STRATEGY RESEARCH PROJECT

DECISION SUPPORT SYSTEMS FOR COMMAND AND CONTROL: THE NEED FOR A COMMANDER'S STRATEGIC DECISION AID

BY

LIEUTENANT COLONEL EDUARDO CARDENAS
United States Army

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U.S. ARMY WAR COLLEGE, CARLISLE BARRACKS, PA 17013-5050

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LTC Eduardo Cardenas

LTC Robert A. Kilmer
Project Advisor

U.S. Army War College
Carlisle Barracks, Pennsylvania 17013

ABSTRACT

AUTHOR: Eduardo Cardenas (LTC), USA

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Future Joint Force Commanders (JFCs) will use the Global Command and Control System (GCCS) for their command and control needs. This study examines this automated decision support system for command and control: the Global Command and Control System. It briefly describes the functional areas of this system and some of the specific applications currently fielded. This overview analyzes the functional areas to determine the various types of information that the system is able to track. The needs of a strategic military leader are investigated to determine if the GCCS system can provide the required decision support. For needs not currently met, decision support technologies in artificial intelligence are examined to see what is currently available external to GCCS that can be used as a decision aid to assist a strategic level commander. The paper addresses and

presents designs for incorporating these decision aids into the current and proposed future system.

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Strategic Decision-Making

"It is absolutely vital that a senior commander should keep himself from becoming immersed in details... If he gets involved in details he cannot defeat the enemy since he will lose sight of the essentials which really matter. He will fail to be that solid rock on which his staff can lean."

-- Field Marshall Viscount Montgomery of Alamein, 1958[1]

The coalition forces in Operation Desert Storm succeeded in defeating Iraq. The coalition's ability to use tools in intelligence, synchronization, and decision-making at a level never before experienced were key factors. The coalition forces clearly won the information war as strategic attacks and bombardment from coalition air forces wiped out the Iraqi intelligence network. The coordinated strategic attack allowed the coalition commanders to dictate the tempo of operations. In today's international environment, our National Security Strategy of Engagement and Enlargement envisions simultaneous conduct of the strategic, operational, and tactical levels of war. The pace and visibility of world-wide events emphasize direct relationships of the military, economic, and political elements of national power. Strategic commanders must be aware of these interrelationships.[2] The strategic military commander must be able to command and control the military element to gain the full potential of national power. In Field Manual 100-5, Operations,

the functions of Command and Control are composed of two vital components. They are decision-making and leadership.[3] Commanders position themselves so they can best assess and influence the battle. Poised to make the right decisions at the right times, they provide the leadership to inspire action, and take responsibility for their decisions.[4] The joint force commander (JFC) must make the proper decisions and do so faster than the enemy executes his decision cycle. The JFC needs a manual or automated aid to assist in the decision-making tasks. A command and control decision aid is crucial to success and must support shorter decision cycles. The need exists for relevant, timely, and accurate information.[5]

There is an obvious need for decision support aids for command and control. The increased tempo of operations and more importantly the increased quantity of information dictates this. The difficulty of applying decision aids, the functions they serve best, and the conditions under which they are most effective will drive the most acceptable solution. The decision aid would be an integral part of the command and control system used by the JFC.

A system is a group of interrelated elements or components that interact together and in this context contribute to

decision-making. A decision support system (DSS) is the over-arching information infrastructure that contains a decision support aid. Decision Support Systems:

- tend to be aimed at less well structured, underspecified problems
- attempt to combine use of modules with traditional data access and retrieval functions
- focus on features that make them easy to use by noncomputer people
- emphasize flexibility and adaptability to accommodate changes in the environment.[6]

In short, decision support systems focus on improving the effectiveness of the commander's problem solving process. Commanders will still need to have the experience and intuitive nature to command effectively, but technology will tend to shorten decision-making-to-action time. The result will be a blurring of strategic, operational, and tactical levels of war. Commanders will act upon their intuitive sense of the battlefield and allow for independent action of subordinates.[7]

A DSS will be useful to a leader confronted with information in large data bases or faced with manipulating or performing computations with the data. A large data base would be useful if there were some means of quickly finding the required nugget of information. Decision aids can help in this situation. The commander uses judgment to recognize or decide what constitutes

the problem, creates alternatives, and chooses a solution to the problem. Time constraints affect all these processes.[8] Time will be the most critical aspect that the commander will have to deal with in making any decision. Methods that assist the decision maker will be welcome.

