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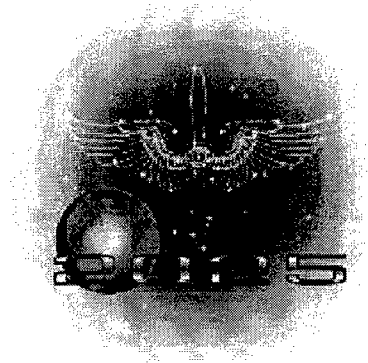
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**The Command or Control Dilemma:
When Technology and Organizational
Orientation Collide**



A Research Paper
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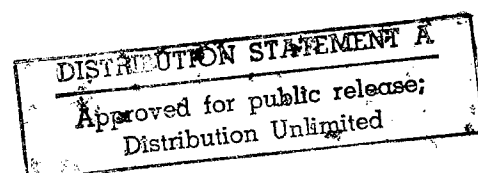
Air Force 2025

by

Gregory A. Roman
Lt Col, USAF

Advisor: Col Victor Budura, Jr.

April 1996



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Disclaimer

2025 is a study designed to comply with a directive from the chief of staff of the Air Force to examine the concepts, capabilities, and technologies the United States will require to remain the dominant air and space force in the future. Presented on 17 June 1996, this report was produced in the Department of Defense school environment of academic freedom and in the interest of advancing concepts related to national defense. The views expressed in this report are those of the authors and do not reflect the official policy or position of the United States Air Force, Department of Defense, or the United States government.

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Executive Summary

In an information-age military, the proper organizational orientation may no longer be one of command and control, but command *or* control. Historically, the military's response to new information technology has always been greater centralized control. Unfortunately, greater centralized control is the exact opposite of what is desired to maximize the benefits of information technology. As the tempo of operations increases, so does the demand for faster decision making. Information technology, however, is creating a faster information- gathering cycle, but not a correspondingly faster decision-making cycle. This creates an imbalance that can only be corrected by the proper organizational orientation which takes full advantage of information. The information-age military needs the shared information-gathering advantages of a networked organization with the decentralized decision-making advantages of a flattened hierarchical organization. Failure to adapt to a new organizational orientation of decentralized control may result in a US military unable to operate at the increased tempo of future warfare.

Biographical Sketch

Lt Col Gregory A. Roman (BS, US Air Force Academy; MS, Troy State University) is a career intelligence officer. His duty assignments include tours as an operations officer and squadron commander for EC-130 and RC-135 operations. He has been stationed in Greece, Korea, Germany, Panama, and Japan. While assigned to the Pentagon, he served as the tactical cryptologic program element monitor and executive officer to the assistant chief of the Air Force/Intelligence, and on the secretary of the Air Force's legislative liaison staff. He is a distinguished graduate of Squadron Officer School and a graduate of Air Command and Staff College.

Chapter 1

Introduction

The functions of command are eternal.

—Martin van Creveld, 1985

Once upon a time, everybody understood what commanders did. They commanded. This was simple enough and sufficient for a thousand years or more . . . now, commanders would exercise command and control.

—Greg Todd, 1985

One of the least controversial things that can be said about command and control is that it is controversial, poorly understood, and subject to wildly different interpretation. The term can mean almost everything from military computers to the art of generalship: whatever the user wishes it to mean.

—Kenneth Moll, 1978

Command and control, words or a phrase very familiar to the military, are subject to much confusion and misinterpretation. What does command and control really mean and is our current command and control orientation the proper one for an information-age military?¹ These are important questions as the US military grapples with the potentially revolutionary changes brought on by modern information technology. If information-age technology is indeed ushering in a revolution in military affairs (RMA), then organizational structures and associated command and control orientation must change. In 1995, the secretary of defense stated:

Historically, an RMA occurs when the incorporation of new technologies into military systems combines with the innovative operational concepts and organizational adaptations² to fundamentally alter the character and conduct of military operations.

These organizational changes are occurring in the business world, but can we say the same for the military?

The Air Force Scientific Advisory Board's (SAB) 1995 "New World Vistas" report notes:

Even the most casual glance at business history makes it clear that each time a new information infrastructure becomes available (e.g., railroad, telegraph, telephone) the entities which are ultimately most successful are also the first to reshape their structures in order to gain maximum advantage of the new information conduits. The new networks emerging today are "geodesic," that is, global, non-hierarchical, and without any central node.³

The SAB concludes with the optimistic view that "it is a safe bet that our [military] organizations will follow suit."⁴ However, this may be easier said than done given the historical resistance of military organizations in adapting to new organizational orientations.

The US military services have thus far failed to create the innovative operational concepts and make the organizational adaptations needed for the information age, because we remain rooted in an industrial-age command and control paradigm. As pointed out in the draft "Warfighting Vision 2010", "technological enhancements may have made 'control' an anathema to 'command'."⁵ This creates a dilemma, as in the information age, the correct orientation may no longer be one of command *and* control, but one of command or control. Centralized control exercised by hierarchical organizations may no longer be possible or desirable in a fast-tempo war.

Failure to address this problem could result in a military not prepared for the operations tempo of information-age warfare. As Maj Gen J. F. C. Fuller points out, "The highest inventive genius must be sought not so much amongst those who invent new weapons as among those who devise new fighting organizations."⁶ However, creating new organizational orientations has never been easy. Brigadier J.P. Kiszely expands Fuller's view:

Without originality, let alone genius, the new technologies will merely be grafted on to existing organizations and doctrines in a way designed to cause the least inconvenience and least unpleasantness in peacetime. The risks of having operated on this principle in the past are as nothing to the dangers of doing so in the future.⁷

Unfortunately, by viewing the benefits of information technology within the current military command and control orientation, we may use that technology in a manner that is the exact opposite of what is most useful.

The seductive nature of information technology is in stimulating military organizational orientation towards greater centralized control and more rigid hierarchical organizations, instead of the desired orientation of decentralized control and more flexible organizations. Unless we recognize the dangers of succumbing to technological temptation, control functions may take priority over command functions, resulting in a military that is both a less efficient and less effective. While this applies to all US military

services, the command or control dilemma particularly impacts the Air Force's command and control orientation of "centralized control, decentralized execution."

This paper will argue that the corrosive effect of an outdated command and control orientation prevents the American military, particularly the Air Force, from fully applying the benefits of information technology. Future warfare, characterized by faster operations tempo, requires a new orientation based not on "centralized control" but on greater decentralized control and more flexible organizational orientation. To better understand this, we must first examine the definitions of command and control to explain why there is so much confusion and misunderstanding. From a historical perspective, we can show how the military traditionally responds to new information technology by emphasizing greater centralized control and rigid hierarchical organizational structures. Then, through the use of an information-gathering and decision-making model, we can determine why our current military orientation of centralized control and hierarchical organizational structures is exactly the opposite of that desired. Finally, from historical evidence and model analyses, we can draw some recommendations on the correct military organizational orientation for the future.

Notes

1 In *War and Anti-War*, Alvin and Heidi Toffler (Boston: Little, Brown and Co., 1993), describe the differences between agrarian, industrial, and information-age societies and militaries. While some have criticized this categorization as oversimplified, the Tofflers' writings are influential within the US military.

2 William J. Perry, *Annual Report to the President and the Congress* (Washington, D.C.: Department of Defense, 1995), 107.

3 USAF Scientific Advisory Board, *New World Vistas: Air and Space Power for the 21st Century* (unpublished draft, the communications volume, 15 December 1995), 17.

4 Ibid.

5 Joint Warfighting Center, draft *Warfighting Vision 2010* (Ft Monroe, Va: Joint Chiefs of Staff, 1 August 1995), 19.

6 Maj Gen J.F.C. Fuller, *Armament and History* (New York: Charles Scribner and Sons, 1945), 158. Of note, on page 146, Fuller gives a scathing critique of Giulio Douhet's motives by stating, "The secret which Douhet could not grasp was that inventive genius when stirred by the instinct of self-preservation knows no bounds. He was a wonderful salesman, and like many people - a prophet of the ridiculous."

7 Brig J.P. Kiszely, "The Contribution of Originality to Military Success," in *The Science of War*, Brian H. Reid (London: Rutledge, 1993), 44-45.

Chapter 2

A Frame Of Reference

Our familiarity with the words command and control may lead one to believe that a problem does not exist. After all, these two words sound like they were meant for each other, so few fully appreciate their separate meanings. This cozy word association also gives the impression of equal weighting, value, and importance. While few would challenge this observation, the truth is that there is no agreement on what command and control really means, though many have made a valiant effort to define the term. In *Command and Control for War and Peace*, Thomas Coakley addresses some of the origins behind these two words. He notes that there is little mention of “control” by the early biographers of the great captains of battle. Control was viewed as an organic function of command. However, the word control appears in literature during World War I and more frequently in World War II, possibly because of the increased automation and sophistication of weapons systems.¹ This led to a belief that one commands people but controls things.² For example, we can make this distinction by stating we command the aircrews that, in turn, control nuclear weapons. Another view is that command is strategic and operational, while control is tactical. Analogies have been made with the human nervous system, with the command brain controlling the rest of the body.³ Others believe is that command is an art while control is more a science. John Boyd wrestles with the differences in describing the epitome of command, which to him means to direct, order, or compel, while control means to regulate, restrain, or hold to a certain standard.⁴ Boyd goes on to suggest that “leadership and monitoring” are more accurate and descriptive than are command and control.⁵

However, is this word association healthy? And what happens when certain words fall out of favor? One solution is to invent new word associations.⁶ For example, command and control (C²) has expanded to

C³ (communications), C⁴ (computers), C⁴I (intelligence), and C⁴I² (interoperability). The US Marine Corps is advocating an orientation of "command and coordination" as part of their future war-fighting concept called "Sea Dragon," while the Air Force is championing an orientation called C⁴ISR (surveillance and reconnaissance).⁷ One wonders which word will be added next. Perhaps C⁵I² (coordination), or C⁶I² (cooperation)? Unfortunately, each new word association that tries to describe new thinking or new technology does so at the expense of the most important word command, or what Greg Todd calls "C₁."⁸

The Joint Chiefs of Staff (JCS) does not provide much help in clarifying the confusion over the term "command and control." JCS Pub 0-2 defines command as

the authority that a commander in the Military Service lawfully exercises over subordinates by virtue of rank or assignment. Command includes the authority and responsibility for effectively using available resources and for planning the employment of, organizing, directing, coordinating, and *controlling* military forces for the accomplishment of assigned missions. (Emphasis added)⁹

By definition then, control is a component of command. Why then do we distinguish control from command, and why give preferential treatment to the notion of control but not to those of organizing, directing, or coordinating? Perhaps it is because we fail to see the difference. There are many obvious similarities when comparing command with the JCS definition of command and control as

the exercise of authority *and direction* by a designated commander over assigned and attached forces in the accomplishment of the mission. *Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission.* (Emphasis added)¹⁰

The differences between these two definitions are italicized above. The latter describes the orientation (which will be discussed later) through which a commander exercises command and control. For now, let us focus on the italicized word "direction." Does this imply control? If so, then one would logically expect the JCS definition of control to be "the exercise of direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission."

