CANADIAN FORCES COLLEGE/COLLÈGE DES FORCES CANADIENNES

JCSP 35/ PCEMI N° 35

MASTER OF DEFENCE STUDIES (MDS) RESEARCH PROJECT

Air Force Command and Control: Exploiting the Networks

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ABSTRACT

Tremendous technological advancements in the field of networks during the last three decades purport to create an environment in which the commander now has access to an operating picture containing all the necessary information needed to arrive at a decision and to permit decentralization of control and execution of forces through a command-by-influence network. Air forces, by virtue of the concept of centralized control and decentralized execution, ought to be well suited to optimise the networks within their command and control (C2) construct. An examination of the history of air force C2, demonstrates that centralized control and decentralized execution are not as well exercised as one might expect. Through an examination of the concepts of command and control, the history of Canada's Air Force, and network concepts, this paper will argue that the air force concept of centralized control and decentralized execution can be optimised through Network Enabled Operations (NEOps) that are developed in appreciation of Air Force doctrine and culture. Optimising the network to more readily leverage the *observe, orient, decide, act* (OODA) loop at the tactical level will permit more effective and efficient use of air resources.

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"The very nature of war makes absolute certainty impossible; all actions in war will be based on incomplete, inaccurate, or even contradictory information."[1]
Colonel John Boyd

INTRODUCTION

The Clausewitzian 'fog of war'[2], to which Boyd was referring above, has plagued commanders since the time of Napoleon and earlier. Tremendous technological advancements in the field of networks during the last three decades purport to create an environment in which the commander now has access to an operating picture containing all the necessary information needed to arrive at a decision. Unfortunately the promises networks offer have, as yet, failed to dissipate the fog and, it is likely that networks will never be capable of completely doing so as long as human will remains a central component of war. There is, however, one aspect of networks which air forces[3] are particularly well suited to harness to their benefit. The decentralized nature of networks has the potential to realize synergistic efficiencies within the air force command and control (C2) structure. The C2 structure, as matured within western air forces since the inception of aerial combat over the fields of Europe during the First World War, already contemplates a role for decentralized control processes. Is there something we can learn

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[1] Grant Tedrick Hammond, *The Mind of War : John Boyd and American Security* (Washington: Smithsonian Institution Press, 2001), 195.

[2] The term "fog of war" is attributed to the Prussian military theorist Carl von Clausewitz. It is described in Book 2, Chapter 2 of *On War*, "The general unreliability of all information presents a special problem in war: all actions take place, so to speak, in a kind of twilight, which, like fog or moonlight, often tends to make things seem grotesque and larger than they really are. Whatever is hidden from full view in this feeble light has to be guessed at by talent, or simply left to chance. So once again for lack of objective knowledge one has to trust to talent or to luck." *From* Carl von Clausewitz, Michael Eliot Howard and Peter Paret, *On War* [Vom Kriege.] (Princeton, N.J.: Princeton University Press, 1989; 1984), 732, 140.

[3] In this paper, the use of "air force(s)" as opposed to "Air Force" shall be employed to differentiate between air forces in general and its use of aerospace power and doctrine, whereas the term "Air Force" shall be employed when discussing the formal organizations of specific air forces. While Canada has not had a formal "Air Force" since unification in 1968, this paper shall continue to refer to Canada's air element after 1968 as an "Air Force" for the purpose of clarity.

from decentralized networks that can be applied to modern air force command and control arrangements which will permit more rapid decision and action cycles? Through an examination of Network Enabled Operations[4] (NEOps) and its application to C2, this paper will argue that the air force concept of centralized control and decentralized execution can be optimised at the tactical level through the application of NEOps thereby permitting more effective and efficient use of air resources.

Canadian Aerospace Doctrine promotes the concept of centralized control[5] and decentralized execution;[6] however, this concept, though espoused by many military doctrinal and historical authors, is commonly misunderstood. For this reason, this paper will start with an examination of the distinct terms, "command", "control" and "command and control". In the Canadian context, since unification in 1968, the air element of the Canadian Forces has wrestled to come to terms with how to best allocate command and control decisions so that air force concerns are adequately addressed. This is particularly difficult given that the air force both supports the land and maritime forces and is in direct competition with those forces for limited military and government

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[4] Network Enabled Operations "represents an approach to the conduct of military operations characterized by common intent, decentralized empowerment and shared information, enabled by appropriate culture, technology and practices." *From* Sandy Babcock, *Canadian Network Enabled Operations Initiatives* (Ottawa, ON: Directorate of Defence Analysis, National Defence Headquarters,[2004]), 4.

[5] Centralised Centralized control is defined as "the vesting of authority in one commander for planning and directing operations. This centralized planning and direction enables timely allocation and tasking of assets to exploit the speed, range, and flexibility of air capabilities across the entire area. Centralized tasking and allocation of resources is accompanied by progressive decentralization of tasks; execution to the lowest command echelons capable of accomplishment." *From* Allan D. English, John Westrop and Canada. Dept. of National Defence, *Canadian Air Force Leadership and Command : The Human Dimension of Expeditionary Air Force Operations* (Ottawa: National Defence, 2007), 267, http://www.loc.gov/catdir/toc/fy0802/2007534566.html, 233.

[6] Decentralised execution is defined as "The delegation of execution authority to subordinate commanders." *From Ibid*., 236.

resources. Centralized control and decentralized execution is a force employment issue only, not one of force generation. Therefore, this paper seeks to address only the force employment issues of air force command and control.

Chapter one will examine the historical evolution of centralized control and decentralized execution. In examining the early evolution of air force C2, it shall become apparent that air forces traditionally operated in a manner that relied heavily on decentralized execution and the concept of mission command.[7] Aircrew were expected to execute the mission in the midst of the 'fog of war' and, until the advent of well defined Air Operations Centres and Targeting Boards in the last 20 years, had a considerable degree of autonomy in executing the mission. That degree of autonomy has been significantly reduced in recent years.

Canadian Aerospace Doctrine now closely resembles the United States Air Force (USAF) doctrine, which was heavily influenced by the American experience in Vietnam. The shift towards employment of a centralized Combined Air Operations Centre within coalition operations is the result. From a pragmatic perspective, as the United States is currently the largest air force in the world and often the largest contributor to coalition operations, it follows that the coalition C2 structures mirror the USAF construct. It is therefore not surprising that Canada's C2 structure also mimics to a great extent the USAF structure.

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[7] "The CF philosophy of command, which basically relies on a clear understanding of the commander's intent to co-ordinate the actions of subordinate commanders and which thereby allows them maximum of freedom of action in how they accomplish their missions. Mission command has its origins in the German Army concept of *auftragstaktik*, and is often contrasted with a command style which relies more on procedural direction and control." *From* Canadian Forces Leadership Institute and Canada. Chief of the Defence Staff, *Leadership in the Canadian Forces : Conceptual Foundations* (Canada: Chief of the Defence Staff by the Canadian Defence Academy - Canadian Forces Leadership Institute, 2005), 144, 131.

To understand the USAF structure, an anlysis of the command and control theories of Colonel John Boyd is necessary. In chapter two, this paper will examine Boyd's 'Observe, Orient, Decide, Act' (OODA) loop. It will discuss his emphasis on mission command as the element that best enables one to disrupt the way the adversary observes, decides and acts (or, as Boyd would describe it, to get inside the adversary's orientation phase). It shall be argued that Boyd's employment of decentralized control and almost exclusive focus upon the *orientation* phase of the OODA loop does not account for the ability of networks to also efficiently enable the *decision* and *act* phases of the OODA loop. Boyd states that the orientation phase "as the repository of our genetic heritage, cultural tradition, and previous experience – is the *most import part* of the OODA loop since it shapes the way we observe, the way we decide, the way we act."[8] It will become apparent that NEOps can assist not only in the orientation phase, but in the decide and act phases if C2 structures are organised in a manner true to the concept of decentralized execution. It shall be argued that, in addition to the efficiencies gained in Boyd's OODA loop through an extensive use of NEOps, their extensive use can result in a C2 structure that is more faithful to the original concept of centralized control and decentralized execution.

As part of the analysis of Boyd's work, it will be necessary to consider the evolution of his concept of mission command. Boyd concludes through his study on the *Patterns of Conflict* that decentralized control through mission command developed over the years as the battle space grew beyond the capacity of the commander to exercise

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[8] John Boyd, "Organic Design for Command and Control" Washington, DC, 1987), http://www.d-n-i.net/boyd/pdf/c&c.pdf (accessed 2 March 2009), slide 26.

command-by-direction and the 'fog of war' dominated the battle space. Thomas Czerwinski, in *Command and Control at the Crossroads,* coined the term command-by-direction as the oldest form of command, largely in unmanageable since the mid 18th century, whereby commanders with full view of the battle space could direct subordinate commanders during the battle.[9] However, as the complexity and scale of battles grew, subordinate commanders needed to understand their commander's intent so that they could execute the mission in the commander's absence, first through command-by-plan then later by command-by-influence. [10] Here, Boyd's explanation of mission command, another title for command-by-influence, borrows extensively from the German-Prussian use of *auftragstaktik,* the central component of which is mission-type tactics by subordinate commanders who have a clear understanding of the mission goal. *Auftragstaktik* combined with real time networks in a decentralized execution environment can enhance the OODA loop. However, before determining what type of C2 arrangement is necessary to properly exploit the network, a practical understanding of networks is necessary.

Chapter three will examine current theories on networks and their technologies to address whether they can be further exploited beyond the current focus on providing primarily situational awareness to a commander. Networks are not a new concept; they are resident in society and nature almost everywhere one looks. The origins of NEOps

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[9] Thomas J. Czerwinski, "Command and Control at the Crossroads." *Parameters* 26, no. 3 (Autumn, 1996): 121-132, http://www.carlisle.army.mil/usawc/Parameters/96autumn/czerwins.htm Internet; accessed 20 April 2009

[10] Czerwinski C2 framework defines *command-by-direction* as "not only the oldest of methods, but virtually the sole method until the middle of the 18th century, and largely in disfavor since." *Command-by-plan* "is characterized by trading flexibility for focus in order to concentrate on identifying and neutralizing centers of gravity, or target sets, in a campaign context." *From Ibid.*

are found in the business community where information technology has been harnessed to provide companies with a competitive advantage over their competitors. Within the military context, the limited emphasis on networks serving to improve the commander's situational awareness or, as Boyd would describe it, to orient him to the enemy, is an incomplete realisation of the full potential of networks. Although there is considerable debate as to what constitutes Network Centric Warfare (NCW)[11], this paper shall use the Canadian definition of NEOps, which is considered to be the next generation of NCW and a definition that is more conceptually based with greater focus upon the human dimension of networks.[12] Although U.S. documentation refers exclusively to NCW, NEOps is inclusive of NCW and more representative of the concepts to be discussed in this paper. NEOps is expected to,

> generate increased combat power by networking sensors, decision makers and combatants to achieve shared battlespace awareness, increased speed of command, higher operational tempo, greater lethality, increased survivability, and greater adaptability through rapid feedback loops.[13]

The majority of NEOps efforts have focussed on the ability to collect information and present the information to an operational commander in an intelligent manner for the purpose of arriving at a tactical decision. This is in part premised on traditional hierarchical Command and Control (C2) systems, systems which are relatively slow to react in a timely fashion to the rapidly changing threats within an area of operations.

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[11] NCW is often referred to in the Canadian context as NEOps and this paper shall use the term NEOps exclusively other than where direct quotes utilise NCW, or where the distinction between the technical aspects of NCW are contrasted with the human dimension aspects of NEOps.

[12] Michael H. Thomson and Barbara D. Adams, *Network Enabled Operations: A Canadian Perspective* (Toronto: Defence R&D Canada,[2005]), http://cradpdf.drdc.gc.ca/PDFS/unc50/p524084.pdf (accessed 8 April 2009), 5.

[13] *Ibid*., 5.

However, since the end of the war in Vietnam in 1975, dramatic advancements have been made in NEOps which promise the flexibility to re-task forces 'on the fly', thereby realising an efficiency and economy of effort for combat operations. Furthermore, the responsiveness of forces suggests sensitive targets could be prosecuted more quickly than ever before. This would prove particularly advantageous in such current theatres of operation as Iraq and Afghanistan where opposing forces, who employing guerrilla tactics, often strike quickly then meld back into the population thereby limiting the ability of coalition forces to counter-attack. These developments support a broader application of NEOps.

The fourth chapter of this paper will tie the three previous chapters together and describe a revised C2 structure that better incorporates the technological and informational advantages that networks offer. While air forces are often regarded as avid supporters of technological advancements, they frequently lag behind in terms of adjusting their doctrine to match these advancements. Technology has traditionally facilitated the centralized control element of air force C2 by facilitating many of the Principles of War such as economy of effort, flexibility and concentration of force.[14] To most effectively harness the full potential of NEOps will necessitate a review and revision of current doctrine on the command of air forces to more accurately reflect the concept of centralized control and decentralized execution. Until now, the technical aspects of NCW has served to increase the speed of traditional C2 structures without

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[14] Canada. Dept. of National Defence, *B-GA-400-000/FP-000 Canadian Forces Aerospace Doctrine*, 1st ed. (Ottawa: Dept. of National Defence, 2007), 66, v, 72, 26.

asking the simple question of whether there is something about the C2 structure which ought to be changed to better harness the potential of networks.

Several authors have suggested that NCW will undoubtedly necessitate a whole new thinking to how militaries are employed in the future. The Revolution of Military Affairs (RMA), as defined by the US Office of Net Assessment, states that the new technologies must be "combined with dramatic changes in military doctrine and operational and organisational concepts, fundamentally alter the character and conduct of military operations."[15] Technology possesses capabilities that if harnessed correctly can optimise certain military functions. As noted by military historian, Martin van Creveld,

> command is both an organizational function and a cognitive function, and … technology, by itself, is not a panacea. Historical success in command has stemmed from a commander's ability to get the most out of his C2 system through structuring, training, and developing his organization to minimize the constraint imposed by the limitations of contemporary technology.[16]

Whereas van Creveld was highlighting the limitations of C2 systems, any optimisations to be achieved by NCW must benefit the commander's abilities without further limiting the C2 structure.

