Governmental Organization
NMDS	National Material Distribution System

NORAD	North America Aerospace Defence Command
NSP	National Security Policy
OGD	Other Government Department
PHE	Public Health and Emergencies
PSEPC	Public Safety and Emergency Preparedness Canada
RCMP	Royal Canadian Mounted Police
SAS	Situational Awareness System
SCTF	Standing Contingency Task Force
SJS	Strategic Joint Staff
SOC	Strategic Operating Concept
SOG	Special Operations Group
TBMCS	Theatre Battle Management Core System
TC	Transport Canada
US	United States

Abstract

Command and control is the foundation upon which our missions and operations are planned, developed and executed. It is also a fundamental element of warfare. Although modern technology has expanded the capacity, the scope, and the reach, and increased the complexity of command and control its main characteristic remains its constancy. The elements revolving around its constancy must, however, be modified to efficiently adapt to a given structure and optimize performance. The Canadian Forces (CF) structure is now changing through its transformation process to become more effective, relevant and responsive. In April 2005 the Canadian Defence Policy Statement (DPS) was released and included the details of implementing the new vision. Among multiple objectives, the transformation will require the CF to adopt a fully integrated and unified approach to operations by transforming their command and control structure and updating their command, control, communications, computers, intelligence, surveillance and reconnaissance. With this in mind, this paper will provide a strategy and a structure optimally tailored for the command and control systems configuration of the transformed CF. It will initially argue that the current construct is problematic and will fail to meet the expectations of the transformation and, in a second facet, propose a model and an associated philosophy to produce a coherent design ideal for the future. Finally, this paper will conclude with recommendations on how to instigate and strengthen the elements composing this new grand command and control strategy.

*Nothing is so important in war as an
undivided command.*
- Napoleon, Maxims of War[1]

Introduction

The world has changed significantly over the last decade and, most remarkably, in the last five years with respect to its political boundaries, civilizations, and military forces. Many states must refocus and develop new national strategies. In fact, national security and defence policies can become distorted through numerous similarities, overlaps, and commonalities. The words used by the Canadian Minister of National Defence in September 2004 at The Royal Canadian Military Institute Conference to describe this very condition were: "Simply put, the lines between security and defence have blurred, if not disappeared altogether."[2]

As Canada evolves within the information age and the 21st century, its military forces, security organizations and governmental agencies, at home and around the world, now face new threats. Global terrorism, domestic and religious extremism, asymmetric actions, foreign espionage, proliferation of weapons of mass destruction and menace generated by failed and failing states all contribute to complicate current and future missions. Canada's preparedness for those missions and its efficiency and effectiveness

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[1] Napoleon Bonaparte, *Napoleon and Modern War: His Military Maxims* (Harrisburg, Pennsylvania: Military Service Publishing Company, 1943), 85.

[2] "Speaking notes for the Honourable Bill Graham, P.C., M.P. Minister of National Defence at The Royal Canadian Military Institute Conference, September 22, 2004" in *The New World of Robust International Peacekeeping Operations: What Roles for Canada and NATO?* Edited by Brian S. MacDonald and David S. McDonough (Toronto: Royal Canadian Military Institute, 2005), 134.

while in theatre must consequently evolve methodically and comprehensively. As indicated in Canada's International Policy Statement (IPS), it will be essential for the Canadian Forces (CF) to become more effective, more relevant and more responsive.[3]

Command and control is the foundation upon which those missions and operations are planned, developed and executed. It is also a fundamental element of warfare and arguably the most important building block of a given nation's military actions. The common goal of military control systems is simply to bring order to chaos.[4] With the purpose of optimizing the results of Canadian military and security operations, command and control systems must become the pillars of the command and control structure itself. Interestingly, and quite timely, for the CF, their overall command and control structure has recently changed and a new construct was adopted. Even though modern technology has already expanded the capacity, the scope, and the reach, and increased the complexity of command and control systems, those systems must be properly adapted to ensure the structure's efficiency is maximized. In order to positively exploit the results of this adaptation a complete grand strategy is required.

The CF must harmonize their new command and control structure with the best configurations of systems existing in this world of fast technological advancements. To capitalize on the tremendous capability of information technology available in recent

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[3] Department of National Defence, *Canada's International Policy Statement: A Role of Pride and Influence in the World – Defence* (Ottawa: National Library of Canada, 2005), 11.

[4] Clayton Newell, *The Framework of Operational Warfare* (London: Routledge, 1991), 121.

years, the CF began to acquire equipment that harnesses the power of information

technology and capable of competing with the world's most advanced command and

control systems. Individually, the Army, Navy and Air Force have developed plans to

improve and excel in the domain of command and control and its associated fields.[5] The

CF, as an entity, are presently developing a global plan to bring numerous portions of

command and control into one system design. While Canadian efforts are significant in

the field of command and control additional efforts are required in the areas of

coordination, integration, commonality, information distribution, flexibility,

interoperability, and support.

The importance of command and control and its impact on security and the

defence environment is generally well understood. This importance may have been

overlooked, however, prior to the understanding that command and control is a

fundamental and critical element of combined and joint operations ideal to combat

today's new asymmetric threat. Moreover, the recognition of the significance of

command and control within the future network centric environment has yielded

increased discussion, military strategies, studies, and academic writing. Some of the

literature also proposes solutions to command and control strategies that could potentially

lead to the development of national system configurations.

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[5] This will be demonstrated in Chapter 1through the various visionary strategies of the three components of the Canadian Forces.

Rafael de Solis examines, through a paper entitled "C2 Data Models, at a Crossroads" the dichotomy of command and control models. He indicates that military command and control systems are at a crossroads. For all military nations there is a need to decide between global information grids in which the information is conceived as a corporate good available anytime and anywhere; and the traditional conception of the information as an integrating element of each one of the functions in which the combat is methodically divided.[6] This challenge was similarly articulated earlier by David Alberts*et al*. in the book "*Understanding the Information Age Warfare*".[7] They mentioned that the nature of the technology itself and the ever increasing rate of change make our times unique and national security challenges, such as strategic and operational command and control, difficult to respond to.[8]

Additionally, in February 2004 David Potts released the "*The Big Issue: Command and Combat in the Information Age*". His book, through various authors, highlights the possibilities and the challenges of command and control in the war of tomorrow. Jake Thackray describes a commander-centric approach to future command structure and investigates associated issues such as span of command and hierarchies. He

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[6] Rafael de Solis, "C2 Data Models, at a Crossroads," (Research Paper, Allied Command Transformation Staff Element Europe, 2004), 1.

[7] Dr. David S. Alberts is a world-known expert in the command and control and information warfare domains. He is a member of the NATO SAS-050 Command and Control Research Projects and has held positions such as Director, Advanced Concepts, Technologies, and Information Strategies (ACTIS) and Deputy Director of the US Institute for National Strategic Studies.

[8] David S. Alberts, *et al*, *Understanding Information Age Warfare* (Washington D.C.: Command and Control Research Program Publication Series, 2001), 1.

also explores the benefits of the application of information age technology to military command and control systems.[9] Finally, Paul Lefever focuses on interoperability by discussing information sharing post 11 September.[10] This chapter is instrumental in understanding how to connect an information grid to a command and control configuration. This dichotomy also causes Alberts and Hayes to expand on command and control approaches in their latest work called "*Understanding Command and Control*".[11] They argue it is by changing the focus from what command and control is to why command and control is that nations will progress. This book also presents command and control models for the various approaches.

From this dichotomy on command and control military nations chose to develop their respective strategies. Most nations have articulated their visions about command and control and its link within the strategic and operational environments of the future. Canada is no exception. The CF have conveyed a guidance plan about C4ISR.[12] The document, entitled "*Canadian Forces C4ISR Command Guidance & Campaign Plan*", affirms that the aim of C4ISR, as an entity, is to support effective CF-wide command and

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[9] David Potts, *et al*, *The Big Issue: Command and Combat in the Information Age* (United Kingdom: Strategic & Combat Studies Institute, February 2004), 43.

[10] *Ibid*., 167.

[11] David S. Alberts and Richard E. Hayes, *Understanding Command and Control* (Washington, D.C.: DoD Command and Control Research Program Publication Series, 2006).

[12] The term C4ISR stands for Command, Control, Communications and Computer, Intelligence, Surveillance and Reconnaissance. This well-known abbreviation has become a common term within the information age and will be used as a single word throughout this paper.

control.[13] The document's aim is to create synergy among C4ISR initiatives and capabilities thereby enhancing the Canadian commander's ability to obtain and exploit information.[14] This guidance, released in 2003, leans on the global information grid solution introduced by de Solis as it relies heavily on a joint information and intelligence capability concept.[15] This campaign plan also supports thoroughly the strategic vision for the development of the CF in the 21st century, called "*Shaping the Future for Canadian Defence – A Strategy for 2020*".

Unfortunately for the CF a lack of coherency is created through the publishing of additional policies and visions about command and control or C4ISR. All three components of the CF – Navy, Army, and Air Force – produced direction, guidance and visions about their future operational and strategic environments and how command and control would transform to adapt to these environments. For instance, the Navy generated maritime guidance by publishing "*The Canadian Navy's Command and Control Blueprint to 2010*". Undoubtedly, this collection of strategies and guidance, released in no logical chronological order, creates confusion about the real intentions of the CF in the field of command and control.

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[13]Department of National Defence, *Maritime Command Strategic C4ISR Plan* (Ottawa: National Defence Headquarters, Deputy Chief of the Defence Staff, December 2003), 2.

[14] *Ibid.*, 6.

[15] This concept, called the Canadian Forces Joint Information & Intelligence Fusion Capability (JIIFC) Concept will be examined later.

However, all those documents were published prior to the release of the IPS in 2004 which was highly focused on the CF transformation. Consequently the existing command and control guidance and strategy does not account for the new command and control structure introduced by the CF transformation. This transformation stresses on the principles of Operational Focus, Command Centric Imperative and Mission Command.[16] Those principles are particularly important in the CDS's vision to execute strategic command and control. The IPS touches concretely, but also very generically, on the new command and control structure adopted by the CF. It indicates the national asset of command and control will, among others, proceed with specific measures to support the transformation.[17] Unfortunately, the remainder of the literature was released too early in order to concentrate effectively on optimizing the new command and control structure through innovations and improvement. Nevertheless, one common term found within all documents is interoperability. All visions agree that a high level of interoperability will be indispensable to future operations.

Much of the written work considering command and control within high interoperable environments proposes solutions through various models and strategies. Those models and solutions can be used by military nations to satisfy the requirements of their strategies. "*Coalition Command and Control*" written by Maurer and released in

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[16] Capt Vance White, "The Strategic Command Construct," *Maple Leaf Journal*, Ottawa: National Defence Headquarters, 8, no. 38 (2 November 2005), 8.

[17] Department of National Defence, *Canada's International Policy Statement: A Role of Pride and Influence in the World – Defence* (Ottawa: National Library of Canada, 2005), 13.

1994 raised fundamental questions about how to re-interpret command and control in the context of a coalition.[18] In 1995, Alberts and Hayes released "*Command Arrangements for Peace Operations*" and suggested some answers but also raised some additional questions.[19] Two books then followed trying to produce some of those answers. In 1998, Czerwinski, through his book "*Coping with Bounds*", addressed many of the challenges associated with complexity.[20] Shortly after, in 1999, "*Network Centric Warfare*", by Alberts, Garstka, and Stein, focused on shared-awareness and self-synchronization.[21] This set the stage for Albert and Hayes who, in 2001, published a book entitled "*Power to the Edge – Command and Control in the Information Age*". Their work articulates command and control through the principles being used to provide the ubiquitous, secure, wideband network that people will trust and use, populate with high quality information, and use to develop shared awareness, collaborate effectively, and synchronize their actions.[22] The book also conveys a command and control solution based on two thoroughly explained principles, *power* and *edge*, to achieve shared awareness, collaboration and synchronization. They culminate by combining the principles of power

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[18] Martha E. Maurer, *Coalition Command and Control* (Washington D.C.: National Defense University Press, 1994), 1.

[19] David S. Alberts and Richard E. Hayes, *Command Arrangements for Peace Operations* (Washington D.C.: Command and Control Research Program Publications Series, 1995).

[20] Tom Czerwinski, *Coping With bounds: Speculations on Non-Linearity in Military Affairs* (Washington D.C.: Command and Control Research Program Publications Series, 1998).

[21] David Alberts, John J. Garstka, and Frederick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority* (Washington D.C.: Command and Control Research Program Publications Series, 1999).

[22] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program Publications Series, June 2003), xx.

to the edge command and control to develop an agile organization characterized by their

complete synchronization. Atkinson and Moffat, in their book entitled "*The Agile*

Organization" also touch on agile organizations and their respective effectiveness. The

book contains real-world observations, anecdotes, and historical vignettes that exemplify

how organizations and networks function. It also shows how the connections between

people, nature, societies, beliefs, the sciences, and the military can be understood in order

to pursue the goal of an agile organization.[23] The concepts of interoperability and agility

both lead to the conceptual and technical framework and Network Enabled Capability

(NEC) or Network Centric Warfare (NCW).[24] To this effect, among much literature, the

Journal of Defence Science released a number totally dedicated to this topic in 2003. It

mentions that the world of NEC spans as deep as our imagination and our resources will

allow. More importantly, it indicates that it must encompass all parts of any given

military force.[25] An article, within the journal, by David Alberts, also demonstrate how

NEC will change the way command and control is approached.[26]

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[23] Simon R. Atkinson and James Moffat, *The Agile Organization: From Informal Networks to Complex Effects and Agility* (Washington D.C.: Command and Control Research Program Publications Series, 2005).

[24] A myriad of terms related to network operations currently dominates the field of generic networked operations. Network Centric Warfare (NCW), Network Enabled Operations (NEOs), Network Enabled Capability (NEC) are all, among others, present in the common military jargon. Although this paper will not define these terms in details it will provide some basic conceptual descriptions to clearly identify the requirement.

[25] Major General Rob Fulton, "Network Enabled Capability," *Journal of Defence Science* 8 no. 3 (September 2003): 103.

[26] David Alberts, "Network Centric Warfare: Current Status and Way Ahead," *Journal of Defence Science* 8 no. 3 (September 2003): 118.

In light of the aim of the CF C4ISR Command Guidance and Campaign Plan, the concepts of power, edge and agility can only be a starting point for the CF as they are transforming and adopting a new command and control structure.

This paper examines current Canadian efforts to enhance the command and control of its entire military organization. It takes an all-inclusive approach by considering the command and control strategies and environments as a whole. In establishing the efficiency of the Canadian command and control systems configuration in this larger context, it will scrutinize the Canadian Forces' effort to maximize the efficiency and effectiveness of its command and control systems configuration. The CF are not only in need of a grand strategy but they must convince the Government that command and control must be treated as a national asset encapsulating all essential aspects of defence, security, and support. It is already known that the current Canadian command and control systems framework cannot efficiently support the transformed CF organization in joint/combined operations or in the future network centric environment. Furthermore, Canada's cooperative interdepartmental approach to command and control lacks the desire to develop a complete national framework, clear leadership, and the necessary vision to excel in the field of command and control.

Based on this situation, this paper will argue that the CF need to lead a national command and control effort that will eliminate individual systems and create a configuration that will not only bring all defence and security organizations together but

that will also optimize the effectiveness of the transformed CF structure. In addition, it will propose a conceptual solution to address all elements derived from the arguments.

A detailed background of the different Canadian command and control strategies will initially be presented and the arguments will be evaluated. Second, the current CF situation with respect to command and control systems, interoperability with other agencies and the information sharing methods will be analysed. This will lead to the establishment of the core requirements necessary to enable the grand strategy within the national context. Fourth, a potential solution based on the *power to the edge*[27] concept will be presented and argued. Finally, suggestions with respect to the support of the grand strategy and the solution will be offered.

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[27] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 4.

> *War is the realm of uncertainty: three*
> *quarters of the factors on which action in*
> *war is based, are wrapped in a fog of*
> *greater or lesser uncertainty. A sensitive*
> *and discriminating judgment is called for; a*
> *skilled intelligence to scent the truth.*
> — Carl von Clausewitz[28]

Chapter 1 – Background and Strategic Environment

Some Important Definitions

Multiple definitions of command and control exist.[29] This large number of definitions is often problematic because it either applies to specific organisations or characterizes particular ways of understanding command and control. In fact, command and control definitions continue to evolve. Frequently viewed as the central nervous system in the human body, command and control feeds a brain, for instance a commander, to produce optimised decision making. Some definitions are convoluted with other notions forming larger scale concepts such as C4ISR. Straightforwardly, this paper offers two definitions of pure command and control. The first one, provided by the Canadian Navy's Command and Control Blueprint to 2010 is one of the simplest:

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[28] Clausewitz, Carl von, Michael E. Howard and Peter Paret eds, *On War* (Princeton, NJ: Princeton University Press, 1976), 101.

