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The operations room of HMCS Athabaskan during a STANAVFORLANT exercise.

## COMMAND IN A NETWORK-CENTRIC WAR

by Colonel Pierre Forgues

*Far from determining the essence of command, then, communication and information processing technology merely constitutes one part of the general environment in which command operates.*

*Martin van Creveld  
Command in War, 1985*

**E**normous advances in information technology have in recent years enabled the development of increasingly capable and sophisticated military command and control systems. In the United States, a concept known as 'Network-Centric Warfare' has been advanced as a means of transforming information superiority into an advantage on the physical battlefield. The concept has been fully endorsed by the United States Navy, and is recognized by the Canadian Navy as a capability that must be achieved.<sup>1</sup>

What, then, is Network-Centric Warfare (NCW), and how is it likely to affect the operational commander? Our examination of this concept begins with an explanation of what is meant by 'information superiority', and is followed by a description of the essential characteristics of an NCW environment. The impact of this highly automated environment is then analyzed by means of its effects on the underlying principles and functions of command. This paper concludes that a network-centric environment cannot alter the essential human attributes of command in war.

### INFORMATION SUPERIORITY

**I**n the industrialized world, the second half of the 20th century saw exponential growth in reliance on Information Technology (IT). Sophisticated computer and communication systems are now at the core of every aspect of traditional military operations, most notably command and control, intelligence, transport and logistics. Driven by a progression of startling advances in the civilian sector, the rate of development and integration of IT systems into military affairs is not likely to diminish. The relatively low cost of computers and software makes it possible to extend the capabilities to users at all levels of the organization, with the result that all functions, regardless of significance, can be served by and depend on this technology. The result of this heavy dependence on IT by military and civilian organizations has, however, led to new vulnerabilities that can be exploited in conflict and, thus, to the concept of 'Information Warfare' (IW).

The term 'Information Warfare' was first used in the 1970s, but it was not until the 1990s that the US Department of Defense (DoD) revealed the existence of command and control warfare concepts as a subset of the broader field of IW.<sup>2</sup> Since that time, defence agencies and the information security industry have studied

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the impact of information warfare on military and civilian organizations with a view to determining how best to protect critical infrastructure. The US concern over the threat posed by the vulnerability of IT systems led to a plan for the protection of vital information infrastructure which was promulgated by a Presidential executive order in 1996.

Military doctrine has recently delineated how offensive and defensive military operations might be conducted in the new environment of cyberspace. In Canada, the *CF Information Operations* manual was published in April 1998, followed by the American manual, *Doctrine for Joint Information Operations*, in October 1998. The two national doctrines are very similar, and the definition of terms is consistent between

inant across the full spectrum of military operations — persuasive in peace, decisive in war, pre-eminent in any form of conflict.”<sup>5</sup>

The role of information technology as the catalyst of the transformation is stressed in the JCS document. It asserts that the end goal of ‘full spectrum dominance’ — which will be achieved through the application of “dominant maneuver, precision engagement, focused logistics, and full dimensional protection” — can be achieved only by realizing the full potential of the information revolution.

Information superiority, touted by *Joint Vision 2020* as a key ‘enabler’ of the future joint force, is defined as “the capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary’s ability to do the same.”<sup>6</sup> This capability, it is suggested, will provide the joint force a competitive advantage that will allow the force to operate freely in a ‘global information grid’. The development of this information grid will provide the *network-centric environment* required to achieve the goal of a fully synchronized information campaign.

Information superiority is therefore analogous to air superiority. One seeks control of airspace, while the other aims to dominate cyberspace. Both are a means to an end, and both are valued for their ability to affect the accomplishment of military objectives. Without air superiority, all elements of a joint force are vulnerable to air attack. Similarly, without information superiority, all elements of a joint force are subject to interference, with the added vulnerability that the theatre of operation in cyberspace is not constrained by geography. If the global information grid envisioned in *Joint Vision 2020* is penetrated, attacks in cyberspace will be able to reach civilian and military targets across the globe, and at the speed of light.

