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ARE WE PREPARING OUR SOLDIERS FOR SUCCESS IN A NETWORKED ENVIRONMENT? THE HUMAN DIMENSION OF NETWORK-ENABLED OPERATIONS

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ARE WE PREPARING OUR SOLDIERS FOR SUCCESS IN A NETWORKED ENVIRONMENT? THE HUMAN DIMENSION OF NETWORK-ENABLED OPERATIONS

By Major Craig Aitchison

Abstract

Recent technological advances have led to the ability to begin to truly leverage the idea behind Network Centric Warfare. But while network enablement brings opportunities and efficiencies, it also comes with concerns. Supporters of Network Centric Warfare see opportunities to link sensors to shooters, the free flowing of information and increased situational awareness. Opponents see flattened hierarchies, increased vulnerabilities, micromanagement and an increased burden on the tactical level as operational and strategic commanders demand more and more of their subordinates. One common theme amongst those concerned is technological reliance and the impact this will have on the human dimension and the organisational culture that western armies depend upon to motivate their soldiers to go to war.

This paper will explore what Network Enabled Operations means to the Canadian Forces, and other western militaries and then discuss the implication on the human dimension using the Canadian Army as the lens. It will look at how the Army develops new capabilities like Network Enabled Operations, its experiences to date and how it can reduce the risk to its most important resource - its people. It will conclude with recommendations to review benchmarks for physical fitness and education standards for entry into the Canadian Forces and to continue the forward looking scientific research in support of technological innovation and the impact it will have on the human dimension.

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> *Network Centric Warfare is an information superiority-enabled concept of operations that generates increased combat power by networking sensors, decision makers, and shooters to achieve shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability, and a degree of self-synchronization. In essence, Network Centric Warfare translates information superiority into combat power by effectively linking knowledgeable entities in the battlespace.*[1]

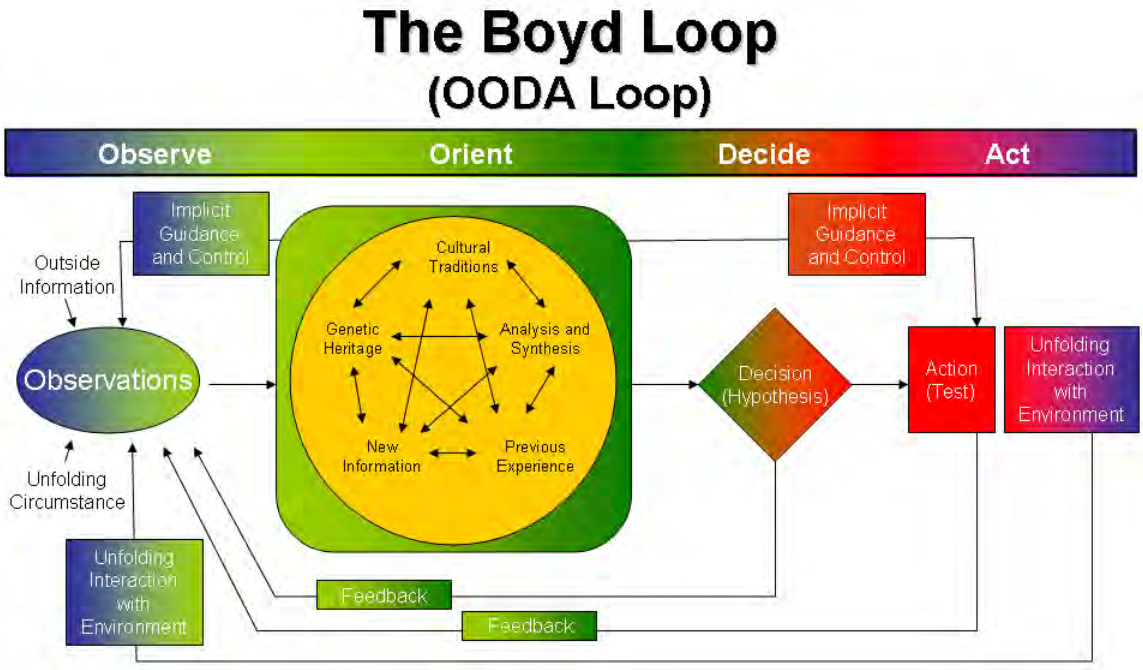

Figure 1-1. The Boyd (OODA) Loop. Source: adapted from Lars Holmdahl, *Strategy*, http://www.larsholmdahl.com/index-e.html; Internet; Accessed 22 February 2008.

[1] David S. Alberts, John J. Garstka, and Frederick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, (n.p.:CCRP Publications, 1999), 2.

Chapter I, Part 1

A Systems Approach to War

Since the beginning of time and all through the evolution of warfare, adversaries have been attempting to find ways of gaining the upper hand. In the mid-80's United States Air Force strategist, Colonel John Boyd, introduced the concept of the OODA Loop. This was a simple model where the aim is to render one's opponent's actions irrelevant by acting faster than they could react. He drew from many historical examples, including Sun Tzu, Greek and Roman engagements like the Battle of Cannae, and Genghis Khan. Boyd derived parallels between these ancient examples of warfare and innovation to more recent battles like the Yom Kippur War. In each case, he built a compelling argument for accelerating the decision-action cycle. In his words, the aim was to

> *operate inside adversary's observation-orientation-decision-action loops to enmesh adversary in a world of uncertainty, doubt, mistrust, confusion, disorder, fear, panic, chaos, …and/or fold adversary back inside himself so that he cannot cope with events/efforts as they unfold.*[2]

With the rapid advancement of microchip processing speeds and information sharing capabilities that networked computers brought, modern armies have tried to meet this ideal using computers. With the more recent development of wireless computer networks, digital data transfer and efficient means of connecting nodes of the network, soon every station in the military organizational web could process and send information rapidly. Improved bandwidth and stability in wireless networking would remove one of the last hurdles in achieving the technological framework that would allow western

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[2] John Boyd, Colonel, "Patterns of Conflict", edited by Chuck Spinney and Chet Richards, (Atlanta: Defence and the National Interest, 2005), 177.

armies to compress Boyd's model to its most efficient state. This led to the ability to begin to truly leverage the idea behind Network Centric Warfare (NCW).[3]

With network enablement come not only opportunities and efficiencies, but also concerns. Supporters of NCW see opportunities to link sensors to shooters, the free flowing of information and increased situational awareness. Opponents see flattened hierarchies, increased vulnerabilities, micromanagement and an increased burden on the tactical level commanders as the operational and strategic level demand more and more of them.

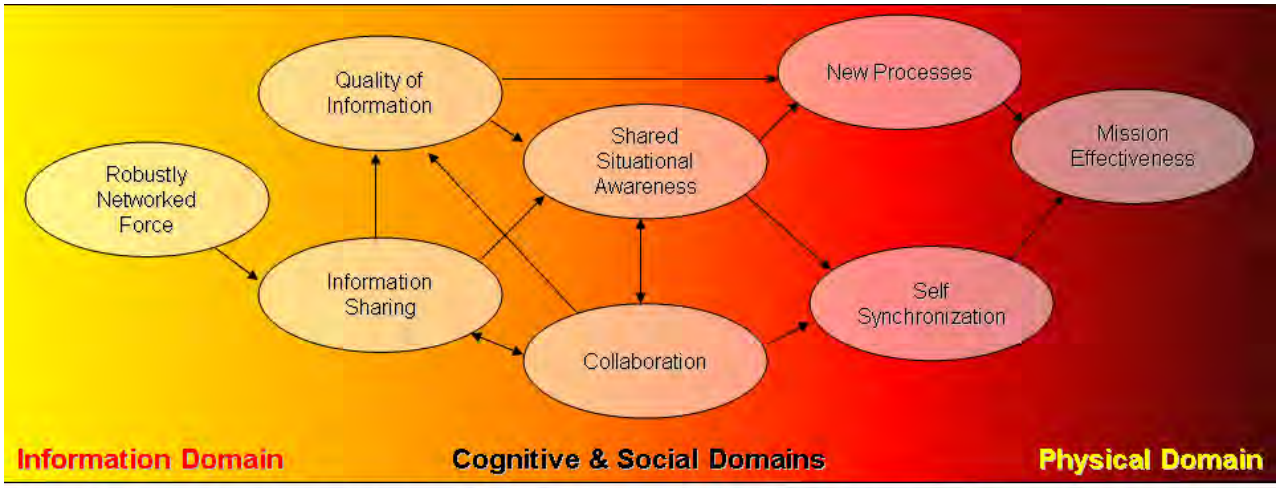

Figure 1-2. Network Centric Warfare Value Chain. Source: Col Gary Agron and Col Chuck Pattillo, US Army Office of Force Transformation adapted from a presentation on *Network Centric Operations: The Power of Information Age Concepts and Technologies;* Internet; www.oft.osd.mil; accessed 16 February 2008.

A common theme amongst those concerned is the reliance on technology and the impact this will have on the human dimension and the organisational culture. Armies take time to instil cultural commonality in their soldiers and then rely heavily on this as well as human relationships to motivate their soldiers to fight. Such practices and ideas as the regimental system, cultural indoctrination and building cohesion to the lowest

[3] Network Centric Warfare and Network Enabled Operations are used interchangeably throughout this paper.

common denominator are all delicate, and some believe have the potential of being undermined, or even rendered irrelevant, with the introduction of NCW. These cultural elements are some of the components of the human dimension of NCW.

Culture plays a major role in the development of any military. The culture of the United States Army is unlike that of the Canadian Army, for example. Amongst other things, this difference stems from national identity differences, heritage and demographic makeup of the force. For example, it is fair to say that the American culture was shaped by the way its people gained independence and by the fact that they suffered through a civil war. This in turn influences the culture of their armed forces. A closer look at their individual services reveals similar differences between the United States Marine Corps and the Unites States Army. Many of the differences between these services and the Canadian Army can be explained through differences in national identity and service heritage.

The Human Dimension

From the outset it appears that the human dimension has been central in the conceptual development of NCW. This dimension is part of the reasoning behind Canada's choice of word-use in "Network Enabled Operations" [4] and is a common thread in many of the writings on both NCW and Network Enabled Operations (NEOps). In Canadian literature the importance of the human dimension is reinforced consistently in an article by Dr Allan English and colleagues, entitled *Beware of Putting the Cart before the Horse: Network Enabled Operations as a Canadian Approach to Transformation*. English points out that there is "significant risk in placing too much reliance on concepts

[4] Sandy Babcock, *Canadian Network Enabled Operations Initiatives*, (Ottawa: NDHQ, June 2004), 4.

like [NCW] which put the technological cart before the human requirements that should drive any transformation initiative."[5] He goes on to point out that traditionally, due to not having access to the same resources and technology as the United States and others' militaries, the Canadian Army has tended to focus on "human-centric networks incorporating technology" [6] as opposed to the converse; this is important.

Command style is a very personal thing. Canadian leadership doctrine stresses the human dimension of command in its capstone doctrinal publication where it states that the essence of command "is the *expression of human will*, as reflected in the concept of *commander's intent* (italics in original)."[7] There is common understanding amongst leading experts in the field of leadership, command and NCW that military forces that have the capability to adopt decentralized approaches, such as mission command,[8] retain the advantage in the contemporary operating environment owing to their ability to adapt their tactical activities rapidly as situations evolve.[9] How does NCW affect this relationship?

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[5] Dr Allan English, Dr Richard Gimblett and Mr Howard Coombs, *Beware of Putting the Cart before the Horse: Network Enabled Operations as a Canadian Approach to Transformation*, a report prepared by KMG Associates for Defence Research and Development Canada, (Toronto: DRDC, 2005), 100.

[6] *Ibid*., 88.

[7] Department of National Defence, *Leadership in the Canadian Forces: Doctrine* (Ottawa: DND Canada, 2005), 7.

[8] Mission Command is generally accepted as the rough translation of "*Auftragstaktik*", the German concept of decentralized command.

[9] Keith Stewart, *Mission Command: Elasticity, equilibrium, culture and intent*, (Toronto: DRDC, 2006), iii.

The History of Network Centric Warfare

NCW is not new. It finds its roots in business,[10] but its military origins are founded in the United States Navy. According to Vice Admiral Arthur Cebrowski and John Garstka, considered to be the fathers of NCW, it came about as a result of some fundamental societal changes "dominated by the co-evolution of economics, information technology, and business processes and organizations"[11] that are linked by three common themes. These themes were seen as "a shift in focus from the platform to the network, a shift from viewing actors as independent to viewing them as part of a continuously adapting ecosystem, and the importance of making strategic choices to adapt or even survive in such changing ecosystems."[12] They offer that network enablement brought with it such profound efficiencies in synchronizing combat power that the United States Navy had to change, or suffer the consequences.

John Garstka says the advantages of NCW are significant, and while the term only "broadly describes the combination of strategies, emerging tactics, techniques, and procedures" [13] he suggests that an organization need not be fully networked to leverage the benefits that NCW offers. He proposes that "even a partially networked force can employ to create a decisive warfighting advantage."[14] According to Cebrowski and Garstka, NCW allows organizations the opportunity to leverage the potential speed of a

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[10] This will be explored further in follow-on sections.

[11] Vice Admiral Arthur K. Cebrowski, U.S. Navy, and John J. Garstka, "Network-Centric Warfare: Its Origin and Future" *Proceedings*, January 1998, n.p.

[12] *Ibid*.

[13] John J. Garstka, "Network-Centric Warfare Offers Warfighting Advantage," *Signal*, May 2003, 58.

[14] *Ibid*.

network in order to compress the Decision-Action cycle, enabling commanders to "develop speed of command" and the ability to "organize from the bottom up - or to self-synchronize - to meet the commander's intent."[15] This in turn allows a commander to quickly mass effect, overcome the adversary's opportunity to react effectively, and render his actions irrelevant. As the conduct of combat operations moves into a high-speed continuum the Boyd Loop virtually disappears, and the enemy is denied the opportunity to regroup and replenish his forces.[16]

Several countries are developing network supported concepts. Each of them tend to see the concept from a slightly different perspective, and this is reflected in their terminology. In an effort to remove the focus from the network, countries like the United Kingdom have developed their own conceptual architecture and labelled it Network Enabled Capabilities. They describe it as more "command centric" than "network centric."[17] Perhaps not surprisingly, this view is not far from the Canadian one which takes the command centric view and adds a national twist through the incorporation of other Canadian concepts such as the 3D (Defence, Development and Diplomacy) approach and JIMP (Joint, Interagency, Multinational, Public) as well as the integration of such emerging capabilities as offered by Canadian Special Operations Forces Command.[18] This led to the selection of the term NEOps. While there is not yet a Canadian definition of NEOps, there is an understanding that it is different from the

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[15] Cebrowski, "Network-Centric Warfare: Its Origin and Future", n.p.

[16] *Ibid*.

[17] English, et al., *Beware of Putting the Cart before the Horse…*, 3.

[18] Thomson and Adams, *Network Enabled Operations: A Canadian Perspective*, (Toronto: DRDC, 2006), 12.

United States' concept of NCW, and that this needs to be reflected in that definition.[19] Lacking an accepted definition, for the purpose of this paper, the definition from Sandy Babcock's paper entitled *Canadian Network Enabled Operations Initiatives* will be used:

> *The conduct of military operations characterized by common intent, decentralized empowerment and shared information, enabled by appropriate culture, technology and practices.*[20]

What it is and what it is not

In 2004, in an interview with Vice Admiral Arthur Cebrowski, Frank Swofford is provided with great insight into Cebrowski's viewpoint on what NCW is and what it is not. He writes that as an emerging theory of war in the information age, NCW is simply the military's response to the technological advancements being offered. It is seen as a natural means (leveraging technology) in order to arrive at the ends of transformation (retaining the competitive edge).[21]

If the realization of NCW is first of all about human behaviour, how does one proceed without losing sight of this? The United States Army publication on the implementation of NCW provides some guidance. It points out that while "network" is a noun, "to network" is a verb. Thus, when one examines the degree to which a military seeks to exploit the power of NCW, the focus should be on the aspect of human networking and human behaviour in the networked environment.[22]

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[19] *Ibid*., 7.

[20] Babcock, *Canadian Network Enabled Operations Initiatives*, 4.

[21] Frank Swofford, "Interview with Arthur K. Cebrowski, Director, Office of Force Transformation", *Defense AT&L*, March-April 2004.

[22] United States. Department of Defense, *The Implementation of Network-Centric Warfare*. (Washington: U.S. Government Printing Office, D.C, January 2005), 3.

The questions that need to be considered are: What is the impact of enablement on human behaviour, on how forces perform and on their organization when they have been network enabled? What is the impact on the human dimension? What are the implications on the cognitive skills and physiological limitations of our soldiers and the human network upon which we rely to conduct operations in the contemporary operating environment?

Chapter I, Part 2

The Benefits and Risks of Network Centric Warfare

> *Network Centric Warfare is about human and organizational behavior. Network Centric Warfare is based on adopting a new way of thinking - network centric thinking- and applying it to military operations. Network Centric Warfare focuses on the combat power that can be generated from the effective linking or networking of the war fighting enterprise. It is characterized by the ability of geographically dispersed forces (consisting of entities) to create a high level of shared battle space awareness that can be exploited via self-synchronization and other network-centric operations to achieve commander's intent.*[23]

According to this definition, the key benefit of this technology is an increase in combat power through the networking of capabilities. This will result in increased speed of communications and the application of effects in operations. NCW will also result in an increase in shared battle-space awareness, through a common operating picture.