[29] The most widely used definitions of command and control are those from NATO and the United States military. Other definitions have been developed by military nations and their respective research establishments. In some occasions, the different environments within a military nation will also have their own individual definition.

> The process by which any commander
> plans, directs, controls and monitors any
> operation for which he has responsibility.[30]

The United States (US) military definition, an extension of the one above, is:

> The exercise of authority and direction by a
> properly designated commander over
> assigned forces in the accomplishment of the
> mission. Command and control functions
> are performed through an arrangement of
> personnel, equipment, communications,
> facilities and procedures employed by a
> commander in planning, directing,
> coordinating, and controlling forces and
> operations in the accomplishment of the
> mission. Also called C2.[31]

This later definition, also used by NATO, provides details about the execution of

the command and control process and cycle. Consequently, command and control refers

both to the process and to the system by which a commander decides what must be done

and sees that his/her decisions are executed.[32] Most of the elements of this definition will

be scrutinized later in this paper to develop core requirements for the ideal operational

and strategic level command and control system configuration. In the interim two

additional terms must be defined. One of the most important tasks of a military nation is

to find the exact and correct command and control concept and then use it to develop its

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[30] Department of National Defence, *The Canadian Navy's Command and Control Blueprint to 2010* (Ottawa, January 2002), 11.

[31] Department of the Navy, *Naval Doctrine Publication 6: Naval Command and Control* (Washington, D.C.: Office of the Chief of Naval Operations, 1995), 6.

[32] *Ibid.*

command and control structure. Hence it is appropriate to define these critical command

and control components.

Smith and Clark define a command and control concept as:

A command and control concept is the set of
characteristics associated with a command
and control structure describing how it
plans, directs, coordinates and control forces
and operations in the accomplishment of the
mission.[33]

They also provide a typical definition of a command and control structure well-

suited for the upcoming analysis:

A command and control structure is an
assembly of personnel, organization,
procedures, equipment and facilities
arranged to meet a given objective, and
within fixed economical limits.[34]

As seen through these definitions, the command and control concept is directly

related to the defence strategy, including the type and nature of the expected missions of

a given nation. The command and control structure will logically be developed from the

concept. To enable the structure a command and control system must perceptibly exist.

Thus, a description of a command and control system is also essential. For the purpose of

this research the command and control system will apply to the term "equipment" used in

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[33] Neill Smith and Thea Clark, *An Exploration of C2 Effectiveness – A Holistic Approach*
(Command and Control Research and Technology Symposium, 2004), 2.

[34] Neill Smith and Thea Clark, *An Exploration of C2 Effectiveness – A Holistic Approach*
(Command and Control Research and Technology Symposium, 2004), 3. In some literature, this definition
is associated with the term "command and control system". This paper will use this definition strictly to
define a command and control structure.

the command and control structure definition. The system will include computers, networks, servers, nodes, satellites, information grids, communications protocols, databases, and numerous applications.

Before analyzing this new structure it must be clear that the intent of this paper is to propose, or recommend, a grand strategy for the "equipment" piece of the new command and control structure. Throughout this paper this will be referred as the command and control systems configuration. Finally, it is also imperative to note that this research will build a conceptual solution for a command and control systems configuration for the CF and will not examine the technical requirements.

Criticality of Command and Control Systems

Efforts to establish effective command and control are shaped by two fundamental factors defining the environment of command and control in every military operation, namely uncertainty and time.[35] Regardless of the type or level of operation, leaders continuously have to deal with these two facets as intrinsic and necessary characteristics of command and control.[36] Opportunely today's technology can assist in solving the difficulties associated with these two factors.

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[35] Department of the Navy, *Naval Doctrine Publication 6: Naval Command and Control*, (Washington, D.C.: Office of the Chief of Naval Operations, 1995), 11.

[36] *Ibid.*

The world lives within the Information Age. For the last few decades, militaries

have been exploiting the potential, improvements, advantages and capabilities of

information technology to develop sophisticated command and control systems. The

impressive progress made recently in telecommunications, networking, and web-based

applications has significantly improved the efficiency of such systems. Command and

control systems have become very critical for many nations, in many cases indispensable.

The increasing complexity of modern warfare and the voluminous data to be processed

rapidly represent a significant problem. Military commanders can optimize their

situational awareness and improve their decision-making process through the benefits of

clear, precise and timely pictures of their respective battlespace. Although a reasonable

level of success in command and control design has been achieved by numerous armed

forces, the emerging network centric environment and increasing joint operations are

creating additional challenges. The key factor within the network centric environment is

the requirement for command and control systems to share information between nations

as modern military operations are increasingly conducted jointly and in coalitions. These

coalitions generate the need for complete interoperability, synchronization and flexibility

in a myriad of complex conditions. An additional factor for modern command and

control systems is the necessity of designing an arrangement that will not only fulfill the

requirements of all services but also optimize their global joint effectives.

It is becoming apparent that nations interested in rigid command and control must

migrate toward a single and integrated battlespace by which land, maritime, and air

forces, as well as space assets, will be directed by joint commanders through new generation C4ISR systems.[37] As a result of the challenges associated with the information age and the upcoming network centric environment command and control systems have become more critical than ever.

Likely Environments of Future Military Operations

The likelihood of Canada participating in operations where such critical systems will be necessary must be assessed. The IPS indicates that the CF will continue to be called upon to perform wide-ranging tasks from delivering humanitarian assistance to establishing the conditions for the rule of law, democracy and prosperity.[38] These missions and tasks will be conducted within a world where asymmetric threats will persist thereby increasing the complexity of our future battlespace. Canada and its allies have been plunged into a chaotic and turbulent new era that is likely to become even more ambiguous, uncertain and volatile.[39] Such a period will be characterised by asymmetric threat potentially including low-cost ballistic and cruise missiles, weapons of mass destruction, and information attacks.[40] Together all these intricacies introduce a more complex enemy and complicate the global environment of future military

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[37] Department of National Defence, *Maritime Command Strategic C4ISR Plan* (Ottawa: National Defence Headquarters, Deputy Chief of the Defence Staff, December 2003), p. B1/4.

[38] Department of National Defence, *Canada's International Policy Statement: A Role of Pride and Influence in the World – Defence* (Ottawa: National Library of Canada, 2005), 32.

[39] Bernard Horn, "Complexity Squared: Operating in the Future Battlespace," *Canadian Military Journal* 4, no. 3 (Autumn 2003): 3.

[40] National Research Council, *Realizing the Potential of C4I: Fundamental Challenges* (Washington D.C.: National Academy Press, 1999), 49.

operations. Coincidently of extreme difficulty for these operations will be the enemy's

command and control structure built around multiple nodes, and most likely with no

centralized command structure to target.[41]

To counter these threats, coalition military forces, including Canada, will remain

involved in new technologies, modern imaging methods, improved communications

methods and sophisticated command and control. Security will continue to be crucial

when designing, producing and implementing new systems. For command and control

systems, new approaches will become essential. Canadian command and control

systems, like coalition systems, will need to be global, capable of supporting a wide

range of operations anywhere in the world and in any terrain, and must be sustained from

early warning and crisis management through to post-conflict tasks.[42]

In the Canadian context, it is also known that service component forces will

operate jointly and, possibly, in coalition. The CF have also started to consider the

concept of network centric operations, particularly the naval component.[43] Network

centric operations are about leveraging information to create a collaborative intelligence

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[41] Bernard Horn, "Complexity Squared: Operating in the Future Battlespace," *Canadian Military Journal* 4, no. 3 (Autumn 2003): 3.

[42] National Research Council, *Realizing the Potential of C4I: Fundamental Challenges* (Washington D.C.: National Academy Press, 1999), 50.

[43] Greg Aikins, "Network-Centric Operations and Interdepartmental Marine Security," *Canadian Naval Review* 1, no. 3 (Fall 2005): 22.

and decision-making environment.[44] Consequently, the systems will have to be ready to be part of a high-scale network in order to effectively and efficiently support NCW and operations. By creating such a setting, command and control has to be re-thought.[45]

To execute command and control, Canadian operational commanders will have to receive information about the threat, operational environment and status of their component forces. They will also be required to communicate with their component commanders[46] with respect to asset allocation and employment. The missions may also add the additional requirement of coordination with multiple department agencies and organizations, non-governmental as well as governmental including those of coalition partners.[47]

The likely environment in which military operations will take place not only highlights the criticality of a coherent command and control system configuration but it will also act as one of the fundamental tenets for the derivation of the configuration's core requirements.

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[44] *Ibid.*, 21.

[45] *Ibid.*

[46] In this context a component commander is defined as the commander of a specific group of personnel belonging to the same component, namely Army, Navy and Air Force.

[47] National Research Council, *Realizing the Potential of C4I: Fundamental Challenges* (Washington D.C.: National Academy Press, 1999), 50.

The Canadian Forces Approach

For the Canadian Forces, command and control systems will be highly critical in future military operations environments. Before analysing the Canadian command and control visions it is appropriate to examine what the overall movement of the CF in the domain of command and control.

If they are to defeat their adversaries commanders must exert exacting control over their forces to advance their plans.[48] Command and control is critical and goes beyond being in a situation room and analyzing information. Nowadays commanders tinker with new technologies such as chat rooms, three-dimensional graphics, and web sites and they call that command and control.[49] In fact command and control seems to have been swept into cyberspace by a whirlwind of technologies. More than ever, it appears critical not only to focus on command and control but to re-approach it intelligently without the complexities of the information age. Within this approach, it seems advantageous to take a step back and revisit why command and control not only contains a soaring degree of criticality but also necessitates a high level vision.

For the CF, taking a step back can be performed by revisiting some of the recent operations they were involved in. Operations Apollo, Enduring Freedom and Katrina all

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[48] R.F. Willard, Rediscover the Art of Command and Control, *Proceedings of the United States Naval Institute* 128, no. 10 (October 2002), 52.

[49] *Ibid.*

contained the key element of interoperability, especially with the United States, and demonstrated that new threats – terrorism, failing states, natural and humanitarian disasters with associated epidemics – will characterize the future environments of military operations.

The CF Strategic Operating Concept (SOC) reveals that the CF will require transforming into agile, knowledge-based force capable of conducting effective joint, multinational and interagency operations.[50] It further indicates the CF must become interoperable with our closest allies and security partners, including local, provincial and federal authorities. Finally, the SOC focuses on the indispensability for the CF to maintain complete interoperability with the US as they will likely act as the lead nation in most future operations in which Canada will participate.[51] Moreover, the CF command and control systems will also need a very high level of inter-service compatibility. The ability to maintain knowledge superiority as well as the ability to effectively distribute it will also be instrumental.[52] The command and control vision must therefore be focused at the national level, include optimised interoperability and compatibility and maximize information and knowledge sharing.

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[50] Department of National Defence, *Canadian Forces Strategic Operating Concept Draft 4.4* (Ottawa: Deputy Chief of Defence Staff, 21 May 2004): 14.

[51] *Ibid.*

[52] S.G. McIntyre, M. Gauvin, and B. Waruszynski, "Knowledge Management in the Military Context," *Canadian Military Journal* 4, no. 1 (Spring 2003), 35.

Although the SOC provides superb substance to commence the derivation of key command and control requirements, a look at the approved Canadian policies with respect to command and control now becomes a prerequisite to the analysis.[53]

Strategy 2020 on Command and Control

In 1999 *Shaping the Future of the Canadian Forces: A Strategy for 2020 –* hereafter referred to as Strategy 2020 - was released and marked a significant milestone for the CF. This strategic framework was created for Defence planning and decision-making to help guide the institution well into the next century. Strategy 2020 identifies both the challenges and opportunities facing the Department and the CF as they adapt to change in a rapidly evolving, complex and unpredictable world. All components of the CF use this document as the foundation of their respective force development efforts. The document clearly states the strategic focal point:

> At its core, the strategy is to position the
> force structure of the CF to provide Canada
> with modern, task-tailored, and globally
> deployable combat-capable forces that can
> respond quickly to crises at home and
> abroad, in joint or combined operations. The
> force structure must be viable, achievable
> and affordable.[54]

Strategy 2020 also specifies attributes that are critical for the development of this strategy. Three of those attributes, namely modernization, global deployability and

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[53] The Canadian Forces Strategic Operating Concept has not yet been approved by the Chief of the Defence Staff. For that reason it will no longer be used as a reference within this paper.

[54] Department of National Defence, *Shaping the Future of the Canadian Forces: A Strategy for 2020* (Ottawa: National Defence Headquarters, June 1999), 6.

interoperability, are directly linked to the field of command and control and provide key guidance to enhancement efforts. The attribute of modernization requires, in particular, that the CF extend their distinctive competencies especially in the areas of space, telecommunications, information and sensing.[55] The notions of global deployability and interoperability, essential to ensure flexibility within the entire spectrum of operations, will be analysed as core requirements later in this paper. These features demand that the CF strengthen their military relationship with the US military to ensure that both forces are interoperable and capable of combined operations in key selected areas.[56]

Army, Navy and Air Force Strategies

Following the release of Strategy 2020 the Army, Navy and Air Force communicated their own strategy including numerous command and control considerations. A brief look at the CF Command Guidance and Campaign Plan, however, must first be taken in order to shape the strategic command and control picture and identify potential problems.

The Department's overarching CF C4ISR goal is to establish and maintain information dominance for DND in support of military operations and the National Security Policy (NSP).[57] The C4ISR vision is as follows:

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[55] *Ibid.*

[56] *Ibid.*

[57] Department of National Defence, *Maritime Command Strategic C4ISR Plan* (Ottawa: National Defence Headquarters, Deputy Chief of the Defence Staff, 2004), 10.

> An effective CF wide Command and
> Control capability that achieves operational
> advantage across the entire spectrum of
> military operations, through the attainment
> of trusted relevant information in a timely
> manner.[58]

Unfortunately, this overall vision is too generic and does not provide the guidance

necessary for the CF to come together as an entity, in synergy with other agencies, to

develop the dynamic command and control system configuration required for to achieve

the stated operational advantage across the entire spectrum of military operations.

Furthermore, through its oversimplification this guidance adds confusion and chaos to the

elaboration of a relevant strategy. Consequently, it became difficult for the three

components to achieve the goals outlined in Strategy 2020. The Army, Nay and Air

Force all released their own strategy in order to achieve the objectives of Strategy 2020.

All three strategies contained elements of command and control.

The Army developed an overall strategy called *Advancing with Purpose: The

Army Strategy*. Their strategy acknowledges that the Army works alongside the Navy,

the Air Force and the emerging CF Joint capability as part of Canada's overall defence

capability.[59] Furthermore, their philosophy recognizes that if their forces are to operate

effectively with their allies, particularly the US Army, they must become a knowledge-

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[58] *Ibid.*, 12.

[59] Department of National Defence, *Advancing with Purpose: The Army Strategy* (Ottawa:
National Defence Headquarters, Chief of the Land Staff, May 2002), 1.

based Army with equipment suited to a force which is strategically relevant and tactically decisive.[60]

Similarly, the Air Force vision, named *Strategic Vectors* is a highly comprehensive document that guides the Air Force's development and transformation into a 21st century Aerospace Force. Although very generic at times, it establishes a long-term transformation vision including generic elements of a command and control strategy. Two parts of the document generate interest for the command and control field. Part IV mentions the Air Force will move from a primarily static, platform-focused Air Force to an expeditionary, network-enabled, capability-based and results-focused Aerospace Force.[61] Likewise, Part V details the eight strategic vectors the Air Force will take to transform itself. Two of those vectors, results-focused operational capacity and transparent interoperability remain very important for the command and control strategy of the CF. [62]

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[60] *Ibid.*

[61] Department of National Defence, *The Strategic Vectors: Air Force Vision Part IV* (Ottawa: National Defence Headquarters, Chief of the Air Staff, May 2004), 33.

[62] Department of National Defence, *The Strategic Vectors: Air Force Vision Part V* (Ottawa: National Defence Headquarters, Chief of the Air Staff, May 2004), 45. The results-focused operational capacity vector states that the Air Force will explore new relationships with the Navy so aerospace control and maritime surveillance and control are executed jointly in Canada. Additionally, it specifies that the Air Force will enter early discussion with the Army and Navy on aerospace power capabilities that could more effectively meet their requirements. The transparent interoperability vector appears even more important as it acknowledges a requirement for absolute interoperability with the US. Finally, the Air Force will improve operational interoperability with coalition partners and work with them to ensure their command, control, and communications systems are interoperable.