The Strategic Decision Support System

"We have set the course with the C^4I For The Warrior concept. Many milestones have been achieved. The Global Command and Control System is well underway. We continue to make progress toward a common global vision to provide the Joint Armed Forces with the critical information they need."[9]

The integrated systems of doctrine, procedures, and resources that are designed to support the JFC's exercise of command and control is called command, control, communications, and computers (C^4). The systems include both the communications and computers required to implement the commander's command and control process. When the critical resource systems of intelligence are added to the integrated C^4 systems, the product is known as command, control, communications, computers, and intelligence (C^4I). The intelligence systems add knowledge to the overall command and control process. This vital ingredient provides the essential battlespace and situational awareness that is deemed critical on today's battlefield.

What system will the JFC use for command and control in the future? The Global Command and Control System (GCCS) is the cornerstone of the command, control, communications, computers, and intelligence (C^4I) infosphere of the future. *The C^4I For The Warrior* (C^4IFTW) concept is the vision set forth to provide our forces with joint interoperability in the future. The evolution

of the C^{4}IFTW concept is seen in Figure 1. GCCS replaced the World Wide Military Command and Control System (WWMCCS) as a quick fix. The separate services each have their own internal C^{4}I systems that operate at the tactical level. As we move toward the future, the GCCS will lay down the base for the common operating environment for all C^{4}I systems. This concept will provide the unifying guidance and milestones to achieve global C^{4}I and joint interoperability. The objective system will be affordable, responsive, reliable, and secure. The common operating system will allow any warrior to perform any mission.

