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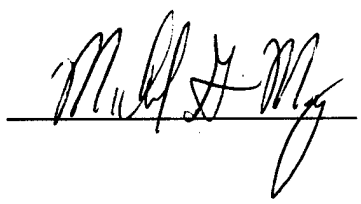
THE INFLUENCE OF FUTURE COMMAND, CONTROL, COMMUNICATIONS, AND COMPUTERS (C4) ON DOCTRINE AND THE OPERATIONAL COMMANDER'S DECISION-MAKING PROCESS

by

Michael G. Mayer
LCDR USN

A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Joint Military Operations Department.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

Signature: 

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Severe budget restraints necessitate unified control of C4 systems under singular leadership for the common good of all the services. In addition, acquisition policy and procedures must be revamped to allow new technologies to be fielded quickly; and the commercial marketplace will become the preferred starting point for modernization.

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TABLE OF CONTENTS

THE INFLUENCE OF FUTURE COMMAND, CONTROL, COMMUNICATIONS, AND COMPUTERS (C4) ON DOCTRINE AND THE OPERATIONAL COMMANDER'S DECISION-MAKING PROCESS

CHAPTER I

INTRODUCTION

"On the battlefield of the future, we will be unable to attain decisive victory without a comprehensive global command and control system. The foundation is a robust C4I architecture."[1]

ADM Jeremy M Boorda, 1995

"Information" is becoming the controlling factor in modern warfare. In On War, Clausewitz explains that one of the most serious sources of friction in war is the difficulty of accurately assessing "information," which leads to uncertainty and doubt in decision-making.[2] Command, control, communications, and computer (C4) systems reduce uncertainty.

Technological advances in C4 will change the operational commander's view of the battlefield. This paper presents the "C4 vision of the future," discusses barriers to this vision, and draws pertinent conclusions about the influence of future C4 capabilities on doctrine and the operational commander's decision-making process.

DEFINING C4. The fundamental purpose of C4 systems is to get the right information to the right place at the right time. This information must be relevant, timely, and in a form quickly and easily understood. In essence, C4 systems are a force multiplier which can overcome budgetary deficiencies, reduced force structure, and opposing force technological capabilities.[3]

The rapidly evolving global information network is referred

to as the "infosphere." C4 systems exist to tap into and extend the flow of information from this infosphere.[4]

C4 CAPABILITIES USING THE GULF WAR AS A BASELINE. The Gulf War demonstrated the lethality of combat in the information age and set the stage for the military to pursue a new paradigm capitalizing on advanced technology and information systems. A statement by two RAND analysts put it best:

> "Warfare is no longer... a function of who puts the most capital, labor, and technology on the battlefield, but of who has the best information about the battlefield. What distinguishes the victors is their grasp of information."[5]

In the Gulf War, "situational awareness" was dependent upon the ability to keep information flowing freely--over 700,000 telephone calls and 152,000 messages per day and management of over 35,000 tactical radio frequencies.[6]

C4 AFTER THE GULF WAR. The Navy began implementing the Copernicus Architecture in 1990, in order to standardize C4I (C4 and intelligence) technological components and systems, rid itself of outdated programs, and to network fleet operations with command centers at the joint, allied, and national levels. "Copernicus" is basically the navy's C4I design and procurement strategy--with joint operability in mind.[7]

The Army was slower to embrace the future concept of a digitized battlefield, but also has one of the toughest problems in command and control--that of developing the architecture necessary to keep track of a multitude of friendly and enemy

"movers, shooters, and emitters." The Army published Army Enterprise Strategy in 1993 to stress the joint C4I effort.[8]

The Air Force vision of C4I, Horizon, was issued in 1994, and is similar to "Copernicus." However, in Horizon, the Air Force views itself as the future custodian of "theater battle management" (a term synonymous with C4I).[9]

CHAPTER II

C4 VISION OF THE FUTURE

"I will support only one [Joint] Command and Control System."[10]
GEN John Shalikashvili
Chairman of the Joint Chiefs of Staff.

