NAVAL WAR COLLEGE
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C⁴ CONCERNS FOR THE OPERATIONAL COMMANDER

by

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

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

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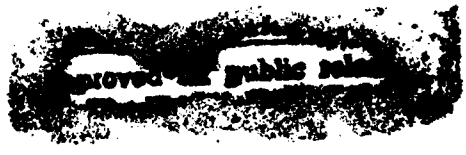
Approved by: 

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THE EXPLOSION OF TECHNOLOGY IN THE PAST FOUR DECADES HAS PRODUCED ADVANCES IN THE COMMUNICATIONS AND COMPUTER INDUSTRY THAT FEW EVER ENVISIONED. AS A MILITARY COMMUNITY, WE LOOK TOWARD MANY OF THESE NEW CAPABILITIES AS EFFECTIVE FORCE MULTIPLIERS IN PROVIDING BETTER COMMAND AND CONTROL FOR OUR OPERATIONAL COMMANDERS. IN EVALUATING ANY OF THE NEW SYSTEMS, WE MUST CONSIDER FIVE FUNDAMENTAL CRITERIA: INTEROPERABILITY, SURVIVABILITY, SECURITY, USER FRIENDLINESS AND OPERATIONAL UTILITY. C4I FOR THE WARRIOR, A CONCEPT INTRODUCTED BY JCS/J-6 IN JUNE 1993, GOES A LONG WAY IN ESTABLISHING A GOAL AND A GENERAL ROADMAP OF HOW TO GET THERE. HOWEVER, WE MUST EXPAND OUR THINKING WELL PAST THE TECHNICAL PROBLEMS WE USUALLY CONCENTRATE ON AND ALSO EVALUATE HOW NEW C4 SYSTEMS AND CONCEPTS MAY IMPACT OUR WARFIGHTING DOCTRINE.

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ABSTRACT OF
C^4 CONCERNS FOR THE OPERATIONAL COMMANDER

The explosion of technology in the past four decades has produced advances in the communications and computer industry that few ever envisioned. As a military community, we look toward many of these new capabilities as effective force multipliers in providing better command and control for our operational commanders. In evaluating any of the new systems, we must consider five fundamental criteria: Interoperability, survivability, security, user friendliness, and operational utility. C⁴I for the Warrior, a concept introduced by JCS/J-6 in June 1993, goes a long way in establishing a goal and a general roadmap of how to get there. However, we must expand our thinking well past the technical problems we usually concentrate on and also evaluate how new C^4 systems and concepts may impact our warfighting doctrine.

Three major challenges are on the horizon for the C^4 community as the US military progresses toward attainment of the "C⁴I for the Warrior" concept: How to control information flow to the operational commander; ensuring we account for bandwidth and budget constraints; and keeping our doctrine foremost in mind as we modify and enhance our C^4 systems. In order to meet these challenges, we must review the functions of the commander at the operational level of war and determine the best way to satisfy his requirements given new capabilities. We must also organize the C^4 community to be more responsive to the warfighter's needs and work closely with commercial industry in military applications of commercial equipment and standards. Finally, we should review the way we test our systems in joint and combined exercises, and honestly assess how well we identify and fix the operational shortcomings of our C^4 systems. An integral part of the entire process is creative thought aimed at improving the operational commander's ability to make and disseminate his decisions.

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CHAPTER I

INTRODUCTION

The technology revolution has produced astounding advances in the communications and computer industry. As we rush to field new systems before they are replaced with the next generation of equipment, we must consider the impact of these new capabilities and effectively integrate them in our quest to better support the operational commander. "More" is not always better, especially if we haven't really considered how to best integrate new capabilities to enhance a commander's ability in making good decisions. If the operational commander needs only one critical piece of information but receives 500 inputs, we've failed. While we probably made tremendous use of new technology, we failed in our tasking to support the warfighter.

As part of the command and control process, C^4 systems are a critical link in providing "inputs" and "outputs" for the operational commander. On the "input" side, the commander needs a wealth of information in order to make effective decisions. However, given the multitude of high tech systems available to him, there is a definite potential for confusion in acquiring the necessary information. On the "output" side, C^4 systems provide the commander the means to disseminate his decisions to subordinate units. However, given the nature of our systems today, we seem to have broadened the levels where operational decisions are made. What are the consequences of having the perceived capability to make these decisions at levels as high as the National Command Authorities (NCA)? Conversely, down to what level should we provide the same information? In analyzing these questions, this research will give some insight as to which direction we should proceed by first developing some criteria to use in evaluating our C^4 systems and applying them to our performance in DESERT STORM. Then, using these conclusions along with some of our new concepts as a point of departure, we will investigate the doctrinal impacts of new C^4 capabilities and our current philosophy for implementing them.

CHAPTER II

SETTING THE STAGE

Section 1: Evaluation Criteria

Before discussing the interaction between the operational commander and Command, Control, Communications, and Computer (C^4) systems, it is essential to define the command and control process and relate the role of C^4 systems in achieving effective command and control. Per JCS Publication 1-02, command and control is:

> The exercise of authority and direction by a properly designated commander over assigned 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.[1]

Embedded in the second part of this definition is a good description of what makes up a C^4 system--"an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces."[2] Consequently, C^4 systems are a means to the end of effective command and control (which in turn is a means to the end of successful mission accomplishment). This is a critical relationship we must maintain as we strive to optimize C^4 systems for the operational commander. Given this, there are a host of measures we could use in determining how effective a C^4 system is and in evaluating its performance, but five key criteria encompass what we should look for: interoperability, survivability, security, user friendliness, and operational utility.

