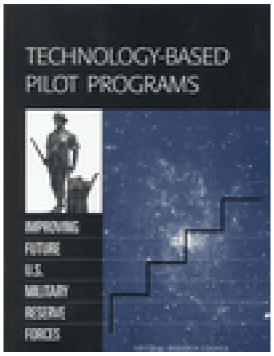

Technology-Based Pilot Programs: Improving Future U.S. Military Reserve Forces

Committee on Reserve Forces for 2010 and Beyond, National Research Council

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TECHNOLOGY-BASED PILOT PROGRAMS

IMPROVING FUTURE U.S. MILITARY RESERVE FORCES

Committee on Reserve Forces for 2010 and Beyond
Division of Military Science and Technology
Commission on Engineering and Technical Systems

National Research Council

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Preface

As the twenty-first century approaches, the number of full-time, active-duty personnel in the U.S. military (excluding the Reserves and National Guard) is about 1.4 million, the lowest level since before World War II. Nevertheless, the U.S. military is supposed to be prepared to fight two major-theater wars almost simultaneously while conducting peacekeeping operations and other assignments around the globe. To fulfill this wide range of missions, the U.S. military must continue to rely on the Reserves and National Guard, which are known collectively as the reserve components. The current number of reserve components is almost equal to the number of active-duty personnel. In the case of the U.S. Army, the number of reserves is double the number of active personnel.

This study addresses how technology can be used to improve the readiness and effectiveness of the reserve components and their integration with the active components. Many technologies are expected to enhance the capabilities of the U.S. military in the twenty-first century, including precision weapons, high-fidelity sensors, long-range surveillance, enhanced stealth characteristics, and advanced communications and information systems. This study reaffirms the importance of improved communication and information systems, for improving comprehensive training and accelerating the mobilization of reserve components for military missions in the coming decade. Although programs using these technologies are already under way in both the reserve and active components of the military, this study focuses on the effectiveness of reserve components and active-reserve integration.

In this study, the committee develops pilot programs to take advantage of these advanced technologies. Well designed, innovative pilot programs could be very valuable to the U.S. Department of Defense because they could provide a low-cost, low-risk means of exploring new approaches and furnishing data related to the effectiveness and use of reserve and active military components. The pilot programs in this study should be considered both specific suggestions and generic examples of the kinds of programs that should be explored by the Department of Defense.

Pilot programs that could promote the integration of reserve and active components are especially valuable. Remote and distributed learning, advanced simulators, and interactive, distributed exercises could substantially improve the proficiency of reserve personnel. These technologies could also be used to train reserve and active personnel simultaneously, even if they are geographically separated. Pilot programs that experiment with modern communications and information technologies could be used to assess whether U.S.-based reserve components could support commanders and forces engaged in overseas military operations. Other programs address the potential for technology to alleviate the time-consuming chores that now accompany the mobilization of reserve forces. Pilot programs may demonstrate that advanced technologies could lessen some of the difficulties of integrating part-time reservists and full-time personnel.

The committee that conducted this study wants to express its appreciation to the many representatives of the Department of Defense and other experts who furnished oral and written information. Their input was vital to the committee's deliberations. Finally, the committee expresses its gratitude to the staff of the National Research Council for its assistance during the study; without their support, this task could not have been completed.

Donald N. Fredericksen, chair
Committee on Reserve Forces
for 2010 and Beyond

Acknowledgments

This report has been reviewed by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the authors and the NRC in making the published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The contents of the review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their participation in the review of this report:

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While the individuals listed above have provided many constructive comments and suggestions, responsibility for the final content of this report rests solely with the authoring committee and the NRC.

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Executive Summary

The armed forces of the United States are composed of active duty personnel, who serve full time, and reserve personnel, who serve part time, mostly in the National Guard and the Reserves (known collectively as "reserve components"). The reserve components have served the nation well throughout its history, and they are being increasingly called upon today to participate in the full spectrum of military operations. Although reserve components bring considerable expertise to the U.S. armed forces, they are geographically dispersed, and their principal jobs are in the civilian world. The tension between the reserve components' part-time status and the increasing demand for their participation with active components in military operations is the basis for this study into how new technologies can be used to improve their effectiveness and their integration with active components.

In a study by the Commission on Roles and Missions of the Armed Forces, the U.S. Department of Defense was advised that better use could be made of reserve components. The commission's report included the following recommendation:

> …where significant uncertainties or differences of opinion exist, ... [the Department of Defense should] establish a series of tests, experiments, and pilot programs to determine whether the reserve components can perform to standard and whether different organizational and training arrangements would be more effective (DoD, 1995).

Following the commission's study, the Office of the Assistant Secretary of Defense for Reserve Affairs requested that the National Research Council conduct a study to fulfill the following tasks:

- characterize the technological environment that could influence the roles of the reserve components in support of active component forces and Commanders in Chief, considering both peacetime and wartime contingencies
- assess the technologies potentially available over the next 10 to 20 years and determine how technological advances could affect readiness of personnel (including effective and efficient training), mission effectiveness of the reserve components, and integration of the reserve components with the active components
- describe a range of scientific and technical pilot programs that will shed light on how to achieve greater reserve component effectiveness and integration

The Committee on Reserve Forces for 2010 and Beyond, under the National Research Council's Commission on Engineering and Technical Systems, was formed to perform these tasks. This report documents the study results.

Based on the anticipated role of reserve components in military operations in the first decade of the next century, the committee identified key technologies that could dramatically improve their readiness, effectiveness, and integration. Many of these technologies and applications are either already in use or are under consideration by some military components, but their applications have been uneven, and their benefits have not been fully realized. The committee has suggested how these benefits could be spread more widely across the total force and focused specifically on improving the effectiveness and integration of reserve components.

CURRENT RESERVE COMPONENTS

Because of recent reductions in military personnel, the aggregate strength of reserve components is now about the same as the aggregate strength of active components.[1] This is a change from the days of the Cold War, when active component strength was one-third greater than reserve-component strength.

The total-force policy, which was introduced in 1970 by Secretary of Defense Melvin Laird, is the basis for the increased reliance on reserve components to expand wartime capabilities. The purpose of this policy was to lower overall peacetime costs without compromising the military's ability to mobilize in time of war. Since the end of the Cold War, reserve components have continued to augment active components in wartime, but they are also increasingly being used to assist in peacetime operations, such as enforcing exclusion zones and embargoes, peacekeeping operations, and bolstering friendly nations around the globe. The extensive use of reserve components in peacetime is unprecedented, and its effects are not yet clear. Up to now, reserve components have been able to fulfill their peacetime missions. However, extensive peacetime use that requires part-time military personnel to spend frequent periods of time away from their families and civilian occupations could adversely affect the retention and recruitment levels of reserve forces.

In addition to a greatly expanded peacetime workload, some reserve component units are also required to be ready to mobilize, train, and deploy rapidly to support and augment active component forces. These requirements have made high priorities of facilitating the transition to active duty status and preparing to fight very quickly. Some of the problems could be alleviated by innovative applications of existing or new technologies.

NATIONAL SECURITY AND TECHNOLOGICAL ENVIRONMENTS AND THEIR EFFECTS

Although characteristics of the future environment in terms of national security and new technologies cannot be predicted precisely, the following significant trends will continue:

- the globalization of business, with relatively rapid transfers of technologies
- increased access by unfriendly foreign governments and nongovernmental entities to sophisticated weapons and weapons of mass destruction
- tensions among and within nations that could necessitate the rapid deployment of U.S. military capabilities, either to deter or respond to hostile actions
- pressure to reduce U.S. defense spending in the absence of a major peer competitor

The specific missions that will be assigned to reserve components in the future cannot be predicted. However, if present trends continue, future assignments will range from very small missions, such as small peacekeeping operations, to major missions, such as augmenting active components in major wars. In addition to working in fully integrated operations with active components, reserve components could also provide the bulk of the forces for some military missions, such as homeland defense against missile attacks (analogous to their long-standing participation in air defense of the United States).

Although the requirements for small-scale operations, such as peacekeeping, may develop gradually allowing time for preparation, the reserve components will be asked to respond rapidly for future combat missions involving major elements. Mobilization time is likely to be measured in weeks, or even days, rather than months. The two common elements of the potential uses of reserve components are (1) the need for them to respond quickly and (2) the potential for leveraging technologies to reduce the training time for part-time forces and facilitate their integration with active components. This need and opportunity can be addressed without having to predict specific future missions.

Technology will certainly influence the ways future military operations are conducted, as well as the character of the missions reserve components will be asked to perform. The committee considered a broad range of technologies and their potential applications to the reserve components. Advanced technologies, such as precision-guided weapons that can be used at very long ranges in all types of weather, will have a profound and positive effect on the capabilities of both active components and reserve components between now and 2010. Most of the potential impact of applying advanced technologies will be common to both

[1] The U.S. armed forces consist of 12 components: (1) three each in the Army and the Air Force (active forces, reserve forces, and the guard forces) and (2) two each in the Navy, Marine Corps, and Coast Guard (active forces and a reserve).

components, particularly applications related to combat systems. However, if technologies are deployed unevenly across the active and reserve components, integration could be adversely affected.

The committee believes that two technology areas have the most potential for improving reserve component capabilities in comparison to active component capabilities. These technologies are key enablers to improving the readiness of reserve components, facilitating the integration of reserve and active components, and enhancing the effectiveness of reserve components for carrying out future missions. These two technology areas are (1) communications technologies, which are providing substantial increases in bandwidth every year (i.e., vastly increased capacity to move large volumes of data quickly); and (2) information technologies, which include dramatically increased computing power and rapid, reliable, worldwide access to information over secured or unsecured intranets. The incredible brawn and speed of these technologies will give individuals unparalleled control over goods, services, and activities effectively eliminating the barriers of time and distance.

The capabilities of reserve components to participate in early overseas operations can be improved in two ways: (1) improving their readiness to deploy rapidly (e.g., better trained individuals on call-up status, more efficient administrative procedures, more efficient postmobilization training), and (2) creating remote organizations with sufficient data communications capability to support deployed forces from the continental United States, thus reducing the need to deploy support forces with combat forces. (Reducing deployment time through additional airlift or sealift capability is another approach to accelerating the overseas deployment of reserve components, but this approach is not addressed in this report.)

Communications and information technologies will be essential for improving the readiness of reserve components that accompany active components. Innovative uses of technology—for example, increasing the availability of information workstations and training reserve personnel in duty stations or even in their homes—could free more of the reserves' limited weekend and annual training time for developing and maintaining unit proficiency. New types of simulations could also improve the training of reserve components and ease their integration with active components. In addition, meeting future deployment time lines will require that reserve components take advantage of uniform, rapidly updatable databases and database management systems.

Databases and database management systems could also simplify studies and assessments of operational variables and performance measures, both for investigating well defined questions (like the effect of turnover rate on performance) and for data mining (i.e., searching databases for hidden relationships). Future studies and assessments of both reserve and active components could be enhanced by performance databases based on distributed simulations and field exercises.

With the communications bandwidth available now (and projected increases) remote support units could be created that could support deployed forces from their home bases. The committee believes that the use of remote staffs[2] will be one of the most important technological advances in the integration of reserve and active forces.

By 2010, technology will provide deployed and forward-based staff with ready access to remote databases, imagery, and technical and operational expertise. This capability will enable personnel operating in multiple locations around the world to share a common picture of events. Advanced technology can make a rapidly expandable and adaptable staff available for the planning and execution of activities. Properly trained remote staffs with specific areas of expertise will be able to respond to unusual events and situations, or simply to augment the capabilities of the staffs of forward-based commanders. Reducing the size of forward-based support organizations, which are often the targets of enemy attack, would limit vulnerabilities. The remote staff concept for augmenting deployed units in times of crisis or conflict could make serving in reserve units more attractive to personnel with certain specialized skills (e.g., information technology) who may be difficult to retain in active components because of competing civilian opportunities.

The committee's focus on communications and information technologies for improving the relative contributions of the reserve components is also consistent with the importance of these technologies in future commercial activities and military operations.[3] In both

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[2] For the purposes of this report, a *remote staff* is a staff that is not physically present with a commander but is well connected to the commander (i.e., has a virtual presence) through a variety of advanced information and communications capabilities.

[3] See *Joint Vision 2010*, the conceptual template for achieving new levels of effectiveness in joint war-fighting, issued by the Chairman of the Joint Chiefs of Staff (CJCS, 1996).

technologies, the committee anticipates that the leadership will be in the civilian sector.

PILOT PROGRAMS

Pilot programs, including tests and experiments, are relatively low-cost ways of exploring the uses of new technologies and, possibly, demonstrating the feasibility of innovative concepts.[4] A successful pilot program can also be an effective tool for securing program funding in the Department of Defense and from Congress. Pilot programs may also have significant benefits for the integration of reserve and active components. These benefits could extend beyond the substance of the program—for example, by increasing confidence in each other's abilities through increased interactions between reserve and active personnel on several levels. Pilot programs represent low-risk opportunities to increase familiarity in a nonthreatening environment.

The scientific and technical pilot programs developed by the committee are intended to shed light on ways of using technologies to improve the readiness or effectiveness of reserve components or improve integration with their active counterparts. The committee reviewed the pilot programs to determine which ones merit priority attention by the Department of Defense in terms of the following criteria: (1) the *impact* of the program on effectiveness and integration, and (2) the *feasibility* of conducting a credible pilot program that would produce valid data and shed light on issues of effectiveness and integration. The four high-priority pilot programs are: (1) increasing training time through technology; (2) using advanced distributed-learning technology for maintenance personnel; (3) streamlining administrative processes; and (4) using telesupport and remote staffing.

The committee recognizes that the Department of Defense is already making limited use of the technologies identified in these pilot programs, and the proposals in this report are not intended as criticisms. It is the committee's intent to focus specifically on how these technologies could affect reserve component effectiveness and active-reserve integration. Second, the pilot programs explore nontraditional uses of technology in lieu of the cost, time, and energy of full-scale implementation.

[4]The committee uses the term *pilot program* as an umbrella concept that includes one or more tests or experiments on subissues. A *test* is a highly structured exercise designed to determine if a measured outcome meets or exceeds some standard. An *experiment* is an exercise in which some control variables are changed to determine their effects.