This would make sense in explaining that command is the exercise of authority while control is the exercise of direction. However, things are not this easy. Control is also exercised by civilian leadership, such as President Kennedy's executive committee handling the Cuban Missile Crisis; or by military personnel, like air traffic or weapons controllers, as part of their official duties. Thus, control also applies to people in noncommand functions.

The JCS definition of control does little to clear up the confusion by describing it as

authority which may be less than full command exercised by a commander over part of the activities of subordinate or other organizations.¹¹

JCS definitions, do little to clarify the command or control definition dilemma. Is command defined by "authority for full command exercised by a commander?" control is defined as "authority of less than full command exercised by a commander?" If so, what exactly does that mean? It would appear that more accurate, unambiguous, and descriptive definitions are the first step in resolving the command or control dilemma.

Perhaps what is needed is a fresher and simpler perspective. The JCS definition of command already asserts that command contains all the essential ingredients necessary for accomplishing the assigned mission. As Todd points out, "If atoms could be split, so could the act of command. Now, commanders would exercise command and control. Eureka! Never mind that command already implied control. Never mind that without control one could not command."¹² By recalling Van Creveld's statement about "the eternal nature of command," we have only ourselves to blame in confusing the issue and making it more complex than it has to be. JCS Joint Pub 1 reminds us that, "The primary emphasis in command relations should be to keep the chain of command short and simple so that it is clear who is in charge of what."¹³ Command, by its very eternal nature, provides that simple orientation that stands the test of time and introduction of new technology.

Notes

1 Thomas P. Coakley, *Command and Control for War and Peace* (Washington, D.C.: National Defense University Press, 1992), 36.

2 Ibid.

3 Ibid., 41-42; and Martin van Creveld, *Command in War* (Cambridge, Mass.: Harvard University Press, 1985), 263.

4 John R. Boyd, "Organic Design for Command and Control" (August 1987), excerpt from "A Discourse on Winning and Losing", a selection of unpublished briefings and essays (Air University Library, document M-h 30352-16no7791), 2..

5 Ibid.

6 This word association may be more psychological than practical. My thanks to Lt Col Chancel T. French (retired) for educating me on a possibility of our habit of word association having historical origins dating to the Battle of Hastings in 1066. One outcome was the mingling of English, French, and Latin words on legal documents and in everyday usage. As a result, word associations like cease and desist, to have and to hold, search and destroy, and command and control are now common jargon. My thanks also to Col Dick

Szafranski for explaining the Russian usage of "duty terms" when talking about certain military subjects. Command and control is a duty term.

7 Provided by US Marine Corps and US Air Force briefers during the Air War College academic year 1995-1996. Used with permission.

8 Greg Todd, "C₁ Catharsis", *Army* (Carlisle Barracks, Pa.: Army War College, February 1986), 14.

9 Joint Pub 0-2, *Unified Action Armed Forces* (Washington, D.C.: Joint Chiefs of Staff, 24 February 1995), GL-4.

10 Ibid., GL-4 and 5.

11 Joint Pub 6-0, *Doctrine for Command, Control, Communications, and Computer (C4) Systems Support* (Washington, D.C.: Joint Chiefs of Staff, 30 May 1995), GL-6.

12 Todd, 14.

13 Joint Pub 1, *Joint Warfare of the Armed Forces of the United States* (Washington, D.C.: Joint Chiefs of Staff, 10 January 1995), III-9.

Chapter 3

A Historical Perspective

Throughout the history of warfare, commanders have had to address two fundamental questions. As Frank Snyder points out, one question is, "What is actually happening?" and the second is, "What can I or should I do about it?"¹ The former question involves a process of information gathering, while the second is the process of decision making. These two processes are critical when studying the evolution of military orientation towards greater centralized control and hierarchical organizations.

Perhaps the only time command and control was not an issue was when warfare involved single command and low technology. In preindustrial-age warfare prior to the mid-1700s, commanders personally gathered information and decided on courses of action. So critical was the commander that a recognized tactic in defeating an enemy army was in capturing or killing the enemy commander.² One of the greatest of these preindustrial-age commanders was Alexander the Great, whose command John Keegan describes as one of strong, centralized control. He commanded alone, as the need for a general staff or subordinate commanders was not deemed necessary.³ Alexander's armies numbered no more than 50,000, but were usually smaller.⁴ His preparation for battle was based on his own observations, knowledge of the enemy, awareness of his own capabilities, his experiences in previous battles, and his genius in formulating battle plans.⁵ To gather information, he usually selected a high point to observe both the enemy and his own troops. Once a decision was made, Alexander issued orders by word of mouth directly to his troops. Prior to one battle, he used a platform to address his army; at another he rode along the entire front of his force of 50,000 men and stopped every so often to repeat his speech, thus allowing the information to be relayed to the rear of the formation.⁶

However, single command also was limited by how much one leader could do. As his record of eight war wounds would attest, once battle was engaged, Alexander would lead the charge, losing the ability to gather information or make decisions except in his immediate vicinity.⁷ In preindustrial-age warfare, command orientation was simple with few technological wonders for controlling large armies. As James Coyne notes in his study of airpower in the Gulf War:

Before the age of electronics and aerospace technology, command and control—in the modern sense of the term—was a comparatively minor element in warfare. Battles were fought, albeit inefficiently and often ineffectively, independent of the health of supporting communications.⁸

The key factor in controlling armies was not technology but rather the commanders' personal capacity to command.

This changed, however, as the industrial age, starting in the mid 1700s, introduced technology and innovations that made control of larger armies possible. The response to this technology was greater centralized control exercised by hierarchical organizations. The Prussian military was one of the first to cope with this increased span of control by introducing innovations such as the general staff and a hierarchical command structure. Both these innovations dramatically affected the commander's information-gathering and decision-making process.

With larger armies spread over greater distances, the industrial-age commander required others to help him gather information and implement decisions. For example, Frederick the Great, unlike previous commanders, remained at a fixed headquarters behind his troops, where he gathered information and made decisions.⁹ Without personal involvement in the information-gathering process, he relied more and more on information provided by his staff and subordinate commanders. By having others helping decide "what is going on," the industrial-age commander became much more susceptible to what Clausewitz describes as the "realm of uncertainty."¹⁰ The obvious response to increased uncertainty was greater centralized control.

Napoléon continued the tradition of centralized control. John Boyd believes that Napoléon, influenced by the writings of Clausewitz and Henshi de Jomini, viewed the conduct of war as essentially one directional, from the top down, emphasizing adaptability at the top and regularity at the bottom.¹¹ While Napoléon probably believed that his military genius did not require subordinate commanders to be burdened with making decisions, he understood that his hierarchical command structure hampered his information gathering

needs. To cope with uncertainty, Van Creveld describes Napoléon's creative use of aides-de-camp as a "directed telescope" to gather information independently of his general staff and commanders.¹² However, despite Napoléon's many creative innovations, his command and control orientation had limits.

In particular, Napoléon's centralized control orientation could not overcome the complexity, size, and tempo of modern, industrial-age warfare. As Van Creveld correctly points out;

The paradox is that, though nothing is more important than unit of command, it is impossible for one man to know everything. The larger and more complex the forces that he commands, the more true this becomes.¹³

While Napoléon commanded 85,000 men at Austerlitz with great success, he lost control of half his force of 150,000 men at Jena and had no control of his 180,000-man force at Leipzig.¹⁴ Boyd believes that Napoléon's eventual downfall was attributable to his highly centralized command and control system. His orientation created unimaginative, formalized, and predictable actions at lower levels of command and "minimized the possibility of exploiting ambiguity, deception, and mobility to generate surprise for a decisive edge."¹⁵ Possible solutions were either a new organizational orientation or a new technological breakthrough; not surprisingly, the technological breakthrough came first.

The major technological innovations of industrial age warfare in the mid-1800s were the railroad and the telegraph. The railroad increased the mobility of larger armies, while the corresponding introduction of the telegraph allowed for greater control of armies over larger distances. Commanders responded to this communications technology by increasing control at the top. However, this technology became a double-edged sword. While increasingly demanding more information from subordinate commanders, senior commanders had to respond to more information requests from their superiors. As an Austrian officer wrote in 1861, "A commander who is tied down in this way is really to be pitied; he has two enemies to defeat, one in the front and one in the rear."¹⁶ History notes that Napoléon III was communicating from Paris and often harassing his generals in Russia about progress in the Crimean War.¹⁷ Col S. L. A. Marshall describes a World War II phenomenon in which company commanders joined a platoon on the front lines just to isolate themselves from the telephone, because "they were literally 'tired to death,' having the battalion commander insist on having a fresh progress report every fifteen or twenty minutes."¹⁸ Thus, information technology proved very seductive in providing the means for greater centralized control.

The need to balance legitimate requests for information while allowing subordinate commanders the freedom of action is a difficult one. Prussian leader Helmuth Karl Bernhard von Moltke “the Elder” was one of the first to appreciate the value of the telegraph, but he also recognized the increased tendency in using it to find out what was happening at the front.¹⁹ In his *Thoughts on Command*, Von Moltke writes:

The most unfortunate of all supreme commanders is the one who is under close supervision, who has to give an account of his plans and intentions every hour of every day. This supervision may be exercised through a delegate of the highest authority at his headquarters or *a telegraph wire attached to his back*. In such a case all independence, *rapid decision*, and audacious risk, without which no war can be conducted, *ceases*.
(Emphasis added)²⁰

General George Patton, reflecting in his *Diaries* about World War II, complained frequently about being tied to the radio and telephone, noting, “The hardest thing I have to do is to do nothing. There is a terrible temptation to interfere.”²¹ And frequently, this temptation became too great to ignore, as Maj Gen J. F. C. Fuller explains from his World War I experience.

The General became more and more bound to his office, and, consequently divorced from his men. He relied for contact not upon the personal factor, but upon the mechanical telegraph and telephone. They could establish contact, but they could accomplish this only by dragging subordinate commanders out of the firing line that they may be at the beck and call of their superiors. In the World War, nothing was more dreadful to witness than a chain of men starting with a commander and ending with an army commander sitting in telephone boxes, improvised or actual, talking, talking, in place of leading, leading, leading.²²

In many instances, commanders relied on information technology to help them navigate the “realm of uncertainty”. How commanders dealt with uncertainty determined the level of control and the organizational orientation.