In 2001 the Canadian Navy published *Leadmark: The Navy's Strategy for 2020*. Traditionally, the Navy, because of its close operational relationship with the US Navy has always been the pioneer within the Canadian military with respect to interoperability and command and control. During the first Gulf War the Navy appreciated and understood the need for complete interoperability with the US and other coalition partners. Today, they are the first to comprehend the concept of network centric operations and its relationship with interdepartmental marine security.[63]

Leadmark contains a substantial amount of capability information and, in many instances, relates to command and control, and some of its derivatives, as fundamental to the entire spectrum of naval operations. The main command and control principles mentioned in the document discuss versatility, jointness, interoperability and capability for a wide range of operations and indigenous capacity. One key requirement of Leadmark is seamless operational integration at short notice with our major allies, the US in particular, in many areas of warfare including C4ISR.[64] It further recognizes that interoperability must be one of the highest priorities when considering procurement of any new equipment or capability.[65] As a final point, Leadmark cleverly notes that a

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[63] Greg Aikins, "Network-Centric Operations and Interdepartmental Marine Security," *Canadian Naval Review* 1, no. 3 (Fall 2005): 20.

[64] Department of National Defence, *Leadmark: The Navy's Strategy for 2020* (Ottawa: National Defence Headquarters Directorate of Maritime Strategy, June 2001), p.131.

[65] *Ibid*.

national command, control, communications system with world-wide capabilities will be required.[66]

More interestingly, the Navy showed its complete grasp of the importance of command and control by releasing their own guidance, namely the Maritime Command Strategic C4ISR Plan.[67] Together Leadmark and the MARCOM C4ISR plan represent the cornerstone for naval forces to be able to respond within this new environment focused on situational awareness and strong command and control.

A look at Canada's National Security Policy

In April 2004 the Government of Canada released its National Security Policy entitled *Securing an Open Society*. This policy is a strategic framework and action plan designed to ensure that Canada is prepared for and can respond to current and future threats.[68] The document focused on core national security interests. More importantly, however, the policy focuses on an integrated security system and an Integrated Threat

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[66] *Ibid*.

[67] Department of National Defence, *Maritime Command Strategic C4ISR Plan* (Ottawa: National Defence Headquarters, Deputy Chief of the Defence Staff, December 2003), 13. A thorough and innovative document this plan is a comprehensive map for the implementation of C4ISR initiatives within the Navy in relation to the CF vision. The MARCOM C4ISR vision relates directly to command and control notions such as interoperability, decision-making. The first part of the vision states: "MARCOM shall, by 2015, develop and implement a C4ISR structure and capability that is joint and fully integrated into our planning and execution of operations. It shall be fully interoperable with allies and OGDs and provide the basis for strategic, operational and tactical decision-making."

[68] Privy Council Office, *Securing an Open Society: Canada's National Security Policy* (Ottawa: National Library of Canada, 2004), vii.

Assessment Centre.[69] The second chapter of the document is entirely dedicated to building an integrated security system. These two concepts are of crucial importance for this research as they refer to global integrated systems as national assets. Furthermore, they complement well the Chief of the Defence Staff (CDS) guidance's end state which aims towards a force capable of operating within a dynamic and evolving security spectrum.[70]

The NSP also acknowledges the importance that all security instruments must work together in a fully integrated way to address the security interests of all Canadians and that the lack of integration in our current system is a fundamental gap.[71] The objectives of the integrated security system are to more effectively respond to existing threats and quickly adapt to new ones. Such objectives are consequently linked to improvement and novelties with respect to how Canada gathers and handles information.

With respect to international security the role of the CF is also tackled. Although no specific mention of command and control exists, the NSP indicates the armed forces of Canada must be flexible, responsive and combat-capable.[72] They must also be in a position to conduct a wide range of operations and prepared to work with allies. As such

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[69] *Ibid.*

[70] General R. J. Hillier, CDS Planning Guidance: CF Transformation (Canadian Forces Headquarters: file 1950-9 (CT), 18 October 2005.

[71] Privy Council Office. *Securing an Open Society: Canada's National Security Policy* (Ottawa: National Library of Canada, 2004), 9.

[72] *Ibid.*, 50.

the policy also asks for a coherent information approach. As national security overlaps between the CF and other organizations such as the Department of Public Safety and Emergency Preparedness (DPSEP) and Public Health and Emergencies (PHE) it will be critical to account for the above statements of the NSP when generating the core requirements and the associated solution.[73]

International Policy Statement on Command and Control

Finally, the IPS, released in April 2005, represents significant change for the CF. It indicates the CF will pursue their transformation efforts with renewed vigour and focus.[74] It further specifies the transformation will require a fundamental change to the culture of our military to ensure a fully integrated and unified approach to operations.[75] It then acknowledges the requirement for new command and control structures and the creation of a national operational command headquarters (Canada Command). Equally important, the IPS mentions interoperability will remain an essential ingredient in future multinational operations and touches on jointness by specifying that the CF will become more effective by better integrating maritime, land, air and special operations forces.[76] Finally, the policy statement dedicates a section to the implementation of the

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[73] Canada's National Security Policy acknowledges that the Canadian Forces have figured prominently in the consequence management of national emergencies, assisting civilian authorities, over the last several years.

[74] Department of National Defence, *Canada's International Policy Statement: A Role of Pride and Influence in the World – Defence* (Ottawa: National Library of Canada, 2005), 3.

[75] *Ibid.*, 4.

[76] *Ibid.*, 11.

transformation vision. This includes the transformation of the command structure, and the update of the C4ISR capabilities.[77]

Overall, the document is rich in command and control guidance and underscores the importance of jointness, fully integrated approach to operations, and interoperability. The main objective of the IPS, rationally, is the support of the current structural transformation of the CF. Unfortunately, these efforts appear to mask the indispensability of an appropriate command and control systems configuration supporting the jointness, interoperability and information lattice required to achieve the operational goals. Since the IPS release, the CF created the nucleus of the transformation efforts, namely the command structure. This structure is depicted later in Chapter 2.

The Difficulties with Multiple Policies and Strategies

Multiple unsynchronized policies and strategies create confusion, generate overlapping requirements and produce ineffective results. Unfortunately this is the current strategic command and control environment of the Canadian Forces, numerous voices but no leader. Although the IPS is clear and thorough with respect to command and control it does not communicate a plan with specific objectives to address the immediate system requirements necessary to enable the command and control structure. Through the NSP, the IPS should be the document of choice to articulate the need to view command and control as a national asset. It should define a strategy to ensure that all operational nodes such as the CF, Royal Canadian Mounted Police (RCMP), Canadian

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[77] *Ibid.*, 12.

Coast Guard (CCG), and the Government work together towards a total solution. This plan can then be refined and communicated at the CF level through the IPS Defence booklet. This plan should cover all aspects of operations to optimize the efficiency of our new structure and the success of our future missions. This should include intelligence gathering, information sharing, surveillance, logistics and support and interoperability.

An additional difficulty lies within the context of the CF transformation. A structural transformation brings an interesting array of new challenges for the field of command and control. In February 2006 some elements of the new CF structure were successfully implemented and became operational, among others the Canada Command organization, the Canadian Expeditionary Force Command (CEFCOM) and Joint Task Force Atlantic. Fortunately the new command and control structure, described later in Chapter 3, is built on past experiences and focuses on increased effectiveness and responsiveness. However, many of the newly created commands will not perform efficiently with the current command and control systems configuration. The challenge is to build a construct that will be effective for all commands and their associated myriad of potential operations (domestic, coalitions overseas, joint international, joint continental, and contingency) and also include the constantly forgotten support component. Should this construct be based on the current systems, new systems for each new command or one common national flexible system? The challenge remains to try to satisfy all constituents of the new command and control structure while accomplishing all objectives of the various policies described above and on achieving mission success. A

high level of efficiency for this new structure will not exist until an expert command and control systems configuration is implemented.

Money Sense to Command and Control

There is no doubt that, for numerous nations, financial constraints on Defence budgets are compelling planners to search for sources of savings beyond the traditional elements of the military force structure.[78] The CF are no exception. Although a recent budget increase has been announced, in part for major acquisition projects to support their transformation and replace some of their older capabilities, the fiscal reality within Canada is still not very favourable for their military forces.

More interesting is the fact that investing in command and control, adds a very fascinating dilemma. On one hand a military desires better information processing and communications for their command and control users.[79] On the other hand, the same military wants more force, often sacrificing plans for existing or additional command and control resources.[80] The difficulty, consequently, lies in placing a value on those command and control systems and on those systems contributing effectively to mission success. Raymond Bjorklund proposes three questions to assist the military planners

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[78] Raymond C. Bjorklund, *The Dollars and Sense of Command and Control* (Washington D.C.: National Defense University Press, 1995), 3.

[79] *Ibid*.

[80] *Ibid*.

with respect to the command and control dilemma.[81] Are command and control systems

effective in improving mission success? Can we measure the effectiveness of command

and control systems? Can we successfully integrate command and control systems within

the military forces structure? According to Bjorklund the answer to all above questions is

yes. This research will demonstrate the same in later chapters. It will also demonstrate

that, although an honest and respectable amount of money should be dedicated to

command and control, the current approach necessitates a more rigid and complete

approach. A meticulous costing methodology established in terms of capital and

recurring costs and an implementation plan over a time scale consistent with the user

requirements are necessary to the future strategy.[82]

A report of the Auditor General of Canada on the C4ISR initiative revealed some

very fascinating and noteworthy facts and figures. For example, DND estimates that by

2015 it will have invested almost $10 billion on projects to improve the way it gathers,

processes, and uses military information.[83] For the Canadian military this amount is not

only significant but represents a key acquisition project such as a fleet of frigates or

transport aircrafts. The report also acknowledges DND has had a solid start in managing

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[81] *Ibid.*

[82] A. Nejat Ince *et al.*, *Planning Architectural Design of Modern Command Control Communication and Information* Systems (Norwell, Massachusetts: Kluwer Academic Publishers, 1997), 267.

[83] *Report of the Auditor General of Canada on Canada's National Defence C4ISR Initiative in Support of Command and Control*, Assistant Auditor General Hugh McRoberts, Chair (Ottawa: Office of the Auditor General of Canada, 2005), 1.

C4ISR and has put in place some guidance for the achievements of its goals.[84]

Unfortunately it further mentions some of the key elements required to ensure successful

implementation of the initiative are not yet in place.[85] A higher priority, according to the

report, must be placed on producing joint C4ISR doctrine, a concept of operations, a clear

definition of interoperability, and a common understanding of what C4ISR means to

better guide its development.[86] Without these fundamental elements, $4 billion of the

$10 billion planned for C4ISR projects will undoubtedly be at risk of developing non-

compatible or duplicate systems.[87]

Those findings from the Auditor General of Canada indirectly reveal a common

command and control strategy for the Canadian Forces should not only make sense

within operations by acting as a force multiplier and contributing to mission success but

should relieve the budget pressures by combining multiple solutions into one integrated

result and eliminating duplication and incompatibility.

Summary of Background and Strategic Environment

Although the Navy, Army and Air Force all concentrate dynamically in the field

of command and control they do not yet converge together into a shared solution. The

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[84] *Ibid.*

[85] *Report of the Auditor General of Canada on Canada's National Defence C4ISR Initiative in Support of Command and Control*, Assistant Auditor General Hugh McRoberts, Chair (Ottawa: Office of the Auditor General of Canada, 2005), 1.

[86] *Ibid.*, 2.

[87] *Ibid.*

leadership provided by the CF C4ISR Guidance Plan also lacks proper direction. The current command and control systems strategic environment remains problematic. It is primarily a collection of a stovepipe visions lacking the necessary focus to deliver a suitable product. Moreover, the current strategic environment does not establish an adequate link between all facets of command and control. Elements such as logistics, engineering, maintenance and training must be integrally connected to the more operational elements in order to give the commanders the complete and absolute set of data required for making decisions.

Although all policies examined above put extensive emphasis on command and control, a national solution, as declared by the Navy in Leadmark, is essential. It has been argued in the above section that our current command and control strategies, as many of them exist, cannot efficiently support the transformed CF organization in joint/combined operations or in the future network centric environment. This is evident through the lack of one common and total solution. As a nation, executing and designing command and control properly within a joint/combined environment means one philosophy and one strategy. Numerous resources have been allocated to command and control in the CF but without a grand strategy those resources will never produce the expected optimized outcome.

> *"To be a successful commander, one must*
> *combine qualities of leadership with*
> *knowledge of his profession. Either without*
> *the other is not much avail."*
>   - Admiral R.A. Spruance, U.S. Navy[88]

Chapter 2 - The Current Situation

The New Structure of the Canadian Forces

Before addressing any command and control systems configuration it is critical to examine the structure requiring support. In 2005, the CDS set in motion the CF transformation process. The key output of this transformation is a new command structure for the forces including the activation of some of its elements. This structure is depicted in Figure 1. It is divided horizontally by functional levels and vertically by the command structure itself.

The transformation of the CF commenced when the CDS guidance was issued on 18 October 2005.[89] The CF transformation will fundamentally re-shape the operational command and control structure of the CF.[90]

Essentially, the CF will reinstate the capability to execute strategic command and control, imposing a clear delineation between the strategic and operational levels of

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[88] Department of the Navy, *Naval Doctrine Publication 6: Naval Command and Control,* (Washington, D.C.: Office of the Chief of Naval Operations, 1995), 6.

[89] General R. J. Hillier, *CDS Planning Guidance: CF Transformation* (Canadian Forces Headquarters: file 1950-9 (CT), 18 October 2005.

[90] *Ibid.*

command.[91] To this effect the CDS directed the creation of a dedicated Strategic Joint

Staff (SJS) and three operational level command structures: Canada Command, Canadian

Expeditionary Force Command (CEFCOM) and the Special Operations Group (SOG).

Those entities are all shown in Figure 1.
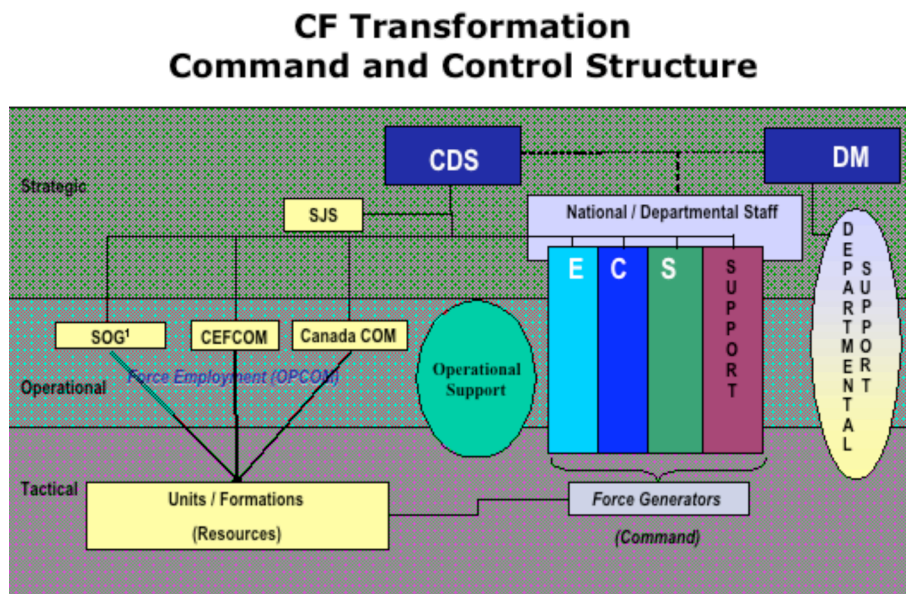
Figure 1 - CF Transformation - Command and Control Structure
Source: "Transformation and Alignment of the Canadian Forces," *Maple Leaf Journal*, January
2006, 12.

Explicitly, the CDS will serve as the principal military advisor to the Government

of Canada and command at the strategic level. The SJS will serve two functions:

command and advisory roles to the CDS. The Environmental Chiefs of Staff, shown on

the right side of Figure 1, will lead their respective Commands including all assigned

formations and units and will have direct responsibility for force generation. On the

other hand, the commanders of Canada COM, CEFCOM and the SOG will command

operations at the operational level. These three commanders will be responsible to the

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[91] General R. J. Hillier, *Concept of Operations: CF Strategic Command* (Canadian Forces
Headquarters: file 1950-2-4 (CFTT/DTP), 18 October 2005.

CDS for the execution of operational missions assigned by the CDS.[92] Moreover,

Canada COM will have six regional commanders (Pacific, Prairie, Centre, East, Atlantic,

and North). Of high importance is the fact that all six commands will contain some level

of jointness. Moreover, not showing on the diagram is the Standing Contingency Task

Force (SCTF). This force, an integrated sea-based high readiness response force, will

enable the CF to respond faster than ever before to crises and conflicts around the world.

This command and control structure will be the key assumption for this paper.