Therefore, the focus of NCW in matching technologies against current C2 arrangements is akin to placing the cart before the horse. We must consider the effect of NCW at the conceptual stage. By focussing on the human dimension of command, NEOps places the cart in its rightful place and aims to define the C2 requirements for

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[15] Allan D. English, "The Operational Art : Theory, Practice, and Implications for the Future" In *The Operational Art : Canadian Perspectives : Context and Concepts*, eds. Allan D. English and others (Winnipeg: Canadian Defence Academy Press, 2005), 1-74, 51

[16] Carl H. Builder and others, *Command Concepts : A Theory Derived from the Practice of Command and Control* (Santa Monica, Ca.: Rand, 1999), 144, http://www.rand.org/pubs/monograph_reports/2006/MR775.pdf Internet; accessed 2 February 2009, 17.

which the NCW technologies can then develop. This paper will argue that a revised C2 structure that uses scale-free networks[17] at the operational level will permit one to not only orient to the enemy faster but to decide and act faster, as well. Scale-free networks permit important nodes,[18] or hubs, to have a seemingly unlimited number of links to other nodes. This connectivity between nodes will not only permit one to get "inside" the adversary's OODA loop, but it is a structure that air forces are most readily capable of implementing as it is consistent with the concept of centralised control and decentralised execution. This C2 structure would see a blending of the traditional hierarchical C2 structure above the operational level with a scale-free network structure at the operational level and below.

A great many buzzwords have appeared in military writings during the last decade, each of the associated concepts promises a new more efficient way of doing business. Despite the dizzying array of terminologies,[19] the pertinent question to ask is whether NEOps necessitates any significant changes to how air forces are commanded, or whether the current structures are inherently flexible enough to harness the potential of new technologies and research. After almost one hundred years of military aviation command and control evolution, evidence will demonstrate that the new technologies are

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[17] "Scale-free networks…contain hubs – nodes with a very high number of links. In such networks, the distribution of node linkages follows a power law in that most nodes have just a few connections and some have a tremendous number of links. In that sense, the system has no 'scale.'" *From* Albert-László Barabási and Eric Bonabeau, "Scale-Free Networks." *Scientific American* (May, 2003): 50-59, 53.

[18] A hub allows multiple segments or nodes to connect.

[19] A review of current literature will find a multitude of terminologies, most of which are closely related to one another, or at the least, can be easily confused with similar yet different terms. Some terms include, RMA, NCW, Effects Based Operations (EBO), Effects Based Approach to Operations (EBAO), Intelligence Surveillance Reconnaissance (ISR), and Intelligence Surveillance Targeting Acquisition Reconnaissance (ISTAR).

enablers to an already robust system of C2. Lastly, as the Canadian Forces currently reviews the C2 structures of the Air Force to limit the span of control inherent in its current structures, this paper shall argue that the benefits provided by networks actually promote a wider control of forces at the higher echelons and further decentralisation of execution at the lower levels.

History demonstrates war is enduring. The most consistent change has been the volume and speed of information available to fighting forces. The future of warfare, though uncertain, is foretold in theatres of operations like Iraq and Afghanistan. Modern irregular warfare (IW) wherein the enemy chooses fleeting contacts, on his own initiative, not ours, is proving challenging. "IW favors indirect and asymmetric approaches, though it may employ the full range of military and other capabilities in order to erode an adversary's power, influence, and will."[20] That is to say, that in order to be effective, NEOps must ensure that small units "are so well networked that they too can call for, and communicate with, joint assets providing their fire support."[21] Utilising mission command, in which all elements are focussed through the commander's intent, suggests networks can increase the efficiency and effectiveness of combat forces. This integration, to work effectively, must link air, land and maritime forces at all levels. The lines between strategic to tactical level capabilities will become more and more blurred.

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[20] United States. Air Force, *AFFD 2-3: Irregular Warfare* (Washington, D.C.: United States Air Force, 1 August 2007), http://www.dtic.mil/doctrine/jel/service_pubs/afdd2_3.pdf Internet; accessed 12 March 2009, 1.

[21] Lamont Kirkland, "Future Challenges for Land Forces: A Personal View." *British Army Review*, no. 142 (2007): 10-13, 12.

CHAPTER ONE –AIR FORCE COMMAND AND CONTROL

An understanding of command and control structures must necessarily begin by establishing a common foundation of terminologies. Defining the common language to be used is essential to ensure the nuances being discussed are clearly understood. This chapter will begin by defining many of the terminologies currently employed when discussing air force C2 relationships. This will then permit an examination of the uniqueness of air force command and control structures that must start by examining the historical beginnings of the world's air forces.

While the Canadian Air Force employs many of the same terminologies as the Army and the Navy, its unique historical context, that of a shared British and U.S. struggle for independent air forces, shapes our C2 relationships. The Canadian Air Force, like many of its allies, purports to operate under the concept of centralized control and decentralized execution. As shall be demonstrated, this term is poorly understood by most air forces. As Dr. Ross Pigeau and Carol McCann argue there is "little consensus within either the military or the research communities on the actual definitions for Command, Control and C2."[22]

An Understanding of Command and Control Terminologies

It must first be noted that each element of C2 – command, control and the joint concept of command *and* control – have distinct meanings. In developing their examination of C2 terminologies, Pigeau and McCann assumed that only humans

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[22] Ross Pigeau and Carol McCann, "Re-Conceptualizing Command and Control." *Canadian Military Journal* 3, no. 1 (Spring, 2002): 53-63, http://www.journal.dnd.ca/vo3/no1/doc/53-64-eng.pdf Internet; accessed 26 March 2009, 53.

command.[23] This assumption, they argue, intuitively makes sense and conforms to various definitions of command. The Rand Institute, in a publication entitled *Command Concepts: a Theory Derived from the Practice of Command and Control*, defines command as "the authority vested in an individual of the armed forces for the direction, coordination, and control of military forces."[24] In the same vein, the U.S. Joint Chiefs of Staff in JCS Pub 1-02 defines command as "the authority that a commander in the Military Service lawfully exercises over subordinates by virtue of rank or assignment."[25] Canada's own *Leadership in the Canadian Forces: Doctrine*, differentiates between leadership[26], command and management[27] and clarifies command as "the purposeful exercise of authority – over structures, resources, people, and activities."[28] While the variances in definitions might lead one to conclude there is not much in common between the definitions, the common feature within all is the human element. In essence,

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[23] *Ibid*., 54.

[24] Builder and others, *Command Concepts : A Theory Derived from the Practice of Command and Control*, 144, xiii.

[25] Gregory A. Roman, *The Command Or Control Dilemma: When Technology and Organizational Orientation Collide* (Maxwell AFB, AL: Air War College, 1997), 5.

[26] Leadership is defined as "the process of directly or indirectly influencing others, by means of formal authority or personal attributes, to act in accordance with one's intent or a shared purpose." *From* Canadian Forces Leadership Institute and Canada. Chief of the Defence Staff, *Leadership in the Canadian Forces : Conceptual Foundations*, 144, 131.

[27] Management is defined as "the authority-based process of planning, organizing, leading, and controlling the efforts of organizational members and the use of other organizational resources to achieve organizational goals." *From Ibid*., 131.

[28] Canadian Forces Leadership Institute and Canada. Chief of the Defence Staff, *Leadership in the Canadian Forces : Doctrine* (Canada: Chief of the Defence Staff by the Canadian Defence Academy - Canadian Forces Leadership Institute, 2005), 43, 7.

computers cannot command. Thus, Pigeau and McCann condense command to "the creative expression of human will necessary to accomplish the mission."[29]

Pigeau and McCann go on to define control as "those structures and processes devised by command to enable it and to manage risk."[30] Control is an enabler to the creative expression defined within command. A fundamental element of Pigeau and McCann's understanding of *command and control* is this notion of control. This portion of their study is not replicated in other studies on the subject. For example, the JCS Joint Pub 1-02 proceeds directly from its definition of command to a definition of command and control imparting an ambiguous and inaccurate definition.[31] While Pigeau and McCann differentiate between *command* and *control*, they also explain how the two concepts relate. They note that command "creates and changes the structures and process of control to suit the uncertain military situation, thus making command pre-eminent. Control should always be subordinate to command."[32]

Having addressed *command* and *control* as separate concepts, Pigeau and McCann proceed to address the single concept of *command and control* (C2). While any individual may command, in the military context, effective command requires a common understanding of the military mission to be accomplished. According to Pigeau and

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[29] Pigeau and McCann, *Re-Conceptualizing Command and Control*, 53-63, 56.

[30] *Ibid*., 56.

[31] Roman, *The Command Or Control Dilemma: When Technology and Organizational Orientation Collide*, 6.

[32] Pigeau and McCann, *Re-Conceptualizing Command and Control*, 53-63, 62.

McCann, C2 is "the establishment of common intent to achieve coordinated action."[33] In contrast, the Rand institute suggests C2 "functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures which are employed by a commander … in the accomplishment of the mission."[34] The Rand definition fails at any point to include establishing a common intent as a component of C2. This omission has significant implications.

Intent must be considered a vital element of C2 because C2 invariably will involve both implicit and explicit intent factors. The explicit intent relates to "that part [of common intent] which has been made publicly available through orders, briefings, questions and back-briefs."[35] It is that which is overtly expressed. Implicit intent will involve the unexpressed: it "is derived from personal expectations, [and] experience due to military training, tradition and ethos and from deep cultural values."[36] Although implicit intent is not directly expressed, it is inherent in the nature of how we conduct military operations. For example, an aviation mission commander, when assigning a task to his flight may order his flight to insert a platoon strength infantry unit to an area in the forward battle area. While not expressly detailing how or with how many aircraft this task is to be accomplished, standard operating procedures (SOPs); tactics, techniques and

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[33] Joe Sharpe and Allan D. English, *Principles for Change in the Post-Cold War Command and Control of the Canadian Forces* (Winnipeg, MB: Canadian Forces Leadership Institute, 2002), 128, 79.

[34] Builder and others, *Command Concepts : A Theory Derived from the Practice of Command and Control*, 144, xiii.

[35] Sharpe and English, *Principles for Change in the Post-Cold War Command and Control of the Canadian Forces*, 128, 79.

[36] *Ibid*., 80.

procedures (TT&Ps); and, common training provide the necessary level of explicit and implicit detail and understanding for subordinate elements to accomplish the mission.

Having developed a common understanding of *command*, *control*, and *command and control,* we can begin to examine from a historical perspective the development of air force C2 structures. A historical examination is necessary to understand the concept of *decentralized execution* and how air forces came to adopt the concept of centralized control and decentralized execution.

A Historical Perspective

The Canadian Air Force evolved from two primary traditions, the first of course being tied to Canada's development as a young nation under the British influences and traditions. The second was the tremendous influence of the development and evolution of the United States Air Force (USAF), particularly during the latter half of the twentieth century. The combination of these two traditions has had great influence on the evolution of C2 in the Canadian Air Force.

This section shall examine in some detail the evolution of Canada's Air Force from its birth as the Royal Canadian Air Force in 1924, through unification in 1968 to the current period. The latter part will examine milestones in the USAF's evolution which directly affected the development of Canadian Air Force doctrine, with particular focus on the post Second World War period.

Early Royal Air Force Influences on the modern Canadian Air Force

The earliest experiences of the RAF during WWI demonstrated the need for centralized control of air resources.[37] This centralized control was necessitated due to the complexity of the increasing number of aircraft being flown into battle, as many as 2000, by 1918.[38] The sophisticated C2 system developed at this time was all but lost in the interwar years with control of air assets being decentralized as the RAF shrank and was quite widely dispersed across the Empire. However, by the outbreak of WWII, C2 relationships once again became rather complex, especially in Fighter Command-charged with defending Britain from attack. Furthermore, the complex network of early warning and air defence systems for the defence of England necessitated a centralized control of all fighter squadrons organised under four groups, each with several sectors further sub-dividing it. The efficiency of this organisation was demonstrated by the quick response times to inbound attacks. Within minutes, hostile aircraft observations could be transmitted to Fighter Command HQ in Bentley Priory, prioritised and assessed, and then forwarded to the Group HQs. The Group HQ would then be responsible for the tactical control of the battle. Throughout the war in other commands such as Bomber Command, it became necessary to exercise centralized control of air forces to coordinate the "increasingly larger air forces."[39] Herein lay the genesis for the concept of centralized control and decentralized execution.

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[37] Allan D. English, "Rethinking 'Centralized Command and Decentralized Execution'" In *Air Force Command and Control*, eds. Douglas L. Erlandson and Allan D. English (Winnipeg, MB: Canadian Forces College, 2002), 71-81, 73.

[38] *Ibid*., 73.

[39] *Ibid*., 74.

The evolution from the two world wars of the concept of centralized control with decentralized execution was brought about by the relative scarcity of air assets. Given that there were never enough air assets to satisfy everyone, management under a single commander was required to control their allocation. Secondly, in complex operations requiring a high level of coordination, centralized control became essential "because of the nature of air assets and the environment in which they operate."[40] Despite this, the management of air resources under a single commander was not the Canadian experience during the post Second World War years. For a period of time in our history, our Air Force almost ceased to exist and came close to being subsumed by the Army and the Navy. The three separate services, the Army, the Royal Canadian Navy (RCN) and the Royal Canadian Air Force (RCAF), with their origins derived from their British counterparts during the First and Second World Wars, were dramatically reorganized in a manner that reflected unique "characteristics based on Canadian geography, culture and political heritage."[41]

The modern air element of the Canadian Forces derives its current structure from Bill C-243, the Canadian Forces Reorganisation Act of 1966, which came into effect on 1 February 1968. Under this act, the Army, the RCN and the RCAF were unified under one command and the former services were replaced through unification by six new functional commands. Despite "unification, in seemingly short order the old service rivalries began to erode the joint commands, especially Mobile Command and Maritime

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[40] *Ibid*., 76.

[41] Canada. Dept. of National Defence, *B-GA-400-000/FP-000 Canadian Forces Aerospace Doctrine*, 66, v, 72, 9.

