

1996

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Recommended Citation

Bodnar, John W. and Dengler, Rebecca (1996) "The Emergence of a Command Network," *Naval War College Review*: Vol. 49 : No. 4 , Article 8.
Available at: <https://digital-commons.usnwc.edu/nwc-review/vol49/iss4/8>

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The Emergence of a Command Network

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IN TODAY'S DYNAMIC WORLD, THE EFFECTIVENESS of any organization at every level depends on how well the individuals within it can cooperate. Whether an organization is as small as a platoon of individual Marines or as large as a joint military comprising separate armed services, coordinated action depends on the flow of information and commands among its parts. In turn, the effectiveness of any organizational structure responding to a rapidly changing environment depends directly on the ability of the members of the unit to communicate among themselves.

We suggest that in the much-discussed "Revolution in Military Affairs" huge changes in organizational doctrine are emerging, and specifically that among the most noteworthy features of the "RMA" is the military's ability to communicate on a global scale, for this ability offers an exceptional opportunity to enhance effectiveness.¹ Organizational structures, though still diagrammed as they were fifty years ago, actually operate very differently in the Information Age. In fact, procedures (or practices) and doctrine that were suitable in the past only for very small units can now be effective for an entire joint military.

The emerging military organization, which we term a "command network," has the strengths of both a network and a hierarchy. It has, in fact, often been used in such settings as infantry companies, shipboard departments, submarines—or even small, primitive societies. Recently, however, command networks have arisen in much larger organizations; one unexpected result has been that the responsibilities of their members and leaders have changed dramatically.

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Naval War College Review, Autumn 1996, Vol. XLIX, No. 4

We argue in this article that the biggest challenge posed by the growth of command networks—even at the national level—is that leadership and organizational doctrine must be redefined. To examine that challenge, we must ask, what *are* command networks? Why have they exploded in size in the last century? What have been their effects upon the concept of responsibility within organizations?

Informed Inaction or Uninformed Action?

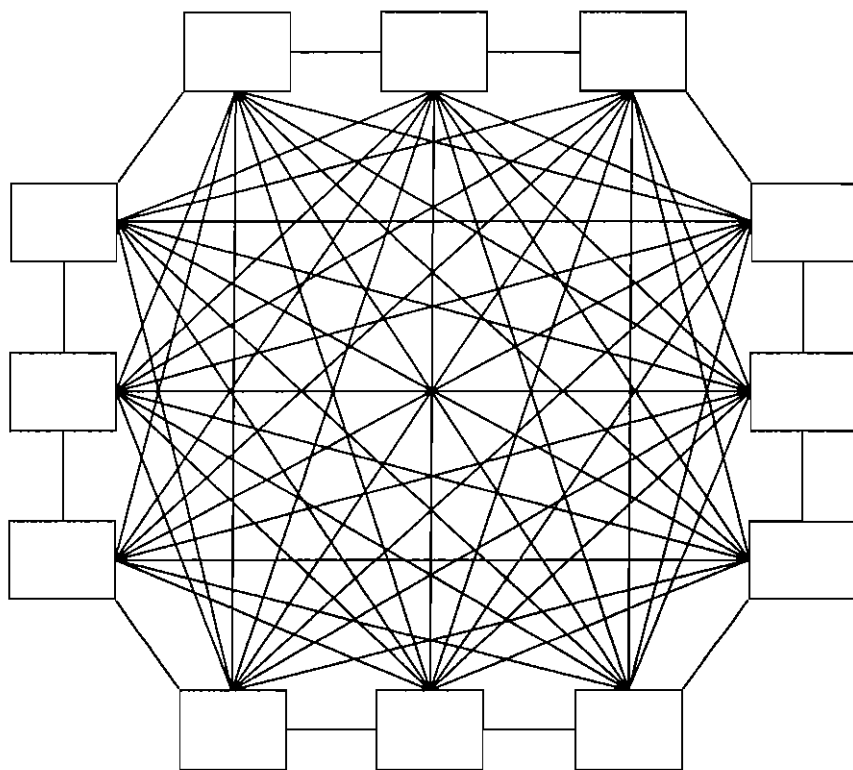
Organizational structures are based primarily on lines of communication. The strengths and weaknesses of any organization, therefore, depend on how data (observations about the environment), information (assessments of the meaning of data), commands (orders for action), and doctrine (rules for action) are passed within it. In the same way that chemists use theoretical substances, such as ideal gases and perfect crystals, to study the structure and dynamics of molecular organizations, we will use two theoretical units—a pure network (Figure 1) and a pure hierarchy (Figure 2)—to study the structure and function of military organizations.