## NETWORK-CENTRIC WARFARE

**N**etwork-Centric Warfare (NCW) represents the next step in the evolution of military thinking about IT and its impact on the conduct of operations. Information Operations doctrine has thus far been limited to a description of how to conduct offensive and defensive action in cyberspace so as to gain information superiority. The emerging concept of NCW is likely to lead to the development of doctrine that describes how the military should organize itself to capitalize on the advantage provided by information superiority to conduct operations in the physical space.

Vice-Admiral Arthur Cebrowski of the US Navy described the NCW concept in his seminal article, “Network-Centric Warfare: Its Origin and Future”<sup>7</sup>, where he argues that advances in information technolo-



The operations room of HMCS *Charlottetown*: ready for network-centric command and control.

the two publications. ‘Information operations’ has been defined as actions taken across the full spectrum, from peace to war, to affect adversary information and information systems while defending one’s own information systems. ‘Information warfare’ is information operations conducted during time of crisis or conflict. ‘Information superiority’ is the outcome of successful information operations where the flow of information is enabled for friendly forces and denied to the enemy.<sup>3</sup>

In 1996, prior to the publication of the doctrine manuals noted above, the concept of information superiority was identified in the US Joint Chiefs of Staff document, *Joint Vision 2010*, as a factor of “emerging importance”.<sup>4</sup> Since then, the concept of information superiority has continued to evolve and grow in importance, and figures prominently in the sequel document, *Joint Vision 2020*, published in June 2000. In this latest document, the Chairman of the Joint Chiefs describes his outlook on the nature and capability of the US armed forces in twenty years, and the transformation that will be necessary to bring about the new capabilities. The end state he envisions is a force “that is dom-

gy are causing military operations to shift from platform-centric warfare to network-centric warfare.

The NCW concept has already been fully embraced by the US Navy. The Chief of Naval Operations is quoted in the January 2000 edition of the Navy public affairs journal as stating that "NCW will be the US Navy's organizing principle in the next century".<sup>8</sup> The literature is now replete with endorsements of the novel concept where "mutually shared information and a common tactical picture will permit coherent employment of the entire naval force as a single synergistic entity."<sup>9</sup> While very little has been written about NCW outside of naval circles, the applicability of the concept to all military operations seems obvious.

In his article, Admiral Cebrowski describes the structural model required to carry out NCW, consisting of information, sensor and engagement grids. The information grid — the computer and communications technology that enables the passing of large amounts of data through interconnected and interoperable networks — provides the backbone for the sensor and engagement grids. Sensor grids collect data from dispersed sensors and rapidly generate battle-space awareness that is shared at all levels of operation. Engagement grids link together lethal and non-lethal weapon systems and capitalize on this situational awareness to optimize the employment of firepower, resulting in a focus on the *massing of effects* rather than the massing of forces.

Admiral Cebrowski points out that many key elements of these grids are already in place, but that full integration is lagging. Information technologies, unlike those of other technologies applicable to military operations, are driven by commercial developments rather than by classified military research and development. This has resulted in the rapid evolution and acquisition of military networks that are not interoperable and, therefore, cannot be integrated. To lay the groundwork for NCW, the US Department of Defense has established technical standards that will allow local and wide area networks to communicate with each other. Admiral Owens, the Vice Chief of the Joint Chiefs of Staff, estimated in 1995 that a "system of systems" could be completed by year 2020, and earlier if priority in defence spending were shifted from other procurement projects.<sup>10</sup>

As mentioned previously, the US Navy has embraced the goal of NCW, and is ahead of the other US services in pursuing its implementation. The Navy has undertaken an ambitious project, called IT-21, to build the 'information grid' needed as the backbone for the NCW concept. A total of \$US 3.6 billion was allocated for this project for a five-year period beginning in 1998. IT-21 will provide an 'intranet' capability to virtually all Navy units afloat and ashore. Commanders will be able to view the common operational picture provided by the US Global Command and Control System, and will have ready

access to mission-critical information (such as weather and intelligence). They will be able to communicate with widely-dispersed forces using secure e-mail and video teleconferencing.