The command and control systems configuration to support and maximize the efficiency

of this structure must now be developed in accordance with the various links showing in

Figure 1. But before such an endeavour can be tackled, in order to logically identify

options for optimization, the structural form of this new transformed organization must

be further analyzed.

Evidently, there are numerous structural forms that a given organization, such as

the CF, can adopt. Through this new transformed structure the CF desire to adjust to

their particular set of purposes and objectives, to increase their mission effectiveness and

to be more flexible in a full spectrum of environments.   Traditional military

organizations have used structures that are well adapted to take on symmetrical

adversaries on a linear battlefield.[93] The recent terrorist attacks and the history of generic

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[92] *Ibid.*

[93] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 181.

guerrilla warfare have demonstrated that structured military forces have significant

difficulty dealing with asymmetrical opponents. Furthermore, those military forces have

also displayed weaknesses when operating in nonlinear battlespaces. Without analyzing

in detail the effectiveness of various organizational structures, in order to later situate the

CF structure, it is appropriate to focus on some basic results from an experiment

conducted by Leavitt and Bahrami and reported by Alberts and Hayes.[94]

Leavitt and Bahrami found that the traditional hierarchy (one with one boss)

proved best suited for stable and simple situations.[95] On the other hand, a circle

organization (one without a boss) proved to be best for a more complex and dynamic

situation where learning is involved.[96] Although weaker in speed and durability, a circle

organization has the advantage of performance and adaptability. In the circle

organization, a centrally-located individual, one with the most access to information

emerged as the leader.[97] Basically, the organization self-synchronized itself.

So where does the transformed CF structure lie? Examining Figure 1,

perceptibly, the structure emerges to be extremely close to a traditional hierarchy.

However, the objectives of the CDS, well articulated in the IPS examined above, incline

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[94] *Ibid.*, 183.

[95] A traditional hierarchy is characterized by one boss with a number of team supervisors under his leadership.

[96] *Ibid.,* 184.

[97] *Ibid.,* 185.

towards those of a circle organization, for performance and adaptability. Consequently, it appears that the command and control systems configuration should focus on providing the CF structure the power of the circle organization. This will enable a traditional hierarchy structure to maximize performance and adaptability, two instrumental variables within the nonlinear battlespace. Ideally, for any given situation, the leader (or the lead sub-organization) will be the one with the most information available. This concept will be vital when developing the overall solution in Chapters 3 and 4. Currently the CF do not reflect a circle organization but, with the right set of requirements, a command and control systems configuration can be developed to make it work as such.

Tunnel Vision: A Collection of Stovepipes

As examined in the previous chapter all environmental components of the CF are focusing on the command and control field and its associated elements such as communications, information management and all other basics of the C4ISR and network centric environment fields.

The CF are currently performing command and control through numerous distinct systems. Over the past two decades, the Army, Navy and Air Force have each developed and acquired specific and individual operational command and control equipment. The national command and control systems environment consequently lacks the homogeneity necessary to meet the challenges produced by today's high information flow and the network centric environment. This also represents a lack of interfacing between the

operational and tactical levels system. Moreover, it lacks the necessary focus on interoperability and, information operations and sharing.

Land Forces. The main system for the Land Forces is the Land Forces Command and Control Information System (LFC2IS). The basic components of this advanced concept consist of a tactical communication system, which connects the Command and Control system (ATHENA), the Situational Awareness System (SAS) and the Operational Database (OPERA) to the national command system. When fully deployed, the LFC2IS will provide the Army with common communication data and automated functionalities that will give commanders information superiority over any potential enemy. At the present time, the LFC2IS does not share information or applications with others components' command and control systems. Furthermore, it does not have the ability to contribute to a common operational picture from a coalition or with Canadian agencies such as the RCMP.

Air Forces. The Air Force made a colossal leap forward in their command and control capability by introducing the Air Force Command and Control System (AFCCIS). At full completion, this internet-based command and control information network will allow commanders at all levels to communicate jointly, on-line, in real time, to and from anywhere in the world. AFCCIS is based on the American Global Command Control System (GCCS). This system should therefore establish a command and control information network to provide air force commanders a single operating environment. Furthermore, the system uses the Theatre Battle Management Core System (TBMCS).

This system, developed and incorporated across the US Department of Defence, provides the capability of generating and managing Air Battle Plans and Air Tasking Orders and presents a Recognized Air Picture across all Air Force units within the CF. One key advantage of this system is that it will provide linkage to the other service information systems, other government department systems and specified alliance systems such as NORAD and NATO. The AFCCIS is interoperable with other command and control systems but does not possess the capacity to accomplish full situational awareness sharing at the sensor level. The overall project has not yet reached Full Operating Capability.

Maritime Forces. The main system for the Maritime Forces is the Maritime Command Operational Information Network (MCOIN). Initially developed and implemented in the early 1980s the MCOIN system continues to lead all others through its advanced interoperability with the United States and its capacity to generate a shared common Recognized Maritime Picture. Thus, the Canadian Navy can conduct distributed collaborative planning and operations with the US Navy exploiting the email, messaging and web services capabilities.[98] This ability is mainly due to the fact that both navies use the GCCS-Maritime system.

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[98] This is accomplished through a system called CENTRIXS (Combined Enterprise Regional Information Exchange System) which permits data exchange in routine coalition peacetime deployments and exercises for naval and joint operations.

The objective of the MCOIN system is to provide a Command and Control Information System (CCIS) with the strategic and operational information needed to exercise effective and efficient command and control decisions. Specifically, MCOIN III systems provide support for the Maritime Command organization operational responsibilities. Those responsibilities can be broadly classified as comprising operations planning, readiness management, situational awareness, operations analysis, communications, and intelligence.

Support and Logistics. The support and logistic component always seems to be the forgotten one. However, this should not be the case. In the CF, material is moved locally, nationally and internationally.[99] In order to manage and supervise this movement, they have developed the National Material Distribution System (NMDS), a government-wide mission critical application.[100] Such an application is essential to provide an automated solution to the processes of shipping, receiving and tracking of material.

A second system exists to complement the functions of movement performed by NMDS. This system is the Canadian Forces Supply System (CFSS). This system is used to order goods and initiate shipments.[101] It interfaces with NDMS to complete the

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[99] Major Yves Pinet, "Automation in the CF Supply Chain," *Logistics Quarterly* 7, no. 3 (Summer 2001): 1.

[100] *Ibid.,* 2.

[101] *Ibid.*

shipping process.[102] Information originating in CFSS can consequently be automatically accepted to populate databases in NMDS. Finally, to complete the CF supply chain, a third system, the Financial Management Information System (FMIS) is used for all financial encumbrances. It has basic links with NMDS. Although this research will not discuss the potential benefits of integrating those three systems into one national supply system, it seems evident that, in order to achieve total asset visibility and maximize our interoperability, integration between the support and operational dimensions must take place.

Canadian Forces. The Canadian Forces Command System (CFCS), TITAN is the primary command and control at the CF level, operating in a SECRET domain. This operational network offers a SECRET National Eyes Only environment linking key strategic and operational level Government of Canada, allied and CF Commanders and staff charged with the planning, conduct and support of CF operations. It supports decision-making and the operational planning process by providing basic tools, connectivity and access to information. Finally, it provides all operational units, world wide, with essential desktop automation plus web connectivity and an electronic mail capability.

Also worth mentioning is the intelligence network, called SPARTAN, that provides a Top Secret Special Access National Eyes Only environment with access to

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[102] *Ibid.*

intelligence data and products and the basic and intermediate tools necessary to support the intelligence process.

Finally, the CF have launched the Integrated Command and Control System (IC2S) project. The vision of the project is to provide Commanders and decision makers, at the operational and strategic levels, the ability to execute command and control within a collaborative Team Canada/JIMP (Joint Interagency Multinational Public) environment. Although, this project addresses the stovepipe problem currently existing within the Canadian Forces and is designed according to the new CF structure, it lacks the completeness necessary to ensure the new command and control structure functions optimally. Furthermore, a concept of pushing the power down into the organization must be inserted within the strategy to ensure that the system's efficiency is maximized by the appropriate decision makers.

The Lack of Efficiency with Stovepipe Systems

It is well known that, although efficient within a specific single environment, stovepipe systems will not be productive or valuable in joint and combined operations. Albert and Hayes clearly demonstrate stovepipe systems will fail to provide joint/combined forces commanders with expected results required to make key decisions.[103]

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[103] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 174.

Stovepipe systems create an additional important difficulty within the command and control process. In a world where information dominates, stovepipe systems will generate redundant and avoidable information barriers. Although it is recognized that data from one unit, the RCMP for example, may not be fully accessible by a joint operational commander, it is crucial to allow the information to become knowledge. Stovepipe systems prevent such a process. Stovepipes, when present in a high numbers within a military and security context such as the Canadian one, make interoperability extremely difficult if not impossible.

As a reminder, the CF C4ISR Command Guidance and Campaign Plan's end state will be considered achieved when, among others, command processes will no longer be constrained by artificial barriers within our doctrine, organization or systems, or those of our allies.[104] Stovepipes, indisputably, create such barriers at the system level and also within organizations. Their elimination is essential to effective command processes. The document also enumerates that a second condition necessary to the attainment of the end state is the conduct of operations from a position of decisive information superiority. Unquestionably stovepipes also contribute to a lack of efficiency within the information sharing domain. Different physical interfaces and information exchange protocols will limit the full use of the information and knowledge potentially present within the grid.

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[104] Department of National Defence, *Canadian Forces C4ISR Command Guidance & Campaign Plan* (Ottawa: National Defence Headquarters, 3 September 2003), 6.

Summary of Current Situation

The new structure of the CF is focused on jointness and coalition operations. First, the Canada COM organization will be required to use forces from all three services to effectively react to any type of domestic operations. Although not all operations will be joint, it is expected that, through the new structure and force deployment, most will be. As a result, it is difficult to imagine a Canadian joint domestic operation, potentially involving the RCMP, with four different command and control systems in use simultaneously. This will certainly create unnecessary problems such as information overlaps and barriers, functional discrepancies and confusion within the decision-making process. Secondly, in joint combined operations, such as those expected from the CEFCOM organization, it is not rational to think allied forces can align their system configuration to match Canadian stovepipe systems. Finally, within network centric operations, stovepipes will be at their worst and could potentially exclude privileged Canadian participation from an important coalition mission or, maybe, disable them to act as a coalition commander. The latest CFCS is making huge strides towards a common concept but an even larger strategy is necessary to compete in the very near future and remain relevant and effective for years to come.

The complexity of the current situation becomes very clear by looking at Figure 2. This figure shows all current systems necessary to ensure that the CF are completely functional in a joint environment. External links to enable operations with other departmental agencies are shown in mauve. This figure does not show information

relationships and how the different nodes access the intelligence database. Nevertheless, one can just imagine how compound and complicated such an information sharing process could be. Furthermore, liaison between tactical systems, shown at the bottom of Figure 2, and operational systems is, in some situation, very weak.
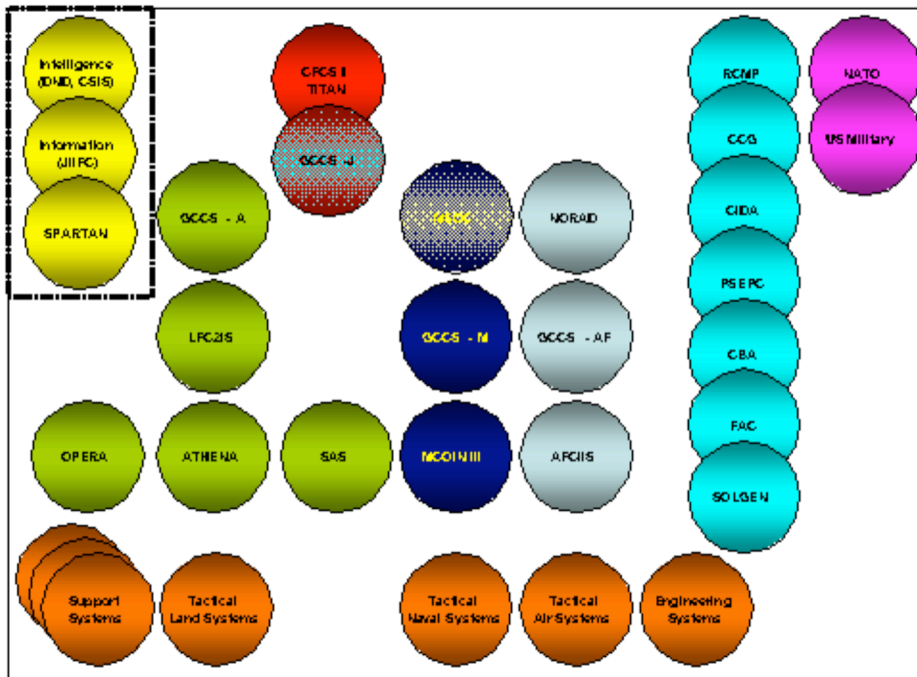
Figure 2 – The Problem: The Current Situation

We have seen, through the analysis of the various Canadian policies that the CF clearly intend to be fully interoperable in joint and combined operations. The collection of current stovepipes cannot, however, efficiently support the transformed CF organization in such operations or in the future network centric environment. Furthermore, still missing, appears to be a grand strategy for the CF that would combine the different requirements from the three services and merge towards a unique philosophy

and a common solution. The development of requirements to enable such a strategy is

worth a methodical and systematic analysis.

> *The growing array of asymmetrical threats*
> *to North America will require the*
> *development and the distribution of the*
> *national Common Operating Picture ... into*
> *a truly comprehensive continental picture.*
> - Leadmark[105]

Chapter 3 - The Core Requirements

Achieving the Ideal Solution

The design process of command and control systems begins with a goal architecture including baseline requirements and main architectural principles in terms of generic, system-specific characteristics and strategic goals.[106] While this paper will not examine system architecture it will provide a comprehensive set of requirements that will form the foundation for the CF's conceptual grand strategy. This grand strategy will be built with a complete Canadian defence and security vision in mind.

The ideal solution for a command and control system structure necessitates a set of comprehensive achievable requirements. The main challenge to build such a set often lies within the organization itself as numerous agencies have their own individual set of requirements and a given level of control over existing and future systems. This creates several uncommon requirements, a lack of uniformity across the different commands,

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[105] Department of National Defence, *Leadmark: The Navy's Strategy for 2020* (Ottawa: National Defence Headquarters Directorate of Maritime Strategy, June 2001), 130.

[106] A. Nejat Ince, C. Evrendilek, D. Wilhelmsen, and F. Gezer, *Planning and Architectural Design of Modern Command and Control Communications and Information Systems* (Norwell, Massachusetts: Kluwer Academic Publishers, 1997), 1.

functional overlaps and an undesired, but significant, lack of efficiency. The findings of Chapters 1 and 2 drive the critical requirements necessary for the ideal solution. Fundamentally, it has been demonstrated that command and control in the CF lacks a common strategy and is built around a stovepipe structure that will not be effective for the interoperability and information sharing required in a future network centric environment.

The proposed solution for the CF therefore revolves around six fundamental characteristics, or core requirements, that are presently lacking within the organization.[107] These core requirements are: unified approach, interoperability, NEC/interfacing, information sharing, agility and technical strength. They are conceptually depicted in Figure 3 and will be discussed at length in this chapter.

The unified approach feeds the main command and control system block as it affects all other requirements. The agility pillar is represented by a circle encapsulating the main block as it affects all aspects of command and control including personnel, resources and the intrinsic synergy that exist within such a system. Interoperability, NEC and interfaces, information sharing and technical strength will combine together to improve the overall command and control process.

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[107] This set of requirements is not all inclusive. Additional requirements are necessary for the complete design of a command and control configuration. Only the requirements considered to be presently lacking or missing within the Canadian Forces organization are presented in this research.