In a pure network, all the individuals are equal and autonomous, and all possible lines of communications can be used. With no leader, all organizational decisions—if indeed any can be made—are reached by consensus, and any individual can interact directly with any other in the network. On the other hand, in a pure hierarchy there are strictly defined lines of communication, “the chain of command”: data and information go up the chain, commands and doctrine come back down. Of course, “pure” networks or hierarchies do not actually exist; real networks—like communes, car pools, and the Internet—have hierarchical components, and real hierarchies, even as rigid as Nazi Germany or Hussein’s Iraq, have elements of a network in them. Nevertheless, our theoretical organization types allow us to examine the strengths and weaknesses of each.

A network provides for *rapid and extensive communication emphasizing assessment*. In a network, no individual is (or can be) more than one communication “step” from any source of information. New data collected by any individual in the network are accessible to all, and all network members can become directly involved in the assessment of any data the network receives—again, through a single communication step. In fact, each must independently consider all the data to determine his own proper course of action. In contrast (as seen in Figure 2), nodes of a hierarchy have access to information only indirectly and through defined channels; communications in a hierarchy are likely to be slow, because of the presence of intermediaries, and assessment may be less reliable, because information is filtered at each step.

A hierarchy provides for *long-distance communication* in a large organization *emphasizing command and doctrine*. Each individual has a line of communication, defined but mostly indirect, to every other member of the hierarchy. New data can be routed to commanders or to “action officers,” who assess them and direct the organizational response; in this way all parts of the organization are coordinated with respect to that response, even if they were too distant to have been sent the initial data. A hierarchy can act in a coordinated manner beyond direct-communication distance because components need to be able to communicate with their immediate superiors rather than with all other counterpart

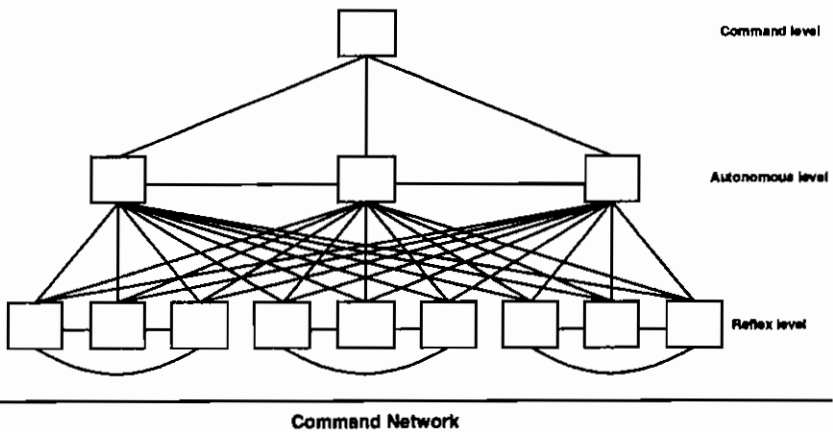
Figure 1



Network

components. Additionally, in the temporary absence of communication within a hierarchy, individuals can “store” commands in the form of doctrine and act thereby even when cut off from the rest of the organization. The price, however,

Figure 3



Organizations with essential characteristics of command networks have arisen in many times and places—societies, military units, manufacturing enterprises, commercial firms, even municipal bodies. We will offer a simple example—a single task in a complex mission—of how the strengths of a network and those of a hierarchy are integrated in a command network.