The future battlefield will center on an information grid without nodes into which weapons are plugged. Sensors provide data horizontally instead of being fused at one point for dispersal. Users can pick and choose only the data they require, and can fuse information at any point.[11]

EMERGING TECHNOLOGIES. Rather than list emerging space-age systems--a list that could never be all-inclusive--it is more important to define the desired endpoints of technology necessary to achieve the C4 vision: First, acquisition policy and procedures must be revamped to allow new technologies to be fielded quickly. Second, software management must be instituted to standardize machine language and communication software which will allow C4 systems to communicate in the infosphere. Third, technological solutions to transmitting more information in existing bandwidth structures must be developed. Fourth, cognitive processes to aid in decision making must be created. Lastly, "Information Warfare" must be improved to protect our heightened dependency on technology and exploit the enemy's dependency.[12]

C4I FOR THE WARRIOR. C4I For the Warrior (C4IFTW) was issued by the Joint Staff in 1992, and has been updated annually. Based

on the "Copernicus" concept, C4IFTW envisions a joint C4I architecture providing timely sensor to shooter information direct to the warfighter.[13] It is the Joint Staff's call to each of the services to go joint. While this concept is embraced by all the services, the reality of the matter is that each service controls its own C4I program. Competition between the navy and the air force persists over future control of the joint C4I architecture, while doctrine preaches the necessity of a joint unified strategy.

C4IFTW also provides a "road map" to reach the C4I vision of the future. This road map is comprised of three phases: the Quick Fix Phase, the Midterm Phase, and the Objective Phase.

The "Quick Fix Phase" was completed in 1993, and involved promulgation of the new C4IFTW concept, implementation of new policy and doctrine, and some near-term interoperability improvements. Key to this phase was streamlining the acquisition process through use of commercial off-the-shelf technology whenever possible.[14]

The current "Midterm Phase" established the Global Command and Control System (GCCS) initial operation capability. Using a "migration" concept, GCCS integrates the best available applications from existing command and control systems to accomplish core functions identified by the CINCs (These functions are listed in note 15). GCCS is not a "grand design" to obtain a finished master system, but continuously migrates new components into a highly adaptable client server

architecture system as they become available. It does not strive for perfection. Instead, each new step in the implementation process builds upon the last in an ever-evolving process designed to provide the warfighter the best possible joint C4I system.[15]

To date, fewer than 60 command and control systems have been identified for migration from over 1000 "legacy" (outdated) systems. In the intelligence area, 48 out of 688 legacy systems have been identified. During the Midterm Phase, a functional committee will analyze the systems nominated for migration to eliminate duplication and identify the best systems.[16]

The "Objective Phase" will continue the migration of advanced technologies into the GCCS to meet the warfighter's needs. VADM Arthur K. Cebrowski, director for C4, the Joint Staff (J6), states:

> "I don't want to buy this year's state of the art, which becomes next year's state of the shelf, which becomes the following year's rubbish. I want a process that allows continuous regeneration."[17]

CHAPTER III

BARRIERS TO EFFECTIVE C4

INFORMATION OVERLOAD. The operational commander must be able to process information and extract only usable bits from virtually unlimited data. However, there are limits to the cognitive processing capabilities of human beings. An operational commander and his staff can easily be overwhelmed by too much information. Information management systems help the commander extract only pertinent information.

There is a down side to reliance on information management systems. Automated systems could dampen the commander's decision-making ability.

INTEROPERABILITY. To be "joint," the services must be able to operate together effectively and efficiently for mission accomplishment--anytime and any place. The buzzword describing this is "interoperability." C4IFTW states that current C4I systems were designed and developed to meet "stovepipe" (hierarchical, vertical, military chain-of-command structures) CINC and service mission needs and are not compatible with joint operations.[18] C4 systems must also be able to manage large multinational efforts. In most cases, technology has far outpaced legacy systems necessitating total replacement.