Organizational orientation determines the degree of uncertainty a commander is willing to tolerate. Van Creveld declares that the history of warfare is an endless quest to decrease the realm of uncertainty, resulting in a race between more information and the ability of technology to keep up with it.²³ Thus, the choice between centralized or decentralized control involves the distribution of uncertainty. Van Creveld believes that while centralization reduces uncertainty at the top, it increases that uncertainty at the bottom. Decentralization has just the opposite effect.²⁴ It is human nature for higher-level commanders to reduce their uncertainty, driving their organizational orientation to greater centralized control. Thus, the cost for less

uncertainty at the top is more uncertainty at the bottom. The cost for greater control at the top is less autonomy in the field.

Unfortunately, the greater the level of control, the fewer opportunities for initiative and flexibility where it is most needed to cope with the dynamics of warfare: at the lower levels of command. Frank Snyder points out that prior to reliable long-distance communications, commanders wrote orders with objectives at a level high enough to give lower-level commanders the flexibility to adjust their actions according to current events.²⁵ Commanders expected that communications would be unreliable and planned accordingly. This is no longer as true today because information technology is making communications more available and more reliable. For example, the number of radio sets rose from one for every 38.6 soldiers during World War II to one for every 4.5 soldiers in Vietnam.²⁶ This is an increase of almost 900 percent. Moreover, communications are more reliable. During Operation Desert Storm, the communications reliability rate was 98 percent in handling 700,000 telephone calls and 700,000 messages per day and managing over 30,000 radio frequencies.²⁷

Information technology increases the temptation for higher-level commanders to involve themselves with lower-level decisions. For instance, the widespread use of radios in Vietnam allowed commanders hovering above the battles in helicopters to direct soldiers by radio. While deemed effective in directing the battle, the "squad leader in the sky" stifled decision making in the lower ranks.²⁸ This top-down direction and involvement by senior commanders at the tactical level became known as "skip echelon" battle management and created great resentment among the junior officers in the field when their decisions were overridden.²⁹ Better information technology increased the skip echelon phenomenon. For example, the commander-in-chief's ability to talk directly with combat troops during the Mayaguez Incident in 1975 and during Operation Eagle Claw--the aborted rescue mission in Iran in 1980--dramatically changed the command and control orientation.³⁰ Information technology provides the means for controlling military forces from greater distances, but—if we have the choice—is this the direction we want to take?

Operation Desert Storm provides the military services with an opportunity to take a fresh look at their command and control orientation. In the wake of the Gulf War, we are at a watershed in deciding whether we ought to retain our present command and control orientation or develop a new, more modern command or control orientation. Will the capabilities provided by information technology be so seductive that we retain a

centralized control and rigid hierarchical organizational orientation, or should we embrace a new orientation of decentralized control and a more flexible organizational structure?

Unfortunately, there is no consensus in answering this question among the services. The Army's Force XXI concept and the Marine Corp's Sea Dragon concept see information technologies as a means for greater decentralization of command and control. The Air Force, on the other hand, sees information technology as providing a means not only for more centralized control but possibly for centralized execution as well.³¹ Perhaps the problem is in only seeing the impact of technology on control and not on command. Technology offers new means to gather information and make decisions; however, unless we take advantage of these opportunities, we will continue to have information-age capabilities constrained by industrial-age organizational thinking, orientation, and procedures.

Notes

1 Frank M. Snyder, *Command and Control: The Literature and Commentaries* (Washington, D.C.: National Defense University, 1993), 15.

2 Col John A. Warden III, *The Air Campaign: Planning for Combat* (Washington D.C.: Pergamon-Brassey's, 1989), 44

3 John Keegan, *The Mask of Command* (New York: Penguin Books, 1987), 40.

4 Ibid., 36-37.

5 Thomas P. Coakley, *Command and Control for War and Peace* (Washington, D.C.: National Defense University Press, 1992), 34.

6 Keegan, 55.

7 Ibid., 90.

8 James P. Coyne, *Airpower in the Gulf* (Washington D.C.: The Air Force Association, 1992), as quoted in Alan D. Campen, ed., *The First Information War*, (Fairfax, Va.: ARMED FORCES COMMUNICATIONS ELECTRONICS ASSOCIATION International Press, October 1992), x.

9 Martin van Creveld, *Command in War* (Cambridge, Mass.: Howard University Press, 1985) 10-11.

10 Michael Howard and Peter Paret, eds., *Carl von Clausewitz: On War* (Princeton, NJ: Princeton University Press, 1989), 101.

11 John R. Boyd, "Patterns of Conflict" notes, in *A Discourse on Winning and Losing*, a selection of unpublished notes and visual aids compiled from 1976-1992, 46.

12 Van Creveld, *Command in War*, 75.

13 Martin van Creveld, *The Transformation of War* (New York: The Free Press, 1991), 109.

14 Van Creveld, *Command in War*, 104-105.

15 Boyd, 38-39; However, Van Creveld presents a more positive impression of Napoléon's command style in *Command in War*, 96-102. I believe there is no inconsistency, as Van Creveld describes Napoléon's early success while Boyd's focus is more on Napoléon's eventual failure.

16 Van Creveld, *Command in War*, 108.

17 Roger Beaumont, *The Nerves of War* (Fairfax, Va.: Armed Forces Communications Electronics Association International Press, 1986), 9.

18 Col S. L. A. Marshall, *Men Against Fire* (New York: William Morrow and Company, 1947), 93.

- 19 Van Creveld, *Command in War*, 108.
- 20 Daniel J. Hughes, ed., *Moltke on the Art of War: Selected Writings* (Novato, Calif.: Presidio Press, 1993), 77. Italics added to highlight the relationship between technology (i.e., the telegraph) and rapid decision making, which is discussed in greater detail later in the paper.
- 21 Beaumont, 28.
- 22 Maj Gen J. F. C. Fuller, *Generalship: Its Diseases and Their Cure* (Harrisburg, Pa.: Military Service Publishing Co., 1936), 61.
- 23 Snyder, 148.
- 24 Ibid.
- 25 Ibid., 61.
- 26 Van Creveld, *Command in War*, 238.
- 27 Campen, 1.
- 28 Beaumont, 22
- 29 Ibid.
- 30 Ibid.
- 31 Col Jeffery R. Barnett, *Future War: An Assessment of Aerospace Campaigns in 2010* (Maxwell AFB, Ala.: Air University Press, January 1996), 33. An academic advisor suggests that this might be "yet another case of obsessive concern over anything that might threaten our autonomy and independence as a service." Personal note, 16 March 1996.

Chapter 4

An Organizational Orientation Model

Van Creveld points out that although the functions of command do not change over time, the means to carry out that command change quite often.¹ He divides the means of command into three categories: organizations, procedures, and the technical means which help determine the degree of control exercised by that commander.² For example, sensor and communications technologies have changed at a more rapid rate than have organizational structures and operating procedures for employing them. Today's military services have progressed from the telegraph to microburst transmitters, but they still operate under the same centralized control and hierarchical organizational orientation employed by Frederick the Great and Napoléon. The danger is that this industrial-age command and control orientation corrodes the benefits offered by the new information technology. The primary impact will be felt if a commander's information-gathering and decision-making processes do not keep up with the increased operations tempo of future warfare.

A key characteristic of future warfare is increased operations tempo, which stresses a commander's ability to observe and react to changes in the battlespace. JCS Pub 3-0 acknowledges that "the tempo of warfare has increased over time as technological advancements and innovative doctrines have been applied to military requirements."³ Thus, the commander operating at a slower tempo than the opposing commander will be at a greater disadvantage because there is a greater degree of uncertainty. This is possible because the commander operating at a faster tempo than his opponent will always be one step ahead and actually setting the tempo. John Boyd addresses the commander's decision-making process as a continuous four-step

mental process—observation, orientation, decision, and action (OODA).⁴ Using the Boyd model, successful commanders are those with the capability to operate within their adversaries' OODA loop.

The ability to observe, orient, decide, and act faster than your opponent is necessary for future warfare. In *War in the Information Age*, Gen Gordon Sullivan, a former US Army chief of staff, observes that throughout history the tempo of operations caused by the impact of technology in warfare has accelerated (fig. 4-1).⁵

	<i>Revolutionary War</i>	<i>Civil War</i>	<i>World War II</i>	<i>Gulf War</i>	<i>War of Tomorrow</i>
Observe	Telescope	Telegraph	Radio/Wire	Near Real Time	Real Time
Orient	Weeks	Days	Hours	Minutes	Continuous
Decide	Months	Weeks	Days	Hours	Immediate
Act	A Season	A Month	A Week	A Day	Less Than An Hour

Source: Sullivan, Gordon R. and James M. Dubik, *War in the Information Age*.

Figure 4-1. Tempo and Command

Information technology has decreased the time available for commanders to gather information and make decisions. Notice that the time differential between orienting (finding out “What is actually happening?”) and deciding (“What can I or should I do about it?”) has compressed to the point that in information-age warfare, orienting and deciding can no longer be sequential actions but must be simultaneous, continuous actions. Thus, organizational orientation and procedures are critical components in determining the tempo of a commander's OODA loop.

To better understand this process, we may consider the OODA loop in a different paradigm--as really two separate cycles, or processes, operating at the same time (fig. 4-2). The first cycle is the information gathering cycle, which addresses the commander's need to find out “What is actually happening?” The second cycle is the decision-making cycle, which addresses the commander's need to decide “What can I or should I do about it?” In this model, the information cycle loosely incorporates Boyd's observation and orientation functions while the decision-making cycle incorporates the decision and action functions.⁶

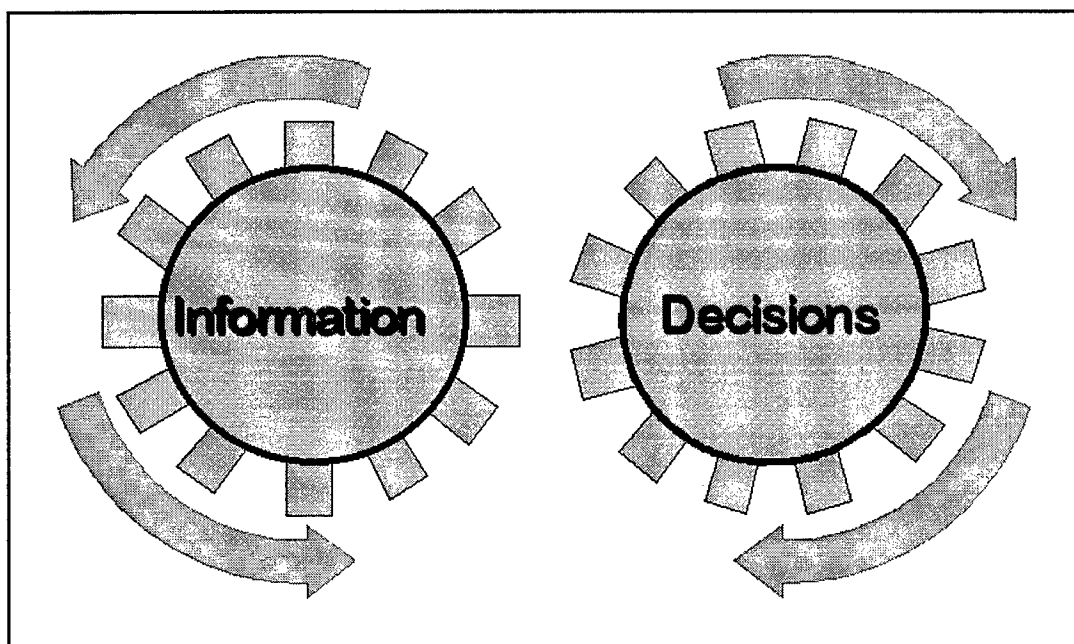


Figure 4-2. C² Dynamics

With the use of this model, we can examine the impact of tempo and technology on organizational orientation.

