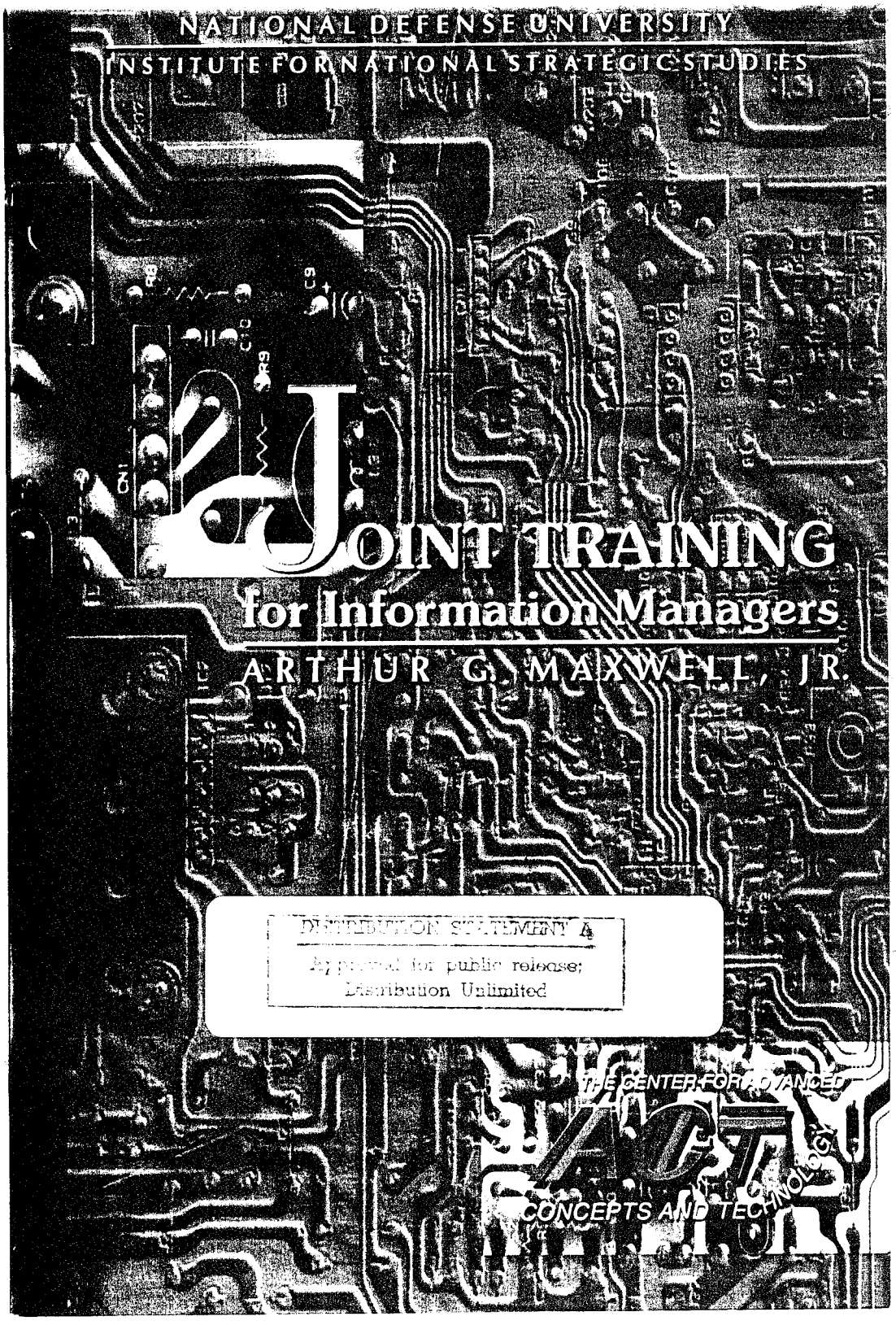
NATIONAL DEFENSE UNIVERSITY
INSTITUTE FOR NATIONAL STRATEGIC STUDIES
JOINT TRAINING
for Information Managers
ARTHUR G. MAXWELL, JR.
DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited
THE CENTER FOR ADVANCED
CONCEPTS AND TECHNOLOGY

Directorate of Advanced Concepts, Technologies, and Information Strategies (ACTIS)

The Directorate of Advanced Concepts, Technologies, and Information Strategies (ACTIS), at the Institute for National Strategic Studies of the National Defense University, focuses on the future composition and employment of instruments of national power by Departments, Agencies, and organizations that comprise the national security establishment. ACTIS is responsible for developing an understanding of the mission challenges that the United States will face and the technological capabilities that will be available to meet these challenges. ACTIS consists of the Center for Advanced Concepts and Technology (ACT) and the School for Information Warfare and Strategy.

Center for Advanced Concepts and Technology (ACT)

ACT identifies and develops approaches to critical operational problems of command and control. The Center pursues a broad program of basic research in command and control theory, doctrine, and use of emerging technology. It also develops new concepts for command and control in joint, combined, and coalition operations other than war. Additionally, the Center promotes the study of command and control at all service schools. To complement research, the Center provides a clearinghouse and archive for command and control research, publishes books and monographs, and sponsors workshops and symposia.

Joint Training for Information Managers

Joint Training for Information Managers

Arthur G. Maxwell, Jr.

Directorate of Advanced Concepts,
Technologies, and Information Strategies
Institute for National Strategic Studies

National Defense University
Fort Lesley J. McNair, Washington, D.C.

NATIONAL DEFENSE UNIVERSITY
• *President:* Lieutenant General Ervin J. Rokke, USAF
• *Vice President:* Ambassador William G. Walker
INSTITUTE FOR NATIONAL STRATEGIC STUDIES
• *Director:* Dr. Hans A. Binnendijk
DIRECTORATE OF ADVANCED CONCEPTS, TECHNOLOGIES, AND INFORMATION STRATEGIES (ACTIS)
• *Director:* Dr. David S. Alberts
CENTER FOR ADVANCED CONCEPTS AND TECHNOLOGY
• *Director:* Captain William H. Round, USN
• Fort Lesley J. McNair, Washington, DC 20319-6000
• Phone: (202) 685-3837 • Facsimile: (202) 685-3664

Library of Congress Cataloging-in-Publication Data

Maxwell, Arthur G., 1951-
Joint training for information managers / Arthur G. Maxwell, Jr.
p. cm.
"The Center for Advanced Concepts and Technology, Directorate of Advanced Concepts, Technologies, and Information Strategies, Institute for National Strategic Studies."
Includes bibliographical references.
1. United States—Armed forces—Communication systems. 2. Information resources management—Study and teaching—United States. 3. United States—Armed Forces—Officers—Training of. 4. Unified operations (Military science) I. National Defense University. Center for Advanced Concepts and Technology. II. Title.
UA943.M38 1996
358'.24'0973—dc20 96-20975
CIP

First Printing, May 1996

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP
Washington, DC 20402-9328 · Phone (202) 512-1800

CONTENTS

FOREWORD

The military communications and computer community continues at an accelerating rate to outpace the warfighting support infrastructure. That infrastructure includes training, doctrine, and education. Given the rate at which new technology is being introduced, it is no wonder that the usual military way of doing business is now unable to keep up. It will take more than simple improvements in outdated processes to maintain pace with the rate of introduction of new technology. Innovative ideas and new approaches will be essential as the services re-engineer the processes.

This book proposes new ideas about joint training for information managers over Command, Control, Communications, Computers and Intelligence (C^4I) tactical and strategic levels. It suggests a substantially new way to approach the training of future communicators, grounding its argument in the realities of the fast-moving C^4I technology. Furthermore, it is also clearly a "purple-suit" approach to this challenging issue.

The Directorate of Advanced Concepts, Technologies, and Information Strategies (ACTIS) feels that publishing this work will help incubate additional thinking in the C^4I community with respect to training and education for the next decade. Although ACTIS may not necessarily endorse every one of the book's specific recommendations, it applauds the author's efforts to break away from the rigidity of old paradigms and offer new ideas for improving joint training.

DAVID S. ALBERTS
Director, ACTIS

PREFACE

In the past decade, communications technology expanded its capacity, speed, and quality more than in any previous decade. Advances in computer automation and access to worldwide communication systems have created a wonderland for commanders and managers in which they are able to talk—virtually instantaneously—across the globe. Communications technological advances produce more sophisticated networks while new products thrust communications capabilities forward at an accelerating pace.

The "C^4" community is hard at work incorporating the flood of new technology into systems and networks to serve the changing needs of strategic, tactical, and support organizations throughout the armed services. One positive note: training service members to operate the equipment—even today's very sophisticated equipment—though difficult, has proven to be accomplishable. Although technological advances in just the past five years have taxed the training base to keep pace, the services seem to have maintained this pace especially for training their enlisted members. All services are doing a creditable job with this "hands-on" level.

What we are *not* doing well, however, is training officers to manage and integrate these systems. For example, the United States Army still maintains (for all practical purposes) two signal corps—the tactical and the strategic. At Fort Gordon, the home of the U.S. Army Signal Corps, junior officers learn how to implement and deploy tactical communications systems. They devote an extensive amount of time specifically to studying the deployment of nodal communication systems, including TRI-TAC and the new Mobile Subscriber Equipment (MSE). All of this equipment is used to communicate at the Corps level and below. The basic curriculum at Fort Gordon emphasizes the technical capabilities, tactical employment, and methods of systems configuration of this new equipment. Yet the only course offered on the management of strategic communications' equipment is an

Echelons-Above-Corps (EAC) elective provided to those officers destined to go to an EAC assignment. Fort Gordon also offers an Information Systems Staff Officer or Network Management Course; however, the focus of the subject matter is communications at the tactical level. In other words only a few officers receive training in these broader applications of communication technologies.