In our illustration, the organization is the battle-stations team of a submarine; the task is to set the correct search depth for a Mark 48 torpedo. In a submarine-versus-submarine scenario, the commanding officer (CO) takes a station in the control room, where such task leaders as the Fire Control Coordinator (FCC), Weapons Control Coordinator (WCC), and the Engineering Officer of the Watch report to him. The WCC, in turn, has the weapons control team and torpedo room reporting to him. When the ship closes to attack, the CO orders, “Make tube one ready in all respects for a submarine contact”; the WCC passes that order to the fire control team and torpedo room, who a few minutes later, having accomplished the task, report back, “Tube one is ready in all respects.” This procedure dates back to World War II, when torpedoes ran straight until they hit something. Today, a Mark 48 torpedo can be given up to forty separate settings (e.g., search speed, ping interval, search pattern, and search depth), but this organization—a command network—causes all forty to be set properly each time with only the single order.

The strength of this command network is its efficient dissemination of information and *silent* assessment of a tactical situation. Long before General Quarters is set, the Weapons Officer and fire control technicians sit down with

technical manuals, sound-velocity profiles, and weather data for the operating area and recommend torpedo settings for as many attack scenarios as they can envision. The Weapons Officer obtains the CO's approval of these contingency plans before the ship even reaches the engagement area. Thus when the order is actually given to make the weapon ready, the fire control technicians and the torpedo room (the reflex level of this command network) have a plan of action; there remains only to compare their own depth and that of the contact with the latest bathymetric data to ascertain the best search depth (so that the sensor and the weapon will be on the same side of any thermal "layer"—through which sound tends not to pass—as the target). The WCC obtains the necessary information either from instrument panels or from the FCC (these two officers constituting the autonomous level) and then passes it simultaneously, via a single phone circuit, to the fire control technicians at the control room firing panel and at the torpedo room monitoring panel, as well as to the torpedoman chief in the torpedo room.

Without further order, the fire controlman enters all the appropriate settings into the torpedo computer, announcing on the phone circuit each step, for instance, "Search depth set at four hundred feet." The WCC in the control room and the fire control technician and the torpedoman chief in the torpedo room all listen without replying, verifying on their own panels that each action takes place correctly and that values applied are consistent with doctrine and the predetermined plan of action. If all goes according to plan nothing is said in the control room until tube one is reported ready. At that point, if the CO (representing, of course, the command level) has a question or believes conditions are different from the scenarios, he can review the indications on the FCC's panel. Thus every setting of the forty on the Mark 48 is discussed by at least three people, and verified by four, prior to launching the weapon—all with a simple exchange of fifty-year-old commands.

This example shows that a command network can act as fast as a hierarchy, because the traditional chain of command is used to pass command and doctrine. A command network can also, however, assess information as well as a network, because open communication channels involve everyone who has the need and ability to be a part of the decision process.

Communications and the Size of a Command Network. Command networks have been around for a very long time, but before World War II they were used only in small organizations. Now they have begun to emerge in much larger structures. Today, in the Composite Warfare Commander organization of a carrier battle group, ships report simultaneously to antisubmarine warfare, antisurface warfare, and anti-air warfare commanders. If a ship faces a submarine and a missile threat at the same time, independent (reflex) action may be needed to address the most

pressing threat while coordinating with nearby ships and the warfare-area commanders about how to deal with the other. Thus command networks now prevail in battle groups, and they are beginning to be seen also in joint operations among all the services. But why has the increase in size of command networks been so recent?

The reason seems to be communications capability, which may be the limiting factor in the size of any network. For a network even to exist, as noted, each node in it must be able to communicate (even if it chooses not to) on a routine basis with every other node in the network. Therefore, a network can be only as large as a single communications link. It follows then that to make a *command* network effective the commander must be able to interact with all subordinates on a day-to-day basis (even if by merely monitoring communications between them). Until the advent of radio, video transmission, and computers, command networks could not be physically larger than one could travel across in, say, a single day, or numerically larger than the number of people one could communicate with at the same time (a hundred or so). Larger organizations had ultimately to become hierarchies, to allow long-range communication or to encompass more personnel (communicating indirectly, through middlemen).