Two other interoperable networks will provide the NCW sensor and engagement grid capability. The secure Link 16 Joint Tactical Information Distribution System (JTIDS) or the Multifunction Information Distribution System (MIDS) digital data radios now being deployed on ships and aircraft will fulfill the requirements of the sensor grid. The JTIDS and MIDS terminals will automatically report friendly positional data, as well as known locations of enemy platforms for display over the network. The Cooperative Engagement Capability (CEC) will combine high-performance sensor and engagement grids. CEC-equipped ships and aircraft will operate as a single distributed air-defense system, passing target data across the entire force in real time. The CEC will 'fuse' the data from the various platforms to develop a target track with much greater accuracy than would be possible using any one sensor. Initial operational capability was achieved in 1996 in a test with the USS *Eisenhower* carrier battle group. Current plans call for completing deployment of this capability aboard aircraft carriers, cruisers, destroyers and Hawkeye aircraft by 2006.

Having reviewed the NCW vision in technological terms, the salient characteristics of such a 'system of systems' can now be identified with a view to determining the effect that an NCW environment is likely to have on operational commanders. From Admiral Cebrowski's



perspective, the emergence of the new technology will enable an evolution from attrition warfare to a new style of warfare that is characterized by 'speed of command' and 'self-synchronization'.<sup>11</sup>

*Speed of command* is achieved in the following ways. First, information superiority on the information grid, coupled with advances in display technology, will result in a dramatic increase in situational awareness



and a better understanding of the battle space. Second, the higher degree of battle-space awareness, coupled with an effective engagement grid, will allow commanders at all levels to employ forces with greater precision and to decide on priorities and allocate weapons more efficiently and effectively. The rapid and effective employment of forces will disrupt the enemy's decision cycle and limit his ability to regain the initiative. Through speed of command, the potential exists to offset a disadvantage in numbers, technology, or position.<sup>12</sup>

*Self-synchronization* is made possible because of the ability to establish and maintain a high degree of situational awareness at all levels of command. Operations no longer have to rely on top-down, command-directed synchronization. Each element of the force can ensure that their unique operating rhythm is in tune with the commander's intent and battle rhythm. This, in theory, eliminates the need for a force-wide friendly decision cycle, so the enemy is thus denied any operational pause and is continuously kept off balance.

In summary, the salient features of a fully developed and functioning Network-Centric Warfare environment are:

- high levels of shared battle-space awareness;
- shared knowledge of the commander's intent; and
- self-synchronization, speed of command and a rapid 'lock-out' of the opponent's options.

## METHODOLOGY

Evaluating the impact of technological change on command is difficult because, as observed by Martin Van Creveld, command is "so intimately bound up with numerous other factors that shape war, the pronouncement of one or more 'master principles' that should govern its structure and the way it operates is impossible."<sup>13</sup> While accepting the complexity of command as noted by Van Creveld, this paper attempts to gain insight of the impact of a NCW environment on command by first drawing from the recent work of the Canadian analysts Dr. Ross Pigeau and Carol McCann on the concepts of command and control.

McCann and Pigeau define command as "the creative expression of human will necessary to accomplish a mission."<sup>14</sup> They convincingly argue that the human attributes essential for command consist of three principal dimensions: competency, authority, and responsibility. They recommend that all new command and control systems should be assessed for effects on these components. Accepting this model as a valid point of departure, this paper begins with an assessment of the effects of a NCW environment on the commander by analyzing its impact on these three human attributes.

Having examined the impact of NCW on a commander's attributes, the paper will then turn to an analysis of the impact of NCW on his ability to exercise command. The "fundamentals of command" in CFP 300-1, *Operational Level Doctrine for the Canadian Army*, provide guidance to commanders in the exercise of command. A review of British Army and US joint doctrine will reveal consistency of these principles across environmental and national boundaries. These fundamentals of command thus form a good basis for our analysis.