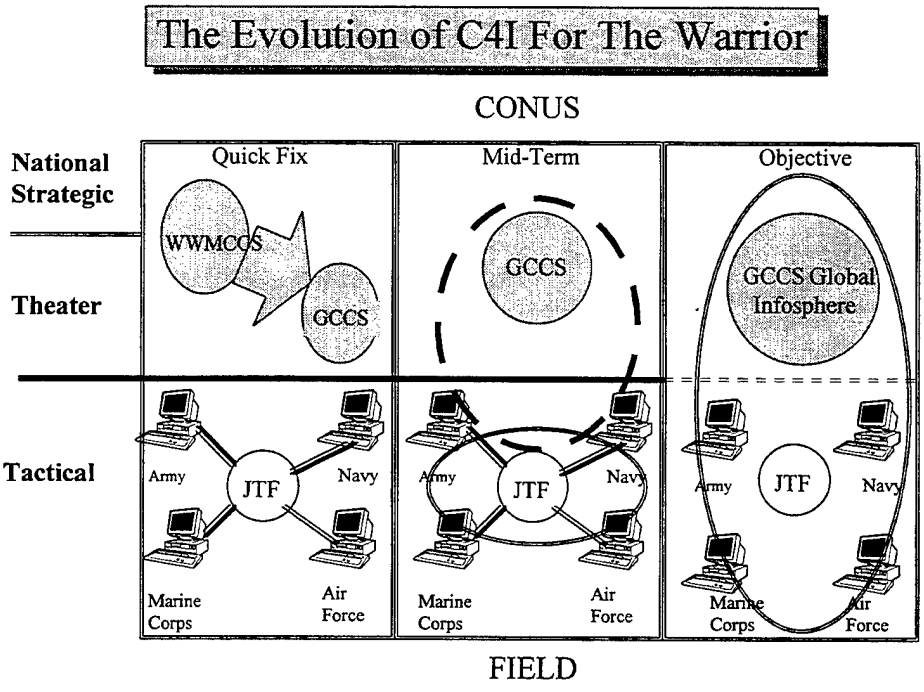

Figure 1. The Evolution of C^{4}I For The Warrior

GCCS establishes interoperability among forces with a focus on providing a common operational picture to support situational awareness to the joint warfighter.[10] The GCCS is a "system of systems" that replaced the World Wide Military Command and Control System (WWMCCS) in 1996. It must be understood, that the GCCS is an evolving system that intends to incorporate state of the art technology and modules of capability designed to give the users a high integrated package in a client-server architecture. At present, GCCS contains the capabilities of multiple data base retrieval, strategic plottage, logistics and transportation planning, and personnel tracking and planning. It also contains planning tools that create and distribute orders, campaign plans, and OPLANS. Its suite of connected systems provides instantaneous, accurate data, and automated decision support to satisfy a myriad of missions. GCCS employs compatible, interoperable, and integrated C^4I systems with information exchange connectivity via the Defense Information Systems Network (DISN). The DISN supports the planning, deployment, sustainment, employment, and redeployment of joint forces worldwide.[11] The main function of GCCS is to support the National Command Authority's (NCA) command and control functions. GCCS maintains connectivity among the NCA, the Chairman of the Joint Chiefs of

Staff (CJCS), and other components of the National Military Command System (NMCS), to include Department of Defense (DOD) agencies. An automated message handling system provides the connectivity to and interoperability with other government agencies, allies, tactical users, and other approved civilian agencies. The main subsystems of the GCCS to date are:

Main Subsytems	Description
Joint Deployable Intelligence Support System (JDISS)	Intelligence retrieval and requests
Global Status of Resources and Training System (GSORTS)	Status of readiness and training
Joint Maritime Command Information System (JMCIS)	Strategic and tactical plottage
Theater Analysis Replanning and Graphical Execution Toolkit (TARGET)	Collaborative OPLAN creation tool
Requirements Development and Analysis (RDA)	TPFDD creation and manipulation
Joint Flow and Analysis System for Transportation (JFAST)	Logistics flow analysis tool

Table 1. Key Application Subsystems of the GCCS

These key applications provide decision support to the key principles of C^4 systems in joint reporting, intelligence, logistics, and planning. The GCCS meets the fundamental objectives of providing unity of effort, exploiting the total force capability, properly positioning critical information, and fusing information.[12] It is within the constructs of the GCCS system that future JFCs will fuse the great amounts of available

information and make the decisions that will provide for successful accomplishment of any mission.

Determining the Needs in a Command and Control System

"If a C^3I system does no more than give a commander good information, allow him to impose his will and thereby inspire his troops to a courageous determination to win, then it is fulfilling its function and doing it well."[13]

To gain insight into an organization at the strategic level, it is necessary to examine the organization in terms of its functional characteristics and the manner in which these functional subsystems interact. These functional subsystems should operate together for a common purpose. That common purpose should be to accomplish the mission and preserve the force. A systems approach permits examination of the system, as well as the environment surrounding the sub-systems, its resources, its outputs, and its process of control. The systems approach will permit us to build a system of systems that will provide dominant battlespace awareness or knowledge. "At the strategic level, the systems approach trades flexibility for focus in order to concentrate on identifying and neutralizing centers of gravity or target sets. A system of systems reduces information requirements by focusing on perceived centers of gravity and by honing the associated target lists into prioritized and---increasingly---synchronized and simultaneous operations."[14] The toughest job for the JFC will be to ensure

his perception of occurring events or, battlefield awareness, is the same at each level of command.

The measures of effectiveness of a command and control system should include:

- stability -- ability of the system to maintain a predictable pattern over time
- sensitivity -- the variation from norms which occurs before an adjusting response is invoked
- responsiveness -- the speed with which the system can correct variations from norms or stated objectives.[15]

Properly evaluated measures of an effective C^2 system reflect stability, sensitivity, and responsiveness resulting in mission accomplishment and efficient resource utilization. Decision processes are normally dependent upon the flow and processing of information. We can view the decision process as a two-stage activity. It involves the formulation of an initial plan for an assigned mission and subsequent adjustment of that plan until it is completed or receipt of a new mission occurs.