Unquestioning—or Unquestionable—Obedience? It is almost inevitable that the more hierarchical an organization, the more centralized are authority and responsibility within it. In the past, large hierarchies could operate very effectively in this manner. Nonetheless, the strictly defined chains for both information and command meant that those at the bottom of the chain would almost inevitably have to act upon incomplete information. Consequently it was extremely difficult for them to evaluate the efficacy, legality, or even, sometimes, the morality of an order.

As communications became more sophisticated, however, it became possible to obtain information by means other than the chain of command. When it did, the concept of responsibility within an organization began to change. Moreover, judges at the trials of Nazi war criminals at Nuremberg had rejected every defense argument that “obedience to orders” could excuse grossly immoral acts. Every leader—indeed, every person in uniform—is held to be a moral being responsible for each action, including orders issued or carried out. The evolution of a certain Army training manual reflects this obligation. Its 1941 edition addressed the issue of authority in these terms: “Success in battle, which is the ultimate aim of all training, requires the cooperation of every individual to the common end. Cooperation requires centralization of authority. Someone must make the decision; when once it is made, everyone must carry out the decision energetically and unquestioningly.”² The 1953 version altered a single suffix in that passage: “unquestioningly” became “unquestionably.”³

This tiny change signalled a major shift in the concept of individual responsibility in an organization, toward one that combined what is demanded in a network with what is required by a hierarchy. In a network, individuals bear responsibility for their own actions, since in a pure network there are no commands or doctrine to appeal to—only data and information. In a pure hierarchy, responsibility rests (theoretically) with the commander, inasmuch as each individual receives only commands or doctrine—not the data and information behind them. In contrast to both, data and information in a command network is shared between the commander and the individual, as are the commands and doctrine. Accordingly, responsibility lies with *both*—the commander, because he has all the background necessary to conceive the order, and also the individual, because he has enough information to assess whether the ordered action will be effective or legal.

In the command network, then, responsibility flows both from the top down and the bottom up. However, turning this approach into military policy has been problematic. Its first codification was in W. Edwards Deming's concept of Total Quality Management (TQM), which was adopted by the military, in modified form, as Total Quality Leadership (TQL). Studying the characteristics of organizations in information and communication-rich environments, Deming postulated that the effectiveness of an organization depends on collecting all data possible, analyzing it most appropriately, and using that data at the lowest possible level. In essence, TQM argues that the best organization arrangement is the one that comes closest to a network while still being able to act effectively: the command network.

The Leadership Challenge of the Command Network

The implementation of TQL from TQM was controversial, and it sometimes became more a battle of buzzwords than a struggle to produce a new organizational approach for the Information Age. We suggest that the reason was that military leadership in a command network is significantly different from that previously known in any unit larger than a company or a submarine. To go beyond TQL, then, to a new organizational approach suitable to a joint military requires a fundamental reassessment and redefinition of organizational dynamics, especially the role of senior leadership.

The need for a new kind of leadership in the Information Age has led to a command network model often termed "leadership by negation." The organizational and leadership dynamics inherent to a command network are quite distinct; though they have always been around in smaller units, some are contrary to the way that large units and formations have been run.

The organization must be *as close to a network as effective action will permit*. As we have seen, a pure network draws upon the observations and ideas of all of its members—it is very well informed. But in practice, a large network is overwhelmed by the flood of inputs, which makes a pure network ineffective in action. A real structure that maximizes the communication channels of a network to the limit of ability to coordinate action must operate, by definition, on the verge of disorder.

It must be clear *who will decide*. In a submarine's General Quarters team, any of several people, from the commanding officer down to the torpedo room phone talker, could establish the inputs for the Mark 48 torpedo. However, the organization can work effectively (and silently) only if everyone knows who has responsibility for each decision.