First of all, consider the commander with a very effective information-gathering capability who yet defers a decision, refuses to make a decision, or makes a wrong decision. While his or her ability to observe and orient is high, the commander may not have the temperament or capability to decide and act on that information. The model tells us that the information-gathering cycle is operating faster in this case than the decision-making cycle, creating an imbalance. While the commander's uncertainty level may be relatively low, it is of no advantage to the troops because the commander is incapable of using the control process to command appropriate action.

Now consider the commander with poor information-gathering capability who nevertheless decides and acts correctly at the right time based on *whatever* information was available. While the commander's information gathering was poor or incomplete, by temperament, training, doctrine, and faith such commanders overcome uncertainty and decide the best course of action. In this case the commander's decision-making cycle is operating relatively faster than his information-gathering cycle, again creating an imbalance.

The balance between the information-gathering and decision-making cycles is critical because it impacts a commander's operating tempo. As Boyd points out, from an external viewpoint it is critical for a commander to operate faster than an adversary or within an adversary's OODA loop. The means to do so,

however, require internal balance between a commander's information-gathering and decision-making cycles. Faster decisions can be possible because of faster information technology. Of course, faster does not imply better information or even better decisions. Even under ideal conditions, it is difficult to always have "perfect" information and to always make perfect decisions, a state where the information-gathering and decision-making cycles are working in harmony. While friction will always be a factor, it is technology, organization, and procedures that either act as a lubricant or throw a wrench into the balancing of the information-gathering and decision-making cycles (fig. 4-3).

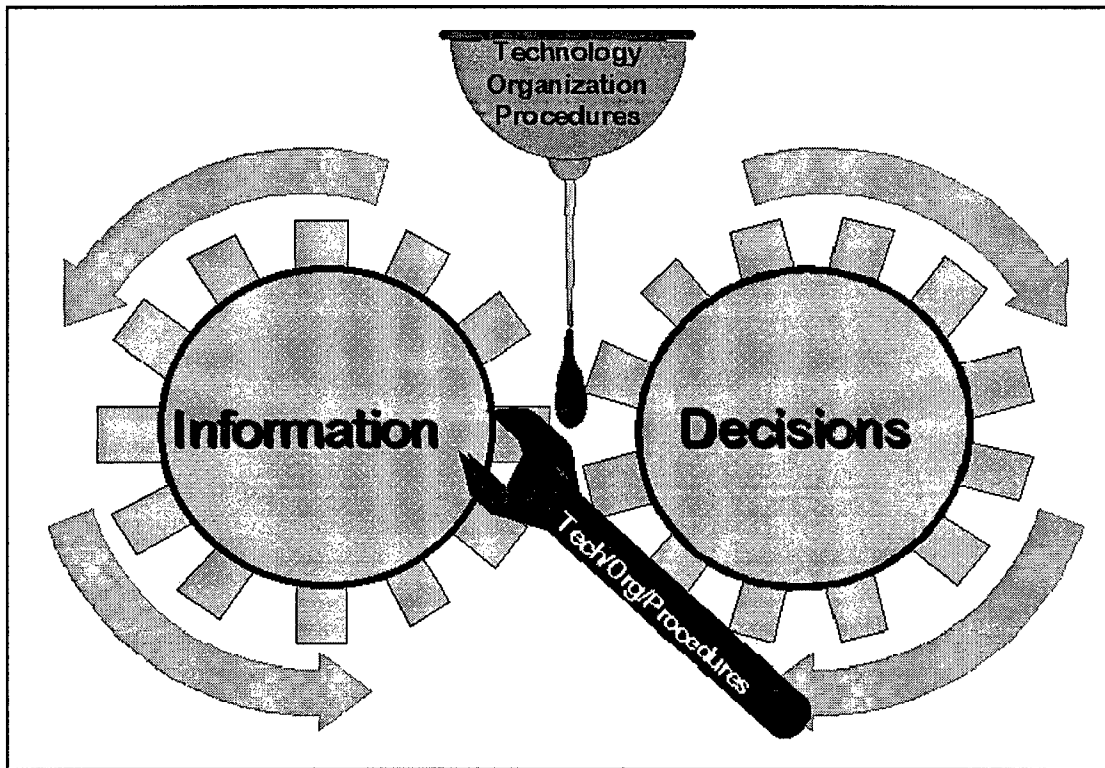


Figure 4-3. Technology/Organization/Procedures Impact

It is the balance between information gathering and decision making that helps determine the amount of uncertainty.

As mentioned earlier, information gathering is critical to addressing the problem of uncertainty. As John Schmitt explains, there are two possible responses. One is to pursue certainty as the basis for command and control. The second is to accept uncertainty as a fact of war and function with it.⁷ The first response is to eliminate uncertainty by creating a highly efficient command and control structure based on the quest for close control:

In such a system, the commander controls with a "tight rein." Command and control is centralized, formal, and inflexible[whereas] detailed control requires strict obedience and minimizes subordinate decision making and initiative.⁸

Thus, there may be greater certainty at the top but decreased certainty at the bottom. As Schmitt points out, if we accept that war is inherently uncertain, then this kind of orientation attempts to overcome a fundamental nature of war, one that we will never successfully overcome.⁹

This makes the second approach, that of operating with a certain amount of uncertainty, a more pragmatic command and control orientation. Schmitt states that "rather than increasing the degree of certainty we *achieve*, we reduce the degree of certainty that we *need*."¹⁰ The result is a command and control orientation that is decentralized:

In such a system, the commander controls with a loose rein, allowing subordinates significant freedom of action and requiring them to act with initiative. . . . Command and control is decentralized, informal, and flexible [which] seeks to increase tempo and improve the ability to deal with fluid and disorderly situations.¹¹

Decentralized control allows for some uncertainty at the top to allow for greater certainty and decision making at the bottom. The greater the degree of control, the less the number of alternatives available to solving a problem.¹² For example, numerous laboratory tests indicate that teams placed under increased stress operate more efficiently and correctly when there is less shared uncertainty coupled with decentralized decision making.¹³ Thus, the ability to gather vital information and make appropriate decisions rapidly is very dependent on the command and control orientation.

Modern technological advances, particularly in the area of computers and communications systems, increase the likelihood that the information-gathering and decision-making cycles will be unbalanced. In fact, technology is the contributing factor for having two separate cycles. In preindustrial warfare, Alexander the Great's personal command style was such that his information-gathering process and decision-making cycles were in harmony. He saw what was happening on the battlefield, made decisions, and took actions based on his personal observations. This is the classic OODA loop, a very sequential process. In preindustrial-age warfare, technology, organization, and procedures were relatively simple.

One of the major characteristics of industrial-age warfare is movement made possible by the internal combustion engine. Vehicles, and the things they transport, move at high speeds. Armies are mechanized and mounted. There are relevant objects in space and beneath the sea. All of these fast-moving objects must be

observed to orient. The consequence is an increase in uncertainty. Faster information-gathering capabilities increase the potential for dealing with panoramic multimedia changes and suspicious, contradictory, or incomplete information, making the decision-making process more difficult. This increase in information-gathering capabilities is a result of technological advances in the information, intelligence, computer, and communications fields. The volume of data processing is growing exponentially, with capacities doubling approximately every 18 months. The maximum communications throughput of two megabits per second in Operation Desert Storm will seem slow when compared to the impending capacity of 30 megabits per second.¹⁴ The result is a faster, technologically driven information-gathering cycle, but a decision-making cycle that has not gotten appreciably faster since the days of Alexander the Great. Making decisions is still very much a human chore.

Unfortunately, decision-making technology, such as computer-assisted logic tools and artificial intelligence, has not progressed as rapidly as information-gathering technology. Technology is making more and more information available, but the commander's ability to process and act on that information is still limited to how much the commander's brain can comprehend. It is organization and procedures that try to reestablish the balance between the process of information gathering and the process of decision making to direct action. Technology and operating procedures can either add friction or mitigate it. Both technology and operating procedures are strongly affected by organizational structure and organizational orientation.

The two most common types of command and control organizational orientations, and hence structures, are hierarchical types and networked types. The traditional military command and control orientation is hierarchical. This came about because traditionally hierarchical organizations required less communications' which substantially simplified the planning and control process.¹⁵ George Orr describes a hierarchical organization as one that

attempts to turn the entire military force into an extension of the commander. Subordinate levels respond in precise and standardized ways to his orders and provide him with the data necessary to control the entire military apparatus. The emphasis is upon connectivity hierarchy, upon global information gathering or upon passing locally obtained information to higher levels, and upon centralized management of the global battle.¹⁶

The key is that both information gathering and decision making are under the personal control of the commander. Power at each level of command within the hierarchical organization is a function of both how much information and the kind of information controlled.

The first problem is that the very nature of controlling information defeats the optimum use of that information. Information gathering and decision making must be made at each level of command before that information is moved on. At each level of command. The information is filtered, added, deleted, and modified. This is a time-consuming process, often resulting in information not reaching the right people or getting there too late to be of any use. This creates a cascading effect, as controlled information becomes slow information. This last point is often cited as a failure of "intelligence" not getting to the right people on time. Perhaps the problem is not with the intelligence process, but rather the hierarchical organization it is supporting. Information must move with a degree of freedom at all levels of command to better balance decision making at all levels of command.