COMMUNICATIONS INFRASTRUCTURE. Outdated communications systems are bulky, hard to transport, vulnerable to "Information Warfare" (IW), and cannot manage the hugh flow of electronic

information. Dissemination of information is dependent on systems able to handle vast data streams and effective alignment between sensors and communications pathways needed to deliver the information. In brief, the communications infrastructure needs to be modernized.[19]

TECHNICAL LIMITATIONS. By far, the most difficult technical limitation to overcome is bandwidth. The evolution in data compression techniques cannot keep up with the ever-increasing data-flow requirements of C4. The physically constrained electromagnetic spectrum also places limitations on communications systems.

SECURITY. Information systems and telecommunications technologies are vulnerable to unauthorized intrusion. The National Security Agency (NSA), Advanced Research Projects Agency, and the Defense Intelligence Systems Agency (DISA) are all tasked with meeting the security challenge by implementing the Multilevel Information Systems Security Initiative (See note 20 for a description).[20]

Multinational operations may involve equipping ad-hoc coalition members with state-of-the-art communications equipment, raising additional security issues.

RELIABILITY. Inaccurate information provided instantaneously to a global database can compound confusion, result in bad decisions, and could be worse than no information at all. As

information is passed between different command centers and reporting systems, data is processed, filtered, manipulated, and analyzed causing possible delays and misinterpretations. Compounding this problem is stress in battle of providing information quickly. Operational commanders must be able to determine the accuracy of incoming information to be of value.

INFORMATION WARFARE. Electronically dependant forces are vulnerable to a variety of electronic attacks including: jamming, saturation, sabotage, damage from low-yield nuclear or non-nuclear electromagnetic pulses, and interference with space-based sensors or communication satellites. Less technologically advanced third world countries are as capable a threat in IW as are the most technologically advanced countries.

The use of extremely high frequencies, highly directional antennas, frequency hopping techniques, and spread spectrum techniques reduce the probability of jamming and interception.

Emerging C4 systems are no more susceptible to these vulnerabilities than modern communications systems. However, greater reliance on these systems, as information becomes central to warfare, causes some concern.

CHAPTER IV

INFLUENCE ON DOCTRINE

CURRENT DOCTRINE. Current joint doctrine for C4 is provided in Joint Publication 6-0, Doctrine for Command, Control, Communications, and Computer (C4) Systems Support to Joint Operations. The doctrine is a visionary view of how a perfect C4 system should operate. It assumes the existing military organizational structure will function properly and does not address the changes that C4 will bring about. It is not too early to identify future doctrinal requirements in order to focus technological efforts. The rapid infusion of new technology into an advanced C4 architecture without an associated modernization in organization and procedures would create unforeseeable future problems.

ORGANIZATIONAL STRUCTURE. As future C4 capabilities alter the traditional balance between force and information, changes in C4 organization will be imperative. One way to focus the joint C4 effort is to form a unified organization operating under centralized doctrine and command. Arguments against a common organization say that it could eliminate critical C4 functions needed by the operational commander and could retard jointness by removing one of the most important reasons for services to work together. These observations must be considered, but are hardly good arguments against forming a single organization.[21]

As of December 1995, a Pentagon working group had presented a proposal to Deputy Defense Secretary John White to create a single analytical center that would weigh all of the budding technologies contributing to the services' C4ISR (C4I plus surveillance, and reconnaissance--the newest acronym) mission. This proposal was in response to the Commission on Roles and Missions report which recommended an integrated C4I architecture to "increase effectiveness when operating across the boundaries among CINC's areas of responsibility." A decision is yet to be made concerning this proposal.[22]

STANDARDIZATION. In an effort to enforce standardization and joint integration (interoperability), Department of Defense (DoD) Directive 8000.1 gave DISA broad authority to enforce "integrated information technology standardization."[23] This gave DISA responsibility for the integration of over 10,000 command and control systems currently in existence.[24] In addition, DoD Directive 4630.5 instructed that "all C3I (C4I minus computers) systems developed for use by U.S. forces were to be considered for joint use.[25]

Developing a standard language within DoD for efficient data exchange has been a slow, tedious process; and has not been fully accomplished to date.