Decisions must be made *at the lowest possible level*. Defining where in a unit any decision is to be made involves a tradeoff: the elements lowest in the hierarchy are usually closest to the action and have the most pertinent information; but the commander can be expected to have the most comprehensive grasp of the situation. Therefore, different types of decisions are best made at differing levels. Reflexive actions, such as immediate responses to flooding, must be done as fast as possible by the first person on the scene; the aptness of those actions is largely conditioned by the command doctrine (inculcated by training) that applies—though even here, the person on the scene is expected to interpret doctrine (i.e., training) with respect to the conditions at hand. Similarly, the actions of a component on the “autonomous level,” such as the antisubmarine assets of a battle group, need to be coordinated with the battle group's other functions, but they do not require the direct and continuous attention of the battle group commander; they require from him only clear doctrine as to how antisubmarine warfare affects the mission. While decisions at the lowest level benefit from rapid response, the immediate access to primary data, and the combined “brainpower” of the individuals directly involved, decisions at the highest level incorporate knowledge of the needs of the entire command. Given high-level input provided ahead of time—as doctrine—decisions in a command network can best be taken at the lowest possible level. “Executing ASW Plan One” may be all that the Antisubmarine Warfare Commander need signal to apprise all units and the battle group commander of a tactical situation and his (doctrinally approved) response. Only if the battle group commander has a larger organizational reason to override that preapproved decision would the lower-level order be negated.

“*Any fool can obey orders!*”—the words of Sir John (“Jackie”) Fisher, the great, reforming First Sea Lord of the Royal Navy before and during World War I. Though made, of course, in a different context, his remark has special weight in a command network, wherein an order is in essence an agreement between holders of shared responsibility. Here, plainly, is a stumbling block; but the issue arises

unavoidably. In a command network, no order should be executed without examination by its recipients, for two reasons. First, the composite "brainpower" offered by the network is mobilized only if every individual involved in an action is always thinking about its consequences. Secondly, if both the commander and an individual are responsible for an action, then both must be proprietors of it. There are, of course, situations where urgency, safety, or other overriding considerations require simple and instant obedience; doctrine can identify these, and the hierarchical dimension of a command network admits of them. But they must be exceptional. In general, a commander who requires that his orders and decisions be followed without question will find that he is the only one in the organization who is thinking.

Continual training is critical to command network operation. If each order is to be examined, then constant training under realistic operational conditions is required. Foreseeable or fundamental ambiguities must have been resolved in advance. In exercises, commands can afford, for educational purposes, to let unintended consequences of orders run their course, or to let subordinates question them ("But, sir . . . !") and take the time to examine the matter or at least discuss it soon afterward. As an actual current example, when Trident submarines on patrol go through a launch-sequence practice, only a few officers on board know that it will not culminate in the firing of all twenty-four nuclear-armed missiles. Everyone on board thus has ample opportunity to question the details and to ponder any moral reservations they may have about nuclear weapons; should the "real thing" ever occur, their crews will be ready, both technically and personally.

Commanders set guidelines. In a command network, where decisions are made at the lowest possible level and are practiced often, the commander has many chances to evaluate his subordinates in action. Thus command input becomes guidance as to discretion decisions by subordinates, in view of their effect upon the unit's mission. Here, the best commander has so trained the unit that in tactical situations he need do virtually nothing but watch the unit perform. With team coordinators making recommendations or taking appropriate autonomous or reflexive steps, his decisions will almost exclusively be to resolve disagreements—such as conflicting claims upon the same resources.

The commander will *let pass without comment* any decision within his guidelines. Within a command network so many different actions and decisions can happen simultaneously, with several individuals monitoring and assessing each one, that most network communications must necessarily be received silently. If everyone on a fire control team replied to each correct Mark 48 setting, there would be bedlam. Similarly, PC users in an e-mail network read many more messages than they actually answer. Only actions that are incorrect or not understood are overtly acknowledged—thus "command by negation," a phrase

full of pejorative connotations. In fact, the useful redundancy afforded by silent monitoring up and down the chain of command is a major strength of command-network leadership and merits a more positive name: perhaps “network leadership,” or “command through confidence.”