High-Priority Pilot Programs

Increased Training Time through Technology

This pilot program applies distance-learning technology (with which all services are experimenting) to increase the time effectively available for training. Reserve units have limited time to conduct *both* individual and unit training. A significant barrier to the effectiveness of reserve units as a whole is that many unit members must use unit training time for their individual training. This pilot program would explore the use of distance-learning technology to increase voluntary individual training, either at home or at another convenient place (examinations would be given under controlled conditions). The pilot program would explore the costs and effectiveness of a wide range of incentives for reservists to complete courses successfully, including satisfying requirements for promotion, early advancement, retirement points, paid training time, the reward of a computer, and cash bonuses.

Advanced Distributed-Learning Technology for Maintenance Personnel

Modern military equipment is becoming increasingly complex, and this equipment tends to fail in unanticipated ways, making repairs difficult. This pilot program would be conducted in cooperation with private companies that have already tackled the same problem to determine if their diagnostic and repair technologies—transferred over long distances from an expert to a user—could be used to maintain military equipment. The program would also examine whether advanced distributed-learning technology for the maintenance of one kind of machine could be readily transferred to another—an important issue for reserve components who must maintain a variety of equipment often different from the equipment used by their active counterparts.

Streamlined Administrative Processes

Current administrative practices, which are both time consuming and labor intensive, cut into training time and slow down mobilization. Although widely available commercial practices and technologies could be used to streamline administrative processes, their adoption has been slow despite strenuous efforts by all of the services. This pilot program would evaluate some "quick fixes" and demonstration projects that use advanced database technologies. One goal of the program would be to demonstrate to Congress and the Department of Defense that streamlining procedures could save time and money that could be reallocated to other essential tasks. If this can be demonstrated, it would exert pressure for the implementation of near-term improvements.

Telesupport and Remote Staffing

With vastly increased bandwidth and computing power, combat units could be linked to technical support units and personnel based in the United States. This capability could reduce the size and vulnerability of units deployed overseas and, at the same time, provide the deployed units with access to the best advice from a wide range of sources. It could also help reserve components retain technical support personnel who might otherwise be discouraged by frequent overseas deployments. The experiments in this pilot program would be used to determine which "remote staffing" technologies and configurations work best.

Highlighted Pilot Programs

One aspect of improving the integration of reserve components with active components is cultural, and the effect of technical pilot programs on cultures is hard to estimate. Nevertheless, the committee decided to highlight four pilot programs that could shed light on reserve component capabilities and, perhaps, mitigate some of the cultural differences. Each program proposes that the Army Reserves or Army National Guard perform an important, visible task in partnership with active component forces. The committee believes that simply working together on a pilot project would promote trust and improve integration between active and reserve components. The four highlighted programs are described briefly below.

Reserve Component Battle-Staff Performance

The Army National Guard has about half of the Army's combat forces in its brigades and divisions. Skeptics are doubtful that these units could be trained quickly enough after mobilization to get into the fight. The principal impediment involves training time for high-level commanders and their staffs to work together to hone their leadership and battle-staff skills. This pilot program is designed to explore using modern simulations as part of distance training of the leadership of the Army National Guard.

Best-of-Type Competitions

The fact that "the reserves often win the annual fighter competition" is often cited as evidence of the capabilities of the Air National Guard and Air Force Reserve. The committee did not find a consensus (or objective data), however, about the capabilities of the Army Reserve. This pilot program would involve experiments featuring competitions using attack helicopters—an important weapon system for all Army components that is also well represented in reserve component units. These competitions could provide objective measures of capabilities (as they do for the Air Force). Competitions might increase incentives for training, reveal new tactics, and engender mutual pride and respect.

Reserve Peacekeeping Battle Laboratory

Although the Department of Defense has been studying small-scale contingencies, little attention has been paid to the role of the reserve components in these missions. This pilot program would explore the merits of setting up a peacekeeping battle laboratory focused on improving the effectiveness and integration of the reserve components in peacekeeping operations.

Continuous Land Warfare

The technological superiority of U.S. forces has enabled them to "own the night" (i.e., to operate around the clock and in adverse weather). However, in the early stages of a military operation, there may not be enough personnel to maintain this momentum. A potential solution could be to augment combat support and combat service support units, whose equipment is already in theater, with personnel who have been shipped into theater ahead of their equipment. Experiments would be conducted to address uncertainties, such as (1) the best level of augmentation (e.g., individual, team, or unit); (2) the most effective timing for augmentation; and (3) the merits of using distributed training, exercises, and battle simulations to integrate the reserve component augmentees with their active counterparts.

Programs for Immediate Action

One focus of this report is improving the readiness of reserve components for deployment by using modern information and communications technologies to improve administrative procedures that now reduce useful training time and impede rapid integration with active components. The committee developed two pilot programs in this area, Management of the Individual Ready Reserve to improve the management of individual ready reservists to fill units more rapidly before deployment, and Reserve Component Automation System to deal with the availability and potential of using a peacetime reserve component computer system after mobilization. After careful consideration, however, the committee concluded that the need for improvements in this area was obvious and that they could be made immediately without waiting for the results of a pilot program.

Other Pilot Programs

The committee strongly believes that the remaining eight pilot programs developed during this study also merit consideration by the Department of Defense. They are listed in Box ES-1 and are described in the report. In addition to pilot programs, the Department of Defense can take other steps to improve reserve component capabilities and integration. For example, in the two areas discussed above, the Department of Defense can simply begin implementing good business practices without waiting for a pilot program. In other areas, gathering data related to existing practices will be necessary to determine whether or not changes in policies or the implementation of pilot programs would be beneficial and cost effective. For example, the stability and cohesion of small units may be very important to their effectiveness. However, before relevant pilot programs are developed and implemented, the Department of Defense should gather data on the stability of individuals in small active and reserve units over time to prove or disprove anecdotal reports of high turnover.

BOX ES-1
Other Pilot Programs for Consideration

- Cadre Units for Peacekeeping Operations
- Reserve Component Participation in the Aftermath of Incidents Involving Weapons of Mass Destruction
- Information Technologists in the Total Force
- Unmanned Vehicles
- Biosensors
- Total Force for the Twenty-First Century
- Helicopter Unit Interfaces with Allies
- Test-Bed for Active Force Transformation

RECOMMENDATIONS

Recommendation 1. The Department of Defense should implement selected pilot programs to provide decision makers with better information on issues affecting reserve components.

The four high-priority pilot programs selected by the committee should be included in the initial set of programs. The Department of Defense should give second priority to planning and conducting the four highlighted pilot programs and should also consider the other pilot programs discussed in this report. The significant increase in the use of reserve components should be accompanied by a significant increase in experimentation in the use of new technologies to ensure that reserve components are ready and trained to operate in concert with active components.

Recommendation 2. The Department of Defense should develop and consider implementing additional pilot programs on an ongoing basis.

The development and initial evaluation of reserve component pilot programs should be conducted jointly by elements of reserve and active components. The Department of Defense could use a selection process similar to the one used for deciding which Advanced Concept Technology Demonstrations will be funded.

Recommendation 3. The individual military services, using currently available communication and information technologies, should integrate information on reserve and active component personnel.

The services should reengineer the processing of information on reserve components and the processing of reserve component personnel upon call-up to eliminate cumbersome and unnecessary transitions between reserve component and active component systems and to minimize the time spent on administrative procedures.

Recommendation 4. The Department of Defense should take immediate action to improve the management of the Individual Ready Reserve and extend the Army's Reserve Component Automation System for use beyond peacetime.

Rather than conduct pilot programs in these two areas, the Department of Defense should employ available technologies to help fill units more rapidly before deployment and to use the existing peacetime computer system after mobilization. If necessary, Congress should be asked to change the law and provide funding.

Recommendation 5. The Department of Defense should instruct the military services to collect data on the stability of reserve component and active component personnel—specifically, the stability of individuals in small units.

The data should be collected in consistent form using standard definitions. The Department of Defense should consider including this data in an integrated database with unit performance data, thereby providing a basis for data mining to search for hidden relationships between best practices and small unit performance. The data should cover, for example, members of tank crews, battle staffs at the battalion or other levels, and maintenance teams for sophisticated equipment. Once these data have been collected and analyzed, the merits of alternative means of improving the stability of individuals in units should be assessed, especially in units where stabilization is essential to performance.

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1

Introduction

This report contains the results of the National Research Council study to (1) characterize the future technological environment that could influence the role of reserve components in support of active components, (2) determine how technological advances could affect the readiness, mission effectiveness, and integration of reserve components with active components, and (3) describe a range of pilot programs, tests, and experiments to investigate ways of improving the effectiveness and integration of reserve components.

BACKGROUND

The armed forces of the United States are composed of active components (full-time military personnel) and reserve components (military personnel who serve part time in the National Guard and other reserve forces). To reduce the size and cost of the peacetime military establishment, the United States has traditionally called on its citizens to augment the armed forces in times of need, either voluntarily or through the draft. Historically, the reserve components have been, and remain today, the first echelon to augment the active components in times of national emergency[1] (Kriedberg and Henry, 1955).

In the aftermath of the Cold War, the U.S. armed forces are expected to (1) deter and, if necessary, fight and win two nearly simultaneous major-theater wars; and (2) conduct a wide range of other operations around the world, such as peacekeeping operations. In recent years, the U.S. armed forces have been engaged in operations three to four times as often as during the Cold War (Collins, 1998). At the same time, the number of active component personnel has fallen to its lowest level since prior to World War II (DoD, 1999b). As a result, reserve components, whose strength now approximately equals that of active components, have been called upon not only to prepare for war but also to augment active components in a variety of ways in peacetime. This new arrangement is consistent with Secretary of Defense William S. Cohen's announcement in September 1997:

> Our goal, as we move into the twenty-first century, must be a seamless total force that provides the national command authorities the flexibility and interoperability necessary for the full range of military operations. We cannot achieve this as separate components. Much progress has already been made. We must continue to work towards the principles of total force and achieve full integration of the reserve and active components (DoD, 1997a).

The growing dependence of the armed forces on reserve components—part-time personnel who must detach themselves from their full-time civilian occupations before reporting for military duty—comes at a time when potential adversaries may attack with little or no warning and when the armed forces are still searching for ways of meeting high operational demands and, simultaneously, modernizing equipment to

[1]The military value of the reserve components has been their readiness to serve with a minimum of refresher training. Today, reserve units are already configured into functioning elements, are fully equipped, and are familiar with the requirements of their positions. By contrast, volunteers and draftees must begin with the rudiments of military training and normally enter at the lowest levels of the military structure as individual fillers and replacements. Volunteers and draftees are not usually available for duty for several months after their induction.

protect our future national security interests. In the 1998 Summer Study, the Defense Science Board acknowledges that maintaining the military's capability to respond very quickly is a significant challenge.[2] If reserve components could improve their reaction times, they could improve the flexibility of the total force.[3]

Commission on Roles and Missions of the Armed Forces

As the Department of Defense realigns to meet post-Cold-War national-security requirements, the roles of the military services and their reserve components are under constant congressional scrutiny. The Commission on Roles and Missions of the Armed Forces established by the National Defense Authorization Act of 1994 noted that "information technologies, space, stealth, and precision-guided weapons will be increasingly important to military success" (DoD, 1995). The report's recommendations for using the reserve components as part of the total force fall under a general directive to "Further Integrate the Reserve Components."

> There are ways that Department of Defense can make better use of the Reserve Components. Some reserve forces are not organized, trained, or equipped appropriately for the types of operations they are likely to face in the future…(DoD, 1995.)

The report further recommended the following:

> ...where significant uncertainties or differences of opinion exist, we recommend Department of Defense establish a series of tests, experiments, and pilot programs to determine whether the reserve components can perform to standard and whether different organizational and training arrangements would be more effective (DoD, 1995).

In recognition of the technological expertise of the National Research Council, the Office of the Assistant Secretary of Defense for Reserve Affairs requested its assistance in assessing how advanced technologies could affect the performance of both active components and reserve components. The Statement of Task below defines the terms of the study.

Statement of Task

The National Research Council will perform the following major study tasks:

- Within the national security visions of the future (2010 and beyond), as estimated by government and other sources, characterize the technological environment that could influence the roles of the reserve components in support of active components and Commanders in Chief in consideration of both peacetime and wartime contingencies.
- Using information provided by the Department of Defense, industry, and other sources, assess the technologies available, or potentially available to the U.S. reserve and active components over the next 10 to 20 years (as well as to allies and potential enemies) and determine how technological advances could affect readiness of personnel, including effective/efficient training; mission effectiveness of the reserve components; and the integration of the reserve components with the active components.
- Describe a range of scientific and technical pilot programs (and their constituent tests and experiments) that will produce valid data if selected and implemented by Department of Defense. The spectrum of pilot programs should shed light on how to achieve greater reserve component effectiveness and integration in light of major changes in technology and how they affect the way Department of Defense fights future wars and maintains military presence.

In general, in light of the then-anticipated technological environment, the study will identify methodologies for Department of Defense to gather data on the broadest set of opportunities for efficient total-force integration after 2010.

The National Research Council established the Committee on Reserve Forces for 2010 and Beyond to conduct the study. According to the Statement of Task, this study is confined to findings related to science and technology and does not include assessments of roles and missions or the size of the reserve components. This constraint was considered repeatedly during the study, and the committee has refrained from taking a position on nontechnical solutions to problems. Nevertheless, many challenges to "efficient total-force integration" do not lend themselves to technological solutions. The committee readily acknowledges that

[2]Data in the Defense Science Board report indicate that, currently, the U.S. military can influence events in 8 to 36 hours through bombers; 8 to 168 hours through naval forces; and 96 hours through land forces (the ground early entry force) (DoD, 1998d).

[3]The reaction times of reserve components vary widely. They are discussed in Chapter 3.

technologies alone cannot solve all of the problems associated with integrating active and reserve components.[4]

Committee Process

The members of the committee were selected for their expertise in a wide range of disciplines and their experience in technology development, experimental design, and issues relating to the military. To augment this knowledge, the committee familiarized itself with the strategies and long-range plans of the Department of Defense and the individual services, especially as they involved the reserve components and future applications of technology. The committee also investigated some technologies being pursued outside the Department of Defense to assess their applicability.

The data-gathering phase of the study continued over the course of the first five committee meetings through a series of briefings by and discussions with representatives of many elements of the Department of Defense, including the individual services, the joint staff, and the reserve components; various industries; organizations that conduct studies or research for the government; and representatives of Israel, an allied nation well known for the successful integration of its reserve and active components (see Appendix A). The committee also reviewed written information in the open literature and from some experts who were unable to attend the meetings.