Section 1.1: Interoperability

Interoperability is the most popular term and sought-after commodity in the C^4 community. While it is often talked about in an all-encompassing context, I would prefer to break it up into two major areas: System (hardware/software) compatibility and procedural compatibility. System compatibility simply means the communications and computer equipment of different services or

nations can "talk to each other." In other words, the technical and physical interfaces, message formats, database structures, and application programs are designed to ensure a system can be quickly built up in a modular or "building block" approach. Given the complexities of systems today, this is a long-term, continuous challenge for the acquisition process. Procedural compatibility encompasses a wide range of problems more related to the doctrinal area and are often overlooked given the current emphasis on system compatibility. Procedural issues deal with how we build a tailored C^4 system (made up of subsystems we have acquired) to support the operational commander in his mission. These issues typically include terminology, joint and combined training, deployment information, contingency planning, frequency management, prioritization of C^4 requirements, and sequencing of C^4 systems to meet user needs. In contrast to system compatibility, procedural compatibility is heavily related to how we employ a system we have already acquired. Taken together, the two elements of interoperability determine how we design, acquire, and deploy a "system of systems" (using a modular approach) capable of meeting the warfighter's needs.

Section 1.2: Survivability

Survivability is another key determinant of C^4 system effectiveness. Some alternative expressions often used are flexibility, adaptability, reliability, and robustness. Whatever the term, the concept is clear: Will the C^4 system be responsive when the warfighter needs it? If one node fails or enemy jamming exists, does the message still get through? In the pursuit for survivability, there are two primary paths: The technical route and the procedural route. In pursuing the technical fix to gain survivability, we consider things such as satellite transponders with anti-jam capabilities, high frequency (HF) systems that automatically search for the best available frequency (known as adaptive HF), hardened ground terminals, transmission protocols that help ensure message delivery, development of complex codes that correct transmission errors, and a host of other concepts. As you would expect, these technical fixes to the survivability challenge are heavily dependent on the development and acquisition cycle. We must have

sufficient foresight to envision the threats to survivability five years in the future and then build the systems required to meet those threats and satisfy the warfighter's needs. Similar to the system compatibility issues of interoperability, the technical fixes to survivability are relatively long lead-time items. However, the procedural path to survivability is much closer to a real-time process. Procedure in this context relates to how a communicator (informal term for a C^4 systems expert) integrates a survivable system of systems in a modular fashion tailored to the particular threats the warfighter will encounter. To put this in perspective, consider two different threat scenarios relative to C^4 systems survivability: One being the old Cold War threat posed by the Soviet Union prior to 1989 and the other being the threat posed by warring factions in Somalia. A survivable C^4 system given the Soviet threat involved a host of systems, since the Soviets could theoretically attack every capability we had. By using a large variety of systems (military satellite, HF, fiber optic cable, microwave, commercial assets, etc.) with hardened or anti-jam capabilities, we hoped to ensure command and control would be maintained through at least one of the media available. In sharp contrast, the C^4 system we built to counter the less developed Somali threat was much less complex. Satellite survivability and sophisticated anti-jamming capabilities were much less important compared to the systems required to meet the Soviet threat. So in building and tailoring an effective C^4 system for the warfighter, the communicator must consider not only the subsystems available but also the enemy threat to those subsystems.

Section 1.3: Security

It would be useless to have the most interoperable, survivable, user-friendly C^4 system imaginable if the enemy could break into your network at will and intercept your orders or any other information they deem worthy. The British and American Ultra operation of World War II is ample proof of this concept. The Allied ability to decrypt German message traffic and discover not only the capabilities but also the intentions of the German commanders was a critical factor in many of the successful operations undertaken against the Axis powers. Consequently,

enormous effort is put into cryptography and coding theory that allows message traffic (whether voice or data) to be transmitted with no threat (or a very low threat) of enemy intercept.

Section 1.4: User-friendly

How user-friendly is the C^4 system for the warfighter? This is the simplest concept, but often the most overlooked. How easy is the system to use in the field? Was it designed for use by someone who may have very little communications or computer background? Or was it built assuming a certain level of knowledge? In general, the fewer assumptions in this area, the better off we are in fielding a system that is truly user-friendly. Systems that don't meet this criteria are either circumvented or cause significant disruption to the flow of operations.

Section 1.5: Operational Utility

The final criteria encompasses the previous four and simply asks the question: "Does the C^4 system support the operational commander?" In other words, does the C^4 system allow the commander to effectively command and control his forces given the specific mission assigned? This acknowledges there is no single or generic C^4 system in existence. Rather, a C^4 system is assembled for an operational commander and tailored to his needs. Also inherent in this criteria are the concepts of throughput and timeliness. The C^4 system must be sized properly to meet all command and control requirements, while also minimizing set up time and message delivery time.

Section 2: DESERT SHIELD/DESERT STORM Analysis

Armed with these five criteria--interoperability, survivability, security, user-friendliness, and operational utility--let's briefly evaluate the performance of C^4 systems in DESERT SHIELD and DESERT STORM (hereafter collectively referred to as DESERT STORM). Interoperability was the most widely critiqued C^4 deficiency in the Gulf war. The seams and barriers to effective information transfer were most apparent in the transmission of the daily Air Tasking Order (ATO). The Air Force electronically transmitted this 300-700 page document to all players in the air phase of the campaign, but the message format was incompatible with the Navy's computers and software. Once the appropriate terminals were supplied to the Navy, we found

a lack of on-board Super High Frequency (SHF) communications still precluded the Navy from receiving the ATO. Consequently, the ATO had to be flown to Navy users, requiring hours for what should have been minutes to accomplish. Another major deficiency was the signaling incompatibility found between fixed communications assets and the tactical systems. These incompatibilities resulted in dismal call completion rates, sometimes as low as 20 percent.[3] Finding and implementing the fix (a software "patch") took over three months and tremendous cooperation from the commercial telecommunications industry. While in this case, we were able to work through this problem before the offensive started, future conflicts may not allow us the luxury of having time on our side.