Grand Strategy

Interoperability

National
Command
and
Control
System

NEC and Interfaces

Agility

Agility

Information Sharing

Technical Strength
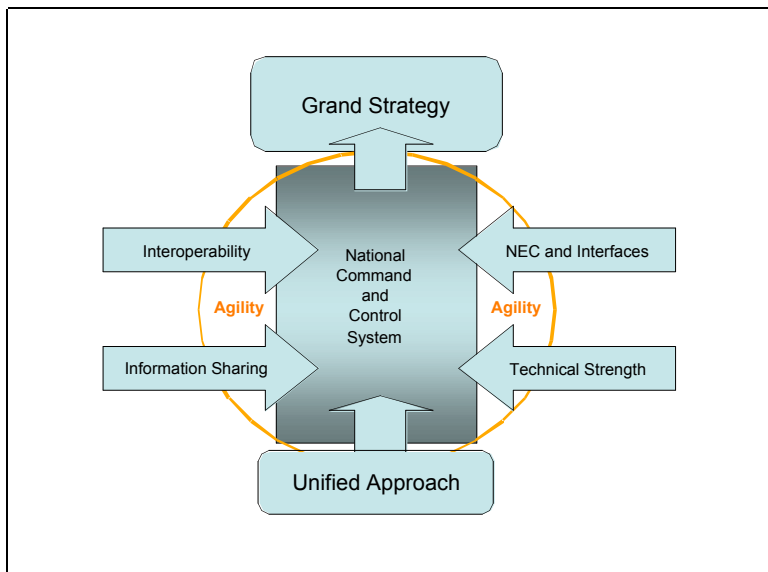
Unified Approach

Figure 3 - Conceptual View of Core Requirements

A Common and Unified Approach

When Canada thinks of command and control it must think of it as a pure national

asset and not only as a collection of various defence or security systems. As indicated in

Leadmark, a national command and control system with worldwide capabilities should be

the foundation for the future. This will not only provide the base for a unified approach

across the nation but also instil the culture necessary to achieve excellence, and

potentially supremacy, in that sphere. Without such a unified approach the joint domain

and its respective operational command and control will become definite weaknesses and

decrease the effectiveness of the CF and Canada in a myriad of operations particularly on

the domestic side and within network centric environments. As noted by Vego,

operational command and control is the principal means by which a theatre commander

sequences and synchronizes joint forces activities and orchestrates the use of military and

non-military sources of power to accomplish assigned objectives.[108]

The unified approach must be exercised horizontally and vertically across the CF

organization and also externally with outside agencies. The vertical approach will enable

the CF to function effectively in terms of command, and its associated intent, while the

horizontal approach will optimize information sharing, maximize the effectiveness of

operations and enable a network centric environment. The external methodology is also

as indispensable because it will fully enable all others agencies to operate with the CF as

if they were internal units. The unified approach is therefore a Canadian approach and

must be applied to all requirements pillars. For instance, in the information sharing

pillar, the introduction of the DND/CF Knowledge Management model in 2004 is a step

in the right direction.[109] The external methodology must now be applied to this model so

that the effectiveness of an operation such as the Kananaskis G8 Summit involving the

RCMP, Canadian Army, local law enforcement agencies, and governmental agencies can

be optimized. A unified approach would create a common information sharing system

indispensable to such operations.

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[108] Milan N. Vego, *Operational Warfare* (Newport: Naval War College, January 2000), 187.

[109] Peter D. Johnston, "Tracking Progress: The Evolution of Strategic KM in DND/CF," *Bravo Magazine*, Volume 5 (Summer 2005), 15.

Interoperability

Interoperability is a broad and complex subject rather than a binary attribute of systems.[110] It deserves particular attention as it not only represents a critical requirement but overlaps the NEC and interfacing requirement. Chapter 1 of this paper clearly demonstrated that interoperability is a vital part of the strategies for the CF. More importantly is the fact that interoperability, within a force or between coalitions, is an issue of policy as much as technology.[111] This research will however focus on the conceptual technology aspect and assume that from the strategy presented here the policy can be adequately supported and optimized.

Definition. Interoperability can be defined at two distinct levels: technical and operational. This research will focus on both levels and it is therefore important to understand the disparity between the two.

Technical interoperability is the condition achieved among communications systems when information or services can be exchanged directly and satisfactorily between them and/or users.[112] The degree of interoperability should be defined when referring to specific cases. Operational interoperability is the ability of systems, units, or

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[110] National Research Council, *Realizing the Potential of C4I: Fundamental Challenges* (Washington D.C.: National Academy Press, 1999), 64.

[111] Major James A.G. Langley, "Network Centric Warfare, An Exchange Officer's Perspective," *Military Review* 84, no. 6 (November-December 2004): 50.

[112] National Research Council, *Realizing the Potential of C4I: Fundamental Challenges* (Washington D.C.: National Academy Press, 1999), 66.

forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together.[113]

Interoperability provides a common operating picture and the rapid decision-making ability associated with it can significantly change the nature, pace, and geographic range of engagement, providing major advantage to forces so enabled.[114] Interoperability is also an important factor in operational efficiency. One of the key goals of the grand strategy will be to increase the operational efficiency of the CF. Where interoperability is lacking, there is the likelihood that multiple systems are performing the same functions, or that information is being manually entered or processed multiple times.[115] As examined in Chapter 2, this deficiency applies to the current command and control construct of the CF. Furthermore, it is expected to worsen during future joint operations.

Interoperability within the Canadian Context. Within the operational plane, the level of interoperability between all systems supporting the command and control process is not only high but central to the success of joint and/or combined operations. As we have seen, the CF recognized the interoperability requirement, its strength and its essentiality. This requirement also appears to be well understood by other agencies.

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[113] *Ibid.*

[114] *Ibid.*

[115] *Ibid.*

Moreover, it is expected that Canada and its military forces will also be in the middle of the network centric revolution. The basic tenets of NCW begin with the existence of a robustly networked force.[116] To fully understand the interoperability requirement, as anticipated in the Canadian context, it must be analysed first within a national joint environment and, secondly, in a combined environment where a number of nations can operate as a coalition.

Interoperability in National Joint Environments. Critical for the CF, and especially for the Canada Command organization, is the element of interoperability within a national joint environment. Communications within the new transformed CF structure will be critical to ensure efficient functioning throughout all operational units and headquarters. The elimination of the existing stovepipe systems examined in the previous section remains necessary to achieve absolute jointness.

For example, in the spring 2005 operation Hudson Sentinel was being designed.[117] MARLANT operations and intelligence staffs, two Marine Coastal Defence Vessels, the parent organization to the ships, the Fifth Maritime Operations Group, and 1 and 2 Canadian Ranger Patrol Group staffs were conducting detailed planning and preparations. Also, 1 Canadian Air Division Detachment in Halifax coordinated with

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[116] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 107.

[117] Initially this operation was referred to as NORPLOY 05.

MARLANT to conduct northern summer patrols by CP-140 Aurora aircraft. Hudson

Sentinel was thereby executed within a broad domestic and security context.[118] All three

components of the CF participated in this operation and three Operational Commands –

MARLANT, Land Forces Quebec and CF Northern Area – were involved. The RCMP

and the CCG also contributed. As researched in the various strategies and policies, it is

known that this type of high interoperability operation will become widespread in the

future Canadian context and within the new command and control structure. In order to

perform effectively at the operational level within a national joint environment the CF

must utilize a unique system optimally designed for them with structured links with other

government departments.[119]

Interoperability in Coalition Environments. The IPS indicates that Canada

will be required to operate effectively in today's challenging security environment

alongside our allies.[120] As observed, our key ally now, and most likely in the near future,

remains the US. The CF will need to keep up with their neighbours as it is anticipated

they will continue to dominate and drive the field of command and control through highly

sophisticated technologies focusing on web base applications and digital satellite

communications. This level of interoperability with the US must occur at all levels of

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[118] Lieutenant-Commander Ian Anderson, "Northern Deployments: Naval Operations in the Canadian North," *Canadian Naval Review* 1, no.4 (Winter 2006): 10.

[119] For Operation Hudson Sentinel a collection of communication and command and control systems was utilized and performance, although satisfactory, was not optimized.

[120] Department of National Defence, *Canada's International Policy Statement: A Role of Pride and Influence in the World – Defence* (Ottawa: National Library of Canada, 2005), 4.

command and control – strategic, operational and tactical. Additional interoperability

requirements with allies such as NATO are also critical. In Afghanistan, for instance,

Canada has contributed significantly to international military efforts including as a key

member of NATO's International Security Assistance Force (ISAF). It was demonstrated

that this type of operation will also remain an essential part of the Canadian spectrum of

activities.

Levels of Interoperability. Interoperability is required for numerous layers, or

levels, to enable entities to communicate, share information, and collaborate with one

another.[121] The degree to which the CF will be interoperable will directly affect their

ability to conduct network-centric operations.[122] David Alberts and Richard Hayes define

four distinct levels of interoperability in accordance to a NCW maturity model. Although

the detailed study of this model is not within the scope of this research, the levels of

interoperability must, nevertheless, be well defined to understand where the CF should be

focusing their efforts in the design of their command and control system configuration.

As interoperability will be one of the keys to effective command and control in

the future it is essential to aim for the best solution. This solution ought to offer

flexibility for reconfiguration and expansion. On too many occasions, when preparing

for missions, the CF find themselves trying to catch up with the US to ensure effective

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[121] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 108.

[122] *Ibid.*

command and control and access to a complete common operating picture. According to

the Alberts/Hayes model depicted below, level 3 requires that entities, or systems, be

interoperable not only in the information domain, but also in the cognitive domain, so

that shared awareness can be achieved.[123] For many missions, this represents the level of

interoperability currently achieved by the CF.
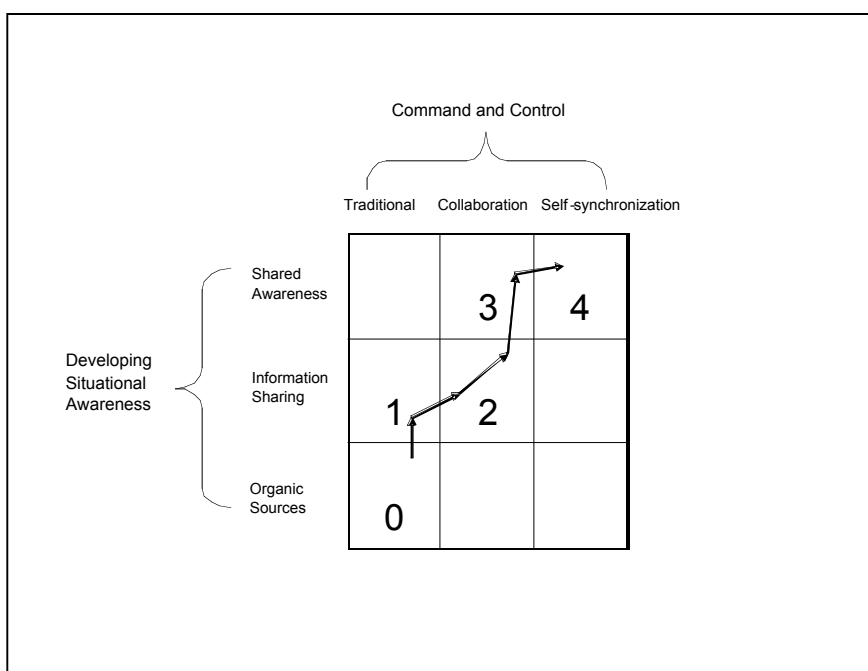
Figure 4 - Levels of Interoperability
Source: Alberts and Hayes, *Power to the Edge: Command and Control in the*
Information Age, 109.

Level 4 takes interoperability to new heights as it introduces the notion of self-

synchronization. Interoperability, in this level, exists in the social domain so that actions

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[123] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 110. The cognitive domain is a domain where perceptions, awareness, beliefs, and values reside and where, as a result of sense making, decisions are made.

can be dynamically self-synchronized.[124] In level 4, a nation possesses not only all the

dimensions of the information domain, namely richness, reach and quality of interactions,

but also interoperability in all domains, namely the information, cognitive and social. In

other words, the equivalent of level 4 interoperability would give the CF complete shared

awareness and synchronization with joint and/or coalition forces. This level will fully

enable the new command and control structure permitting many entities to share a

common operational picture and trust operational commanders to accomplish assigned

missions.

      Desired Level of Interoperability.   To fully understand the necessary level of

interoperability it is useful to revisit the CF C4ISR Command Guidance and Campaign

Plan. The vision itself asks for a C4ISR capability that is inherently joint and

interoperable.[125] Within its objectives the Campaign Plan then describes a need for

connectivity between all commanders and their staff, and permits full collaboration and

interoperability amongst CF units, key allies, OGDs, and essential elements in the public

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[124] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 110. The social domain is associated with a set of interactions between and among force entities. A self-synchronized force has a clear and consistent understanding of command intent, high quality information, shared situational awareness, competence at all levels of the force and trust in the information, subordinates, superiors, peers, and equipment. The command function is not absent in self-synchronized forces but dictating details to subordinates is absent.

[125] Department of National Defence, *Canadian Forces C4ISR Command Guidance & Campaign Plan* (Ottawa: National Defence Headquarters, 3 September 2003), 6.

domain.[126] Finally, the plan establishes a necessity for an improvement of the current state of interoperability.

So what elements should then define the desirable interoperability? The first item, structured data, including complete information databases is one of the fundamental elements required to achieve the desired interoperability level. This data can take any shape including images, maps, documents, and web pages. The second item necessary to achieve the desired level of interoperability is software applications. This signifies that applications residing within one system can share and/or access information with other applications residing within another system. For instance, a NATO system, through a local application, could access Canada COM information from an application belonging to the Canadian national command and control system. A second example would be accessing information from the American Theatre Battle Management Core System (TBMCS).[127] Ultimately, the sharing, combining and optimizing of common operational pictures, not only between components from the CF for full jointness but also with coalition partners such as the United States or NATO, are also critical. This would be the entry key to the NCW environment.

The complete set of information assumed to be necessary to achieve complete shared awareness is therefore composed of basic protocol information, messages,

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[126] *Ibid.*, 14.

[127] The Theatre Battle Management Core Systems (TBMCS) program provides the American Combat Air Forces (CAF) and the Joint/Combined Forces with an automated and integrated capability to plan and execute the air battle plan for operations and intelligence personnel at the force and unit levels.

databases, applications and operational pictures. Once components from different self-synchronized agencies can share and effectively optimize combined operational pictures then an acceptable level of interoperability would be achieved.

Interdependent Operations. Finally, in the future battlespace, military forces, including the CF may have to move beyond joint to interdependent operations.[128] Interdependent operations can be compared to the operations taken place within a network centric environment. Swift responses to fleeting opportunities on the battlefield will be essential and will require adaptability and flexibility. The ability to designate platforms, regardless of which service owns them, will be a critical element to these operations. Two fundamental characteristics of current command and control constructs must be eliminated to enable effective interdependent operations. First, the continued existence of ponderous chains-of-command and unwieldy and unmanageable targeting protocols will be equivalent to failure.[129] Second, an inability to ensure connectivity and precise situational awareness of all friendly forces will generate breakdowns. Essentially, capability and effects must be completely embedded in one command.[130] The interoperability and the agility requirements, through their collective solution, will ensure that interdependent operations are conducted successfully.

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[128] Lieutenant-Colonel Bernard Horn, "Complexity Squared: Operating in the Future Battlespace," *Canadian Military Journal* 4 no. 3 (Autumn 2003): 14.

[129] *Ibid.*

[130] *Ibid.*

Network Enabled Capability and Interfaces

The NCW notion has been embraced by numerous nations and is considered the cornerstone of many of the military transformation initiatives currently seen within the US.[131] Numerous key allied nations believed that NCW has critical implications across the full spectrum of military operations, support organizations, personnel, training and infrastructure.[132] Logically, it appears that NCW should become, for the CF, the basis for future projects definitions and requirements, including command and control. However, despite such global initiative, the Canadian DND has been very reluctant to formally embrace such a notion.[133] Nevertheless, even if the term NCW was found to be inadequate for its purpose, Canada is now slowly adapting.[134] Another term, Network Enabled Operations (NEOs), has also received some praise within Canada. No matter what the final outcome of Canada's position with respect to the terminology of this domain, Canada will have to embrace the notion of NCW in order to remain relevant in coalition operations.

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[131] Sandy Babcock, "Canadian Network Enabled Operations Initiatives," (Ottawa: National Defence Headquarters Directorate Defence Analysis Paper, 2005), 1.

[132] *Ibid.*

[133] *Ibid.* This has been the case for a variety of reasons, including among others operational tempo, and budgetary constraints.

[134] *Ibid*., 4. For example, the term Network Centric Warfare tended to focus attention excessively on the network and its related technology, and seemed to exclude military operations other than war. The United Kingdom term Network Enabled Capabilities seemed to come closer to satisfying Canada's concerns.

Implementing the initiative of NCW is called Network Enabled Capability (NEC). The NEC shares the tenets of NCW but is more limited in scope in that it is not doctrine or vision.[135] NCW is, more accurately, focused with evolving capability by providing a coherent framework to link sensors, decision makers and weapon systems to enable emerging CF doctrine on effect-based operations to be achieved. In order to achieve politically satisfactorily outcomes, effect-based operations are considered necessary to enhance the coalition's strategic capabilities at the political, economic, technological and information networking levels.[136] Effect-based operations are a method of leveraging the resources available to achieve maximum impact allowing a nation or coalition to achieve its strategic objectives at minimal costs.[137] This seems to admirably match the transformation objectives of the CDS for a more relevant, responsive, and effective force. Moreover, of high importance is the fact that effect-based operations have universal applicability to any international or national security enterprise.[138] Such universal applicability ought to make effect-based operations extremely attractive for Canada. A NEC therefore creates a logic environment for effect-based operations and enables a command and control system to possess universal applicability.