The common theme at the "Signal Center" is that you're not a "real" communicator unless you are tactical. This prejudice is perpetuated at Gordon and held as a truism by virtually every junior officer and even some senior officers in the Signal Corps. Yet we in the Corps are the information managers of the Army, with the common mission of providing communication and information management support to commanders at every echelon. To provide that management, one would assume that communications officers follow carefully developed career paths, blending their experiences with increasingly more sophisticated education. Actually, almost the reverse is true. There are no restrictions on an officer's assignment. Any officer can draw a myriad of tactical and strategic assignments throughout his or her career. This shotgun effect is particularly critical as junior officers begin their time in the military. To enter the tactical environment, with a relatively strong foundation in technology at the tactical level enables the young lieutenant to perform well on the whole. However, to then transition lieutenants and captains to the strategic world of more diverse and complex systems without the benefit of more sophisticated education seriously limits their ability to successfully execute their mission. This problem is not unique to the Army. All four services have integration problems between the tactical side of the mission and the strategic. This in fact is one of the challenges of the leadership for the next several years—the integration of communications support across tactical and strategic levels encompassing the entire battlefield.

Amid the ever expanding availability of information at every level of the chain of command, the communicator faces the responsibility of managing networks that are capable of rapidly

providing valuable data to commanders. General Colin Powell, speaking as Chairman of the Joint Chiefs of Staff, has told us, "At the height of the Persian Gulf conflict, the automated message processing network passed nearly two million packets of information per day through gateways in the Southwest Asian Theater of operations. Efficient management of information increased the pace of combat operations, improved the decision-making process, and synchronized various combat capabilities. The technology developed to support these networks proved to be a vital margin that saved lives and helped achieve victory." General Powell's remarks reveal the vast scope of modern operational information management. Surely the importance of preparing our junior leaders to meet the challenges of that duty is obvious.

Commanders at every level of the expanded battlefield evaluate information from many sources and they interact with numerous components to wage war effectively. We now face a battlefield that we call "seamless," because the enemy is no longer solely to our front, nor can we be content to plan against his immediate actions. Instead, we must look at events three to four days in advance, while keeping ever vigilant to our flanks and rear. Such complex planning necessitates a well-trained information manager capable of providing the commander with the communication systems that support rather than hinder the war fighting effort.

As General Powell concluded, "information is the life blood of an organization and effective communications can support the war fighter as a combat multiplier." But to own this technological capability in information management without training those who must manage the system makes little sense. Logic suggests that we actively pursue a dynamic, innovative training program to keep our managers ahead of the power curve—capable of leading the men and women who actually operate the equipment.

The necessity for this training becomes even more apparent as we look at the interoperability issues facing all the armed services who now participate jointly in conflicts with foreign aggressors or in peace building/keeping operations with allies.

The need to pass information—both tactical and strategic—efficiently in joint operations is paramount. My intention is not to argue for total consolidation of communication capabilities because one cannot ignore the fact that each service has its own unique requirements to communicate. However, with the advent of interoperability requirements, we can no longer delay our efforts to establish and manage information networks that share common data in support of the successful accomplishment of the mission. The technological fixes are available. An appropriate effort to train information managers to employ the available technology would provide the commander a seamless battlefield with every warfighting "tool of the trade" at his disposal.

Certainly, the shrinking defense budget, our reduced force strength and the ever fluid world situation all affect this transformation to a greater reliance on information sharing. So we must maintain our technological advantage, something we may not be able to do without improving our training base. Capital investment has provided the equipment to accommodate this transformation. A major effort toward the education of system managers is necessary to produce the force multiplier of new capabilities necessary to achieve victory over defeat. A total educational system that allows the communicator to implement the entire communications network—from the tactical level to the strategic—is essential.

To understand why the training of managers has become so important, we first need to understand the advances in technology that have taken place in the communications field, to include communications support and computer capabilities. We'll evaluate the impact of this technology in terms of added capabilities for the war fighter and discuss the current training doctrine of each service for preparing managers to implement these diverse communication networks. Next we'll examine the requirement of each of the services for both tactical and strategic operations. Then we'll consider the ever present variable of resource constraints. Among the constraints are service rivalries, budgetary short comings, extensive time requirements for training

and the cost of developing facilities required to accomplish the training.

I realize I am proposing a major undertaking, but the task before us approaches the monumental—so the scale of the remedy is necessarily large. The stakes are likewise high: the difference between rapid low-casualty victory and extended costly engagement, or perhaps between victory at all and inconclusive stalemate. I will offer a strategy to implement a coordinated training program for the services with an outline of a curriculum that could be used to ensure the most effective use in today's information management networks.

THE BEGINNINGS OF C^4

"Ours is the Information Age. Just as previous ages were named after the technology that dominated their civilization, so ours is designated as it is because of the central role played by information in the way we live and do business."[1] It is useful to understand the accelerating dynamics of the communications age. By understanding the accelerating dynamics of the information age and the military's role in communications development one appreciates the need to improve the services' communications educational system. The military has long been a leader in the developing communications technology, and military communications specialists have pioneered innovative means for command and control. Furthermore, military communications technicians have often set standards for improvement and implemented innovative communication technologies. The individual services have developed communications along different lines, and they have somewhat different policies and approaches toward Command, Control, Communications, and Computers (C^4). However, through it all, you can see the dedication to the mission and the absolute commitment to ensure that the "message gets through."

Sails, Flags and Couriers

The Navy has been a leader in the development of communication and computer technologies since its earliest days. The first American fleet—made up of privateers—used standard operating procedures (SOP) to communicate.[2] In essence, the captains operated independently with little regard to talking with anyone else. The SOP was a common language that the ships could use if they needed to talk among themselves. On January 5, 1776, the Naval Committee of the Continental Congress issued *Orders and Directions to the Commander in Chief of the Fleet of the United Colonies* to devise a means for communicating within

the fleet and enhancing their fighting capability.

The new system manipulated sails, pendants, flags, and lanterns for communications between ships.[3] The signals were based upon an SOP defining the specific meaning of each medium.

Generals Washington and Lafayette recognized communications as an essential aspect of the colonies' battle plan. They used a system of mounted couriers to speed communications between Army and Navy forces to assist in the war effort.[4]

In 1797 Captain Thomas Truxtun, USN, issued the first American naval signal book. It contained 10 numerical pennants that combined different colored flags. More than 290 signals could be transmitted between ships, but a major problem with this advancement was distribution. However, the Navy had difficulty getting the manual to every ship. The fact that not every delivered copy of the manual was identical, lead to obvious communication problems.[5]

The United States Army ventured into the communications field in 1856 when an Army doctor, Albert James Myer, proposed the creation of a professionally-trained organization to provide signal support to the commander.[6] Since that time, the Signal Corps has employed and helped develop technological advances ranging from visual communications to wire, wireless radios, pigeons, aerial observation, photography, meteorology, radar, TV, and encryption.[7] Certainly, the Army used various communication systems prior to 1856—flags, streamers, lights, and trumpets, for example—however, Myer was the first in the Army to suggest a specific branch within the service. His interest in signal communications developed while he worked on his dissertation "A New Sign Language for Deaf Mutes" in 1851. When Dr. Myer discussed his system of sign writing with people in the military, he discovered that other individuals, in particular a Lieutenant Stoddard in the Department of the Navy, were also at work on similar signalling systems. Encouraged by the news of other professionals working in the area, Myer wrote to the Secretary of War, Jefferson Davis, about the possibility of

military signals based upon the models he had developed for the deaf.[8]

Although Davis was not interested, his successor, John Floyd, requested that Myer submit his scheme to a board for consideration. Eventually, in March 1859, Myer presented his ideas to a technical evaluation board, headed by Lieutenant Colonel Robert E. Lee. Partial success followed as the board requested tests on this new technology. The system was tested during the 1860 Navajo Expedition, by utilizing flags during the day time and lamps at night to transmit signals between organizations.[9] Myers expected to train every Army officer—much like the Navy—in the use of these flags. However, he was also convinced that this task was too monumental and that a core of professional communicators was necessary to properly implement this new technology. His experiments were the beginning of the U.S. Army Signal Corps.[10] Throughout the Civil War, Myer and his band of communicators perfected the use of signalling flags (wig wag), balloons, and the telegraph.[11]

Telegraph

The development of the telegraph was an advance unmatched in communications history. Samuel Morse's telegraph system was revolutionary in the way people reacted to it and in the way it changed the manner in which we performed our daily tasks.[12] Although this technology was not developed by the military, both services recognized the importance of the technology and exploited its capabilities during the Civil War.