While the survivability of our C^4 systems was never threatened during DESERT STORM, the systems were quite vulnerable to jamming had the Iraqis chosen to do so.[4] Given over 90 percent of communications going into Saudi Arabia were satellite channels, with 75 percent riding the Defense Satellite Communications System (DSCS),[5] our C^4 systems were based on a foundation that was narrow and somewhat fragile. However, given our assessment of Iraqi threats to our systems, the network was effectively built to reliably support our operational requirements. Also, the deep-basing approach we used (resulting from allied air superiority and in-flight refueling capabilities) served to enhance survivability of our C^4 systems even more.

Security of the coalition C^4 systems was not significantly challenged during DESERT STORM. Tactical military systems and commercial leases were all encrypted using standard equipment and recognized procedures. With the widespread use of Secure Telephone Units (STUs), even the integration of coalition members into an interoperable secure voice system required only several relatively minor modifications.

Given the interoperability problems mentioned earlier, the user-friendly nature of DESERT STORM C^4 systems suffered considerably. The Navy and Air Force frustration in trying to integrate the Computer Assisted Force Management System (CAFMS) equipment to support the ATO dissemination was understandable, especially when you consider the resulting ATO format

was by no means easy to read or quickly deciphered into usable data. And the signaling incompatibilities that resulted in only one in five calls being completed would be a frustrating experience in peacetime, but a major limitation in the context of any conflict, especially a major regional contingency (MRC).

While much of the attention surrounding DESERT STORM C^4 systems focused on interoperability challenges, significant lessons can be gained when evaluating their operational utility. Did the C^4 systems support the operational commander? Overall, we would have to answer "yes." In four months, more circuit capacity was established between the United States and the Arabian peninsula than was put into the European theater in the past 40 years.[6] To provide for the warfighter's needs, we repositioned two satellites for intra-theater communications. We also exchanged military satellite assets between the Army, Navy, and Air Force, and increased communications capacity on an Ultra High Frequency (UHF) satellite owned by another government agency.[7] Satellite circuits were taken from military users with lower priorities and given to US Central Command (USCENTCOM). Thousands of computer terminals were shipped to the Gulf. Then, after the C^4 system was fairly well established, we developed a structure to control it and provide the required changes operations would require. However, even with this historic effort, we were still marginal in providing all the capacity our warfighters desired. As demonstrated by DESERT STORM, the challenge that looms for any operational commander in future conflicts is to quickly and efficiently establish a C^4 system large enough to support mission accomplishment. Given our national military strategy is based on two near-simultaneous MRCs, we may not be able to reposition satellites--they may be needed elsewhere just as urgently. Or we may not have the luxury of five months to deploy and integrate our C^4 systems. Timeliness and capacity will become even more important criteria as we develop more sophisticated systems and the warfighters require even more information. Given these reasons and the changing world threat, the Air Force decided to trade some survivability for additional capacity in MILSTAR (Military Strategic and Tactical Relay), the next generation

satellite system.[8] It also served as a catalyst for the Joint Chiefs of Staff (JCS) C^4 Systems Directorate (J-6) to produce C4I for the Warrior, a concept aimed at establishing "joint interoperability for our forces by producing an Objective derived from the Joint Warrior's requirements and providing a roadmap to focus unity of effort within the C4I community."[9] A worthy goal, but how do we determine the warrior's requirements?

Section 3: Warrior Requirements for C^4 Systems

The Joint Warrior (or in a more generic context, the operational commander) performs several key functions in determining the best path to our objectives. First, the commander must determine what military conditions must be produced to achieve the strategic goals. Then, he must sequence his actions to produce those conditions and accordingly allocate resources. Throughout this process, the commander is continuously assessing the risks or costs associated with his actions.[10] Around these functions, C4I for the Warrior has built a vision for the C^4 systems that will efficiently provide the warrior with the inputs and outputs needed to make and execute his decisions. The goal is to provide the warrior the most accurate battlespace information--where battlespace is defined as any area over which the warrior exercises control or has a military interest. This real-time battlespace information is the fused total of three information sources: (1) Pre-Planned Essential Elements of Information (P2E2I), which is the initial database containing information the warrior anticipates he will need to plan and execute his mission. (2) Over the Air Updating (OTAU) is the "push" process, meaning data is pushed into the P2E2I database as it is updated. (3) "Pull on demand" exists to account for unanticipated information requirements not covered by P2E2I or OTAU. Information from these three sources is then fused to provide the operational commander with real-time battlespace information, his basis for making operational decisions.[11] Conceptually, this a very enticing goal, but closer scrutiny uncovers several significant challenges we must address as we proceed toward development and implementation of the "C4I for the Warrior" concept.

CHAPTER III

CHALLENGES FOR C⁴ SYSTEMS

The basis for C⁴I for the Warrior and the general course of action it proposes point us in the right direction to better support the operational commander. However, we must be extremely cautious while implementing the roadmap it provides. We have to ensure each step in the development of C⁴ systems helps us gain ground toward meeting the needs of the operational commander. General Colin Powell summed up the vision best when he said "The ultimate goal is simple--give the battlefield commander access to all the information needed to win the war. And give it to him when he wants it and how he wants it." This statement serves as the basis for the "C⁴I for the Warrior" concept, but along the roadmap to implementation, we need to acknowledge and confront several challenges to be successful. From the perspective of the operational commander, these challenges can be arranged in the following three groupings: The potential for inadequate information flow, bandwidth limitations and budget realities, and how doctrine will keep pace with the rate of implementation.

Section 1: Information Flow--How Much is Right?