REPORT ROAD MAP

Chapter 2 contains background information on current reserve components in the context of the total U.S. military force. Chapter 3 characterizes the emerging national security and technological environments, as well as the potential effects of advanced technologies on the participation of future reserve components in a wide variety of missions. Chapter 4 summarizes the pilot programs developed by the committee, including associated tests and experiments. Chapter 5 describes the eight pilot programs that the committee believes merit the greatest attention by the Department of Defense. Detailed descriptions of the remaining pilot programs are given in Appendix B. In Chapter 6, the committee presents its conclusions and recommendations.

[4]For the purposes of this report, the committee defines integration of active and reserve components as the process of uniting these components into a total force that can be maintained at reasonable cost in peacetime without compromising wartime output. In this integration process, the units are melded into a fighting force without relinquishing their individual identities, and reserve components are joined with active components to accomplish missions.

2

Reserve Forces Today

This chapter provides a general overview of current reserve forces, including their organization, their part in the U.S. military's total-force policy, their capabilities and limitations, and barriers to their integration into the total force.

ORGANIZATION

Each of the 12 components of the U.S. armed forces (Table 2-1), some active and some reserve, has its own leadership, culture, traditions, policies, regulations, and, most significantly, congressional appropriations. The reserve components can be divided into many categories, each with specific operational and training stipulations, pay and allowances, and availability limitations, all formalized by law and based in part on their diverse origins. The following is a simplified description of a complex establishment and should not be considered definitive.

As Table 2-1 shows, the Army's guard and reserve components (together, approximately 800,000 personnel) are by far the largest of the reserve component organizations, larger than the other reserve components combined. The Army's ready reserve (which includes both guard and reserve units) also constitutes a larger percentage of the total Army organization than the reserve components of the other military services. The sheer magnitude of the Army's reserve components led to a natural emphasis in this report on issues related to the readiness and effectiveness of the Army's ready reserve and its integration with elements of the Army's active component.

TABLE 2-1 U.S. Armed Forces: Active and Ready Reserve Strengths as of September 30, 1998

	Active Components		Ready Reserve				
			Guard		Reserve		
Service	Strength	Percent of Service	Strength	Percent of Service	Strength	Percent of Service	Total Strength
Army	484,000	38%	367,000	29%	432,000	34%	1,282,000
Navy	382,000	65%	N/A	N/A	206,000	35%	589,000
Marine Corps	173,000	64%	N/A	N/A	99,000	36%	272,000
Air Force	368,000	61%	108,000	18%	128,000	21%	604,000
Total DoD Force	1,407,000	51%	475,000	17%	865,000	32%	2,747,000
Coast Guard[a]	35,000	73%	N/A	N/A	13,000	27%	48,000
Total Force	1,442,000	52%	475,000	17%	878,000	31%	2,795,000

[a]The Coast Guard is a unit of the U.S. Department of Transportation.
Note: Numbers have been rounded off.
Source: DoD, 1998a; DoD, 1998c.

TABLE 2-2 Total Force Strength during and after the Cold War

	Active		Ready Reserve		
	Strength	Percent	Strength	Percent	Total
1987 Cold War	2,174,000	58%	1,637,000	42%	3,811,000
1998 Post Cold War	1,442,000	52%	1,353,000	48%	2,795,000

Source: DoD, 1988; DoD, 1998a; DoD, 1998c.

Table 2-2 profiles the U.S. military active and ready reserve manpower pool in 1987 and 1998. The ready reserve is the largest portion of the reserve components and the most likely to be used first in a crisis or conflict. The standby reserve, which is quite small in numbers, and the retired reserve, whose members are not involved in ongoing training but can be recalled, are not included in Table 2-2. The table shows that, with recent reductions in the active components, the number of ready reservists is almost equal to the number of active personnel. This situation is different from the situation in 1987, during the Cold War.

Contingency plans call for using forces in order of their readiness—normally, elements of the active component first followed by elements of the ready reserve. The retired reserve can be recalled on the same basis as the ready reserve.[1] In the event of a very large conflict, reserve components can be used to rapidly augment manpower while volunteers or draftees are being trained.

In addition to their anticipated participation in wartime, members of reserve components are playing a relatively new role—augmenting active forces in peacetime. In fact, their peacetime service is increasing. For example, some reserve components are working with active component units to enforce embargoes and exclusion zones, serving as peacekeepers, and bolstering friendly nations around the globe (DoD, 1998b).

All military personnel, active or reserve, are volunteers who have an eight-year military service obligation (with various combinations of active and reserve duty). Upon entry into their service, all personnel undergo basic military training and training in initial skills. Active personnel then report to their active units, where they learn new skills and maintain currency in their specialties through experience and frequent reinforcement training. Reserve personnel return to their civilian occupations and meet for training with their reserve component units, typically, one weekend a month and two weeks a year. Most members of the reserve components are former members of active components—some serving just for the remainder of their military service obligations and others for a full reserve component career. Reservists interested in a full career quickly find that they must put in significantly more time throughout the year than the statutory minimum of one weekend a month.

Unlike active components, reserve components are primarily a part-time force. Reservists have military training, but their primary occupations are in the civil sector, whereas the primary occupation of active personnel is providing military capabilities to assist in implementing U.S. national security policy. Although the political process is beyond the scope of the committee's task, it warrants separate consideration because it has had a significant influence on the organization of the reserve components. Individual members of Congress are often vitally interested in supporting the reserve units in their districts, and Congress as a whole must agree to increases or decreases in unit strengths and plays an active role in equipping reserve components. In the committee's experience, congressional and executive branch actions and conflicting views sometimes undermine positive relationships within the total force. Occasionally, as a result of congressional interests, units and missions are retained in the reserve components much longer than their services and the Secretary of Defense think appropriate. In some situations, some active component functions or unit responsibilities have not been transferred to reserve components because of fears that active component forces may be further reduced by Congress.

Ready Reserve

The ready reserve is the only source of organized reserve units and the primary source of reserve manpower. For the purposes of this report, the term "reserve components" applies principally to the ready reserve. The ready reserve is divided into two categories—the Selected Reserve and the Individual Ready Reserve (Table 2-3).

[1]Members of the retired reserve may be somewhat less technically proficient because they do not train in peacetime. However, these personnel are mostly senior officers and non-commissioned officers whose experience and proven leadership are important stabilizing and reinforcing qualities in a rapidly expanding force.

TABLE 2-3 Organization and Strength of the Ready Reserve as of September 30, 1998

	Selected Reserve				Individual Ready Reserve		
	Guard		Reserve		Reserve		Total Ready Reserve[a]
	Strength	Percent	Strength	Percent	Strength	Percent	
Army	362,000[b]	45%	205,000	25%	231,000[c]	29%	799,000
Navy	N/A		93,000	45%	113,000	55%	206,000
Marine Corps	N/A		41,000	41%	58,000	59%	99,000
Air Force	108,000	46%	72,000	30%	56,000	24%	236,000
Total Department of Defense	470,000	35%	411,000	31%	459,000	34%	1,340,000
Coast Guard[d]	N/A		8,000	61%	5,000	38%	13,000
Total	470,000	35%	418,000	31%	464,000	34%	1,353,000

[a]Numbers have been rounded off.
[b]Army Guard numbers do not include the Inactive National Guard.
[c]Army Individual Ready Reserve numbers include the Army Inactive National Guard.
[d]The Coast Guard is a unit of the U.S. Department of Transportation.
Source: DoD, 1998c.

Selected Reserve

The Selected Reserve receives the most training of all reserve components, is the first called upon to augment active components in time of war, and is the source of most (but not all) peacetime augmentation forces. Most of the Selected Reserve is configured into military units that have missions, organizations, equipment, and training comparable to their counterparts in the active component. Some selected reservists are fully trained personnel assigned to positions in active component organizations to provide a wartime expansion capability or a unique skill. Other Selected Reserve personnel serve on full-time active duty in active component organizations or in reserve component units.

Members of Selected Reserve units, by law, must train at least 14 to 15 consecutive days annually and perform 48 drills annually. A drill is a four-hour training period, normally performed in groups of two plus two, over a two-day weekend, although a variety of combinations are possible.[2] The annual training is normally performed at a major training area; drills are performed at home-station armories and reserve centers. Training, both weekend and annual, is generally conducted by a team of full-time support personnel.[3]

Members of the National Guard have additional requirements to serve their respective state governors. Units of the National Guard may be called to help in times of natural disaster, such as floods, fires, or hurricanes. They are also the governors' first line of defense during periods of civil unrest and may participate in state actions to reduce or interdict drug traffic. All of these activities can detract from military training in preparation for wartime, although they could enhance training for some kinds of missions (e.g., providing assistance to large numbers of displaced persons).

Individual Ready Reserve

The Individual Ready Reserve is a large pool of trained individuals who, in wartime, are called-up to fill personnel vacancies in their service, either in the theater of operations or in state-side support organizations. All members of the Individual Ready Reserve have already served in some capacity, either in the active component or in the Selected Reserve. Most are serving out their military service obligations. Once individuals are in the Individual Ready Reserve, they have no statutory requirement to continue their training. Currently, few, if any, members of the Individual Ready Reserve are paid for training time.

The Army National Guard has a category of personnel, the inactive national guard, with many of the same

[2]Training requirements for individual selected reservists not assigned to units are less precise. All selected reservists must participate in the 14 to 15 days of annual training, but their inactive duty training ranges from none to the full 48 drills.

[3]Each service approaches the full-time support program differently. The Air Force reserve components have the highest level of full-time support, approximately 28 percent of the authorized strength. The Army reserve components have the lowest, approximately 11 percent. The Navy, with 26 percent, and the Marine Corps, with 17 percent, fall into a middle category (DoD, 1998e).

characteristics as the Individual Ready Reserve. These personnel are used only to fill vacancies in the Army National Guard.

TOTAL-FORCE POLICY

The total-force policy, introduced in 1970 by Secretary of Defense Melvin Laird, described a sliding scale of the defense-force structure, ranging from the use of active components only, which are very effective early in a campaign but very expensive, to some combination with reserve components, which are less effective early but also less expensive. The ratio of active to reserve components changes, depending on the perceived threat to the nation and the willingness of the American people to accept risk and to pay for defense.

Historically, reserve components have been used to augment and expand active components in wartime but did not play a significant role in peacetime beyond the state-level missions of the National Guard. Faced with escalating costs of the war in Vietnam, the disenchantment of the American people with the military, and the imminent end of the military draft, Secretary Laird issued the following directive:

> A total-force concept will be applied in all aspects of planning, programming, manning, equipping and employing Guard and Reserve Forces. Application of the concept will be geared to the recognition that in many instances the lower peacetime sustaining costs of reserve force units, compared to similar active units, can result in a larger total force for a lesser budget. In addition, attention will be given to the fact that Guard and Reserve Forces can perform peacetime missions as a by-product or adjunct of training with significant manpower and monetary savings (DoD, 1970).

Over the next 25 years, the total-force concept matured into a policy that has been gradually implemented throughout the armed forces. The total-force policy has enabled the military services to rely on reserve components to expand their wartime and peacetime capabilities at a fraction of the costs of expanding full-time active component units. A limited presidential call-up authority was requested and approved by Congress in the 1970s authorizing the President to call up some reservists. Today, the President can call up as many as 200,000 members of the reserve components for not more than 270 days without declaring a national emergency (Title 10 USC, 1995). Thus, reserve components can now be used more easily in smaller contingencies. The success of the policy during major conflicts was acknowledged to depend on the ability of national command authorities to provide sufficient warning for reserve components to be called-up, processed into the force, and provided with refresher training.

The implementation of the total-force policy by the various services has been uneven, as was observed in a recent National Defense Panel report:

> While the other services have continued to increase the integration of their active and reserve forces, the Army has suffered from a destructive disunity among its components, specifically between the active Army and the National Guard. This rift serves neither the Army nor the country well (DoD, 1997b).

Approximately two of every three persons in the Army are members of the guard or reserves (see Table 2-1). This may partly explain why the Army faces particularly difficult challenges in integrating its active and reserve components.

Despite the uneven implementation of the total-force policy to date, the Department of Defense's current goal is full integration of the total force. This goal was alluded to in the Secretary of Defense's report to the President in 1998:

> Reserve Component combat and support roles have been expanded in all post-Cold War operations, including explicit recognition of the Guard's state role as an integral component of U.S. Security...although the Reserve Components were erroneously perceived during the Cold War as backup forces of last resort, attitudes are changing (DoD, 1998b).

CAPABILITIES AND LIMITATIONS

After being called up and undergoing post-mobilization training, units and members of the reserve components are expected to be indistinguishable from their active component partners. However, a debate has been ongoing concerning the amount of time required for a part-time force to become as effective and productive as a full-time force and the relative benefits and costs of reserve components for performing specific functions. Some capabilities and limitations of reserve components are described below.

In Operation Desert Storm, approximately 260,000 members of the reserve components were called up to serve with elements of the active components of their services. In that operation, reserve components were successfully integrated, and the Department of Defense has used the lessons learned from the call-up to improve reserve component availability, training, and fitness standards. Since Desert Storm, even more mission assignments have been given to the reserve components.

Although most of the reserve component units have the same missions as active components, certain types of units and skills are maintained principally in reserve components. Table 2-4 illustrates types of missions and levels of reserve component participation, including some in which reserve components and active components have significant numbers of the same types of units.

Recently, reserve components have proven that they are capable of augmenting active components during peacetime, although the limits of this participation have yet to be tested. The committee was concerned that if reservists and guardsmen are called upon too frequently or for too long, this will adversely affect their civilian careers and families, and they may lose interest in staying in the reserve components.

TABLE 2-4 Varying Levels of Participation by Reserve Components

	Type of Unit	Percent of this Unit Type Maintained in the Reserve Components
Army		
	Prisoner-of-War Brigades	100%
	Civil Affairs Units	97%
	Chemical Battalions	75%
	Field Artillery Battalions	58%
	Attack Helicopter Battalions	45%
Navy		
	Mobile Inshore Undersea Warfare Units	100%
	Warfare Support Helicopter Squadrons	100%
	Cargo Handling Battalions	93%
	Military Sealift Command Personnel	85%
Marine Corps		
	Civil Affairs Groups	100%
	Tank Battalions	50%
Air Force		
	Strategic Intercept Force	100%
	Tactical Airlift	64%
	Aerial Refueling/Strategic Tankers	55%
	Tactical Fighters	30%
Coast Guard		
	Deployable Port Security Units	99%

Source: DoD, 1998e.