There is no doubt that a new leadership doctrine is required for the emerging organizations of the Information Age. TQL and leadership by negation are a beginning. Those models can and should be transcended, however, by reassessing the fundamentals of responsibility and communication.

Toward a Military Command Network

A major advantage of a command network is its flexibility in adapting not only to changing missions but also to changes in the size of an organization. It may therefore be possible to form throughout the U.S. military a “virtual organization” with the characteristics of a command network, one that can rapidly regroup and reassemble in response to threats. As force levels decrease, the ability quickly to integrate disparate units from all services into a joint task force will become vital.

But what is the maximum possible size of a command network? While in the U.S. military a worldwide hierarchy has already been achieved, through the Unified Command Plan, a worldwide network requires that every individual in the American armed forces be able to communicate with every other individual, anywhere in the world, and (with due regard to classification restrictions) have access to all data, information, doctrine, or commands stored anywhere on the network—and both on a real-time basis. Such “connectivity” may well be technically achievable within the next decade; the ultimate size of a command network will soon be limited not by technology but by people. A “virtual” command network thus would make it easier to form and re-form effective units rapidly, even at the unified commander-in-chief level. New doctrine, therefore, will be most useful if it anticipates the existence of a worldwide military command network with certain characteristics of the World Wide Web; it should begin to apply the lessons of face-to-face command networks to a web-based, national-scale command network. We can suggest a framework for such organizational doctrine.

First, a command network should be a network when considering options but a hierarchy when issuing and implementing decisions. Given certain precautions against “groupthink” and other handicaps, networks generate the most options and produce the fullest information, so in the evaluation and deliberation process a command network should structure itself as closely as possible to a pure network. When (as is usually the case in military operations) there are considerable time pressures, decisions are best reached by a well informed hierarchy. In

any event, unless a consensus obtains, the need for closure requires an authoritative (i.e., hierarchical) decision. Once a decision has been made, commands and doctrine should flow downward through a hierarchy—silently monitored and validated throughout the surrounding network. Thus individuals in a command network need to be comfortable switching between hierarchy and network modes depending on whether the organization is considering or implementing decisions.

Second, each individual should give and receive commands and doctrine through the command hierarchy. Individuals within a command network should continue to follow the traditional chain of command whenever coordinated action is necessary. This means passing recommendations for action up the chain as well as commands and doctrine downward. As in the past, orders should be acknowledged by repeating them back (signifying both understanding and acceptance of responsibility), and they should not be considered delivered until the senior receives that acknowledgement.

Third, each individual should pass data and information to the network while monitoring and filtering information from it. This is the major challenge in defining doctrine for a military command network. The more pertinent information any individual has, the better informed his decisions or recommendations can be; the more silent monitoring that occurs, the better advised decisions and actions can become. Thus, in theory each individual should monitor all information available throughout the network; doing so in practice, however, could rapidly lead to inability to act due to information overload. To maximize the network character of a military command while still retaining the ability to function, a number of basic steps are possible.

- All communications, and every document or video image, should become part of a military “web.” As is now the case with the World Wide Web, access to any such message, document, or image is simple if it has associated links. The technology and procedures to build this kind of web are partly in place: such links are already part of military communications, in message headers (e.g., FROM, TO, INFO, SUBJ, REF, and the SSIC).

- Each individual should monitor information affecting the steps in the command hierarchy above and below, and also the units on his own level. This is already an ingrained habit for many (“Read the message board!”). Shipboard officers, for instance, automatically receive messages addressed to them for action or information, but effective officers at least scan many more. A submarine’s Reactor Controls (RC) division officer who routinely looks at traffic for all the other engineering division officers and the Engineer in addition to his own should be a more effective Engineering Officer of the Watch and be ready much sooner to become an Engineer. A web structure gives the “message board” a new dimension by providing access to information in parallel chains of command. In

the submarine example, if the RC division officer had a problem with a control rod motor he could not only check all the technical manuals online but find very rapidly any other submarines that had already solved a similar problem. Also, by regularly scanning the “subject lines” of all messages addressed for action to other RC division officers in the squadron, he could significantly enhance his own effectiveness and training. Individuals at every level of a command network should “read the message board” of all those a step away in the hierarchy.