A second problem with hierarchical organizations is a tendency to control decision making at the highest levels of the organization. Again, technological advances drive higher levels of centralized control, threatening to stifle ingenuity and initiative at the lower levels. Combating this temptation requires trust in subordinates. During the Civil War, Gen Ulysses Grant, though he had the technical capacity to centrally manage the war, was successful because he "trusted subordinates thoroughly, giving only general directions, not hampering them with petty instructions."¹⁷ Gen Dwight D. Eisenhower seemed to support this approach on the art of high command: "He can and should delegate tactical responsibility and avoid interference in the authority of his selected subordinates."¹⁸ Gen Norman Schwarzkopf applied this lesson into joint war fighting by attesting, "I built trust among my components because I trusted them. . . . If you want true jointness, a commander in chief (CINC) should not dabble in the details of component business."¹⁹ This freedom from interference is extremely important, as Sir William Slim explains:

Commanders at all levels had to act more on their own; they were given greater latitude to work out their own plans to achieve what they knew was the Army Commander's intention. In time they developed to a marked degree a flexibility of mind and a firmness of decision that enabled them to act swiftly to take advantage of sudden information or changing circumstances without reference to their superiors.²⁰

Thus, faster decision making in response to the faster tempo of war requires an orientation of decentralized control.

Unlike hierarchical organizations, networked organizations offer a decentralized control orientation that makes better use of information technology. RAND's John Arquilla and David Ronfeldt point out that the advances in computers and information technologies influence related innovations in organization and

management theory.²¹ This is reinforced by John Naisbitt's book *Megatrends* and the Air Force Scientific Advisory Board, which predicts that organizational changes will result as we transition from an industrial-based society to an information-based one.²² This trend will drive hierarchical organizations to become networked organizations, and centralized control should yield to decentralized control. George Orr defines a networked organization as one that

views the commander as controlling only in the sense of directing a cooperative problem-solving effort. The emphasis in this style is on autonomous operation at all levels, upon the development of distributed systems and architectures, upon networking to share the elements needed to detect and resolve possible conflicts, and upon distributed decision making processes.²³

In a networked organization, the information-gathering process will be more equally distributed and more information will be available more rapidly to all levels of command. Commanders will share rather than control information, resulting in faster decision making at all levels of command.

A networked sharing of information is much different than that of the hierarchical control of information. A faster decision-making cycle is possible with shared information. This also provides all levels of command with approximately the same level of certainty. It also eliminates irritants. For example, Admiral Metcalf, Task Force 120 commander during Operation Urgent Fury, remembered his experiences from Vietnam with the "long-distance screwdriver."²⁴ To prevent recurrence, he worked hard at increasing the confidence and certainty of his superiors by providing them with masses of information during the operation to liberate Grenada.²⁵

More important than the elimination of irritants, however, is another advantage of networked information sharing: troops engaged will have and generate more information than the "headquarters." If warfare is "chaotic," the chaos arises from adding information or energy to a system. Since troops in contact will be the first to observe that information, they must be empowered to use it for their decision making. What appears to be chaotic and uncertain to the headquarters may be much less chaotic and much more certain to troops empowered to respond to "local conditions." Headquarters, then, can use information technology as Boyd suggests: to monitor.

While the principle of sharing information at all levels of command is important, it is modern information technology that makes it more usable. By using better communications and computer technology, Central Command was able to share information during Operation Earnest Will in the Persian Gulf with great

success. Admiral Jerry Tuttle, then director of the Command, Control, and Communications Directorate of the Joint Staff (J-6), provided communications equipment for sharing information with national-and theater-level commanders:²⁶

With the on-scene commander, Rear Admiral Less, the CINC (General Crist in Tampa, Florida), and the Secretary [of Defense] and the Chairman [of the JCS] all having the same picture and same databases, the requirement to communicate diminished markedly. By having red and blue forces depicted in one composite picture, the relative urgency for decision making could be readily determined and priorities set more intelligently²⁷

While shared information decreases uncertainty, it has the added benefit of fostering decision making at lower levels of command. General Crist discovered that because the national command authorities were getting the same shared information, they did not feel compelled to monitor or control the operation by skip echelon.²⁸ As Paul Strassmann writes, "The more people share information, the more its importance will increase."²⁹ Shared information provides the means to faster and decentralized decision making. To achieve faster decision making, it is critical that all levels of command are operating from a shared vision or commander's intent. A commander's intent is

a concise expression of the purpose of the operation and must be understood two echelons below the issuing commander. It must clearly state the purpose of the mission. It is the single unifying focus for all subordinate elements. . . . Its purpose is to focus subordinates on the desired end state.³⁰

Through a unifying commander's intent, we can generate initiative. Boyd supports this assertion when discussing the ability to act faster than an opponent:

This is best accomplished by the exercise of initiative at the lower levels within a chain-of-command. However, this decentralized control of how things are done must be guided by a centralized command of what and why things are done.³¹

US Marine Corps FMFM 1-1 echoes this by stating, "We generate tempo by creating a command system based on decentralized decision making within the framework of a unifying intent."³² Therefore, the commander's role is to establish the boundaries within which subordinate commanders can make decisions and increase operating tempo.

However, while a networked organization may be ideal for sharing information gathering, it may not be the best model for military commanders when dealing with tough decisions in combat. Unlike their business counterparts, military commanders must really make life-and-death decisions and put subordinates at risk. In a networked organization, who among the collaborators will make those decisions? War requires

commanders, not collaborators. Thus, decision making may be more a hierarchical function than information gathering. For example, the success of a deception plan usually requires fooling your own troops. During Operation Desert Storm, the US marines afloat off the coast of Kuwait may have conducted their daily preparations and routines differently, even subconsciously, had they been aware that their amphibious landing preparations were only a ruse. Their subtle changes in behavior or an inadvertent communications transmission might have been detected by the Iraqis, thus compromising the deception plan. Thus, some type of hierarchical organization is needed to support the decision-making process, though it can be made more effective.

The answer is a flattened hierarchical organization which greatly facilitates a commander's decision-making process. Eliminating layers of command between the commander and operational forces facilitates the execution of those decisions. The goal is combining a clearly defined commander's intent with decentralized control at all levels of command, allowing for greater flexibility, ingenuity, and initiative. The German concept of *Auftragstaktik* during World War II demonstrates how this works. German commanders at each echelon, when out of contact with higher echelons, were free to operate in meeting objectives at two levels higher than their command without specific permission. Each level of command understood the commander's intent and what other commanders were expected to do.³³ This Germans' decentralized decision-making cycle was able to operate at a faster tempo than that of the opponents. For example, German counterattacks were often conducted within 30 minutes after losing a position, while American, British, Russian and French counterattacks usually took hours.³⁴ The German decision-making process, facilitated by decentralized control, allowed them to operate within the OODA loop of their adversary.

Thus, the ideal command and control organization combines the shared information-gathering advantages of the networked organization with the decision-making advantages of a decentralized, flattened hierarchical organization (fig. 4-4).³⁵

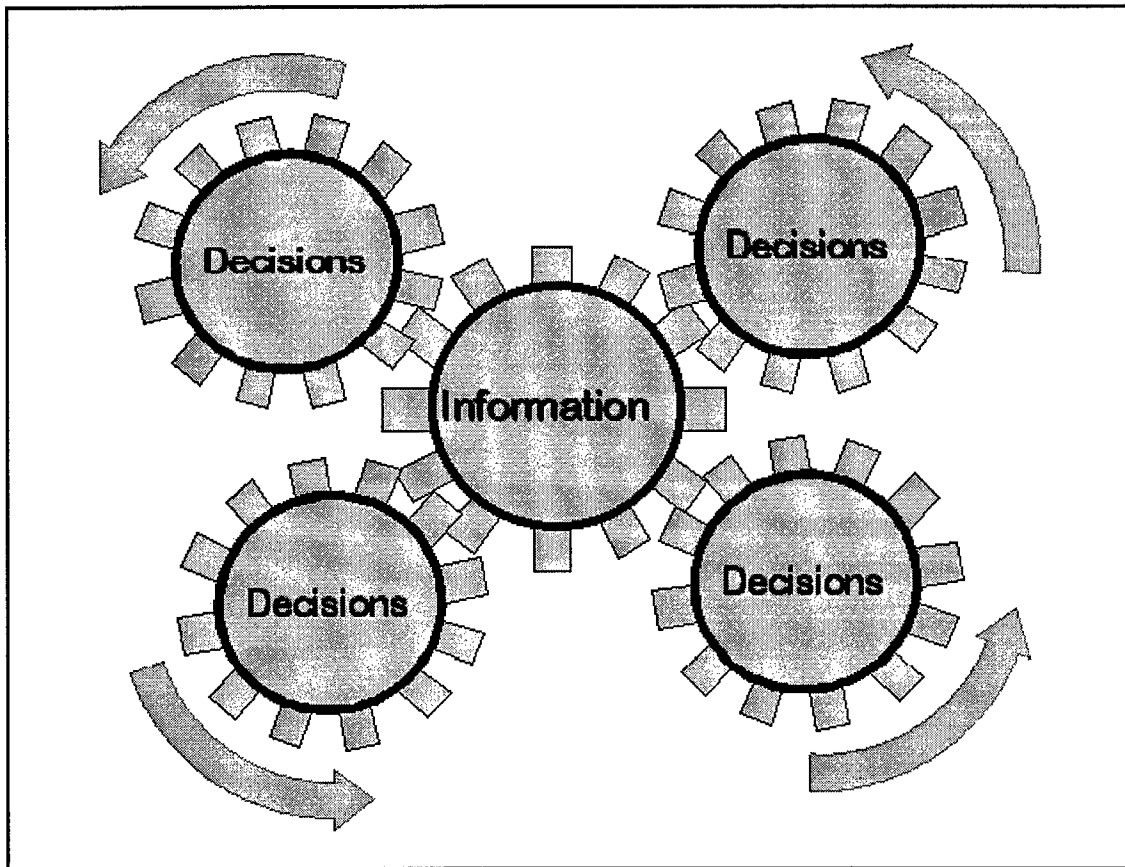


Figure 4-4. Shared Information/Decision Process

John Warden's experiences from the Gulf War support this orientation.

The coalition managed its own information requirements acceptably, even though it was organized in the same way Frederick the Great had organized himself. Clear in the future is the requirement to redesign our organizations so they are built to exploit modern information-handling equipment. This also means flattening organizations, eliminating most middle management, pushing decision making to very low levels, and forming worldwide neural networks to capitalize on the ability of units in and out of the direct conflict area.³⁶

Thus, to maximize the advantages from information technology, one must redesign the military organizational orientation.