The part-time status of the reserve components, which allows them to operate at lower cost than full-time active components, is also the basis of their greatest limitation. Members of reserve components are limited by having to balance the civilian and military aspects of their lives. Military training, professional development, and peacetime augmentation typically require time away from their civilian lives and occupations, which are usually the primary basis for family income and medical benefits. These conflicts were acknowledged in a recent article in the *Air Force Association Magazine*:

> The reserve components have moved into an unprecedented partnership with the active force, but it has not been without its costs. Reserve members now share the stress of optempo with their active duty counterparts and must cope with the problems of frequent deployments and prolonged separations from their families. In addition, they face the unique challenge of meshing their military duties with their civilian careers (Callander, 1998).

Although the committee did not have hard data on the negative effects of the extensive peacetime use of part-time military personnel, based on a wide range of anecdotal evidence, the committee concluded that continued peacetime call-ups may have an adverse effect on the ability of reserve components to recruit new members and retain existing members.

In addition to finite training time, training/maneuver areas are sometimes inaccessible to some members of reserve components. Also, some units have older equipment than others or not enough trainers. These and similar problems can limit the capabilities of reserve components.[4]

An additional limitation is the amount of unit training the reserve components are given before they must report for duty or deployment. In the current national security environment, neither the President, the Congress, nor the reserve components can predict with confidence when they will be needed or how much notice they will have.

An extensive code of laws, policies, directives, and regulations, much of it dating to World War II, governs the availability of reserve components in peacetime or in war. The lengthy administrative processing required by the code significantly delays the availability of

[4]Some elements of the active components have similar limitations.

reserve components. Complicated processing procedures require everything from physical and dental assessments to new identification cards and confirmation of wills. The availability of reserve components is further hampered by the absence of a single personnel and pay database for each military service. Only the Marine Corps and the Coast Guard include their reserve components in their service's active component personnel and pay systems. The reserve components of the other services have developed their own standalone systems, which are not necessarily integrated or compatible with active component systems.

BARRIERS TO INTEGRATION

The Reserve Forces Policy Board, a statutory body established by Congress in 1952 to advise the Secretary of Defense on reserve component issues, has conducted a series of symposia to identify ways to optimize the use of the reserve components. The most recent symposium focused on barriers to integration of the components of the total force. The results reported to the Secretary of Defense identified a variety of barriers to integration. The four major ones are listed below (DoD, 1998f):

- lack of coordinated total-force budgeting
- incompatible pay and personnel systems
- incompatible equipment and weapons systems
- lack of coordinated training and military education

The budgeting issue (different appropriations for each reserve component) involves both Congress and the leadership of the Department of Defense and is clearly beyond the scope of this study. The other three barriers are consistent with the observations made by the committee during its data-gathering period. The use of technology to help overcome these barriers is the purpose of the pilot programs, tests, and experiments developed by the committee.

Cultural differences are also significant inhibitors to integration. To the extent that cultural challenges are the results of real or perceived differences in capabilities, such as lower readiness or lower training status, selected technology applications and pilot programs to improve capabilities could help reduce cultural differences.

3

National Security and Technological Environments and Their Effects

National security and technological environments are intertwined because technology has a strong influence on the ways wars are fought and the character of the missions reserve components are asked to perform. Of the broad range of technologies considered by the committee, two—communications (with continuously increasing bandwidth) and information (with dramatically increased computing power and advanced data-handling capacity)—were judged to have the most potential for improving the readiness and effectiveness of reserve components and their integration with active components.

THE ENVIRONMENTS

Technology will have a major influence on the national security environment and on the ways military operations are conducted. Although the specifics are impossible to predict, the committee developed a general characterization of the future based on significant current trends that are expected to continue.

In *A New National Security Strategy for a New Century*, the new multipolar world is described as extremely complex—in stark contrast to the simpler, more linear, bipolar world of the Cold War. The dangers of this scenario include the following [emphasis added]:

> …Ethnic conflict and outlaw states threaten regional stability; *terrorism, drugs, organized crime and proliferation of weapons of mass destruction* are global concerns that transcend national borders...(The White House, 1997).

The Defense Strategy (DoD, 1998b), which focuses on how the Department of Defense will implement the National Security Strategy, forecasts similar dangers [emphasis added]:

> The foremost regional danger to U.S. security is the continuing threat that *hostile states with significant military power* pose to allies and friends in key regions. Between now and 2015, it is reasonable to assume that more than one such aspiring regional power will have both the motivation and *the means* to challenge U.S. interests militarily.... In addition, transnational challenges—*including terrorism, illegal drug flows, international organized crime,* and migrant flows—are likely to increase through 2015, at times directly affecting U.S. citizens and interests both at home and abroad (DoD, 1998b).

If the United States is challenged, the military will probably not have a very long time (unlike Operation Desert Shield in 1990) to mobilize and deploy its forces, wherever they are needed to deter hostile actions or respond to them with force. While small-scale operational requirements, such as peacekeeping, may develop gradually with ample time for preparation, most response times will be measured in hours or days rather than months. For example, in *Global Engagement: A Vision for the 21st Century Air Force*, "the ability to bring intense firepower to bear over global distances within hours to days" is part of the strategic vision. The vision includes an air expeditionary force that can "be ready to fight in less than three days" and rapid global mobility to meet "the need for immediate response to overseas events" (USAF, 1997).

New technologies are becoming increasingly available. The proliferation of technology reflects, in part, the growing globalization of business and the rapid transfer of technology applications, as well as the increasing flow of information. Technology is not always used for peaceful purposes, however. Foreign governments and nongovernmental entities that are not friendly to the United States will continue to have access to relatively sophisticated weapons and weapons of mass destruction. No doubt hostile states, as well as terrorists, drug lords, and organized crime, will continue to exploit every advance in technology.

These visions of the future were projected against a backdrop of constrained funding for the Department of Defense. Although some increases over recent levels are forecast for procurement budgets, which contain the funds for buying advanced weapons, in general funding levels are expected to be approximately 50 percent lower in real terms than they were in the mid-1980s (DoD, 1999c). The overall defense budget is expected to be about 30 percent lower.

The pressure to restrain defense spending reflects the absence of a major peer competitor to U.S. military power. Given the decreases in the overall defense budget, the pace of current operations (e.g., in the Balkans and Persian Gulf areas), and the need to maintain military readiness, there are not enough funds to modernize weapons systems. Because budgetary pressures can be expected to continue, the military has strong incentives to look to new technologies to maximize the benefits of its expenditures.

Joint Vision 2010 was issued by the Chairman of the Joint Chiefs of Staff to establish a conceptual template for using emerging technologies to achieve new levels of joint war-fighting effectiveness (CJCS, 1996). *Joint Vision 2010* was developed on the premise that modern technologies—particularly information-specific technologies—would make possible an unprecedented increase in joint operational capability:

> We must have information superiority: the capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same. Information superiority will require both offensive and defensive information warfare.... Offensive information warfare will degrade or exploit an adversary's collection or use of information. It will include both traditional methods, such as a precision attack to destroy an adversary's command and control capability, as well as nontraditional methods such as electronic intrusion into an information and control network to convince, confuse, or deceive enemy military decision makers (CJCS, 1996).

The *Concept for Future Joint Operations* (CJCS, 1997), which was issued to amplify *Joint Vision 2010*, focuses directly on the importance of technology. The armed forces are attempting to determine how emerging technologies, combined with organizational and operational changes, could affect military effectiveness. In fact, technologies could revolutionize military affairs.

> A revolution in military affairs...is a conceptual point of departure for future joint operations. In response to a strategic opportunity or threat, [a revolution in military affairs] may be a complete renovation of the conduct of war. Generally, the military of an affected state *must incorporate advanced technology* [emphasis added], leading to new tactical, operational, and strategic concepts and relevant organizational adaptation (CJCS, 1997).

Some examples of the military's use of advanced technologies are described below:

- Precision weapons, with unprecedented worldwide mobility and long-range, all-weather capabilities, will be used on various platforms.
- The combination of precision weapons and effective sensors, command-and-control systems, and accurate reconnaissance, surveillance, intelligence, target tracking, and target acquisition systems will change the nature of military operations and tactics.
- Information technologies, including signal control and management, will dramatically improve the gathering, processing, storing, and dissemination of information in near-real time.
- Space-based platforms and unmanned vehicles will enhance information systems and related command, control, and communications capabilities.
- Units armed with lighter and more lethal equipment will be able to deploy faster than today's units and will require a smaller logistics footprint in the theater of operations.
- Highly mobile combat units will be dispersed over the battlefield, increasing both their survivability and their reliance on precision fire to engage the enemy at long ranges.
- Greatly enhanced situational awareness, made possible by advanced sensors, communications, and computational capabilities, will make dispersed operations practical.
- A global information grid, much like today's Internet or corporate intranets, will link deployed military operators in close proximity to each other

or in other countries, in the United States, in the air, or in space (e.g., remote staffs or systems).
- Many ground, sea, and air vehicles (e.g., airborne reconnaissance vehicles) will be unmanned and remotely controlled; this will be possible because of the robust communications and other information capabilities available to controllers and users, wherever they might be.
- The use of very sophisticated, high-fidelity simulations for training and for near-real-time mission planning will become widespread.

The cutting edge of technology development for the military services is likely to be (1) the development of advanced intelligence and reconnaissance capabilities, (2) the development of new weapons systems and munitions (e.g., sensors and other electronic systems along with ships, aircraft, tanks, missiles, bombs, and bullets), and (3) integration through networking. The Army Research Laboratory's *Annual Review* is filled with descriptions of projects in support of a future digitized battlefield, including ideas for advancing sensors, signal and image processing, displays, information distribution, visualization, modeling, simulation, vehicles, armor, and munitions (DA, 1998a). Publications by other laboratories in other military services are filled with similar scenarios.

Advanced technologies will have a profound effect on the capabilities of active and reserve components, especially as the technologies relate to combat systems. In many respects the effects on both components will be positive (e.g., advanced weapons and sensors can increase the effectiveness of active and reserve component forces). However, if these technologies are not deployed evenly across the active and reserve components, integration could be adversely affected. Also, if advanced technologies introduce requirements for increased training time that are not offset by improvements in training efficiency, the reserve components' limited opportunities for training may put them at a disadvantage relative to the active components. In short, the positive and negative influences of advanced technologies on the integration of the reserve and active components have to be recognized. In this study, the challenge was to identify advanced technologies that could improve the integration of reserve components with their active counterparts.

Two of these technologies are communications and information. Both are areas in which civilian applications are expected to lead the way as they have in the past several years. Indeed, the Department of Defense no longer drives research, development, and the applications of many technologies in the United States. As a result, the trend toward wider use of commercial off-the-shelf hardware and software for military communications and information applications seems certain to continue.

Two areas of military operations that will be strongly influenced by changes in technology, especially communications and information technologies, are (1) distributed operations (called "network centric warfare" in the Navy) and (2) joint operations (see Box 3-1). They will evolve over time, no doubt, partly in response to insights from testing and experimentation and partly in response to real-world experience with adversaries seeking to exploit the vulnerabilities created by the reliance of U.S. forces on new technologies. The committee intends the pilot programs described in this report to be part of this evolutionary process and hopes that the recommended tests and experiments will prepare U.S. forces to respond to creative enemy tactics and technological innovations. The committee believes that equally creative testing and experimentation will increase the capability of highly sophisticated forces to respond to a wide range of threats.

MISSIONS FOR THE RESERVES

Given the uncertainties in the national security environment, the specific missions assigned to reserve components cannot be predicted. Therefore, the committee decided to consider a range of missions that seem reasonable from today's perspective.

Future Missions[1]

Based on missions that the reserve components are currently being asked to perform, future missions for the reserve components can be categorized into several types along a continuum, from traditional war-fighting missions to serving as a test-bed for new doctrines, tactics, and technologies. The following descriptions of missions include indications of the possible role of technology.

First, traditional war-fighting missions in a major-theater war will continue to be the most demanding

[1]General references from the Department of Defense for this section include Cohen (1999), Cragin (1999), and Shelton (1999).

BOX 3-1
Potential Areas of Change

For many years, the Navy has encouraged distributed operations and the sharing of data and information across and among different weapon platforms. This concept, which the Navy calls "network centric warfare," is also being explored by the other military services. The concept reflects the idea that disparate units with the same understanding of the combat situation can be equipped with weapons that strike precisely over longer distances and can coordinate their operations. At the same time, they can also be more dispersed. The significant implications of this concept include a shift toward greater specialization (e.g., less air defense by ground forces in favor of more airborne air defense) and potentially smaller, less concentrated units of force.

The Marine Corps has explored reversing the traditional relationship between its fire and maneuver elements in ground-force operations. Instead of relying on fire to keep an opponent in place so the maneuver elements can close in on and destroy him, the Marines have experimented with using maneuver elements to avoid direct contact with the opponent while directing long-range precision fire to destroy him.

The Army has begun to consider significant changes in its long-term "Army After Next" project: (1) a shift toward smaller, more agile combat units and (2) a parallel shift toward more flattened command hierarchies. One possibility, for example, is eliminating the division as an echelon and moving toward an all brigade structure.

The Air Force has acknowledged that the ability of future joint military teams to achieve full awareness of the battlefield will depend heavily on air-based and space-based intelligence, communications, weather analyses, and navigation. The Air Force's commitment to precision weapons will take advantage of the emerging ability to find and attack any target on the surface of the earth. The Air Force also recognizes the growing importance of information warfare and has indicated that the defense of U.S. information-intensive capabilities will have top priority.

Sources: Cebrowski and Gartska, 1998; USAF, 1997; MacGregor, 1997.

task for active and reserve forces over the next decade or more, even if a major-theater war is less likely to occur than other contingencies. Future war-fighting missions will have familiar requirements for reserve components. The technology issues for these missions include: (1) the extent to which technology could improve the readiness of reserve components to meet wartime demands for conflicts involving states, such as Iraq or North Korea; and (2) the ways technology could improve the integration of reserve components with the active forces in these missions. The potential time line for a major-theater war will include little or no warning time, which will limit the use of reserve component units in the initial phase of operations.[2] However, even if warning times are short, Selected Reserve units will play critical roles in mobilization, airlift, and U.S.-based activities in support of regional commanders. Because information and communications technologies have the potential to provide all units, anywhere on the globe, with a common operational picture, "remote staffs" could conduct integrated planning and support activities from geographically separated locations. This would allow forward deployed staffs to concentrate on essential mission events in the theater.