## IMPACT ANALYSIS

McCann and Pigeau observe that command is a uniquely human characteristic that any individual in the organization, from private to general, can assume. They advance that varying levels of competency, authority and responsibility set the general officer apart from the private in their abilities to command.<sup>15</sup>

Competency attributes encompass four general categories: physical, emotional, interpersonal and intellectual. A commander's physical or emotional competency is not likely to be any more challenged in a network-centric environment than in current settings. However, new interpersonal and intellectual competencies may need to be developed.

The NCW environment will provide the commander and his staff with an increased capability to communicate via e-mail and video teleconferencing with all levels of his command. For most, this will not be a significant change as video is already being used as a means of communication between staffs and commanders with generally good results. There is always a risk that video teleconferencing will be employed as a tool for micro-management — unwarranted interference in the exercise of command and control by subordinates. However,

barring this misguided use, an expanded and appropriate use in an NCW environment is not likely to have any negative impact, and may in fact enhance rather than diminish the communication function.

Intellectual competency is an essential attribute for absorbing large amounts of information, analyzing courses of action and making decisions. The NCW environment certainly has the potential to overwhelm commanders with too much information — information overload — so the ability to sort quickly through the unimportant will be a crucial skill. As previously discussed, the system will need to provide innovative decision support tools to assist commanders in this task. However, increased information will not necessarily result in improved leadership, nor make commanders more effective. According to US Army Lieutenant General C.J. Kennedy, “command is still largely a function of a commander’s intuition . . . individuals perceive information in different ways.”<sup>16</sup> Essentially then, in spite of the vast amounts of data generated by a myriad of interconnected networks, in the final analysis, commanders will still need to rely on their creativity and intuition to make sound decisions in a NCW environment.

Authority, the second attribute identified by McCann and Pigeau, refers to the domain of influence of the commander. It consists of legal authority — defined as that authority assigned by the government, and personal authority — the authority granted by peers and subordinates. McCann and Pigeau posit that “command authority is achieved almost exclusively through personal authority . . . [and personal authority is] based on reputation, experience, and character”.<sup>17</sup>

A network-centric war environment has the potential to significantly affect a commander’s personal authority. The increased level of shared battle-space awareness and shared knowledge of the commander’s intent will, assuming the commander is making correct decisions, bolster his reputation and increase his degree of personal authority over the entire force. Obviously, quite the opposite could also occur in situations where the commander exhibits questionable judgement. With respect to personal authority, an NCW environment will create a double-edged sword that commanders will need to wield carefully.

Responsibility, the final dimension of command, refers to “the degree to which an individual accepts the moral liability and obligation with Command”.<sup>18</sup> McCann and Pigeau identify two components of responsibility. *Extrinsic responsibility*, which is equivalent to accountability, deals with the formal obligations of command. *Intrinsic responsibility* relates to self-generated obligations and is a function of the resolve and motivation of the individual. An NCW environment has the potential to induce

higher degrees of intrinsic responsibility in commanders and subordinates alike; however, once again, an opposite effect is also possible. The higher degree of shared awareness can be a strong motivating force and increase the will to fight in all combatants. On the other hand, a shared awareness of imminent defeat may send shock waves through the force and adversely affect morale. In an NCW environment, perhaps to a greater extent than today given the heightened awareness of the situation, commanders will have to be vigilant and ensure that effective leadership is exercised at all times.

McCann and Pigeau assert that the three dimensions of competency, authority, and responsibility are sufficient to account for Command capability, and “together form an abstract three-dimensional space within which the Command potential of all military personnel lie.”<sup>19</sup> They explain that “there exists a roughly linear relationship among the three dimensions, one that reflects an optimal balance for different levels of Command.” Thus, to be effective, a given commander’s abilities must match the levels of competency, authority, and responsibility associated with his position. Therefore, to function in the self-synchronization mode, NCW will need to ensure that commanders at all levels have the attributes necessary to accomplish the task. In effect, information technology alone is not sufficient to enable self-synchronization in a NCW environment. In the final analysis, it is the human element in the system — the commanders — that will make it work.