Modern technology can help redesign a military organization based on a theory of "centralized command decentralized control and execution," which mirrors the "massively parallel" designs of modern computers.³⁷ To support information gathering;

each BAU [Basic Action Unit] has direct access to the situation model. This is achieved by linking all the units together in a single data net. . . .The BAU commander can then access the battlefield model and pull out the information they need to accomplish their objectives.³⁸

To support decision making;

the command unit does not issue explicit orders but identifies mission objectives and a focus of main effort. . . .The BAUs are given wide latitude in conducting their mission. Coherence is achieved because all the units share a common doctrine, a common goal, and a common view of the situation. . . .Instead of waiting for exact orders to funnel through intermediate units, each BAU will access its mission order against the common modal and act accordingly.³⁹

This concept of a shared information-gathering cycle and a decentralized decision-making cycle is being discussed among the military services, but there is no agreement on what organizational orientation is best suited to take advantage of information technology. The only agreement is that organizational change eventually will happen.

Notes

1 Martin van Creveld, *Command in War*, 9.

2 Ibid., 10.

3 JCS Pub 3, *Doctrine for Joint Operations* (Washington, D.C.: Joint Chiefs of Staff, 1 February 1995), III-15.

4 John R. Boyd, "Organic Design for Command and Control" *A Discourse on Winning and Losing*, selection of unpublished notes and visual aids, 5-12.

5 Gen Gordon R. Sullivan and Colonel James M. Dubik, *War in the Information Age* (Carlisle Barracks, Pa.: US Army War College, 4 June 1994), 5.

6 Although Col Boyd cautioned against separating these functions in a telephone interview on 20 March 1996, it is just this kind of "analysis" (or destructive deduction) he argues for in his 3 September 1976 "Creation and Destruction" notes, 5-17.

7 John F. Schmitt, "A Concept for Marine Corps Command and Control," *Science of Command and Control: Part III*, by Alexander H. Levis and Ilze S. Levis, ed. (Fairfax, Va: Armed Forces Communications Electronics Association International Press, 1994), p. 17.

8 Ibid.

9 Ibid.

10 Ibid.

11 Ibid.

12 John P. Crecine and Michael D. Salomone, "Organization Theory and C³," in *Science of Command and Control: Part II*, Stuart E. Johnson and Alexander H. Levis, eds. (Fairfax, Va.: ARMED FORCES COMMUNICATIONS ELECTRONICS ASSOCIATION International Press, 1989), 50.

13 Proceedings of the 1992 Symposium on Command and Control Research, held at Naval Post Graduate School, Monterey, Calif., 12-14 June 1992, and compiled by Science Applications International Corp., McClean, Va. Some of the better studies include: "A C³ Workstation Utilizing Value-Based Message Scheduling," by J. E. Bake, L. P. Clare, J. R. Agree and W. Heyman; "Horizontal and Vertical Structures in Small Teams: Team Performance and Communication Patterns," by Clint A. Bowers, Paul B. Kline, and Ben B. Morgan, Jr.; "The Application of a Model of Adaptive Decision Making to the Collection and Analysis of Domain Expertise," by Peter D. Morgan; and "Examining Cognitive Processing in Command Crises: New HEAT Experiments on Shared Battle Graphics and Time Tagging," by Dr Paul J. Hiniker and Dr Elliot E. Entin.

- 14 US Space Command briefing given to the Air War College during academic year 1995–1996. Used with permission.
- 15 Crecine and Salomone, 50.
- 16 Maj George E. Orr, *Combat Operations C³I: Fundamentals and Interactions* (Maxwell AFB, Ala.: Air University Press, July 1983), 87–88.
- 17 Maj John M. Vermillion, "The Pillars of Generalship," *Parameters*, Summer 1987, 11.
- 18 Edgar F. Puryear, Jr., *Nineteen Stars: A Study in Military Character and Leadership* (Novato, Calif.: Presidio Press), 229.
- 19 Joint Pub 1, II-6.
- 20 Sir William Slim, *Defeat Into Victory* (London: Cassell and Company, 1956), 292.
- 21 John Arquilla and David Ronfeldt, "Cyberwar is Coming", RAND Study P-7791, Air University Library Document, M-U 30352-16, no. 7,791), 2.
- 22 John Naisbitt, *Megatrends* (New York: Warner Books, 1982), 1–2.
- 23 Orr, 88.
- 24 Raymond C. Bjorklund, *The Dollars and Sense of Command and Control* (Washington, D.C.: National Defense University Press, 1995), 79.
- 25 Ibid.
- 26 Ibid., 83.
- 27 Vice Adm Jerry O. Tuttle, "C³, An Operational Perspective," in *Science of Command and Control: Part II*, Va.: 4.
- 28 Bjorklund, 83.
- 29 Ibid., 85.
- 30 FM 100-5, *Operations* (Washington, D.C.: Department of the Army, 14 June 1993), 6–6.
- 31 Maj David S. Fadok, "John Boyd and John Warden: Airpower's Quest for Strategic Paralysis" (Maxwell AFB, Ala.: Air University Press, February 1995), 15.
- 32 US Marine Corps FMFM 1-1, *Campaigning* (Washington, D.C.: Department of the Navy, 25 January 1990), 73.
- 33 James G. Hunt and John D. Blair, eds. *Leadership on the Future Battlefield* (London: Pergamon-Brassey's, 1985), 183.
- 34 Ibid.
- 35 I am deeply indebted to Maj Patrick Pope, a fellow Air Force 2025 colleague, whose wise counsel, shared interest, energy, and computer wizardry helped channel many of my random thoughts into a coherent pattern.
- 36 Barry R. Schneider, "Principles of War for the Battlefield of the Future," *Battlefield of the Future*, ed. Barry R. Schneider and Lawrence E. Grinter (Maxwell AFB, Ala.: Air University Press, September 1995), 36–37.
- 37 1stLt Gary A. Vincent, "A New Approach to Command and Control: The Cybernetic Design," *Airpower Journal*, (Summer 1993), 29 and 31.
- 38 Ibid., 30–31.
- 39 Ibid.

Chapter 5

Differing Service Orientations

US military service organizational orientations for information-age warfare are striking in their contrast. There is general agreement that the operations tempo of Operation Desert Storm may be slow compared to that of future wars. Here is how the various military service doctrines define tempo:

US Army: "Tempo is the rate of speed of military action; controlling or altering that rate is essential for maintaining the initiative. A quick tempo demands an ability to make tactical decisions quickly, to execute operations that deny the enemy a pause, and to exploit opportunities according to commander's intent."¹

US Marine Corps: "Tempo is a rate or rhythm of activity. Tempo is a significant weapon because it is through a faster tempo that we seize the initiative and dictate the terms of war."²

US Navy: "Tempo is the pace of action—the rate at which we drive events. One way of doing this is to exploit the dynamics of warfighting by maintaining a high tempo."³

US Air Force: There is no mention of tempo in current or proposed Air Force doctrine. However, "speed" is mentioned as a characteristic of airpower.⁴

Why does the Air Force emphasize speed over tempo? Tempo is defined as speed over time—the consistent ability to operate fast.⁵ One might well argue that tempo, not speed, is a more accurate description of the desired characteristics of airpower. Speed is more a characteristic of airpower technology, that is, the speed of the aircraft, or how long it takes to hit the target, while tempo is more a characteristic of command and control orientation. In a 1995 speech, the Air Force chief of staff stated that "Not too far in the next century, we may be able to engage 1,500 targets within the first hour, if not the first minutes, of a conflict."⁶ This describes speed, not tempo. The real question is what happens after the first strike? Do we have a command and control orientation that maintains and even increases the tempo of operations? If our doctrine remains

one of "centralized control, decentralized execution," then it is unlikely "tempo" will increase throughout the course of the war.

With the exception of the Air Force, every US military service recognizes that increased operations tempo requires decentralizing control and decision making to the lowest level. These service observations are fairly clear:

Army: "Initiative requires the decentralization of decision making to the lowest practical level."⁷

Marine Corps: "In order to generate the tempo of operations we desire and to best cope with the uncertainty, disorder, and fluidity of combat, command must be decentralized."⁸

Navy: "A rapid tempo requires that commanders be provided . . . enough decentralization to allow subordinate commanders to exploit opportunities."⁹

Air Force: "To exploit speed, range, flexibility, precision, and lethality that makes air and space so versatile, their organization must make it possible for missions to be centrally controlled. The need to respond to and exploit unforeseeable events requires that these same forces are capable of decentralized execution."¹⁰

In the aftermath of Operation Desert Storm, the Army Force XXI concept and Marine Corps Sea Dragon concept are the respective services' thinking about future warfare which emphasizes decentralized control and decision making. The Air Force has no such new paradigm.

Notes

1 FM 100-5, *Operations* (Washington, D.C.: Department of the Army, 14 June 1993), 7-2 and 7-3.

2 FMFM 1-1, *Campaigning* (Washington, D.C.: Department of the Navy, 25 June 1990), 72-73.

3 Naval Doctrine Publication 1, *Naval Warfare* (Washington, D.C.: Department of the Navy, 28 March 1994), 40-41.

4 Speed is referenced in both the draft "Air Force Doctrine Document 1", 15 August 1995, 24, and AFM 1-1, *Basic Aerospace Doctrine of the United States Air Force*, vol. 1 March 1992, 18 (Washington D.C.: Department of the Air Force) March 1992,. Of interest, the 1986 version of AFM 1-1 reflects the Air Force thinking about timing and tempo as a possible new principle of war, but any discussion of timing and tempos was dropped in later versions.

5 FMFM 1-1, 32.

6 Gen Ronald R. Fogelman, "Getting the Air Force into the 21st Century," speech to the Air Force Association's Air Warfare Symposium, Orlando, Fla., 24 February 1995.

7 FM 100-5, 2-6.

8 FMFM 1-1, pp. 61-62.

9 Naval Doctrine Publication 1, 40.

10 Air Force Doctrine Document 1 draft, 24.

Chapter 6

The Air Force Orientation

The Air Force is taking a much different direction because it remains rooted to an orientation of centralized control-decentralized execution, which Eliot Cohen describes as “a catchphrase of Air Force doctrine, much as ‘don’t divide the fleet’ preoccupied American naval strategists in earlier times.”¹ Although Air Force doctrine has changed 12 times, based on 50 years of experience (another change is in draft), doctrine is now the basis for increased centralized control through the joint forces air component commander (JFACC) concept and the air tasking order (ATO) process.²

The seductive effect of information technology is seen in those proponents advocating stronger centralized control. For example, some have advocated that future aerospace operations not only require greater centralized control, but increasingly *centralized execution*. Col Jeff Barnett, in his book *Future War*, argues that “only a centralized C² system has the potential to deconflict these factors in the chaos of war” and that “decentralized execution, effective in past wars, won’t answer this challenge.”³ He goes on to suggest that the JFACC has the technology and should conduct future warfare from the continental United States. Unfortunately, this thinking increases the danger of military micromanagement at a time when just the opposite is desired. As Eliot Cohen argues:

A general in Washington, an admiral in a command ship or a theater commander in rear headquarters may have access to almost the same information as a forward commander, and in some cases more. Those distant commanders will often succumb to the temptation to manipulate individual units in combat accordingly.⁴

In many ways, the ATO reflects JFACC micromanagement of airpower through centralized control.