In the process of making decisions and exercising control over functional systems, the commander and the staff must have some common framework to ensure unity of effort. Decision strategy refers to this framework. This is not a gaming theoretical approach. Initially, the number of alternatives is too large, the uncertainty is high, and the variables initially are too numerous to allow gaming techniques. Moreover, gaming

approaches do not appear tractable in the dynamic environment of combat. In such an environment, attempts to arrive at an immediate optimal solution may be disastrous. The commander and his staff must move in a finite number of steps to reach an acceptable plan with the correct decisions. The commander and staff seek purposeful information to reduce any uncertainty. Additional information is expensive in terms of time, resources expended and opportunities lost. Quality decisions require establishment of cause and effect relationships. Stability created by effective command and control enables learning to occur at all levels. The effective decisions result from certainty and time.

> "A commander who is able to reduce uncertainty in a timely fashion in any of the three areas of friendly force status, enemy force status, or the environment will be more effective in making decisions. Better decision-making ability enables a commander to effectively perform the functions of C^2: planning, directing, coordinating and controlling forces."[16]

Quality information, not only in terms of the current situation, but also in terms of how the situation is changing over time, is a principal tool the commander and the staff must use to reduce uncertainty and risk. Reduced uncertainty is key to the decision-making process. The process depends on certainty and time. We now see leaders preferring to wait as long as

possible to gather and analyze the maximum amount of information before they have to make a decision.[17] The wait for more information compresses the time the staff has for planning, and may result in a less than desirable execution phase of the mission. A mission can fail because one waits until that last bit of information comes in and the process exceeds the planning time-line. The execution phase is then not accomplished.

The command and control decision-making process can be described as:

- Sense the situation
- Consider and decide what to do about it
- Execute the decision or issue instructions for its execution
- Continue to sense the situation. Start again.[18]

Typically, there are many simultaneous situations occurring that a commander has to track. The commander must monitor the present situation and adjust the plan as needed. Concurrently, he must begin planning for any future operations to complete the mission. Human thought embeds itself in each part of the decision cycle. The control cycle interwoven into the decision cycle is an iterative process of monitoring the system outputs, comparing actual results with the desired results, and any appropriate adjustments to procedures and resource allocations to accomplish the mission.

Commanders have a need for critical information to make an informed and good decision. The failure of a commander's command and control process will often lead to a bad command decision. An example of such a failure was the Charge of the Light Brigade under Lord Cardigan on 25 October 1854, at Balaclava. The cause of the brigade's defeat was due to the subordinate leaders not having the correct situational awareness and having their execution orders misphrased and misunderstood. It is thought by some strategic level commanders the "essential characteristics of C^4 are the right information, at the right time, at the right place, with free and open information flow. In addition, the integrated strategic system must be reliable, survivable, jamproof and secure, with automatic entry and generation of information."[19]

These mentioned characteristics are deemed essential ones. However, there does not seem to be full agreement with these premises. It might become too difficult to ensure that free and open information flow will not make our systems susceptible to information corruption. Automatic entry and generation of information are indeed desired characteristics, but validity of data and information becomes a problem. How does one ensure automatically generated data is proper and quality data? The

amount of nodes that would have access to a strategic system would have to have some checks and balances to possess all these desired characteristics. Another pressing consideration at the strategic level is that a commander's decision has a political dimension. Along these same lines, there is a need to consult with allies and coordinate with other forces not directly in the command. The bottom line is that commanders need C^4 systems that cross regional boundaries.

When considering what a C^4 system can do for a commander, we must evaluate with carefully selected means. The JFC must select techniques to answer the following questions:

- "What are we trying to accomplish?
- What are the criteria for determining our success or failure?
- How will we know when the system is complete?
- How can we determine if the effort was worth the cost?"[20]

A decision support aid can help answer these questions by giving commanders and staff a better understanding, richer insights, and a more extensive assessment and synthesis of data. The decision support aid should also provide a projection and prediction capability. A projection and prediction capability would use a data base composed of a table of parameters. The parameters would be dependent on the particular scenario being investigated and would specify rates of particular resources that

concern the commander. Combat simulations would provide the parameters. Analysis of actual combat engagements would improve the values of the parameters. Using these parameters will allow modeling of measurable levels of the force over time, terrain, and projected combat, to predict the future condition of the force. This projection and prediction capability may identify undesirable time, distance, and force relationships that might not be intuitively obvious to the commander. The trends can be from both enemy and friendly actions. Doing so will tend to project the commander's situational awareness into the future. The Army has precedents for establishing the specific criteria wanted by the commander by using commander's situation briefings, his Prioritized Intelligence Requirements (PIR), and his Critical Information Requirements (CIR).[21]