CONTROL OF RESOURCES. Funding the C4 vision is perhaps the most difficult problem to solve. Each service still separately controls the procurement of expensive C4 systems; and each

service's C4 program has different requirements. In short, maintaining state of the art, interoperable communication systems in a fiscally constrained environment necessitates a new procurement process. The military's cumbersome and restrictive procurement process has resulted in military systems which continuously lag commercial technologies. It makes sense, then, to turn to the commercial market to solve this vexing problem.

The first attempt at streamlining procurement was in 1994, with passage of the Federal Acquisition Streamlining Act. This act only began necessary reforms by reducing regulations governing procurement. A new bill, named HR1670, when passed would emphasize commercial procedures to simplify government sales. Fiscal year 1995 spending for information technology exceeded $9.8 billion, and C4I accounts involved over $30-plus billion.[26] With the allure of this large federal budget and a simplified, commercial-like procurement system; the commercial sector has all the incentive it needs to provide state-of-the-art systems for continued growth of C4.[27]

C4 must receive top priority in funding requirements. Without effective command and control, having the best weapon system in the world is irrelevant.

CHAPTER V

EFFECT ON THE OPERATIONAL COMMANDER'S DECISION MAKING PROCESS

MANAGING INFORMATION. Much has been written about getting inside the enemy's "OODA Loop", an acronym for John Boyd's functional description of combat (observation, orientation, decision, and action).[28] In a world where the outcome of battle may be decided by who has the best information first, Boyd's philosophy remains valid. The opponent able to make the quickest informed decision wins. Speed in decision-making may be the force multiplier of the future. C4 systems, therefore, must get only pertinent information as rapidly as possible from the source to the user, without overwhelming the user, to prevent paralyzing the decision-making process.

FLATTENING THE ORGANIZATION. As high level strategic and operation information becomes more and more important at lower tactical levels, traditional command hierarchies must necessarily be bypassed to obtain that information. VADM Cebrowski states:

> "Its [information's] value increases with the number of people who have access to it. Separating the command subordination from the information flow...empowers forces to respond to the commander's needs."[29]

Information, then, creates new responsibilities for decision-making at lower levels.

Traditional command structure is essentially a top-down approach to responsibility for decision-making. Because information decentralizes and redistributes decision-making and responsibility, it could create tension within the traditional command structure.

The short term fix is to keep command structures as flat as possible until the relationship between command and information flow can be worked out. Limited intelligence collection resources should be managed through a hierarchical command structure, but intelligence information is best distributed horizontally across non-hierarchical systems.

CENTRALIZED COMMAND, DECENTRALIZED CONTROL AND EXECUTION. Every time data is relayed or a decision must be made about what to do with the data, precious time is lost. To solve this problem, all intermediate levels of control between the operational commander and the unit executing the commander's orders (which serve only as conduits to pass information along) should be eliminated. These command levels would still function for training, logistics, and maintenance purposes; but they slow command and control down in a wartime setting. Rather than view this as a threat to intermediate-level command, the efficiencies of this concept should be understood. Instead of waiting for orders to trickle down through intermediate commanders, mission orders and information needed to make instant decisions would be accessed via the infosphere. This is "centralized command,

decentralized control and execution."[30]

Eliminating intermediate level, non-decision information flow points also eliminates vulnerable nodes in a C4 system.