Second, in an unstable world environment, U.S. forces, including reserve components, will continue to engage in small-scale contingency operations throughout the world involving a range of so-called "stability

[2]Current response times of reserve components vary widely. Individual reservists can react within hours. Some small units can report within 3 to 5 days; larger force elements, which require longer processing times, can be available within 30 to 90 days (Smiley, 1999). Experts disagree about the response times for Army National Guard divisions, the largest organized force elements; members of the committee heard estimates ranging from a few months to the better part of a year.

operations," from peacekeeping to providing humanitarian assistance. These operations could take place in a wide variety of climates, terrains, and locations, including urban areas.

Because the political process that precipitates U.S. involvement usually takes time to develop, there is usually sufficient time to prepare for these operations. Each contingency situation is unique and requires forces, and perhaps training, tailored to meet specific needs. Also, the mix of forces for each stability operation is different, and participating organizations may not have trained together. Distributed training and simulation technologies could help prepare both reserve and active components for stability operations.

Third, the spread of weapon-related technologies and the growing threat to critical U.S. infrastructure (e.g., from cyber and terrorist attacks), both during peacetime and wartime, could increase the potential scope of reserve component responsibilities in homeland defense. In the past two decades, reserve components have contributed to the defense of the continental United States by providing the majority of air defenses and the capability to control U.S. sovereign airspace. Looking ahead, the Department of Defense is considering using reserve components to augment active components for defense against missile attacks on U.S. territory or even to take almost full responsibility for these missions, similar to their responsibilities for current U.S. air-defense missions. Reserve component involvement in meeting nontraditional challenges inside the United States is also being expanded. For example, reserve components have been asked to assume more prominent roles in response to the use of nuclear, chemical, or biological weapons inside the United States. Advanced technologies for training and simulation, as well as advanced communications capabilities, could be crucial to the success of homeland defense missions.

Finally, there are some indications that reserve components might be used as a test-bed for working out the implications of new doctrines, tactics, and related new technologies. For example, relative to information technology, the Department of Defense has decided to create a reserve component team of 22 persons to test information technology.

> …to monitor and evaluate Department of Defense Web sites to ensure the sites do not compromise national security by revealing sensitive defense information…[the team] will scour Defense Web sites for information and trends of data that could be used to breach security or pose a threat to Defense operations and personnel. In addition, team members will evaluate Web site content to ensure compliance with departmental policies, procedures and best practices (DoD, 1999a).

Common Elements

Common elements in most of the potential missions of the reserve components are: (1) the need for relatively quick response times on the part of U.S. military forces, and (2) the opportunity to leverage technologies (especially, advanced communications and information capabilities) to train part-time forces in the time available (by law and policies) and to improve the integration of reserve components and active components. These common elements can become the focus of improving the readiness, effectiveness, and integration of reserve components, without predicting their specific future missions. To that end, this study developed pilot programs, tests, and experiments to assist future decision makers.

RELEVANT TECHNOLOGIES

Considering the potential positive and negative influences of a range of technologies and the challenges of identifying technologies that can improve integration, the committee focused on two related topics: communications and information technologies, including computing. This focus is consistent with the military's joint vision and operating concepts for the year 2010, which encompass a variety of advanced communications and information technologies that underlie many of the plans for fighting wars more effectively. These two technologies will be fundamental to improving reserve components' ability to provide timely support for active components and joint military commanders. These technologies can also be used to improve reserve components' readiness, through more efficient use of limited training time, and to help create organizations that can perform essential functions in locations remote from the theater of operations.

So what might the communications and information environment of the year 2010 look like? In 1965, Gordon Moore, a co-founder of Intel Corporation, observed that the number of transistors per square inch on integrated circuits (and therefore their computing power) had doubled yearly since they were invented. The rate of exponential growth soon declined a bit but leveled off with a doubling time of about 18 months.

This rate of growth has continued to the present. Exponential growth cannot continue forever, of course, but the consensus opinion is that "Moore's Law" will hold for many years to come. Recently, Moore predicted that, unless there is a radical shift in microprocessor science, the finite size of atomic particles will be the limiting factor in about five generations, about the year 2017 (Gibbs, 1997). Based on Moore's Law, by 2010 the density will be more than 100 times greater than it is today.

Many other communications and information performance measures have also grown robustly. Examples include data storage densities, display densities, transfer speeds, and transmission bandwidths. Bandwidths have been increasing substantially each year in nearly all transmission media—wired, wireless, and satellite communication—and this growth is expected to accelerate. By 2010, the capacity to move high volumes of data quickly is expected to be vastly increased. Advances in military communications and information technologies will be fostered primarily by the explosive growth in commercial communication and information systems (e.g., terrestrial backbones, satellite relays, and computers). Advanced military-specific applications of these technologies will be driven by the requirement for information superiority inherent in the conceptual template of *Joint Vision 2010.* Collectively, these advances are expected to lead to a capability of providing commercial and military users all over the world with rapid and reliable access to information.

The communications and information environment in 2010 will be characterized by incredible brawn and speed. One consequence, which is already obvious today, will be the merger of communications and information technologies (e.g., computing at a distance, data at a distance, and the blurring of the line between the desktop and the Internet). Even a dozen years ago, the role of the Internet, and especially the World Wide Web, could not have been predicted. Based on past experience, there is no reason to think that the role of communications and information systems in 2010 can be accurately predicted. It is likely, however, that inexpensive worldwide access to information will be available to both wired and wireless sites over secured[3] and unsecured intranets, which would also improve access to information by geographically dispersed elements of the military, especially reserve components.

Generations of hardware and software will continue their rapid turnover, costs will continue to decrease, accessibility will continue to improve, and systems will become increasingly standardized. Software dependence on specific platforms will decrease as software development tools improve. As familiarity with the concepts and details of computing and communications increases, much of the general population, including reservists, will acquire reasonable facility with using these technologies.

INFLUENCE OF TECHNOLOGY ON THE RESERVES

Modern technology could be used to improve the readiness and effectiveness of reserve components and facilitate integration of active and reserve forces of the U.S. total force.

> …information systems are a lever for increasing capabilities or reducing costs by enhancing access to and accountability for data and services…. A modern revolution in information technology offers the Navy another opportunity to make startling improvements. IT [information technology] provides individuals with unparalleled control over goods, services, and activities that cross the barriers of time and distance (NRC, 1999).

The committee believes that improving the capabilities of the reserve components to deploy (or to support the operations of deployed units) and improving the integration of the reserve components and the active components will depend on: (1) achieving readiness to deploy more rapidly (e.g., better trained individuals on

[3] The committee believes that techniques for securing information will keep pace with the growing need to transmit information to geographically dispersed users via communications networks. Today, electronic commerce over the Internet is becoming commonplace, including the transfer of secure information involving financial transactions. More robust security measures are possible if highly classified data must be transmitted. The security aspects of using advanced communications and information technologies are explored in *Commercial Multimedia Technologies for Twenty-First Century Army Battlefields*, which includes the following statements: "Commercial technology in the area of security is evolving rapidly...The committee believes it is likely that at least some large classes of Army security applications can be satisfied by [commercial off-the-shelf] security technologies, even if there remains a significant residual set of applications that must be served by Army-specific developments....The Army, and the DoD as a whole, can stimulate the development and accelerate the use of robust security protocols built on publicly available technologies" (NRC, 1995).

call-up through more effective and efficient training, less time for administration of the call-up process, more efficient post-mobilization training to cut integration time, and integration at multiple levels of an organization); or (2) creating remote organizations with sufficient data-communications capability to support deployed forces from the continental United States, thus reducing the need to deploy support forces with combat forces.

Specific technology applications, such as learning and simulation at a distance, are well suited to training distributed elements like reserve components who have limited time for training. Another application is to use modern, automated databases to help reserve components mobilize and deploy more quickly. A third application is to employ advanced communications and information technologies to enable reserve components to provide support for active components operating overseas without having to be deployed with them. Although these technologies are not new and are already under consideration by some military components, this report focuses on using them to improve the effectiveness and integration of the reserve components. (A more traditional way to reduce deployment time would be to increase airlift or sealift capability by procuring more transport aircraft and cargo ships. However, this approach, along with its budgetary and cost implications, is not addressed in this report.)

The discussion that follows provides a general overview of the impact of technology on readiness and integration. The discussion is based on the assumption that enhancing the readiness and integration of reserve components will improve their mission effectiveness.

Readiness

A challenge for reserve components of the twenty-first century will be to achieve a higher state of readiness in peacetime and to compress the time required for them to mobilize, train, and deploy to operating locations for a wide range of military missions. The committee believes that the new deployment commitments of reserve components, particularly combat forces, require that communications and information technologies be used to improve their readiness to operate alongside active components. Several examples of how these technologies could improve readiness are described below.

The mobilization process involves the transition of units and individuals from their day-to-day peacetime readiness posture to a state of complete wartime readiness for a designated operation. Technology can be used to identify appropriate units, speed up administrative processing, and conduct operation-specific training.

Improving administrative processing will require developing common databases that identify the current status and availability of reserve component units and individuals. This information is currently stored in disparate sources in a wide range of formats, and processing is still done manually after units and individuals arrive at mobilization-processing stations. Existing and emerging technologies could greatly reduce administrative processing time if records were kept current, which will require common formats so that updates can be made electronically at the peacetime location of each unit and individual. Through technology, such as the judicious use of a mobilization smart card, some mobilization-processing stations might even be eliminated entirely.

Training could also be vastly improved through advances in communications and information technologies, especially distance learning and simulation, which could be used for individual, unit, and joint training. Some reserve components have already recognized the importance of these techniques and have put programs in place to capitalize on them. Because of the unique ability of these technologies to bring training to the location where individuals or units reside (even into their homes) and to tailor training programs to the demands of a particular situation, communications and information technologies are particularly well suited to improving the training of reserve components.

Although some reserve components are already using learning at a distance, the committee believes that by 2010 it will be very common, and the list of courses available will be extensive. Moreover, by 2010, the vast majority of existing military training courses will be digitized and accessible via secure sites on the Internet or secure electronic networks, as appropriate. (The committee notes that training at a distance might involve classified doctrines and tactics, which would require encryption.) Software that manages the training process independent of a student's location will be in place and will span both the active and reserve components. Tools for the development of self-paced instruction will be easier to use, multimedia presentations will be routine, and the cost of developing instruction will have decreased. "Intelligent tutors and mentors" may become commonplace and could be incorporated into courses, thus improving their effectiveness. The technologies are changing so rapidly, however, that it is difficult to predict the state of the art in five years, let alone 10 years. The only guiding principle in this environment is to remain flexible enough to ensure that the direction of training and simulation programs does not lead to a dead end.[4]

If distance learning becomes accessible to individuals at home, some training courses that are commonly conducted during reserve component drill periods could be taken at home. This would enrich the "hands-on" training time during drill periods by preparing all participants at home through mission-preparation materials. Units and individuals would arrive at the armory or base ready for field training.

The committee believes that technology will improve all three kinds of simulations used by the military: live, virtual, and constructive simulations.[5] Live exercises will involve more instrumentation for more objective assessments and improve after-action reviews. Instrumented ranges similar to those at the Army's National Training Center will be available for company-sized units of the National Guard. Mixing live and constructive-simulation exercises will be common. The quality and realism of virtual simulations will improve,[6] and all types of weather conditions and environments will be represented. If virtual simulators were made available to reservists, and if other elements of the training paradigm (e.g., after-action reviews and interactions with other participants) were replicated and distributed in near-real time, then dispersed members of the reserve components could have the advantage of the same kind of training currently available to active components (and to some reservists) at the National Training Center and Red Flag.[7] Constructive simulations will exercise staffs at all echelons and include joint operations. Perhaps the most important advance will be that constructive simulations will be distributed.

The increasing capabilities of simulation devices will reduce the need for trainees to operate actual systems. The key to operating an F-16, for example, is to master the avionics systems, which means setting up and operating the computer programs (i.e., quasi-simulations) embedded in the aircraft. Tank operations require acquiring targets through sensors and aiming with lasers and computer-based displays. Maintenance of modern weapon systems is becoming increasingly dependent on computer-based diagnostics. Of course, at some point, trainees will still have to operate real systems to experience the time, distance, and stress of actual operational environments. Advanced simulation environments will be used to augment, but not replace, in situ practice whenever possible.

Distributed simulations will have a major effect on the training of reserve components—especially the training of unit staffs. A major challenge on the modern battlefield is synchronization, which is a primary responsibility of the commanders and their battle staffs. The principal bottleneck in training combined arms formations (e.g., divisions and brigades) is the training of battle staffs. The challenge to individuals in reserve components who hold battle-staff positions is to undergo training often enough to become proficient. Constructive simulations have facilitated training by enabling individuals to train without combat elements. As technology advances between now and 2010,

[4]The committee notes, for example, that new learning approaches are being planned for the Army of the Future. The main thrust of these approaches involves "the realization that training, particularly the way we learn and sustain digital skills, will present new and different challenges" (DA, 1998b). The Army has developed a "digital learning strategy" for individuals, battle staffs, and units that is evolving as the Army discovers more about digital learning. The most advanced stage of the three-step learning strategy is intended to "develop highly adaptive, hyper-proficient, individuals, small teams, leaders, and units." At this highest level of proficiency, "high performance organizations are discovering new ways to do new things ... improving things as they go along through reflective thought combined with interactive, intense, immersion-based experimental observation, then by execution. They routinely modify tactics, techniques and procedures..." The Army indicates that a foundation of this kind of training is distributed learning. However, even with this advanced thinking, the Army intends to follow proven principles like "train as you fight."

[5]Live simulations include live elements, for example, real exercises such as wargames. In virtual simulations, people are immersed in a virtual reality provided by computer-driven displays and interactions. Constructive simulations involve analytic representations of various aspects of the real world (e.g., ground vehicles and aircraft) that can be manipulated by computer to experiment with force-on-force interactions and performance. For additional information, readers may consult *Commercial Multimedia Technologies for Twenty-First Century Army Battlefields* (NRC, 1995).