The fundamentals of command, as defined in CFP 300-1, are: unity of effort, decentralization, trust and mutual



The operations room of HMCS Victoria.

understanding, and timely and effective decision making. Command promotes force cohesion to achieve unity of effort. Whenever possible, command must be decentralized and rely on the ability of sub-units to operate independently, while maintaining unity of effort. This favourable situation is made possible through the development of trust and mutual understanding. In such an environment, commanders can exercise timely and effective decision-making. The impact of a network-centric warfare environment on each of the fundamentals of command will be addressed in turn.

Although employing decentralization, the commander must remain able to coordinate the activities of his subordinates to achieve synchronization . . . and to preserve unity of effort across his force.<sup>20</sup>

Maintaining unity of effort is of course more difficult when command is decentralized. CFP 300-1 argues that the conflict between unity of effort and decentralization is resolved by ensuring that the commander's intent is communicated and understood, the main effort is clearly designated, a proper command climate is maintained, and the forces operate based on a common doctrine. The role of the leader in establishing purpose, providing direction, and generating cohesion and motivation is stressed. These guiding principles are fully consistent with the views expressed by McCann and Pigeau that command "is first and foremost a human endeavor", and that command and control is "the establishment of common intent to achieve coordinated action."<sup>21</sup> These fundamental tenets operate independently of technology, and will retain validity in a network-centric environment.

To establish purpose, leaders require awareness. As advanced by the noted historian, John Keegan, "the essentials of action by the commander are knowing and seeing."<sup>22</sup> In this sense, a network-centric warfare environment certainly has the potential of facilitating the leadership function by increasing awareness. However, NCW runs the risk of overloading the commander if not properly designed. The technological challenge was expressed at a 1997 AFCEA conference. In the words of Major General Charles Thomas, who chaired a panel on information systems at the conference, "building the right software filters, the right profiles, so that we can provide the right information without overloading each commander, is one of our great challenges."<sup>23</sup> As stated earlier, this paper assumes that this technical hurdle has been successfully overcome.

In an NCW environment, where the self-synchronization of forces is enabled and valued, commanders will be able to adopt a *command by negation* approach to maintain unity of effort. With the assumption that the technology will provide the means to effectively filter the large amounts of data and present a valid picture of the battlefield, commanders will be able to focus on the monitoring rather than the control of operations. While the means to achieve unity of effort may change, this important and fundamental aspect of command will remain in an NCW environment.

To generate the required tempo of operations and to cope with the uncertainty, disorder, and fluidity of combat, command must be decentralized to the maximum extent possible.<sup>24</sup>

NCW will facilitate the decentralization of command. "No longer dependent on information being passed along, units can act on changing situations as they happen to exploit weaknesses and counter enemy strategies to accomplish the overall mission."<sup>25</sup> However, decentralization cannot be applied indiscriminately. Decentralization relies on implicit communications, up and down and across the system. In an NCW environment, the push for speed of command and self-synchronization will drive all participants to rely too heavily on the common operating picture, and to treat this situational display as a shared reality that is neither shared nor real due to the inherent inaccuracies of any information system.<sup>26</sup> Centralization may be more appropriate if the higher commander has better information, if subordinate commanders are not sufficiently trained, or if a climate of trust and mutual understanding has not been achieved.

NCW may bring out the best and the worse in leaders. Some have argued that while NCW will allow for the flattening of organizational structures, the grave nature of military operations may push some commanders to seek too much control. The best commanders will learn to use the increased situational awareness to their advantage. The complete linkage of the information network to all command hierarchies will allow commanders to adapt command and control roles and responsibilities based on the changing war-fighting scenario. Commanders that use NCW effectively will "banish over-supervision and expect — demand — initiative from subordinates based on improved situational understanding."<sup>27</sup>

CFP 300-1 explains that commanders must "allow subordinates to exercise freedom of action but [must be ready] to exert control when necessary by asserting their authority."<sup>28</sup> This will continue to be sound guidance for commanders who seek to apply the principle of decentralization in a NCW environment.