Self-synchronization is another expected outcome of NCW. The concept of self-synchronization is rooted in the Manoeuvre Warfare tenet of Mission Command. It is based on the idea that given a common understood goal and supporting intent behind that goal, organizations have ability to conduct continuous reorientation to meet that goal and intent without having to seek further guidance or direction. It allows for faster execution and offers subordinates the occasion to exploit opportunities. The addition of a common operating picture further enhances that opportunity by allowing subordinates to self-synchronize in a highly informed manner. It allows a military to truly adopt a philosophy akin to Von Moltke's *Auftragstaktik.*[24]

According to NCW critics, the supposed increase of speed of execution in net-

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[23] Cebrowski and Garstka, "Network Centric Warfare: Its Origin and Future", 28-35.

[24] Mission orders stressing decentralized initiative within an overall strategic design, commonly referred to as simply "commander's intent."

centric operations and the shared battle-space awareness has the potential to cause problems by creating favourable conditions for micromanagement. Milan Vego of the Naval War College argues that:

> *having a common operating picture will lead operational commanders to be increasingly involved in purely tactical decisions, instead of focusing on the operational and strategic aspects of the situation.*[25]

According to Gregory Blencoe, a management consultant and prolific reviewer of written works on management, micromanagers "give employees tasks to do and then meddle by overanalyzing every minute detail involved with the job in order to make sure that it is "done right."" [26] Blencoe believes that this results in decisions being continually questioned and second guessed, individual initiative and problem solving being stifled, and trust completely undermined. [27]

So will network enablement erode trust? While this concern seems to be a matter of personal perspective, the flattening of networks and the capability of strategic commanders to see tactical situations certainly presents the possibility for strategic interference. History has shown, though, that enhanced battle-space awareness also keeps commanders informed of what and how their subordinate formations are doing. This removes the desire for strategic and operational commanders to demand situation reports and constant updates; they can see the situation on the screen.[28]

Shared situational awareness through data fusion and net-wide, real time

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[25] Milan Vego, "Net-Centric is Not Decisive", *United States Naval Institute Proceedings* 129, (January 2003): 56.

[26] Gregory J. Blencoe, "The Eight Rules of Management", *Challenge Consulting*, http://www.challengeconsulting.com.au/aboutus/press_release/good_business/8_rules_2.html; Internet; accessed 14 February 2008.

[27] *Ibid*.

[28] See ***Canadian commanders' views and experiences*** in Chapter II, Part 3.

connectivity are only some of the benefits of NCW. All participants within the network will have access to the same information, and their connectivity enables unsurpassed speeds of control and execution. Admiral William Owens, former vice chairman of the United States Joint Chiefs of Staff, has made the argument that the Clausewitzian maxims of "fog and friction" of war will be a thing of the past.[29] He believes that commanders will now have access to the exact location, movements and activities of enemy and friendly units. Commanders will have as good information as the soldiers under his command will have; reconnaissance forces, troops in contact and strategic collectors. All of this information will be at his disposal, allowing him to make effective decisions rapidly.

The Origins of Network Centric Warfare

The genesis of NCW is found within the exceptionally competitive arena of business. It comes specifically from such companies as Cisco, Charles Schwab, Amazon, American Airlines and Dell.[30] All are companies working in exceptionally competitive markets: computer networking, investment management, online retail, commercial transportation and computer systems.

Supporters of the concept maintain that these companies developed and maintained significant economic advantages over their rivals by developing extensive and intricate databases and networks that could be leveraged by other users of information systems. Although these companies used these tools to manage supply and demand, by predicting inventory needs to effectively meet customer demands and allowing them to

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[29] William Owens and Ed Offley, *Lifting the Fog of War*, (New York: Farrar, Straus and Giroux, 2000), 14-15.

[30] English, et al., *Beware of Putting the Cart before the Horse*, 69.

become "maximally adaptable"[31] they were, in effect, using Boyd's Loop and shortening the time between observation (order placement) and action (order fulfillment). It should, therefore, be useable as a model for any decision-action cycle.

Information networks allowed these businesses to realize significant efficiencies because they could accurately predict outcomes, mitigate risk and adjust to rapidly changing situations; this is the key to being successful in military operations in the contemporary operating environment. According to its supporters, to leverage NCW is to realize information dominance over one's adversary in much the same way that successful businesses use information to exploit their markets.

One must proceed with caution though, as not all lessons translate directly from conducting business to waging war. More recent criticism of NCW has been aimed squarely at its business origins. Military historian Frederick Kagan argues that the underlying flaw in NCW is precisely that it reflects an effort to translate a business concept of the 1990s into military practice.[32] Adversaries are not customers; adversaries are cunning, adaptable and often unpredictable. Often the information on our adversaries is unclear, conflicting or simply non-existent. They are quite capable of foiling attempts to gather intelligence, often using the same methods we will; we do not have a corner on access to technology for the purpose of waging war.[33]

Nor do the concepts behind NCW translate directly into more effective organizations; it takes a number of elements to make a military capability, with a key one

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[31] *Ibid*.

[32] Frederick W. Kagan, "War and Aftermath," *Policy Review Online*, 102 (August/September 2003), 3; http://www.hoover.org/publications/policyreview/3448101.html; Internet; Accessed 23 February 2008.

[33] *Ibid*.

being doctrine. But while Army doctrine and business "doctrine" may not be dissimilar, Garstka and colleagues remind us that the "assertion that "what is good for business is good for the [Department of Defence]" is a dangerous oversimplification. However, the converse assertion that "lessons learned in the commercial sector have no application to the domain of warfare" is equally untrue and if believed, would deny us an opportunity to learn from the experiences of others when they are applicable."[34]

The Myths and Realities of Network Centric Warfare

It's all about the network.

As was suggested above, NEOps is more about networking than it is about networks. It is about the increased generation of combat power that can be generated by network enablement. The benefit of NEOps comes from the successful linking of knowledgeable, capable people and organizations that are already related, but perhaps not geographically collocated. It is this networking that allows them to efficiently share information and in turn collaborate effectively to achieve enhanced shared situational awareness. Through collaboration a degree of self-synchronization is achieved, and in military operations this results in greater combat power.

Network Enabled Operations will make us more exposed to asymmetric attack.

September 11th, 2001 clearly demonstrated how vulnerable we all are. NEOps will not necessarily make us less vulnerable, but once NEOps are leveraged to their fullest extent and integrated across the Whole of Government, a nation's ability to develop and maintain broad situational awareness is enhanced. Its ability to compress its decision-action cycle is improved. While our increasing reliance on rapidly evolving

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[34] David S. Alberts, John J. Garstka, and Frederick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, (n.p.: CCRP Publications, 1999), 10.

technology should be tempered with caution, to not take advantage of what the speed of the microprocessor brings begets risk in itself - our adversaries will render us irrelevant if we do not.

Network Centric Warfare will give us the power to dominate our adversaries.

NEOps is not a panacea. It does, however, allow us to leverage our most important asset: our people. But people have limitations. Improved situational awareness depends upon not only collecting and sharing information, but also upon an ability to analyze information and manage information flow. Faster information flow does not equate to better collaboration, faster speed of command or other aspects of command and control. It will not compensate for people that are not up to the task. Investment in the human network remains as vital as the overarching technical network that will be used to leverage it.

Chapter 1, Part 3

Net Enablemen:, what it means to the Canadian Army

Given what NEOps offers in terms of an advantage over our adversaries, it should come as no surprise that interest amongst senior leaders in the Canadian Army is high. The complexity of domestic and international security has increased dramatically since 9/11; this is reflected well in the Army's Force Employment Concepts. NEOps may well offer the ability for governments to respond to a threat or crisis in an integrated way, achieving the "JIMP-ness" that will allow for a coordinated whole of government approach. A government's capability to mobilize all elements of national power is a powerful, effective and efficient tool.

NEOps brings with it other less obvious advantages. It is likely that the substitution of technology for some people will occur with the implementation of a network enabled force. While network enablement likely means more technical support, it may also mean fewer operators and human linkages in the passage of information than before. This decrease in some fields might allow the Canadian Army to focus its scarce human resources on occupations that have a high personnel tempo, relieving the stresses felt there.

In 2004 the Canadian Army recognized the importance of information technology when it published its *Force Employment Concept.* This publication clearly identified that the changing character of gathering, processing and using information was "perhaps the single most important advance to affect military operations in the near future."[35] In the follow-on *Land Operations 2021* it is even clearer that the information domain becomes

[35] Department of National Defence, *Purpose Defined: The Force Employment Concept for the Army: One Army, One Team, One Vision*, (Ottawa: Department of National Defence, 2004), 10.

more central to achieving success in the contemporary operating environment.

This has not escaped the scientific community within the Department of National Defence's Research and Development branch. As the Army was releasing its *Force Employment Concept,* Strategic Analyst Peter Gizewski was supporting the conclusions that were found within it as it relates to NEOps. In his words,

> *Network Enabled Operations is viewed by many as a key means of facilitating land force transformation. Indeed, the enhanced information sharing and situational awareness it promises would aid in transit to a lighter, faster, more agile, mobile, lethal and knowledge-based force. And careful integration of Network Enabled Operations into Army planning, doctrine, and capabilities would conceivably enhance the forces ability to effectively perform virtually all of its operational functions and ultimately, its key missions. The result would be a more effective, truly manoeuvrist approach to future operations and missions.*[36]

Gizewski goes on to suggest that joint operations would be enhanced as network enablement allows for more effective and efficient cooperation between services. Indeed, he proposes that even interdepartmental cooperation, collaboration between non-governmental organizations and combined operations with other nations could be enhanced with technology.[37] This concept is clearly articulated in the Canadian Army's *Land Operations 2021.*

But this idealistic view has to be taken with caution. For a military, the ability to use information and knowledge in order to establish a high level of situational awareness and understanding is a continuous process involving education, training and investment in high-technology. A military must be capable of adopting "a way of fighting that is agile enough to adapt to adversaries who will attempt to neutralize our technological

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[36] Peter Gizewski, *Toward a Network-Enabled Land Force: Problems and Prospects*, (Kingston: Defence Research and Development Canada - Centre for Operational Research and Analysis, 2004), 6.

[37] *Ibid*., 7.

advantage."[38] The path to acquiring this ability is to fully adopt a mission command and manoeuvrist approach to warfare. And while this may be the doctrine of the Canadian Army, it is not necessarily the reality.

An Army must also be able to select and train the right kind of soldier; a soldier who is capable of learning how to operate, and operate within, a networked environment. Soldiers must be able to adapt to new technologies and adapt technologies to new environments and situations. At the same time, the Army cannot assume perfect situational awareness will be achieved, and as such, it must prepare its force to be able to operate in situations where that is not the case. There will be times in the contemporary operating environment where modern armies will operate against a technologically inferior foe that can still defeat our sensors, and therefore negate the technological advantage we are attempting to leverage.[39] It is for these reasons that the Canadian Army needs to consider how it selects, trains and educates its soldiers. "It could well be essential to ensure future relevance and ultimately - mission success."[40]

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[38] Sandy Babcock, *DND/CF Network Enabled Operations Working Paper: A DND/CF Concept Paper and Roadmap for Network Enabled Operations*, (Ottawa: Defence Research and Development Canada, 2006), 19.

[39] Department of National Defence, *Purpose Defined: The Force Employment Concept for the Army…*, 11.

[40] Gizewski, *Toward a Network-Enabled Land Force…* 7.

Chapter I, Part 4

Other Armed Forces' Experiences to Date

The Australian Defence Force - A conceptual look

Not unlike her key allies, Australia sees NCW as an enabler. It is seen specifically as an enabler for the "Future Joint Operations Concept [which] provides a point of reference for the range of integrating and supporting operating concepts."[41] In fact, Australia's approach to NCW has been very similar to Canada's: focusing on the human dimension.

The Five Premises of Network Centric Warfare

Professional mastery is essential to Network Centric Warfare.

Mission command will remain an effective command philosophy into the future.

Information and intelligence will be shared if a network is built by connecting engagement systems, sensor systems, and command and control systems.

Robust networks will allow the Australian Defence Force, and supporting agencies, to collaborate more effectively and achieve shared situational awareness.

Shared situational awareness will enable self-synchronization, which helps warfighters to adapt to changing circumstances and allows them to apply Multidimensional Manoeuvre more effectively.

Figure 1-3. Australia's Five Premises of Network Centric Warfare.
Source: Australian Department of Defence, *Enabling Future Warfighting: Network Centric Warfare* (Canberra: Defence Publishing Service, 2004) 2-2.

According to its capstone doctrinal publication, *Enabling Future Warfighting: Network Centric Warfare*, the Australian concept of NCW is based on five premises. These are shown in Figure 1-3.

The premise of professional mastery is critical to the human dimension. It is the

[41] Australian Department of Defence, *Network Centric Warfare Roadmap 2007*, (Canberra: Defence Publishing Service, 2004) 4.

embodiment of how individuals apply their abilities, knowledge and points of view to a given task or problem. Professional mastery is the product of training, education and experience. It is the glue that binds a profession together, and is a strong component of trust. Professional mastery is one of the cornerstones of the human dimension in NCW. Within the concept of NCW there are four key elements that enable professional mastery: organization, commanders and their staff, training and doctrine.[42]

Organization is the first key element. Militaries are organized to achieve a number of principles and fundamentals. These include having unity of command, maintaining an effective span of control, exercising efficient resources management and delineating clear responsibilities. NCW provides a framework to leverage new concepts and technology in order to modify organizational structures and command relationships by emphasizing cooperation across lines of operations and common operating concepts and doctrine.

For *commanders and their staff*, network enablement creates an opportunity to access a significant amount of information. This in itself creates challenges. Micromanagement has the potential to flourish in an environment where commanders have complete visibility on a situation. It also creates considerable challenges for using Mission Command, another underpinning of effective NCW. This reinforces the requirement to foster team cohesion and trust between peers, subordinates and superiors.

Militaries rely on *training* in order to form trust between people and build confidence across an organization. It is through training that we build an understanding of how members of the team will react to given situations, and this helps people prepare

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[42] Australian Department of Defence, *Enabling Future Warfighting: Network Centric Warfare*, (Canberra: Defence Publishing Service, 2004) 2-2.

for the stress of combat. People must be trained to make efficient use of all information available to them, and must understand how to manage information effectively. This should encourage action in ambiguous or unclear situations; in Canadian training mantra, we need to teach people how to think, not what to think.

Doctrine is a reflection of how we do what we do. It is a collection of understanding of the nature, role and conduct of armed conflict. Doctrine provides a foundation for training, and in many militaries is closely linked and under a single commander. In Australia, Canada and the United States training and doctrine are the responsibility of a single formation commander. This is seen as the most efficient way to provide the best training and education to the members of our armed forces. Australia again articulates the importance of doctrinal underpinning and recognizes that "because connected networks of the type envisaged in NCW will change the application of force, organization and collaboration, the Australian Defence Force's doctrine must be reviewed constantly to ensure that it reflects observed and anticipated changes, and that it incorporates the lessons of our experience."[43]

In the Australian Defence Forces NCW doctrine, Mission Command plays a central role because it emphasises "flexibility and individual initiative."[44] Since information systems are fragile, and the contents of these systems can be compromised, Mission Command philosophy allows for subordinate commanders to continue the mission if the network were to fail, and continue to work toward the fulfillment of the commander's intent.

Militaries that apply the principles of Mission Command need their members to

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[43] *Ibid*., 2-3.

[44] *Ibid*., 2-4.

be able to act in the absence of direction and information, but still be able to leverage the benefits of the network when that direction and information are available. A unifying commander's intent creates this opportunity. Again using Boyd's Loop, friendly force actions will change the situation before the adversary can react, rendering their actions irrelevant. Modern militaries need to use Mission Command, and commander's intent in order to maximize these opportunities.[45]

Professional Mastery and Mission Command philosophy are the two key components to the Human Dimension. It is this dimension that makes up one of the three underpinning components of Australia's concept for implementing NCW. She sees NCW as dependent upon the concurrent development of the network dimension, the human dimension and networking. In its publication *NCW Roadmap 2007* the network dimension is described as consisting of sensors, decision makers and engagement systems, and there is recognition of the impact this network will have on the human dimension. Within the human dimension it is understood that organization, commanders and their staff, training, and doctrine all play a significant role in developing professional mastery, and that the mission command philosophy develops trust between soldiers and commanders. The component referred to as "networking" includes both the technical and human networks that are required to achieve operational effectiveness.[46] As is apparent from just this one part of Australia's doctrinal library, the human dimension is a key component of its development of NCW.

Using "target states", Australia identifies its mid to long-term goals with respect

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[45] *Ibid*., 2-4.

[46] Australian Department of Defence, *Network Centric Warfare Roadmap 2007*, (Canberra: Defence Publishing Service, 2007) 5-7.

to net enablement. These target states are broad aiming points for how the Australian Defence Force sees itself in a networked environment in the year 2020. Australia uses six of these to articulate its vision. They are Force Application, Information Superiority and Support, Command and Control, Force Deployment, Force Protection and Force Generation and Sustainment. As aiming marks, they provide only the end state envisioned, not the path to get there.

Force Application refers to the generation of effects. In the context of NCW, Australia sees these as "a range of lethal and non-lethal effects that are both timely and appropriate and are synchronized with other partners to achieve the desired effect."[47] Network enablement would allow the Australian Defence Force to be able to "accurately apply an appropriate level of force in close combat and from standoff ranges in complex environments." [48] This speaks of precision strike capabilities, capacity for rapid response and effective battlefield combat identification to minimize the possibility of fratricide and collateral damage. Network enablement allows for the establishment and sharing of a Common Operating Picture which in turn increases the overall effectiveness of a force, providing commanders "a greatly enhanced decision making environment." [49]

The target state of *Information Superiority and Support* presupposes effective and uninterrupted connectivity that links the sensors, decision makers and engagement systems. The Australian Defence Force is aiming for "seamless interfaces between fixed and deployed domains" both internally as was as with her allies. Information Superiority and Support allows for better situational awareness, the ability for decisive action, and

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[47] *Ibid*.