Technology Support for Development of Decision Support Aids for Command and Control

"The most successful commanders will be those who possess a few basic traits: courage, intellect, and a cultivated sense of intuition"[22]

What are the technologies that lend themselves to solving the problems associated with an automated command and control system? Artificial intelligence (AI) is one of the technologies that seem to have some inherent means to assist the commander in his decision-making and in applications for decision support systems. What is AI? AI is that part of computer science that seeks to develop machines and/or programs that exhibit the characteristics we associate with intelligence in human behavior. It is the application of knowledge, thought, and learning to computer systems to aid humans.[23] The various applications of AI that would fit the design of a decision support aid, would be expert or knowledge-based systems, neural networks, and heuristics. "The highest future payoff area for AI technology probably lies in integrating information from a variety of sources and in providing high level interpretation and advising capability."[24]

Expert systems investigate methods and techniques for constructing man-machine systems by applying specific expertise. Consistent, reliable, decisions are the result of these expert

rules of thumb. The expertise comprises knowledge about a situation as it exists, an understanding of the problem and the skill to solve the problem. Knowledge-based systems are basically the same as expert systems. There are three major components that form the system. The situation data base represents all relevant background information and the goal. The knowledge database contains the expertise of the system. The control system determines how to best apply the knowledge base of productions to the situation database.[25] Figure 2 sketches out the major components of the expert or knowledge-base system.

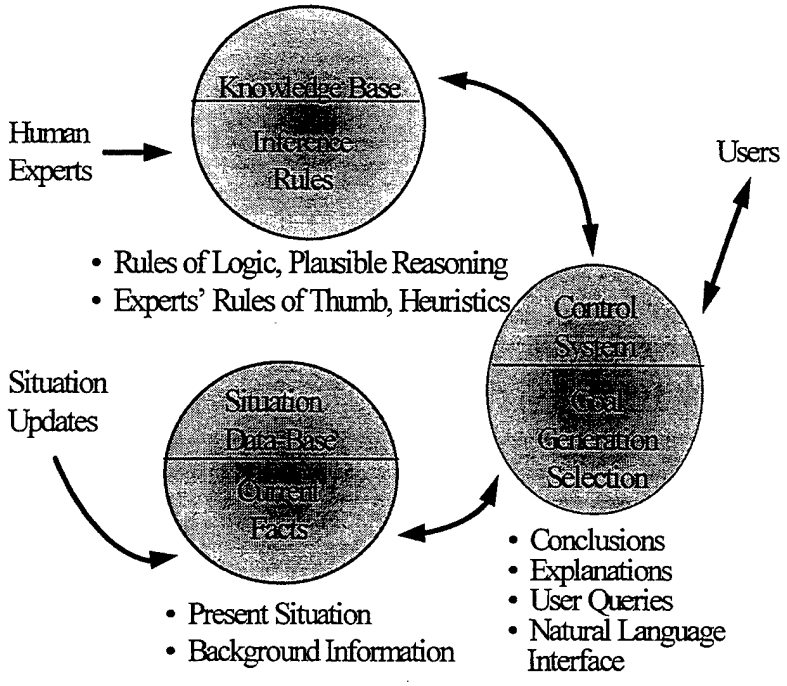

Figure 2: Components of a Knowledge-Base System

By the year 2020, knowledge-based systems will be able to handle more broad and general, knowledge representations. The systems will model time more richly and perform inferences under real-time constraints. Problem solving, distributed across multiple processes, processors, and physical sites, will be performed.[26]

Heuristics is another area of AI application that has potential use in supporting a decision support aid. A heuristic search application could contribute to efficient problem solving. "Heuristics is the expression of the experience and intuition the analyst applies to his craft. It relates to the dynamic operable human dimension of the system."[27]