[6]Future simulations can be expected to be very realistic. For example, consider today's Internet accessibility of satellite photos [http://terraserver.microsoft.com/] and extrapolate, using Moore's Law, to 2010.

[7] Red Flag is Air Force pilot training for air-to-air and air-to-ground tactics involving aggressor forces. Active, Air Guard, and Air Force Reserve units are eligible to participate, but it is principally an active event.

reserve battle-staff members will be able to train at their local armories or even in their homes.

Just as changing military technologies have increased the range of weapon systems, environmental and safety concerns have reduced the available training space. Some weapon systems that will be used in 2010 require so much space that they cannot be used for training anywhere. For example, the crew of a supersonic-cruise F-22 armed with extended-range missiles probably will not be able to train to its full mission capability within the continental United States airspace; theater-missile defense systems will be fully operated only in real-life circumstances. Therefore, advanced, high-fidelity simulations will be necessary for training, and reserve component personnel and units can be trained on the simulation devices as well as their active counterparts.

In the field, information-based mission-rehearsal and post-mission playback devices can be combined with field simulators to increase the "reality" and effectiveness of mission-training sessions. In addition, virtual forces can be used to expand the scale of current training exercises to enable units to train at the unit level. Today, full-scale, unit-level training is possible only occasionally by reserve component units because of the difficulty of securing training areas and amassing supplies, equipment, and personnel. With simulation technology, the rare experiences gained from live exercises (e.g., at the National Training Center) could become common experiences for all units.

Integration

Some integration issues reflect cultural differences based on historical and traditional experiences and will require sociological and doctrinal, rather than technological, solutions. But technology can remove obstacles to other kinds of integration. For instance, the limited availability of reserve component units and their geographical separation is a constraint on their integration with active component units. As a rule, units operate most comfortably with other units in close proximity with whom they are familiar, and many active component units are based at the same post and interact with one another daily. However, even active component units in the same division, or wing, may train at command centers in different locations and only meet face to face to prepare for an exercise or to engage in post-exercise reviews. With a robust communications network, reserve and active component units will be able to participate in the same exercises (despite their geographic separation) on a regular basis.

This training can encourage a sense of unit cohesiveness, as well as involve reserve components in mission rehearsals, such as those that were conducted by forward-based divisions in Germany prior to deployment to Bosnia.[8] Replacement units and individuals like those cycling through Bosnia and Northern and Southern Watch in the Middle East would have the benefit of experiencing real-world operations electronically before they arrive in the theater.

One of the most important benefits of new technology will be the use of remote staffs. Sometimes staffs that plan and execute operations for major regional conflicts or for stability operations do not have the in-house expertise to meet the full range of challenges they face. For example, when forces were sent to Bosnia, the European Command staff was substantially expanded to support them, and hundreds of reserve personnel were sent to Europe temporarily to assist in staff planning. For both Bosnia and Operation Desert Storm, reserve component units were mobilized and deployed in the continental United States to provide logistics support for forces deployed overseas.

The technology of 2010 will provide forward-based staff with ready access to remote databases, imagery, and technical and operational expertise. Personnel operating in multiple locations around the world will have strategic and tactical pictures of events at the same time as the commander and his staff. Although a staff that works with a theater commander on a day-to-day basis and is physically located in the theater will have some advantages, the forward-based commander and staff will not require that experts be physically present to meet the full range of situations and environments they will encounter. Information and communications technologies can provide a rapidly expandable and adaptable staff capability for planning and execution that

[8]Currently, mission rehearsals, also known as maneuver readiness exercises, are preparatory exercises conducted at Fort Polk for brigade and battalion task forces deploying to conduct the mission in Bosnia. These exercises consist of two phases. Phase 1 is a seven-day leader's training program seminar during which the unit staff goes through the "orders process" for typical missions, issues, and situations. After-action reviews and discussion groups are used extensively. Phase 2 is a 10-day exercise program in which leadership deals with the typical missions, issues, and situations they will face in Bosnia. The program takes place on the ground and includes extensive use of role players.

capitalizes on "reach-back" for data and "reach-out" for the expertise to perform different functions. Remote staff elements will have to be carefully selected and receive specific guidance from commanders to ensure that they focus on data and analysis not readily available to the forward staff. Combat support (e.g., artillery) and combat service support (e.g., maintenance, supply, and transportation operations) staff elements may benefit substantially from remote staffing because of their need for diverse data and expertise.

By 2010, well trained remote staffs that have access to expertise for special events and unique situations, or that can simply augment the capabilities of forward-based commanders, will become more common. Indeed, they may become the norm because they would limit the vulnerabilities (and attendant casualties) of forward-deployed U.S. forces.

The remote staff concept for augmentation in a crisis or actual conflict is particularly well suited to the situation of reserve components. Among other things, reserve components may be more likely to retain personnel with a broad range of specialized skills who may be difficult to retain now because of competing job opportunities in the civilian marketplace.

4

Pilot Programs

The committee developed 18 pilot programs to improve the effectiveness and integration of reserve components (see Box 4-1). This chapter begins with definitions of the terms *pilot program*, *test*, and *experiment*. Next, the committee explains how it (1) developed the 18 pilot programs and (2) selected the four that warrant priority attention, the four that address cultural issues, and the two that address obvious deficiencies the Department of Defense should focus on immediately. The remaining eight programs are described in Appendix B. The chapter closes with some general observations about future methodologies for developing pilot programs and collecting and managing data.

DEFINITIONS

A *pilot program* usually consists of one or more tests or experiments that address subissues related to the major issue (see example in Box 4-2).

A *test* is designed to determine whether a measured outcome meets or exceeds some standard, either a desired outcome or a baseline measurement. Tests are highly structured and usually measure the specific outcome of a single level of an independent variable. The measurement methodology is specified in advance.

An *experiment*, which also examines a subissue under a pilot program, has a formal structure (an "experimental design") in which some variables are changed from time to time during the experiment to determine the relationship between those variables and measurable outcomes. By providing new information, experiments improve the basis for decision making. Experiments are broader than tests and may encompass tests. They are also usually more difficult and costly to conduct than tests.

The committee did not fully develop the designs of the experiments and tests suggested for the pilot programs. Designing the recommended experiments and tests will require specifying measures and developing methodologies for analyzing the data, which were beyond the scope of this study.

METHODOLOGY

Development of Candidate Pilot Programs

The committee developed many concepts for candidate pilot programs intended to shed light on ways to improve the readiness and/or effectiveness of reserve components or improve their integration with active components. After refining the most promising concepts, the committee had developed 18 pilot programs. The development and application of selection criteria are described below.

Criteria

Six criteria were used for prioritizing and selecting pilot programs:

- scope of impact (breadth)
- magnitude of impact (depth)
- ability to change
- credibility
- technical feasibility
- administrative feasibility

These criteria were divided into two groups of three, the first group relating to the potential impact of a pilot

**Box 4-1
Overview of Pilot Programs**

Areas for Immediate Action

- Management of the Individual Ready Reserve
- Reserve Component Automation System

High-Priority Pilot Programs

- Increased Training Time through Technology
- Advanced Distributed-Learning Technology for Maintenance Personnel
- Streamlined Administrative Processes
- Telesupport and Remote Staffing

Highlighted Pilot Programs

- Reserve Component Battle-Staff Officer Performance
- Best-of-Type Competitions
- Reserve Peacekeeping Battle Laboratory
- Continuous Land Warfare

Other Pilot Programs for Consideration

- Cadre Units for Peacekeeping Operations
- Reserve component Participation in the Aftermath of Incidents Involving Weapons of Mass Destruction
- Information Technologists in the Total Force
- Unmanned Vehicles
- Biosensors
- Total Force for the Twenty-First Century
- Helicopter Unit Interfaces with Allies
- Test-Bed for Active Force Transformation

program and the second relating to the chances of successfully conducting the pilot program.

The first group of criteria includes (1) scope of impact (breadth), (2) magnitude of impact (depth), and (3) Department of Defense's ability to change. These criteria involve the anticipated effect on defense capability of a policy change based on the results of a pilot program. The impact is measured both by the scope (number of units [or people] affected) and the magnitude (the amount of change in a typical unit [or in Department of Defense readiness and budgets]) of the change, as well as the Department of Defense's ability to make these changes. A successful pilot program would be useless if resultant changes could not be implemented.

The second group of criteria relates to the expectation of performing a pilot program successfully. The criteria are (4) the credibility of the results, (5) the technical feasibility of conducting the pilot program, and (6) the administrative feasibility of conducting the pilot program.

Scope of Impact (Breadth)

How many units or people would be affected? Would they be in one or all services, in the active components only, in the reserve components only, or in both? How many skills or occupational specialties would be affected? A few? Many? All? Are they critical skills?

BOX 4-2
Sample Pilot Program, Test, and Experiment

Assume that the leadership of a military service is concerned about the condition of its personnel system because its personnel record keeping is slow, cumbersome, and prone to errors. The leadership might establish a ***pilot program*** to determine whether automation could improve the situation. Early experiments could generate data for measuring the effectiveness of several aspects of the automated system.

As part of the pilot program, a ***test*** could be conducted using a given computer program, exercised in a specific way, to see whether it produced less than x-percent errors.

The program could also include an ***experiment*** to (1) use multiple software programs and compare the results, (2) investigate ways to use the system most effectively, or (3) develop and evaluate measures of effectiveness, such as data accuracy, time to record data, and failure rates.

Magnitude of Impact (Depth)

What would the effect of the changes be? For example, would there be a substantial improvement in readiness (e.g., improved training, improved capability to mobilize the reserve components), a significant reduction in resources or costs (e.g., fewer personnel required to perform a function, improved active/reserve component integration), less turnover, greater retention, or better administration?

Ability to Change

Would credible results lead to changes? For example, would laws or executive branch policies have to be changed? Would there be political resistance or inertia to overcome (e.g., by the Office of the Secretary of Defense, the active components, the reserve component establishments, Congress, state governors, the public)? Would the changes require large investments in dollars, equipment, people, or time?

Credibility

Would this program produce believable results? For example, would the results be difficult to measure or not measurable at all (e.g., not demonstrable statistically)? Would the results be representative (e.g., is the situation realistic militarily)?

Technical Feasibility

Would the pilot program be technically difficult to conduct? Would the experiment required for meaningful results take too long? Would the costs or other resources required be within reasonable bounds?

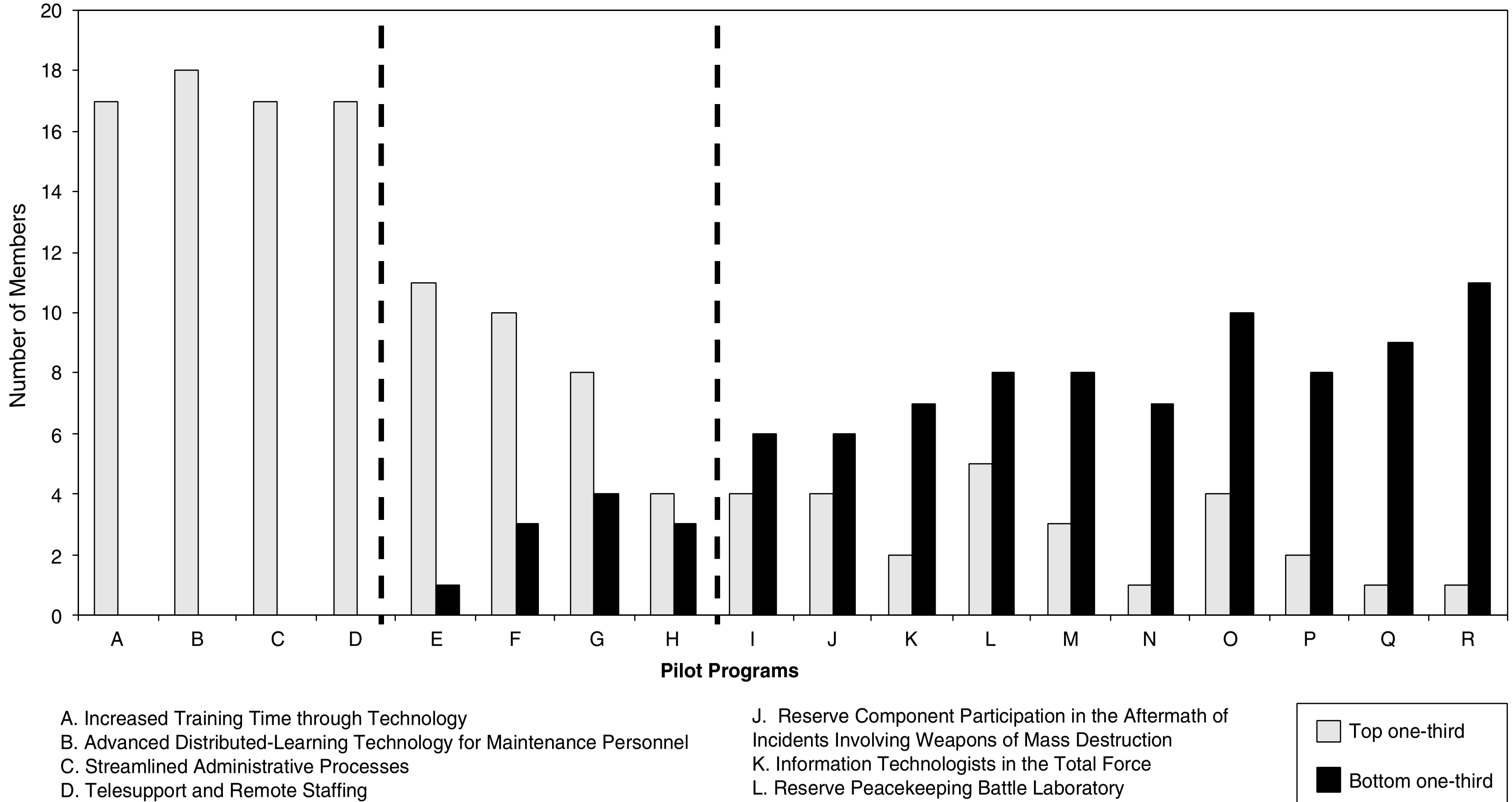
Administrative Feasibility

Is the pilot program likely to be conducted? Would conducting the pilot program have an adverse impact on personnel or readiness? Would there be legal or policy impediments? Would political difficulties arise (e.g., from the active components, the reserve component establishments, Congress, state governors, the public)?