[48] *Ibid*.

[49] *Ibid*.

efficient collection, tasking, processing and analysis, and dissemination if information and intelligence. This would all occur within a robust and secure architecture that is resistant to outside attack and influences.[50]

A benefit of network enablement is the support it provides to *Command and Control*. Net-enablement allows commanders to become and remain informed so that they can provide direction and guidance to subordinates and updates to superiors. It promotes the integration of decision-support tools which are "an integral and trusted element of the decision-making ability of commanders and their staff." [51] These tools create an environment that promotes rapid and effective decision-making. Australia believes network enablement facilitates the development of trust and improves command relationships.

A force incapable of deploying is not of use to a nation with region responsibilities or aspirations. *Force Deployment* is about the "rapid and accurate identification, and the protected deployment, of an optimized force."[52] Under the target state of *Force Deployment* there is an aim to have deploying forces provided with "access to appropriate areas of the Common Operating Picture and the tactical information environment."[53] Network enabled deployments would be conducted with maximum efficiency, tactical awareness and minimum interference by adversaries. To meet this objective, individual services are expected to align their joint force capability development initiatives to achieve self-synchronising networks.

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[50] *Ibid*.

[51] *Ibid*., 9.

[52] *Ibid*.

[53] *Ibid*.

Force Protection is a priority for all militaries functioning in the contemporary operating environment conducting asymmetric operations. In 2020 the Australian Defence Force sees deployed forces, domestically and internationally, having full access to an overarching network of active and passive sensors that in turn contributes to a common operating picture. This degree of situational awareness will contribute to the ability to anticipate emerging threats and shield deployed forces from them. The network will also require protection from threats, both physical and virtual, in order to maintain the level of situational awareness required in theatres of operations today and into the future. The ability to deny an adversary's Information Operations campaign will be enhanced by network enablement through the acceleration of the decision-action cycle, in turn denying their adversaries the effect they seek to achieve.

In 2020, organizations responsible for *Force Generation and Operational Sustainment* will be supported by networks and connected to theatres of operations. This will provide connectivity and a collaborative ability with industry and coalition partners for such sustainment functions as repair and replenishment. This network will provide logistic commanders and their staff with complete visibility of the logistic system, providing information that will allow for rapid and effective prioritization of scarce resources required to sustain deployed forces. Those networked will be able to conduct automated ordering and replenishment of consumables as they are used. Network enablement permits effective reach back, minimizing forward deployed stocks and optimal use of extended sustainment systems.

The United States Army - A detailed look

It should come as no surprise that the United States Army digitization efforts are

leading much of the work done in this area. Beginning in the mid-nineties, following the collapse of the Soviet Union, the fall of the Berlin Wall and success in the First Gulf War, the United States Army began to contract the size of its Army. In order to compensate for this reduction in size there was a push to leverage information technology and modernize the force. The United States Army began to experiment with new brigade and divisional structures, developed new intelligence capabilities and integrated combat systems in order to build a force that could respond effectively to a range of emerging post-Cold War threats.

By the end of the decade, United States Army Chief of Staff, General Eric Shinseki envisioned a medium-weight 21st-century Army capable of deploying anywhere in the world in 96 hours. In developing this new medium-weight, wheeled force, he would simultaneously maintain the current Army structure and yet focus on aggressively designing a new, high-tech Army called "objective force."[54] Objective Force would be "more strategically responsive, be dominant at every point on the spectrum of military operations, more deployable, more agile, more versatile, more lethal, more survivable, and more sustainable" than the legacy Army.[55] Objective Force would field "formations that are affordable and capable of reversing the conditions of human suffering rapidly" but also still be capable of decisive combat.[56]

General Shinseki designated two such brigades to begin training at Ft. Lewis, Washington, using lightly armoured wheeled vehicles instead of the traditional heavier-tracked Bradley armoured personnel carriers. Named after the United States designation

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[54] United States Army, *United States Army White Paper: Concepts for the Objective Force*, 9.

[55] *Ibid*., 8.

[56] *Ibid*.

for this family of light armoured vehicles, these brigades would be dubbed Stryker Brigade Combat Teams. Later, in 2001, with the election of George W. Bush, Donald Rumsfeld was appointed Secretary of Defence, and he reinforced General Shinseki's view espousing "a smaller, nimbler, and more networked military that could respond swiftly to threats anywhere in the world."[57] Network enablement began to take on a central theme in the United States Army's Modernization.

In April 2003 The Department of Defence issued its Transformation Planning Guidance that provided clear direction on how the United States Military would transform from a platform-centric to a more network-centric force.[58] Rumsfeld directed each of the Service Chiefs of Staff to design and produce their own "transformation roadmaps to achieve transformational capabilities" in support of the Department's initiatives.[59]

In the *Objective Force White Paper*, The United States Army acknowledged that there are two enablers to transformation: human and technological. It recognized that technology is not the end all solution, but it is in the integration of the human capital and technology, as well as what the United States Army calls DTLOMS,[60] that transformation to the Objective Force had the means to succeed.[61]

When the United States Army issued its first Transformation Roadmap it laid out

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[57] Michael Kirk, "Rumsfeld's War", *Frontline*, PBS transcript, http://www.pbs.org/wgbh/pages/frontline/shows/pentagon/view/; Internet; accessed 13 March 2008.

[58] United States Department of Defence, *Transformation Planning Guidance*, (Washington: Defence Printing Services, 2004), 9.

[59] *Ibid*., 13.

[60] Similar to the Canadian PRICIE, or Personnel, Research and Development, Infrastructure, Concepts, Information Technology and Environment, DTLOMS stands for Doctrine, Training, Leader Development, Organizations, Material and Soldiers.

[61] United States Army, *United States Army White Paper: Concepts for the Objective Force*, 15.

its intent on how it would support the Department's transformational goals. This roadmap described a deliberate and phased approach that would allow for capabilities to be developed over time. Using planning horizons of near, mid and far, it established priorities for change. In the near term the Army would focus on completing the fielding of their medium weight Stryker Brigade Combat Teams but would continue to digitize the Legacy Force. Design of the Objective Force would continue. In the midterm they would complete the fielding of Stryker Brigade Combat Teams and the digitization of the Legacy Force, and begin fielding their Objective Force. In the far term the United States Army would continue to field their Objective Force, while continuing to develop future requirements and capabilities.[62] Much as the CF does, the United States Army sees Transformation as a continuous process.[63]

The United States Army hoped to create a "culture of innovation". By encouraging critical and original thought, from both the top down and from the bottom up, there was hope that an "outside of the box" thinking culture could be developed. Through the revamping of the United States Military Academy at West Point, the Army War College at Carlisle and the Army Command and General Staff College at Leavenworth, United States Army senior commanders hoped to promote "a synergy in which leaders at all levels emphasize the need for innovation and foster it within their organizations."[64]

The Army would seek to leverage experimentation and simulation, primarily through Training and Doctrine Command and the Army Experimentation Center, to

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[62] These horizons are also referred to as Legacy Force, Interim Force and Objective Force.

[63] United States Army, *2002 Transformation Roadmap*, vii.

[64] *Ibid*., 11.

further inform the transformational process. Analysis, modelling and simulation would be used to "observe issues at system, unit, and force levels across the spectrum of operations from peacekeeping to major regional conflict."[65] Each of these processes would help in the development of such fundamentally important projects as Stryker (Interim Armored Vehicle), Stryker Brigade, Future Combat Systems, and the Objective Force.

The multi-billion dollar project called "Land Warrior" is another of the United States Army's primary means of delivering the Objective Force. The Army's 2002 Transformation Roadmap saw Land Warrior "making every soldier a sensor, shooter, and assessor for the full range of Joint Fires",[66] a concept similar to the Canadian Army's Integrated Soldier System Project (ISSP), which will deliver similar capabilities to the Canadian soldier. Both the Land Warrior and the ISSP will be described in more detail later in this paper.

In 2003 and 2004 the United States Army continued to build upon its plan established in 2002, focusing on the institutional changes to the Army's leadership culture using the learning establishments at West Point, Leavenworth and Carlisle. Articulation was made with respect to the complications that arose with the invasion of Iraq, creating tension between their Legacy Force and Objective Force by creating stress across the force generation base. The United States Army realized and acknowledged that it could not transform with the operational tempo they were experiencing, identifying

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[65] *Ibid*., 12.

[66] *Ibid*., 24.

a "transition zone" in their transformation continuum.[67]

The United States Army continued to recognize that the human dimension was central to the transformational process. Human resource policies, practices and systems would need to be reviewed and synchronized for "military, civilian, contractor, joint and multinational forces to provide the Joint Force with the right individuals and units, at the right place, and at the right time."[68] The human dimension was seen as the critical path that would allow for the achievement of such initiatives as Objective Force while still maintaining the Legacy Force.

[67] United States Army, *2003 Transformation Roadmap*, 1-6.
[68] *Ibid*., 8-1.

Chapter 1, Part 5

The Conceptual Hurdles Still to Overcome

From technological challenges to policy issues, there are many steps to be taken before the Canadian Army could complete a transformational process such as has been suggested in *Land Operations 2021*. Developing standards or doctrine, changing institutional cultures, or simply overcoming the misconceptions people hold will take command vision and determination.

For example, only recently with the creation of the Chief of Force Development could communications standardization for the CF become a goal. With network enablement there will be significant challenges created with the expansion of the number and nature of the systems used in the CF and Canadian Army. As Peter Gizewski points out in his paper called *Toward a Network-Enabled Land Force: Problems and Prospects*, "the establishment of data standards, procedures ensuring greater interoperability of networks, and the standardization of processes for information handling from sensors and information to decision-makers and effectors would all be essential." He points out that information management, including movement and storage, requires legal and procedural revisions. Agreements on the sharing of information, both what and how, will have to be considered and established. Education and training would have to be reviewed and revised for Army communicators and communications officers. This not only to deal with the technological changes being faced, but also with information sharing between organizations, both internal and external to the CF, Department of National Defence and Canadian Government.

Doctrinally, the Canadian Army promotes Mission Command. While it has been

pointed out that this style of command philosophy is central to the success of NCW, this does not mean that doctrinal review and further development need not take place. Many opponents to moving too quickly are quick to point out that teaching our leaders how to operate in an imperfect information environment must continue and, therefore, that doctrine to support that must continue to exist.[69]

Notwithstanding Canada's Army being well positioned doctrinally to exploit NEOps, further development must continue. Gizewski points out that the NEOps concept "could involve the development of doctrinal and organizational concepts and command doctrines better suited to exploiting the potential that a physically networked force could provide."[70] He maintains, as do many Canadian Commanders, [71] that such institutional changes as shifting from a need to know" to "a willingness to share" culture would need to occur for NEOps to work as it is envisioned. Commanders and staff at all levels are going to have to learn to leverage the network, which will likely lead to "flattening", or a less hierarchical network. This would be a major change for traditional armies like Canada's. It would call for more indirect leadership, and demand greater interoperability between arms, services, departments and organizations. And this is only what can be anticipated. What of the unforeseen? What demands will be placed upon the organization that have not been predicted?

Gizewski sees the "economic, technological, institutional and cultural challenges

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[69] Richard E. Hayes, "Network Centric Operations Today: Between the Promise and the Practice", *RUSI Defence Systems* (Summer 2004), 83 and Gizewski, *Toward a Network-Enabled Land Force…*, 7.

[70] Gizewski, *Toward a Network-Enabled Land Force…,* 7.

[71] See Chapter II, Part 3, ***Canadian Operational Commanders' views and experiences***.

involved in bringing about such changes" as significant.[72] Even in an Army the size of Canada's, to network a force involves assigning nodes to each element requiring a connection to the network. This in some cases could mean each individual soldier. For instance, to establish a friendly force disposition, [73] each soldier and vehicle would need a global positioning system and transmitter. While this would no doubt decrease the chance of fratricide, it would be extremely expensive. It would require a robust and stable network and would face such issues as compatibility between systems, bandwidth and protocols between users and systems alike. The technological, institutional and cultural barriers may prove too much for a small army given today's technological and financial limitations.

Technology and money are but two limiters to realising a network enabled force. Even if technological and informational superiority were achieved, and situational awareness was improved, there remains the counterpoint to each of these advantages. These include such possibilities as "information overload, inappropriate information sharing and chronic micro-management."[74] Each of these in turn could easily lead to rendering the advantages moot, or worse, reversing whatever advantages may have been realized for "widespread confusion, gridlock and frustration."[75] Furthermore, there are the technological vulnerabilities a network force faces. A resourceful adversary can target networks directly or indirectly, by attacking nodes and relays or through cyber attack using viruses, corrupting data or denying friendly force access. Networked forces

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[72] Gizewski, *Toward a Network-Enabled Land Force…*, 7.

[73] Like Blue Force Tracker or Blue Positional Awareness (PA) systems.

[74] Gizewski, *Toward a Network-Enabled Land Force…*, 8.

[75] *Ibid*.

open themselves up to exploitation by an intelligent and cunning adversary who would use the network "as a gateway to spread disinformation and chaos." [76] In any case, the results of an effective strike against a network could be disastrous for any military force conducting operations.[77]

With all of these concerns then, why should a military pursue such programmes as network enablement? If the advantages are unproven and unclear, and the disadvantages and hurdles obvious, why should a military invest such a sizable portion of the limited resources it has in establishing a network enabled force? Despite that the Army accepted that it will face an adaptable foe, [78] there has been little consideration for that adversary's ability to adapt to new and emerging technologies. It is precisely because of the fact that low-technology solutions are having success against high-technology forces, that the belief that "technology is the solution" to a military's problems ought to be questioned.

Low tech forces have been instrumental in modern military successes. As Gizewski points out, "it took boots on the ground to capture Saddam Hussein in Iraq, the Northern alliance played a role in the Taliban's collapse that was equal *if not more* significant than US strike operations and the use of considerable airpower in Kosovo *could not* destroy the Serb Army."[79]

If technology is not the solution to all of our problems, why proceed toward network-enablement? If NEOps does actually facilitate military operations, what is the path to implementing such an initiative? What are the implications of implementation?

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[76] *Ibid*.

[77] *Ibid*.

[78] As the Canadian Army articulates in *Land Operations 2021: Adaptive Dispersed Operations, the Force Employment Concept for Canada's Army of Tomorrow.*

[79] Gizewski, *Toward a Network-Enabled Land Force… ,* 8.

How does the Canadian Army set itself up for success in a network centric world? The answer lies in the human dimension.

Chapter II - The Roadmap for Canadian Network Enabled Operations

Chapter II, Part 1

Concept Development, the evolution of the idea

Crisis in Zefra - "Science Fact"?

> *At the same time as a warning indicator flashed across his Head Mounted Display, Sergeant Campbell heard a voice, "Patrol, be advised that the threat assessment has increased to level three." The voice wasn't Warrant Officer Desai's, but that of a Command computer located at Canadian Task Force Zefra Headquarters. The same message would be flashing out to every other patrol simultaneously.*[80]

To many the above quote falls neatly into the category of science fiction. *Crisis in Zefra* is science fiction, in a sense. It was written by a fiction writer, is set in the year 2020 and explores the use of high technology; much like Star Trek did in the mid-sixties. But the difference is that all of the technology used in *Crisis in Zefra* was already conceived or in design when the book was written in 2005. In fact, whenever a piece of technology or innovation was mentioned, it contained a link to the website where readers could find out more information.

When the Army's Directorate of Land Strategic Concepts developed the idea for *Crisis in Zefra* they saw it as a tool to launch debate and discussion over what the future operating environment might look like. It was designed to consider how technology might impact on the business of warfighting in the not-so-distant future. Readers could consider alternate organizational models, how tactics would develop to leverage technological advances and how a network enabled communications architecture might change the way tactical operations were controlled and executed in a complex operating environment.

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[80] Karl Schroeder, *Crisis in Zefra* (Kingston: Department of National Defence, 2005), 17.

The opening paragraph quoted above suggests in a simple word picture that soldiers could be controlled by a commander well removed from the immediate stresses of combat, that all members of the team would have real time shared situational awareness and that this shared awareness would be distributed rapidly using visual interfaces over a network. NCW enables many of these concepts.

Crisis in Zefra proved to be a useful document to underpin the development of other Army conceptual models. It envisioned dispersed operations with sections operating independently, separated by time and space from the remainder of their platoon. It foresaw sections splitting and reforming in order to meet the needs of the mission; in today's terminology: aggregating and dispersing.[81] To coordinate these disparate operations, a network would be established in order to provide these sections with a common operating picture which would allow for them to more effectively meet the commander's intent.

Land Operations 2021: Adaptive Dispersed Operations

Crisis in Zefra was followed in 2007 by *Land Operations 2021: Adaptive Dispersed Operations, the Force Employment Concept for Canada's Army of Tomorrow.* This new force employment concept recognized that a "key enabler for dispersed operations is the networking of the soldier and junior combat leader."[82] It went on to acknowledge that the Army's ISSP is expected to deliver a "progressively enhanced, integrated soldier system, which will significantly enhance the ability of the Land Force

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[81] Department of National Defence, *Land Operations 2021: Adaptive Dispersed Operations, the Force Employment Concept for Canada's Army of Tomorrow* (Kingston: Directorate of Land Concepts and Design, 2007), 16.

[82] *Ibid*., 22.

to conduct adaptive dispersed operations."[83] The operating environment described in *Land Operations 2021* is very similar to the one described in *Crisis in Zefra*.

According to *Land Operations 2021*, the effective operation of a network-enabled force rests on four basic tenets. These are depicted in figure 2-1 and effectively represent the premise that an overarching network will improve the sharing of information, that the sharing of information will improve its quality as well as the force's situational awareness, that better situational awareness will allow for self synchronization and better sustainability and decision making, and that these will increase mission effectiveness.