Information overload for the operational commander is one of the greatest dangers resulting from the technology explosion of the last four decades. Too many people tend to cut Gen Powell's quote to "give the battlefield commander access to all the information" and disregard the key qualifier "needed to win the war." These people would argue that information is good and the more you have of it, the better off you are. However, information is only good if it helps the commander make decisions by reducing the uncertainty inherent in any conflict. All the information available to a commander is not necessarily useful. In fact, 99 percent is likely to be unneeded, with the remaining one percent having a rather profound effect on operations.[12] The "C⁴I for the Warrior" concept accounts for this potential overload with a "pull" system, where pull is defined as polling "the global C⁴I network for any desired

information from any location, at any point in time" and then presenting it "to the Warrior on time and in a form that is tailored to the Warrior's needs."[13] While it can't be argued this type of system would be nice to have, aren't we setting ourselves up for failure with such an idealistic approach? Retired USAF General Lee Paschall, former director of Defense Communications Agency (DCA) and National Communications System (NCS), concisely summed up the reality of the situation as follows: "Information needs or information overdose is very hard to define. When somebody asks what you want in your computer, the almost inevitable answer is "everything"--and real time. That obviously will not work."[14] We've historically maintained the tendency to confine our actions to what high tech systems can do for us and assume we have an unlimited supply of resources to meet our needs.[15] A much more effective approach would be to understand our realistic limitations and then devise doctrine and training to fill in the gaps. In this context, knowing that a complete "pull on demand" will never realistically exist, we should optimize the C^4 systems as best we can but also concentrate our energies on developing our operational commanders so they know system limitations and the right questions to ask in the early planning stages of any operation. This would minimize the amount of information that would need to be pulled. And even if we could put all the potentially needed information at his fingertips, how would the warrior know what to pull? Or more importantly, if he pulled some information, how would he know the "system" interpreted his request in the same context he envisioned it? Again we see limitations that aren't imposed by the technical aspects of the system, but by the thought process the system is in place to support.

Along the same lines, the "C^4I for the Warrior" concept relies on the fusion of P2E2I, OTAU, and pull on demand information to give the operational commander an "accurate, complete, and timely summary of essential information." It goes on to say that "fused information is more valuable to the warrior than information received directly from separate, multiple sources to the degree it provides the Warrior with real truth."[16] However, in his classic On War, one of Clausewitz's most widely accepted opinions concerns what he calls the fog of

war--how nothing is certain in war.[17] We depend on operational commanders and their staffs who use a human element to cut through the fog as best we can. To imply that any system can provide the "real truth" (especially during armed conflict) is misleading and dangerous. Another potential impact of depending on a fusion system external to the commander (or his staff) is that we lose the focus of why something may be happening. At times, the fusion process itself removes individual bits of information that may be critical in a given situation. This is not to imply fused data is not beneficial, because some degree of fusion is always desired. However, it seems that high tech capabilities may be pushing us too far. General Robert T. Marsh, former commander of Air Force Systems Command, summed it up well as follows: "How you would fuse the information--that's where we really met our nemesis. We just bit off way, way too much in trying to automate human decision making."[18] Going back to the criteria developed in Chapter II, we must always evaluate the operational utility of any C^4 system. Just because a system has the best features technology can offer doesn't imply it will enhance the commander's ability to command and control his forces.

Section 2: Reality

Another pair of realities that must be maintained in the "C^4I for the Warrior" concept are budget constraints and bandwidth limitations. Even though C^4 systems survived the 1994 defense budget reductions virtually unscathed with a $19 billion allocation, the military services' budgets will still be stretched to provide the types of capabilities addressed in C^4I for the Warrior.[19] Capacity, or bandwidth, also costs money and is fairly limited when compared to operational requirements. Keep in mind this is not said to dispute the vision established by the concept. Putting all the information a warfighter will need at his fingertips is a goal we should continue to strive for. However, we still have to be smart when proceeding along the roadmap, knowing where cost or capacity constraints will force us to alternative solutions or tradeoffs. The trick will be knowing where we can get the "most for our money" given the threat scenario and the operational commander's requirements. We always need to remember that C^4 systems are a

means to an end, not an end by themselves. A good illustration of encountering reality can be found in video teleconferencing (VTC), one of the most sought-after capabilities of recent years. The ability to effectively transmit images or provide face-to-face briefings over long distances is a vast improvement and gives new meaning to communicating "the commander's intent." A significant drawback is that it consumes large portions of bandwidth. Given we don't have a lot of capacity sitting free on our military systems, we have turned to commercial leased systems for transmission. Since the system was designed, tested, and demonstrated in the United States, t wasn't a major problem, since bandwidth is relatively cheap here. However, in migrating VTC to Europe, the same leased service obtained here for $15,000 a year costs well over $1 million![20] Once the budget and capability tradeoffs are made, you then hope the system can still meet baseline requirements. The point to remember is that even though the objective phase of C⁴I for the Warrior "will remain warrior-centered and drive technology," we will still run into roadblocks we must detour around given the real constraints imposed on us. Our goal then, should be knowing our warfighter's requirements and doctrine well enough to make the detour as short as possible.

Section 3: Doctrinal Issues

The final issue I will address relative to the "C⁴I for the Warrior" concept is also the most challenging from a doctrinal perspective. Even though it is questionable whether our C⁴ systems will ever achieve the optimistic objective proposed in C⁴I for the Warrior, it is inevitable we will move steadily toward that goal of placing all the information the warfighter needs at his fingertips. The "C⁴I for the Warrior" concept says the "warrior terminal" must satisfy his needs at any time, any place, and for any mission. The existence of a system that will theoretically provide the capability to make and disseminate decisions at any level having access to the real-time battlespace information has a tremendous potential for changing the operational level of war. If the President or other NCA representative has all the information needed to make a decision, why would there be a need for a decision-maker at the operational level? On the other end of