The hardware systems being developed for the military communications systems will use digitization for data transfer. Digitization will reduce uncertainty on the battlefield. Digitization will mean that we can get a timely flow of increased volume of data. The increased flow of data has the potential to reduce the uncertainty related to both the friendly and enemy situations. If the data is correct, the results will be better information and more time for the commander to make critical decisions. The commander must determine how to utilize the extra time. If the commander exhibits divergent thinking traits, he/she probably will use the extra available time for his/her

use. If the commander is a convergent thinker, then he/she will probably make a quicker decision and afford the extra time for planning and execution. Quality information will get to the commander if the system uses digitized data.

A decision support aid will be able to provide various levels of support. Three levels of support are:

- information retrieval
- computations, comparisons, and projections
- models and simulations

It's most basic level of support would be access to facts or information retrieval. This level of support enhances the addition of data or information filters. The filters and pattern recognition abilities for data retrieval could help build profiles for the user that depend on the actual scenario and the user's personal requirements. A developed data search agent can then search through multiple networks and databases for relevant information or critical information wanted by the commander. Another level of support would add computational facilities to permit asking for simple computations, comparisons, and projections. The last level would involve giving useful models to the commander. It is important to remember that the decision support aid must provide answers commanders can use for command and control, regardless of the level of support.

The decision support aid can be a component of an automated system. Computer networking, program design, proper file management, and information gates achieve automatic revision of the decision support aid. A flagging system effectively alerts the commander and staff. The automated decision support aid can simply manage data or assist in decision-making. In order to provide wanted information for the decision maker, a decision support aid should provide:

- a single possibility display (done automatically for worst or best case)
- a prompt when a promising action alternative has been overlooked
- a simple display of data sources and the hypothesis they support
- an alert when sources of data are in conflict
- a method to wargame alternative courses of action

"Displays which represent information in accordance with a user's own internal representations and/or leadership traits are important in determining required information. The displays should be more readily utilized, understood more quickly and accurately, and should provide a more effective context for eliciting on-the-spot user knowledge."[28]

Because the capability exists to get a common picture of the battlefield, commanders must maintain a thorough understanding of the operational and strategic goals. JFCs will have to visualize

how the tactical goals compliment or detract from the strategic goals. How well the JFC understands the situation, will determine his ability to plan, react, and make good decisions. A decision support aid must provide a full and accurate situation display to be effective. All levels of command should share a common picture. The common picture will provide situational awareness. Offensive and defensive actions of Command and Control Warfare (C^2W) will protect the system. Information protection ensures countermeasures are in place, and information and the C^4 major components remain undisturbed. Intrusion or attack detection and offensive actions to eliminate threats are other methods used to ensure the C^4 systems are not vulnerable to attack or infection.

Multi-media and distributed computing technologies can serve as a base for our decision support systems. The trend will be to develop hybrid systems composed of different technologies including, among others, distributed systems, expert systems, and neural networks, in conjunction with traditional, mature, technologies. The popular technology of the internet and the world wide web should also provide interesting results. Multi-media technology will allow one to use sound and visual cues to inform and provide the user with appropriate decision-making

information. This strategy will result in a reduction in time and effort to perform tasks, a reduction of risk, and a more optimal utilization of resources.[29]

A decision support aid will not be a decision-making system. Instead, its use is to determine when to make decisions. Its goal will be to display information that contributes to the decision-making process and provides a means of tracking information pertinent to the decision at hand. Successful military decision-making requires decision cycles that are shorter than the enemy's decision cycles. The decision maker must be able to plan and manipulate many concepts at one time and do so intuitively. The JFC will rely heavily on any well-developed intuitive decision-making skills to plan and manipulate many concepts. The JFC acquires these skills by knowledge of his operating environment, coupled with his experience. A decision support aid will likewise have to acquire knowledge of this same operating environment. Future systems will learn from situations and be able to suggest how to perform a process more efficiently.