Command, into their old army and navy camps while the remnants of the Air Force floundered as it lacked any centralized C2 component to develop doctrine and tactics.[42]

Even though unification brought the aviation assets of the RCAF, RCN and the Army under functional command formations, the uniqueness of their former command relationships could not be so easily unified.[43] Early C2 relationships were constructed which permitted the former services to retain some control over the assets. That which was formerly under command of the Army was now placed under Mobility Command (MOBCOM) along with some fast air resources. The concept was that those aviation and air resources which directly supported the land element would be under command of MOBCOM, first as the Tactical Aviation branch and then subsequently as a separate headquarters integral to MOBCOM, identified as 10 Tactical Air Group (10 TAG). Under MOBCOM, the air element grew to become "the largest 'air force' in the CF"[44] including fighters, helicopters, and spotter aircraft.

The RCN Aviation Branch underwent a similar transformation. Elements of the former RCN Aviation Branch were subsumed by Maritime Command (MARCOM) along with elements of the former RCAF Maritime Air Command. Air Transport Command, Material Command and NATO Europe's 1 Air Division were further examples of the dissection of the former RCAF. The 'air element', established in 1966, was being slowly

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[42] English, Westrop and Canada. Dept. of National Defence, *Canadian Air Force Leadership and Command : The Human Dimension of Expeditionary Air Force Operations*, 267, 53.

[43] *Ibid*., 41.

[44] *Ibid*., 44.

dissected into various air warfare communities that were "threatening to fracture Canadian air power and to divide it into small, divided functional communities."[45]

Separating into functional communities, without some central direction was seen to be an inefficient means of providing the air capabilities required by the CF. By 1975, under CANFORGEN 15/75 "Formation of Air Command," all air resources were unified under Air Command, however operational control of some air assets would be retained by user commands such as MOBCOM, MARCOM and CF Europe. "The new command would, however, have CF-wide jurisdiction over air doctrine, flight safety and common air policy, including training standards."[46] Air Command would be responsible for the majority of force generation issues and some force employment, while function-specific force generation issues and the majority of force employment responsibilities would be retained by the functional commands.

During this period of transformation in Canada's Air Force, the United States was further refining the C2 relationships of its air resources as a result of the Vietnam War.

United States Air Force Influences – From WWI to Vietnam

While the USAF can draw much of its lineage to common influences alongside the Royal Air Force in both world wars, its experiences since WWII have uniquely shaped its character. Though the RAF was founded in 1918, and the RCAF in 1924, the USAF struggled for independence from the Army and was not created as a distinct force until 1947. By the Vietnam War, the USAF had developed the Tactical Air Control

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[45] *Ibid*., 49.

[46] *Ibid*., 50.

Center (TACC) as a mechanism for permitting more responsiveness of air power to the needs of the traditional land campaign; however, it was apparent to senior commanders that the ability to plan for and execute deep interdiction and strategic attacks remained problematic for the USAF in terms of the level of planning required to accomplish this task.[47] This level of targeting planning was not resident within the TACC organisation as the focus had been upon the close battle with land components.

The TACC, during the early years of Vietnam, had clearly demonstrated its glacial approach to targeting. During Operation Linebacker II, the services were required to submit their respective target lists several weeks in advance.[48] This resulted in the TACC over-centralising "planning and execution by staffs far removed from the operational environment."[49] By the end of the War, the TACC had "emerged from Vietnam as a dual system"[50] where pre-planned interdiction targets were processed and attacked within 24 to 72 hours. Time sensitive targets were handled altogether differently by the TACC. The evolution towards a dual system meant time sensitive targets were more appropriately handled through "forward controllers for final target assignment based on the ground situation."[51] The decentralized execution whereby aircraft were 'on station' to loiter in anticipation of a mission was now considered a secondary mission by

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[47] J. Taylor Sink, "Rethinking the Air Operations Center: Air Force Command and Control in Conventional War" Air University), v.

[48] *Ibid*., 18.

[49] Anonymous, "Decentralized Execution." *Air & Space Power Journal* 18, no. 1 (Spring, 2004): 60, www.proquest.com Internet; accessed 20 April 2009, 60.

[50] Sink, *Rethinking the Air Operations Center: Air Force Command and Control in Conventional War*, 19.

[51] *Ibid*., 20.

the TACC, which was beginning to place priority upon the selection, targeting and battle damage assessments of strategic targets over the tactical level employment of air resources in direct support of troops on the ground.

Experiences from Vietnam had demonstrated to senior Air Force officers the inability of the TACC structure to rapidly target and prosecute deep objectives. Had it not been for political interference, strategic bombing could have ended the war years earlier,[52] however this strategic level oversight of target selection impeded the ability of the TACC to execute timely interdiction targeting. In the intervening years between Vietnam and the Gulf War of 1991, the TACC had been renamed the Air Operations Center (AOC) and greater focus has been placed upon the target selection and assignment of air resources for tactical execution.

The Gulf War of 1991 (Operation Desert Storm) was a seminal event in the understanding of centralized command and control in the air force in that the AOC would include. The primary responsibility of the air component commander is the careful selection of and prosecution of targets, wherein the target is the objective to be achieved with measurable results.[53] Without the careful selection and prioritisation of targets, matched to the appropriate asset, air resources are inefficiently managed. Here the AOC matured beyond its predecessor the TACC, to include the in-depth planning necessary to conduct deep interdiction and strategic targeting.

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[52] Michael W. Kometer, *Command in Air War: Centralized Versus Decentralized Control of Combat Airpower* (Maxwell Air Force Base, Alabama: Air University Press, 2007), http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA473231&Location=U2&doc=GetTRDoc.pdf, 31.

[53] Sink, *Rethinking the Air Operations Center: Air Force Command and Control in Conventional War*, 5.

During Operation Desert Storm, the pendulum swung fully in the opposite direction from Vietnam. Whereas the TACC, at the outset of the Vietnam War was highly agile in responding to immediate calls for interdiction but limited in its ability to rapidly select and target tactical objectives, by 1991 the number of sorties flown during Operation Desert Storm resulted in inefficiency in the ability of the AOC to rapidly prosecute targets of opportunity.[54] In examining the post Desert Storm results of the AOC, it becomes apparent that the AOC must be capable of striking strategic targets just as rapidly as the TACC had demonstrated its ability to strike time sensitive tactical targets.[55] The question will remain how to go about doing this and, as will become apparent, decentralized execution in a network environment permits the same level of flexibility at both the strategic targeting and tactical targeting levels. Decentralized execution does not, however, equate to separate services each with their own dedicated air arm. Consistent with United States Air Force Doctrine, "a single, cohesive organisation is required with clearly defined lines of command and commanders with requisite authorities at appropriate levels."[56]

In the latest edition of the USAF Basic Doctrine of November 2003, the first tenet of air and space power remains centralized control and decentralized execution. Recognising the competing nature of the list of tenets, "for example mass versus

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[54] *Ibid*., 31.

[55] *Ibid*., 39.

[56] United States. Air Force, *Air Force Basic Doctrine* (Washington, DC..: Dept. of the Air Force, 2003), http://www.dtic.mil/doctrine/jel/service_pubs/afdd1.pdf Internet; accessed 10 March 2009, 5.

economy of force, concentration versus balance, and priority versus objective"[57], commanders are obligated to judiciously apply the tenets in a given situation. Centralized control and decentralized execution are regarded as "being critical to effective employment of air and space power." [58] USAF Basic Doctrine goes further by stating this first tenet is the fundamental organising principle borne out of decades of experience.

Whereas Dr. English in *Canadian Air Force Leadership and Command* borrows from U.S. Joint Publication 1-02 in defining decentralized execution as "the delegation of execution authority to subordinate commanders,"[59] the USAF Basic Doctrine defines decentralized execution as "the delegation of execution authority to responsible and capable lower level commanders to achieve effective span of control and to foster disciplined initiative, situational responsiveness, and tactical flexibility."[60] It goes on to explain that decentralized execution permits the flexibility of subordinate commanders to prosecute the mission, having a clear understanding the commander's intent. Despite these professed benefits, the examples of the AOC from Operation Desert Storm seem to indicate C2 structures are evolving in exactly the opposite direction, more towards a centralized control and centralized execution.

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[57] *Ibid*., 27.

[58] *Ibid*., 28.

[59] English, Westrop and Canada. Dept. of National Defence, *Canadian Air Force Leadership and Command : The Human Dimension of Expeditionary Air Force Operations*, 267, 236.

[60] United States. Air Force, *Air Force Basic Doctrine*, 28.

Centralized Control and Decentralized Execution: Paying Lip Service

The benefits of decentralized execution are apparent, regardless of how well it is practiced by air forces. USAF Basic Doctrine states, "a high level of centralized execution results in a rigid campaign unresponsive to local conditions and lacking in tactical flexibility."[61] Why is it then that air forces do not seem to practice what they preach? Is there a misunderstanding of what decentralized execution really means?

Pigeau and McCann's study differentiates between explicit and implicit C2 structures. Their assertion is that highly centralized C2 structures tend to be very explicit in nature where subordinates are not only explicitly told what to do, "but how to do it."[62] By contrast, decentralized C2 structures tend to be more implicit. Implicit structures are by their nature, more flexible, but less efficient.[63] However, as indicated by Dr. English in *Command & Control of Canadian Aerospace Forces: Conceptual Foundations*, there remains considerable confusion on the *raison d'etre* of mission command within the decentralized execution of NEOps.[64] Does not the implicit nature of decentralized C2 structures demand the use of mission command?

It would seem the USAF at least understands the concept, even if evidence suggests the USAF has not practiced the concept in recent operations.

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[61] *Ibid*., 30.

[62] Sharpe and English, *Principles for Change in the Post-Cold War Command and Control of the Canadian Forces*, 128, 80.

[63] *Ibid*., 80.

[64] Allan D. English, *Command & Control of Canadian Aerospace Forces: Conceptual Foundations*, ed. Canadian Forces Aerospace Warfare Centre Production Section (Canada: Her Majesty the Queen, 2008), http://www.airforce.forces.gc.ca/cfawc/eLibrary/eLibrary_e.asp Internet; accessed 20 January 2009, 2.

> Execution should be decentralized within a command and control architecture that exploits the ability of strike package leaders, air battle managers, forward air controllers, and other front-line commanders to make on-scene decisions during complex, rapidly unfolding operations.[65]

The exception to this is where the control of strategic effects is so great as to require the sacrifice of tactical efficiency.[66] An example would be where the collateral damage to civilian infrastructures is deemed politically undesirable. This seems to imply that decentralized execution, while promoting flexibility, will almost always be abandoned where the effect to be achieved is strategic in nature. How then can one ever expect to truly have decentralized execution if the higher echelons or even the political level are exercising command-by-direction[67] or at the least demanding meticulous command-by-plan?

The current Canadian Forces Aerospace Doctrine does not seems to offer any greater clarity on the definition of decentralized execution. Decentralized execution is defined as, "the delegation of authority to lower-level commanders … essential for effective span of control and to foster initiative and situational responsiveness."[68] However, the Canadian doctrine manual fails to demonstrate any real understanding of decentralized execution, instead, using by way of example, the physical dislocation between the Air Component Commander (ACC) and the Joint Task Force Commander

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[65] United States. Air Force, *Air Force Basic Doctrine*, 30.

[66] *Ibid*., 30.

[67] "This form of command has been used since the beginning of organized warfare, and it is based on commanders attempting to direct all of their forces all of the time." English, Westrop and Canada. Dept. of National Defence, *Canadian Air Force Leadership and Command : The Human Dimension of Expeditionary Air Force Operations*, 267, 117.

[68] Canada. Dept. of National Defence, *B-GA-400-000/FP-000 Canadian Forces Aerospace Doctrine*, 66, v, 72, 30.

during Operation Desert Storm. The doctrine states, "the CF task force command was not co-located with the JFACC but was in fact in a different country."[69] One could hardly consider this decentralized decision making and execution in practice as decentralized execution is not about the physical dislocation of subcomponents rather the delegation of authority to lower level commanders.

The key element of effective decentralized execution is the delegation of authority to influence operations at the appropriate level. However, modern networks, by virtue of their increased speed and multitude of connections to C2 structures, Intelligence Surveillance and Reconnaissance (ISR) platforms and common operating picture, now permit strategic command levels to directly influence tactical level decisions. This erodes decentralized execution. As Pigeau and McCann stress, the explicit and implicit intent component of C2 is fundamental. A "common intent among military members . . . is necessary for achieving coordinated actions."[70] Mature C2 systems impart common intent and delegate responsibility to the appropriate level. However, as will be demonstrated, the effect of networks on immature C2 systems appears to foster centralized command, control and execution. It is the air force which is first amongst those readily adopting this centralisation while professing the merits of decentralized execution.

As expressed earlier, both implicit and explicit intent leads to a clear understanding of the commander's criteria for mission execution. Referred to as *mission command,* it is a philosophy whereby the commander provides guidelines which provide

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[69] *Ibid*., 33.

[70] English, *Command & Control of Canadian Aerospace Forces: Conceptual Foundations*, 19.

subordinate commanders the latitude to determine how to achieve mission success.[71] This philosophy, derived from the Prussian concept of *auftragstaktik* will be addressed in greater detail in the next chapter.

If mission command provides the guidelines, then the command concept provides "a vision of a prospective military operation that informs the making of command decisions during that operation."[72] Providing the essential information resident within command and control systems, the command concept assists in defining the C2 network structure which "would transmit *only information that helps the commander convey his command concept, or alter it.*"[73] In essence, it protects the commander from information overload, providing him only the information necessary to arrive at a decision. But this also flows the other way, ensuring the commander's intent is transmitted to subordinates with the essential information upon which they can execute the mission. This command concept ensures the commander is permitted to focus upon the whole picture without being distracted as a result of information overload. Only that information which alters his vision for the mission is transmitted, although the flexibility remains to confirm his intuition, if he wishes. For example, having determined what the commander believes to be the enemy's critical vulnerabilities, the network may inform the commander that his assessment is incorrect, which will directly affect the mission of subordinate commanders. In this instance, the commander will wish to immediately redirect those subordinate commanders.

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[71] *Ibid*., 6.

[72] *Ibid*., xvii.

[73] *Ibid*., xvii.