Land Operations 2021 concludes that once effectively implemented, network-

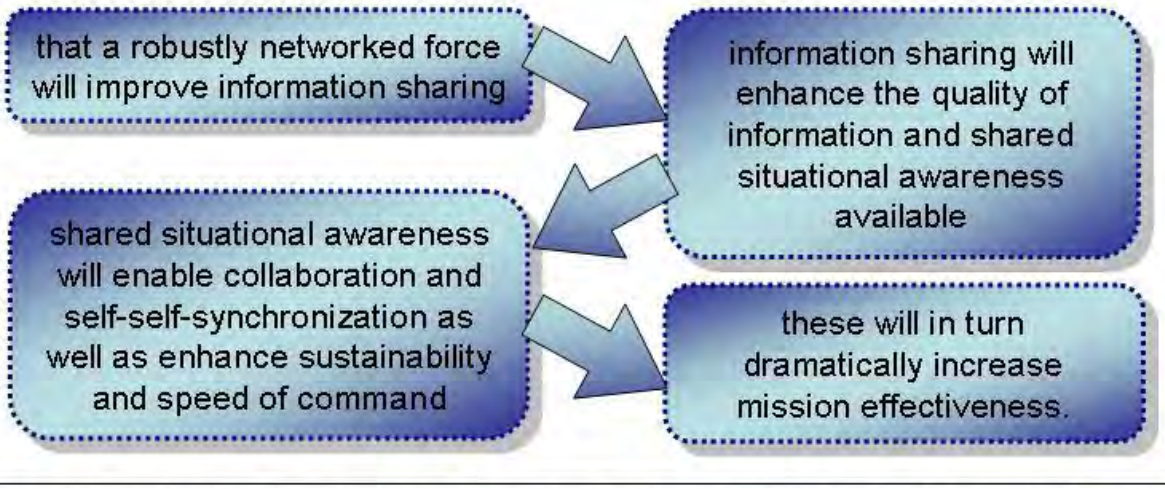

Figure 2-1. The four basic tenets that lead to an effective network-enabled force. Source: Department of National Defence, *Land Operations 2021 : Adaptive Dispersed Operations, the Force Employment Concept for Canada's Army of Tomorrow* (Kingston: Directorate of Land Concepts and Design, 2007) 23.

enabled operations will consist of networked forces supported by joint sensors, fires, and C4ISR systems linked to create a heightened plane of situational awareness, tactical and operational mobility, and access to fires that will in turn contribute to the overpowering of the enemy's decision action cycle and neutralize his ability to react. Results achieved in the battlespace will be better coordinated, there will be more rapid command, and the

[83] *Ibid*.

lethality, survivability and responsiveness of forces will be enhanced. The consequence will be an ability to conduct a more precise, responsive style of manoeuvre operations in which land forces will be able to engage in near continuous action. Land forces will possess increased capacity to more effectively and efficiently defeat their adversaries, but also enhanced capability to engage in actions that can break an adversary's will to fight whilst leaving the majority of his forces intact, the ultimate in manoeuvre warfare. [84]

Land Operations 2021 reflects the idea that a network-enabled land force will be supported by a mission command philosophy allowing for decentralized decision making. Network enablement will permit better command and control practices and procedures. It accepts that there will have to be changes in selection standards, and changes to the conduct of education and training to better reflect NEOps related skills and requirements. It reinforced the notion that the sharing and management of intelligence, data and information will have to move from a "need to know" to a "willingness to share" culture.[85]

In order to realize this idea, the Army initiated a project called the ISSP. The ISSP is a $330 Million[86] omnibus project managed by the Army's Directorate of Land Requirements that includes amongst other things personal protective equipment, communications equipment and other enabling technologies to provide soldiers with an enhanced ability to conduct operations in an evolving, uncertain and chaotic

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[84] *Ibid*.

[85] *Ibid*., 23.

[86] Department of National Defence, *Integrated Soldier System Project Chief of Land Staff Programme Review Board Synopsis Sheet* (CLS PMB SS) 5 March 2008, 1.

environment.[87] It aims to provide better command and control capability, superior protection against blast and small arms, and improved common access to information and situational awareness. It is designed to improve "lethality, command, control and communications, survivability, sustainability and mobility" for the soldier.[88]

The ISSP's roots are planted in the successful Clothe the Soldier Programme that was initiated in 1996. The ISSP has adopted the legacy projects from Clothe the Soldier and added others to them, taking a holistic view of individual soldier needs in the contemporary operating environment. The ISSP will be further explored later in this chapter.

Land Operations 2021 recognizes the impact that the contemporary operating environment and the emerging technology will have on soldiers. It surmises that in order "to meet the demands of full spectrum engagement, the Land Force will produce a soldier with a broader body of knowledge and skills."[89] In the Adaptive Dispersed Operations construct, as the face of a mission, soldiers will act as diplomats with local leaders, teachers with foreign militaries and assist in developing the functions of government as we see today with the Strategic Advisory Team in Kabul. While the Army does not want to take a leadership role in all three elements of the "3D Approach", certainly during transition operations this paradigm is likely to persist. Adaptive Dispersed Operations will demand local decision making, placing more responsibility on the junior leadership of our Army's soldiers.

Crisis in Zefra represents this challenge when a section is faced with the reality of

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[87] Department of National Defence, *Land Operations 2021…*, 23.

[88] *Ibid*., 24.

[89] *Ibid*.

conducting full spectrum operations within minutes of each other, in only a small part of the sector they've been assigned. In Chapter 2 of the story, they are faced with a direct asymmetric attack, gathering hostile mobs and coordinating the delivery of aid at an aid station that has also just been attacked. High technology is used throughout this scenario, both by the Canadian section as well as the insurgents. Some of this technology is in use today in Afghanistan; more of it will be delivered by the ISSP. We as an Army need to understand how best to employ this technology, what the limitations of the technology are and what the impact of this technology will be on our soldiers.

Chapter II, Part 2

From Ideas to Implementation

Past Experiences - The "Multi-Mission Effects Vehicle"[90]

In October of 2003, then Commander of the Canadian Army, Lieutenant-General Rick Hillier gave a press conference where he laid out the process that would see the Army transform into one that would be able to "punch well above its weight no matter what missions we ask it to do."[91] At the time, like the United States Army, Hillier foresaw converting a good portion of his heavier armoured vehicles to more a strategically mobile Light Armour Vehicle (LAV) based fleet. He would also take steps to centralize the direct fire capabilities under a single command with the Lord Strathcona Horse (Royal Canadians), nicknamed the "Direct Fire Unit."

The Direct Fire Unit would consist of a system of systems, fight together and embody the military principle of mutual support. Conceptually it was closely linked to Defence Research and Development Canada's Future Armoured Vehicle Systems which was designed to help overcome the challenge of making future armoured fighting vehicles more survivable and lethal on the battlefield.[92] The Future Armoured Vehicle Systems project was also forward looking in terms of technology integration to leverage innovative ideas and emerging capabilities into the LAV III platform. Amongst other things, it would look at automatic target recognition, target processing and adaptive

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[90] Much of this segment is based upon the author's personal experience working as a desk officer in the Directorate of Land Force Development.

[91] Lieutenant-General R.J. Hillier, "Commander speaks about Army Transformation", delivered at a press conference 29 October 2003, http://www.forces.gc.ca/site/newsroom/view_news_e.asp?id=1239 Internet; Accessed 17 March 2008.

[92] Defence Research and Development Canada, "Future Armoured Vehicle Systems Website", http://www.drdc-rddc.gc.ca/researchtech/afvt/favs_e.asp; Internet; Accessed 18 March 2008.

camouflage. The Future Armoured Vehicle Systems project also envisioned the possibility of a "vehicle concept with the capability to fight in direct, indirect, and air-defence roles."[93] Enter the Multi-Mission Effects Vehicle.

In Hillier's vision, the Strathconas would take over stewardship of the direct fire capability and convert its Leopard tanks to a LAV-based mobile gun system (MGS), assume the Infantry Corps' LAV TOW Under Armour (TUA) role and adopt the Air Defence Anti-Tank (ADATs) capability which would also be retooled to be LAV-based. The ADATs function would also take on a more direct fire role, with the anti-tank role becoming their focus. This member of a new "world class, battle winning direct fire system"[94] would be known as the Multi-Mission Effects Vehicle.

With Oerlikon Contraves[95] as the designer, the Multi-Mission Effects Vehicle would take a LAV III chassis and add to it the existing turret from the ADATs, and install an improved 3-dimensional RADAR with extended range. It would be able to provide long range direct fire, air defence coverage and precise beyond line of sight indirect fire. The Multi-Mission Effects Vehicle would provide some balance for the loss of firepower with the retiring of the Leopard tank, and be part of a "system of systems", fully integrated with the MGS and LAV TUA. Critics panned the idea as pushing economies of effort too far, in effect trying to build an all singing all dancing system, that would do no one thing well. Proponents argued that in the contemporary operating environment, precision and flexibility were key to mission success.

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[93] *Ibid*.

[94] Hillier, "Commander speaks about Army Transformation"

[95] Oerlikon owned the technology behind ADATs and was therefore selected as the contracted party to develop the Multi-Mission Effects Vehicle.

In September of 2005 the Minister of National Defence announced that the CF would move forward with a plan to "design, develop, and deliver 33 Multi-Mission Effects Vehicles"[96] allocating up to $750 Million to the project. Oerlikon Contraves was given a contract for $100 Million in order to design and develop the system. Touting it to lead to an "increase [in] our efficiency, interoperability and deployability", now CDS General Hiller continued to push the Multi-Mission Effects Vehicle as a "significant step forward in Army Transformation."[97]

The concept behind the Multi-Mission Effects Vehicle was that it would at once provide long-range direct fire, air defence coverage and beyond line of sight precision indirect fire. All of this would come from a single platform, generally as part of a pairing or foursome of Multi-Mission Effects Vehicles. With the addition of a troop of MGS and a section of LAV TUA, this pairing would in turn be part of a direct fire team. All of this sounded wonderful. Could the Multi-Mission Effects Vehicle deliver what was promised? As will be demonstrated below, the answer was "no."

There are four steps and several elements that make up the Canadian Army's Capability Development Process. The steps of Conceive, Design, Build and Manage are done by different directorates within the Land Staff, through collaboration with other supporting Land Staff directorates and other Army and CF organizations. This collaborative approach is designed to make sure that all elements of a capability are considered and addressed prior to delivering it to the Army. The Army uses the PRICIE construct, which provides a framework to consider the implications with respect to

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[96] Bill Graham, Minister of National Defence, "Army to Acquire New Multi-Mission Vehicle", delivered at a press conference 22 September 2005, http://www.forces.gc.ca/site/Newsroom/view_news_e.asp?id=1766; Internet; Accessed 19 March 2008.

[97] *Ibid*.

Personnel, Research and Development, Infrastructure, Concepts, Information Management and Technology and Environment. Each of these headings is further broken down into discrete elements like leadership and individual training, selection and production capacity of the individual training system under the heading "Personnel." "Concepts" includes such ideas as Doctrine and Personnel Concepts.

At each step of the process, analysts charged with moving the capability forward are expected to consider each of their elements, and begin to, or complete, the development of solutions to any problems that arise along the way. In the case of Multi-Mission Effects Vehicle, the Capability Development Process was short circuited; it was an idea that was being implemented without the benefit of analysis. That is until after announcements had been made, plans had been written and expectations had been created.

There were two factors that ultimately led to the end of the Multi-Mission Effects Vehicle project; one was technological, the other was human. The technological hurdle that was unable to be overcome had to do with fusing new and old technologies. There were simply too many roadblocks in linking the ADATs fire control and target acquisition systems to the new technologies that were necessary for ADATs to become a Multi-Mission Effects Vehicle.

The human hurdle was even more challenging and was ultimately the basis for the recommendation to discontinue the project. Land Personnel Concepts and Policy is the name of the section within the Land Staff that looks at the impact of new capabilities on people. It consists of a number of Military Psychologists who look at the impact of change on occupational groupings, standards for recruitment, professional competencies

and organization. It was this section that began to raise flags with respect to the Multi-Mission Effects Vehicle project. They had two key concerns with the concept from a human dynamic perspective. The first concern was command and control, the second was operator capacity.

Command and control of the direct fire team was seen to be a simple extension of the model used for other combined arms groupings. In the case of a combat team, one of the manoeuvre sub-units' commanders is designated as the combat team commander. He is then responsible for formulating plans and commanding the group on operations. He would be able to place himself in a position to influence the actions of the combat team, maintain situational awareness and pass information up and down his chain of command.

In the case of the direct fire team, and in particular the Multi-Mission Effects Vehicle troop, the troop commander was responsible to command his own vehicle, command the troop and maintain sufficient situational awareness to coordinate and engage targets along three planes: long range direct (eg. a tank); in the air (eg. an aircraft); and long range indirect (eg. a hard, fixed target). Land Personnel Concepts and Policy analysts providing input to the Capability Development Process determined that given the technological[98] and physical[99] limitations of the vehicle, this was not going to work.

More complicated than commanding the troop was the role of fire control system operator. Being a gunner for a simpler engagement system like a LAV III is still a full time job. Qualification on the weapon system takes many weeks. Continuation training

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[98] For the vehicle to track and engage targets along three planes meant that a complex fire control and target acquisition system would have to be purpose built.

[99] Primarily visibility for the crew commander and communications network limitations.

takes several hours a week. The gunner is a member of a crew and helps perform routine maintenance on the vehicle. The gunner is also a soldier who has to maintain core trade skills and competencies. This all takes time.

Multi-Mission Effects Vehicle Gunners have all of these responsibilities plus being an Air Defence gunner, which takes considerably more time in maintaining skill-sets. Air Defence Gunners are expected to spend hours every week in simulation, maintaining their engagement and tracking skills and refreshing their target recognition skills. They are responsible for the basic maintenance of a far more complex weapons system and communications system.

In addition to all of the crew and Air Defence Gunner skills described above, Multi-Mission Effects Vehicle gunners would now be responsible for developing and maintaining new skills for long range direct fire engagements and long range indirect fire engagements of fixed targets. While operating, they would be responsible for maintaining sufficient situational awareness to be able to accurately track and engage targets along all three planes. Following significant consideration and thought, it was the conclusion of the Land Personnel Concepts and Policy section that this was simply too much for one soldier to perform.

But this conclusion came after the announcements, organizational changes and promises to industry. If the analysts had been given the opportunity to consider the consequences of the ideas presented in 2003, this might have been avoided.

Given this experience, how would the Army proceed with the implementation of NEOps?

Chapter II, Part 3

Operational Commanders' Experiences

There exists a significant lack of documented information and informed operational experiences on the subject of NEOps in a Canadian context. Recently some steps have been taken in an attempt to capture some senior Canadian leaders' opinions on NEOps, and what it means to the CF. One such recent attempt was *NEOps: The Experiences of Senior Canadian Commanders* by retired Brigadier-General Joe Sharpe and Doctor Allan English.[100]

Sharpe and English leveraged a range of CF senior officers' experiences in such roles as Deputy Commanding General of the Multi-National Corps Iraq, Naval Task Group Commander in the Persian Gulf during Operation APOLLO[101] and Chief of Staff of Joint Task Force South-West Asia during Operation APOLLO (Tampa).[102] The officers interviewed ranged from a Lieutenant-Colonel to a Major-General at the time of their operational experiences. Those still serving now occupy positions to influence the way ahead for the CF as they pursue network-enablement. Their experiences and their perceptions of the advantages and disadvantages of NEOps will guide the path taken and set the pace for its implementation.

The subjects of the interviews were asked to share their experiences as deployed commanders, and in particular their lessons learned as a result. The conclusions fall into

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[100] BGen Joe Sharpe and Dr Allan English, *Network Enabled Operations: The Experiences of Senior Canadian Commanders*, a report prepared by KMG Associates for Defence Research and Development Canada (Toronto: DRDC, 2006).

[101] Op APOLLO was the Canadian contribution to the campaign against international terrorism immediately following 9/11.

[102] Tampa is the location of US Central Command (USCENTCOM) the Combatant Command for operations in South West Asia.

eight broad categories, including how we rationalise the need for and use of human and technological networks, how NEOps may encourage micromanagement from the chain of command, and how partnering with allies is affected by differing technological capability. The findings are reassuring to those who believe NEOps might negatively affect the way the CF operates. Many of their conclusions and remarks fall within the human dimension of operations.

Human versus Technological Networks

All of those interviewed shared the common understanding that "command is a face-to-face matter," and in order to create a common goal and establish trust, it was necessary for commanders to invest time in getting to know the members of the Task Group, Battle Group or Wing.[103] It was also agreed that the ideal time to do this is prior to deployment.[104] In Rear-Admiral Rouleau's presentation to the Canadian Forces College's Joint Command and Staff Programme in 2008 on Operational Command of Maritime Forces he spoke of his practice of personally welcoming new ships to the NATO Reaction Force, regardless of when they joined; at port or at sea.[105] Other methods he and others used to facilitate the establishment of trust and a team spirit were through the embedding of liaison officers.[106] This personal relationship is seen as an extension of that with the Commander and allowed subordinate commanders to make informed decisions.

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[103] Sharpe and English, *Network Enabled Operations: The Experiences of Senior Canadian Commanders…,*19.

[104] *Ibid*., 24.

[105] 21 February, 2008.

[106] Sharpe and English, *Network Enabled Operations: The Experiences of Senior Canadian Commanders…,*19.