Once the Navy replaced the sail with a propeller as the primary means of propulsion, the manner in which the Navy communicated became increasingly complex, with the telegraph providing a method to keep in contact with the fleet. Because the signal books could no longer keep up with the speed at which new ships steamed, codes and a semaphore dictionary were soon developed to pass messages between ships. This new system

allowed captains to spell out their messages rather than relying on predetermined meanings, as was the case with the flags developed earlier. The semaphore system remained in effect throughout the Civil War and long after. The Navy used the wig wag system of signalling so extensively that every officer had to become proficient in using it. The Navy, also adopted Morse Code for signalling between ships by use of lights. The Army and Navy used Morse Code over ground telegraph wire systems.[13]

Prior to the development of the telegraph, the commander had been tied to the battlefield—directly observing the conflict. Telegraph systems freed commanders from having to directly observe the battle and allowed them greater mobility. He could now position his staff away from the immediate battle, where detailed planning could be accomplished, without the heat of battle distracting them. The obvious problem with this advance was the creation of uncertainty and misunderstanding as news of the conflict was passed over the wires by observers who might not understand what they were seeing. As a result, the telegraph was rarely used for tactical employment in battle but rather as a means of strategically controlling the battle from a far.[14]

After the war, the advances continued as the desire for up-to-date, accurate information continued to grow. Specific contributions by the Army's Signal Corps included development of a battery telegraph, the national weather service, the construction and maintenance of over 4,000 miles of telegraph lines that connected the country, and the development of field phones for use in the tactical environment.[15]

Wire

Wire communications carried Morse Code across the continent—tying the west to the east. The telegraph itself had first been used during the Mexican War of 1846. Prior to the war's outbreak there were roughly 130 miles of wire in the

country. Newspapers—frustrated with the slowness of news from the theater—demanded a faster means of communications. This spurred the development of wire communications and the use of the telegraph for the country.[16]

As time passed, the Army Signal Corps cooperated with civilian companies to improve wire capabilities and terminal equipment, leading to multiple transmissions over a single line. The Army could not keep pace with the increasing demands on the communications network; therefore, Western Union and American Telegraph and Telephone (AT&T) aided in the expansion of telecommunication networks across the globe.[17]

Radio

Military interest in wireless long distance communications began in the summer of 1899 following successful radio tests by the British Royal Navy. The Navy began its own testing of the radio following an Italian inventor's, Guglielmo Marconi, experimentation. By December, the Navy decided that wireless communications had future applications, despite static interference problems. Marconi's system was not immediately adopted because of cost and the Navy's desire not to be tied to one particular radio system.

The Navy led the way in wireless development, including waging necessary patent battles, to protect the national interest.[18] Marconi's inventions consisted of "methods" for transmitting and receiving signals and the use of antennas. Since there were various ways of employing this technology, many competitors improved upon his crude machine. The courts found that the improvements were legal as long as a competitor did not infringe on Marconi's or anyone else's specific equipment patents. Most of the competition and tests took place aboard U.S. Naval vessels. Thus, the Navy was instrumental in the development of the radio.[19]

Due to the efforts of the Chief of the Bureau of Equipment,

twelve radio sets from six vendors were ready for testing late in 1902. The first operational uses of this technology came in 1903 when the Atlantic Fleet used the radio to pass strategic communications between ships and the shore.[20]

However, the new technology did not meet with approval from all quarters of the Navy. Many officers resented the intrusion the radio represented in their authority to command. They saw the radio, much like the telegraph, as a medium that could bring orders to the ship from the next higher command, thereby usurping the captain's authority. Therefore they tended to use the radio to pass strategic rather than tactical information.[21]

The radio did provide the United States an opportunity to become actively involved in imperialism. President Theodore Roosevelt used the radio to employ one of the most powerful Navies in the world to carry out his "big stick" policy.[22]

Before World War I, the Army's use of the radio had been limited to Morse Code. During the war, Army engineers experimented extensively with the radio, following up on work started by the U.S. Navy. Working with the Allies, the Signal Corps replaced old technology with radiotelegraph equipment that used vacuum tubes, again developed by the Navy, to transmit information across the battlefield. Within six months of U.S. Army involvement, factories were producing standardized, replaceable tubes for military radios. The Signal Corps began a research program that explored the possibility of radio-telephone communications. By 1918, despite problems with this innovation, the Signal Corps had produced two types of radio-telephones that were used on the battlefield in France.[23] The Army did not use the radio extensively in the tactical theater. Much like the Navy, the Army used the radio to connect the battlefield commander to higher echelons of command. The most significant use of the wireless by the Army was in the communications between the ground and the Army's new "flying machine".[24]

Aircraft

The Army had joined with the Navy in 1898 to investigate the usefulness of Professor Samuel Pierpont Langley's heavier-than-air flying machine. Chief Signal Officer, Brigadier General Adolphus W. Greely provided Langley with a grant for research. Although the Langley project was not a success, it advanced interest in these flying machines, and history was forever changed.

In 1907 bids were accepted for a flying machine that could reach speeds of 40 miles per hour and travel a distance of 125 miles. On February 10, 1908 the Army entered an agreement with Wilbur and Orville Wright for a machine meeting these specifications. The Signal Corps intended to use these machines as aerial observation platforms much like the balloons of the Civil War. These faster platforms would provide the commander instantaneous information on the disposition of friendly and enemy forces.

Pilots began carrying weapons in the planes, initially as protection as they flew, but this soon gave way to offensive applications. Thus began the military's movement to the sky and the eventual establishment of the U.S. Air Force in 1947.[25]

Meteorology, Photography, and Pigeons

During the development of these new technologies many other forms of communications aided the commander on the battlefield. The Navy continued to use homing pigeons to transmit messages back to home bases until 1942. Pigeons, used as couriers, had few equals on the battlefield: 95% of their missions were successful. The pigeon was a secure source of communications and could travel over vast expanses of water, but the amount of information a pigeon could carry was of course very small.[26]

During World War I, General Pershing, recognizing the importance of a visual history of the battle, directed the Signal

Corps to provide combat photography not only for its historical value but also for the intelligence benefits it represented.[27] This request built upon the first use of combat photography by General Myer, who hired a photographer to record actions on the battlefields of the Civil War.[28] The Army Signal Corps also began providing valuable meteorological information for the commander's planning estimate. Unfortunately, between World War I and World War II, the Corps, like all activities in the military, underwent what we now euphemistically term "downsizing," but the communicators remained alert to new and developing technologies.

Radar

In May 1937, the Signal Corps patented and built the Army's first radar, which successfully detected the Japanese aircraft on the morning of December 7, 1941. This radar technology later was used for target acquisition by antiaircraft artillery at Anzio, Italy in 1944.[29] Additionally, the Naval Research Laboratory magnified the improvements of wireless communications with the development of sonar and radar. The requirement to identify forces at great distances and extreme depths, and then transmit that data to friendly forces, stimulated the Navy's demand to stay at the forefront of the electronic field with improved design. The Navy set the standard for the sonar industry.[30] Simultaneously developed in the 1930s and 1940s was the frequency modulated (FM) radio. The developer, Dr. Edwin Armstrong, also helped the Signal Corps to introduce push button tuning. This technology led to clearer communications that was portable and flexible as well.[31]

Space

The military, benefitting from the developments of the civilian market, ventured into space in the 1940s. In 1946, the Signal

Corps participated in Project Diana, which bounced a signal off the moon, thus proving that space communications were feasible. Tropospheric communications—using the troposphere to bounce signals across the globe—were perfected.

The Signal Corps participated in the launch of the Vanguard I and II satellites.[32] However, the first practical use of communication technology in space was made by AT&T with the successful launch of Telstar. All three services saw the usefulness of this technology and quickly became involved in the exploitation of space communications.[33]

Progress also followed in more reliable and much more flexible forms of tactical communication assets. In the Korean War, these improvements were crucial to the employment of forces across the entire peninsula.[34]

Eventually the advent of new and more effective weapon systems, to include conventional and nuclear weapons, mandated a requirement for more effective and efficient command and control systems. In the forty years following the Korean War these systems have continually improved. Communications through space born platforms have led to this improvement. Areas such as mobility, flexibility, self-containment, and increased capacity now assure the commander access to all elements of the battlefield.[35] The nature of these developments thrust the military's information managers into constant contact with civilian counterparts. This contact stimulated ideas and the growth of military applications of these civilian ideas. And, civilian industry adopted ideas from the military.[36]

Computers

In the late 1940s the military developed the Semi-Automated Ground Environment system for air defense. This system was a precursor for American Air Lines' first computerized reservation system—SemiAutomated Business Research Environment (SABRE)—the contemporary standard for that technology.[37]

The advancement of computer technology quickly progressed as the potential of this medium became understood. Probably the most significant advancement for computers was the development of a network that enabled individual computer users to communicate between themselves on their computers. The system was developed by J.C.R. Licklider—an engineer—at the Defense Advanced Research Products Agency (DARPA). DARPA is a group of government engineers and scientists working with civil industry on specific defense technologies. By definition these individuals have an understanding of advanced technologies and the necessity for advancements in information sharing. The information system—the Advanced Research Projects Agency Network (ARPANET)—provided the engineers at DARPA a means to communicate with each other without having to travel great distances. It also fostered a sense of congeniality and cooperativeness between different groups working on the same issues. The computer based network was not as universal as the telephone system, but it did provide the opportunity for the engineers to share large volumes of data on very complex issues.[38]

The Rand Corporation in conjunction with the Air Force developed packet switching in 1964. Packet switching allows transfers of large amounts of data through an information network. As the title indicates—packets of information are bundled, sorted and transmitted via different paths to a distant location where the data is reassembled and presented to the addressee. Unfortunately, the Air Force failed to exploit the innovation, so networking of computers within the DoD was delayed for several years. This technology, once incorporated in the ARPANET frame work, became the basis for that particular system. The ability to transfer data between locations was the precursor to today's electronic mail (E-mail) systems.[39]