As discussed earlier, commanders must resist the temptation to exercise command-by-direction as a result of the increased situational awareness created by networks, but also networks must not be viewed as simply being there to provide the commander with the information upon which he may arrive at a decision. This presumes that military organisations are designed to be information processing mechanisms, but as Pigeau and McCann summarise, *command* and *control* are much more. Command involves the creative human expression while control provides the structures and processes to enable that expression. "Viewing a military organization primarily as an information-processing mechanism neglects many aspects of command but enables C2 models to be constructed without confronting these difficult aspects."[74] Networks should not be built to meet the C2 structures but rather to find the appropriate balance between providing the commander the necessary intelligence through which his mission concept may be executed and providing him the situational awareness to confirm or refute his intuition. The network must be capable of assisting mission command, not replacing it with command-by-direction.

A contemporary theorist on mission command, who has had tremendous influence on the popularisation of manoeuvre warfare, is Colonel John Boyd of the United States Air Force. His rejuvenation of mission command as a concept of effectiveness and efficiency in the operational art are examined in greater detail in the next chapter.

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[74] Builder and others, *Command Concepts : A Theory Derived from the Practice of Command and Control*, 144, 10.

CHAPTER TWO – BOYD'S OODA LOOP

Theory of…

Appreciating Boyd's Observe, Orient, Decide Act cycle must begin with understanding its author so as to appreciate why and where he places the emphasis in command. Boyd was outspoken, abrasive, strongly opinionated and yet often correct in his theories throughout his military career. A pilot, amateur philosopher, historian and engineer, Boyd wove together his interests to first study the physics of aerial combat and later the patterns of conflict throughout military history. An A-type personality, his view of the world was dominated by absolutes. His ability to defeat every student pilot of the F-100 within 40 seconds of aerial combat became notorious in the Air Force fighter community while he taught tactics at Nellis Air Force Base in the late 1950's earning him the title of "40 second Boyd."[75] Yet, rather than be content with being the best "stick" on squadron, Boyd examined every aspect of his flying and came to the conclusion that there were certain absolutes about flying that would always lead him towards victory.

In the post World War II period, very little about the conduct of aerial combat was documented. While teaching at the Fighter Weapons School (FWS), Boyd drafted the first complete "Aerial Attack Study," largely on his own time.[76] His zeal for examining that which everyone took for granted, led him to enter into an industrial engineering undergraduate program in 1960. The culmination of this study resulted in Boyd authoring the now famous Energy-Manoeuvrability (E-M) Theory. "The E-M Theory, at

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[75] Robert Coram, *Boyd : The Fighter Pilot Who Changed the Art of War*, 1st ed. (Boston: Little, Brown, 2002), 485, http://www.loc.gov/catdir/toc/fy036/2002022816.html, 94.

[76] *Ibid*., 119.

its simplest, is a method to determine the specific energy rate of an aircraft."[77] Through a simple equation developed by Boyd, the relative energy of an aircraft can be calculated in any regime of flight, thereby defining in a dogfight which aircraft would have the advantage of being able to get into a firing position the fastest. The theory is being taught to this day to fighter pilots around the world.

There were those throughout Boyd's career who saw the potential genius in his work; unfortunately there were far more who could not see past the abrasive personality to the genius beneath.[78] His intellectual zeal and desire for perfection carried over into virtually every aspect of Boyd's professional life; he would challenge the conclusions of others where he felt his own research indicated otherwise. He was critical of several aircraft procurement programs throughout the 70's and 80's, which in turn garnered him many unsupportive superiors in the Pentagon. To him it was not a matter of being somebody, going with the majority and thereby not rocking the boat. It was a matter of doing something. "To *be* somebody or to *do* something. In life there is often a roll call. That's when you will have to make a decision. To *be* or to *do*? Which way will you go?"[79] Unquestionably in Boyd's mind it was either one or the other, no middle ground, and he personally set about to do something.

His intellectual curiosity and perfectionism led Boyd, with the same resolve as he examined the E-M theory, to ponder philosophically the process of how it was that he came about this theory and whether this process could be more universally applied. By

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[77] *Ibid*., 147.

[78] Hammond, *The Mind of War : John Boyd and American Security*, 194.

[79] Coram, *Boyd : The Fighter Pilot Who Changed the Art of War*, 485, 285-6.

1986, after spending years studying every battle from ancient times to the Vietnam conflict, Boyd created his discourse on the *Patterns of Conflict,* latter amending his lecture to include *An Organic Design for Command and Control*.[80] In it, he emphasises the requirement of adaptability "to cope with uncertain and everchanging [*sic*] circumstances."[81] The adaptability he refers to is the ability to rapidly alter direction in a variety of manners. It is this unpredictability that requires the enemy to constantly re-orient himself, to the benefit of one's own forces. However, the ability to re-orient one's self to the enemy's unpredictability is of equal importance. The essential elements to achieve this adaptability, in Boyd's opinion, were variety and rapidity combined with harmony and initiative. The correct balance among these essential elements was the key to success.

The central question to Boyd's *Organic Design for Command and Control* was how to generate harmony and initiative to exploit variety and rapidity.[82] Harmony and initiative without variety and rapidity would lead to a rigid, predictable and inflexible organisation while variety and rapidity without harmony and initiative would lead to confusion, disorder and chaos.[83] In other words, the question was which interactions promote harmony and initiative so as to exploit variety and rapidity? The processes are complimentary and not exclusive of one another. For Boyd, the key to this process was the orientation of oneself to the enemy.

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[80] Hammond, *The Mind of War : John Boyd and American Security*, 155.

[81] Boyd, *Organic Design for Command and Control*, 3.

[82] *Ibid*., 9.

[83] *Ibid*., 9.

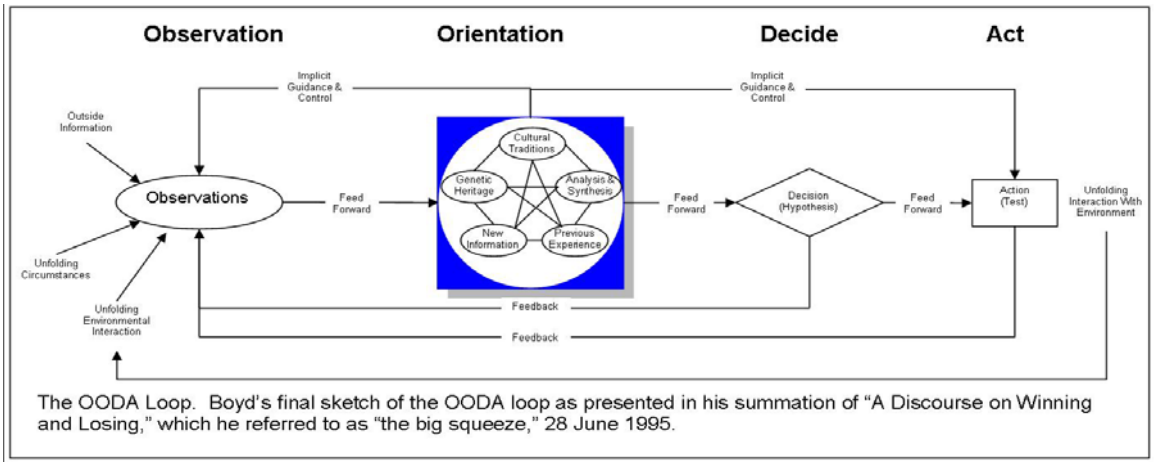

Figure 1 - ***OODA Loop as presented by Colonel John Boyd***

The culmination of that work, for which Boyd is most often cited, was the development of the OODA loop. This loop is intended to guide one through the process of observing through a number of cues, then applying an understanding to the information in context with various other factors including culture, genetic heritage, previous experience, analysis and synthesis, and new information. From a thorough orientation to the enemy, Boyd suggested one could make an accurate decision on what to do next and then act upon it. Throughout was the requirement to provide continuous feedback to the observation function. Within the diagram represented at Figure 1, the majority of military theorists, including Boyd, place the emphasis primarily upon the orientation phase. The orientation phase was, according to Boyd, the most critical phase because it was the most difficult for the military commander to grasp. As demonstrated in Figure 1, the orientation phase demonstrates the intricacy of cross-referencing necessary to accurately orient to the enemy. Boyd did not consider the list of interactions as exhaustive, but representative of the complexity of understanding necessary to orient to the enemy.

Various elements of the Orientation Phase might include such things as enemy doctrine and standard operating procedures, political intent, and technical capability, to name but a few. As important as it is to orient oneself to the enemy, so too, the commander must orient to oneself – "to unveil adversary plans and actions as well as to foresee our own goals and appropriate plans and actions."[84]

Boyd's understanding of military history from Sun Tzu through Bourcet, Napoleon, Clausewitz, Jomini, Forrest, Blumentritt and Balck led him to conclude that, although friction and confusion were natural in conflict, harmony and initiative could overcome, thus granting an advantage over the enemy. Creating confusion in the enemy's orientation is as important as attempting to resolve any confusion in orienting to the enemy. For "40 second Boyd" it was no different than the ability of a fighter pilot to manoeuvre his aircraft to gain a firing position on an enemy first before the enemy could do likewise. The orientation phase was to Boyd the *schwerpunkt* (focal point) and "shapes the way we observe, decide, and act."[85]

In all of Boyd's dissertations, the OODA loop leads to a superior command and control system in which "what is unstated or not communicated explicitly to one another… diminishes friction and compresses time, gaining both quickness and security."[86] Boyd's theories borrowed extensively from the Prussian concept of *auftragstaktik*, which has been a component of German tactics since the 19th century, and is largely credited with the successes of the *blitzkrieg* of the Second World War.

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[84] Hammond, *The Mind of War : John Boyd and American Security*, 163.

[85] *Ibid*., 164.

[86] *Ibid*., 164.

Auftragstaktik was introduced by the Prussians following the disastrous defeat at Jena and Auerstedt to Napoleon's modern brand of warfare.[87] Ironically, it was the advent of the breach loading rifle in the mid-19th century that had demonstrated "that advances in armaments had outstripped advances in tactical and doctrinal development."[88] This revolution in military affairs (RMA) was recognised by Field Marshal Helmut von Moltke, Chief of the General Staff from 1857-1888. By granting subordinates the authority "to act within the guidelines of his superior's intent," the senior commander places trust in the subordinate to perform his duty unwaveringly. [89] To achieve success, the commander specifies the objective and the framework to accomplish the mission and provides the resources to the subordinate necessary to carry out the mission. "Thus, *Auftragstaktik* is not merely a technique of issuing orders but a type of leadership that is inextricably linked to a certain image of men as soldiers."[90]

'Mission command', a concept closely related to *Auftragstaktik,* is a term Boyd influenced in United States doctrine. For Boyd, granting subordinate commanders the opportunity to exercise initiative in order to realise higher commander's intent would permit "opportunistic, fast-breaking, imaginative leadership. . . For Boyd , the issue was not a matter of doctrine, but of doctrines—a whole quiver full of options to be applied in

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[87] MGen Werner Widder, "Auftragstaktik and Innere Führung: Trademakers of German Leadership." *Military Review* (September-October, 2002): 3-9, http://usacac.army.mil/CAC2/MilitaryReview/Archives/oldsite/English/SepOct02/SepOct02/widder.pdf Internet; accessed 20 January 2009, 3.

[88] *Ibid*., 4.

[89] *Ibid*., 4-5.

[90] *Ibid*., 6.

rapid, staccato thrusts."[91] Appreciating the significance of creating command and control systems that could exploit the advantages of a rapid orientation to the enemy, Boyd stated,

> It seems that the command and control (C&C) we are speaking of is different than the kind that is being applied. In this sense, the C&C we are speaking of seems more closely aligned to *leadership* (rather than command) and to some kind of *monitoring* ability (rather than control) that permits leadership to be effective. In other words, leadership with monitoring, rather than C&C, seems to be a better way to cope with the multifaceted aspects of uncertainty, change, and stress. On the other hand, monitoring, per se, does not appear to be an adequate substitute for control. Instead, after some sorting and reflection, the idea of *appreciation* seems better.[92]

So if Boyd was suggesting that *command* could be replaced by *leadership*[93] and *control* could be replaced by *appreciation*[94], what does this mean for traditional command and control relationships? It means that not only can orienting to the enemy faster than the enemy can orient to us give us the advantage, but our ability to make decisions faster and act quicker can also permit us to stay inside the enemy's OODA loop, thereby creating opportunities to attack the enemy while denying him the same.

More than about the orientation…

Suggesting that orientation is the most critical phase of the OODA loop, as Boyd did, does not preclude us from focussing on ways to accelerate the loop in the *decide* and

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[91] I. B. Holley, "Reflections on the Search for Airpower Theory" In *The Paths of Heaven: The Evolution of Air Power Theory*, ed. Philip S. Meilinger (Maxwell AFB, AL: Air University Press, 1997), 579-599, http://aupress.maxwell.af.mil/Books/Meil-Paths/Paths.pdf (accessed 9 March 2009), 592.

[92] Hammond, *The Mind of War : John Boyd and American Security*, 166.

[93] For Boyd leadership "implies the art of inspiring people to enthusiastically take action toward the achievement of uncommon goals." *From* Boyd, *Organic Design for Command and Control*, slide 37.

[94] "Appreciation refers to the recognition of worth or value, clear perception, understanding, comprehension, discernment, etc." *From Ibid*., slide 37.

act functions as well. MGen Widder articulates, "Only *Auftragstaktik* enables the meaningful exploitation of the most sophisticated technology, and only *Auftragstaktik* allows mastery of the increasingly complex challenges of the 21st century."[95] If we are now willing to accept that commanders at various levels have faith in their subordinates' understanding of the commander's intent, and we are willing to accept that the subordinate is accepting of their respective responsibilities, what can networks provide as a means of facilitating *auftragstaktik*?

The speed with which one can orient to the enemy, decide and then act can be greatly benefited through NEOps, however commander's intent will be an essential factor in determining mission success.[96] NEOps will permit subordinate commanders to maintain the rhythm of decisions of higher commanders and will permit higher commanders to maintain a situational awareness through the 'fog of war.' "The major challenge for command and control in the information age will be to recognise where transparency will be required and where it will not be needed."[97] In effect, having trained our subordinates to think independently and to act within the commander's intent, we can now provide through effective NEOps, the ability to decide and act faster than the enemy's ability to do so.