A superior needs to have the trust of, but also have trust in his subordinates. The basis of this two-way trust is mutual understanding.<sup>29</sup>

CFP 300-1 identifies trust as one of the 'cornerstones' of command. The maintenance of trust is vital to the maintenance of morale. Soldiers must trust not only their immediate superiors, but must believe in the abilities and judgement of commanders throughout the chain of command. Soldiers need to understand 'the reason why' and maintain a sense of involvement in the decisions made by their superiors.

Pigeau and McCann stress the importance of shared intent between commanders and their subordinates. The components of shared intent are explicit and implicit intent. Explicit intent is passed overtly through orders but is not sufficient for ensuring operational success. Implicit intent is passed through the exercise of leadership and the continual personal interaction with subor-

dinates. By communicating implicit intent, “a Command climate is established where trust, confidence, motivation, creativity, initiative, pride, discipline and esprit de corps are developed.”<sup>30</sup>

The NCW environment will greatly facilitate the sharing of explicit intent and may, if the technological challenges are surmounted, service the need of maintaining close contact and shared implicit intent between the commander and the commanded. In any event, the fundamental need of shared intent and the element of trust it engenders will remain a cornerstone of command in network-centric warfare.

An effective planning and decision-making capability requires a balance between information and time . . . The key is to make timely and effective decisions, appropriate to the level of command.<sup>31</sup>

According to CFP 300-1, decision-making is a “time-competitive process to try to get inside the opponent’s decision-action cycle.” The ‘faster commander’ thus retains the initiative, and keeps his opponent off balance by rendering his actions ineffective and inappropriate. However, the doctrine points out that timely decision-making does not only mean that decisions must be made quickly, but equally important is the need to “make good decisions at the right time.”<sup>32</sup>

The ‘speed of command’ characteristic of the NCW environment could lead to some undesirable effects. “We may find ourselves acting so rapidly within our enemy’s decision loop that we largely are prompting and responding to our own signals . . . like Pavlov’s dog ringing his own bell and wondering why he’s salivating so much.”<sup>33</sup> While networked organizations can process information faster, this does not necessarily mean that speed of command is increased. Rather “this should translate into increased time for analysis and contemplation of appropriate response.” NCW should not seek to change the Observe-Orient-Decide-Act (OODA) loop to a DADA loop.

Professor Mackubin Owens of the US Naval War College points out that “possessing a mass of data does not mean that the decision maker understands their significance or what to do with them.”<sup>34</sup> Only when data has been synthesized and converted into knowledge does the decision-maker achieve true situational awareness. Neither is more data necessarily better. Another analyst noted, more data would have “clogged an already crowded process” and would not necessarily have altered the *Vincennes* commanding officer’s decision to identify as hostile and order the shoot down of an Iranian commercial airliner. What was needed was “exactly the right information, provided in a 2 minute and 22 second window.”<sup>35</sup>

CFP 300-1 points out that commanders must be conscious of the gravity of decisions that could result in the loss of life. One element of decision-making may be aided by NCW, in that ‘perfect’ information will alleviate the burden of choosing. However, no amount of information technology will ever allow complete insight