ARGUMENTS AGAINST CENTRALIZED CONTROL AND FLATTER ORGANIZATIONS. Centralizing control over subordinates tends to limit tactical freedom, autonomy, and command prerogatives of subordinates. This could detrimentally effect the quality of command at lower levels.[31]

On the other hand, many studies agree that as the tempo of action-reaction-counteraction increases due to instantaneous information, combat units become more autonomous and self-sustaining; thus, pushing decisional authority to the lowest possible level. The case for decentralization, then, centers on reducing information overload by keeping tactical decisions at the tactical level and operational decisions at the operational level. In this scenario, the operational commander's "intent" becomes the operational dictum.[32] It remains crucial that operational commanders ensure subordinates have a clear understanding of "intent." This allows subordinate commanders greater freedom in decision-making and unifies effort to achieve a common goal, even when electronics cease to function.

Another downside of centralized control is that operational commanders can easily bypass subordinate commanders to micro-manage the battlefield, causing tension and confusion across several command echelons. This scenario can easily develop when

a frustrated operational commander attempts to remedy organizational or procedural ineffectiveness.[33] In a similar vein, conflicting guidance from authorities with direct access to the same subordinates can also create problems. Flatter command structures would alleviate these problems.

THE MERGING LEVELS OF WAR. Current doctrine defines three levels of war: Strategic, operational, and tactical. A rather contentious issue at present is how much technology will alter this vertical continuum. Joint Publication 3-0 warns commanders to be aware of the change that is taking place:

> "Advances in technology, information age media reporting, and the compression of time-space relationships contribute to the growing interrelationships between the levels of war....commanders at every level must be aware that in a world of constant, immediate communications, any single event may cut across the three levels."[34]

With the potential for military decisions at any level to influence national strategy, the operational commander will have to recognize those events and be able to integrate them at the operational level.[35]

POLITICAL RAMIFICATIONS. Direct political involvement in all levels of war is a real possibility with information instantaneously available to all levels. This problem closely parallels that of the commander bypassing the chain-of-command. It could be remedied by keeping all levels in the chain-of-command informed through a fully automated system of notification and feedback. This system does not now exist.

CHAPTER VI

RECOMMENDATIONS AND CONCLUSIONS

RECOMMENDATIONS. The reality of a severely limited budget in an age of fiscal restraint leaves no alternative but to unify control of C4 systems under singular leadership for the common good of all the services.

In addition to centralized joint control, flatter command structures are essential to make the C4 vision a reality; but the command structure must also be able to work in a worst-case environment where information and communication systems are lost in battle. The military cannot be so dependant on information that it fails to function without it.

Commanders will have to strike a balance between exerting greater control and allowing subordinates enough flexibility to maintain initiative. This will be increasingly difficult as the vertical levels in the continuum of war merge. Clearly, the "commander's intent" remains the most important tool in striking this balance.

Interoperable C4 systems are required for increasingly higher levels of coordination and synchronization between the services. It is clear that in order to achieve interoperability and capitalize on state-of-the-art technology, the current procurement process will have to be revamped much more than

efforts have achieved to date; and the commercial marketplace will become the preferred starting point for modernization. Under the current system, technology becomes obsolete by the time a system is fielded.

CONCLUSIONS. Future C4 capabilities will certainly influence doctrine and the operational commander's decision making process. Implications are that organizational changes will supplant traditional hierarchies, the military procurement process will improve, and future C4 will be the glue that binds all the services together for true "joint" integration.

The greatest resistance to these changes will come from intermediate commanders who feel their job is threatened should the traditional military hierarchy disappear. History is fraught with commanders who are unwilling to change. Commanders must embrace the future concept of C4 and learn to use the evolution of technology to their advantage. Recognizing these changes now and understanding them will make the inevitable transition easier. Change will certainly come. We must be prepared for it.

NOTES

1. Jeremy M. Boorda, "Leading the Revolution in C4I," Joint Forces Quarterly, Autumn 1995, p. 15.

2. Carl Von Clausewitz, On War ed. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1984), p. 117.

3. Office of the Joint Chiefs of Staff, JCS Pub 6-0, Doctrine for Command, Control, Communications, and Computer (C4) Systems Support to Joint Operations (Washington: GPO, 30 May 1995), pp. I-1 - I-6.