Boyd died March 9, 1997, never having formally published his *Discourse on Winning and Losing*. What remains of his work are the products of a few colleagues and students, those to whom he would often call in the middle of the night to discuss and

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[95] Widder, *Auftragstaktik and Innere Führung: Trademakers of German Leadership*, 3-9, 9.

[96] *Ibid*., 8.

[97] *Ibid*., 9.

refine his observations. Having retired from active service in 1975, one must wonder whether Boyd emphasised the orientation phase as the most critical phase of the OODA loop because it is the one stage wholly dependant upon the commander's intellectual capability or, if he had lived to witness the technological capabilities of today's NEOps, he would have concluded, as this paper does, that there exists potential for greater effectiveness in the other phases of the loop as well.

CHAPTER THREE – NETWORK ENABLED OPERATIONS: AN ENABLER TO COMMAND AND CONTROL?

Defining Network Enabled Operations

Network Centric Warfare is a concept as opposed to a defined entity. Its origins are found in the business community where, by harnessing information technology, companies can obtain an advantage over their competitor and "lock-out" the competition.[98] In the military context, this concept translates to focussing on the sum of the parts (the network structure) rather than the individual platform capabilities, permitting through shared knowledge a level of self-synchronisation at the lowest levels.[99] In this way, forces are capable of higher tempo operations and faster decision-making than the adversary, thereby getting inside the enemy's decision-making cycle. This ability to "get inside" the adversary's decision cycle, as postulated in Boyd's OODA loop, focuses upon the speed with which adversaries can orient to one another. NEOps when exploited properly permit one to realise Boyd's vision of an adversary enmeshed "in a world of uncertainty, doubt, mistrust, confusion, disorder, fear, panic, chaos … and/or fold [the] adversary back inside himself so that he cannot cope with events/efforts as they unfold."[100]

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[98] Donald K. Hansen, "Can Decentralized Command and Control Doctrine Complement Network-Centric Warfare?" Naval War College), , http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA422815&Location=U2&doc=GetTRDoc.pdf (accessed 15 February 2009), 2.

[99] "Fewell and Hazen (2003) describe self-synchronization as the ability of individual unit commanders to synchronize their unit's individual efforts in order to mutually support other commander's units, and accomplish the overall shared goal." *From* Thomson and Adams, *Network Enabled Operations: A Canadian Perspective*, 10.

[100] Boyd, *Organic Design for Command and Control*, 7.

Misunderstood by many, NEOps is not about the technology, it is actually "about the human and organizational behaviour."[101] The technology often referred to when discussing NEOps is but the mechanics behind the concept. By way of analogy, when discussing aviation and what makes an aircraft fly, many would begin to discuss the engines or perhaps the size of wings on an aircraft. In reality, the principle of flight is much more simple in that it is ultimately about Bernoulli's principle of fluid dynamics. So, just as discussion about the engines and the wings is akin to discussing the technology of NEOps, so too, the principle of fluid dynamics is akin to discussing the human and organisational behaviour that is the focus of NEOps. Just as the engines and wings are inputs that put the principle of fluid dynamics into effect, the technologies of communication, sensors and data sharing are inputs that put NEOps human and organisational behaviour models into effect. Understood correctly, NCW technology is an enabler to current command and control systems in that it contributes to "the facilities, equipment, communications, procedures, and personnel essential to the commander for planning, directing, and controlling operations of assigned forces pursuant to the missions assigned."[102] Whereas some authors will use NCW and NEOps interchangeably, they are not. NCW has as its emphasis the technology where as NEOps has as its emphasis the human dimension.

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[101] David S. Alberts, John J. Garstka and Frederick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 2nd Edition ed. (Washington, DC: Department Of Defence, 1999), http://www.dodccrp.org/ Internet; accessed 2 March 2009, 88.

[102] Builder and others, *Command Concepts : A Theory Derived from the Practice of Command and Control*, 144, xiii.

An examination of the concepts of networks in this chapter leads to a recommended C2 model in the next chapter which best capitalises on the technological advantages provided through networks.

The Canadian Army's *Land Operations 2021: Adaptive Dispersed Operations* refines the earlier definition of NEOps to include,

> the integration of information systems, weapons and other effects-producing platforms in ways that promise substantial gains in the effectiveness of military operations. At its crux lies the idea of networking, and the military advantages that the effective integration of information systems—both technological and human— can produce through the creation and exploitation of information. By linking knowledgeable entities in a battlespace, forces will be more capable of gaining information superiority and ultimately, greater mission effectiveness.[103]

This definition, encompassing all service elements, has its genesis in the navies of the world. The world's navies were amongst the first to operate in coalitions thereby necessitating "a command and control system that can effectively coordinate maritime operations in a relatively complex, multi-threat environment, over a wide area."[104] The initial concept was one of creating a simplified common operating picture and common protocols for transmitting data amongst the fleet: a network.

Networks are not a new concept. The application of networks to C2 structures may be relatively new, generating a whole new lexicon supporting the RMA, however a closer examination demonstrates the presence of networks within nature. Working in the 1960s to establish the hierarchical structure of the brain's memory patterns, scientists at

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[103] Andrew B. Godefroy, *Land Operations 2021: Adaptive Dispersed Operations: A Force Employment Concept for Canada's Army of Tomorrow*, ed. Directorate of Land Concepts and Doctrine (Kingston, Ontario: Canada. Department of National Defence, 2007), 22.

[104] English, *Command & Control of Canadian Aerospace Forces: Conceptual Foundations*, 24.

the Massachusetts Institute of Technology postulated that any single memory is not resident within any one cell but rather, through associations, is linked across the brain's neural network.[105] This seemingly disorganised and decentralized network is replicated in the structure of the internet, where no one single computer monopolises and controls the network. All computers contributing information to the internet are linked through loose associations to other computers. While certain computers may have more links than others, the system itself is not dependant upon any one computer to keep the internet active. Remove the computer with the greatest number of links and the internet would simply re-route around the disabled system. Why do networks work so effectively? It is the redundancy of the structure and the lack of a central hub which provides its resiliency and longevity. Networks are constructed of nodes which are bound to other nodes through links. Where any one node connects to several other nodes, it is referred to as a 'hub.' [106]

As prevalent as networks are, there is much about networks that has yet to be understood. Two prevailing theories on network structures divide networks into *random networks* and *scale-free networks. Random networks* are structured such that "despite the random placement of links [within the network], the resulting system will be deeply

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[105] Ori Brafman and Rod A. Beckstrom, *The Starfish and the Spider : The Unstoppable Power of Leaderless Organizations* (New York: Portfolio, 2006), 230, 5.

[106] Using an airline analogy, outlying airports with minimal connections may be seen as a node. Large airports like Toronto's Pearson International, which connects with many other airports, would be considered a hub in the system.

democratic: most nodes will have approximately the same number of links."[107] *Scale-free networks* in contrast, contain "nodes with a very high number of links."[108]

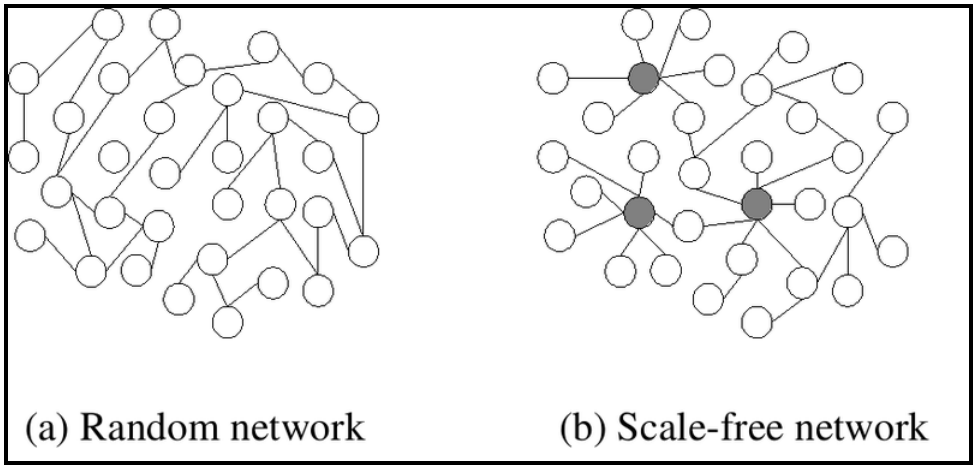

Figure 2 - Random and Scale-Free Networks
Source: http://en.wikipedia.org/wiki/File:Scale-free_network_sample.png

Random and Scale-Free Networks

The distinguishing feature between random and scale-free networks is that random networks will not have hubs. Every node is connected randomly to other nodes without any one node acting as a hub. Network theorists originally presumed the internet operated as a random network but were surprised to discover that certain sites served as major hubs linked to a virtually boundless number of other sites on the internet. One has only to think about sites such as Google or Yahoo to recognise that certain hubs can contain a seemingly limitless number of links. This prompted theorists to label this new network structure "scale-free," having demonstrated no boundary to the number of links a node could contain.[109]

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[107] Barabási and Bonabeau, *Scale-Free Networks*, 50-59, 52.

[108] *Ibid*., 53.

[109] *Ibid*., 53.

Scale-free networks do not exist solely within the realm of the internet. *The human web* postulates that every person on earth is connected to every other person on earth by no more than six links.[110] Though the majority of individuals have only a few connections in the human web, certain others have numerous connections, thereby making them significant hubs within the network. Thus, any scale-free network is dependant upon the hubs and the links. The scale-free property of particular hubs is what permits the network to expand or contract as necessary to achieve the greatest efficiency.

An appreciation of the theory behind networks leads towards a better understanding of network enabled operations. NEOps is primarily about the "increased combat power that can be generated by a network-centric force."[111] Through the sharing of information and collaborative shared awareness, the theory of NEOps suggests a degree of self-synchronisation is achievable. In effect, the self-synchronisation is a level of consciousness within the network itself. Guided by principles or in the military context by the commander's intent, the network then resolves how to best achieve the mission. Here, the technology serves to share the information to effect a more rapid decision. Understanding the capabilities and limitations of the technology will lead us in the next chapter to a better understanding of the C2 modifications designed to improve our decision and action cycle.

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[110] The human web has been a popularized concept widely discussed on the internet for a number of years. The genesis of the human web has spawned such popular games as the Hollywood based game of Six Degrees of Kevin Bacon in which based on the concept of the small world phenomenon and rests on the assumption that any actor can be linked through his or her film roles to actor Kevin Bacon within six steps.

[111] Alberts, Garstka and Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 7.

Integral to NEOps is the concept of information superiority. The U.S. Joint Pub 3-13 *Information Operations* posits that information superiority is about, "the ability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same."[112] Increasing the speed of command creates more options for the commander while permitting him to pre-empt enemy options. Boyd would describe this as being able to get inside the enemy's OODA loop. NEOps allows the commander to orient to the situation more rapidly than the enemy. The same effect may be achieved through denying the enemy the ability to collect, process and disseminate information.

[112] Joint Chiefs of Staff, *Joint Publication 3-13: Information Operations* (Washington, D.C.: Dept of Defense, 2006), I-5.

Linking the Systems

An examination of current sensor weapon systems exhibits the tremendous advantage to be gained through networking. Consider that a single platform with its own integral sensor has a limit to its sensor, for the sake of argument, of 200 km. The weapons range of the platform may only be 150 km and the effective engagement envelope may only be 50 km. On its own, this platform's combat power is directly proportional to the effective engagement envelope. Without the ability to share the information from the sensor package, 50 km is the best engagement envelope at any instant in time.[114]

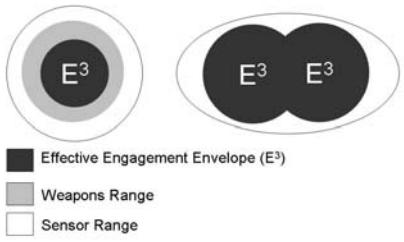

Figure 3 - NEOps Value-Added Combat Power[113]

Now consider for a moment that if two platforms of similar capabilities are linked together sharing the combined sensor picture, the effective engagement envelope increases dramatically. Furthermore, efficiency can be achieved through the management of weapons stores between the platforms ensuring the best weapon is launched against the target.

The value-added combat power of linking platforms together is limited only by the technology which connects the systems and the manner in which they are linked. It would be naïve to presume that merely connecting more and more platforms together

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[113] Alberts, Garstka and Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 102.

[114] *Ibid*., 96.

would result in an exponential increase in capability. Without doctrine, organisation, and training, it is quite possible that unintended consequences of degraded performance and decreased war fighting effectiveness may result due to the absence of implied intent discussed earlier.[115]

The progression of various technological enablers permits, within the network environment, hubs with increasingly higher numbers of links. Employing Metcalf's Law, which states the power of the network increases in proportion to the square of the number of nodes on the network,[116] suggests that the exponential growth of the network through advancing technologies will necessitate a revised C2 structure to harness and exploit this power. No longer will commanders alone possess the 'big picture' upon which to execute operational plans. The network itself is capable of a collective consciousness. This consciousness "does not exist at just one place (node) in the battlespace, but rather at all relevant nodes in the battlespace - across echelons and functional components."[117]

Lieutentant-Colonel Donald Hansen observes that the fog and friction of war will not be mitigated through networks alone. C2 boundaries will need to be established "for commanders to operate effectively in future conflicts."[118] To suggest that NEOps "was going to result in battlefields that were transparent giving us information superiority and allowing us to see first and act first,"[119] may be somewhat immature. For all the efforts

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[115] *Ibid*., 103.

[116] *Ibid*., 32.

[117] *Ibid*., 144.

[118] Hansen, *Can Decentralized Command and Control Doctrine Complement Network-Centric Warfare?*, 4.

[119] Kirkland, *Future Challenges for Land Forces: A Personal View*, 10-13, 10.

of NEOps to provide a common operating picture, the enemy will be endeavouring to seek out the nodes and destroy them. Any revised C2 structure must be robust enough to handle these interruptions.

Modified Hierarchical Networks

Military C2 is traditionally established upon hierarchical structures. How then does one incorporate the power of scale-free networks within existing hierarchical networks? Military C2 structures are one form of network in which the hubs have a restricted number of links to each node. The hubs in these instances are not scale-free. Defined relations between nodes and hubs limits the ability of the structure to optimise the strength of the network.