E-Mail, or communication networks that utilize computers, continues expansive growth today. In the 1970's DARPA developed a system (Internet) that ties various computer networks

together into one large network. Thus the government can now speak to industry (R&D) and educational institutions via E-mail.[40]

Another spin-off from the ARPANET is the Worldwide Military Command and Control System Intercommunications Network (WIN). This highly visible command and control system provides a decision-making aid to the commander in the planning of operations. The network links the commanders of the unified and specified commands with the National Command Authority for instantaneous transfer of information critical to the conduct of an operation.[41]

Modernization

The future of C^4 is unbounded. As we have seen, the advancements of all forms of communications have spurred more demand and innovation. In today's environment one probably cannot envision a world without the use of computers in global communications. And modernization continues with the military developing sophisticated applications of commercial technologies. The Army is converting to digital communications with the implementation of the Mobile Subscriber Equipment (MSE). This suite of equipment provides increased command and control capabilities to the commander across the entire battlefield, allowing virtually instantaneous access to digital communications, no matter where on the battlefield a commander finds himself. This system provides secure capacity without interruption to maneuver. MSE gives the battlefield commander more options of terminal equipment. These include: facsimile, personal computer interface, radiotelephone access to stationary and mobile subscribers as well as standard telephone usage. Thus, the battlefield commander now has total access to information, much like today's travelling business executive.[42]

Another technological advance spurred on by increasing demands from the warriors is the Single Channel Ground Airborne Radio System (SINCGARS). This new generation of

combat net radio will provide the commander a secure data and voice communication capability free from jamming and electromagnetic interference. This capability is an-order-of magnitude advancement from the current single channel frequency modulated (FM) radios. This technology provides the infantryman, down at the squad level, the capability of using his squad FM radio with little regard to interference from the enemy. Despite the limited capacity of the small net radios, they are likely to remain the primary means of communicating in the tactical environment down to the squad level as a direct result of this new technology.[43] Finally, the Army is actively involved with the Air Force and Navy in the development of the Joint Tactical Information Distribution System (JTIDS). This new computer/communications hardware is a jam-resistant navigation and identification system for use in combat. It provides more effective identification of enemy targets, for their eventual destruction, while enhancing command and control of friendly platforms.[44]

As you can see, the continual improvements in technology seem to never end. Through all these advancements, the military has been a leader in technological development for much of the past 150 years. The military has often set the standards for industry as well as exploiting the advances of civilian technology to ensure constant communications. The key for today's military leaders is to remain at the forefront of technological advancement and maintain a viable educational system to exploit all of the new technologies that are being developed. The question remains: is our educational system set up to deal with the changes in technology and keep our leaders at the head of the class in C^4?

TRAINING THE INFORMATION MANAGER

The Armed Services have developed diverse communications and computer systems, but the pace of today's developments has increased. The new technologies, improved applications, and the pace of development make education of the officer corps vital to the future success of our Armed Services. Unfortunately, not enough thought has been given to education when justifying a new computer or communications system. The technology guru will typically say that education is secondary to the technological advantage provided by the hardware and software. However, without education, new technology is of limited use. New systems could fail the mission if the people responsible for using them do not obtain the proper training.[45] While speaking to a 1987 Command and Control Symposium at the National Defense University, General Robert T. Herres of the U.S. Air Force put it thus:

> "I believe the most rudimentary form of education for military professionals should have a healthy, but not necessarily overpowering, dose of coverage of the C^2 process. Our professional military education programs do not address this field in any significant depth and a major obstacle to progress was the virtual absence of educational course material dealing with this subject. In effect we are trying to nurture a new and vital professional field of endeavor without a well recognized set of fundamentals or basic principles."

The services have followed different paths of formal training for professionals in the information community. Three of the four services provide entry and mid-level training to their communications and computer specialist. All services provide advanced- or graduate-level training opportunities to their most successful and ambitious officers. One common thread; however, is the *separation of communications training from computer training*. These two disciplines, though recognized by all as intertwined, are taught by different cadre with different goals for

each program. In two services these fields are separated so that the communications expert will not necessarily become an expert in the computer field. The following is a description of the various programs.

Army

The first signal training began at the conclusion of the Civil War at Fort Whipple near Washington, D.C. This training was for the new techniques developed by Dr. Albert J. Myer. (Fort Whipple was later renamed Fort Myer in honor of the founder of the Signal Corps.[46]) In 1917 training was moved to various military installations and with civil industry across the United States. Training at these institutions focused on the technical skills necessary to perform the radio, telegraphy, and other emerging missions. Fort Gordon, Georgia was designated the Signal Corps Training Center in 1948, with Fort Monmouth, New Jersey retaining some responsibility for the communications education of officers until 1974 when Fort Gordon officially became the home of the Signal Corps.[47]

Today Fort Gordon conducts all the basic education for signal corps officers in the technical aspects of their Military Occupational Specialty (MOS). The officers come from a variety of educational backgrounds, though the Corps attempts to obtain college graduates from the computer and mathematical fields. The Signal Corps sponsors the Professor-of-Military Science slot at six universities across the United States that are especially strong in the science, information, and computer fields—one method to assure that qualified and competent technicians enter the communications field. New officers attend the Signal Officers Basic Course. There they are trained in the Army doctrine of AirLand Battle, communications planning, automation, computer science, electronics, communications security accounting, signal systems tactics, and leadership. The half-year course provides new lieutenants a basic understanding of tactical communications

and the underlying military philosophies.

After three-to-five years in the field at any number of varied assignments, the officers return to Gordon for the Signal Officer Advanced Course (SOAC). During this 20-week course, they are again exposed to AirLand Battle doctrine, but the bulk of the course is devoted to insuring that senior first lieutenants and captains are well-grounded in tactical communications technology. The curriculum includes communications systems planning, digital and analog engineering operations, communications interfaces, electronic warfare, and more leadership training. Again, as in the basic course, the SOAC is geared primarily toward tactical communications.

Both courses produce what the Army calls a "25C" or signal operations communicator. There are three other specialties or functional areas (FA) that can be awarded to a signal officer between the 4- and 8-year mark in a career. These functional area communicators receive detailed and comprehensive training in a specialty, most often at the graduate level, to become a technical expert in the field. These specialties are:

- 25B communications-electronics automation specialist
- 25D electronics engineer
- 25E information systems and networking specialist

All three of these MOS are technical in nature where as the 25C is most readily recognized as the combat communicator. The 25B and 25D primarily receive their training from the Air Force Institute of Technology at Wright-Patterson Air Force Base, Ohio, while the 25E is trained at a 20-week course at Ft. Gordon. The 25B and 25D specialty MOS can be awarded as a result of graduate work at an accredited graduate program.

Fort Gordon also trains communicators with special requirements needed in the field at specific assignments. The

ATACS/TRITAC Management Course is a 3-week temporary duty class that teaches a basic course graduate—with an assignment to a TRITAC unit—the capabilities and characteristics of the TRITAC system. The course identifies the tasks necessary to direct installation, operation, maintenance and system trouble shooting of the TRITAC system to include various switching systems, line of sight radio systems and management facilities.

The Joint Tactical Communications Systems Management Course is another 3-week course offered to active duty Army, Navy, Air Force, and Marine commissioned officers who have prior computer and tactical communications experience, and are graduates of the SOAC or equivalent service schools. The officer also has to either be serving in or have a follow-on assignment to a TRITAC Network. The instruction centers on the characteristics, capabilities, limitations, and applications of tactical automated switching systems; joint communications architecture; network planning; and data base management.

The only technical course offered to officers regarding strategic communications is the 3-week Director of Information Management (DOIM) Operations course. This class is given to military and civilians serving or selected to serve as the Director of Information Management at a post, camp, or station. The primary thrust of this course is to provide the DOIM with an understanding of the five functional areas of the Information Mission Area—the term used by the Army to denote information services provided the post commander. These areas are: telecommunications, computers, records management, printing and publications, and visual information. It is a misnomer to say that this course focuses on strategic communications. Strategic topics *are* covered but the thrust of the course is providing communications to the post commander, not providing strategic communications to the national command authority.

Training communications specialists in the Signal Corps includes work in the automation (computer) arena; however, true automation specialists of the Army are a different group of

functional area officers.

In the case of the automation specialist, the functional area is known as a Systems Automation Officer (FA 53). This functional area provides officers of *all* branches in the Army the opportunity to serve in positions requiring technical competence in the fields of systems automation management (FA 53A), systems automation engineering (FA 53B), and systems automation acquisition (FA 53C). These officers manage computer systems and provide automation policy, technical expertise and advice to all levels of the chain of command. They also manage the development of software and the integration of software, hardware, and data communications services. This work includes the planning, programming, and budgeting for automation systems supporting functional users, commanders, and staffs.

As with the other functional areas mentioned earlier, this area designation occurs between the 4th and 8th year of an officer's careers. Officers can then expect to serve in the FA after training and alternate assignments between their primary branch and the FA on each subsequent assignment. Signal officers can attend these functional area courses and at times do; however, the preponderance of these courses are filled with branch officers other than the Signal Corps.