the spectrum, how low in the chain of command should these same capabilities be passed? Here, we see a potential for tactical commanders making operational decisions from the tactical level. Given these two ends of the spectrum, it would seem the strategic and tactical levels of war could overlap the operational level dramatically more than they ever have in the past--even to the point of eliminating it. However, on this point, we must be careful of terminology. Even though the operational commander may lose some of his decision-making authority or be eliminated entirely, the functions at the operational level of war must still be carried out. Some entity must translate the strategic goals (derived from policy) into military conditions, arrive at a sequence of actions most likely to produce those conditions, allocate resources, and evaluate the risks associated with the operational plan. If we detract from the operational commander's ability to make decisions, then the players at the strategic (NCA) or tactical levels of war have an increased role in the decisions that link strategy to tactics. What is true in any case is the President (NCA) must decide how to provide positive control of the military instrument (to attain the national goals) without micromanaging and adversely impacting military operations. Depending on where the military actions fall in the spectrum of conflict will determine to a fair degree how much involvement the operational commander can expect from the National Command Authorities (NCA). For example, the NCA will tend to be much more "engaged" at the operational level (and even the tactical level) in "operations other than war" for three principal reasons:

(1) War (or any use of the military instrument) is a political tool, a means to an end. At the lower end of the spectrum of conflict, there is a much finer line between military and political action because the military is often used to create a "show of force" or to "signal" the opponent.

(2) Operations other than war tend to be more focused and require a smaller number of forces. This often leads to the mistaken impression that a full-time commander is not essential for effective decision-making.

(3) The situations which usually bring us to this type of military use are typically politically charged and place the United States under international scrutiny. While survival of the

United States or even our vital security interests may not necessarily be at stake, our national prestige is.

The other levels in the spectrum of conflict are also subject to NCA involvement and accompanied by the same factors only in varying degrees. The take-away is to remember that in today's environment of real-time communications and especially given the vision of C⁴I for the Warrior (where any data can be made available any time or anywhere to anyone), we have essentially moved the President to the battlefield as far as decision-making is concerned. If the NCA has a warrior terminal and can "pull" any desired information at any time, hasn't the operational commander been relegated to an advisory position at best? While this may not be a desirable situation, we must consider it as a possibility and see how it fits into our warfighting theory. A successful implementation of the vision set forth in C⁴I for the Warrior could be catastrophic to effective command and control (rather than supportive) if we don't also concurrently develop the doctrine to go along with it. In much the same way, we run into problems with the tactical commander having the same information and making operational level decisions from too low a level. Even though he would theoretically have all the information readily available, he may not have the time or ability to develop a theater focus that will link tactical victories to achievement of strategic goals. In this case, there is a definite potential for battlefield confusion.

As you can see from these two extremes, C⁴I for the Warrior forces a review of our doctrine never before envisioned. With the current push oriented toward building joint doctrines from the individual service doctrines, we must now (given the "C⁴I for the Warrior" concept) go to a new level and evaluate how the functions at the operational level of war will be satisfied given capabilities never envisioned just several years ago.

CHAPTER IV

ROADMAP FOR THE VISION

The end state envisioned by the "C⁴I for the Warrior" concept is a global, seamless C⁴ system architecture capable of significantly enhancing decision-making by the operational commander. It provides a roadmap to focus on, but along the path we must make smart decisions. However, to make a decision implies you know there is a choice to be made. It's in this area where we stand to lose the most in our implementation of C⁴I for the Warrior. This is because we aren't just buying new systems as we had in the past. We are making fundamental changes to the way we do business. Given this, we must evaluate C⁴ systems from both their technical and non-technical aspects. The criteria set forth in Chapter II, along with the direction from C⁴I for the Warrior, give us a good start. In this new era, we have to start at ground zero and determine how a new system (or more importantly, if a new system) fits into our entire warfighting doctrine and the new vision we've established for C⁴ systems.

Section 1: "Push" or "Pull"?

In the area of "pull on demand" information, we have to make sure our operational commanders know what is available. One of the advantages of the "push" system was most of the information needed was presented to the operational commander. Granted, he or his staff had to sift through all the information to find the relatively few pieces that were needed, but at least he had a picture painted for him. Now, we are giving the operational commander the brush to "paint his own picture." This is a good philosophy as long as we teach the warfighter what information is available to be pulled. Otherwise, we risk leaving our warfighter in an information vacuum, which is as bad or worse than information overload. So a system emphasizing "push" threatens to overload the warfighter, whereas a "pull" system has the potential of leaving the commander in a vacuum. Any doctrine that relies on only one mode will be less effective.

Consequently, developers of C^4 systems--together with the warfighter--need to find the right balance between these two philosophies .

We also need to better understand the role of fused data. There are many times when fused data is critical to efficient operations. However, there are many situations where the commander would be much better off if he was provided the individual pieces and used his on-scene staff to correlate the data using their theater focus and hands-on experience. In some cases, their assessment may be very similar to a "long distance" assessment. However, their day-to-day experiences may also lead them to different assumptions, significantly altering the output from their in-theater fusion process. So again, we encounter a case where our new C^4 system philosophy can provide significant enhancements as long as its implementation parallels an effort to better educate our warriors in the system limitations and doctrinal considerations.

Section 2: Confronting Realities

Given our vision to provide the warrior all the information needed to effectively prosecute an operation, we must consider the realities of bandwidth limitations and the budgets required to procure systems that will reduce those limitations. To provide the most effective support for operational commanders, we must constantly balance capabilities and doctrine since both are continually changing. For example, the Navy envisions communications requirements totaling six megabits of capacity in the year 2000 (over seven times the current requirements) for a Joint Task Force (JTF) commander afloat.[21] However, given current programs and acquisition underway, the most we can expect to have by then is four megabits. Given this situation, we need a timely consideration of the impacts this two megabit differential will have on the operational commander, rather than waiting until the year 1999. We have to establish who controls the available bandwidth, prioritize our requirements, and (together with the warfighter) try to find alternate means to get the information to him. Failing to address the existence of system limitations will result in "gaps" for the operational commander where there are no systems to support his requirements and also no doctrine or forethought as to work-arounds. We have

always had deficiencies in our systems--and always will. However, as long as we know the limitations, we can effectively deal with them and avoid being surprised.