Process

The members of the committee evaluated each candidate pilot program by each criterion. The committee then reviewed the prioritized list for reasonableness, discussed the viewpoints of individual members, and revised some of the programs. This process enabled the committee to balance the views of various members and select pilot programs informed by the wisdom and judgment of the committee as a whole. Several pilot programs were eliminated because they were considered to be infeasible, impractical, or intended to resolve issues of limited importance. The shortcomings identified in some early pilot programs led committee members to seek input from defense and industry experts and to improve experimental designs. Thus, the committee was able to evaluate the programs on a systematic and rational basis.

Figure 4-1 shows that there was considerable consensus among the committee members about four of



A. Increased Training Time through Technology
B. Advanced Distributed-Learning Technology for Maintenance Personnel
C. Streamlined Administrative Processes
D. Telesupport and Remote Staffing
E. Reserve Component Battle-Staff Officer Performance
F. Management of the Individual Ready Reserve
G. Reserve Component Automation System
H. Best-of-Type Competitions
I. Cadre Units for Peacekeeping Operations
J. Reserve Component Participation in the Aftermath of Incidents Involving Weapons of Mass Destruction
K. Information Technologists in the Total Force
L. Reserve Peacekeeping Battle Laboratory
M. Continuous Land Warfare
N. Unmanned Vehicles
O. Biosensors
P. Total Force for the Twenty-First Century
Q. Helicopter Unit Interfaces with Allies
R. Test-Bed for Active Force Transformation

Note: The specific rankings in this figure were developed for the evaluation process during this study. They do not reflect the adjustments in pilot program M (Continuous Land Warfare) that occurred as a result of the peer review process and the committee's final deliberations. If the committee were to reevaluate that pilot program, its relative position might be different. However, the committee believes that the general rankings would not be changed.

FIGURE 4-1 Rankings of pilot programs.

the pilot programs; almost every member ranked these four (A through D) in the top one-third. The next four pilot programs (E through H) were ranked in the top one-third more often than in the bottom one-third. The rest of the pilot programs (I through R) were most often ranked in the bottom one-third.

AREAS FOR IMMEDIATE ACTION

One focus of this report is to improve reserve component capability for rapid deployment by recommending modern information and communications technologies that would minimize administrative impediments. The committee developed two pilot programs to address administrative issues but decided, after careful consideration, that these programs would only delay the necessary changes to administrative procedures. The committee believes the Department of Defense could take immediate action in these two areas (management of the Individual Ready Reserve and Reserve Component Automation System), using currently available technology to improve the integration of reserve component and active component personnel systems and information processing systems. If necessary, the Department of Defense should ask the Congress to change laws and provide support. In these areas, the need for pilot programs, although they might provide supplementary information, would only delay the straightforward implementation of improvements. The two pilot programs developed for these areas are summarized below; they are described more fully in the appendix to this chapter.

Management of the Individual Ready Reserve

By design, neither active nor reserve units are fully manned in peacetime. Trained replacements are drawn from the Individual Ready Reserve (and other sources) to fill out the unit as it deploys. This pilot program would evaluate the active and reserve data systems with respect to both supply and demand, determine whether the systems were compatible, and determine how long it would take for trained people to show up for deployment. After careful consideration, however, the committee concluded that the Department of Defense could and should adopt modern personnel and data management tools to improve management of the Individual Ready Reserve without waiting for the results of this pilot program.

Reserve Component Automation System

Currently, Army Reserve and National Guard units use the Reserve Component Automation System, a computer system that is only used in peacetime. When reserve units are mobilized, they must use a different system, which is based on software incompatible with the first system. The delays caused by the changeover could delay mobilization and, possibly, wartime operations as well. Experiments in the pilot program would determine the costs and benefits of expanding the Reserve Component Automation System to a "go-to-war" status. The committee concluded, however, that the Department of Defense should take immediate action and request congressional approval for making changes without taking the time to implement a pilot program.

HIGH-PRIORITY PILOT PROGRAMS

Using the process and criteria outlined above, the committee reached strong consensus on four pilot programs that warrant priority attention by the Department of Defense because of their potentially significant impact and relatively good chances of success. These programs, which are applicable in various degrees to all of the military services, are described below. (See Chapter 5 for more detailed discussions.)

The four programs involve (1) distance-learning technology, (2) advanced distributed-learning technology (3) the use of technology to streamline administrative processes, and (4) bandwidth and computing power for increasing remote staffing. The committee recognizes that the Department of Defense already makes limited use of these technologies, and these proposals are not intended as criticisms. These pilot programs specifically focus on reserve component effectiveness and active-reserve integration. This discussion also focuses on pilot programs to explore nontraditional uses of technology to determine if full-scale implementation is warranted.

Increased Training Time through Technology

This pilot program applies distance-learning technology (with which all services are experimenting) to increase the time effectively available for training. Reserve units have limited time to conduct *both* individual and unit training. An important barrier to the effectiveness of reserve units as a whole is that individuals must often use unit training time for their individual training. This pilot program would explore the use of distance-learning technology to encourage voluntary individual training, either at home or at another convenient place. (Examinations would be given under controlled conditions.) The pilot program would explore the costs and effectiveness of a wide range of incentives for reservists to complete courses successfully, including meeting requirements for promotion, early advancement, retirement points, paid training time, the reward of a computer, and cash bonuses.

Advanced Distributed-Learning Technology for Maintenance Personnel

Modern military equipment with more reliable components is becoming increasingly complex. But this equipment tends to fail in unanticipated ways, making repairs difficult. This pilot program would be conducted in cooperation with private companies that have already tackled this problem to determine if their diagnostic and repair technologies—transferred over long distances from an expert to a user—could be used for military equipment. The program would also examine whether advanced distributed-learning technology for the maintenance of one kind of machine could be readily transferred to another—an issue of great importance to reserve components whose units must maintain a variety of equipment often different from the equipment used by their active counterparts.

Streamlined Administrative Processes

Current administrative practices, which are both time consuming and labor intensive, cut into training time and slow down mobilization. Although widely available commercial practices and technologies could be used to streamline administrative processes, their adoption has been slow despite strenuous efforts to make improvements. This pilot program would evaluate some "quick fixes" and demonstration projects that use advanced database technologies. One goal of the program would be to demonstrate to Congress and the Department of Defense that time and money could be saved and reallocated to other essential tasks, thereby creating pressure for implementation of near-term improvements.

Telesupport and Remote Staffing

With vastly increased bandwidth and computing power, combat units can be linked to technical support units and personnel based in the United States. This capability could reduce the size and vulnerability of units deployed overseas and, at the same time, provide the deployed units with access to the best advice from a wide range of sources. It could also help reserve components retain technical support personnel who might otherwise be discouraged by frequent overseas deployments. The experiments in this pilot program would be used to determine which "remote staffing" possibilities work best.

HIGHLIGHTED PILOT PROGRAMS

A part of the reserve component/active component integration problem reflects cultural differences, and it is difficult to assess the ability of technology to change culture. Nevertheless, the committee decided to highlight four pilot programs that could shed light on reserve component capabilities and address some of the issues stemming from cultural differences. Each program involves the Army Reserve or Army National Guard performing an important, visible task in partnership with active component forces. The committee believes the simple act of working together would promote trust and improve integration.

Reserve Component Battle-Staff Officer Performance

The Army National Guard has about half of the Army's combat forces in its brigades and divisions. Skeptics are doubtful that these units could be trained quickly enough after mobilization to get into the fight. The principal impediment involves training time for high-level commanders and their staffs to work together to hone leadership and battle-staff skills. This pilot program is designed to explore the use of modern simulations as part of distance training of the leadership of the Army National Guard.

Best-of-Type Competitions

The fact that "the reserves often win the annual fighter competition" is often cited as evidence of the capabilities of the Air National Guard and Air Force Reserve. The committee did not find a consensus (or objective data), however, about the capabilities of the Army Reserve. This pilot program would involve experiments featuring competitions using attack helicopters—an important weapon system for all Army components that is also well represented in reserve component units. These competitions could provide objective measures of comparison of capabilities (as they do for the Air Force). Competitions might increase incentives for training, reveal new tactics, and engender mutual pride and respect.

Reserve Peacekeeping Battle Laboratory

Although the Department of Defense has been studying small-scale contingencies, little attention has been devoted to the role of the reserve components, which are significant participants in these operations. This pilot program would explore the merits of setting up a peacekeeping battle laboratory focused on improving the effectiveness and integration of the reserve components in peacekeeping operations.

Continuous Land Warfare

The technological superiority of U.S. forces has enabled them to "own the night" (i.e., to operate around the clock and in adverse weather). However, in the early stages of a military operation, there may not be sufficient personnel to maintain this momentum. A potential solution could be to augment combat support and combat service support units, whose equipment is already in-theater, with personnel who have shipped into theater ahead of their equipment. Experiments would be conducted to address uncertainties, such as (1) the best level of augmentation (e.g., individual, team, or unit); (2) the best timing for augmentation; and (3) the merits of using distributed training, exercises, and battle simulations to integrate reserve component augmentees with their active counterparts.

OTHER PILOT PROGRAMS

The committee believes that the remaining eight pilot programs also merit consideration. They are described below in order of their ranking by the committee members using the criteria described earlier. Over time, issues and technologies will change, and the Department of Defense might decide to perform some of these pilot programs. The Department of Defense's (and the committee members') judgments could change as new issues and uncertainties arise. The committee believes that the Department of Defense should consider using the criteria outlined above in its deliberations—and not rely on the rankings in this report. Some programs are Army-specific, but several are applicable to more than one military service.

Cadre Units for Peacekeeping Operations

Some Army reserve component units (e.g., psychological operations, civil affairs, and military police) are in such high demand for peacekeeping and stability operations that they have been deployed repeatedly in recent years, raising the possibility of growing dropout rates in the years ahead. This pilot program would evaluate the adequacy of deploying cadre units at one-quarter strength and filling them at the time of mobilization with active and reserve component volunteers who had received some training through distance-learning techniques.

Reserve Component Participation in the Aftermath of Incidents Involving Weapons of Mass Destruction

One mission of the reserve components is to help manage the consequences of attacks with weapons of mass destruction in the United States. This pilot program would focus on the establishment of reserve component units in major cities comprised of technical specialists who can diagnose a situation immediately after an incident and call in appropriate experts. Locating and using these units in major cities might attract experts who, not wanting to leave their home areas, might otherwise not volunteer to serve in the reserve components.

Information Technologists in the Total Force

In the future, the Department of Defense's doctrine and tactics will rely increasingly on information dominance. However, the private sector will continue to take the lead in the application of new information technologies, and few information specialists are likely to choose active component duty given the attractiveness of civilian jobs. This pilot program would explore innovative ways of using information technologists in the reserve components to make service more attractive. A subsequent experiment could then evaluate incentives for attracting such individuals to the reserve components.

Unmanned Vehicles

Advanced unmanned aerial vehicles have great potential not only for war but also for operations other than war (e.g., reconnaissance and communications). Today they can be operated remotely within a theater of operations (e.g., Bosnia). In the future, technology will enable control of unmanned vehicles from halfway around the globe. Reserve component personnel could participate in the operation of advanced unmanned aerial vehicles. This pilot program would involve a series of graduated experiments to determine if unmanned vehicles could be operated by reserve component personnel.

Biosensors

Injury and stress naturally degrade an individual's performance. Personal biosensors, similar to the ones used for manned space flight, could be attached to military personnel in stressful situations (e.g., during training) to detect conditions that could affect performance and relay the information back to a command post where it could be interpreted remotely by reserve component specialists. Several experiments in this pilot program would focus on using this information effectively.

Total Force for the Twenty-First Century

It will be difficult for large, Army National Guard units to meet rapid deployment requirements. Large units generally require more post-mobilization training, and heavy equipment requires sealift and airlift. This pilot program would explore the capability, mobilization time, and integration potential of small, elite Army National Guard combat units, such as helicopter companies and special reconnaissance units, equipped with the latest hardware.

Helicopter Unit Interfaces with Allies

The Army National Guard has had very few early-entry combat assignments and thus has had limited opportunities to prove that it can successfully discharge these assignments. This pilot program would experiment with using Guard-operated, high-technology helicopters to provide battlefield information to allied forces.

Test-Bed for Active Force Transformation

Future military operations, as described in *Joint Vision 2010*, will be strikingly different from current military operations. The development of, and transformation to, future doctrine will take years. As the military (particularly the Army) changes, it will have to decide when to deploy and fight using the former (abandoned) doctrine and/or when to change to the new (not yet mastered) doctrine. This pilot program would explore ways for evaluating new doctrine by reserve components.

ADDITIONAL CONSIDERATIONS

The Statement of Task concluded with a request for the study to "identify methodologies for Department of Defense to gather data on the broadest set of opportunities for efficient total force integration after 2010." In consideration of this subtask, the committee developed a process for the continued development and expanded use of pilot programs, as well as targeted data collection and data management.

Benefits of Pilot Programs

The committee urges the Department of Defense to consider a wide range of pilot programs (the ones described in this report and others). In addition to offering relatively low-cost ways of exploring opportunities for using new technologies, pilot programs could demonstrate the feasibility of innovative concepts. A visible, successful pilot program could also be useful for getting program funding approved by authorities in the Department of Defense and Congress.

Tangible benefits to the integration of reserve and active components can result just from conducting pilot programs. Increased interaction between reserve and active components at a variety of levels could increase their confidence in each other's capabilities. Pilot programs represent low-risk opportunities for reserve and active components to become familiar with each other's capabilities and operations in a nonthreatening environment.

Development of Additional Pilot Programs

The committee believes that the Department of Defense should explore potential pilot programs on an ongoing basis. Pilot programs should be developed and evaluated jointly by elements of reserve and active components. A process like the one used by the Department of Defense to evaluate funding for Advanced Concept Technology Demonstrations could be adapted for this purpose.

Baseline Data Collection

Despite the great value of pilot programs, they will not solve all of the problems associated with maintaining and improving reserve component capabilities. For example, in the administrative areas discussed earlier, the Department of Defense simply needs to implement good business practices. In other areas, the Department of Defense first has to gather data on existing practices to determine whether or not changes in policies or the implementation of pilot programs would be beneficial and cost effective. For example, based on this study, the committee concluded that the Department of Defense should gather data on the stability of personnel in small reserve component units over time to prove or disprove anecdotal reports of high turnover. The committee's experience in this area is described below.