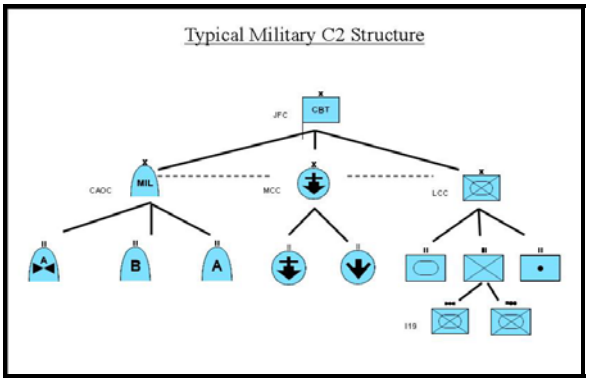

Figure 4 - Example Military C2 Structure

Appreciating the human element within the network, the typical military C2 structure has well defined reporting lines, which may be referred to as links within the network parlance. While informal relations may occur, represented by dashed lines in figure 4, generally forces work within the vertical structure established. Specific command relationships such as *operational command* in which "the authority granted to a commander to assign missions or tasks to subordinate commanders, to deploy units, to reassign forces and to retain or delegate operational control (OPCON)

and/or tactical control (TACON) as necessary"[120] may permit relationships in which one element may be tasked directly to a sub-element of a parallel hierarchy. For example, the attack helicopter element of the Air Component Commander may be assigned TACON to an infantry unit of the Land Component Commander "necessary to accomplish missions or tasks assigned."[121]

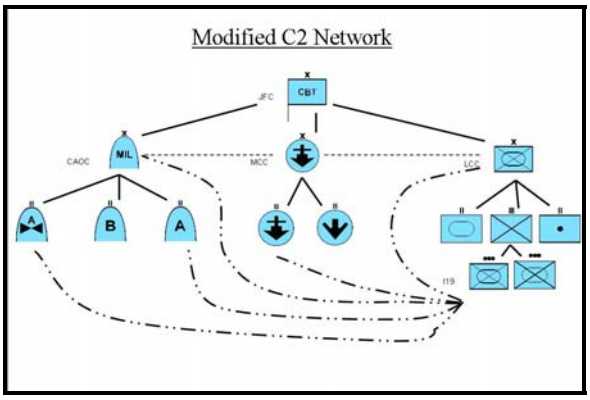

Figure 5 – Example of a Modified C2 Network

A shift from reliance on the hierarchical network structure to reliance on a structure based on a scale-free network model has significant implications for the speed and flexibility of operational responses. Modifying the network to exploit the common operating picture may include the ability of the lowest echelons to request effects from anyone else in the network. In the example represented by figure 5, an infantry platoon commander, acting as a hub within the network, requiring an immediate effect against the adversary would make his request through the network. It does not matter to the infantry commander how and by whom the effect is delivered, as long as it arrives within the prescribed timings he establishes. Whereas traditional C2 structures would require his request to be channelled up the chain of command to be vetted and then apportioned to the appropriate component commander to execute, this model allows direct access to the delivery platforms. Not as easily discernable in the graphic representation is that there

[120] Canada. Dept. of National Defence, *B-GA-400-000/FP-000 Canadian Forces Aerospace Doctrine*, 66, v, 72, 51.

[121] *Ibid*., 52.

remains an element of centralized control, if so desired. While all platforms may be networked together, higher command elements may restrict certain platforms from responding, utilising the same network structure to limit them.

The network suggested is actually borrowed from the taxi cab industry.[122] Modern taxis employ Global Positioning Satellites (GPS) along with automated dispatch computers in the vehicles. Each vehicle electronically receives bids for their service (decentralized execution), but the system will only display those bids where, based upon the vehicle's GPS position, the vehicle is capable of responding. Caveats may also be imposed, such as a requirement for a multi-person van, or one that is handicap accessible, which the computer automatically vets to determine if the unit is capable of responding. Likewise, the dispatch operator at a centralized facility has the ability to over-ride bids at any time: an exercise of centralized control. This is the type of responsiveness required to operate in the type of current Irregular Warfare (IW)[123] environments that has been representative of the conflicts of the last several decades.

The Power of Networks in Irregular Warfare

In the IW environment, a highly responsive C2 structure capable of operating inside the enemy's OODA loop is essential. The activities of IW may include shaping

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[122] Examples of modern dispatch systems may be reviewed online at http://www.taxidispatchsystem.com/pages/taxi_detail.htm#1 or http://mihirenterprises.com/taxi-dispatch-system.htm.

[123] "A violent struggle among state and non-state actors for legitimacy and influence over the relevant populations. IW favors indirect and asymmetric approaches, though it may employ the full range of military and other capabilities, in order to erode an adversary's power, influence, and will." *From* Joint Chiefs of Staff, *Irregular Warfare (IW) Joint Operating Concept (JOC)*, Version 1.0 ed. (Washington, DC: Department of Defense, 2007), http://www.dtic.mil/futurejointwarfare/concepts/iw_joc1_0.pdf Internet; accessed 20 April 2009, 6.

and deterring, counter-terrorism, counter insurgency and support to insurgency. USAF doctrine identifies several 'truths' for airmen in prosecuting IW, three of which are highlighted for discussion.

The first 'truth' is that: "The Air Force must be prepared to simultaneously conduct irregular and traditional warfare operations."[124] The flexibility of air resources to alternate between regular and irregular warfare necessitates a highly robust and flexible C2 structure. This leads to another of the 'truths' – "IW is intelligence-intensive."[125] The ability to accurately identify and target the adversary where he is able to blend into the general population is extremely challenging for air forces. The timely targeting of such mobile and translucent foes necessitates a reliable and real-time link with the troops on the ground. Lastly, USAF doctrines state that "integrated C2 structures enable flexibility at all levels and are vital to successful counterinsurgency operations."[126] Adaptability of capabilities is centered out as key to successfully fighting in an IW environment. Here, the network can permit the rapid adaptability identified while also providing for an economy of effort.

Without concentrating on the technical aspects of NEOps, this chapter has argued that networks can provide a more agile and responsive C2 structure, especially in an IW environment. The technological advancements of NEOps now permit near-real-time situational awareness of the battle space. Modifying current hierarchical C2 structures to optimise the concepts of random networks can achieve a level of responsiveness to fluid

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[124] United States. Air Force, *AFFD 2-3: Irregular Warfare*, 8.

[125] *Ibid*., 8.

[126] *Ibid*., 9.

IW environments in which ground troops are most readily capable of identifying targets and calling for effects directly from various combat capable systems - the ‘sensor to shooter’ relationship. The network effects its own level of efficiency in prosecuting targets, but if required, may be restricted through traditional mechanisms such as the AOC. The next chapter will address some of the challenges of realising NEOps at the tactical level and apply them against the Tenets of Aerospace Power to determine whether air force C2 is capable of encompassing NEOps.

CHAPTER FOUR – APPLYING THE MODIFIED NETWORK TO AIR FORCE C2 STRUCTURES

Dr. English in *Command & Control of Canadian Aerospace Forces: Conceptual Foundations* identifies that "true manoeuvre warfare, as described by the Boyd model, cannot be practiced by the US Army because toleration of mistakes and the use of initiative are antithetical to US Army culture today."[127] This argument is not unique. Naysayers of NEOps have suggested the same and more. Thomson and Adams go further stating that some of the challenges facing NEOps include trust, understanding of common intent, accountability and organisational culture.[128] This chapter will address each challenge and apply them to the Tenets of Aerospace Power to answer the simple question of whether there is something inherent in air forces that permits them to implement NEOps more easily than armies or navies. The Tenets of Aerospace Power aim to manage valuable air resources to avoid fragmentation and "dissipation of effort… to ensure the optimal employment of aerospace power."[129] It shall be argued that current NEOps already adheres to many of the Tenets of Aersopace Power and that future developments in NEOps should continue to be shaped by these tenets.

The Tenets of Aerospace Power are the result of lessons learned in military aviation over the last century. While they are not hard and fast rules, they provide

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[127] English, *Command & Control of Canadian Aerospace Forces: Conceptual Foundations*, 34.

[128] Thomson and Adams, *Network Enabled Operations: A Canadian Perspective*, 13-15.

[129] Canada. Dept. of National Defence, *B-GA-400-000/FP-000 Canadian Forces Aerospace Doctrine*, 66, v, 72, 30.

guidance in concert with the Principles of War.[130] Therefore, the decision to violate any of the tenets should be carefully weighed by theorists of NEOps before implementing changes to current C2 constructs. The Tenets of Aerospace Power are as follows: centralized control and decentralized execution, flexibility and versatility, synergistic effect, persistence, concentration, priority, and balance.

The criticisms of NEOps can be categorised into one of two general themes. The first counter argument of NEOps suggests that current technologies do not promote creative command-by-influence but rather command-by-direction.[131] As such, the technology is regarded as undoing all the benefits of mission command. The second counter argument is that NEOps cannot be universally applied across the spectrum of operations and therefore should be rejected in whole.[132] That is to say that even though NEOps may be appropriate in IW, it has no application in conventional war. In the air force context, the argument made by some authors, including English, Gimblett and Coombs in *Network Operations and Transformation: Context and Canadian Contributions*, is that the unique characteristics of primarily centralized control is contrary to NEOps emphasis on synchronisation and mission command.[133]

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[130] Canada lists the Principles of War as: selection and maintenance of the aim, maintenance of morale, offensive action, security, surprise, concentration of force, economy of effort, flexibility, cooperation, and administration. *From Ibid*., 26.

[131] John J. Schaefer, *Centralized Execution in the U.S. Air Force* (Leavenworth, Kansas: School of Advanced Military Studies,[2006]), http://www.dodccrp.org/events/2006_CCRTS/html/papers/218.pdf (accessed 28 February 2009).

[132] Allan D. English, Howard Coombs and Richard Howard Gimblett, *Networked Operations and Transformation : Context and Canadian Contributions* (Montreal: McGill-Queen's University Press, 2007), 186, 69.

[133] *Ibid*., 69.

The approach taken by these authors is to assess current technologies and measure them against current C2 constructs. This is rather like fitting a square peg in a round hole. The more appropriate approach is to analyse current C2 constructs and ask the question of how should NEOps be developed henceforth. If, as stated by Czerwinski, "turbulent times await us" which will favour command-by-influence,[134] then air forces must address under which conditions this form of command is appropriate. English states, "air forces today and in the foreseeable future rely on command-by-plan and, in certain cases such as when a command decision could have important political repercussions, even command-by-direction."[135] Though he does not address it specifically, command-by-influence is currently used by some components of Canada's Air Force. Failure to address in Canadian Air Force doctrine the circumstances under which each style of command, including command-by-influence, is appropriate and then shape NEOps to facilitate the respective style of command, will prove inefficient. Given that there is never enough air assets to meet all operational demands, air forces cannot afford to bypass any opportunity for greater efficiency.

Challenges to NEOps

The need to effectively fuse networks with C2 structures has been recognised for some time now. A study of the U.S. dynamic command and control and battle management (DC2BM) system, by the Rand Corporation, identified critical shortfalls in the ability of current networks to enhance existing C2 systems. Specifically, it addressed

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[134] Czerwinski, *Command and Control at the Crossroads*, 121-132.

[135] English, Coombs and Gimblett, *Networked Operations and Transformation : Context and Canadian Contributions*, 186, 70.

the requirement to refine contingency operations plans; tactics, techniques and procedures; and, the integration of ISR capabilities with weapons systems to enhance DC2BM.[136] The report goes on to specify that such a robust and collaborative system must include "a flexible network and server architecture with responsive operating protocols; an effective network manager; and an empowered information manager."[137] The ability to effectively prosecute time critical targets necessitates a system capable of responding within minutes.

Unleashing control in a NEOps environment does not negate the command function. "Often new command and control concepts arise out of a desire to leverage new capability that provides increased information."[138] NEOps harnesses the ability of the educated soldier "to apply their critical thinking abilities."[139] How does this differ from manoeuvre warfare? Whereas manoeuvre warfare focuses upon speed, surprise and decisive action to attack the enemy's critical vulnerabilities, NEOps optimises the creativity of the subordinate leader and empowers him to take advantage of information rapidly, without the need for higher authority and to exploit enemy weaknesses as they become apparent during conflict.[140] Manoeuvre warfare is an operational tactic, whereas

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[136] Myron Hura, United States. Air Force and Project Air Force, *Enhancing Dynamic Command and Control of Air Operations Against Time Critical Targets* (Santa Monica, CA: Rand Corp., 2002), 51, xv.

[137] *Ibid*., xv.

[138] Alberts, Garstka and Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 75.

[139] Bernd Horn and Peter Gizewski, "Defying Definition: The Future Battlespace" In *Towards the Brave New World: Canada's Army in the 21st Century* (Kingston, ON: Directorate of Land Strategic Concepts, 2003), 87-108, 96.

[140] Hansen, *Can Decentralized Command and Control Doctrine Complement Network-Centric Warfare?*, 3.

NEOps as a concept which aids the manoeuvre commander. The network provides the capacity for the commander to call for effects from whichever platforms he is networked to that are capable of delivering in a timely fashion. Only when manoeuvre warfare is optimised through effective NEOps is the force truly exploiting the concept of *Auftragstaktik* where the commander specifies "to subordinates *what* to do, not *how* to do it."[141]

Recalling the taxi analogy earlier and applying it to a military context, a soldier operating with a clear understanding of the commander's intent could call for an immediate effect against a time sensitive or time critical target.[142] Utilising the technology of modern NCW, the request would be received by numerous combat platforms. They could include an artillery battery ten miles away with GPS guided Excalibur rounds, a B-1 bomber with precision guided munitions operating at forty thousand feet, an F-16 conducting a Close Air Support (CAS) mission in the vicinity or an AH-64 in direct support of land forces. Each of these platforms would be capable of delivering the effect and each of them is operating with the same understanding of the commander's intent. Also within the network would be the AOC, the Fire Support Coordination Center (FSCC) and the soldier's own vertical chain of command. In circumstances where the AOC, FSCC or Army formation chain of command are aware of a higher priority, they could override the request for an effect for any one platform or all

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[141] *Ibid*., 4.