It would probably come as a relief to most members of the CF that all of the officers interviewed believed that this personal relationship, this human network, should not be displaced by technology, but that the technological network should "enable the human network."[107] This position was reinforced by Brigadier-General Tabbernor's experiences in Afghanistan where in his opinion the human interface was vital, as there simply was no communications infrastructure to allow for interaction otherwise. He concluded that to not continue to develop that face-to-face human interaction - that social human network skill within our soldiers - meant they would be ineffective in the field on such operations as we face with Op APOLLO.[108]

This opinion was shared by all services. Rear-Admiral Girouard underlined the importance of developing the human network, because it was from this network that relationships formed, and because it was this relationship upon which trust was formed and it was trust that "is the foundation for putting technology to work."[109] The establishment and maintenance of trust was a common thread through much of Sharpe's report.

Micromanagement by the Chain of Command

There is a strong belief that network enablement will allow the operational and even strategic chain of command the ability to see, and therefore reach down to the tactical level. This is sometimes described as the "5,000 mile screwdriver." Stories, true or not, of the President of the United States demanding a live Predator feed during relief operations following hurricane Katrina in New Orleans directly to his desk make any

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[107] *Ibid*., 22.

[108] *Ibid*., 9.

[109] *Ibid*.

military commander cringe with the possibility. The superimposition of networks allows for a flattening affect; it allows commanders to see and potentially influence tactical operations. But because the CF espouses Mission Command this belief was not a concern to those interviewed.

Lieutenant-General Walt Natynczyk, who experienced firsthand the use of the United States' highly developed command and control network on operations in Iraq, found that "commanders could resist the temptation to interfere inappropriately because the information provided by the technical network enabled them to monitor subordinates' action to ensure that commander's intent was being realized."[110] The Sharpe/English paper even suggested that because subordinate commanders were no longer being peppered with demands for updates and details that their higher headquarters was able to receive visually, they were more free to conduct their operation unimpeded.[111]

As technology allows for better situational awareness amongst senior level commanders and their staff, the temptation to move away from the mission command philosophy has the potential to increase. According to Sharpe a way to control this possibility is "to understand the relationships among a commander's authority, responsibility, and accountability."[112] They conclude this is best done early in an officer's career through effective education.

Partnering with allies with different capabilities

For better or for worse, when deployed the CF will almost certainly be operating within a coalition. Some of our coalition allies do not possess the technology that we do.

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[110] *Ibid*., 23.

[111] *Ibid*.

[112] *Ibid*.

In the cases of the United States and United Kingdom, they possess better technology than do we; technology that may not be able to talk to us, or to some of our more technologically disadvantaged partners. It has been the experience of those interviewed that while leveraging technology has facilitated interaction amongst those allies in possession of the technology, it has proven burdensome in addressing the technology gap amongst those who are not. On operations in Bosnia, Afghanistan and the Gulf of Arabia, Canada has had to overcome this gap with NATO and non-NATO partners as well as with Non-Governmental Organizations. Major-General Devlin recalls sending Canadian signallers to coalition partners in Afghanistan in order to "provide better connectivity to the network than these partners could achieve on their own."[113] Non-Governmental Organizations and Other Government Departments added an additional challenge to operations in that they did not have "networked systems that could match the technical capabilities of Canadian Forces systems; therefore, human networks were critical to making integrated operations work."[114]

Rear-Admiral Girouard also underlines the importance of making certain that all elements of the team are kept abreast of the situation and are included in the transmission of orders, situational awareness data and updates. He stressed that while it poses as a key challenge to the leadership of a Task Group, he links this vital element of information sharing directly back to the development and maintenance of trust.[115] This question of trust is not only to those at a disadvantage technologically, but those providing the information being passed. While there are several ways to overcome differences in

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[113] *Ibid*., 14.

[114] *Ibid*.

[115] *Ibid*., 15.

capability, Girouard proposes that the most effective way is through effective leadership.

Technology can also play a role in assisting a Task Group Commander in achieving cohesion. Canadian destroyers can, and soon frigates will be able to, provide a gateway service by receiving information using Link 16 or Link 11[116] via satellite, and then retransmitting, or acting as a gateway to the rest of the NATO world via Ultra High Frequency or High Frequency radio link enabling full access to the Task Group. By retaining some legacy systems, Canadian ships are ideally suited to be in a position to foster cohesion and trust within the Task Group.

Sharing of information, and in particular intelligence, remains a sensitive issue. Canada values its position as a member of the "4 Eyes" community, the integrated intelligence sharing amongst Canada, the United States, the United Kingdom and Australia. Sharing this intelligence to members outside the "4-Eyes" community may promote mission effectiveness, but may also risk losing membership status. Commanders operating today conducting combined and coalition operations need to find the point that "need to know" and "need to share" intersect.

This can prove to be especially difficult. "Being able to deliver that information in a timely fashion without violating the trust" due mainly to the nature of the source of the intelligence is the main challenge. Major-General Devlin again reinforced that "trust is built by working on relationships and by sorting out various procedures to ensure that all partners have the information they require to do their jobs within the limitations imposed by technology differences and access rules." As Major-General Devlin points

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[116] Link 11 is is a secure radio link used by NATO that receives or transmits using a digital link. Link 16 is a military inter-computer data exchange format used primarily by Air and Naval Forces within NATO. Land Forces are beginning to adopt this system for Air/Ground operations. Courtesy of wikipedia.com.

out, "it was "painful" to see how unwilling some nations were to share information, but that the human network could allow coalition partners to share necessary sensitive information."[117] He concluded that "if you're not in the know, from a command and control perspective, you become irrelevant."[118]

So what? What does all of this mean to the implementation of new technological solutions? It means that the fundamental elements of how militaries conduct their business remain valid today, as they have for centuries. It means that leadership continues to play a key role in finding the solution to complex issues. It means making sure that each member of the operation feels as though they have the ability to contribute meaningfully. And most importantly, it means we should continue to develop social skills in our people, so that they can interact with their coalition partners. For it is all about developing and leveraging relationships, and learning how to get the best out of people, and the human social network upon which we've relied for generations.

What Have We Learned From These Experiences?

It appears that proceeding with some caution is best. While there are many considerations that need to be made when developing a new capability, the Human Dimension needs to be closely considered in that development as well as when implementing a plan, particularly when it seems to be a technological "solution." Human beings have cognitive and physical limitations. It remains about personal relationships and the social network, first and foremost. Human relationships can bridge technological gaps, but the converse does not necessarily hold true. As the Canadian Army moves

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[117] Sharpe and English, *Network Enabled Operations: The Experiences of Senior Canadian Commanders…,*15.

[118] *Ibid*.

forward with the implementation of such projects as the ISSP, we will see that in fact the human dimension and human dynamics plays a central role in its development.

Chapter II, Part 4

Army Modernization - Where We Are in Development

Since the fall of the Berlin Wall and end of the Cold war, Armies have been under significant pressure to reduce their size and their draw on public funds. The "peace dividend" that came with these global changes led to such initiatives as the Force Reduction Programme in the CF, as well as what the present Chief of Defence Staff has dubbed the "decade of darkness". In contrast to the cuts in the maintenance budgets of vehicle and equipment fleets, the post 9/11 era has been a period of reinvestment and technological innovation. Certainly within Canada's Army and her close partners, Army Transformation and Modernization have been a priority.

The United States Army's Future Combat Systems and Land Warrior programmes and British Army's Future Integrated Soldier Technology project are very similar to the work being done by the Land Staff's Director of Land Requirements under the guise of the ISSP. This section will look at these four modernization projects.

Allied Efforts - The United States Army's Future Combat Systems

Three years ago, United States Secretary of Defence Donald Rumsfeld was visiting soldiers in Kuwait who were bound for Iraq. One soldier asked why their equipment was so inadequate. Rumsfeld's response was a thoughtful one, one that also reflected the position of Congress. He said "You go to war with the army you have, not the army you might want or wish to have at a later time."[119] While this answer may be true, from the point of view of the United States Army, any view that armies need not modernize in order to have success in battle, is inaccurate. Success in the First Gulf War

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[119] Mackenzie Eaglen and Oliver Horn, "Future Combat Systems: Dispelling Widespread Myths of the US Army's Primary Modernization Program", *The Heritage Foundation*; http://www.heritage.org/Press/Commentary/021208e.cfm; Internet; Accessed 23 March 2008.

and initial phases of the Second Gulf War will not necessarily translate into success in the contemporary operating environment. We've seen this in the past four years in Iraq.

Future Combat Systems is the United States Army's response to enable broad-based transformation and is seen as the primary modernization project for the United States Army. Its priority is reflected in the fact that it represents the only Army project amongst the top 15 of the Pentagon's priority weapons system projects; they have cancelled over 100 competing projects to secure that position.[120]

Future Combat Systems has encountered and been forced to overcome hurdles from within the Department as well as Congress. Misunderstanding about the need, its place in Army transformation, its relevance in the contemporary operating environment, the perceived option to refurbish present fleets instead of procuring new, and imagined or real cost overruns have all put Future Combat Systems at risk. But if Future Combat Systems is to become the centre piece for United States Army modernization, the Army is going to have to educate the decision makers on its merits.

In support of this endeavour is the American Military think tank The Heritage Foundation. In 2007 they published a backgrounder aimed squarely at Congress called "Future Combat Systems: A Congressional Guide to Army Modernization". Meant to be an educational as well as propaganda tool, it challenges Congress to consider the programme closely, and to understand the funding decisions it makes regarding its future. Notwithstanding the procedural hurdles faced by Future Combat Systems, the programme creates the foundation for significant change for the United States Army.

Many Canadian Army Officers might recognize the transformational steps being undertaken by the United States Army as they are very similar to the way its Army is

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[120] *Ibid*.

organized today. The United States Army is reorganizing from their bulky 10,000 to 20,000-man divisions to more agile, self sufficient, modular brigade combat teams[121] of around 4,000 soldiers. These brigade combat teams are designed to be more rapidly deployable and more flexible organizations that can perform a wider array of missions with little or no augmentation or reorganization.[122] These brigades have already demonstrated their usefulness by sustaining a high level of tempo and success on operations. Furthermore, these brigades are optimized to retain unit cohesion by rotating in and out of a theatre of operations in their entirety, reducing personnel issues for augmentees and maintaining a centre of mass for post-deployment support.

According to The Heritage Foundation's Backgrounder to Congress, Future Combat Systems constitutes the materiel backbone of a larger modular organization effort. This is because, unlike its sister services, the Army has little platform-to-platform interconnectivity between individual systems.[123] Future Combat Systems is designed, in part, to overcome this.

Future Combat Systems consists of over 300 different technologies, 600 different contracts, and 14 different systems or platforms.[124] The Army describes the programme as a "systems of systems"; others describe the transformation as more organizational. Because it includes a computer network, seven kinds of robots, and eight kinds of manned vehicles, others consider it more of "an updated brigade, built around a light-to-

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[121] Canadian Mechanized Brigade Groups are very similarly structured.

[122] *Mackenzie M. Eaglen and Oliver L. Horn, "*Future Combat Systems: A Congressional Guide to Army Modernization", *The Heritage Foundation*, December 11, 2007, 4. www.heritage.org/Research/NationalSecurity/bg2091.cfm; Internet; Accessed 23 March 2008.

[123] *Ibid*., 6.

[124] *Ibid*., 4.

medium-weight armored vehicle, which will be supported by many more computer networks, sensors, and robots than any current mechanized unit."[125]

Future Combat Systems is not the only modernization programme the Army is considering; there will also be a refurbishment and recapitalization of existing heavier fleets. But the room to manoeuvre on these fleets is limited by two key factors; protection and power.

In military circles, the 70-ton M1 Abrams is widely regarded as one of the best tanks in the world. In Iraq, tank battalion commanders tell about how Abrams tanks "took 45 hits from various weapons, including heavy machineguns, anti-aircraft guns, mortar rounds, and rocket-propelled grenades, with no penetration."[126] But this protection was largely centred on the front and bottom of the tank, protecting it from Soviet 215mm frontal shots and anti-tank mines. In the contemporary operating environment, vehicles are equally vulnerable from all sides making the Abrams ill-suited for close terrain counter insurgency operations. To complicate matters, the Abrams, like its smaller sibling the Bradley, is maxed out in terms of weight and "adding even more armor would begin to sacrifice mobility, transportability, and reliability."[127] Conversely, Colonel Charles Bush of the Army staff's Force Development Division sees the Future Combat Systems ideal weight range as "about 24 to 26 tons" because "at that weight, [he]

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[125] Sydney J. Freedberg Jr, "Future tanks could surprise critics", *National Journal,* 20 September 2006. http://www.govexec.com/dailyfed/092006nj1.htm; Internet; Accessed 23 March 2008.

[126] John Gordon IV, and Bruce R. Pirnie, ""Everybody Wanted Tanks" Heavy Forces in Operation Iraqi Freedom", *Joint Force Quarterly*, Issue 39, 85.

[127] Eaglen and Horn*, "*Future Combat Systems: A Congressional Guide to Army Modernization", 6.

can achieve most of [his] lethality, survivability, and deployability objectives."[128]

Power is the second limiter to the modernization of existing platforms. It should come as no surprise that a network enabled force will take more power than the legacy force would. With each platform accessing and informing the network, there will be a requirement for each node to connect and communicate with another through sensors and communications equipment. The present diesel engine in legacy vehicles produces only a portion of the electrical power needed to run the full Future Combat Systems network software. Meanwhile, the Future Combat Systems platforms will possess hybrid electric engines that will be able to generate enough power to operate future technologies and also export power as needed, effectively turning them into mobile battlefield power packs. Consequently, more than two-thirds of the network sensors in a Future Combat Systems brigade will be deployed on the platforms acquired.[129] Nonetheless, legacy vehicles will still be able to use the Future Combat Systems network. Abrams will be equipped with supplementary power units to power new computers, sensors, and communications equipment, but the size of the equipment and the space available will still prevent them from fully leveraging the technology behind Future Combat Systems.

Allied Efforts - The United States Army's Land Warrior Project

The Land Warrior project is an on-again off-again soldier systems programme that is very similar to the ISSP that the Canadian Army is pursuing. Suspended in 2007 due to funding challenges, its future at the time was in serious doubt. It was only as a

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[128] Sydney J. Freedberg Jr, "Future tanks could surprise critics", *National Journal,* 20 September 2006. http://www.govexec.com/dailyfed/092006nj1.htm; Internet; Accessed 23 March 2008.

[129] Association of the United States Army, "A Transformed and Modernized U.S. Army: A National Imperative", *Institute of Land Warfare*, 9 April, 2007. http://www.ausa.org/PDFdocs/TBSecRpt/TB_FCS_3Apr07.pdf; Internet; Accessed 23 March 2008.

direct result of field trial feedback, as well as success on an operational deployment, that the Senate Armed Services Committee recently allocated funds for fiscal year 2009 in order to revive the project.[130] The United States Army will leverage this newfound governmental support, dovetailing Land Warrior into the Future Combat Systems programme.

The Land Warrior system is designed to integrate previously separate components, or subsystems, such as individual protective equipment, communications systems, sensors and power supplies. This should enhance capabilities while minimizing the weight addition. These components will be "integrated into a system that makes the dismounted combat soldier lethal, survivable, and informed."[131]

Land Warrior includes a *Weapon Subsystem* that integrates weapon-mounted sensors such as Multi Function Laser, Daylight Video Sight and Thermal Weapon Sight and a voice communication system directly from the weapon. It has a *Computer Subsystem* that provides control of all system functions, including mission planning and execution functions, data message preparation and transmit/receive functions. Land Warrior incorporates a *Communication Net Radio Subsystem* that provides the soldier the ability to transmit and receive voice and data using a voice/data radio connected to the Tactical Internet. It also has a *Navigation Subsystem* that integrates both GPS and Dead Reckoning Devices to provide position location data to the soldier and a time reference to the system. Finally the *Helmet Subsystem* provides full-color display for the computer interface, and display of weapon-mounted sensor video as well as a speaker and

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[130] The US Army Land Warrior Program, *Defence Update*, http://www.defense-update.com/products/l/land_warrior_update07.htm; Internet; Accessed 24 March 2008.

[131] General Dynamics, *Information Pamphlet on Land Warrior*, www.gdc4s.com/landwarrior; Internet; Accessed 24 March 2008, 1.

microphone.[132]

The Land Warrior system operationally deployed to Iraq with the 4th Brigade Combat Team out of Fort Lewis, Washington, in 2007 and the feedback to date has been very positive. From Battalion Commanders to senior Non Commissioned Officers, the advantages of such a system are apparent and appreciated.[133] This operational feedback serves to help improve the Land Warrior system for final fielding.

Allied Efforts - The British Army's Future Integrated Soldier Technology

The aim of the British Army's Future Integrated Soldier Technology programme is "to provide an integrated fighting system in order to improve the operational effectiveness of individuals committed to dismounted close combat."[134] As does the Canadian Army's ISSP, the British Army's Future Integrated Soldier Technology programme addresses five areas. They are C4I, lethality (weapons and sights), mobility (navigation, size and weight of equipment), survivability (clothing, stealth, body armour) and sustainability (logistics).[135]

Like its Canadian cousin, the Future Integrated Soldier Technology project integrates a number of systems to enhance overall effectiveness. Aimed at the dismounted soldier and airman, and like the United States Army's Land Warrior programme, it is expected to "provide the soldier with improved situational awareness,

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[132] *Ibid*., 2.

[133] General Dynamics, *Land Warrior Statements*, http://www.gdc4s.com/documents/Land_Warrior_Statements_Aug_2007.pdf; Internet; Accessed 24 March 2008, 1.

[134] British Army Website, *Soldier System Modernisation Section*, http://www.army.mod.uk/infantry/capability_dev_and_equip_trialling/soldier_system_modernisation_section.htm; Internet; Accessed 24 March 2008.