Navy

The Navy's system of training their communicators and computer specialists is quite different, but possibly the best operationally of the four services. The Navy first thought that communications training was necessary back in the 1800s when Admiral Farragut ordered all officers to receive training in the wig wag system.[48] Then in 1899 the first order of business for the implementation of the new radio equipment was to instruct officers and sailors alike in the use of the equipment. This instruction, including a course in electricity (for Naval officers)

was provided at Newport, Rhode Island.[49]

Today the Navy maintains that the first responsibility of the unrestricted line officer is to be proficient in his or her primary specialty—that is, the operation of the ship. Therefore, there isn't any formal training for entry-level personnel in communications. Upon arrival aboard a ship, officers assume certain additional duties, one of which could be that of communications officer. Such officers attend special schools to train on the transmission devices of the ship. Thus, communications gear associated with weapon systems is made familiar to all personnel associated with firing the weapons. After officers are fully qualified as unrestricted line officers, they can then branch out into other fields for more indepth (and in the case of communications this represents graduate-level training) schooling and training for future assignments.

In this regard Navy communicators are better qualified to support the customer because they are the customer. From a technical perspective this communicator/computer operator is not as well trained; but, he or she does have a much better understanding of the needs of the war fighter.

Marine Corps

As one might expect, the Marine Corps begins its training of professional communicators in the field. All officers, regardless of military specialty, begin in the infantry. In this aspect, the lieutenant becomes a Marine first and then transitions to his or her specialty.

In the case of the communicator, the Marine Corps looks for personnel that have experience in a hard science, although, as with the Army, this is not a mandatory requirement. The second lieutenant attends an 18-week Basic Officer Course at Quantico, Virginia, where the curriculum is a tactical—grass roots—course, teaching the officer the basics in communications at the platoon level. The emphasis is on providing the young officer a

framework by which he can go to an operational assignment and provide effective C^4 to the commander.

After at least one assignment in the field, the Marine communicator returns to Quantico for the Command and Control Systems Course (CCSC). This course provides professional military education at the career level with an emphasis on command and control systems. Successful completion of the 41-week course will allow the officer to effectively perform his mission in a Marine Air-Ground Task Force, with a joint or combined staff.

The Marines already have a leg up on the other services as far as communicating between ground-air-sea components, which is, after all, the primary benefit of having a Marine Corps—a service that can provide rapid projection of all three elements of power. CCSC focuses on this marriage and expounds upon it by looking at the structure of the Department of Defense and studying the communications requirements to operate in a joint environment. In war game exercises, the student is exposed to the myriad of communications requirements at the joint task force level and the planning necessary to provide command and control to the commander. In this aspect the Marine Corps is ahead of the other services in recognizing and implementing a curriculum that at least deals with joint communications.

The Automated Data Processors are another career field entirely. These officers have a computer background and are used as the programmers for the Marine Corps. There is a 13-week basic course that teaches mainframe computing, microcomputer operations, both hardware and software, and the implementation of both wide and local area networks (WANs and LANs). It should be noted that the communicators do receive some data methods instruction from the automation data processing cadre; however, this subcourse is more of a familiarization. Any significant engineering of WANs or LANs must go to the ADP specialist.

Air Force

The Air Force begins the training of their communicator and computer career fields by first looking for college graduates with Computer Science, Software Engineer, Physics, Electrical Engineer, Information Science, Math, or Physical Science backgrounds. These lieutenants travel to Keesler Air Force Base, Mississippi to attend an 18-week Basic Officer course. All the officers go through a core section teaching the basics of the military. Then the course is broken into four "finger" courses that emphasize specific career fields:

- Basic Communicator
- Electrical Engineering
- Software Engineering
- Communications Computer Systems Analyst

The course length for each is different with different requirements for successful completion. For example, the Software Engineering course is a series of five 2-week courses provided at the Air Force Institute of Technology. The officer must pass all phases of this course before he or she is allowed to engineer a system—their primary job. This is mandated even though the officer will have a background in computer language from college.

One can see that the Air Force begins their communicators and computer experts off on the same foot and basically in the same school. But, as with the other branches, this soon changes as the lieutenant travels to the finger course. That is not to say that there isn't better coordination between the two career fields—there is. The point must be made however that the fields do split.

Between the 8- and 13-year mark all these officers return to Keesler for the Advanced Course. Unfortunately, this course is now 10-weeks long, reduced from seven months as a result of

budget reductions. The Advanced Course is now a general course that focuses on military leadership issues and updates the officer on the new communications and computer technologies in the field. Officers are also encouraged to enroll in extension and correspondence courses to keep them current in their field. Participation is not mandatory and these courses cannot begin to make up for the valuable time lost at the training installation learning not only from professionals but also sharing ideas among contemporaries.

Upon promotion to major, an Air Force officer's specialty changes to Communication/Computer Specialist. They receive assignments to major commands, the Air Force staff, or a joint staff to serve as experts in either field regardless of previous background. This can obviously lead to some shortfalls in planning capabilities and performance for the Air Force.

The Air University also offers a class called "Executive Forum for Communicator/Computer Systems" for senior level communicators. The 10-day class provides up-to-date information on emerging technology and a corporate perspective on C^4 to colonels and GM 15s. The class does maintain a few seats open to the other services, but the preponderance of the students are Air Force.

Alternative Schooling

There are several other institutions within DoD that provide advanced and graduate level training to military and civilians alike, among them: the Naval Postgraduate School in Monterey, California and the Air Force Institute of Technology at Wright Patterson Air Force Base. Both offer graduate and advanced courses in computer operations and technology.

Several other institutions provide opportunities in advanced work in various information management subjects, mostly for civilians. The Information Resources Management College, (IRMC) at Fort McNair, Washing-ton, D.C. provides an

Advanced Management Program to senior information systems managers for decision making and problem solving. IRMC also teaches numerous courses on information planning, engineering, security strategies, and corporate information management.

The Defense Systems Automation Center (DSAC) in Columbus, Ohio is a part of the Defense Logistics Agency (DLA) and provides DLA telecommunications/computer specialist training in different computer languages and information engineering. This training is given to DLA mid-level professionals.

The Army Management Engineering College (AMEC) located in Rock Island, Illinois, part of the Army Material Command and the Defense Acquisition University, provides different courses in information management for predominately mid-level DoD civilians. The focus for the school is software engineering.

Finally, the Navy does have an advanced institution for their information management specialist. The Naval Computer and Telecommunications Stations are a component of the Naval Computer and Telecommunications Command. Nine schools are located across the United States and provide training for those personnel that need special work on specific software applications. This training is provided on an as needed basis and not as a part of a professional development program. The schools also provide training in security accreditation and provide consulting services in the information systems area.

TRIMMING THE FAT

As the military moves from a world of global strategy to one of regional focus, it may face more difficulties abroad than ever before, especially with the rise of religious radicals and new nationalism springing forth from the states that made up the Soviet Union. Still the argument can be made that because we in America have the best military in the world, we therefore can work with reductions in manpower and operating budgets.

The Congress recognized long before the fall of the Soviet Union a requirement to place additional controls on the military to combat inefficiencies in our system. By passing the Goldwater-Nichols Act, Congress streamlined many functions and consolidated assets. Certainly, the Chairman of the Joint Chiefs of Staff was provided more authority, and the Service Chiefs were put in charge of equipping, manning, and training the force.

The fact that consolidation of assets is shrinking the Department of Defense does not remove the requirement for a strong, viable, and robust means of defense. By definition, this requirement means the ability to communicate from the fox hole to the National Command Authority if the situation dictates. In fact, the requirement for strong technical solutions with the impending reductions of 25% or more makes the exploitation of technology even more important. The military's most recent "exercise" in the deserts of Iraq and Kuwait demonstrates the importance of sophisticated communications—for the leader that has a clear view of the battlefield can then transmit his combat intent to subordinates, thus assuring victory. We have certainly seen the opposite of this phenomenon as recently as the 1980's. Communications deficiencies that were experienced in Grenada and Panama demonstrate the problems of inadequate communications support for the commander. Although both of these operations were successful, they would have been more so if the communications had been adequate at every moment. The key to any successful communications service provided to the commander is that the information is on time and in an usable

form so that the communications capability is a combat multiplier and not a combat inhibitor.

We have already seen the importance that communications has played in the history of our military. However, with and the ever present specter of budget reductions C^4 experts must be more prepared and better educated than ever before. Recently the Office of the Secretary of Defense has issued several Defense Management Report Decisions (DMRD) that will address the issues of consolidation and more efficient management of the department for the next five years.

DMRD #918

A clear vision of communications needs and a sustained, coordinated effort to develop and deploy the necessary communications/computer systems are fundamental to an effective, flexible policy that supports commanders in various battlefield contingencies. DMRD #918's intent is to consolidate the infrastructure of defense information systems. DoD spends over $15 billion a year and employees roughly 369,500 military (active and reserve component) and civilian personnel on communications and computer information transfer across the department. Yet, the department still has problems exchanging, protecting, and combining critical information between and among command and control systems. The high cost of operations, and the technical problems associated with DoD components led to this DMRD.

According to the DMRD, "The information structure supporting the defense mission must provide an end-to-end information support capability encompassing collection, generation, storage, display, and dissemination of information Department wide." The implementation of this system must also be transparent to the user, improve reliability, and provide service at a lower cost. This decision was meant to expand upon the approach of the Joint Staff's "C^4I for the Warrior" concept that

spurs a warrior to perform any mission, any time, any place, at a reasonable cost. Naturally, the communicator is an integral part of this equation. Information support must be responsive, secure, and reliable. The intent is to provide the commander with a command, control, communication, computer, and intelligence system—upon arrival to the battlefield—that is effective and in sync with the other elements of the battle.