Designs for Automated Support in Development of a Decision Support Aid

"Command centers still risk inundation with data that cannot be sorted, screened, and displayed as useful information to commanders. This remains a major challenge for technology."[30]

To deal with the expected information overload, commanders must request specific information or expect that sufficiently trained staffs will filter information, and gather it to find the defined information objectives. Finding the specific data results in translating it into a usable bit of knowledge. There must be an information prioritization methodology for a DSS to operate. The priority must key on the JFC's critical information needs because of the influx of information available. This found and useful information is separated and kept from being ignored or discarded. Completion of the data "mining" task uses techniques of AI to perform prioritization. . The requisite staff element then establishes a filter. Queuing by these filters provides the information requested by the commander, and given by his commander's critical information requirements (CCIR). The system flags the information so its priority ensures the commander's immediate attention.

There are some important informational and physical needs for the C^4 architecture to possess if the command and control

system is to be responsive to the JFC. The architecture must support the operation by providing data that is timely, accurate, sufficient, and understandable. The architecture must be fully interoperable with joint forces, combined forces, and civilian agencies or have work-arounds with their systems to make the command and control functions work. The architecture must provide comprehensive data to support decision-making and operational planning. Finally, it must be responsive to the commander's taskings and retaskings to meet his needs. Additionally, the physical needs of the architecture are also important. The system must be available when needed, and self-sustaining, if possible. It must be as mobile and adaptable as the force it supports, as well as being reliable and robust. Lastly, the system must provide support to, and be supported by, the combat service support spectrum.[31]

Even though the coalition achieved ultimate success, a documented result from Operation Desert Storm indicated that the intelligence system architecture lacked responsiveness and when received was not timely. One of the causes of this shortcoming was due to the fact that manual analysis of intelligence data occurred. This resulted in a lack of timely and needed information at the tactical level. Intelligence processing and

analysis leans toward using applications of AI techniques, in particular expert systems. Tools developed to navigate and find information intuitively from distributed data sources are high priority requirements.[32] The overall intelligence preparation of the battlespace (IPB) of the future could very well need automated support to meet the JFC's timelines. Tasking of sensors, processing sensor data, and disseminating the products are applications needing automated support. Navigation from networks to databases to identify information, analyze and resolve conflicts, and return the information to the requester would use "intelligent agent" technology. These "intelligent agents" would also be able to define and set triggers to track critical changes in the situation and bring them to the attention of critical users.[33]

Other possible uses of AI technologies in an automated decision support aid could be to locate and provide status of units and also performance of equipment. The GCCS now gives a roll-up of units, to include their status and location, and allows the command headquarters to track both enemy and friendly units in their area of responsibility. By installing small, low cost transponders in major items of equipment, and connecting these to on-board sensors, performance of equipment could be sent

in periodically. The logistics headquarters can then capture the data. Determining what the port capacity and throughput of personnel and supplies through a port would be a good example of applying a decision support aid. Tactical and operational simulations determine the requirements for the receiving units and their equipment. Among the items portrayed in the simulation are the numbers of required service support units needed to operate the port. If the port is not fully operational, then what-if planning can take place to determine what the JFC needs to do to get his forces quickly into a theater and build combat power. To resolve the problem of what a port can adequately support, the application of a combination of expert systems and neural networks is valid.

Of course, the best training value one would get from any command and control system would be to use the system in realistic, simulated conditions. It is desirable to have systems that can switch between real and exercise worlds. The GCCS system has stated to have this capability. The trick is to ensure that the real world and exercise world data bases are separate. Separation ensures that exercise data does not corrupt real world data.

Recommendations and Conclusions

"The future command and control support structure must provide an environment that enhances the capabilities of its users and optimizes information value."[34]

The man-machine interface will be the critical link in the C^4 architecture that eventually takes shape. The C^4 system will be reliant on human interface for initial input and final decision-making. The system will be in place to support and to help in the primary tasks of a commander's decision-making process. AI applications and simulations will allow commanders at the highest levels to practice their art of warfare. The winning of battles will depend on iterative and intuitive responses of humans to all available C^4 information. The physical and mental capabilities of the user are the limiting factors of system performance. The C^4 system will fail if the users cannot or will not use the system.[35]

Successful future JFCs will have more information access, so they must be able to sort out the important from the interesting. At the same time, leaders must guard against a desire to take personal control of every incident that occurs, or even worse to try to second guess every decision. "While decision support systems might present an unparalleled opportunity to eliminate risks, they could obscure a strategic leader's awareness of key

inputs to the decision-making process."[36] These key inputs could be that bit of information or data that intuitively the JFC needs to make a good decision. What if the decision-making of our senior leaders is flawed for some reason? Then we must rely on our critical resource of people. Properly trained and disciplined people will prevail in this type of situation. This resource will remain as important in the future as it is today.