Highly centralized, the ATO is the tool of inflexibility. The Gulf War Air Power Survey Summary (GWAPSS) Report notes that “the ATO process used by the air planners and commanders in Riyadh merely

modified an approach long used within NATO; it also bore a striking family resemblance to the way American planners had constructed and executed air campaigns as far back as World War II.”⁵ A common understanding was that “An airplane didn’t fly unless it was in the ATO.”⁶ The reaction of one squadron commander to the ATO was typical: “By day three, the ATO was basically a historical document that described what we were supposed to do after we have already done it. Virtually all our tasking was received by phone and changes were the rule.”⁷ Twenty percent of all air missions were changed during the few hours between the printing of the ATO and the time the aircrews launched. Still more changes were made before the ATO was officially released or after the aircraft had left their bases.⁸ Much as our model predicts and as Cohen points out, “Sometimes these decisions made sense; other times they did not. In all cases they created great uncertainty among the pilots flying the missions.”⁹

The reaction of other services to the slow ATO process was equally harsh. One US marine experience described the ATO process as “an attempt to run a minute-by-minute air war at a 72-hour pace.”¹⁰ Marine Corps Gen Royal N. Moore commented:

It [ATO] does not respond well to a quick-action battlefield. If you’re trying to build a war for the next 72 to 96 hours, you can probably build a pretty good war. But if you’re trying to fight a fluid battlefield like we were on, then you need a system that can react.¹¹

There was even criticism from a US Navy admiral claiming that the Iraqis had figured out the 72-hour nature of the ATO and were moving aircraft around within that window.¹² That Saddam Hussein was able to operate within the OODA loop of the Air Force gives him more credit than he deserves and is probably more reflective of service parochialism about the JFACC and ATO process than an accurate characteristic of one of the world’s worst generals. However, the admiral is correct about the ATO process being a dinosaur of industrial-age warfare. The timeliness of the ATO calls into question its value in a fast-tempo war.

Perhaps the concept of centralized command decentralized control and execution is an idea whose time has come. Fast-tempo warfare, with the need for balanced information sharing and decision making, requires a new command and control orientation. Cohen believes that “a new concept of high command, one that acknowledges that technology inevitably diffuses authority, will have to take root.”¹³ Certainly, if technology provides the means for transmitting a 300-page ATO, that same technology could be applied in making airpower more responsive. The GWAPSS Report points out that “coalition commanders relied on an air-

tasking system whose cycle times . . . had not changed appreciably from the Vietnam era.”¹⁴ It is little wonder then that we had much greater success against stationary targets than against the mobile Scud launchers; and this was against a relatively benign enemy with a snail-like operations tempo. As US Navy Capt Lyle G. Bien observes, “The 48-hour ATO cycle did not permit rapid response to mobile targets.”¹⁵ We may not be so fortunate in the future if the number of mobile targets increases, or if enemies become more agile.

What is required is an organizational orientation that will take advantage of this information technology for faster information-gathering and decision-making cycles. As General Gordon Sullivan points out, “The present, regular ‘conveyor-belt’ pace of the machine age is over. Only fast-paced, adaptive organizations will succeed.”¹⁶ There are those who argue that airpower is different than land and sea forces, because it requires greater, not lesser, centralized control. Any discussion of decentralized control immediately brings forth historical failures of airpower, such as “penny packets” during the North African campaign of World War II and “route packaging” of Vietnam.¹⁷ But, information technology has come a long way in 25 years, demanding that a fresh organizational orientation be made.

The advantages of decentralized control in the fast-paced tempo of future wars make it essential for the Air Force to give it greater attention by relooking at the ATO process. Former Air Force Chief of Staff Gen Larry Welch said, “I believe we overcontrolled in Desert Storm. We did focus on the CINC’s intent . . . but it took us 5000 pages and 72 hours to produce an ATO.”¹⁸ Gen Merrill A. McPeak, the Air Force Chief of Staff during Operation Desert Storm, expressed interest in exploring mission-type orders to try and shorten the ATO cycle:

It is a disgrace that modern air forces are still shackled to a planning and execution process that lasts three days. We have hitched our jets to a hot air balloon. Even when this lackluster C² system works properly, we are bound to forfeit much of the combat edge we know accrues to airpower because of its flexibility and speed of response.¹⁹

As one Air Force officer notes, “Mission-type orders are the laxative for constipated communications.”²⁰ However, institutional orientation continues to be that the ATO must be centralized at the top. Thus, the only improvements sought will be in shortening the ATO cycle rather than looking at alternatives. In any case, there appears to be little interest in the Air Force joining the other services in advocating a new command

and control orientation. Without a fresh perspective, the Air Force may not be able to operate at the operations tempo demanded in future information-age warfare.

Notes

1 Eliot A. Cohen, "The Mystique of U.S. Air Power," *Foreign Affairs*, Jan/Feb 1994, 389.

2 It is interesting that during Operation Desert Storm, the Air Force correctly identified Saddam Hussein's hierarchical organizational orientation with its highly centralized control as a vulnerability. Destroying or disrupting key control facilities and communications paths was necessary to induce strategic paralysis at all levels of Iraqi command. Yet, ironically, American-led airpower had a similar organizational orientation and, likewise, similar vulnerabilities.

3 Jeffery R. Barnett, *Future War: An Assessment of Aerospace Campaign in 2010* (Maxwell AFB, Ala.: Air University Press, 1996), 33.

4 Cohen, 388.

5 Thomas A. Keaney and Eliot A. Cohen, *Gulf War Air Power Survey Summary Report* (Washington, D.C.: Department of the Air Force, 1993), 247.

6 John P. Hyde, Johann W. Pfeiffer and Toby C. Logan, "CAFMS Goes to War," in *The First Information War*, Alan D. Campen, ed. (Fairfax, Va.: Armed Forces Communications Electronics Association International Press, October 1992), 44.

7 Maj J. Scott Norwood, "Thunderbolts and Eggshells" (Maxwell AFB, Ala.: Air University Press, September 1994), 24.

8 Cohen, 386.

9 Ibid.

10 Keaney and Cohen, 150.

11 Col Stephen J. McNamara, *Air Power's Gordian Knot: Centralized Control versus Organic Control* (Maxwell AFB, Ala.: Air University Press, 1994), 131.

12 Michael R. Gordon and Gen Bernard E. Trainor, *The Generals' War: The Inside Story of the Conflict in the Gulf* (Boston: Little, Brown and Company, 1995), 320. Vice Adm Stanley Arthur, senior Navy officer in the Persian Gulf, said that his intelligence officers were telling him that the Iraqis were moving what combat planes remained in Iraq every day or so, having discovered that it took three days to get all but the most critical targets on the allies' target list.

13 Cohen, 118.

14 Keaney and Cohen, 237.

15 McNamara, 131.

16 Gordon and Dubik, 9.

17 One of my fondest memories of the Air War College experience will be spirited arguments in the seminar room. None were more heated than over the Air Force doctrinal (or to some, "dogmatic") issue of "centralized control." I am deeply indebted to Lt Col Pivo Pivarsky, Lt Col Joe Sokol, and Lt Col Gary Coleman -- scholars and warriors all. Their intelligent, and usually emotional, debate helped keep me focused.

18 Maj Michael E. Fischer, "Mission-Type Orders in Joint Air Operations" (Maxwell AFB, Ala.: Air University Press, May 1995), 55.

19 Maj James P. Marshall, "Near-Real-Time Intelligence on the Tactical Battlefield" (Maxwell AFB, Ala.: Air University Press, January 1994), 66

20 Lt Col J. Taylor Sink, "Rethinking the Air Operations Center" (Maxwell AFB, Ala.: Air University Press, September 1994), 42.

Chapter 7

Recommendations

Technology is a tool, and humans decide how they will organize and how they will use the tools available. A screwdriver can be used as an icepick, and a person can pound nails with a laptop computer. Information technology—computer machines and communications devices—can enable us to fight more effectively. If fighting more effectively is the goal, we should decide how to organize to use these new tools to our best advantage. Thus these recommendations follow:

1. The US military must establish useful definitions to clarify command and control. We can eliminate considerable confusion by abolishing the use of command and control and reinforcing the importance of command. In its present context, command embraces planning, organizing, directing, coordinating, and controlling. Command has also proven to be the timeless notion in spite of organizational changes and technological advances. We must resist efforts to hang additional attributes on the function of command because that dilutes the most critical component of war: Command.

2. Information, by its very nature, is most useful when not hierarchically controlled. A characteristic of military hierarchies is control of information. We must take advantage of networked organizational orientation in providing access to shared information at all levels of command. Shared information helps reduce uncertainty and improve a commander's decision-making cycle. Given the danger of information overload, new technological innovations such as computer smart agents and data mining will allow commanders to tailor their information-gathering capabilities to meet their specific needs. Shared information gathering allows for increased operations tempo.

3. Decision making is most effective in a flattened hierarchical organization. Eliminating layers of command provides the means to operate at a higher tempo. Decentralized control also encourages innovation and initiative at the lowest levels of command and promotes morale.

4. The Air Force must reexamine the doctrine of centralized control, decentralized execution against an information-age adversary. The JFACC and ATO concepts are a product of hierarchical organizations and centralized control, perhaps the last vestiges of excessive concern over "independence." While effective in industrial-age warfare, the limitations centralized control places on timeliness, flexibility, and tempo create potentially serious problems should we face an adversary operating at a faster operations tempo. The same technology that promotes greater centralized control can also apply to decentralized control. As Boyd points out, perhaps the JFACC's primary role is that of "monitoring" and not "controlling." We should expect future enemies to be smarter, not more stupid, than Saddam Hussein.¹ We should expect that joint and combined operations will require the Air Force to change, if the other services also change.

Notes

¹ The only officers more stupid than Saddam Hussein were his sons-in-law. They were killed "by angry relatives" shortly after returning from self-imposed exile for denouncing their father-in-law.