Section 3: A Focus on Doctrine

Given the sophistication and proliferation of C^4 systems envisioned by C4I for the Warrior, we will have the ability to put all the information required by an operational commander anyplace in the world. We must evaluate how this situation will impact the operational level of war. Specifically, we must assess the implications of having a "long-distance" operational commander rather than an on-scene leader. Given the experience of the British in their Falkland Islands campaign, it would seem there is still a definite need for an on-scene commander. The commander of their JTF was over 6,000 miles away in the United Kingdom. Even though the mission was accomplished, there was significant confusion and a reduced unity of effort resulting from the absence of an on-scene commander dedicated to the mission. From living daily life in the same environment as the combatants, the on-scene commander has a theater focus that is impossible to convey through any C^4 system, no matter how advanced. It's also been observed that raising decision thresholds reduces the initiative of subordinate units and limits their ability to cope on their own, resulting in an increase in the immediate risk with which they are faced.[22] An exhaustive analysis of the impacts of C^4 systems on the operational level of war is very broad in scope, but one message is clear. Continual emphasis on the merits of an on-scene operational commander is critical--command and control cannot be automated and effectively performed from a location distant from the battle. While it is true that computer and communications technology present us an expanding capability to make "long distance" decisions, the key qualifier for the operational commander is effective decisions. We must resist the temptation to do everything technology will allow us to achieve. We've got to consider and protect the doctrinal fundamentals we base our warfighting theory on. To do this, we must fully evaluate the possible impacts of our new concept, not from just a joint doctrine perspective, but by evaluating how we may be changing our perception of the operational level of war. In other words, as long as we believe

the operational level of war provides a critical link between the tactical and strategic levels, then no new system or support concept should detract from that link. On the contrary, we should do everything possible to enhance it.

Section 4: Organization Restructuring

A well-maintained balance between C^4 system capabilities and our warfighting doctrine is essential in retaining an effective military, but this balance can be much easier to achieve if we have an organizational structure that enhances the process. Defense Management Report Decision (DMRD) 918 acknowledged some organizational deficiencies in the C^4 community and was aimed at assuring "an end-to-end information transfer capability which is protected, interoperable, and cost effective" by transferring resource management and control to Defense Information Systems Agency (DISA), who would be the central manager of the Defense Information Infrastructure.[23] Too many systems in the past have been tailored for a specific service or agency use. The users in receipt of the tailored service have benefitted but interoperability has taken a beating from this stove-pipe approach. In the quest for a better structure, this DMRD has three broad goals, all of which are part of the "C^4I for the Warrior" concept:

(1) Revolutionize defense-wide information interchange.

(2) Take advantage of communications, computer, and information management to effectively accomplish the Department of Defense (DoD) mission.

(3) Reduce the burdens of information technology on operational and functional staffs.[24]

Given these goals, the report then goes on to exclude three major groups of systems: C^4 systems designed as an integral part of weapons systems; information technology resources dedicated to strategic or tactical command, control, and intelligence missions; and wargaming systems. The broad scope of these exclusions allowed the individual services and agencies to retain control of almost any system they wanted, and this was essentially what occurred. By the time an implementation plan for DMRD 918 was in final draft, only two major areas were planned to transfer to DISA: Data Processing Installations (DPIs) and Central Design Activities (CDAs) for

software programming. A second phase would then determine which remaining systems the services would agree to transfer in keeping with the intent of the DMRD. However, of the 20,000 personnel to be transferred along with operational control of the facilities, only 5,000 were transferred. Also, transfer of the CDAs along with the remainder of the DMRD implementation was put on hold at the request of then Deputy Secretary of Defense Perry.[25] The Assistant Secretary of Defense for C^{3}I, Mr Emmett Paige, concurred and has directed an independent study of the core DMRD 918 issues that should be completed by March 1994. The results of this study and our subsequent course of action will have a dramatic impact on our ability to efficiently progress toward the vision set forth in C^{4}I for the Warrior. One of the best options would be to consolidate C^4 systems development and acquisition under DISA with requirements being generated by the unified CINCs and individual services. This would provide a unity of effort never possessed by the C^4 community. As an illustration, take the challenge of finding a system that ensures multi-level security for our computer systems. Every service and agency is pursuing their own "fix" to this requirement, so why shouldn't we pool our requirements, let go of service parochialisms, and allow one organization (DISA) to manage an all-inclusive effort? Then interoperability is guaranteed and we've also streamlined the acquisition process. While it's true the Military Communications-Electronics Board (MCEB) has been reorganized to better ensure interoperable systems, why should we depend on an external board to catch all the possible disconnects resulting from separate service-driven programs? Rather than modifying the separate programs, we should be looking at the organizational issues in administering them. Rather than having multiple service-driven programs combined into one interoperable system, we should concentrate on developing one interoperable system that satisfies all the service (user) requirements. A possible disadvantage from the regional CINC's perspective is the perceived loss of a supporting architecture that is tailored to his specific needs and "close to home." However, if DISA is given the authority to develop and acquire all new C^4 systems, the CINC is really better supported because he, in effect, has what DISA refers to as "one-stop shopping." This is

an integral component of their program called "Vision 21," the vision that will take our C^4 systems into the 21st century. They are committed to providing reliable, flexible, and affordable information systems and related services to their customers (the warfighters) in support of their DoD mission.[26] Under the one-stop concept, the CINC should have only one major support agency (DISA) to confer with regarding C^4 systems, rather than the current five or six primary players he now interacts with. An additional benefit of this consolidation of acquisition and development is the authority DISA would gain to achieve the significant responsibilities they were assigned by JCS Pub 6-0:

> DISA is responsible for planning, developing, and supporting C^4 systems that serve the needs of the NCA under all conditions from peace through war. It ensures the interoperability of the World-Wide Military Command and Control System (WWMCCS), the Defense Communications System (DCS), theater and tactical C^2 systems, NATO and/or allied C^4 systems, and those national and/or international commercial systems that affect the DCS.[27]

Any action that will give DISA the "teeth" to satisfy these responsibilities will put us well on the way to achieving the worldwide, seamless network envisioned by C⁴I for the Warrior.