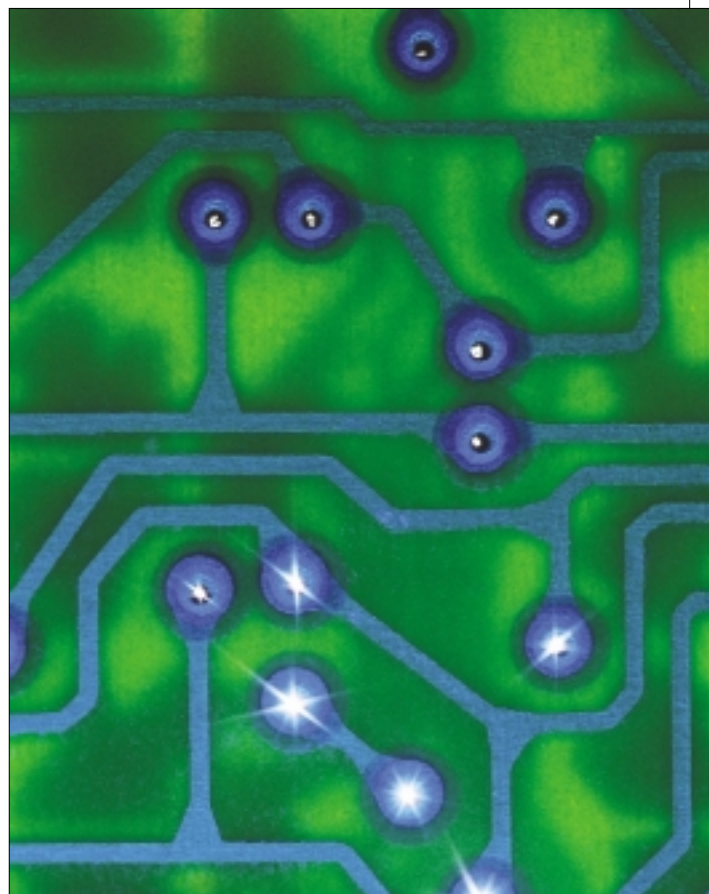
into the minds of the opposing commander, or the intentions of a potential foe. Admiral William Owens, Vice Chief of the US Joint Chiefs in 1996, explains:

The system-of-systems does not offer omniscience or omnipotence. It has demonstrated the ability to reduce the fog and friction of war and promises to do even more so in the future. What counts in war is the relative influence on the opposing side of what some have called the fog and friction of conflict. The side that can reduce the effect of that fog and friction significantly, relative to its opponent, will win.<sup>36</sup>

Risk taking, and the need to make decisions in the absence of perfect information, will continue to be a burden of command in the NCW environment. Technology, no matter how sophisticated, will never change this simple and unavoidable truth.

## SYNTHESIS

As previously argued, the NCW environment will not change the fact that command is a mission-oriented human endeavour performed within the limits of a commander’s personal attributes. However, two features of NCW have the potential of significantly affecting the attributes of competency and authority. First, the processing and assimilation of large amounts of data can overstress the intellectual competency of commanders. This paper assumes that system designers will be successful in their goal of filtering the data and providing commanders with adequate decision-support tools. Arguably, a failure to design network systems in this



manner will seriously constrain any potential advantage of a NCW environment, as any increase in awareness will be limited by the human ability to process information. Second, the effectiveness of commanders can be diminished through a loss in personal authority in situations where a commander's questionable judgement is quickly disseminated across the information grid for all to see. However, while the new technology may alter the environment to the point that personal attributes are affected, the central fact remains that command potential and effectiveness are limited by the personal attributes of the commander. In this respect at least, the essence of command is unchanged.

The analysis has also shown that commanders will continue to be guided by existing fundamentals of command in an NCW environment. While the means to achieve unity of effort may change, and the ability to decentralize command functions will be enhanced, the importance of these elements in the effective exercise of command is undiminished in an NCW environment. Similarly, and as argued in the previous paragraph, the establishment of trust and mutual understanding may be altered in means but not import. Finally, decision making will continue to be the province of commanders, and will continue to be dependant on a commander's experience and intuition.

The NCW environment will not determine the essence of command in war. The technology will indeed bring a new set of variables to the command equation that must be solved by commanders. In the words of Martin van Creveld, "Far from determining the essence of command, then, communication and information processing technology merely constitutes one part of the

general environment in which command operates."<sup>37</sup> The technological component of war can never fully account for the dynamic interaction of human beings and "war will remain predominantly an art, infused with human will, creativity, and judgement."<sup>38</sup>

## CONCLUSION

The emergence of the concept of Network-Centric Warfare represents a significant milestone in the evolution of military thinking on how to integrate information technology into military operations. The first impact of information technology on military doctrine has been the formulation of organizing principles dealing with the conduct of operations in cyberspace and the idea of information superiority. The concept of Network-Centric Warfare seeks to further exploit information technology and significantly enhance the functions of command and control on the battlefield.