In addition to the problems of communications support for the commanders-in-chief in Grenada and Panama, alluded to earlier, other issues as well caused the formulation of this DMRD. Specifically, there are:

- over 1,700 separate data processing installations in DoD
- over 38 major software design activities
- over 650,000 work stations

Most of these systems and installations were established as support for the services or agencies and not for the war fighters. As can be expected, these facilities are labor intensive and have difficulty sharing data between one another. Additionally, the design centers often produce applications that are duplicated or lack interoperability.

The implementation of DMRD #918 would have placed the responsibility of overall management of the communications infrastructure on the Defense Information Systems Agency (DISA). The agency would have been responsible for information security protection, information technology standards, network management, operations of all communications assets above the installation level, and monitoring of installation-level information mission area operations. The DMRD intended to capitalize all computer and communication assets at the installation level, with software development activities and maintenance of computer assets under DISA. Information technology design, engineering and acquisition are centralized

under DISA and an executive agent will be established by DISA to handle information technology education for civilians.

It is also important to examine what the report *did not* include. DMRD #918 excluded tactical command and control, tactical communications, weapon systems software, war gaming, and software support for command and control. Also excluded was the responsibility to train/educate the military in C^4. This particular mission was deemed the direct responsibility of the service chiefs. As you can see, the DMRD still maintains that the service chiefs are responsible for manning, equipping, and most importantly training the force.

Due to service pressure to maintain control of infrastructure assets, much of the DMRD was not adopted; however, it is appropriate that the findings of DMRD #918 be applied to the services in the more efficient operation of C^4I equipment.

To examine the problems with communications and computer implementation across the department, DoD formed several "Executive Level Task Force" groups to evaluate the problems of information sharing and develop possible alternatives for these problems. The six areas studied, and their notable findings follow.

- **acquisition project management**
  no central acquisition with little or no interaction between the services on acquisition strategies

- **data processing installation, central design activities, and base level computers**
  no common design of software application support among the services along with large computer facilities often within the same geographical location performing the same or similar data processing functions

- **standards, security, system engineering**
  no centralized standards for architecture, resulting in

DoD purchasing equipment that cannot operate with other equipment

- **communications**
  systems that have interoperability problems and networks that were being purchased and utilized at less than full capacity

- **resources**
  overhead in all four services performing the same missions along with appropriations for systems in each service without coordination among the services

- **professional development**
  lack of central direction for the education of military and civilian counterparts in the information field

The military has long been a proponent of professional development. Educating our junior leaders is the cornerstone for future development. The military can ill-afford to provide its leadership with less than the best possible training, and each service donates considerable time and expense to educate it's professionals. However, the services view training differently.

The professional development task force for DMRD #918 examined these differences and recommended changes to the programs.

They sought to improve individual and team performance, work towards a more professional, technical, and balanced work force, and finally to reduce the cost of services to the field. The weaknesses and findings, as identified in their published report of October 2, 1992, were:

- no common DoD patterns in information systems (IS) work force education, training, and career development practices for military or civilian personnel.

- no central policies, procedures, or organizational structure for IS (civilian) career development.
- DoD spends only approximately 1% of its civilian personnel dollars on training.
- need for consistency and fairness in terms of policies and actions between DMRD 918 centralized work force and the IS work force remaining in the DoD components.
- DoD needs to emphasize a business environment for delivery of training.
- no oversight of IS education or training.
- technical vitality of IS work force is critical to effectively deploy information systems to support warfighting missions.
- streamlining training overhead will reduce cost while implementing high tech training methods will increase cost.
- no central focus on IS SES management or succession planning.
- certification programs can increase professionalism and performance.
- trend is toward multi-disciplined professionals for cost and performance reasons.

As you can see, the primary focus of this study was the education of the civilian work force; however, these results fit across the board for both the military and civilian communities. The task force recognized the short falls in training practices for the military in their first finding. The issue is—the service chiefs are directly responsible for the training of the forces, and implementing any change advocated by this study could infringe on this responsibility. However, the reader cannot ignore the fact that the common theme through out this report was a lack of central direction in the education process. This paradigm is the issue that faces all of us in the military as we attempt to improve the basic training of our future leaders.

In establishing a new direction one must be careful not to attempt to over-centralize the process by dictating the specifics of what should be taught, at what time, and by what method. The key in developing any form of common-based training is to coordinate among all the services, ensure everyone understands the basic competencies required of military and civilian specialists, achieve some consensus on which competencies need to be taught, standardize lessons if appropriate, and allow maximum flexibility given the diverse mission requirements of the group.

But we must not allow ourselves to think that solutions to these problems will immediately turn the professional development program of the service information managers around. Solutions to these complex issues require a constant challenging of the paradigm to ensure that we maintain our technical advantage in a very dynamic field. Technological advances are occurring rapidly. DoD must add value to these technological improvements by developing an educational system that recognizes the dynamics of the field and works to stay ahead of the advances. The true test of success for today's leadership is the ability of those that follow to fight and win wars at the least risk, expense and loss of human life possible. The senior leadership of the military is responsible for training subordinates. To abdicate this responsibility with the thought that training/educational will take care of itself is criminal. A concentrated effort by all services must take place to correctly identify the competencies necessary for our information managers to effectively operate in the 21st Century.

LIGHT AT THE END OF THE FIBER

Unfortunately, education and training are among the first items to be cut once management faces budgetary constraints. But it is imperative that our leaders resist this urge and focus on improving training versus solely reducing the cost of doing business.

Currently there aren't any formal civilian training programs standard within a particular service or across the services. It is logical to establish a formalized program for the education of our civilians. In fact, Defense Management Report Decision #918 addresses this issue and offers several appropriate solutions to the civilian training problem. But the potential short-coming is that the military may be left out of the formula for success by failing to provide the means for coordinating consistent joint communications and computer training at military officer schools. If ASD(C^3I) became the executive agent of training for both military and civilian, then the office would provide opportunity for cross fertilization. The military can benefit from the development of new methods of instruction while the civilians can gain from the experience of the service schools. We cannot afford to place military training on the back burner. If we do let the training of our officers decline, then DoD runs the risk of creating yet another educational system. The task of developing an overarching set of standards for information managers would best be left to a group of training development professionals from the four services—totally familiar with the requirements of the services and dedicated to the proposition that joint training is necessary.

Consolidation of resources is a popular concept in today's astringent world, but we must weigh the total cost, risk, and consequence of cutting training. Each service has its own unique school to train C^4 technicians. There is good reason for these divisions. Each service has different requirements for their communicators and computer operators. Although there are numerous similarities, we cannot forget that each service has a

different mission that requires different applications of command and control. Additionally, we cannot forget that the Goldwater-Nichols Act ensured that the training and equipping of the force remained with the service chiefs. This act can obviously be amended but I believe that would be counterproductive. Combining schools just for cost reduction's sake does not solve the problem. The result is a shift of responsibility and perhaps a loss of the unique aspects of the various schools.

The key for future instruction is to develop a set of base line competencies to be taught at *every* school. These competencies should not be taught as separate entities but rather as part of a whole. By teaching these competencies, the schools will be able to incorporate their own specific types of equipment as the vehicle for the training. The delicate part of training development is to correctly identify the competencies that need to be taught.

The following are the six basics that I believe need to be included in any training program.

Basic Communications

The first competency necessary for the foundation of an effective telecommunications manager is the basics of the telecommunications industry. Every C^4 professional must have an understanding of the fundamentals of telecommunications. This instruction should be more than just Ohm's Law. The range of education must encompass standard wire communications, radio, switching, video teleconference support, and the new fiber optic capabilities, along with any other new technologies as they are developed. The key is not to make the leader an expert on every type of system but rather to expose the officers to the various means of communications and how they operate separately and in concert with each other. This program should extend from basic officer courses to advanced courses for company grade officers. Additionally, the span of communications covered

should be from the basic handheld communicating device all the way to systems that support the National Command Authority. By covering this broad range of topics over these two courses, the communicator can begin to comprehend the enormity of the mission at hand.

Computers

The second absolutely essential competency to an effective manager is to understand computer operations. Many people use computers today and this block of instruction might be redundant for many of them. However, a level playing field must be provided. The instruction should shy away from discussion of specific software applications. These applications change from command-to-command and the rate of improvements among the applications is astronomical. More appropriate for this block of instruction would be the basic operations of a computer, how they are configured, and the various uses of the machines given the demands of the customer. This would be an excellent time to discuss any particular software that the students might use over the course of their classroom instruction. This basic instruction should be provided immediately upon entry to the basic course. During the advance course remedial work should be given to those that did not hone their skills during their first assignment. However, the thrust of the instruction on computers in the advance course curriculum should be focused on the particular applications in problem solving. In other words, the computer must become a problem solving tool for information managers.

Network Management

Failure to teach network management is the main weakness of our educational system. The Army trains separate network managers; the Navy doesn't train any; the Air Force exposes officers to some basics at the entry level but then fails to improve

upon this training; and the Marine Corps trains in this area but restricts the network management to tactical communications.

It was evident during the past three conflicts that the U.S. participated in—Grenada, Panama, Iraq—that all four services must operate together over the entire battlefield. Each service will be required to communicate from the tactical environment back to the National Command Authority. The fog of battle is becoming more dense. Unless we in the telecommunications field get serious about managing our myriad of networks, then the warfighter will not be able to use his telecommunications assets as a combat multiplier.

Today, the commander of a Joint Task Force must be able to communicate not only with Marine and Army ground forces, he also must be able to communicate with Air Force and Naval assets, as well as multinational forces supporting United Nations efforts to stabilize a region. We cannot assume that state-of-the-art systems will be operational. We must have trained professionals who can enable messages to traverse the entire network providing a commander with the capability to talk to all his forces. Without an understanding of network management and systems integration this mission cannot be completed by the communicator supporting the ground commander.