Chapter 8

Conclusion

The command or control dilemma is real. The confusion starts with trying to establish a common frame of reference on exactly what command and control means. In future wars, characterized by increased operations tempo, the correct command and control orientation may be that of command *or* control. Centralized control exercised through hierarchical organizations reflects old and dangerous thinking against future enemies operating at a faster decision-making cycle. Greater access to shared information and decentralized decision making are key to operating at the tempo required in information age warfare. The US military has the information technology needed to operate at faster tempos, provided we have the correct organizational orientation and procedures to take advantage of it. Brig Gen Robert Eaglet points out that the command and control capability adopted by a nation should reflect and support those national characteristics that are its greatest strength. He identifies ingenuity, initiative, and *esprit de corps* as qualities Americans like to claim as national strengths, and the command style most appropriate for America should be designed to capitalize upon these characteristics.¹ As Carl Builder reminds us, "Each age of warfare required different treasured capabilities. In agrarian-age warfare, strength and cunning were valued. In industrial-age warfare, organization and discipline were valued. In information-age warfare, the treasured capabilities are knowledge and creativity."² We must have the organizational orientation to take advantage of these capabilities. To do this, our most treasured military capability is, and will always be, enlightened command.

Notes

1 George E. Orr, *Combat Operations C³I: Fundamentals and Interactions* (Maxwell AFB, Ala.: AU Press, July 1983), 89.

2 Mentioned during one of Carl Builder's many visits to Air University in support of the *Air Force 2025* study. Builder is a RAND analyst.

Bibliography

Books

- Barnett, Jeffery R. *Future War: An Assessment of Aerospace Campaigns in 2010*. Maxwell AFB, Ala.: Air University Press, January 1996.
- Beaumont, Roger. *The Nerves of War*. Fairfax, Va.: Armed Forces Communications Electronics Association International Press, 1986.
- Builder, Carl H. *The Icarus Syndrome*. New Brunswick, N.J.: RAND, 1994.
- Bjorklund, Raymond C. *The Dollars and Sense of Command and Control*. Washington, D.C.: National Defense University Press, 1995.
- Campen, Alan D., ed. *The First Information War*. Fairfax, Va.: Armed Forces Communications Electronics Association International Press, October 1992.
- Coakley, Thomas P. *Command and Control for War and Peace*. Washington, D.C.: National Defense University Press, January 1992.
- Fuller, J. F. C. *Armament and History*. New York: Charles Scribner's and Sons, 1945.
- Generalship: Its Diseases and Their Cure*, Harrisburg, Pa.: Military Service Publishing Co., 1936.
- Gleick, James. *Chaos: Making a New Science*. New York: Penguin Books, 1988.
- Gordon, Michael R. and Bernard E. Trainor, *The Generals' War*. Boston: Little, Brown and Company, 1995.
- Howard, Michael and Peter Paret, ed. and trans. *Carl Van Clausewitz: On War*. Princeton, N.J.: Princeton University Press, 1976.
- Hughes, Daniel J., ed. *Moltke on the Art of War*. Novato, Calif.: Presidio Press, 1993.
- Hunt, James G. and John D. Blair, eds. *Leadership on the Future Battlefield*. London: Pergamon-Brassey's, 1985.
- Johnson, Stuart E. and Alexander H. Levis, eds. *Science of Command and Control: Part II*. Fairfax, Va.: Armed Forces Communications Electronics Association International Press, 1989.
- Keaney, Thomas A. and Eliot A. Cohen, *Gulf War Air Power Survey Summary Report*. Washington, D.C.: Department of the Air Force, 1993.
- Keegan, John. *The Mask of Command*. New York: Penguin Books, 1988.
- Levis, Alexander H. and Ilze S. Levis, eds. *Science of Command and Control: Part III*. Fairfax, Va.: Armed Forces Communications Electronics Association International Press, 1994.
- Mann III, Edward C. *Thunder and Lightning*. Maxwell AFB, Ala.: Air University Press, April 1995.
- Marshall, S. L. A. *Men Against Fire*. New York: William Morrow and Company, 1947.
- McNamara, Stephen J. *Air Power's Gordian Knot: Centralized Versus Organic Control*. Maxwell AFB, Ala.: Air University Press, August 1994.
- Naisbitt, John. *Megatrends*. New York: Warner Books, 1982.

- Nichiporuk, Brian, and Carl H. Builder. *Information Technologies and the Future of Land Warfare*. Santa Monica, Calif.: RAND, 1995.
- Orr, George E. *Combat Operations C³I: Fundamentals and Interactions*. Maxwell AFB, Ala.: Air University Press, July 1983.
- Puryear, Edgar F. *19 Stars*. Novato, Calif.: Presidio Press, 1971.
- Reynolds, Richard T. *Heart of the Storm*. Maxwell AFB, Ala.: Air University Press, January 1995.
- Schneider, Barry R. and Lawrence E. Grinter, eds. *Battlefield of the Future*. Maxwell AFB, Ala.: Air University Press, September 1995.
- Shultz, Richard H. and Robert L. Pfaltzgraff, *The Future of Air Power in the Aftermath of the Gulf War*. Maxwell AFB, Ala.: Air University Press, July 1992.
- Sullivan, Gordon R. and James M. Dubik. *War in the Information Age*. Carlisle Barracks, Pa.: US Army War College, 4 June 1994.
- Slim, William. *Defeat Into Victory*. London: Cassell and Company, 1956.
- Snyder, Frank M. *Command and Control: The Literature and Commentaries*. Washington, D.C.: National Defense University, 1993.
- Thibault, George E., ed. *The Art and Practice of Military Strategy*. Washington, D.C.: National Defense University, 1984.
- Toffler, Alvin, and Heidi Toffler. *War and Anti-War*. Boston: Little, Brown and Company, 1993.
- Van Creveld, Martin. *Command in War*. Cambridge, Mass.: Harvard University Press, 1985.
- The Transformation of War*. New York: The Free Press, 1991.
- Warden III, John A. *The Air Campaign*. Washington, D.C.: Pergamon-Brassey's, 1989.
- Winnefeld, James A., and Dana J. Johnson, *Joint Air Operations*. Annapolis, Md.: RAND, 1993.

Articles

- Cohen, Eliot A. "The Mystique of U.S. Air Power." *Foreign Affairs*, vol. 73 (Jan/Feb 1994).
- Crecine, John P. and Michael D. Salomone "Organization Theory and C³." In Stuart E. Johnson and Alexander H. Levis, eds. *Science of Command and Control: Part II*. Fairfax, Va.: Armed Forces Communications Electronics Association International Press, 1989.
- Hyde, John P., Johann W. Pfeiffer, and Toby C. Logan, "CAFMS Goes to War." In Alan P. Campen, ed. *The First Information War*. Fairfax, Va.: Armed Forces Communications Electronics Association International Press, October 1992.
- Kiszely, J.P. "The Contribution of Originality to Military Success." In Brian H. Reid, ed. *The Science of War*. London: Rutledge, 1993.
- Schmitt, John F. "A Concept for Marine Corps Command and Control." In Alexander H. Levis and Ilze S. Levis, eds. *Science of Command and Control: Part III*. Fairfax, Va.: Armed Forces Communications Electronics Association International Press, 1994.
- Schneider, Barry R. "Principles of War for the Battlefield of the Future." In Barry R. Schneider and Lawrence E. Grinter, eds. *Battlefield of the Future*. Maxwell AFB, Ala.: Air University Press, September 1995.
- Todd, Greg. "C¹ Catharsis." *Army*, vol 36 (February 1986).

Tuttle, Jerry O. "C³, An Operational Perspective." In Stuart E. Johnson and Alexander H. Levis, eds. *Science of Command and Control: Part II*. Fairfax, Va.: Armed Forces Communications Electronics Association International Press, 1989.

Vermillion, John M. "The Pillars of Generalship" *Parameters*, vol. 17 (Summer 1987).

Vincent, Gary A. "A New Approach to Command and Control: The Cybernetic Design." *Airpower Journal*, vol. 7 (Summer 1993).

Documents, Studies, and Speeches

FAM 1-1, vol. 1, March 1992, and draft *Air Force Doctrine Document 1*, 15 August 1995. Washington, D.C.: Department of the Air Force.

Arquilla, John, and David Ronfeldt. "Cyberwar is Coming" (RAND Study P-7791, Air University Library, Document M-U 30352-16, no. 7791).

Boyd, John R. "A Discourse on Winning and Losing." A collection of unpublished briefings and essays, compiled from 1976-1992. Air University Library.

Fadok, David S. "John Boyd and John Warden: Airpower's Quest for Strategic Paralysis." Maxwell AFB, Ala.: Air University Press, February 1995.

Field Manual (FM) 100-5, *Operations*. Washington, D.C.: Department of the Army, 14 June 1993.

Fischer, Michael E. "Mission-Type Orders in Joint Air Operations." Maxwell AFB, Ala.: Air University Press, May 1995.

Fleet Marine Forces Manual (FMFM) 1-1, *Campaigning*. Washington, D.C.: Department of the Navy, 25 January 1990.

Fogelman, Ronald R. "Getting the Air Force into the 21st Century." Speech to the Air Force Association's Air Warfare Symposium, Orlando, Fla., 24 February 1995.

Joint Pub 0-2, *Unified Action Armed Forces*. Washington, D.C.: Joint Chiefs of Staff, 24 February 1995.

Joint Pub 1, *Joint Warfare of the Armed Forces of the United States*. Washington, D.C.: Joint Chiefs of Staff, 10 January 1995.

Joint Pub 3-0, *Doctrine for Joint Operations*. Washington, D.C.: Joint Chiefs of Staff, 1 February 1995.

Joint Pub 6-0, *Doctrine for Command, Control, Communications, and Computer (C⁴) Systems Support*, Washington, D.C.: Joint Chiefs of Staff, 30 May 1995.

Joint Warfighting Center, Warfighting Vision 2010, draft. Fort Monroe, Va.: Joint Chiefs of Staff, 1 August 1995.

Marshall, James P. "Near-Real-Time Intelligence on the Tactical Battlefield." Maxwell AFB, Ala.: Air University Press, January 1994.

Naval Doctrine Publication 1, *Naval Warfare*. Washington, D.C.: Department of the Navy, 28 March 1994.

Norwood, J. Scott. "Thunderbolts and Eggshells." Maxwell AFB, Ala.: Air University Press, September 1994.

Perry, William J. *Annual Report to the President and the Congress*. Washington, D.C.: Department of Defense, 1995.

Proceedings of the 1992 Symposium on Command and Control Research, held at Naval Post Graduate School, Monterey, Calif., 12-14 June 1992, and compiled by Science Applications International Corp., McClean, Va.

Sink, J. Taylor. "Rethinking the Air Operations Center." Maxwell AFB, Ala.: Air University Press, September 1994.

USAF Scientific Advisory Board. *New World Vistas: Air and Space Power for the 21st Century*.
Unpublished draft, the Communications Volume. 15 December 1995.