[135] Army Technology.com, FIST - Future Infantry Soldier Technology, United Kingdom, http://www.army-technology.com/projects/fist/#adEnd; Internet; Accessed 24 March 2008.

lethality and survivability."[136]

Improved communications and situational awareness will be realized by creating voice and data links that can be established directly with the soldier or via an Unmanned Aerial Vehicle facilitated relay. This link will provide battlefield commands as well as "information and images from forward observers, unmanned air vehicles, remote sensors and other airborne or satellite surveillance assets."[137] It uses GPS, dead-reckoning systems and digital maps to help improve the soldier's situational awareness.

By improving sighting and weapon systems, the future soldier will have the capability of observing and engaging around obstacles, determining precise ranges using laser range finders and achieving more effective results against modern armoured vehicles with "Main Battle Tank Light Anti-tank Weapon, Javelin anti-tank missiles and High Explosive Fragmentation Grenade launchers" as well as smart ammunition.[138]

Survivability will be enhanced through low signature uniforms that are effective against infra red, radar and visual detection. Ballistic protection in the form of improved vests and helmets will be fielded. New lightweight protective clothing will be combined with networked warning systems to allow British soldiers to operate effectively in contaminated environments.

Expected to enter into service in the next decade, trials have been conducted since 2005. With the British Army procuring only 35,000 sets, the expectation is that not every infantryman will be issued a set, but that commanders will determine whether the mission

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[136] *Ibid*.

[137] *Ibid*.

[138] *Ibid*.

requires the use of the system or not. [139]

The Integrated Soldier System Project - An evolution from Clothe the Soldier

Clothe the Soldier was originally established to move the Army's clothing programme into the 20th century and leverage such materials as Gore-Tex and Thinsulate. It eventually delivered a number of garments like the integrated environmental clothing system, the wet weather and temperate climate boots, a sock system and a series of functional glove systems. In 2002, as a result of the increased operational demands for the mission in Afghanistan, Clothe the Soldier was leveraged to provide soldiers and commanders the tactical tools they needed to improve operational effectiveness and interoperability with Task Force Rakkasans[140] as well as minimize the risk of casualties. These initiatives fall under two broad categories: Command, Control, Communications, Computers and Intelligence (C4I) and Lethality. C4I included such items as Generation III AN/PVS-14 Monocular Night Vision Goggles, AN/PAC-4C[141] and AN/PEQ-2A[142] Laser Aiming Devices, SOPHIE, Kite and Maxi-Kite Thermal Binoculars and Weapon Sights[143] and Personal Role Radios.

The element of lethality included a Midlife Small Arms Optimisation by providing an upgrade to the C7A1 to include, Close Combat Non Lethal Systems and

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[139] Army Technology.com, FIST - Future Infantry Soldier Technology.

[140] 3rd Battalion, 187th Infantry 3rd Brigade 101st Airborne (Air Assault)

[141] The PAQ-4C has a Surefire weapon light and the Tri-rail mount and is issued to all combat arms soldiers deploying on operations that are likely to see combat.

[142] The PEQ-2A has a visible aiming laser and an IR flood laser, Surefire flashlight and the Tri-rail mount. These are issued to commanders.

[143] The Sophie, Kite and Maxi-Kite Sights were acquired in more limited numbers, and specifically for operations in Afghanistan. The Sophie is hand-held, the Kite is for personal weapons and the Maxi-kite for crew served weapons. For further information on what the Canadian Army has for Night Fighting Equipment and TTPs, see http://nightoperations.com.

many weapons Unforecasted Operational Requirements (UOR).[144]

Like the British Army's Future Integrated Soldier Technology, the ISSP's mission was to address the five NATO capability components of C4I, lethality, mobility, survivability and sustainability.[145] It hopes to build upon advances made with the Clothe The Soldier project to significantly enhance individual and team capability in the future digitized battlespace.[146] The aim of the ISSP was to "field a modern integrated system of electronic devices, weapons accessories, operational clothing and individual equipment capable of operating in complex terrain, that meets the needs of the Land Force Warfighter in the network enabled, command centric, effects based digitized battlespace".[147]

Specifically the ISSP would enhance C4I by introducing electronic devices such as Personal Role Radios and "wearable computer combinations" which would provide the ability to communicate laterally to all members of the section, platoon and company, extending vertically as high to the task force level. This network would be both voice and data capable, and provide the organization command, control and communications and situational awareness to the dismounted soldier. It will include the ability to conduct dispersed planning and briefings, provide situational awareness on friendly and enemy forces and connectivity to other higher level sensors to further enhance the sense

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[144] Department of National Defence Website (Assistant Deputy Minister (Materiel), "Director General Land Equipment Project Management" http://www.forces.gc.ca/admmat/dglepm/ustano/index_e.htm; Internet; Accessed 16 February 2008.

[145] Department of National Defence, Integrated Soldier System Project Synopsis Sheet (Preliminary Project Approval) (ISSP SS (PPA)), December 2006, 3.

[146] Department of National Defence, Director Land Requirements 5 Presentation on Canadian Soldier Modernization, undated.

[147] *Ibid*.

function.[148]

Under lethality, the Diemaco manufactured Canadian service rifle (C7A1) was given a mid-life refurbishment and redesignated the C7A2. It included green 'furniture' (butt stock, pistol grip, and handguards) which helped to reduce the contrast against lighter backgrounds, a telescopic butt to adjust for variable eye relief and working in close quarters, a new ambidextrous cocking handle and magazine release, a refurbished C79A2 optical sight, and a Triad multipurpose mount (used for the aiming aids described above).

Overall the C7A2 represents an improvement in flexibility of employment with the telescopic butt and rail system, but there are some dissatisfiers with the refurbishment too, the first being the ambidextrous cocking handle. With finger catches on either side of the cocking handle, it has a tendency to catch on clothing and equipment, which in the least is distracting, the worst dangerous. Furthermore, the barrel remained 50cm long, which proved to be a point of contention amongst the user community as it affected centre of balance. Notwithstanding these complaints, the ability to engage targets more effectively and efficiently was achieved through the acquisition of the command and control tools previously mentioned and the improvements made to the weapon itself. The ability for a commander to provide accurate target indication and the riflemen to acquire targets more effectively has been enhanced.[149]

With the acquisition of navigation aids, a soldier's ability to navigate will be improved. Together with the communications equipment outlined above, the capacity for

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[148] ISSP (SS (PPA)), 4.

[149] Department of National Defence, "Op ATHENA Roto 2: The State Of Infantry Weapons In Afghanistan," *Army Lessons Learned Centre's The Bulletin*, Vol 12 No 3 (May 2006), 1-6.

dismounted manoeuvre is increased as groups coordinate cover, fire and movement. Coupling navigation aids with graphical interfaces showing terrain, friendly and enemy dispositions will allow for formations to move quickly through an area with greater security and situational awareness.[150]

Enhancements to protective equipment for use in contaminated areas will improve the survivability of ground forces in affected regions. New, improved and lighter ballistic technology means soldiers operating in stressful environments will be better protected and less encumbered by their vests. Combat identification and other low light and night recognition technology will help reduce the probability of fratricide.[151]

Sustainability is vital to the success of the acquisition of the new equipment and technologies. To maximize this, the Clothe the Soldier project will be used as a baseline, and all new acquisitions will be integrated with it. A human engineering approach has been, and will continue to be followed to meet this important aspect of the ISSP.[152] This should be reassuring to the rank and file of the Canadian Army but does not come without its own challenges.

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[150] ISSP SS (PPA), 4.

[151] *Ibid*.

[152] *Ibid*., 5.

Chapter II, Part 5

The Challenges to Modernization

Cost

With competing priorities within governments, militaries and armies, it should come as no surprise that projects like the United States Army's Future Combat Systems might meet with resistance, externally and internally. Estimated at $US 160 Billion in 2004,[153] Future Combat Systems alone represents about 13 times the entire Canadian Defence Budget[154] and one third of what all levels of government spent on elementary and secondary education in the United States in 2003-04.[155] By comparison Land Warrior, which is similar in scope to the ISSP, has the potential to run as high as $US 7.6 Billion.[156]

While significantly smaller in scale than Land Warrior, the ISSP at $330 Million still represents a major capital project and about a quarter of the Canadian Army's annual operating budget for fiscal year 2008/2009.[157] In terms of anticipated cost, the ISSP is about on par with other Canadian initiatives in support of the Army such as the Tank Replacement Project, the Armoured Heavy Support Vehicle System, the Advanced

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[153] *Eaglen and Horn, "*Future Combat Systems: A Congressional Guide to Army Modernization", 7.

[154] Department of National Defence, Minister of Defence Website, *Budget 2004 (Defence Budgets 1999-2003)*. http://www.mdn.ca/site/Reports/budget04/9903_e.asp; Internet; Accessed 24 March 2008.

[155] United States Census Bureau, *Public Education Finances 2004*, March 2006, x. http://www2.census.gov/govs/school/04f33pub.pdf; Internet; Accessed 21 March 2008.

[156] United States Department of Defence, Office of the Inspector General, *Acquisition of the Army Land Warrior System*, 5. http://www.dodig.osd.mil/Audit/reports/fy02/02-143.pdf; Internet; Accessed 21 March 2008.

[157] Department of National Defence, *Army Strategic Operations and Resource Directive and Land Force Funding Model version 1, 2008*. http://armyonline.kingston.mil.ca/CLS/D143000440106701.asp Defence Wide Area Network; Accessed 24 March 2008.

Lightweight Anti-armour Weapons System and the Close Area Support Weapon.[158]

Need

The question over the need to modernize has continually perplexed Armies and governments alike. Whether for the purpose of leveraging new technology in order to accelerate the ability for effective decision-making, maximizing precision strike capability, addressing an evolving threat or achieving economies in uncertain times, militaries have been forced to adapt to evolving security environments. This challenge balanced with the fiscal realities of the day make the question of need more difficult to determine.

The United States Army appreciates the necessity to modernize. Former Chief of the Army, and Retired General Gordon Sullivan, sees the priority of "investing sufficiently in modernization is a strategic necessity that meets a compelling operational need now and in the future."[159] His view is supported by other interest groups, including the Heritage Foundation in their report entitled *Future Combat Systems: A Congressional Guide to Army Modernization*. In this report they succinctly counter any opponent to modernization as ignoring "the emerging threat environment, which is markedly different from the Cold War environment that shaped today's force." They go on to point out that the United States Army's warfighting capabilities were created to counter conventional threats in 20th century Europe.[160] This force went on to demonstrate "its unrivaled ability

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[158] Estimated at $650M, $160M, 170M and 126M respectively. Source: Department of National Defence, Capability Investment Database. http://otg-vcd-webs018.ottawa-hull.mil.ca/CID; Defence Wide Area Network; Accessed 21 March 2008.

[159] Association of the United States Army, "A Transformed and Modernized U.S. Army: A National Imperative", *Institute of Land Warfare*, (April 2007), 4.

[160] The Government of the United States, *The National Security Strategy of the United States of America*, September 2002, 1. www.whitehouse.gov/nsc/nss.pdf; Internet; 24 March 2008.

to conduct large-scale conventional operations" against Saddam Hussein's army in Kuwait.

But this is not the 1990s. The operating environment has changed. Concepts like "Force Protection" have become an overwhelming priority for both militaries and politicians. Political strategic success is far more likely to be characterized as not losing, than winning. The geo-political context in which western armies are fighting a global insurgency is different today. Strategic centres of gravity in counter-insurgency operations are generally identified as domestic support of the people. This support is quickly and easily affected by the loss of soldiers on operations in Afghanistan and Iraq. It is for this reason that Canadian initiatives such as the Armoured Heavy Support Vehicle System project has been implemented at such record breaking speed. Force Protection is but one argument for the need to modernize.

Meeting Expectations

There is constant a tension between governments and their militaries over efficiency. Balancing inputs and outputs is a challenge for militaries because often the outputs are intangible. The Canadian government expects a lot from its CF, from domestic search and rescue to rapid international response from strategic forces. Both of these examples are high-readiness standby tasks and are resource intensive.

As has been illustrated throughout this paper, modernization also demands extensive resources. While the financial implications are easily measured, it is the demands placed upon the people and the institution that is less obvious. Operational tempo and change fatigue are both very real concerns for a busy military that seeks to

modernize;[161] government will continue to demand for its military to produce outputs.

Maintaining readiness while modernizing has been a focus of the Army's Operations and Force Development staffs since the turn of the millennium. When Army Commander Lieutenant-General Jeffries announced his transformational objectives in 2002, the Canadian Army also embarked on an intense period of combat operations in Afghanistan. This coincided with a renewal in investment of equipment and the development of new capabilities. Such significant changes as the creation of the Canadian Manoeuvre Training Centre, an enhanced Electronic Warfare capability, cutting edge night-fighting capability and significant growth within the Army had to be accomplished simultaneously.[162] But this was not done without significant challenge and cost.

Preserving Culture and Trust

Land Operations 2021 identifies the centrality of the operational function of command and in particular how it is affected by "culture, the need to accept risk and perhaps most importantly, on an ability to instil trust."[163] The Canadian Army's command culture relies heavily on mission command, which depends on trust; trust in subordinates and trust in commanders. Change in any organization impacts on culture, and so the challenge to maintain an operational focus while transforming, as well as preserving the momentum of change, is real. When General Hillier spoke of his

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[161] This is recognized in *Land Operations 2021: Adaptive Dispersed Operations, the Force Employment Concept for Canada's Army of Tomorrow,* particularly the impact on the people in the Army.

[162] CMTC was created by reallocating establishment positions from infantry pioneer, mortar and anti-armour platoons and armour assault troops. EW, night-fighting and Army Expansion all began in 2003-2004. For the Army to expand by 3,000 positions (representing growth of about 15%) it needed to expand its training institutions, its leadership to train soldiers and its equipment holding, while also conducting operations in Kandahar with, at time, more than 25% of its field force deployed.

[163] Department of National Defence, *Land Operations 2021...*, 28.

organization change to adopt a more command centric operational focus, he spoke of creating an irreversible momentum. The changes he implemented with the creation of Canadian Expeditionary Forces Command, Canada Command, Canadian Operational Support Command and Canadian Special Operations Forces Command had a significant impact on the command culture within the CF.

Implications to Human Resource Management

Central to any complex organization is people. The CF is no different. How the CF selects and trains it people evolves with time, and for the most part reflects the Canadian culture. But has the CF adapted to the modern demands of soldiers? Selection standards for the CF vary by military occupation, or Military Occupational Structure Identification (MOSID) code. Not surprisingly the entry requirements for an infantryman are different than for an electro-optical technician. But the standards for enrolment have not changed with the operating environment. Infantry soldiers are expected to use high-technology equipment while under the immense stress of combat yet only require a grade 10 education. Physical fitness standards are different for a Special Operations Assaulter than for a Supply Technician but the physical fitness standards for an infantryman deployed to Kandahar, who is engaged in intense combat operations in a hot complex environment, are the same as for the clerk completing claims in an engineer regiment at CFB Gagetown. These inconsistencies do not reflect the demands of the contemporary operating environment and need to be reconsidered.

Culture

Future changes as a result of the implementation of even small projects such as ISSP have the ability to impact on culture. To help understand the impact of ISSP on the

human dimension, Defence Research and Development Canada Toronto's Human Sciences Division has conducted studies into trust, culture and the impact of technology on organization and structure. Through trials, simulation and analysis in such areas as fitness, ergonomics, team performance and collaborative behaviour and stress reactions in different situations, defence scientists are looking forward to determine how to avoid friction and failure in the modernization of the Canadian Army.

The matters of cost, need and expectations can only be addressed through dialogue between the Department of National Defence and the Prime Minister, his Cabinet and the Prime Minister's Office. The concerns of impacts on culture, trust, ergonomics, physiological and cognitive impacts and other human dimensions need to be addressed for the Canadian Army to be able to modernize without failing as it did in the case of the Multi-Mission Effects Vehicle. The connection between culture, trust, education, cognitive skills and fitness needs to be analyzed and steps need to be taken to ensure we are setting our soldiers up for success on the battlefield. This relationship is the focus of the next chapter.

Chapter III

The Human Dimension

> *Under the baking Afghan sun we are rediscovering, by way of pain, that the first determinants in war are human. In combat, the power of personality, intellect and intuition, determination, and trust, outweigh the power of technology, and everything else.* [164]

Chapter III, Part 1

The Way Ahead

When writing *Land Operations 2021* the Canadian Army recognized the importance of the human dimension of soldiering in the Army of the future. The soldier of the future "must possess the physical competency, … intellectual competency, … and social competency… to be effective".[165] These elements represent this paper's recurring themes of: physical fitness; capacity for advanced reasoning, visualization, and decision making skills; resiliency, hardiness and ability to cope with stress; and the ability to develop trust, respect and teamwork. This is an idea about soldiers who are selected, trained and maintained to a high standard; probably a higher standard than they are today. Because the human dimension is so vast and complex, one element from each of the three components will be developed a bit further. These are education, fitness and trust.

Elevated standards of education, training, fitness and social integration are essential in delivering this type of soldier to the force. In order to achieve this principle, a comprehensive strategic personnel plan would have to be developed and supported by modern policies and practices. A review of fitness standards and educational

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[164] Lieutenant-Colonel Ian Hope, "Reflections on Afghanistan: Commanding Task Force Orion," in *In Harm's Way, The Buck Stops Here: Senior Military Commanders on Operations,* ed. Colonel Bernd Horn, 211-226 (Kingston: Canadian Defence Academy, 2007), 211.

[165] Department of National Defence, *Land Operations 2021…*, 25.

requirements would have to be conducted, and the CF would have to look closely at how it develops such notions as trust, particularly in the fighting echelons.

Chapter III, Part 2

The Physiological Domain - Physical Fitness

The importance of fitness in a military cannot be overemphasized. Since the battle of Marathon, when Phidippides reportedly ran 26 miles to relay a message on an impending invasion, fitness on the battlefield has been a key element of an army's culture. In the case of the Canadian Army in 2008 - an Army engaged in combat operations in a hot, vast and mountainous country - it is a vital one.