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[135] Anthony Alston, "Network Enabled Capability – The Concept," *Journal of Defence Science* 8, no.3 (2003): 108.

[136] David Carment, "Effective Defence Policy for Responding to Failed and Failing States" (Ottawa: Canadian Defence & Foreign Affairs Institute's Research Paper Series, 2005), 12.

[137] *Ibid.*

[138] Edward A. Smith, *Effects Based Operations: Applying Network Centric Warfare in Peace, Crisis and War* (Washington, D.C.: Command and Control Research Program, 2002), xv.

The NEC will also fortify the idea of information superiority, essential for joint operations within coalitions. Without such a requirement the CEFCOM will not be in a position to contribute adequately to a coalition force. On the other hand, within an organization like Canada COM, the NEC would permit Canada to integrate the imagery from an Unmanned Aerial Vehicle looking over land, the Recognized Maritime Picture from a warship at sea, and the associated intelligence information from Canadian Security Intelligence System (CSIS) to create a complete security environment for a decision-making entity potentially located in the JTF Headquarters Atlantic. This will optimize effect-based operations.

Finally it is important to discuss interfacing. Without appropriate interfaces a national command and control system is valueless. This is where the unified approach towards a global national command and control system becomes instrumental. Internal national and external international interfaces, built within the command and control system configuration, for each of the desired agency the CF must liaise with, are necessary. This sound interfacing with multiple clients will maximize the level of interoperability within the Canadian nation and set up the terrain for an effective network-centric environment. Acknowledging security windows will be necessary to ensure information sensitive to one organization is not accessed by others, a common system for all Canadian organizations is essential.

It is difficult to imagine command and control in the information age and for the future without its association to the NEC and without multiple interfaces. Consequently, the NEC/interfacing, conjointly with interoperability, is assessed as the center of gravity of the requirements set.

Information, Intelligence and Knowledge

An information structure will be necessary to enable the command and control systems design. Information technology constitutes, without a doubt, the core element of the current Revolution in Military Affairs.[139] An information structure is essential for a command and control system configuration with multiple clients. Information superiority entails a capacity for defence intelligence to provide real-time, accurate, and relevant battlespace awareness and operational knowledge across a full spectrum of military operations. [140] Again, this message is closely related to many of the Canadian strategies examined in Chapter 2. For information superiority, the operational backbone is the C4ISR system. However both information superiority and knowledge management form the base of command and control effectiveness.

In order for an operational commander to make correct decisions an element of certainty must exist within the array of information presented by the system. At the outset, it is imperative to understand certainty is a function of knowledge, not of

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[139] Martin Rudner, "Intelligence and Information Superiority in the Future of Canadian Defence Policy," (Occasional paper, Carleton University, 2001), 2.

[140] *Ibid.,* 4.

information.[141] The two are undoubtedly related but the distinction is of the essence. In simple terms, information is the raw material from which knowledge is generated.[142] The process of cognition uses people to transform information into knowledge products optimally designed for a cohesive decision-making process. The real requirement is to integrate a maximum of knowledge and intelligence, from all sources, and fuse it cleverly. Knowledge and intelligence will be required at all levels, strategic, operational and tactical. The content of the knowledge and intelligence will differ, sometimes drastically, at each level. However, information/knowledge sharing connection between the command and control configurations at each level must exist.

The three services of the CF have already commenced their transformation efforts. Concepts such as knowledge-based, network-enabled, information dominance, expeditionary, interoperable, decision-making, collaboration and contribution to security are describing the different facets of transformation across the Department and the CF.[143] At the strategic level these concepts are being addressed and examined by the Joint Information Intelligence and Fusion Capability (JIIFC) Project. The vision of the team aims at providing the best possible situational awareness to all levels of command in the

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[141] Department of the Navy, Naval Doctrine Publication 6: Naval Command and Control, (Washington, D.C.: Office of the Chief of Naval Operations, 1995), 12.

[142] *Ibid.*

[143] Commander Tim Addison, "Fusing Knowledge: A Key to Transformation," *Bravo Magazine* 5 (Summer 2005), 23.

Canadian Forces and to the extent possible, the Government of Canada.[144] Moreover, JIIFC is also engaged in the enhancement and promotion of interdepartmental and other government departments (OGDs) connectivity among security partners.[145] This endeavour aligns itself perfectly with the objective of this research as situational awareness, interoperability with the Government of Canada and interoperability with OGDs all represent answers to the solution discussed in the next Chapter.

Agility

A new concept within the field of command and control, agility is arguably one of the most important characteristics of successful information age organizations. Agile organizations are the result of an organizational structure, command and control approach, concepts of operation, supporting systems, and personnel that have a synergistic mix of the right characteristics.[146] It can also be argued the new transformed CF organization must be an agile organization. Agile organizations must be able to meet unexpected challenges, to accomplish tasks in new ways, and to learn to accomplish new tasks.[147] It appears that this definition matches perfectly some of the organizational transformation objectives articulated by the CDS. Moreover, agility will address

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[144] *Ibid.*

[145] *Ibid.*

[146] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 123.

[147] *Ibid.*, 60.

deficiencies such as the lack of responsiveness and flexibility created by stovepipe command structures.

It can be deducted therefore that the command and control structure proposed and implemented by the CDS not only defines the organization of the CF but meets the features of agility. The command and control systems configuration associated with this structure must also contain a high degree of agility. Agile organizations depend upon the ability of individual members to get the information they need to make sense of a situation. However, they also depend significantly on organizational entities.[148] The command and control system configuration corresponds to such an entity. Although the lack of interoperability considerably impacts the agility of an organization centralized planning processes remains its worst enemy. Centralized planning is a manifestation of a belief in the ability to optimize. Interestingly, despite a belief in the power of reductionism and a strong desire to optimize, the concept of centralized planning has evolved into a set of processes that often prevent optimization.[149] In this case, optimization represents a method that seeks to find a specific military option that provides the best possible results.

It therefore remains critical for the command and control structure of the CF to be an agile organization capable of offering optimized solutions and processes to its

[148] *Ibid.*

[149] *Ibid.*, 62.

personnel particularly those deployed in operational missions. Canada's IPS indicates the military will become more effective, relevant and responsive.[150] An agile organization is characterized, among others, by its ability to respond to changes.[151] The command and control system structure is therefore obligated to hold a high degree of agility.

Technical Strength

The command and control systems configuration construct must also meet an array of technical requirements typical of such systems. The construct must possess a high level of redundancy and function through an open architecture concept essential for interoperability challenges and future expansion. This section describes the minimum set of technical requirements necessary for the design of the desired configuration. It should not be forgotten that although the systems configuration being discussed is at the operational and strategic levels, technical requirements remain highly critical to the overall design.

Robustness in Combat Operations. Not only should the command and control system configuration be capable of rapid efficient deployment but it should also be able to resist enemy attacks. The vulnerability of the system must be minimised. Although the cyber war between command and control systems, called command and control

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[150] Department of National Defence, *Canada's International Policy Statement: A Role of Pride and Influence in the World - Defence* (Ottawa: National Library of Canada, 2005), 11.

[151] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 63.

warfare, will not be elaborated in this discussion it must be understood such a design feature is critical for success.

System Flexibility. This is the equivalent of the system's readiness for the conduct of the entire spectrum of operations the CF will be involved in. From unexpected domestic operations to properly plan overseas deployments and special operations, the system must possess the necessary flexibility to adapt and perform efficiently in all situations. This may include setting up new users or interfacing with new coalition partners.

System Promptness. This corresponds to the ability of the system configuration to ensure command and control in near real time and the associated adjustment of plans to the combat operations being executed. This feature is technology dependent. Sometimes, the ability to ensure effective command and control in real time compensates for the shortfalls of plans that were developed earlier as well as for personnel training deficiencies.[152] For instance, the success the Americans achieved in Iraq was to a very large extent predicated on their ability to exercise rapid and effective command and control of their units and large strategic formations.[153]

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[152] S.B. Yvanov, "The Military Command and Control System and Ways of Improving It in Light of New Defense Tasks and Changes in the Character of Future Wars," *Military Thoughts* 13, no.2 (2004): 191.

[153] Ibid.

Integration. This factor takes into account all factors in the fundamental situation in which various military tasks and missions are executed. One element of integration would be the application of the CF Operational Planning Process, the process used to prepare plans and orders for operations.[154] Additionally, it could also integrate external planning processes such as the NATO method currently being updated. This will assist Commanders within the edge organization elaborating a functional solution within certain time and situational constraints in most scenarios.

Security. For the CF to benefit from a new command and control systems configuration then it must be secured against attack from enemy forces or neutral parties. Because the system's key advantage relies on its integration and interoperability, making the CF system potentially a sub-system of an even larger configuration, the security aspect is not only complex but also very considerable in size. Two dimensions are normally associated with the security of command and control systems, namely the physical dimension and the information systems security.[155]

The physical dimension is associated with the protection of computers and communications links as well as the facilities sheltering those systems from being

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[154] Department of National Defence, *Canada, B-GJ-005-500/FP-100 The Canadian Forces Operational Planning Process* (Ottawa: National Defence Headquarters, 2003), p.1-1.

[155] National Research Council, *Realizing the Potential of C4I: Fundamental Challenges* (Washington D.C.: National Academy Press, 1999), 130.

physically destroyed or jammed.[156] Beside physical attack on communication satellite

systems, it is not anticipated that the CF will experience problems within this task as

multiple installations across the country exist to support such sophisticated system

infrastructure.

The information systems security dimension is a significantly more challenging

undertaking.[157] It is often connected with information warfare. This dimension relates to

the task of protecting systems connected to the communications network against an

adversary's information attack against those systems.[158] This misunderstood dimension,

which includes hacking and cyber war, is therefore not independent on national

information infrastructure. Command and control experts and system designers are fully

aware that vulnerabilities exist. The US Congressional Research Service mentions the

cyber terrorism and *information warfare response* as key issues for future and how it is

critical for the US Department of Defense to possess clear policy and doctrine on the

subject.[159]

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[156] *Ibid.*

[157] *Ibid.*

[158] *Ibid.*

[159] Clay Wilson, *Computer Attack and Cyber Terrorism: Vulnerabilities and Policy Issues for Congress,* CRS Report for Congress (Washington D.C.: Foreign Affairs, Defense, and Trade Division, 2003), 4.

The information systems security, including hacking and cyber war, must be assessed as a vital requirement for the CF because communication signals without their intelligence content are simply irrelevant, harmful and detrimental.

Analysis and Summary of the Core Requirements

This chapter examined all core requirements necessary for the construct of the grand strategy. Conceptually it is essential to assess the core requirements as an entity. Without each other they do not mean anything nor do they represent a valuable solution. Interoperability, a global information and knowledge matrix, and interfacing with a maximum number of clients within a secure and technically healthy environment are all instrumental drivers to the solution. In dynamic support to these drivers is the agility requirement. But encompassing all, and most important, is the requirement for a unified Canadian approach in which the CF must take the lead in order to design a unique national command and control solution optimized for today's defence and security environment.

Sometimes requirements are autonomous from each other but within this conceptual design it is not the case. Without a coherent information grid interoperability is not optimized; similarly, without interoperability interfacing with multiple users is unachievable. Only the technical strength requirement stands by itself as independent. However, without a secure environment a system configuration could be so weakened that it will become completely ineffective.

*"Heaven forbid that I should pretend to
lessen the dignity of the sublime art of war
by reducing it to such simple elements!"*
- Jomini[160]

Chapter 4 - The Grand Strategy

The Fundamentals of a Strategy

A strategy is the art of coordinate actions in order to achieve a desired goal. A

strategy will outline the plan of those future actions. More specifically, it will also

include key objectives and their associated global solutions, priorities, resources and the

various phases necessary for its complete achievement. The strategy should follow

fundamental principles linked to the required result. Although a strategy should be

thorough, wide-ranging and inclusive, a degree of flexibility should also exist within the

plan to accommodate for changing and unexpected circumstances. This will form the

risk analysis of the strategy. Finally, the usefulness of a strategy lies within its goal and

objectives.

A grand strategy is a strategy that pertains to a complete organization; in our case

the CF.[161] Some of the conceptual elements of a strategy will be provided in this section.

The desired goal and key objectives to optimize the command and control efficiency of

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[160] Baron Antoine Henri de Jomini, *The Art of War* (London: Greenhill Books, 1992), 344.

[161] The Canadian Forces will be the leader of the grand strategy. However, the command and control grand strategy will encapsulate the entire Canadian defense and security organization.

the transformed CF will be derived in accordance with the core requirements identified in the previous section.[162]

Desired Goal and Key Objectives

The desired goal is to improve the efficiency of the CF command and control systems configuration in order to maximize the overall effectiveness of the new command and control structure presented in 2005 by the CDS. An improved command and control systems configuration will not only support the objectives of the IPS but ensure new organizations, such as Canada COM, the SCTF and CEFCOM, will conduct operations in an optimal manner.

The key objectives of the grand strategy will individually enhance the command and control systems configuration, and, collectively, augment and maximize the overall configuration's effectiveness. The key objectives of the grand strategy and their respective solution are herein logically derived from the core requirements.

Key Objectives

Unified Approach and its Solution. In order for Canada and the CF to consider command and control as a national asset then a national command and control office must be put in place. This office must contain, or have links with, all agencies with responsibilities in the defence and security domain. Thus, agencies such as the DND, National Security Advisory Council, Department of Foreign and International Affairs, the

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[162] The technical strength requirement will not be examined in Chapter 4 as the solution presented will be of conceptual nature.

RCMP, the CCG, NORAD, and DPSEP must all have connections with this conceptual national command and control office. This office will ensure the strategic and operational aspects of command and control, possibly in accordance with the CF Operational Planning Plan will be optimised in efficiency and effectiveness. Logically this office will be home to the future Integrated Threat Assessment Centre, one of the goals laid out in the NSP[163] and also to the output of the JIIFC project discussed in Chapter 3.

Command and control must be visualized, thought of and considered as a national asset. Although expressed in some of the policies examined previously it does not seem to be fully understood. This is a cultural change for the CF, one that will maximize their overall effectiveness. Such an asset will undoubtedly need a support team to strengthen its efficiency. [164] Equally important, the requirement for commonality must be articulated. Commonality must be part of the unified approach solution. If all Canadian agencies use systems belonging to a common configuration then commonality will be achieved. Such a result will not only eliminate multiple technical interoperability problems but also create the necessary environment to cultivate the configuration as an expert national asset.

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[163] Privy Council Office, *Securing an Open Society: Canada's National Security Policy*, (Ottawa: National Library of Canada, 2004), vii.

[164] The support team concept, a key to this strategy, is the object of the next chapter.

Interoperability and its Solution. Interoperability remains arguably the most important objective of the grand strategy. It will drive the ability to be relevant in network centric operations and our ability to establish interfaces with external agencies. It will ensure both Canada Com and CEFCOM organizations conduct efficient operations. In their book *Power to the Edge*, Alberts and Hayes propose a conceptual solution, named power to the edge, to the interoperability element.[165] This concept will be defined and then assessed as a solution for the CF command and control system configuration with respect to the notions of interoperability and agility.

As established earlier, the information age still dominates our world. The power to the edge concept is an inherently information age approach to organization. Once power to the edge concepts are applied to command and control and its supporting information structure, military organizations will be able to develop the interoperability and agility necessary for success.[166]

Power. Rather than explore and analyse the numerous existing definitions of power, the military views of power will be examined. Within the industrial age, military platforms such as ships, tanks, and fighter jets have come to symbolize military power.[167] This association still persists despite the fact that the value of platform is diminishing.

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[165] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 179.

[166] *Ibid.*, 165.

[167] *Ibid.*, 167.

The network will become the single most important contributor to combat power.[168] The

network will link military platforms. Future combat systems foresee war fought in a

network-centric manner with machines' observations enabling network fires to engage

the enemy.[169] The network will also become the key element and contributor to the

command and control systems configuration. This focus on networking means applying

force with precision and accuracy will become more important than the ability to deliver

disaster or destruction. Although a certain degree of offensive supremacy remains

essential, the asymmetric environment that governs today's conflicts does not require

large and costly firepower platforms.

In the information age the network will dominate and control power. Platforms

are now being transformed. Military forces once relied upon their organic information

assets but they now rely immensely on networks for targeting priorities and information.

The 2003 Gulf War II was a superb example of the efficiency of the network as numerous

planes received their target information just in time thereby considerably increasing the

agility of the force.[170]

Platforms will thus transform themselves into nodes in the network. This

complete and absolute transformation will make the very notion of a platform

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[168] *Ibid.*

[169] Major James A.G. Langley, "Network Centric Warfare, An Exchange Officer's Perspective," *Military Review* 84, no. 6 (November-December 2004): 47.