4. Ibid., pp. II-2 - II-3.

5. C. Kenneth Allard, "The Future of Command and Control: Toward a Paradigm of Information Warfare" in Turning Point: The Gulf War and U.S. Military Strategy, ed. L. Benjamin Ederington and Michael J. Mazarr (Boulder, CO: Westview Press, 1994), p. 162. Original source of the quote is John Arquilla and David Ronfelt, "Cyberwar Is Coming!" Comparative Strategy 12, no. 2 (1993), p. 141.

6. Office of the Joint Chiefs of Staff, Joint Pub 6-0, p. III-6. Information reported in Department of Defense, Conduct of the Persian Gulf Conflict: Final Report to Congress (Washington, D.C., GPO, 1992), 559-560.

7. Boorda, p. 16.

8. Allard, p. 184.

9. Ibid., p. 180.

10. Office of the Joint Chiefs of Staff, C4I for the Warrior (Washington: GPO, 12 June 94), p. 17.

11. Robert K. Ackerman, "Military Planners Gird for Information Revolution," Signal, May 1995, p. 71.

12. Ibid, p. 76.

13. Boorda, p. 16.

14. Office of the Joint Chiefs of Staff, C4I for the Warrior, p. 6.

15. Ibid., p. 12. Core functions identified by the CINCs include: Crisis planning, force deployment, force employment, force status, logistics, air operations, fire support,

intelligence, personnel, position, and narrative information.

16. "From the Cold War to the Global Information Age," Defense Issues, V. 10, no. 34, p. 2.

17. Ackerman, p. 71.

18. Office of the Joint Chiefs of Staff. C^{4}I for the Warrior (Washington: GPO, 12 June 93), p. 2.

19. Allard, pp. 172-174.

20. "From the cold War to the Global Information Age," pp. 3-4. The Multilevel Information Systems Security Initiative is a security capability which allows users to access only the information for which they are authorized. All future work stations and personal computers procured by the Department of Defense will be equipped with a minimum of two PCMCIA (Personal Computer Memory Card International Association) Type II slots which will allow NSA developed PCMCIA cards to provide encryption/decryption standards.

21. Martin C. Libicki and James A. Hazlett, "Do We Need an Information Corps?" Joint Forces Quarterly, Autumn 1993, pp. 90-96.

22. "Pentagon Task force to Tell White of C4I Analysis Center Plans," Inside the Pentagon's Inside the Navy, 20 November 1995, pp. 1 and 8.

23. Allard, p. 179. Quote is from paragraph E.5(a) of U.S. DoD Directive 8000.1, October 27, 1992.

24. Ibid.

25. Office of the Joint Chiefs of Staff, Joint Pub 6-0, p. III-1. From U.S. DoD Directive 4630.5, November 12, 1992.

26. John G. Roos, "Ending the C^{4}I Tunnel of Babel," Armed Forces Journal, October 1994, p. 19.

27. "Information Needs Burgeon Despite Defense Drawdown," National Defense, September 1995, p. 22.

28. Allard, p.169.

29. Ackerman, p. 71.

30. Gary A. Vincent, "A New Approach to Command and Control: The Cybernetic Design," Airpower Journal, Summer 1993, pp. 28-33.

31. Defense Technical Information Center, Mercury's Dilemma: C3I and the Operational Level of War (Alexandria, VA: DLA, 20 July 1988), p. 16.

32. David Jablonsky, "U.S. Doctrine and the Revolution in Military Affairs," Parameters, Autumn 1994, p. 28.

33. Defense Technical Information Center, p. 17.

34. Office of the Joint Chiefs of Staff, JCS Pub 3-0, Doctrine for Joint Operations (Washington: GPO, 1 February 1995), p. II-2.

35. Jablonsky, pp. 23-26.

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