There are many advantages to being physically fit. According to the Canadian Public Health Agency, being more physically fit will bestow benefits on an individual's health including reduction in fatigue, increased flexibility, greater stamina, strength, endurance and co-ordination, less stress and tension, and improved work performance.[166] All of these benefits contribute to more effective soldiers on operations. These health benefits are vital to an army such as Canada's.

But the CF has had little success in motivating its members to adopt a healthy lifestyle. According to a survey released in 2004, while the vast majority of CF members recognize that starting to exercise or increasing the amount they exercise will improve their overall health, only 43% of CF members reported living an active lifestyle.[167] Many soldiers, sailors and airmen and women have developed "a culture focused on passing

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[166] Public Health Agency of Canada, "Research Layer -Key Benefits of Physical Activity," http://www.phac-aspc.gc.ca/pau-uap/fitness/work/res_layer3_e.html; Internet; Accessed 1 April 2008.

[167] Department of National Defence, *CF Health and Lifestyle Information Survey 2004* (February 2005), 61.

tests,"[168] training only to meet the minimum standard once a year. With a staggering 81 per cent of Regular force personnel reporting having jobs that require little or no physical activity,[169] a significant cultural hurdle will have to be overcome in order to develop a fitness ethic as desired by the Chief of Defence Staff.

In order to achieve his aim of the CF adopting a better attitude toward health and fitness, on the 1st of April, 2008 the Chief of Defence Staff announced a series of new initiatives. In his words, "the new Canadian Forces Health and Fitness Strategy… will enable operational success by providing the ways and means for all Canadian Forces personnel to attain and maintain their personal health and physical fitness sufficient to meet Canadian Forces operational requirements at home and abroad."[170] In March, Esquimalt's military newspaper *Lookout* published a six-page spread where this new, comprehensive vision is described. General Hillier will attack the CF's laissez faire attitude toward fitness along six lines of operation: Shared Ownership, Lifelong Lifestyle Commitment, Regular Physical Fitness Activity, Healthy Nutrition, Healthy Weight and Addiction Free Lifestyle.[171] High levels of individual fitness will be rewarded on promotion boards and with public recognition. Elevated levels of collective fitness will be recognized at the annual CF Fitness and Sports awards Banquet in Ottawa.[172]

With a plan to overcome the cultural hurdle, the path to realistic fitness standards for all occupations can begin to be addressed. General Hillier's strategy will have

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[168] "Paving the Way to Health: The CF Health and Physical Fitness Strategy from the office of the Chief of the Defence Staff", *Lookout*, Volume 53 Number 12, 25 March 2008, 10.

[169] Department of National Defence, *CF Health and Lifestyle Information Survey 2004* , 63.

[170] CANFORGEN 042/08, CMP, *Revised Physical Fitness Testing Policies*, 18 February 2008.

[171] "Paving the Way to Health", 12.

[172] *Ibid*., 12-13.

individual fitness standards developed for each job using bona fide occupational requirements (BFOR) to determine environmental norms for the Army, Navy and Air Force. Certain occupations that demand specific standards will have new benchmarks established based on legally defensible and scientifically validated occupation specific fitness needs. In the future, the CF's Minimum Physical Fitness Standard will serve "only as a standard for graduation from basic training and continued membership in the Canadian Forces," not a global standard for fitness.[173]

The recognition that certain occupations require different standards is a significant step forward. But the key is to make certain the standards are reflective of the true requirement. The CF exercise prescription or "EXPRES" test was developed in 1981 and is based on the seven common tasks that all members of the CF are expected to be able to carry out. These tasks include land and sea evacuation, entrenchment dig, sandbag carry and low/high crawl. Using scientific tests and a control group of 200 people, standards for four easily administered exercises were established. Using a cardiovascular testing method[174] that measures oxygen consumption, along with push-ups, sit-ups and a hand grip measurer that gauges upper body, core and hand strength, results are indicative of a member's ability to carry out each of the five common tasks. But the problem most have with the EXPRES test does not lie in the basis, but the standard.

Standards for men and women, over and under 35 years of age, were established based on the control group's ability to successfully complete the test with a pass rate of 95%. This remains reflective of the success rate in the CF, with 95.6% of those that

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[173] *Ibid*., 12.

[174] Originally a step test was used and heart rate and blood pressure measured to determine oxygen levels. Since 1996 a 20-metre shuttle run has been used.

completed the test passing, in 2004.[175] This pass rate in itself, though, is indicative of the fact that the standard requires review.[176] 21% of the CF are obese, and obesity rates are on the rise.[177] Obesity and failure of the EXPRES test are directly related.[178] But despite this, less than 5% of the CF fail to meet the minimum standard of the EXPRES test. This is indicative of the standard's lack of difficulty.

How can the leadership of the CF believe that a soldier is adequately prepared to perform on the battlefield if the CF EXPRES standard continues to be used as a measure of fitness? The good news is that this will be a measure of the past. According to Doctor Lindsay Goulet, a Personnel Support Programme Research Manager in Esquimalt, the Human Performance team from Defence Research and Development Canada will shortly begin focusing its attention on "the development and scientific validation of an operational physical fitness standard for each Canadian Forces environment."[179]

With the establishment of an Army fitness standard, the Army can begin to build on its culture of fitness and begin to expand its combat fitness programme.[180] This programme is a functional fitness regime that is intense, diverse, challenging and

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[175] Department of National Defence, *CF Health and Lifestyle Information Survey 2004*, 66.

[176] Joan Stevenson, et al., "Development of Physical Fitness Standards for the Canadian Armed Forces Younger Personnel", *Symposium on Occupational Fitness Screening*, 214-221.

[177] Department of National Defence, *CF Health and Lifestyle Information Survey 2004*, 89.

[178] Department of National Defence, *CF Health and Lifestyle Information Survey 2004*, 66.

[179] Lindsay Goulet, "Researchers focus on human performance at CFB Esquimalt", *Lookout*, Volume 53 Number 12, 25 March 2008, 12.

[180] http://www.army.forces.gc.ca/land_force_doctrine_training_system/ex_aita_trg/acim/courses/acim/acim.swf

addresses the needs of combat arms soldiers in particular. It is based on the CrossFit[181] methodology that many military and paramilitary organizations have adopted since its inception in the 1970's. In the summers of 2005 and 2006 the Infantry School at Combat Training Centre Gagetown completed trials during the Common Army Phase and Infantry Platoon Commander's Courses[182] as a test bed for the effectiveness of the programme. During the summer of 2006 study, 15 periods of physical training were conducted over a 41 day period. The results were conclusive and reinforced the results of 2005. For example, of the 19 candidates that were tracked in the study, all of them improved their 2400 m run time, with an average improvement of 3 minutes 56 seconds.[183]

The establishment of an Army fitness standard and the integration of the Army's Combat Fitness Programme into physical fitness regimes are vital steps in setting the conditions for success in the Army of Tomorrow. The Chief of Defence Staff's new Health and Physical Fitness Strategy will go a long way toward improving the overall health and fitness levels of the CF. But it will take a significant change in the collective attitude for the members of the CF to adopt a lifestyle that promotes healthy living.

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[181] www.CrossFit.com

[182] Infantry Officer Development Period 1.1 and 1.2

[183] Capt LW Rutland, Capt JT Williams, and Capt Jeff Bird, *The Canadian Infantry School Austere AOFP Briefing*, 1 August 2006, 19.

Chapter III, Part 3

The Cognitive Domain - Education Standards

Land Operations 2021 recognizes that in the contemporary operating environment in order to disrupt an adversary's decision-action cycle, decentralized decision-making will have to occur. This decentralized concept will have to be supported by an environment enabled through mission command and net-enabled situational awareness to soldiers directly engaged in combat operations. These junior leaders are going to have to make fast, informed and well-thought out decisions that will have life or death consequences for their subordinates.

Education is one factor that helps determine a soldier's ability to make decisions under stress. According to a study on solving complex problems under time pressure, other factors include "psychomotor skills, knowledge and attitude, information quality and completeness, stress (generated both by the problem at hand and any existing background problem) and the complexity of elements that must be attended to."[184] Network-enablement will help with the quality and completeness of information, fitness will help with the management of stress, and knowledge and attitude will be expanded through training; but education is the key to helping soldiers tackle complex problems and understand how best to solve them. In establishing higher education standards the CF will help ensure soldiers are better prepared for the ambiguity of the contemporary operating environment by making sure they have been exposed to complex problem solving situations, a variety of cognitive challenges and broader intellectual considerations before they encounter them in the execution of their duties.

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[184] Kathleen M. Kowalski-Trakofler, Charles Vaught and Ted Scharf, "Judgment and decision making under stress: an overview for emergency managers", *International Journal of Emergency Management*, Vol. 1, No. 3, (2003), 278-289.

The present situation is that the common minimum educational standard for entry into the CF is grade 10; of the 87 the non-commissioned member occupations advertised on the CF Recruiting website, 25 identify grade 10 as the minimum educational requirement. All occupations in the combat arms are within those 25. This may be insufficient.

The soldier of tomorrow is likely going to be placed under great intellectual stress. Infantry officers on operations in Afghanistan relate stories of deploying away from the safety of the Kandahar Airfield for short periods of time, returning mentally exhausted from the constant threat of attack and the sensory overload of from monitoring multiple radio networks and fire control systems.[185] Even the stress of anticipating making difficult decisions is enough to wear out experienced, educated officers. What does this mean to the private soldier with a year in the Army with only a grade 10 education?

In the contemporary operating environment, soldiers are going to have to be able to process vast amounts of information and make good decisions while separated from higher commanders. It is for this reason that education standards require review. The soldier of the future should have a high school education with math and sciences. A percentage of soldiers need to be selected from applicants that have some university or college experience, and a smaller pool from those that have post-secondary degrees.

It may be comforting to see that the demographic of our infantry soldiers reflects that more have completed high school than have not, but there are still 22% of

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[185] Major Russ King, Deputy Commanding Officer 2 RCR Battle Group, Op ATHENA February-August 2007, telephone conversation with author, 2 April 2008.

infantrymen who have not completed secondary school.[186] Amongst privates and corporals the trends are better, with a high school completion rate 20 higher than the rest of the Army population.[187] Interestingly there are also almost 400 infantrymen who have post-secondary educations including 2 post-graduate educated soldiers.[188]

Standards and practices may not always coincide, and it is encouraging to see that the practice of recruiters today is to not offer enrolment to applicants with less than high school educations.[189] However the standards still require review for the day when someone appeals not being selected or the intake needs of the CF are such that recruiters choose to follow the policy rather than the current practice. Nonetheless, the CF need to ensure educational standards are reflective of the future needs of the occupations undergoing change. Infantrymen operating in the contemporary operating environment may require more than the standard presently demands; it may be the difference between surviving and not.

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[186] *2007 Annual Report on Regular Force Personnel*. Received from Director Strategic Military Personnel Research and Analysis, 2 April 2008.

[187] *Ibid*.

[188] *Ibid*.

[189] MWO Tim Power, Sergeant-Major to the Land Staff Secretariat, telephone conversation with author, 7 April 2008.

Chapter III, Part 4

The Social Dimension - Trust

Trust is a central theme in the evolution toward the Army of Tomorrow. *Land Operations 2021* explains that future Army structure should be a modular design based on the "optimized battle group".[190] In an effort to determine the advantages of this concept, 2nd Battalion of The Royal Canadian Regiment was designated to conduct a multi-year study to look at the idea. *Land Operations 2021* explains that the optimized battle group is "designed to provide optimum capabilities through affiliated groupings of core strengths, the battle group will strengthen social and task cohesion, discipline, and will establish personal and performance related reputations based on trust that extends beyond the immediate, intimate social group to strong leader-follower bonds."[191]

In order to provide some context to what affects trust development, Defence Research and Development Canada has conducted significant research into trust. In particular, they have studied how soldiers respond to new team members, how teamwork is enhanced and how the integration of new technology affects trust in the systems we are fielding. It is Defence Research and Development Canada's belief that understanding trust is "critical as the Canadian Forces moves toward increasingly dynamic, diverse and distributed operations."

"Swift Trust"

The concept of swift trust is relatively new, first appearing in 1996. It came about as researchers sought a description for the finding that some teams seem immediately able to develop high levels of trust that in turn allow them to function in high risk, high

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[190] Department of National Defence, *Land Operations 2021...*, 14.

[191] *Ibid*.

vulnerability situations. Teams working in the fields of film, theatre, presidential commissions, senate select committees, and cockpit crews were particularly adept at forming high levels of trust quickly.[192]

In 2007 Defence Research and Development Canada sponsored a study into the development of "Swift Trust" that looked at how such variables as regimental affiliation affected team members' views of their teammates. Results showed that even with only indirect knowledge about teammates' regimental affiliation, team trust was significantly higher in distributed teams that apparently shared a common regimental identity. This suggests that shared regimental identity promotes the establishment of swift trust at the very early stages of working as a team.[193] In the Army's Adaptive Dispersed Operations construct, this becomes important. In Adaptive Dispersed Operations it is anticipated that while "dispersion provides many significant advantages, dispersed forces may not be appropriate for every situation encountered. Consequently, the dispersed force must be capable of rapid aggregation in order to conduct operations as a larger aggregated force."[194] This aggregation will likely be from across the Army and it therefore follows that an understanding of rapid trust and how to positively affect its development is important to the Army of Tomorrow.

Trust from a Battle Group Commander's Perspective

In Harm's Way, The Buck Stops Here: Senior Military Commanders on Operations is a collection of accounts by a number of serving and former commanding

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[192] Barbara D. Adams, et al., *Swift Trust in Distributed Ad Hoc Teams*, a report prepared by Human*systems* Incorporated for Defence Research and Development Canada (Toronto: DRDC, 2007), 3.

[193] *Ibid*., iii.

[194] Department of National Defence, *Land Operations 2021…,* 21.

officers about their experiences from such contemporary operations as Afghanistan, Bosnia, Haiti and Sudan. Lieutenant-Colonel Ian Hope, Commanding Officer of the 1st Battalion, Princess Patricia's Canadian Light Infantry Battle Group was a contributor. Lieutenant-Colonel Hope talks at length about trust, its importance and how to foster it in an ad hoc unit.

In his opening paragraph he draws the reader's attention to the importance of trust, particularly trust in oneself, trust in the heart and head of each other and trust in the heart and head of ones superior.[195] He goes on to say why he took the controversial step of naming the Battle Group *Task Force Orion*, something many people saw as an American-ism, not necessarily to the taste of Canadian soldiers. Lieutenant-Colonel Hope elaborates on the decision, stating that he took it "to give everyone in this uncommon grouping of soldiers, sailors, airmen and women a common identifier, something that might help them bond more easily."[196] He selected a neutral symbol, Orion, the mythological Greek hunter, in order to give them a larger entity with which to be associated than their pre-existing companies, battalions and regiments, each with its own unique identifier. He then went on to lead the Battle Group through rigorous, realistic training, including extensive live-fire training, in order to establish a more broad trust across arms, branches and services.[197]

In his article, Lieutenant-Colonel Hope speaks about the establishment of trust with villagers in Afghanistan. He stresses the importance of establishing human relationships as a way of developing situational awareness and gathering human

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[195] Hope, "Reflections on Afghanistan: Commanding Task Force Orion," 211.

[196] *Ibid*.

[197] *Ibid*., 212.

intelligence. Over time his Battle Group was able to discern what sources of information and intelligence were reliable in their effort to locate Taliban forces. Eventually the success in information gathering led to actionable intelligence, which further developed trust in his junior leadership and soldiers as they conducted successful operations.[198]

Lieutenant-Colonel Hope's experience on operations in Afghanistan reinforces what many leaders believe to be a key element to building trust amongst subordinates: sharing risk. Company commanders positioned themselves well forward during firefights so they could best influence the battle, but were also risking their lives. He, as the Battle Group commander, would always travel by vehicle, sleep on the ground, and avoided the use of helicopters as that removed him from his soldiers. This risk-taking was real, but effective. His LAV III, struck four times by Improvised Explosive Devices or Rocket Propelled Grenades, was clearly exposed to the same dangers as the rest of his soldiers. But he saw this as vital to the development and promotion of "trusts essential to the fighting spirit of Task Force Orion."[199]

As was introduced at the beginning of this section, the Canadian Army is moving toward an affiliated battle group structure. While the final decision will be supported by the Optimized Battle Group Experiment, which should determine whether a changed structure will in fact strengthen cohesion and establish trust,[200] caution must be exercised. As was supported by the swift trust studies, regimental affiliation does have an impact on trust, and the changes to the regimental system that will inevitably come with the establishment of affiliated battle groups may cause irreparable damage.

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[198] *Ibid*., 215-7.

[199] *Ibid*., 219.

[200] Department of National Defence, *Land Operations 2021…,* 14.

Chapter III, Part 5

Human Dynamic Engineering

Beyond fitness, education and trust, there remains the issue of analysis when it comes to fielding new equipment and technology. The Multi-Mission Effects Vehicle experience underlines that importance and it should not be lost. Human dynamics studies in support of such initiatives as the ISSP have been extensive and many. These sorts of studies need to be continued.

Under the guise of the Soldier Information Requirements - Technology Demonstration (SIREQ TD), Defence Research and Development Canada - Toronto's Human Systems Engineering Group and Soldier Systems Integration Group looked at factors that would affect the integration of technology and soldiers. SIREQ TD's formal aim was to "define and empirically validate the performance requirements for the future Soldier System by demonstrating capability enhancements in command execution, target acquisition and situational awareness for the individual Canadian dismounted soldier in 2010-2015."[201] The project was conducted over a period of five years and involved interviews with subject matter expert, laboratory and field studies, and simulation studies for the integration of future technologies and concepts.