[170] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 169.

evaporate.[171] The network will become the weapon. A weapon characterized by a collection of highly dynamic and reconfigurable components that work together meticulously and intimately within a network centric environment.

Edge. In the current military context, information and analytical functions find themselves now located at the edge of organizations. The edge components can provide real time, crucial information such as coordinates required to guide ordinance to their targets.[172] In a traditional hierarchical organization such as the CF, with a topology organized by status and power, those at the top are at the center and those at the bottom are at the edge. The top of the organization can be thought of as the element exercising command while the middle component exercises control. It has been established that one significant problem with the current command and control systems configuration lies within its collection of stovepipes. Specialized stovepipes commonly characterize hierarchies and diminish the coherency of the organization and, in general, inhibit information flow, constrain command approaches, and restrict asset utilization.[173] Stovepipes work only for as long as an organization plays by the same rules. As soon as these rules are challenged, control fails and command crumbles.[174] This is exactly where the CF and other Canadian agencies stand with their current collection of stovepipes

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[171] *Ibid.*, 169.

[172] *Ibid.*, 174.

[173] *Ibid.*

[174] Simon R. Atkinson and James Moffat, *The Agile Organization: From Informal Networks to Complex Effects and Agility* (Washington D.C.: Command and Control Research Program Publications Series, 2005), 169.

command and control systems. In the industrial age, stovepipes appeared to represent the

best solution. They were necessary because the economics of information made it too

costly to develop broad information sharing and multiple interactions systems. In the last

few years the level of technology associated with networks and web-based applications

eliminated this necessity. Organizations now find themselves in a position to maximize

network systems technology and optimize the effectiveness of their processes.

The edge notion redefines organizations and their intrinsic relationships. Today's

technology now enables the flattening of organizations. The traditional hierarchy is no

longer the only game in town for military organizations.[175] The edge organization

concept has arrived. Edge organizations are simply characterized by the widespread

sharing of information and the predominance of peer-to-peer relationships.[176] NATO

associates with edge organizations a broad dissemination of information, fully distributed

patterns of interaction and peer-to-peer allocation of decision rights.[177]

Edge organizations differ significantly from traditional organizations with respect

to power topology. This is where the CF must focus. As command and control is a

national asset they must however converge together with other organizations. In an edge

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[175] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 176.

[176] *Ibid.*

[177] SAS-050 Project Team, Exploring New Command and Control Concepts and Capabilities, Report prepared for NATO (January 2006), 1.

organization, virtually each individual is at the edge because they are empowered. The distinctions between line and support organizations disappear.[178] This will become extremely important when we examine the grand strategy later in this section. An edge organization is not only a collaborative but an organization where everyone has the freedom to do what makes sense. They are organizations that embody a power to the edge approach to command and control.[179] The CF must therefore become a power to the edge organization, eliminate their stovepipe command and control systems, and develop a command and control systems configuration that will optimize the empowerment of their people. This is the only solution for interoperability and agility. Edge links must be created within the complete Canadian context, particularly within the defence and security environment.

The power to the edge approach must now be applied and integrated into the CF command and control system architecture. When fully applied to the design of a mission capability package, such as a command and control system, the result will be an instantiation of the tenets of NCW. Furthermore, when fully applied to systems architectures, the result will be an edge info-structure that has the characteristics of a Global Information Grid (GIG) described later.[180]

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[178] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 176.

[179] *Ibid.*

[180] *Ibid.*, 180.

Ideally, the environmental command stovepipes have been eliminated and focused commands form the nucleus of the structure which can now be called a power to the edge structure. The CDS remains in charge of the organization and the structure of the organizations does not have to be modified. However, power to the edge links can be used to connect the various components of the structure. This is the interoperability solution illustrated in Figure 5.
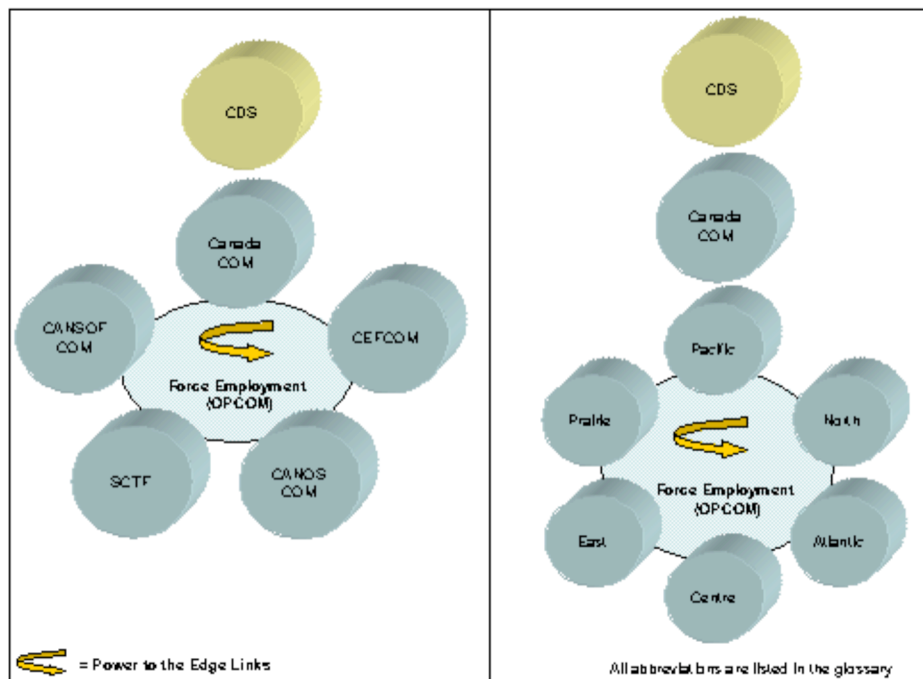

Figure 5 - Power to the Edge Concepts for the Canadian Forces

This means that within a given mission, various commands will, depending on the information available to them, take control of tasks, empowering every formation, doing what makes the most sense in accordance with the knowledge available. If in a given situation the Atlantic Region Commander must pass command on to East Region

Commander then, through the power of the GIG, the East Region Commander can take

the lead and control tactical units belonging to other regional Commanders.

Network Enabled Capability/Interfacing and its Solution. Canada, through its

current transformation initiative and its desire to maximize interoperability within its

organizational entities has the luxury of being able to enable a maximum number of

internal clients to a common command and control system.[181] As examined, a common

system is the easiest method for interoperability and integration. This must be the chief

priority. Absolute commonality within the entire DND is primordial. Sharing modules,

information and applications with other Canadian agencies systems is also essential. For

example, the RCMP and Canada Command should be in a position, through the same

system, to access the same information and some of the same applications. Finally,

although complete commonality with external clients is not a requirement, interfacing

with external clients such as NATO and the US must then be performed through

advanced interoperability techniques and/or shared applications.

The key task for this solution is to enable and empower as many clients as

possible. Figure 6 illustrates some of the essential national system interfaces necessary

for the grand strategy to make command and control work within a joint, interagency

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[181] Department of National Defence, *Canada's International Policy Statement: A Role of Pride and Influence in the World - Defenc*e (Ottawa: National Library of Canada, 2005), 14.

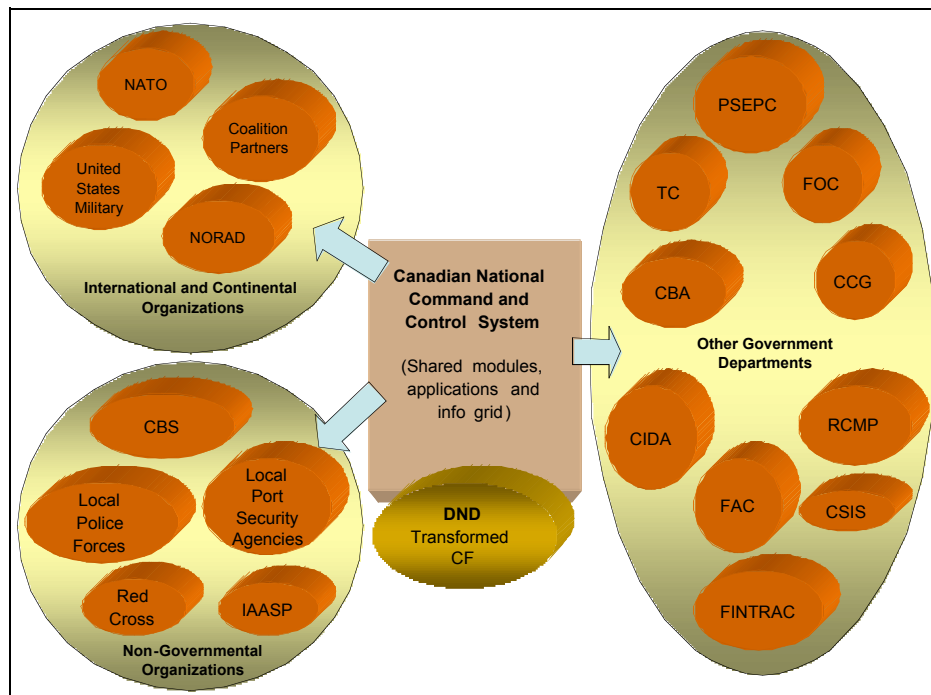framework. DND, the key interface, must lead the overall design including its interfacing relationships with OGDs and NGOs.[182]

Figure 6 - The Organizational Solution

Through the element of commonality of the grand strategy all Canadian links should amalgamate and disappear. An absolute joint spectrum is created. Such a synergy constitutes the basis of the NEC solution. The central DND block comprises all elements of Figure 1 to form a total joint defence environment. Individual missions will determine the necessary level of jointness and the composition of the contributed forces. Two elements of the DND block deserve particular attention as they have not historically been considered adequately, namely logistics and engineering, and reserve units.

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[182] It is acknowledged that interfacing with some NGOs will be mission dependant. The use of deployable systems or shared applications should be a valid options for effective liaison with NGOs.

Logistics and Engineering. Logistics are the bridge between operations and strategy. A critical component of operations, this field, named CANOSCOM through the transformation, must be included within the system configuration with the same priority as Canada COM or CEFCOM. Although crucial and vital in most missions the component of support and logistics is often the forgotten one. Not only should logistics be synchronized with combat operations but they must be an integral part of the system. The deploying and supporting operations are among the most challenging of all the tasks required to utilize any instrument of national power, more particularly the military instrument.[183]

This component must comprise all aspects of logistics including maintenance, engineering, and operational unit fitness reports. It is believed that the solution for this vital requirement should be aligned with the *focused logistic* concept of the US Joint Vision 2010.[184] Focused logistics, takes a basic issue and seeks the best way to provide combat support to the warfighter.[185] In the American context, the most often quoted reasons for developing focused logistics are downsizing, changing threat environment, technology, and political and fiscal realities. Those reasons also apply completely to the Canadian situation. Consequently, the Canadian solution must evolve from its current state described in Chapter 2, to encompass the policies, procedures, and systems to

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[183] M.E. Krause, "Logistics and Support," *Joint Forces Quarterly,* Issue 39 (4th Quarter 2005): 10

[184] John J. Cusick and Donald C. Pipp, "In Search of Focused Logistics," *Joint Forces Quarterly* (Spring 1997): 126.

[185] *Ibid.*

provide information for data sourcing and monitoring, planning and execution of

mobilization deployment, employment, sustainment, redeployment, and force

regeneration activities associated with command and control of military operations.

The support solution must also connect with the engineering field. The Material

Acquisition and Support Information System (MASIS) must be integrated into the

solution. Ideally, one focused sub-system incorporating all elements of logistics, support

and engineering must be implemented and integrated into the national command and

control system configuration. This will permit, for instance, a support establishment, to

receive real-time information on deployed units and provide appropriate required

resources in the right quantity and at the right time. It will also assist in long-term

planning and in building engineering and logistical trends.

Reserve Units. It is expected the role of the CF military reserve units within the

operational world will increase through the transformation. To this effect, the IPS

indicates the Reserves must improve their ability to respond to domestic contingencies

and address specific capabilities required for overseas deployments.[186] The command

and control system configuration must integrally include the Canadian Reserve force.

Finally the Network Enabled Capability solution must be discussed. In the

Canadian context, at the current time, the JIIFC is one of the only entities making formal

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[186] Department of National Defence, Canada's *International Policy Statement: A Role of Pride and Influence in the World – Defence* (Ottawa: National Library of Canada, 2005), 15.

references to pure NEOs.[187] The implementation of NCW capabilities to enable the joint

force and the ongoing shift from platform-centric to network thinking is a continuous

process and this will be the case for the CF as well.[188] The clients, or interfaces, to build

a strong national and international network are in place. The NEC solution must now be

based around key themes.[189] Our current overall solution for the grand strategy includes

intrinsically many of those themes: agility, synchronization, shared awareness, full

information availability, resilient information infrastructure and inclusive flexible

acquisition. It can therefore be concluded that if the entire grand strategy solution is

addressed the NEC will be achieved. Whether the CF will embrace terminology

associated with NEC or NCW remains to be seen.

Information and its Solution. The CF grand strategy must include inputs from

all possible intelligence and knowledge sources. The focus of the JIIFC team is to

capture and fuse all available and pertinent information from CF information and

intelligence systems, information from open sources, OGDs and agencies, as well as

allied security and intelligence organizations. It must, however, be strongly tied in with

other core requirements and expand to all interfaces mentioned in the previous section.

Only through complete inter-agency integration and fusion will the information network

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[187] Commander Tim Addison, "Fusing Knowledge: A Key to Transformation," *Bravo Magazine*, Volume 5 (Summer 2005), 24.

[188] Department of Defense, *The Implementation of Network-Centric Warfare* (Washington, D.C.: Office of the Secretary of Defense, January 2005), 44.

[189] Anthony Alston, "Network Enabled Capability – The Concept," *Journal of Defence Science* 8, no.3 (2003): 110.

be optimized and truly useful. With the transformed CF the synthesis of this information and knowledge, pertinent to operations, must be performed in a joint fashion and must be an integral part of the operational command and control configuration. As described above, the JIIFC work also represents part of the CF route towards a NEC.

The US Department of Defense is making progress on the deployment of an information age info structure, referred to as Global Information Grid (GIG).[190] Such a comprehensive grid will also be necessary for the CF design. For the purpose of this research this grid will be called the Canadian Information Network (CIN). The CIN will be indispensable to facilitate a high level of shared awareness and to optimize the transformation of this information and awareness into meaningful actions necessary to accomplish the mission. A collection of operational level sensors will be required to feed into the CIN. A project such as Polar Epsilon would, for example, be a key piece to the CIN. The project Polar Epsilon is a Joint Space-Based wide area surveillance and support capability that will provide all weather, day/night observation of Canada's Artic region and its ocean approaches.[191] Other sources will include the High Frequency Surface Wave Radar (HFSWR), ISTAR[192], intelligence, information operations, NORAD

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[190] The Global Information Grid, conceived with power to the edge principles, will provide a set of secure information and telecommunication services that will enhance sense making and support collaboration.

[191] Kristina Davis, "Project Polar Epsilon: Canada's Security and Surveillance Enhancement," *Maple Leaf Journal*, Ottawa: National Defence Headquarters, 8, no. 38 (13 July 2005), 7.

[192] Intelligence, Surveillance, Target Acquisition and Reconnaissance. The role of ISTAR is to integrate the intelligence process with the surveillance, target acquisition, and reconnaissance assets in order to improve a commander's situational awareness and to cue manoeuvre and strike assets.

data, and common operating pictures from operational and tactical units including automated vehicles. Fused information, through the CIN, will become the livelihood of the Canadian defence and security organization. The CIN will be an adaptive entity that will produce seamless info structure providing access to a variety of information sources and information management resources.

Agility and its Solution. It is very difficult to express the solution to the requirement of agility. Agility is increasingly becoming recognized as the most critical characteristic of a transformed force, with network-centricity being understood as the key element to achieving agility.[193] The grand strategy includes a network enabled capability and consequently a portion of the solution already exists. However, agility cannot be considered to be merely an attribute of the command and control system.[194] Albert and Hayes focus on six key dimensions to achieve a level of agility that will enable a force to permeate mission capability package, operational concept, or force.[195] This involves possessing the right equipment, doctrine, organization, personnel, training and leadership.[196] Those six dimensions, interestingly, relate directly to the Canadian IPS and its vision of the transformed force.

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[193] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 126.

[194] *Ibid.*, 127.

[195] The six dimensions are robustness, resilience, responsiveness, flexibility, innovation and adaptation.

[196] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 128.