The civilian telecommunications industry is leading the way by incorporating an open systems approach to transfer information. This open system dictates that the managers of the network are familiar with the system and are able to modify the network when and where required. The focus of the entire advance course curriculum should be in this area. The senior company grade officer must understand the complexities of the network and be able to manage the network to allow the commander to communicate anytime, anywhere. Without this emphasis, the ability of the C^4 professional to utilize the technological advances of today will be greatly impeded and a commander's ability to lead, seize initiatives, or counter enemy efforts may flounder when communications lag at critical junctures.

Security

As with any dynamic network of communications, signal transmission security is an essential part of system operations. The network manager must be aware of the security implications of tying secure and non-secure networks together. Protocols for transfer of information must be understood, coordinated, and established by each information manager. The focus of this part of the program of instruction in both the basic and advance course should be on providing a familiarity of the issues regarding security. The intent should not be on making security managers—there are other courses that provide this level of detail.

This portion of the field of study is probably the most ill-defined of all the subjects. For several years there has been a need for communication platforms that have multi-level security devices as a part of the architecture. This advancement has not occurred to date—which makes the study of security implications of communications networks even more critical. Tomorrow's leaders must overcome the shortfalls of today's unsecured communications and again provide the commander a seamless, secure communications architecture across the battlefield.

Joint Operations

The success of joint forces on the battlefield requires interoperable communications. This military axiom is especially applicable to C^4, "You do well in war what you train well in peace time". Unless we begin joint training we are doomed to failure. We should start by teaching service doctrines as they pertain to telecommunications and computer operations in all service schools related to C^4. This is most critical in advanced courses. This instruction is critical to understanding how we operate during war. Without an appreciation of the complexities

of the other service's information dissemination issues we cannot expect to effectively work together.

Leadership

Too often the technical wizards of the telecommunications field leave leadership out of the C^4 equation. Enlisted and noncommissioned personnel do an outstanding job operating and maintaining the equipment. It is the responsibility of the officers to provide guidance and leadership that assures mission accomplishment. This competency must be taught at every level and in every forum possible. As leaders in the Signal Corps our business is to ensure that we provide a service to the commander. That service is the ability to talk to anyone on the battlefield. If we fail, we fail in our primary responsibility. Our job is not to develop elaborate communication schemes but rather to lead soldiers in providing communication support to the commander. We must set the example by developing logical common sense operations that are a combat multiplier for the war fighter.

How do we implement such a strategy given the diverse nature of the current training programs in the four services? As with what to teach, developing the method to carry off the program is not an easy proposition to sell. These recommendations strongly favor a more rigorous training program. For the Navy and the Air Force, this will represent a significant addition to an already crowded plate of training and operational assignments. The Marine Corps and the Army are currently performing most of these tasks—their challenge will be to incorporate new objectives.

The bottom line recommendation is that more emphasis must be placed in the training arena, with a focus on interoperability between the services.

Following is a methodology that might work:

- **Joint Training Development Council**

First, establish a council to include all service schools, ASD (C^3I), DISA and any other affected party to further analyze, design, develop, and evaluate training shortfalls and potential solutions. The council should establish specific competencies to be taught at C^4 training facilities, and establish standards to ensure all services are measuring up to the requirements of becoming a force multiplier for service and joint commanders. The council would not circumvent the established training doctrines of the services but would assist the services in establishing information manager training. Certainly, services would lose some autonomy, and there is a potential for abuse by the council and by the services. However, not to have this central direction will doom our future training efforts to repeat the mistakes of the past. We can ill afford duplication of efforts and failures to properly train the C^4 officer for joint operations.

- **Holistic Education**

Today, civilian universities employ holistic education, that is to say, presenting a curriculum as a whole program rather than a series of separate courses. This idea of holistic education or teaching a system is essential in the modern world. At the senior service schools and staff colleges, the military *is* working to present a holistic approach to education. Unfortunately, the military training developers design courses in our *entry level* training schools as individual courses—never really tying the information together or for that matter never even attempting to look at the whole. Typically, the military school teaches individual subjects and then tries to tie them together in some grand esoteric manner—never really making the connection in any meaningful manner. The U.S. Army Signal Center comes the closest to providing holistic training. Their curriculum is taught in small work groups focusing on the support required by the warfighter, however, the subjects are still taught in increments. In today's military it becomes incumbent upon the

instructor to make these connections and assist the student in his or her discovery of the overall scheme of things. This type of instruction will also lay the foundation for the network management competency that I have already discussed. Providing the entire picture will enable the student to begin to see a seamless battlefield.

- **Joint Exchange**

Vital to our future success is the exchange of officers at the service schools to share information regarding each service's unique C^4 needs. This cross fertilization of officers should take place at the advanced course level. These officers have had at least one assignment at the unit level and can provide some unique perspectives to their counterparts in the other services. The best way to learn another service's methods of communications is through talking with the professionals responsible for that mission. The Navy is at a disadvantage regarding this recommendation, since they do not have an advanced officers course; however, it would be appropriate for the Navy to send their officers to other service schools. The Army and Marine Corps already participate in this exchange. The Air Force could be easily added in, with other service officers attending the Air Force Advance Course on a TDY basis. I would also suggest that the Air Force expand their officer advanced course to accommodate the competencies talked about earlier, but this would obviously require a hard decision on funding. As for the Navy, I believe they are too ingrained in their particular method of training. Specifically, the Navy probably will not develop a special school for information managers. They will keep their method of sending officers off to specific schools on individual pieces of equipment. Unfortunately, this means the Naval mid-level planner will be at a disadvantage to his counterparts when developing the war plans for tomorrow.

- **Simulation**

As part of the officer advanced courses, a command-and-control battlefield simulation should be established incorporating all four services in a combat maneuver. This simulation should track an on-going operation with the appropriate problems associated with communicating from the forward edge of the battlefield—to the air—to the sea—and back to the decision makers at higher echelons. The simulation could also be exported to the field to give operational units an opportunity to exercise their command and control over the diverse systems they will encounter during an actual operation. This technology is certainly available today. It is a matter of placing resources to the problem and developing the software for implementation. Who develops the program? Certainly ASD (C^3I) should oversee the venture. An institution such as the Information Resources Management College (IRMC) at the National Defense University should be given the responsibility of developing the program with input from the experts—military and civilian—in the field. This would be a tactical simulation that ties the battlefield together with the strategic decision makers.

- **Field Grade Training**

There is currently little training for senior-level communicators. The Air Force attempts to expose senior leaders to technological advances, as does the Navy to a lesser degree, but the other two branches disregard this senior-level training. To fill this void, IRMC should develop a senior-level C^4I course that specifically discusses C^4 issues arising in the joint community. The course should not exceed more than two weeks, but should have enough detail to challenge these senior officers in the complexities of communicating between services. Again, the specifics of this course would best be left for the JTDC to decide. Without highly trained professionals, battlefield commanders will not be able to communicate.

- **Data Exchange**

Finally, I would establish a communications network among the schools. The network could foster a sharing of ideas and pass critical developments to the professionals in the field. The network would be more than the current E-Mail system for unclassified traffic. This network should be state of the art equipment with simultaneous transmission of data, voice, and video. This system could be used to train other professionals off-site and promote the interoperability of the services. Finally, the network could be configured to allow student management of the network in the systems integration phase of the program of instruction.

Communicators and automation specialists will be expected to provide global communications—to include transfer of massive amounts of data—in a joint or combined operation with all four services and our allies. This will require the ability to deploy worldwide and operate on a highly mobile battlefield. The architecture that we employ to accomplish this mission must be responsive, reliable, secure, and most importantly affordable.

To provide this capability will not be an easy assignment. The equipment must be mobile, interoperable, and customized for user needs—performing many diverse missions transparent to the customer—insuring commanders effective communications so they can successfully accomplish NCA goals. This is certainly an awesome task, but one that the information community is capable of performing. The technology is available or is in the process of being developed. The question remains—Are we educating our officers to manage this highly diversified and complex system?

The answer to that question is—"Not at this time". However, the educational system for the officer corps in all four services is alive and well. Each service obviously considers different priorities in their educational programs, but they do take the education of their officers very seriously.

So, is there light at the end of the fiber? Most definitely! The

technology is available to keep DoD at the forefront of information transfer; giving our country, and its military, the best communications and the greatest combat multiplier. The key is to train our leaders in the proper employment of this technology and exploit the vast amount of talent we have in the communications and computer fields.

No one agency or service can do this alone. A joint effort can capitalize on other ideas as we push the technology window. We also must properly address technological changes before the training is outdated. To train a leader on a specific type of equipment or software can become counterproductive given the speed at which technology advances. More appropriately, training developers must design programs that emphasize competencies that can be applied across any suite of equipment. The competencies must be based on open systems that operate with commercial off-the-shelf equipment. Finally, until we put our service biases aside, we are doomed to repeat the data sharing problems of the past. We do not have to forget our heritage or even the primary purpose of C^4I in our particular service. Nor do we have to think solely in terms of a "purple" organization. We can keep the service requirements at the forefront while educating communicators and leaders to operate with the other services and civilian telecommunications organizations.

It is time to put service differences aside and get on with the work at hand. The success of joint training for the information manager will be determined by those who truly believe that there is a time for change and that time is today.