Studies included cognitive task analyses, alternatives for terrain visualization, a selection of input devices and displays, the impact of technology on navigation, the use of thermal imagery, night vision devices and sensors, the effectiveness of off-bore target engagement systems, advances in communication equipment, and the impact of technology on mission planning and situational awareness.

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[201] Soldier Information Requirements - Technology Demonstration CD-ROM [CD-ROM] (Toronto: Defence Research and Development Canada, 2005).

By the end of the project, over 70 reports were produced, many using the high-tech Military Operations on Urban Terrain (MOUT) site at Fort Benning, Georgia. Reports' topics ranged from studies into a *Cognitive Task Analyses of Information Requirements in Dismounted Infantry Operations* to an examination of the *Effect of Night Illumination Devices on Target Engagement Accuracy*. The former was conducted in order to "investigate, identify, and characterize the critical information requirements of dismounted infantry soldiers"[202] and formed the basis for future studies on the benefits of technology integration. It determined that "the core capabilities of sensing, terrain visualization and information exchange are critical to all soldier activities and thus emphasized that technology incorporation at the individual and team levels could prove to be very beneficial."[203]

This study set the stage for future studies into such subject matter as *Impact of Night Vision Devices on Individual and Group Movement and Separation on the Battlefield*. This study concluded that individuals operating at the section-level had increased separation with the use of night-vision goggles during night operations. This would have a positive impact on survivability when attacked by area weapons such as mortars and would allow sections to cover more terrain.[204]

Another study looked into the impact of communications equipment on how a dismounted infantry section operated. Eventually a total of seven such studies would be

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[202] David W. Tack and Harry Angel, *Cognitive Task Analyses Of Information Requirements In Dismounted Infantry Operations*, a report prepared by Human*systems* Incorporated for Defence Research and Development Canada (Toronto: DRDC, 2005), 3.

[203] *Ibid*., iii.

[204] Paul G.S. Vilhena and Harold A. Angel, *Impact of Night Vision Devices on Individual and Group Movement and Separation on the Battlefield*, a report prepared by Human*systems* Incorporated for Defence Research and Development Canada (Toronto: DRDC, 2005), 16.

conducted, some adding different network configurations, digital maps and personal role radios. It hoped to draw conclusions about performance effectiveness with and without radios, the communications processes used and soldiers' opinions on the advantages and disadvantages of using the technology.[205]

Interestingly, and perhaps contrary to expectations, the results of this study indicated that having radio communications did not significantly improve team performance, awareness or teamwork. Teams transmitted more information with the addition of a radio, and were able to anticipate information needs fairly effectively, but this did not translate into in improved performance.[206]

Other conclusions included outcomes in support of the cognitive argument presented above, strengthening the thesis that educational standards need review. Because awareness and teamwork did not improve with the addition of radios, it was surmised that this could have been as a result of the "significant increase in perceived workload … suggest[ing] that soldiers needed to expend greater cognitive resources when using the radio."[207] A closer look at the ability of soldiers to operate high-technology equipment while conducting combat operations in a complex environment needs to be taken.

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[205] Barbara D. Adams, David W. Tack, and Jessica A. Sartori, *Evaluation Of Radio Communication In Dismounted Infantry Sections*, a report prepared by Human*systems* Incorporated for Defence Research and Development Canada (Toronto: DRDC, 2005), 3.

[206] *Ibid*., 34.

[207] *Ibid*., 36.

Conclusion

The need for further and more detailed analysis is obvious. Real-world experiences should be studied for lessons on the operational imperative to take a very close look at the human dimension and the impacts of rapid technological changes. Following the limited examples used in this paper, three areas of review need to be undertaken.

Physical fitness is only one element within the physiological factor of the human dimension, but it is an important one because it impacts on so many facets of operations. Physical fitness affects a soldier's ability to manage stress, operate in challenging climates and terrain, process information and survive and recover from physical injury. Physical fitness is a factor in the establishment of first impressions; fit soldiers are seen as better soldiers. The CF need to develop a culture of health and fitness, and part of this comes from the establishment of more rigorous standards.

Within the cognitive component, we need to begin to understand the intellectual demands placed upon all soldiers fighting and supporting in the contemporary operating environment. We need to define our expectations of our officers and soldiers and then map those expectations to standards for entry into the CF, and developmental programmes like the Officer and Non-Commissioned Member Professional Military Education programmes.

Culturally, we need to closely consider how we leverage technology to complement the social network that Canadian soldiers learn from birth. Canadian soldiers take pride in their ability to engage the local population and connect with

them. They take pride in conducting dismounted patrols in high-risk environments because they understand that in order to win the counter-insurgency they must first win the hearts and minds of the people. But we must first understand how to develop the key elements of the cultural piece; trust. Trust in one's fire team partner, one's chain of command and one's military.

Additionally, it is critical that any research into the value of technology on military operations be examined through modeling, simulation, and other available scientific and mathematical methods. The success to date of the SIREQ TD sets the conditions for further research into this area.

Since conceiving the basis for this paper many changes have taken place; changes driven by the senior leadership of the Canadian Forces, led by the Chief of Defence Staff himself. Changes to the physical fitness standards, changes to the way we look after our soldiers, changes driven by combat veterans who understand the environment in which we now live. This momentum needs to continue under the watch of our future leaders.

Bibliography

Adams, Barbara D., David W. Tack, and Jessica A. Sartori. *Evaluation Of Radio Communication In Dismounted Infantry Sections*, a report prepared by Human*systems* Incorporated for Defence Research and Development Canada. Toronto: DRDC, 2005.

Adams, Barbara D., Sonya Waldherr, Jessica Sartori and Michael Thomson. *Swift Trust in Distributed Ad Hoc Teams*, a report prepared by Human*systems* Incorporated for Defence Research and Development Canada. Toronto: DRDC, 2007.

Alberts, David S., John J. Garstka, and Frederick P. Stein. *Network Centric Warfare: Developing and Leveraging Information Superiority*. n.p.: CCRP Publications, 1999.

Army Technology.com. *FIST - Future Infantry Soldier Technology, United Kingdom*. http://www.army-technology.com/projects/fist/#adEnd; Internet; Accessed 24 March 2008.

Association of the United States Army. "A Transformed and Modernized U.S. Army: A National Imperative", *Institute of Land Warfare* (April 2007).

Australia. Department of Defence. *Network Centric Warfare Roadmap 2007*. Canberra: Defence Publishing Service, 2004.

Australia. Department of Defence. *Enabling Future Warfighting: Network Centric Warfare*. Canberra: Defence Publishing Service, 2004.

Babcock, Sandy. *Canadian NEOps Initiatives*. Ottawa: NDHQ, June 2004.

Babcock, Sandy. *DND/CF Network Enabled Operations Working Paper A DND/CF Concept Paper and Roadmap for Network Enabled Operations*. Ottawa: Defence Research and Development Canada, 2006.

Blencoe, Gregory J. "The Eight Rules of Management", *Challenge Consulting.* http://www.challengeconsulting.com.au/aboutus/press_release/good_business/8_rules_2.html; Internet; accessed 14 February 2008.

Boyd, Colonel John. "Patterns of Conflict", edited by Chuck Spinney and Chet Richards. Atlanta: Defence and the National Interest, 2005.

Canada. Defence Research and Development Canada. "Future Armoured Vehicle Systems Website", http://www.drdc-rddc.gc.ca/researchtech/afvt/favs_e.asp; Internet; Accessed 18 March 2008.

Canada. Department of National Defence. *2007 Annual Report on Regular Force*

Personnel. Received from Director Strategic Military Personnel Research and Analysis, 2 April 2008.

Canada. Department of National Defence. *Army Strategic Operations and Resource Directive and Land Force Funding Model version 1, 2008*. http://armyonline.kingston.mil.ca/CLS/D143000440106701.asp Defence Wide Area Network; Accessed 24 March 2008.

Canada. Department of National Defence. CANFORGEN 042/08, CMP, *Revised Physical Fitness Testing Policies*, 18 February 2008.

Canada. Department of National Defence. *Capability Investment Database*. http://otg-vcd-webs018.ottawa-hull.mil.ca/CID; Defence Wide Area Network; Accessed 21 March 2008.

Canada. Department of National Defence. *Canadian Forces Health and Lifestyle Information Survey 2004*. February 2005.

Canada. Department of National Defence. *Director Land Requirements 5 Presentation on Canadian Soldier Modernization.* Undated.

Canada. Department of National Defence. *Integrated Soldier System Project Chief of Land Staff Programme Review Board Synopsis Sheet.* 5 March 2008.

Canada. Department of National Defence. *Integrated Soldier System Project Synopsis Sheet (Preliminary Project Approval)* (ISSP SS (PPA)). December 2006.

Canada. Department of National Defence. *Land Operations 2021: Adaptive Dispersed Operations, the Force Employment Concept for Canada's Army of Tomorrow*. Kingston: Directorate of Land Concepts and Design, 2007.

Canada. Department of National Defence. *Leadership in the Canadian Forces: Doctrine*. Ottawa: DND Canada, 2005.

Canada. Department of National Defence. *Minister of Defence Website, Budget 2004 (Defence Budgets 1999-2003)*. http://www.mdn.ca/site/Reports/budget04/9903_e.asp; Internet; Accessed 24 March 2008.

Canada. Department of National Defence. "Op ATHENA Roto 2: The State Of Infantry Weapons In Afghanistan," *Army Lessons Learned Centre's The Bulletin,* Vol 12 No 3 (May 2006).

Canada. Department of National Defence. *Purpose Defined: The Force Employment Concept for the Army: One Army, One Team, One Vision.* Ottawa: Department of National Defence, 2004.

Canada. Department of National Defence Website (Assistant Deputy Minister (Materiel). "Director General Land Equipment Project Management" http://www.forces.gc.ca/admmat/dglepm/ustano/index_e.htm; Internet; Accessed 16 February 2008.

Cebrowski, Vice Admiral Arthur K., U.S. Navy, and John J. Garstka. "Network-Centric Warfare: Its Origin and Future", *Proceedings.* (January 1998).

Eaglen, Mackenzie and Oliver Horn. "Future Combat Systems: Dispelling Widespread Myths of the US Army's Primary Modernization Program", *The Heritage Foundation*. http://www.heritage.org/Press/Commentary/021208e.cfm; Internet; Accessed 23 March 2008.

Eaglen, Mackenzie M. and Oliver L. Horn. "Future Combat Systems: A Congressional Guide to Army Modernization", *The Heritage Foundation.* (December 11, 2007). www.heritage.org/Research/NationalSecurity/bg2091.cfm; Internet; Accessed 23 March 2008.

English, Dr Allan, Dr Richard Gimblett and Mr Howard Coombs. *Beware of Putting the Cart before the Horse: Network Enabled Operations as a Canadian Approach to Transformation*, a report prepared by KMG Associates for Defence Research and Development Canada. Toronto: DRDC, 2005.

Freedberg, Sydney J. Jr, "Future tanks could surprise critics", *National Journal*, 20 September 2006. http://www.govexec.com/dailyfed/092006nj1.htm; Internet; Accessed 23 March 2008.

Garstka, John J. "Network-Centric Warfare Offers Warfighting Advantage," *Signal.* (May 2003).

General Dynamics. *Information Pamphlet on Land Warrior.* www.gdc4s.com/landwarrior; Internet; Accessed 24 March 2008, 1.

General Dynamics. *Land Warrior Statements*. http://www.gdc4s.com/documents/Land_Warrior_Statements_Aug_2007.pdf; Internet; Accessed 24 March 2008, 1.

Gizewski, Peter. *Toward a Network-Enabled Land Force: Problems and Prospects*. Kingston: Defence Research and Development Canada - Centre for Operational Research and Analysis, 2004.

Gordon, John IV, and Bruce R. Pirnie. ""Everybody Wanted Tanks" Heavy Forces in Operation Iraqi Freedom", *Joint Force Quarterly*, Issue 39.

Goulet, Lindsay. "Researchers focus on human performance at CFB Esquimalt",

Lookout, Volume 53 Number 12. 25 March 2008.

Graham, Bill. Minister of National Defence. "Army to Acquire New Multi-Mission Vehicle", speech delivered at a press conference 22 September 2005, http://www.forces.gc.ca/site/Newsroom/view_news_e.asp?id=1766; Internet; Accessed 19 March 2008.

Hayes, Richard E. "Network Centric Operations Today: Between the Promise and the Practice", *RUSI Defence Systems.* (Summer 2004).

Hillier, Lieutenant-General R.J. "Commander speaks about Army Transformation", speech delivered at a press conference 29 October 2003, http://www.forces.gc.ca/site/newsroom/view_news_e.asp?id=1239 Internet; Accessed 17 March 2008.

Hope, Lieutenant-Colonel Ian. "Reflections on Afghanistan: Commanding Task Force Orion," in *In Harm's Way, The Buck Stops Here: Senior Military Commanders on Operations,* ed. Colonel Bernd Horn, 211-226. Kingston: Canadian Defence Academy, 2007.

Institute of Land Warfare Association of the United States Army. "A Transformed and Modernized U.S. Army: A National Imperative". 9 April, 2007. http://www.ausa.org/PDFdocs/TBSecRpt/TB_FCS_3Apr07.pdf; Internet; Accessed 23 March 2008.

Kagan, Frederick W. "War and Aftermath," *Policy Review Online*, 102. (August/September 2003). http://www.hoover.org/publications/policyreview/3448101.html; Internet; Accessed 23 February 2008.

Kirk, Michael. "Rumsfeld's War", *Frontline*, PBS transcript. http://www.pbs.org/wgbh/pages/frontline/shows/pentagon/view/; Internet; accessed 13 March 2008.
Owens, William and Ed Offley. *Lifting the Fog of War*. New York: Farrar, Straus and Giroux, 2000.

Kowalski-Trakofler, Kathleen M., Charles Vaught and Ted Scharf. "Judgment and decision making under stress: an overview for emergency managers", *International Journal of Emergency Management*, Vol. 1, No. 3, (2003).

"Paving the Way to Health: The CF Health and Physical Fitness Strategy from the office of the Chief of the Defence Staff." *Lookout*, Volume 53, Number 12, 25 March 2008.

Public Health Agency of Canada, "Research Layer -Key Benefits of Physical Activity." http://www.phac-aspc.gc.ca/pau-uap/fitness/work/res_layer3_e.html; Internet;

Accessed 1 April 2008.

Rutland, Capt LW, Capt JT Williams, and Capt Jeff Bird. *The Canadian Infantry School Austere AOFP Briefing*. 1 August 2006.

Schroeder, Karl. *Crisis in Zefra*. Kingston: Department of National Defence, 2005.

Sharpe, BGen (ret'd) Joe and Dr Allan English. *Network Enabled Operations: The Experiences of Senior Canadian Commanders*, a report prepared by KMG Associates for Defence Research and Development Canada. DRDC, Toronto: 2006.

Soldier Information Requirements - Technology Demonstration CD-ROM. [CD-ROM]. Toronto: Defence Research and Development Canada, 2005.

Stevenson, Joan, J. Tim Bryant, George M. Andrew, J. Terry Smith, Sheryl L. French, John M. Thomson and Janice M. Deakin. "Development of Physical Fitness Standards for the Canadian Armed Forces Younger Personnel", *Symposium on Occupational Fitness Screening*.

Stewart, Keith. *Mission Command: Elasticity, equilibrium, culture and intent*. Toronto: DRDC, 2006.

Swofford, Frank. "Interview with Arthur K. Cebrowski, Director, Office of Force Transformation", *Defense AT&L.* (March-April 2004).

Tack, David W., and Harry Angel. *Cognitive Task Analyses Of Information Requirements In Dismounted Infantry Operations*, a report prepared by Human*systems* Incorporated for Defence Research and Development Canada. Toronto: DRDC, 2005.

Thomson and Adams. *Network Enabled Operations: A Canadian Perspective.* Toronto: DRDC, 2006.

United Kingdom. British Army Website, *Soldier System Modernisation Section*, http://www.army.mod.uk/infantry/capability_dev_and_equip_trialling/soldier_system_modernisation_section.htm; Internet; Accessed 24 March 2008.

United States. United States Census Bureau. *Public Education Finances 2004, March 2006*. http://www2.census.gov/govs/school/04f33pub.pdf; Internet; Accessed 21 March 2008.

United States. Department of Defense. *The Implementation of Network-Centric Warfare*. Washington: U.S. Government Printing Office, D.C, January 2005.

United States. Department of Defence. *Transformation Planning Guidance*.

Washington: Defence Printing Services, 2004.

United States. Department of Defence. *Office of the Inspector General, Acquisition of the Army Land Warrior System*. http://www.dodig.osd.mil/Audit/reports/fy02/02-143.pdf; Internet; Accessed 21 March 2008.

United States. The Government of the United States. *The National Security Strategy of the United States of America*. September 2002. www.whitehouse.gov/nsc/nss.pdf; Internet; 24 March 2008.

United States. United States Army. *2002 Transformation Roadmap*.

United States. United States Army. *2003 Transformation Roadmap*.

United States. United States Army. *2004 Transformation Roadmap*.

United States. United States Army. *The US Army Land Warrior Program, Defence Update*. http://www.defense-update.com/products/l/land_warrior_update07.htm; Internet; Accessed 24 March 2008.

United States. United States Army. *United States Army White Paper: Concepts for the Objective Force*.

Vego, Milan. "Net-Centric is Not Decisive", *United States Naval Institute Proceedings* 129. (January 2003).

Vilhena, Paul G.S., and Harold A. Angel. *Impact of Night Vision Devices on Individual and Group Movement and Separation on the Battlefield*, a report prepared by Human*systems* Incorporated for Defence Research and Development Canada. Toronto: DRDC, 2005.