Section 5: Support from the Commercial Sector

Another significant step we can make toward providing the operational commander with effective C^4 systems is to be much more flexible and open to changes in the commercial industry than we have in the past. The rapid pace of communications and computer technology has quickly bypassed our slow acquisition process and our ability to keep up with military specification documentation. Without taking advantage of the advances made by commercial industry in both product and standards development, we risk falling behind in providing the operational commander the most effective C^4 systems available, and our "C⁴I for the Warrior" vision may never be attained. Brigadier General Beasley, a leader in DISA, was on the mark when he remarked that "We can no longer go to war without our partners in US industry. Military preparedness and operations depend heavily upon a strong partnership with commercial vendors and the capabilities they give us."[28]

Our goal should be to place new required capabilities in the hands of the warfighter as soon as possible. Waiting for the typical acquisition cycle of four to seven years only provides a military system that is already two to three generations behind the available commercial systems. And the argument that unique military requirements are not fulfilled by commercial industry is rapidly losing ground. True, there are some requirements the commercial sector is not interested in (i.e. jamming), but for the most part, they have the same criteria for their business interests that we have for our military systems: They want a reliable (survivable) communications network that is user-friendly, meets their needs (operational utility), and can connect them with anyone they want at any time (interoperable). And if you don't think the private sector is interested in secure communications, consider a corporation making closed bids on a multi-million dollar acquisition. Consequently, given the decreased threat scenario we face in the military and the universal emphasis on high capacity communications, commercial and military systems will continue tc become more and more similar.

As a key ingredient to interoperability, it is imperative we establish and enforce standards for our systems. The JCS gives this responsibility to a part of DISA, the Joint Interoperability Engineering Organization (JIEO). Per JCS Pub 6-0, JIEO (in coordination with the combatant commands) is responsible for "developing technical interoperability standards and procedures for the interconnectivity of C^4 systems used during joint operations."[29] In carrying out this critical responsibility, JIEO must quickly evaluate and adopt the appropriate commercial standards to better support our operational commanders. We can no longer take the time and effort to generate a unique military standard and expect the commercial industry to effectively respond. Since many commercial standards are also international, adopting them can also aid immeasurably in combined operations interoperability. A good illustration of the importance of standards comes with the VTC confusion we've recently experienced. When VTC became commercially available, it was viewed as a capability that would provide tremendous benefits to the operational commander. Given this, multiple services, agencies, and CINCs went about procuring their own

systems. The problem was our standards assessment was too slow to respond with which one of the available commercial standards was best suited for our military requirements. The result was three different systems being procured with little or no interoperability. Have we helped the warfighter or progressed toward our seamless network capable of supporting the operational commander any place or any time? I would say the answer is an emphatic NO. This case also illustrates a need to change our tendency to perform acquisitions and standards development in a vacuum separate from operations. Decisions made in these supporting areas are critical and can have a dramatic impact on the warfighter. Supporting agencies and organizations must always remember who they are working to support--the operational commander.

Section 6: Testing Philosophy

The way we test the C^4 systems and standards we've acquired includes not only the factory checks and tests we perform in a controlled environment, but also the most important tests--joint and combined exercises. If we really want to learn how well our C^4 systems will support the operational commander, we must run frequent exercises using realistic scenarios. We have to turn away from our current mode which tends to emphasize a successful exercise rather than an honest identification of areas we need to work on. Too often, exercise players know the scenario months in advance and preparations for C^4 systems support start then. The bottom line is that we've got to practice the game just like we plan to play it or we'll certainly have unwelcome surprises during the next contingency or regional conflict we are called on to support. Operations DESERT SHIELD and DESERT STORM proved we could set up adequate C^4 systems given several months time. Our exercises must now concentrate on the worst case scenarios--no-notice contingencies world-wide. These types of exercises, complemented by an enhanced and realistic war-gaming capability, will help to ensure our C^4 systems are mission capable and ready to support the operational commander any time, any place.

CHAPTER V

CONCLUSION

During a recent speech, Lt Gen Carl O'Berry, the USAF Deputy Chief of Staff for C^4, noted that the interface between man and machine is currently defined by software programmers but needs to shift to a "user-centric" mentality.[30] With our "user" being the operational commander, our goal should be to provide C^4 systems that are interoperable, survivable, secure, and user friendly in supporting that commander's mission. C^4I for the Warrior goes a long way in defining a vision and a roadmap for providing the necessary systems, but we must carefully assess tradeoffs as we proceed toward implementation. The risk of an information overload or vacuum is ever-present, and implications for how new C^4 systems impact the very nature of the operational level of war are also very real. To avoid these pitfalls, we must establish and use effective criteria to evaluate our C^4 systems. We must also consider realistic constraints in the development of new systems and expand our thinking well past the technical problems we usually concentrate on. In doing this, we will be in a much better position to evaluate how our C^4 systems and concepts will affect doctrine (and conversely, how our doctrine will affect our development of C^4 systems.)