SUMMARY

The education of information managers in the Armed Services has begun to lag behind technological advances. Although new black boxes are being developed for many applications, the managers who will soon be responsible for those new systems are still receiving dated basic instructional programs. Current training programs seem unaware of the complexities of today's battlefield, in which warriors must coordinate air, land, and sea battles while keeping abreast of the enemy's capabilities to his front, flanks, and rear. The task of providing effective command, control, communications, and computers to warriors is not made easier by the dated training programs maintained by the four Services. Even within each Service, the breadth of education is inadequate for the multitude of assignments that may face information managers.

To resolve these problems and establish a firm footing for information managers, I suggest the following seven-step course of action:

- Establish a joint training council to identify the C^4I issues that should be taught by Service schools.

- Develop the following six core competencies to be taught at *every* officer-training installation—
  - Basic Communications
  - Computers
  - Network Management
  - Security
  - Joint Operations
  - Leadership

- Change instructional teaching methods at the Service schools to a building-block-module approach.

- Establish an exchange program among Service schools to integrate officers of all Services in the classroom.

- Develop new battlefield simulations that focus on the command and control of operations.
- Develop a C^4I Field Officer Training Course.
- Establish a data network between institutions for exchange of ideas and new methods of communications.

NOTES

1. Irwin Lebow, *Morse's Legacy Changing the World through Communication,* ("n.p.", 1993), 1.

2. Linwood S. Howeth, *History of Communications-Electronics in the United States Navy*, (Washington, D.C.: U.S. Government Printing Office, 1963), 4.

3. Ibid. 5.

4. "Military Signal Communications," ed. Paul J. Scheips, vol. 1, *A.J. Myer and the Early Signal Corps*, (New York: Arno Press, 1980), 41-48.

5. Linwood S. Howeth, *History of Communications-Electronics in the United States Navy,* (Washington D.C.: U.S. Government Printing Office, 1963), 6-7.

6. Kathy R. Coker and Carol E. Stokes, *A Concise History of the U.S. Army Signal Corps* (Fort Gordon, Ga.: U.S. Army Signal Center, 91), 3.

7. "Military Signal Communications," ed. Paul J. Scheips, vol. 1, *A.J. Myer and the Early Signal Corps, 1828-1880* (New York: Arno Press, 1980), 1.

8. Kathy R. Coker and Carol E. Stokes, *A Concise History of the U.S. Army Signal Corps*, (Fort Gordon, Ga.: U.S. Army Signal Center, 91), 7-8.

9. "Military Signal Communications," ed. Paul J. Scheips, vol. 1, *A.J. Myer and the Early Signal Corps, 1828-1880* (New York: Arno Press, 1980), 2.

10. Linwood S. Howeth, *History of Communications-Electronics in the United States Navy*, (Washington, D.C.: U.S. Government Printing Office, 1963), 9.

11. Kathy R. Coker and Carol E. Stokes, *A Concise History of the U.S. Army Signal Corps*, (Fort Gordon, Ga.: U.S. Army Signal Center, 91), 9.

12. Irwin Lebow, *Morse's Legacy Changing the World through Communication*, ("n.p." 1993), 2.

13. Linwood S. Howeth, *History of Communications-Electronics in the United States Navy*, (Washington, D.C.: U.S. Government Printing Office, 1963), 8.

14. Irwin Lebow, *Morse's Legacy Changing the World through Communications*, ("n.p.", 1993), 19-21.

15. Kathy R. Coker and Carol E. Stokes, *A Concise History of the U.S. Army Signal Corps*, (Fort Gordon, Ga.: U.S. Army Signal Center, 1991), 12.

16. Irwin Lebow, *Morse's Legacy Changing the World through Communication*, ("n.p.", 1993), 16

17. Air Force Manual #100-33, *Army, Navy and Commercial Communications Systems*, (Washington, D.C.: U.S. Government Printing Office, 1960), 1.

18. Linwood S. Howeth, *History of Communications-Electronics in the United States Navy*, (Washington, D.C.: U.S. Government Printing Office, 1963), 9-11.

19. Irwin Lebow, *Morse's Legacy Changing the World through Communications*, ("n.p.", 1993), 6-8.

20. Air Force Manual #100-33, *Army, Navy and Commercial Communications Systems*, 1960, 33.

21. Linwood S. Howeth, *History of Communications-Electronics in the United States Navy*, (Washington, D.C.: U.S. Government Printing Office, 1963), 25-36.

22. Irwin Lebow, *Morse's Legacy Changing the World through Communications*, ("n.p.", 1993), 9-10.

23. Kathy R. Coker and Carol E. Stokes, *A Concise History of the U.S. Army Signal Corps*, (Fort Gordon, Ga.: U.S. Army Signal Center, 1991), 17-21.

24. Irwin Lebow, *Morse's Legacy Changing the World through Communications*, ("n.p.", 1993), 10-14.

25. Kathy R.Coker and Carol E. Stokes, *A Concise History of the U.S. Army Signal Corps*, (Fort Gordon, Ga.: U.S. Army Signal Center, 1991), 15-16.

26. A.M. Willcox, M.G. Slade and P.A. Ramsdale, *Command Control and Communications (C^3)*, (Oxford, England: Brassey's Defense Publishers, 1983), 402.

27. Kathy R. Coker and Carol E. Stokes, *A Concise History of the U.S. Army Signal Corps*, (Fort Gordon, Ga.: U.S. Army Signal Center, 1991), 20.

28. "Military Signal Communications," ed. Paul J. Scheips, vol. 1, *The Signal Corps*, (New York: Arno Press, 1980), 10-20.

29. Kathy R. Coker and Carol E. Stokes, *A Concise History of the U.S. Army Signal Corps*, (Fort Gordon, Ga.: U.S. Army Signal Center, 1991), 20-22.

30. Linwood S. Howeth, *History of Communication-Electronics in the United States Navy*, (Washington, D.C.: U.S. Government Printing Office, 1963), 402.

31. Kathy R. Coker and Carol E. Stokes, *A Concise History of the U.S. Army Signal Corps*, (Fort Gordon, Ga.: U.S. Army Signal Center, 1991), 20-22.

32. Kathy R. Coker and Carol E. Stokes, *The Concise History of the United States Signal Corps*, (Fort Gordon, Ga.: U.S. Army Signal Center, 1991), 23.

33. Irwin Lebow, *Morse's Legacy Changing the World through Communications*, ("n.p.", 1993), 48-52.

34. Kathy R. Coker and Carol E. Stokes, *A Concise History of the U.S. Army Signal Corps*, (Fort Gordon, Ga.: U.S. Army Signal Center, 1991), 23-24.

35. Ibid., 24-26.

36. "Military Signal Communications," ed. Paul J. Scheips, vol., 1, *The Signal Corps* (New York: Arno Press, 1980), 1.

37. LTC T.B. McDonald, *Management of Army Communications, Computer, and Electronic Systems Resources*, (Carlisle, Pa.: U.S. Army War College, 1976), 5-6.

38. Irwin Lebow, *Morse's Legacy Changing the World through Communications*, ("n.p.", 1993), 1-6.

39. Ibid., 8-10.

40. Ibid., 11-14.

41. Ibid., 15-16.

42. Kathy R. Coker and Carol E. Stokes, *A Concise History of the U.S. Signal Corps*, (Fort Gordon, Ga.: U.S. Army Signal Center, 1991), 26-32.

43. A.M. Willcox, M.G. Slade and P.A. Ramsdale, *Command, Control and Communications (C^3)*, (Oxford, England: Brassey's Defense Publishers, 1983), 44.

44. Kathy R. Coker and Carol E. Stokes, *A Concise History of the U.S. Army Signal Corps*, (Fort Gordon, Ga.: U.S. Army Signal Center, 1991), 32.

45. *Information Systems Management in Practice*, ed. Ralph H. Sprague Jr. and Barbara C. McNurlin, (New Jersey: Prentice-Hall, 1986), 444.

46. "Military Signal Communications," ed. Paul J. Scheips, vol.1,*The Signal Corps*, (New York: Arno Press, 1980), 7.

47. Kathy R. Coker and Carol E. Stokes, *A Concise History of the U.S. Army Signal Corps*, (Fort Gordon, Ga.: U.S. Army Signal Center, 91), 33-49.

48. Linwood S. Howeth, *History of Communications-Electronics in the United States Navy*, (Washington D.C.: U.S. Government Printing Office, 1963), 9.

49. Ibid., 12-15.

ABOUT THE AUTHOR

Colonel Arthur G. Maxwell, Jr., U.S. Army, is the Deputy Chief of Staff for Operations, U.S. Army Information Systems Command at Fort Huachuca, Arizona. Prior to his assignment to Fort Huachuca he attended the Industrial College of the Armed Forces where he researched and wrote this study.

Col. Maxwell is a career signal officer. He has attended many of the courses he writes about and was responsible for leadership instruction at both the Signal Officers Basic and Advanced Courses. He has served on the 7th Signal Command operations staff and as commander of the 1111th Signal Battalion.

Col. Maxwell has a B.S. from Presbyterian College and an M.S. from the Naval Postgraduate School. He is a graduate of the Industrial College of the Armed Forces and the Command and General Staff College.

*U.S. G.P.O.:1996-405-201:40007

JOINT TRAINING FOR INFORMATION MANAGERS

Text composed in Times Roman
Titles in Helvetica Bold

Cover design and art by ***Karina Braszo***

Book design and editing by ***Jonathan W. Pierce***