[142] "Time sensitive targets are those requiring immediate response because they pose (or will soon pose) a danger to friendly forces or are highly lucrative, fleeting targets of opportunity. Time critical targets are time sensitive targets with an extremely limited time window of vulnerability, the attack of which is critical to ensure the successful execution of the Joint Task Force operations. They rank high on the joint integrated prioritized target list." *From* Hura, United States. Air Force and Project Air Force, *Enhancing Dynamic Command and Control of Air Operations Against Time Critical Targets*, 51, 2.

platforms, if necessary. Left unchecked, any one platform could accept the request and deliver the effect within a matter of minutes.

The scale-free links of the soldier on the ground permit him to operate within the enemy's OODA loop. Having oriented himself to the enemy and called for an effect, the network facilitates his being able to act faster than the enemy may act. Or, as suggested by Schaefer, the network affords the soldier more time to continue orienting to the enemy, knowing that when required and called upon, the effect to be delivered is readily available.

Current USAF air doctrine has wrestled with the concept of centralized control and decentralized execution. It has been noted by some authors, such as Davis, that this principle is inconsistent with Joint Doctrine which is based on manoeuvre warfare and mission command, however, he goes on to note that the concept itself is illogical.[143] Contemporary employment of air resources is centralized from take-off to landing. Missions are promulgated in Air Tasking Orders with their targets carefully vetted prior to being added to the target list. Aircraft assigned to close air support missions are restricted from dropping weapons without clearance from a ground controller. As Davis points out, "The only decentralized aspect … is the tactics involved in striking the target, and even then rules of engagement could be a controlling factor."[144] But Davis' observation fails to recognise that CAS missions require a combination of command-by-plan and command-by-influence. Though directed by a forward air controller (FAC), the

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[143] Mark G. Davis, "Centralized Control/Decentralized Execution in the Era of Forward Reach." *Joint Force Quarterly*, no. 35 (2004): 95-99, http://www.dtic.mil/doctrine/jel/jfq_pubs/1835.pdf Internet; accessed 15 January 2009, 96.

[144] *Ibid*., 96.

pilot in this example would not drop ordinances if he/she felt doing so would be in contravention of either the Rules of Engagement or Laws of Armed Conflict – these contribute to the implicit intent of the commander and are therefore elements of command-by-influence.

In the Canadian context, the Air Force encompasses more than fighters and transport aircraft. Canada is unique in that what evolved from unification was an Air Force with maritime and army aviation components. Navies are adapting to command-by-influence with the implementation of NCW technologies,[145] while armies have commanded-by-influence for a long time already. The maritime and tactical aviation forces serve as integral components to the navy and army respectively, and necessarily employ the same command-by-influence style. Therefore, Canada's Air Force C2 structure must be prepared to bend to the appropriate command style depending on the mission. Typically, those missions executed in closer proximity to own troops will be characterised by greater uncertainty and call for more of a command-by-influence style.

Harrison suggests the solution "is to reduce layers of bureaucracy but retain decentralisation within the context of the three levels of war… As well, we must be less territorial in our protection of the layers in the chains of command."[146] This suggests that the hierarchical C2 structures as currently exist should be retained but incorporate greater decentralized execution, particularly at the tactical level. As Boyd concluded, such

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[145] English, Coombs and Gimblett, *Networked Operations and Transformation : Context and Canadian Contributions*, 186, 56.

[146] Richard P. Harrison, "Command, Control, and the Information Age of Military Operations" Canadian Forces College), , http://www.cfc.forces.gc.ca/papers/amsc/amsc2/harrison1.pdf (accessed 19 February 2009), 18.

decentralized execution, reliant upon the implicit intent, exploits "lower-level initiative yet realises higher-level intent."[147]

Tenets of Aerospace Power

Focussing on Babcock's definition of Canadian NEOps as "characterized by common intent, decentralized empowerment and shared information, enabled by appropriate culture, technology and practices,"[148] English states that Canada has "a lack of awareness of the assumptions and cultural outlooks that [have been] imported with other approaches to networked operations."[149] In the Air Force context this statement directly relates to the Tenets of Aerospace Power. Simply importing the network concepts from other nations will not meet the Canadian requirements. Therefore, the development of NEOps within the Canadian Air Force should be guided by these tenets.

Paul Johnston argues that the historical experiences and culture of armies, which one may read to include all services, has effect on the shape of reforms militaries undertake.[150] English takes this further to suggest that those wishing to implement cultural changes within the military as result of NCW may have to wait "years, and even decades, because major culture change may require paradigm shifts in the

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[147] Boyd, *Organic Design for Command and Control*, 18.

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

[149] English, Coombs and Gimblett, *Networked Operations and Transformation : Context and Canadian Contributions*, 186, 6.

[150] Paul Johnston, "Doctrine is Not enough: The Effect of Doctrine on the Behavior of Armies." *Parameters* 30, no. 3 (Autumn, 2000): 30-39, http://www.carlisle.army.mil/usawc/Parameters/00autumn/johnston.htm Internet; accessed 20 April 2009

organization."[151] This implies that the culture of the military must be amended to include NCW. Recalling that NCW is more about the technology than the human dimension, whereas NEOps is focussed on the human dimension first, it stands to reason that any developments in NEOps is driven by the culture of the organisation it serves vice the other way around. Therefore, English's suggestion that NCW may have to wait for military cultural shifts to be truly effective, fails to appreciate that NEOps should evolve within the military's culture and traditions as that is what it serves.

The first tenet which has been discussed at length in chapter one, is *centralized control and decentralized execution.* Defined as:

> Centralized control gives coherence, guidance and organisation to the employment of aerospace power. It is achieved through a single commander who has the authority to assign the available assets to best achieve the assigned objectives. Decentralized execution, the delegation of authority to lower-level commanders, is essential for effective span of control and to foster initiative and situational responsiveness.[152]

NEOps should be developed to foster the centralized control. In the hypothetical example above, the AOC would continue to centrally control all assets for employment. Where NEOps has the capacity to augment this arrangement is through rapid redistribution of those assets while airborne. This is already achieved through the employment of Airborne Warning and Control Systems (AWACS) aircraft. AWACs does not require individual platforms to have an understanding of commander's intent. The controller aboard the AWACs exercises this responsibility. However, AWACS may

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[151] English, Coombs and Gimblett, *Networked Operations and Transformation : Context and Canadian Contributions*, 186, 12.

[152] Canada. Dept. of National Defence, *B-GA-400-000/FP-000 Canadian Forces Aerospace Doctrine*, 66, v, 72, 30.

not be always employed in theatres of operation; therefore, NEOps development should include the ability for decentralized execution which permits immediate re-tasking.

As discussed earlier, decentralized execution, while promoted by various air forces, is not necessarily practiced. The emphasis of decentralized execution is to foster initiative and situational responsiveness. This implies that with proper mission command, aviators operating in theatre will have the best situational awareness upon which to base a decision. *Air & Space Power Journal* goes so far as to suggest centralized control and decentralized execution is the fundamental organising principle for the employment of air resources and further states, "decentralized execution balances any command-level tendency toward micromanagement by authorizing subordinates to seize the initiative in dealing with the inevitable uncertainties faced during combat mission execution." [153] Therefore it follows that any NEOps structure must foster the decentralized execution while limiting the temptation of higher commanders to micromanage air resources. "A high level of centralized execution results in a rigid campaign that is unresponsive to local conditions and results in the joint effort losing its tactical flexibility."[154]

This leads to the second tenet, *flexibility* and *versatility*. Flexibility is intended to permit air resources to "shift from one objective to another, quickly and decisively," while versatility permits those same resources to be "used for a broad spectrum of

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[153] Anonymous, *Decentralized Execution*, 60, 60.

[154] *Ibid*., 60.

objectives at the strategic, operational, or tactical levels of conflict."[155] The recommended C2 structure suggested in chapter three that augments the vertical hierarchy of current C2 with tactical level connectivity between nodes would provide the flexibility to rapidly respond. An aircraft employed on a mission to conduct air interdiction, could, if available, be re-tasked to another objective under this construct without the intervention of the AOC. However, U.S. doctrine suggests this "economy of force may require a commander to establish a balance in the application of airpower between attacking, defending, delaying, or conducting deception operations"[156] This would be dependant upon the priority of competing objectives, which could be resolved in a NEOps structure by the AOC in real-time. Here, the tenet of priority would be also satisfied as the AOC could also ensure through the network that resources are only "employed for tasks that give high-value pay-offs."[157] Having suggested that NEOps can work from bottom-up, the consciousness of the network would arguably have a certain self-organisation to prioritise objectives, however the centralized control of the AOC could de-conflict missions as required and prioritise, where necessary.

Czerwinski states that command-by-plan "is a futile quest to will order upon chaos."[158] The Air Tasking Order (ATO) process of the AOC is a complex and time exhaustive command-by-plan process. Anecdotal evidence is emerging from theatres of operations in Afghanistan and Iraq that indicates troops were often unwilling to wait for

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[155] Canada. Dept. of National Defence, *B-GA-400-000/FP-000 Canadian Forces Aerospace Doctrine*, 66, v, 72, 30.

[156] United States. Air Force, *Air Force Basic Doctrine*, 24.

[157] Canada. Dept. of National Defence, *B-GA-400-000/FP-000 Canadian Forces Aerospace Doctrine*, 66, v, 72, 31.

[158] Czerwinski, *Command and Control at the Crossroads*, 121-132.

the targeting process to run its course. When encountered by an enemy in the IW environment, where the enemy's presence is fleeting, troops would knowingly move into contact, referred to as troops in contact (TIC), so their call for effect would be dealt with immediately.[159] TICs would automatically circumvent the targeting process and aircraft would be tasked immediately to support. Troops have learned to exploit the current network. This is not to suggest that because troops are going to circumvent the targeting process anyway, we might as well change to meet this requirement; it suggests that this reality should at least be considered by future NEOps concepts.

The capacity of tactical level commanders to directly call for effects would have obvious *synergistic effects* – the third tenet of aerospace power. "The coordinated employment of aerospace power"[160] would be a direct result of the link between nodes at the tactical level in that the immediate support to ground troops in an all arms response would exceed the contributions of individual units engaged with the enemy. *Persistence* the fourth tenet, in cooperation with other combat elements, would give the commander a more continuous presence. Within the NEOps concept, aerospace power alone does not provide the persistence, but is networked with all combat forces to provide the persistence required in an area of interest.

As suggested earlier, the AOC's responsibility in NEOps, is to ensure competing demands for aerospace power is balanced. The fifth tenet of aerospace power, *concentration*, ensures "effective employment of aerospace power must achieve

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[159] The author has spoken with several returning members from Afghanistan and Iraq who indicated they are personally aware of this having occurred, though this has not been quantified in any research.

[160] Canada. Dept. of National Defence, *B-GA-400-000/FP-000 Canadian Forces Aerospace Doctrine*, 66, v, 72, 30.

concentration of purpose to guard against fragmentation of effort in attempts to fulfill the many competing demands of the operation."[161] Therefore, while there is an argument for NEOps to be more decentralized at the tactical level to provide greater flexibility, NEOps development which does not also permit for centralized control would violate the tenet of concentration. U.S. lessons from North Africa during World War II demonstrate that air resources not centrally controlled result in them being misallocated, "causing delays in achieving operational objectives."[162] "In their competition for dominance over the resource, the U.S. Army's ground and air forces failed to create a workable air support system."[163] These costly lessons ultimately led to the creation of tactical air support doctrine.

The last tenet, *balance*, which is the "employment of aerospace power with due consideration for the Principles of War and the Tenets of Aerospace Power".[164] It is already achieved through NEOps. These principles and tenets serve as elements of the implicit intent of commanders within mission command – a central component of the human dimension of NEOps. Balance also considers "the impact of accomplishing objectives against the associated risk to friendly forces."[165] Here, the greater situational awareness provided by NEOps will significantly lower the risk to friendly forces by

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[161] *Ibid*., 31.

[162] Anonymous, "Centralized Control." *Air & Space Power Journal* 18, no. 1 (Spring, 2004): 38, www.proquest.com

[163] B. M. Bechthold, "A Question of Success: Tactical Air Doctrine and Practice in North Africa, 1942--43." *Journal of Military History* 68, no. 3 (07, 2004): 821-851, http://search.ebscohost.com/login.aspx?direct=true&db=mth&AN=13658200&site=ehost-live, 849.

[164] Canada. Dept. of National Defence, *B-GA-400-000/FP-000 Canadian Forces Aerospace Doctrine*, 66, v, 72, 31.

[165] *Ibid*., 31.

providing in real-time access to the firepower when and where required in the face of the enemy.

The recurring theme in reviewing the Tenets of Aerospace Power is the requirement for greater command-by-influence. The Tenets of Aerospace Power are the result of the lessons learned by generations of airmen through two world wars and numerous other engagements over the last 100 years. NEOps development should not, as has been suggested earlier by some authors, drive future C2 constructs; rather, these tenets should serve to guide future developments in NEOps. Focussed foremost upon the human dimension, NEOps provides a common operating picture which, when coupled with a common intent, will help to dissipate the fog of war.

A Common Operating Picture

Alberts, Gartska and Stein suggest the lack of battlespace awareness can be resolved through effective networks. This lack of awareness "has resulted in our inability to tap into our collective knowledge, or the ability to assemble existing information, reconcile differences, and construct a common picture."[166] Their suggestion is that NEOps should foster the shared awareness and will thereby empower all levels within the chain of command. This in turn leads to what they argue is decentralized control, but which this paper suggests is more akin to decentralized execution. The technology of networks "seems to be taking us down the road to increased (improved) awareness for all

[166] Alberts, Garstka and Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 71.

players with more collaboration and decentralization in the form of self-synchronizing forces."[167]

Though the common operating picture permits a level of self-synchronisation between forces realised through a consciousness of the network, this will not eliminate errors in judgement. Just as the commander must have confidence in her subordinates for decentralized control to be put into effect, so to must the political level have confidence in the air force C2 process. Policy makers have demonstrated uneasiness in accepting any errors when it comes to air forces dropping bombs. Even though objectives are often established for the military to determine an appropriate strategy, policy makers have overruled the military in the past. One only has to recall the fallout of the bombing of the Al Firdos bunker in Baghdad during Operation Desert Storm when several hundred civilians were killed in what planners mistakenly believed was a military C2 node. In the fallout, General Schwarzkopf prohibited the targeting selection board from authorising any further bombing in downtown Baghdad unless personally approved by himself following consultations with the Chairman of the Joint Chiefs of Staff, General Powell.[168] This suggests that future developments in the technological aspects of NCW may prove too tempting to policy makers, and they are likely to delve into the operational and tactical levels of command through command-by-direction.