The bottom line is that our C^4 systems must act as force multipliers and enhance the operational commander's capabilities by providing effective command and control of his forces. To fully accomplish this and give the operational commander the most effective systems available, we must also work closely with commercial industry and avoid "re-inventing the wheel" in our military applications of commercial equipment and standards. Then, as we test the C^4 systems for the operational commanders, we must use realistic exercises that will identify shortcomings and aid us in working toward timely fixes. Finally, as a basis to all this, we must efficiently consolidate the development of new C^4 systems under DISA in order to gain a greater unity of effort as we work to provide the warfighters with the best service possible.

A key process central to the whole mechanism of providing effective C^4 systems to the operational commander is creative thought. We can no longer afford to use old templates to solve new problems. Rather, we have to be prepared to start from ground zero and use constructive, creative thought to build and operate our C^4 systems and organizations on firm doctrine aimed at more effectively helping the operational commanders make their decisions and promulgate their executive orders.

Notes

Chapter II

1. Joint Chiefs of Staff (JCS) Pub 1-02, Department of Defense Dictionary of Military and Associated Terms (Washington, DC: GPO, 1 Dec 89), p. 77.

2. JCS Pub 1-02, p. 77.

3. Brig Gen Dennis C. Beasley, "DESERT STORM: The Ultimate Jointness," address to Bellcore, 1991.

4. Office of the Secretary of Defense (OSD), Conduct of the Persian Gulf: An Interim Report to Congress, "Question 15," (Washington, DC: GPO, July 1991), p. 15-2.

5. VADM William A. Dougherty, "Storm from Space," Proceedings, August 1992, p. 51.

6. Brig Gen Beasley address.

7. Interim Report, p. 15-2.

8. James W. Canan, "A Watershed in Space," Air Force Magazine, August 1991, p. 40.

9. Joint Chiefs of Staff, J6I, C^4I for the Warrior (Washington, DC: GPO), 12 Jun 93, p. 1.

10. JCS Pub 3-0, Doctrine for Joint Operations (Washington, DC: GPO, 9 Sep 93), p. II-4.

11. C^4I for the Warrior, pages 10-13.

Chapter III

12. R. Wohlstetter, Pearl Harbor: Warning and Decision (Stanford, CA, 1962), Chapters 1-2.

13. C^4I for the Warrior, page 13.

14. Lee Paschall, "C^3I and the National Military Command System," ed. Thomas P. Coakley, C^3I: Issues of Command and Control (Washington, DC: National Defense University, 1991), pp. 285-286.

15. Martin Van Creveld, Command in War (Cambridge, MA: Harvard University Press, 1985), p. 275.

16. C^4I for the Warrior, page 13.

17. Carl von Clausewitz, On War, ed. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1984), p. 101.

18. Robert T. Marsh, "Air Force C^3I Systems," ed. Thomas P. Coakley, C^3I: Issues of Command and Control (Washington, DC: National University Press, 1991), p. 20.

19. Neil Munro, "C^3I Survives Reductions Essentially Unscathed," Defense News, 5-11 Apr 93, p. 14.

20. Interview with action officer from Defense Communications Contracting Office (DECCO), European area.

Chapter IV

21. Navy N6 lecture on C^4 systems, presented to US Naval War College, Newport, RI, 28 Jan 94.

22. Van Creveld, p. 274.

23. OSD, Defense Management Report Decision (DMRD) 918 (Washington, DC: GPO, 15 Sep 92), p. 1.

24. DMRD 918, p. 1.

25. Telephone interview with Mr Jim Gress, DISA, Jan 94.

26. Letter from Director, Defense Information Systems Agency (DISA), subject: Vision 21/Total Quality Management, 16 Mar 92.

27. JCS Pub 6-0, Doctrine for Command, Control, Communications, and Computer Systems Support to Joint Operations (Washington, DC: GPO, 3 Jun 92), p. IV-3.

28. Brig Gen Beasley address.

29. JCS Pub 6-0, p. IV-3.

Chapter V

30. Lt Gen Carl O'Berry speech to St Louis Chapter of AFCEA, Oct 93.

BIBLIOGRAPHY

Allard, C. Kenneth. Command, Control, and the Common Defense. Yale University Press, New Haven, CT, 1990.

Canan, James W. "A Watershed in Space." Air Force Magazine, August 1991, pp. 32-41.

Clausewitz, Carl von. On War. Ed. Howard, Michael and Paret, Peter. Princeton, NJ: Princeton University Press, 1984.

Coakley, Thomas P., ed. C^{3}I: Issues of Command and Control. National Defense University Press, Washington DC, 1991.

Cushman, John H. Handbook for Joint Commanders. United States Naval Institute, Annapolis, MD, April 1993.

Dougherty, William A. "Storm from Space." Proceedings, August 1992, pp. 48-52.

Munro, Neil. "C^{3}I Survives Reductions Essentially Unscathed," Defense News, 5-11 Apr 93, p.14.

Office of the Joint Chiefs of Staff. C^{4}I for the Warrior. Washington, DC: GPO, 12 June 93.

_____. JCS Pub 1-02, Department of Defense Dictionary of Military and Associated Terms. Washington, DC: GPO, 1 Dec 89.

_____. JCS Pub 3-0, Doctrine for Joint Operations. Washington, DC: GPO, 9 Sep 93.

_____. JCS Pub 6-0, Doctrine for Command, Control, Communications, and Computer Systems Support to Joint Operations. Washington, DC: GPO, 3 Jun 92.

Office of the Secretary of Defense. Conduct of the Persian Gulf: An Interim Report to Congress. Washington, DC: GPO, July 1991.

_____. Defense Management Report Decision (DMRD) 918. Washington DC: GPO, 15 Sep 92.

Snyder, Frank M. Command and Control: Readings and Commentary. Cambridge, MA: Harvard Program on Information Resources Policy, 1989.

Wohlstetter, R. Pearl Harbor: Warning and Decision. Stanford, CA, 1962.

Van Creveld, Martin L. Command in War. Cambridge, MA: Harvard University Press, 1985.