What will we do if an automated C^4 system degrades or fails? If the planning cycle follows the proper sequence, then commanders at all levels will know the strategic and operational goals. They will have their mission and should understand the higher commander's intent. They will do as all great leaders in the past have done, that is, operate with mission type orders and re-establish communications. Our system of training military leaders must still maintain the values of intuition, risk-taking, and creative thinking.

The applications of artificial intelligence offer the potential for applications in decision support by providing interpretation aids, automatic analysis, or situation assessment. It is possible to have applications that would assimilate the latest data from sources such as sensors, intelligence reports, and human decision makers, so that they could provide plausible

hypotheses about the current situation to operators, staff planners, and decision makers. Recent work by the Defense Advanced Research Projects Agency (DARPA) has shown there is interest and feasibility in pursuing decision support aids to assist the strategic level commander.

This paper examined concepts and ideas concerning development of a decision support aid at the strategic level. The GCCS system is the system of the future for a JFC's command and control system. It appears that the design of GCCS is robust enough to incorporate the leading edge of technology. Flexibility is a strong benefit of GCCS, because it has not been locked into a rigid set of requirements, like most of our earlier command and control systems. The fact that GCCS will be allowed to explore and evolve into a system that provides benefits for the commander, is truly a great leap in the way we have been doing business. We must ensure that the GCCS will indeed provide decision support for the commander. Careful investigation of present tools and those tools to be found in the future will provide the edge needed to act and decide faster than our enemies. Application of some of the concepts and ideas presented in this paper should be investigated when development of future modules for GCCS occurs. The C^4IFTW concept will allow the GCCS

system to develop modules of decision support that should also produce decision aids for the commander.

If a decision support aid is successful, it should provide a means to synchronize activity and show when there is an opportunity to exercise initiative. It should also enable our forces to be more agile than the enemy by permitting our force to make decisions and act faster than he does. A command and control decision aid is crucial to future success. "It can give the JFC information that is relevant, essential, timely, and in a form that warriors can quickly understand and use."[37] The American public expects quick and decisive victories, a la Desert Storm. Our emerging information technology, specifically GCCS with modifications suggested herein, will give our senior leaders the tools to meet these expectations and be successful.

GLOSSARY

ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
C^2	Command and Control
C^2W	Command and Control Warfare
C^3	Command, Control, and Communications
C^4	Command, Control, Communications, and Computers
C^4I	Command, Control, Communications, Computers, and Intelligence
C^4IFTW	C^4I For The Warrior
CCIR	Commander's Critical Information Requirements
CIR	Critical Information Requirements
CJCS	Chairman of the Joint Chiefs of Staff
DISN	Defense Information Systems Network
DOD	Department of Defense
DSS	Decision Support System
GCCS	Global Command and Control System
GSORTS	Global Status of Resources and Training System
IPB	Intelligence Preparation of the Battlespace
JDISS	Joint Deployable Intelligence Support System
JFAST	Joint Flow and Analysis System for Transportation
JFC	Joint Force Commander

JMCIS	Joint Maritime Command Information System
NCA	National Command Authorities
NMCS	National Military Command System
OPLAN	Operation Plan
PIR	Prioritized Intelligence Requirements
RDA	Requirements Development and Analysis System
TARGET	Theater Analysis and Replanning Graphic Execution Toolkit
WWMCCS	Worldwide Military Command and Control System

ENDNOTES

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[2]Le'Ellen Kubow, LTCol, Command and Control in the 21st Century: A Construct of the Future (Carlisle Barracks, PA: US Army War College, 1995), 9.

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