Thomas Barnett cautions that one of the seven deadly sins of NCW, in which "the unspoken assumption concerning speed of command seems to be that because we receive

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[167] *Ibid*., 107.

[168] Wayne W. Thompson, "After Al Firdos: The Last Two Weeks of Strategic Bombing in Desert Storm." *Air Power History* 43, no. 2 (Summer, 1996): 48-65, 52.

and process data faster, we have to act on it faster."[169] While NEOps will permit us to get inside the enemy's OODA loop, what do we do once we are there? His argument is that we should use this additional time to improve "analysis and contemplation of appropriate response."[170] It is the delta between how quickly we can proceed through the observe, orient, decide and act cycle while endeavouring to deny the enemy the same that will provide us the operational advantage.

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[169] Thomas P. M. Barnett, "The Seven Deadly Sins of Network-Centric Warfare." *U.S.Naval Institute Proceedings* 125, no. 1 (01, 1999): 36, http://search.ebscohost.com/login.aspx?direct=true&db=mth&AN=1757971&site=ehost-live

[170] *Ibid*.

CONCLUSIONS

> *Decentralized tactical decision making to well-trained and experienced leaders directly engaged in operations will allow us to control the tempo of tactical decision making. This will, in turn, allow us to disrupt the adversary's decision cycle at times and places of our choosing*.[171]

In the preceding quote, Godfrey highlights how decentralized tactical decision making – decentralization at the direct and act phase of Boyd's OODA loop – allows us to disrupt the adversary's ability to orient itself, resulting in significant tactical advantage. Modifications to C2 that facilitate decision making at this level will further enhance this result. While NEOps has been used extensively at the centralized control level, this paper has argued that a greater focus on the use of scale-free NEOps at the decentralized execution level will increase and enhance our ability to "control the tempo of tactical decision making" and disrupt the adversary's orientation phase.

Centralized control compliments the command function of C2. Pigeau and McCann define command as "the creative expression of human will necessary to accomplish the mission."[172] This definition emphasizes human creativity and will. With their view of the "big picture" and their interaction with the political level, the higher echelons are best placed to engage in the creative exercise of command.

Command is inextricably related to the concept of control. Pigeau and McCann explain how the two concepts relate. They note that command "creates and changes the structures and process of control to suit the uncertain military situation, thus making

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[171] Godefroy, *Land Operations 2021: Adaptive Dispersed Operations: A Force Employment Concept for Canada's Army of Tomorrow*, 19.

[172] Pigeau and McCann, *Re-Conceptualizing Command and Control*, 53-63, 56.

command pre-eminent. Control should always be subordinate to command."[173] That makes intuitively good sense. Whatever control mechanism an organisation employs must serve to achieve the goals of the command. In essence, the control is the *how* to the command's *what* and *why*. For Pigeau and McCann, "control provides the means and context for command. It is the indispensable mechanism for command expression."[174]

The focus, to date, on the use of NEOps at the centralized control phase of C2 has encouraged "control creep" – having access to information that allows higher echelons to make direct control and execution decisions, in which they have become increasingly involved with the control of the tactical levels. A number of network theorists suggest that this is the inevitable result of networks which facilitate centralized control and execution in an organisation. This paper argues that this need not be the case. It argues that air forces, by virtue of their espousing the concepts of centralized control and decentralized execution are the most suited of all military elements to optimise the broader benefits of NEOps without encouraging increased centralization. However, the concept of centralized control and decentralized execution, though professed by the air forces of Canada, the U.K. and the U.S., is not a clearly understood concept. Historical evidence indicates that technological developments and lessons of combat through the latter half of the twentieth century moved air forces more towards centralized control and centralized execution. Whereas the genesis of air forces encouraged decentralized execution, as exemplified during the Second World War, experiences in Vietnam and during Operation Desert Storm gave rise to a more centralized control and centralized

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[173] *Ibid*., 62.

[174] *Ibid*., 54.

execution of aerospace power. This was accomplished first through the creation of the TACC and then its successor organisation during Operation Desert Storm, the AOC.

A difficulty of comparing Canada's Air Force wit the air forces of other nations is the unique history of our current construct. Its genesis is found in Canada's involvement with the RAF during the two world wars of the twentieth century, in which one can find the source of the centralized control and decentralized execution. However, unification of all aerospace power under an air element, in addition to the lessons gained from the USAF during the latter half of the twentieth century, significantly influenced Canada's current C2 construct. It is difficult to imagine Canada's Air Force being involved in future combat operations where one would not also find the USAF involved. So it makes sense that our C2 construct should be capable of operating within such a coalition. The development of the AOC, while still doctrinally professing centralized control and decentralized execution, is taken almost verbatim from USAF doctrine.

Schaefer suggests that the centralization of execution in the AOC, which through networks could potentially permit the JFACC to transmit orders directly to aircraft in flight, will possibly eradicate decentralized execution in future conflicts. [175] He goes so far as to suggest that mission type orders, or command-by-influence, are not antithetical to centralized execution. "Centralized execution that assures a mutual understanding of the battlespace can improve the effectiveness of aircrews operating under mission type orders."[176] Perhaps, but then does this suggest that there is no difference in how one would employ manned aircraft and unmanned aerial vehicles (UAV)? Schaefer's view

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[175] Schaefer, *Centralized Execution in the U.S. Air Force*, 8.

[176] *Ibid*., 8.

certainly does not accord with the delegation of authority that is a central component of the concept of decentralized execution, as defined in U.S. doctrine.[177]

Alberts, Garstka and Stein counter this argument when they suggest that networks actually should create "an environment where collaborative decision making can be employed to increase combat power … because of the distribution of awareness and knowledge in the battlespace, and partly because of the compression of decision timelines."[178] They argue that this permits self-synchronization and a level of consciousness within the network itself. For Boyd, these optimisations, enabled by the network, will allow one to orient to the enemy faster at all levels of the C2 process.

Boyd's OODA loop was the result of his years of study, both in the engineering sciences and the humanities. A philosophical curiosity which evolved out of his enthusiasm for aerial combat and the history of armed conflict, led him to conclude that there was a direct association between these disciplines. As a fighter pilot manoeuvres his aircraft to be the first to gain a firing position on the enemy, so too, he felt, successful commanders through time have demonstrated success by being able to orient to the enemy in such a fashion as to gain the advantage by targeting the enemy's weaknesses first. This process, whereby one gathers information through observation is then carefully analysed, or oriented with respect to the adversary. However, orientation includes consideration of more elements than just the raw information provided by the observation function. It includes a proper appreciation for culture, heritage, previous

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[177] United States. Joint Chiefs of Staff, *Joint Publication 1-02 Department of Defense Dictionary of Military and Associated Terms*, Amended 17 October 2008 ed. (Washington, D.C.: Joint Chiefs of Staff, 2001), www.dtic.mil/doctrine/jel/new_pubs/jp1_02.pdf Internet; accessed 20 January 2009, 147.

[178] Alberts, Garstka and Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 73.

experiences which inform you to what the enemy is likely to do next, and other information. For Boyd, the commander who could orient first would gain the advantage of being able to decide and then act against the adversary first. Boyd's consideration of the decide and act functions was almost an after thought. His analysis did not focus on them beyond highlighting that these functions must ensure feedback is provided to the observation function. Thus, the loop was primarily about the how fast one could orient.

Consistent with his focus on the orientation phase, Boyd felt response time could be improved through a clear understanding of the commander's intent – both explicit and implicit intent. Here he borrowed heavily from the Prussian concept of *aufstragstaktik*, which he labelled mission command. This concept of mission command, he explains, employs the concept of command-by-influence. Mission command has been adopted as doctrine within most modern armies. Although Boyd never published any of his work on the OODA loop, William Lind, a student of his, codified much of Boyd's work in the *Maneuvre Warfare Handbook* which was tailored to the United States Marine Corps. "In it, Lind posited that those who could decentralize actions, and accept confusion and disorder while avoiding all patterns and formulas of predictive behaviour would dominate future ground combat."[179] Not only does decentralized action permit one to orient faster to the enemy, but through the use of real-time networks, one can also decide and act faster, or at least as Barnett cautions, we could use that extra time to conduct a more thorough analysis of the situation.

NEOps permits lower echelons to respond proactively to changing events faster than previously witnessed in the history of warfare. As Alberts, Garstka and Stein point

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[179] English, *The Operational Art : Theory, Practice, and Implications for the Future*, 1-74, 47.

out, "decision-making processes no longer need focus on the defensive oriented approaches that were required to hedge against uncertainties (fog and friction)."[180] Whereas Boyd regarded the priority of effort upon orienting to the adversary, NEOps allow one to focus upon the *decide* and *act* functions of the OODA loop, as well.

In discussing the potential of NEOps, this paper intentionally avoids discussing the many technologies involved in networks. This is because the technology is only the *how* of a network – how a network is facilitated. The networks themselves are concepts. When applying the concept of networks to C2 structures, we are, after all, in keeping with the Pigeau and McCann model of command, interested primarily in the human dimension.

Returning once again to the Air Force C2 structure, this paper explores how the network could facilitate centralized control and decentralized execution. Through scale-free networks, where technology facilitates the construction of nodes at the tactical level which have a potentially limitless number of links to other combat entities, any entity could be called upon to prosecute targets in real-time. This structure requires an adherence to the concept of decentralized execution. For air forces, the control element, while permitted to operate in a decentralized fashion, could still be centrally controlled through the JFACC which participates within the network under this construct. In relying on decentralized execution, Harrison cautions that it will be essential "with a reduced hierarchy, for all lower levels to fully understand their commander's intent or

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[180] Alberts, Garstka and Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 159.

guidance."[181] This can be exercised through the "consciousness" of the network as it will permit tactical level commanders to "have a better understanding of both the big picture and the local situation than operational level commanders currently have today."[182] Thus, the imperative is upon command-by-influence for aerospace power wherein the decision to prosecute targets is made with a clear understanding of commander's intent.

"Rigid doctrine, restricted information flows, and emphasis on unity of command are among the legacy of centuries of dealing with the fog and friction of war."[183] USAF doctrine on Irregular Warfare emphasises the requirement for adaptable C2 structures. The situational awareness encourages initiative, particularly against targets capable of melding back into populations long before any targeting selection board assesses and assigns it to an Air Tasking Order. "Timely decisions and situational responsiveness are keys to compressing the 'kill chain,' exploiting fleeting opportunities, and providing operational adjustments to negate adversary resourcefulness."[184] For success in the IW environment, NEOps must be fully exploited.

NEOps ought to be capable of reducing layers of control. Across the spectrum of conflict, it may well be necessary to retain command-by-plan and command-by-direction components within air force C2 structures. This does not preclude the adoption of command-by-influence where necessary. IW by its nature is a complex environment requiring a clear understanding of commander's intent in order to prosecute in a timely

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[181] Harrison, *Command, Control, and the Information Age of Military Operations*, 18.

[182] Alberts, Garstka and Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 107.

[183] *Ibid*., 72.

[184] United States. Air Force, *AFFD 2-3: Irregular Warfare*, 16.

fashion time sensitive or time critical targets. "The ability to fuse multiple bits of information from multiple sources in a timely manner provides the commander options."[185] The key in any C2 construct is the flexibility to adapt the style of command to the mission. A NEOps construct which properly considers the culture of the structure which it serves will achieve this flexibility. NEOps links battlespace entities together with a shared understanding but does not require them to act in a linked manner. That can be controlled through command. The concept of NEOps, with its emphasis on the human dimension, decentralized control and execution, is well suited to the Air Force doctrine of centralized control and decentralized execution. The effectiveness and efficiency of aerospace power can only benefit from a proper application of NEOps in the Canadian Air Force.

NEOps is an enabler only. Future C2 structures must be designed so as to permit rapid decision making at the lowest levels permissible. The technologies behind NEOps will change as rapidly in the future as they have in the past twenty years. Future conflicts "will be won by changing the way we think and the way we approach problems,"[186] and more importantly by C2's ability to adapt to circumstances in a battle space in which the time, speed and volume of information threatens to overwhelm current C2 structures.

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[185] *Ibid*., 46

[186] Kirkland, *Future Challenges for Land Forces: A Personal View*, 10-13, 13.

LIST OF ABBREVIATIONS

10 TAG..... 10 Tactical Air Group

AOC ..... Air Operations Center

ATO ..... Air Tasking Order

AWACS ..... Airborne Warning and Control Systems

C2 ..... Command and Control

C4ISR..... Command, Control, Communications, Computers, Intelligence, Surveillance, Reconnaissance

CAOC..... Combined Air Operations Center

DC2BM..... Dynamic Command and Control and Battle Management

EBAO..... Effects Based Approach to Operations

EBO..... Effects Based Operations

GPS ..... Global Positioning Satellites

ISR ..... Intelligence, Surveillance, Reconnaissance

JFACC..... Joint Force Air Component Commander

JTIDS ..... Joint Tactical Information Distribution System

MARCOM..... Maritime Command

MOBCOM..... Mobility Command

NATO..... North Atlantic Treaty Organisation

NCW ..... Network Centric Warfare

NEOps..... Network Enabled Operations

OODA ..... Observe, Orient, Decide, Act loop developed by Col J. Boyd

RCAF ..... Royal Canadian Air Force

RCN ..... Royal Canadian Navy

RMA ..... Revolution in Military Affairs

SOPs ..... Standard Operating Procedures

STANAG ..... Standardization Agreement

TACC..... Tactical Air Control Center

TADIL ..... Tactical Digital Information Links

TIC..... Troops in Contact

TT&Ps ..... Tactics, Techniques and Procedures

UAV..... Unmanned Aerial Vehicle

U.K..... United Kingdom

U.S. ..... United States

USAAF ..... United States Army Air Force

USAF ..... United States Air Force

WWI..... World War One

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