- Filtering information in parallel chains of command can provide new links across several levels of the command hierarchy. If each individual in the command network scans and analyzes a unique set of information on a daily basis, he can provide important inputs for decision-making anywhere in the organization by simple but thoughtful recommendations. Consider how the following insights (reached by linking associated messages on the web) could help the effectiveness of a command: “Three subs in this squadron have had the same problem with the rod control motors in the past month”; “Five different pilots in the Gulf report a new type of electronic intercept during their last combat air patrol”; “There are only two ‘widgets’ for SPS-48E radars available in-theater.” So important are the possibilities for exploiting vast amounts of computerized information that two of the “hottest topics” in the Management of Information Services field are *rapid accessing of multiple databases* and *easily customized data-filtering*.

Fourth, commanders need to balance their dual roles—at the command level of their own units, and at the reflex level of the larger grouping of which their units are a part. The military is already forming a “nested” command network, in which the commander of a single unit links that unit to a larger command network. These commanders can perform much more effectively than in the past, because, with the distributed decision-making inherent in a command network, each has fewer operational decisions to make than before. A commander’s major job within his unit is to define guidelines for action in accordance with its mission. At the same time, within the reflex level of the larger command network, his primary task is to interact with other units and autonomous coordinators so as to adjust his unit’s mission and operation to that of the larger organization.

Upward and parallel links from unit commanders are currently the weakest in the emerging military command network, because such relations traditionally have been handled in hierarchical fashion. The commanding officer now has the assets to monitor and evaluate information both from above and in parallel (just as the division officer always has done). Thus his jobs up and down the chain are, for once in history, compatible—but only if he knows how to act simultaneously at the lowest and highest levels of command.

Command networks have been around (if not by that name) in the American military for a long time, and the best leaders knew how they operated when they were majors or lieutenant commanders. In the Information Age, forming a command network that encompasses the entire U.S. military has become possible, but it requires reexamining both leadership models and organizational doctrine. The challenge for leaders is to apply the lessons they learned and information channels they used as department heads or company officers to the larger organization they have (or will) become responsible for at more senior levels. This entails reassessing and going beyond the lessons of Total Quality Leadership and leadership by negation, taking advantage of the new ability to integrate and assess large amounts of information, and adopting the concept of shared responsibility for every order. The key to jointness at a national level, as at any other level, is not technology itself but how it allows individuals within the organization to interact and communicate to make all their efforts mutually reinforcing with respect to a common, proper goal.

Notes

1. On the RMA generally, see Colin S. Gray, "The Changing Nature of Warfare?" and James H. Patton, Jr., "The New 'RMA': It's Only Just Begun," *Naval War College Review*, Spring 1996.
2. John McComsey and Morris O. Edwards, *The Soldier and the Law* (Harrisburg, Penna.: Military Service Publishing, 1941).
3. Morris O. Edwards and Charles L. Decker, *The Serviceman and the Law* (Harrisburg, Penna.: Military Service Publishing, 1953).

Ψ

Call for Papers Siena College World War II Conference, 29–30 May 1997

Siena College continues its annual multidisciplinary conference on World War II. The foci for 1997 will be 1947 (the Aftermath) and 1937 (the Beginnings). For 1947, papers dealing with the Holocaust, displaced persons, war crimes trials, literary and cinematic studies, veterans affairs, the G.I. Bill and economic conversion, and others, will be welcome. For 1937, papers on fascism and nazism, Ethiopia, Spain, literature, art, film, women's and Jewish studies of the era, and the Sino-Japanese War will be particularly appropriate. Inquiries to: Prof. Thomas O. Kelly II, Dept. of History, Siena College, 515 Loudon Rd., Loudonville, NY, 12211-1462, (518) 783-2595, fax (518) 783-4293. Deadline for outline/abstract, 1 December 1996; final paper, 15 March 1997.