For the CF, the development of an agile organization will mean the consolidation of the new command and control structure and its respective doctrine. It will also entail a cultural change in operational concept and a strong dedication towards shared awareness and NCW. This will take time, but when all six dimensions are present, the likelihood of success, or mission accomplishment, increases significantly.[197]

Command and Control

Although the intent of this paper is not to examine the technical functions of a national command and control system it is important to examine how the command and control process is in fact improved through an edge based solution.

Traditional command and control principles and practices have evolved over time in response to the nature of the threat, the nature of the forces and the information technologies available.[198] A NEC is identified in this paper as a fundamental element of our new command and control system configuration. That is because it has been demonstrated that the current command and control processes and principles are no longer effective within the new security environment. Command and control must be rethought. Through the power to the edge solution and the other objectives of the grand strategy, the CF would become an information age organization as they would

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[197] *Ibid.*

[198] *Ibid.*, 201

fundamentally adopt a new approach to command and control. The grand strategy

essentially relies on the three command and control approach dimensions in a way where

peer-to-peer allocation of decision rights, broad dissemination of information and

unconstrained patterns of interactions are all obtained.[199]

In the information age command is ultimately not the sole responsibility of any

individual. The system configuration developed within this grand strategy will

consequently have to accommodate a shared and distributed command process. It has

been demonstrated that through the power to the edge concept such a process is possible.

The difficulty associated with such a concept pertains to what entity, or what person, is

actually in charge. Putting someone in charge, however, does not result in either

effective command or control.[200] Albert and Hayes smartly indicate that in the 21st

century the function of command will be accomplished in a distributed and collaborative

fashion.[201] The new CF command and control structure can adopt a power to the edge

command strategy creating the conditions for success. This strategy will also allow

flexibility when deriving the commander's intent and the scope of the solution. More

importantly, such a strategy permits the modification of the solution as the need arises, a

perfect situation when fighting new threats within today's context of military operations.

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[199] David S. Alberts and Richard E. Hayes, *Understanding Command and Control* (Washington, D.C.: DoD Command and Control Research Program Publication Series, 2006), 75.

[200] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 204.

[201] *Ibid*.

Through this new strategy control will become decentralized and will be optimized for NEOs. The CF organization will become adaptive meaning many independent actors will contribute to mission success and control will not be imposed. The organization will create the conditions that are likely to give rise to the desired behaviours.[202] This form of emergent behaviour lies within the magic of a network centric organization that can leap from shared awareness to self-synchronization. The grand strategy will change command in such a way that it will be exercised through the establishment of congruent command intent across the organization, dynamic allocation of resources and the assertion of rules of engagement.[203]

Summary of the Grand Strategy

The grand strategy is best summarized through the conceptual design pictured in Figure 7. The backbone of the design is the common national command and control system, represented by the red oval in the middle, replacing all current CF stovepipe systems and integrating the logistic, support, and engineering components. This system also encapsulates all functionality from non DND organizations such as the RCMP, CCG, CBA and CSIS. Within this system, power to the edge links can be created to empower all organizations to their full potential for the entire spectrum of missions mentioned in the DPS. Potential power to the edge links can also be created with external

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[202] *Ibid.*, 208.

[203] *Ibid.*, 210.

organisations such as NATO or the US military. This will depend on the development of international standards for command and control system.

The yellow oval represents the central information network necessary to optimize the Canadian defence and security power to the edge organization. Security windows would be inserted within the grid in order to ensure sensitive information is handled by the appropriate agencies. Additional ovals show how various systems can share applications and/or modules. Such a grid will provide the organization with the agility necessary to guarantee the right agency has the right information at the right time. The tactical systems used onboard warships, aircraft and army field units as well as information and intelligence collection systems used by various agencies are also represented. They must overlap with the national operational command and control system in a duplex way as required. Their contribution may be critical to the operational, and even strategic, decision-making process. Although a distinction must exist between all levels of command the agility of the organization will promote optimized decision-making and a self-synchronized environment.

Finally, but also very critical are the two block arrows representing the unified common Canadian strategy towards command and control and the unique combined support team necessary to ensure the system is not only performing effectively now but into the future. This is the solution for a command and control system configuration as a

national asset with optimized effectiveness towards all defence and security tasks and missions.
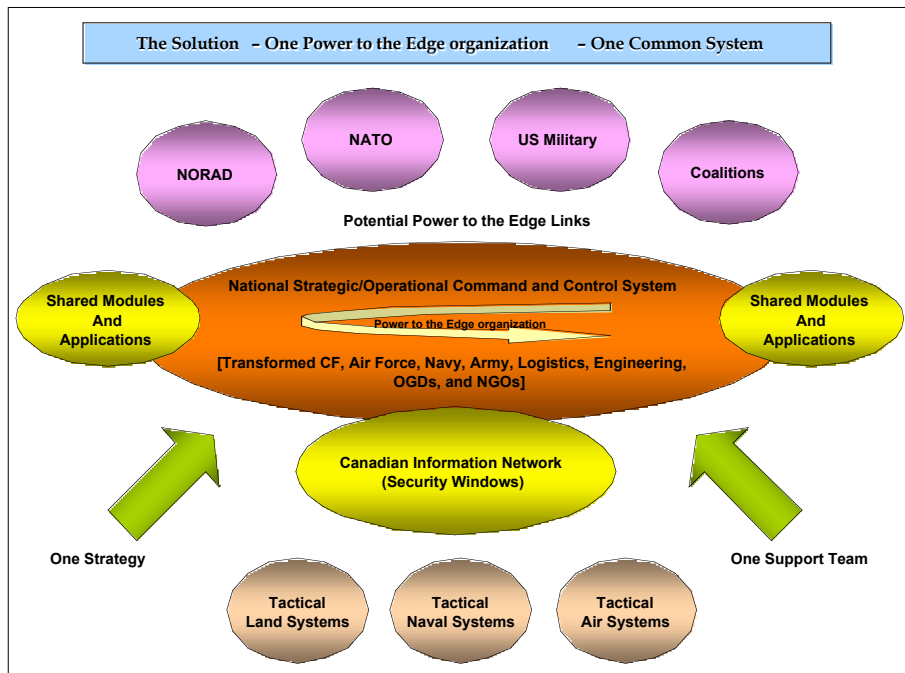

Figure 7 - The Solution: One Power to the Edge Organization - One Common System

> *"The technological and economic elements of national power must be considered a part of logistics from the strategic perspective of supporting the war."*
> - Clayton R. Newell[204]

Chapter 5 - Supporting the Configuration

Joint Support Team (JST)

A fundamental assumption made in designing command and control systems is that it will meet all users' requirements.[205] In order to properly support a national asset such as a command and control systems configuration a complete array of support element remains essential. The first element is a team of experts. It is vital, and well-known, that such a configuration be supported both in resources and technically. But, just as critical, is the need to keep thinking ahead, continuously evaluating the performance of the system and anticipating potential systems expansion thereby eliminating drastic systems modifications that would require significant training and operational adjustments and optimizing research and development opportunities.

The need for a joint team with representation from a maximum of the involved operational environments, military and non-military, is essential. This team could be divided into three sections: resources, technical support, and strategic thinking/research

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[204] Clayton Newell, *The Framework of Operational Warfare* (London: Routledge, 1991), 101.

[205] A. Nejat Ince, *et al*, *Planning and Architectural Design of Modern Command and Control Communications and Information Systems* (Norwell, Massachusetts: Kluwer Academic Publishers, 1997), 253.

and development. The CF need to gradually eliminate the numerous amount of teams working independently on command and control issues. This not only creates overlaps in work efforts but also generates conflicting concepts, misunderstanding of joint operations, and confusion of capability requirements. A Joint Support Team (JST) will revolutionize how we see, develop, and move forward in the domain of command and control systems.

Resources

The CF are currently experiencing personnel shortages at almost all levels. On the bright side, the creation of a command and control JST would actually reduce personnel requirements across all operational environments. There are presently too many personnel resources working independently on command and control issues at the strategic and operational levels. The operational environments would be required to keep those working on tactical command and control systems while only a small portion of those working on operational and strategic command and control systems would be required to join the Joint Support Team. Although the exact numbers will not be worked out within this research a gain in resources appears evident.

Similarly, the CF are restricted in capital acquisitions through a tight budget. It is anticipated that the creation of a national command and control system configuration would reduce the overall financial burden for the CF and also for all agencies involved with the configuration. Moreover, the existence of a national system introduces the

opportunity to build a steady cash flow for this capability. Not only does a steady cash

flow ease the planning of the capital budget but it also allows the support team to

optimize its use through advanced forecast. Again, the exact numbers will not be worked

out within this research but significant gains in capital money seem apparent.

Technical Support: Commonality as the Core Concept

Numerous complex methods of command and control performance measurement

exist.[206] However, for the purpose of this discussion we will concentrate on articulating

the need for critical technical characteristics necessary to ease the support of a national

system of such breath and scope. Although the technical support team would most likely

be concerned with the continuous monitoring of functions such as network management

and control, traffic monitoring, fault analysis and configuration control, it would also

focus on the vital aspect of commonality and two key operational criteria, namely

expandability and survivability.

By owning a common system the CF and the other Canadian agencies will reduce

drastically most problems usually associated with command and control systems

configurations. Common communication profiles, network services and applications will

exist and thereby eliminate a myriad of familiar problems. Common solutions contribute

to the reduced cost of development and acquisition, operations and maintenance, and also

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[206] NATO and the United States have produced numerous research papers on this topic.

training.[207] Common solutions must be generated at the requirements level. A single

designing and implementation contract is, in most cases, the ideal solution to

commonality and the CF must explore this sub-strategy. The current plethora of

contractors with their hands on some aspect of Canadian command and control makes the

unified approach notion virtually impossible. Security and system changes will also be

significantly simplified through the process of commonality.

Moreover, there are two specific additional technical areas where the real

advantage and power of common solutions can be observed throughout the lifetime of a

given system architecture, namely expandability and survivability.

For a country as large as Canada and a military force dispersed throughout

physical and internal expandability. Internal expandability will be necessary to ensure

the system configuration is continuously equipped with maximum processing and

memory power available or the latest in input/output technologies. But, more

importantly, will be the ability of the system to expand externally in order to

accommodate new clients. Those clients may come from within the nation or may be

potential forces from other states. Fulfilling the requirement of commonality is possible

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[207] A. Nejat Ince, *et al*, *Planning and Architectural Design of Modern Command and Control Communications and Information Systems* (Norwell, Massachusetts: Kluwer Academic Publishers, 1997), 50.

by adopting international standards.[208] This will be crucial for the CF, Canada when supporting the new system configuration.

As imperative will be the ability of the system to reconfigure itself in order to adapt to any type of missions or sub-system failures. Survivability is a very critical feature for military systems. Survivability is the ability to resist external influences and for certain parts of a system to operate autonomously when cut off from the rest of the system.[209] A high degree of survivability will not only enable the CF to possess a solid level of robustness against enemy system attacks but it will also allow them to develop and use contingency reconfiguration plans.

Strategic Thinking: The Key to Relevancy

In military organizations, power is a function of the collective means and opportunity possessed by the individuals in the organization with respect to their ability to accomplish essential capabilities. [210] Four organizational capabilities must be continuously evaluated to ensure that the system configuration still serve the structure efficiently. The first capability is the ability to make sense of the situation.[211] Data and

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[208] A. Nejat Ince, *et al*, *Planning and Architectural Design of Modern Command and Control Communications and Information Systems* (Norwell, Massachusetts: Kluwer Academic Publishers, 1997), 50. NATO is currently developing international command and control and interoperability standards.

[209] *Ibid*., 48.

[210] David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington, D.C.: DoD Command and Control Research Program, June 2003), 214.

[211] *Ibid*., 214.

information fusion and producing strong command decision-making aids is instrumental

for command and control within a military organization. Without this means

Commanders will not be able to achieve mission success. The second capability is the

ability to work within a coalition. The third capability is possession of the appropriate

means to respond. Finally, the fourth capability is the ability to orchestrate the means to

respond in a timely manner. Those capabilities closely match the vision of the

transformed CF laid out in the IPS whereas the forces will be more effective, more

relevant and more responsive.[212] By continuously assessing their operations, and their

respective response, the CF will be in a position where they will rarely be playing catch-

up in the domain of command and control. At the opposite, they dominate in the

command and control research domain and may be regarded as a leader of excellence.

Development and Acquisition Processes

As stated earlier, command and control must be viewed as a national asset,

arguably one of the most important for a military nation with such a complex security and

defence environment. Accordingly the development and acquisition processes must be

adapted to reflect such a status. It is imperative that command and control for Canada be

thought of as one entity. Without this understanding the grand strategy will not achieve

its objectives. At the operational and strategic level, within each environment (Army,

Navy, Air Force and Support), there should be no command and control system

development. Even the tactical system, developed within a given environment, must be

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[212]Department of National Defence, Canada's *International Policy Statement: A Role of Pride and Influence in the World – Defence* (Ottawa: National Library of Canada, 2005), 11.

interfaced with the national command and control system. The strategy should enclose

all organisations discussed in Chapter 4.

A special acquisition process for command and control is also necessary. It must

be understood within the DND acquisition organisations and the respective contractor

that a single contract for the design and support of the complete configuration is ideal.

This will ensure all technical requirements are uniformly met and all interfacing and

integration problems are resolved at one focal point. Furthermore, it should maximize

the efficiency and capability of the system while optimizing the support piece. Finally, it

could also prove to be very cost effective.

Summary of Supporting the Solution

Supporting the grand strategy will be as important as implementing it. As

analysed it will influence two vital areas namely the costing envelope and mission

effectiveness. These are two key fields for the CF. Command and control is a common

task to all security and defence agencies of Canada. Putting together one unique team to

support a national command and control system configurations is not only logical but will

ensure the strategic and operational decision-making in Canada produces the best

solutions possible. It is expected such an office would create the cultural change

necessary for all Canadians involved in the domain of defence and security to treat

command and control as a national asset.

Conclusion

An array of new threats including terrorism, failed and failing states, and proliferation of weapons of mass destruction has increased the criticality of command and control systems. The likely environment of future military operations will contain a high degree of uncertainty and planning will be more difficult and complex. Military forces within such an environment will have to demonstrate flexibility and compatibility. Multiple sensor, communications and command systems will need to be integrated in order to provide a maximum of mission effectiveness. In most operations, such a network centric environment, where interoperability dominates, will become the norm. Military units will become nodes within a network of information, analysis, and efficient decision-making. Effective command and control systems will be the core of such military units.

The transformed CF are no exception. According to their IPS they will remain involved in a large spectrum of operations including coalitions overseas and domestic security. The CF have already adopted a new command and control structure based on mission success and an overall force that is more responsive, relevant and effective. This new structure combined with the new environment will necessitate a new command and control system configuration because the current conditions are unacceptable. Stovepipes simply dominate the current framework making a basic operation between the Navy and Army within Canada COM potentially difficult and confusing.

Most of the CF components have acknowledged the need for a reenergized command and control system through various policy and strategy documents. Through the C4ISR Guidance and Campaign Plan a complete scheme exists for the CF to achieve better results particularly in the command and control domain. However, the strategy needs to be even larger. The network centric environment and its associated network enabled operations, as well as many key interfaces with internal and external agencies, must be better emphasised. The information grid must be pushed to the limit and security barriers must be smartly overcome. The power of the organization will reside in information and knowledge being pushed to the edge. Finally, the system configuration must be effectively supported. These are the pillars of the grand strategy depicted in this paper. Canada, with the CF leading, must treat command and control as a national asset and nothing less. This is the cultural change that must occur within our nation. Instead of thinking about marine security Canada should be thinking about national security within a continental context.

The configuration of the next command and control system will be instrumental and vital for its future particularly for its overall mission effectiveness. It was demonstrated in this paper that the current configuration, and its associated future developments, will not encompass all the necessary elements for optimum system efficiency within the transformed CF and Canada. A power to the edge solution

combined to an unlimited information grid is a possible key to the accomplishment of all objectives.

Executive and governmental level leadership will be necessary to bring together and coordinate the various agencies involved in such a venture. For the Army, Navy and Air Force to operate effectively together within Canada COM, and for CEFCOM to be relevant within network centric environments, a new configuration and its respective leadership will be necessary. Furthermore, with respect to security for instance, it is vital that the command and control system configuration be effective for not only the CF but also for the CCG, RCMP and government agencies. Once such a configuration is in place as a total national asset, the operational output of the transformed CF will be optimized and Canada, as a country and in accordance to their NSP, will be able to focus on events and circumstances that generally require a national response, at home or abroad.[213]

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[213] Privy Council Office, *Securing an Open Society: Canada's National Security Policy*, (Ottawa: National Library of Canada, 2004), vii.

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