However, this paper has argued that a network-centric environment will not determine the essence of command in war. Command is in essence a mission-oriented human endeavor, performed within the limits of a commander's personal attributes and guided by a framework of fundamental principles. In spite of advances in technology, command will always be limited by human attributes and capabilities, and will rely on a commander's creativity and intuition. The fundamental principles governing unity of effort, decentralization, trust, mutual understanding and decision making remain unchanged in a network-centric environment.



## NOTES

- David Morse, "STANAVFORLANT under Canadian Command." *Canadian Military Journal*, Vol. 1, No. 2 (2000): p. 62.
- Edward Waltz, "The US Transition to Information Warfare", *Journal of Electronic Defense*, December 1998, pp. 35-42.
- United States, Joint Chiefs of Staff, Joint Publication 3-13: *Joint Doctrine for Information Operations*, October 1998: p. 1-1.
- United States, Joint Chiefs of Staff, *Joint Vision 2010*, 1996.
- United States, Joint Chiefs of Staff, *Joint Vision 2020*, June 2000.
- United States, Joint Chiefs of Staff, *Joint Vision 2020*, June 2000, p. 8.
- Arthur K. Cebrowski, "Network-Centric Warfare: Its Origin and Future", *United States Naval Institute Proceedings*, 124-1 (January 1998), pp. 28-35.
- C. Dour and V. Beck, "A Network-Centric Frame of Mind", *Public Affairs Communicator*, January 2000.
- Edward C. Whitman, "Submarines in Network Centric Warfare", *Sea Power*, July 1999, pp. 33-36.
- William A. Owens, "The Emerging System of Systems", *United States Naval Institute Proceedings*, 121-5 (May 1995), p. 39.
- Cebrowski, *Network*, p. 32.
- Arthur K. Cebrowski, "Sea Change", *Surface Warfare*, 22-6 (Nov./Dec.1997), p. 5.
- Martin Van Creveld, *Command in War* (Cambridge: Harvard.) p. 261.
- C. McCann and R. Pigeau, "Clarifying the Concepts of Control and of Command", *Proceedings of the 1999 Command and Control Research and Technology Symposium* (Washington, DC: CCRP, Dept. of Defense) p. 5.
- ibid*, p. 7.
- ibid*, p. 8.
- ibid*.
- ibid*, p. 9.
- ibid*.
- CFP 300-1, p. 3-5.
- McCann and Pigeau, pp. 2-5.
- John Keegan, *The Mask of Command*, (New York: Viking Penguin), p. 325.
- Campen, *Joint Vision*, n.p.
- CFP 300-1, pp. 3-5.
- Jay L. Johnson, "Network Centric Warfare - Real Time Awareness", *All Hands*, Jan. 1998.
- Thomas P.M. Barnett, "The Seven Deadly Sins of Network-Centric Warfare," *United States Naval Institute Proceedings*, January 1999.
- Steven J. Mains, "Adopting Doctrine to Knowledge", *Military Review*, 7-2, March-April 1997, p. 95.
- CFP 300-1, p. 3-3.
- CFP 300-1, p. 3-7.
- R. Pigeau and C. McCann, "Re-defining Command and Control." In C. McCann & R. Pigeau (Eds.), *The Human in Command* (New York: Kluwer Academic/Plenum) n.p.
- CFP 300-1, p. 3-3.
- ibid*.
- Barnett, *Deadly Sins*, n.p.
- M.T. Owens, "Technology, the RMA, and Future War", *Strategic Review*, 26-2, Spring 1998, p. 69.
- Alan D. Zimm, "Human-Centric Warfare," *United States Naval Institute Proceedings*, 125-5, May 1999, p. 31.
- William A. Owens, "The Emerging System of Systems," *National Defense University Strategic Forum*, Number 63, February 1996.
- Van Creveld, *Command in War*, p. 275.
- F.G. Hoffman, "An Alternative to the 'System of Systems'", *Marine Corps Gazette*, 84-1, January 2000, p. 22.