Recognizing the importance of stability to unit effectiveness, some committee members tried to develop pilot programs to improve the stability of important units, such as tank crews. According to anecdotal reports, some small reserve component units have not been stable because individuals tend to leave to take advantage of opportunities for promotion elsewhere. The committee also heard anecdotal reports that reserve components are highly stable. In addition, the committee learned that Israel has adopted measures to award promotions to reserve personnel without their having to leave their units, thus improving stability. (Stability is an issue that also affects active components.)

The committee decided that it would make the most sense for the Department of Defense to gather data on the stability (turbulence and turnover) of personnel in small units, both active and reserve, before suggesting pilot programs in this area. The data should be collected in consistent form using standard definitions, and it should cover, for example, tank crews, battle staffs at the battalion or other levels, and maintenance teams for sophisticated equipment. Once these data have been gathered and analyzed, the Department of Defense might design and conduct one or more pilot programs. For example, experiments could focus on the correlation between combat effectiveness and various levels of stability in small units. The results of the pilot programs could be used to assess the merits of alternative means of stabilizing personnel to maintain quality performance in times of crisis or war.

Data Management

The Department of Defense already collects extensive data from distributed simulations and field exercises. To facilitate future assessments, the committee encourages the Department of Defense to create and maintain performance databases that incorporate these data. If integrated databases and measures of performance are developed soon, they could encompass forthcoming simulations (such as Warfighters' Simulation 2000 and Joint Simulation System) and could influence the specifications for the next generation of test ranges during the transition from analog to digital instrumentation. In addition, integrated databases could be "data mined" (i.e., opened to undirected searches for relationships hidden in high-dimensional data).

Finally, the lack of uniformity among reserve components is an ideal situation for creating a performance database of best practices. For example, the committee was frequently told of solutions to problems that had been found by one or another of the 54 state and territory guard organizations. In an organization as large as the Department of Defense, there are many, informal "pilot programs" occurring all the time. A well constructed performance database of best practices would enable the benefits of these informal pilot programs to be used by many groups.

Appendix to Chapter 4

MANAGEMENT OF THE INDIVIDUAL READY RESERVE

Objective. Determine how technology can improve the management of the Individual Ready Reserve.

Problem

The Individual Ready Reserve is the primary source of fillers and replacements for active and reserve component units of all the military services in the event of a deployment of forces for a major-theater war or complex contingency operation. The Individual Ready Reserve can also provide units with individuals with special skills. Although the Army has the most urgent need for improvements in the management of the Individual Ready Reserve, the Marine Corps, Navy, and possibly the Air Force could also benefit.

Most military units are staffed in peacetime with fewer personnel than they are authorized. These units are filled to their full authorized strength before they are deployed overseas for a military operation. New personnel—officers, noncommissioned officers, and enlisted personnel—assigned to a unit in preparation for deployment are called "fillers." Personnel assigned later to replace combat losses are called "replacements." The goal of the personnel system is to provide a filler for each vacancy that matches the grade and skill specified in the authorization document.

The Individual Ready Reserve is not as effective as it could be because of the difficulties and time required to match supply with demand. Although each military service maintains databases with the names, grades, and skills of the members of its Individual Ready Reserve, there is no system that can rapidly correlate this information with shortages of personnel in deploying units. Because supply and demand are changing continuously, regular annual or semi-annual estimates of the numbers and types of personnel needed to fill units are almost immediately out of date. A system that would earmark members of the Individual Ready Reserve who could meet specific requirements on a near-real-time basis would benefit all of the services.

The demand for deployment fillers could be calculated by comparing the assigned strength of a unit with the authorized deployable strength of the unit. Demand for casualty replacements, however, is hard to estimate because the numbers and kinds of combat casualties are hard to predict. Replacements have to be available only after combat has started, while fillers must be available immediately after mobilization. The current system does not even begin operating until units have been alerted. Therefore, fillers usually arrive long after units have begun their post-mobilization training.

Description

This pilot program would determine whether emerging relational-database technology and wide-band communications links could provide near-real-time matching of the Individual Ready Reserve supply with the demand for fillers. The overall measures of merit for the pilot program would be the time it takes to fill a deploying reserve component unit after it has been alerted for mobilization and the unit's skill-qualification rating after it has been filled. The pilot program would involve the Army and Marine Corps, but the results could also be used by the Navy and Air Force.

This pilot program would focus only on the Individual Ready Reserve, but fillers and replacements from active component individuals (nonunit manpower), recent graduates of initial-entry training, and retired military personnel might be included later. If this pilot program is successful, the new technology might be expanded to cover all sources of pretrained individuals for both active and reserve component units.

Experiments

The experiments would demonstrate how long it would take to determine the demand and then supply the required fillers. Each experiment would consist of a simulated mobilization of a combat organization—an enhanced separate brigade for the Army National Guard, an infantry regiment for the Marine Corps Reserve, and fighter wings for the Naval Reserve and Air Force reserve components. Each simulated mobilization would begin with an alert date and end when the demand for fillers had been met. The first experiment would establish a baseline, and the next two experiments would examine how well near-real-time systems could complete the process.

The ground rules for each experiment would be (1) no personnel could be exchanged between units; (2) only the Individual Ready Reserve would be used to supply fillers; and (3) unqualified unit members would be replaced by qualified Individual Ready Reserve personnel.

Experiment 1

Objective. Determine how long it takes for the exercise combat organization to receive its fillers.

This experiment would use the existing system for reporting vacancies to the mobilization station, ordering fillers from the Individual Ready Reserve, and bringing the unit to deployable strength. The members of the Individual Ready Reserve would be deemed to have reported as ordered.

Question 1. What method is used currently to determine filler requirements for mobilizing reserve component units?

- Identify the person or office that determines filler requirements.
- Identify the method used to determine filler requirements.
- Determine at what point in the mobilization process the filler requirements are established.
- Identify changes or modifications to initial requirements during mobilization.
- Identify the persons or agencies to whom filler requirements are sent.

Question 2. How is the filler requirement met?

- Identify the individuals or agencies that receive filler requirements.
- Identify the person or agency responsible for providing fillers.
- Identify the agency that supplies the fillers.

Question 3. How long does it take for fillers to join their units?

- Determine how long after the alert date the filler requirement was transmitted.
- Determine when and how filler requirements were transmitted to the supplying agency.
- Determine when the supplying agency matched the requirement with the available supply.
- Determine when the supplying agency issued orders to fillers.
- Determine the latest time for all fillers to report to the requesting organization.
- Determine the total elapsed time to provide fillers.

Question 4. How well did the fillers meet the needs of the units?

- How many fillers met the stated filler requirement?
- Could mismatches be used in the units in some other capacity?
- What were the skill-qualification data of units before and after fillers arrived?

Experiment 2

Objective. Determine the feasibility of matching the demand and supply of fillers on a weekly basis.

This experiment would evaluate a system using advanced relational-database software to connect the requesting organization directly with the supplying organization. It would provide a weekly strength report to the supplying organization that identified by grade and skill code the authorized positions in the organization that either have no incumbent or a nonqualified incumbent. The new system would identify demand weekly and identify Individual Ready Reserve personnel who could meet that demand. If the unit is alerted for mobilization, the supply agency would automatically compute Individual Ready Reserve fillers for that week, identify them, and order them to report to the mobilization station on the date the organization is mobilized.

Question 1. Can the demand and supply of fillers be matched weekly?

- How much extra time is required to compute and transmit filler requirements?
- How much would computing requirements weekly add to the workload?
- How much time would it take to match supply with demand?
- How much does matching supply with demand weekly add to the workload?

Question 2. What is the effect of weekly matching on filling mobilizing units?

- How long does it take to fill units using the weekly system?
- How closely do fillers match the demand at mobilization time?
- How much does the weekly filler system cost?

Experiment 3

Objective. Demonstrate the effectiveness of quarterly pre-assignments of Individual Ready Reserve fillers compared to weekly matches and the current system.

This experiment would test a system that pre-assigns Individual Ready Reserve fillers on a quarterly basis. Unlike Experiment 2, which focuses on matching supply and demand, this experiment would also pre-assign specific individual personnel to specific units each quarter. Units would report shortages by grade and skill via quarterly reports. Upon receipt of a request for fillers, the supply agency would identify appropriate personnel and earmark them for that unit. If the units were alerted, the supply agency would automatically issue orders for the pre-assigned fillers to report to the mobilization station on the day the unit is mobilized.

Question 1. Could the supply and demand of fillers be matched quarterly?

- How long does it take to compute and transmit filler requirements?
- How much work is required to compute demand quarterly?
- How long does it take to identify specific personnel to meet requirements?
- How much work does it take to match specific personnel with requirements quarterly?

Question 2. What is the effect of quarterly matching on filling units?

- How long does it take to fill units using the quarterly pre-assignment system?
- How closely does the quarterly pre-assignment system match the actual requirements?
- How does pre-assignment compare to the current bulk identification system?
- How much does a quarterly ordering and pre-assignment system cost?

Implications

The results of the three experiments in this pilot program should provide enough data for the services to determine whether to retain the current system for filling mobilizing units, install a weekly matching system, adopt a quarterly preassignment system, or try another system.

RESERVE COMPONENT AUTOMATION SYSTEM

Objective. Demonstrate how technology could improve the Reserve Component Automation System.

Problem

When reserve component units are mobilized, they need computers to support military operations and tie into active component systems. Currently, many reserve component units must use commercial computers and adapt software to support their operations and then try to tie into active component systems. This is a distinct disadvantage for small units participating in small-scale contingencies; it would be a major problem if large numbers of reserve component units were mobilized to support a major-theater war. Modern technology could be used to improve the integration of reserve component systems into active-force systems for wartime operations. One approach would be to use some or all of the elements of the Reserve Component Automation System to support wartime operations.

Description

The Reserve Component Automation System has been in development for a long time and is now being fielded to the Army National Guard and the Army Reserve. However, the system was developed as administrative support in peacetime. By law, the system cannot be used to support wartime operations. Therefore, units can use the Reserve Component Automation System to support peacetime administration and the planning and preparation for mobilization but must leave Reserve Component Automation System computers behind when they are deployed for military operations. To support military operations, many units are issued or purchase commercial computers that use standard software. Thus, many reserve component units must maintain two incompatible computer-support systems, neither of which may be compatible with the systems used by the active forces.

With congressional approval, the Reserve Component Automation System might also serve as all or part of a "go-to-war" system for the Army National Guard and Army Reserve. A pilot program could demonstrate the feasibility of integration and determine if the tangible benefits would exceed the cost of the modifications. The Reserve Component Automation System Program Executive Office should manage this pilot program in coordination with the U.S. Army Forces Command, the U.S. Army Reserve Command, and the National Guard Bureau. Factors that should be considered for all of the experiments described below are cost, benefits, coverage of operating systems, the speed of operations, and the quality of performance.

Experiments

The experiments would consist of modifying the existing Reserve Component Automation System to perform post-mobilization tasks. The first experiment would provide a baseline for comparison with other configurations. Each configuration would extend the capabilities for degrees of wartime use. The modifications must be made in a way that preserves current functionality of the system.

The overall pilot program would consist of five experiments that would be conducted simultaneously by similar elements of the Army National Guard and Army Reserve. Enhanced separate brigades of the Army National Guard (perhaps the brigades in two integrated divisions) could provide five to six battalion headquarters and about 20 companies for each experiment. The Army Reserve, using combat service support brigades, each with a traditional set of battalion headquarters and operating companies, would provide five to six battalion headquarters and about 20 companies for each experiment.

Each experiment would include two exercises: (1) a mobilization exercise that would simulate bringing units to active duty, moving them to a mobilization station, performing soldier-readiness processing, and commencing post-mobilization training; and (2) a combat simulation in which the units would engage in simulated combat or support operations in a major-theater war. A JANUS[1] simulation would be used for the Army guard brigades. Combat-support simulation would be used for the Army reserve headquarters and units.

Each experiment would take 60 days. The experiment period would also require one annual training period for each participating company, battalion, and brigade headquarters. Teams of observers would record the results of each experiment, and participating personnel would prepare after-action reports. The results of each experiment would be collated and compared. Appropriate members of Congress and congressional staff would be invited to observe and or take part in these experiments. The Reserve Component Automation System Program Office, in coordination with the Army Staff, the National Guard Bureau, and the Chief, Army Reserve, would determine whether and how much the Reserve Component Automation System should be modified to provide wartime support.

[1]JANUS is a series of land-combat models with limited air and naval operations, primarily sponsored by Lawrence Livermore National Laboratory and the Army's Training and Doctrine Command.

Experiment 1

Objective. Determine what kind and how much wartime computer support Army reserve component units can expect in the event of a major-theater war.

This experiment would provide a baseline for comparison. The Reserve Component Automation System computers and software would not be used for mobilization or wartime operations, and reserve component units would use a different system upon mobilization. The results would be compared with the results of the other experiments in this program.

Question. What computer systems does the Army use in wartime for combat, combat support, and combat service support operations?

- What are the capabilities and distribution of Army wartime computers used to support field operations?
- What are the standards for Army wartime computer systems for combat and combat-service support?
- What plans and programs are in place to provide reserve component units with wartime computer systems during and after mobilization?
- Can these systems be linked to the combat and combat-service support systems used by the Army in a theater of operations?
- What is the cost of providing a complete set of Army wartime computer systems to Army reserve component units being mobilized for a major-theater war?

Experiment 2

Objective. Determine if Reserve Component Automation System software could be adapted to provide wartime support.

This experiment would use Reserve Component Automation System software to provide administrative support for reserve component units during and after mobilization to determine if the current software suite could be modified for installation on the Army wartime computers issued or purchased by units. If current software could be used, units would not have to transfer administrative data during mobilization.

Question 1. Can the Reserve Component Automation System software be modified to operate on Army wartime computers?

- Can the Army's wartime computer system operate Reserve Component Automation System software without modification?
- What modifications are required for Reserve Component Automation System software to run on the Army wartime computer system?
- What problems would be encountered in adapting Reserve Component Automation System software to meet the Army standards?

Question 2. Does it make sense to use the Reserve Component Automation System software on Army wartime computers?

- How useful would the current Reserve Component Automation System software suite be in a theater of operations?
- How useful would modified Reserve Component Automation System software be for each battlefield operating system?
- What would be the cost of modifying the Reserve Component Automation System software to run on Army wartime computers?

Experiment 3

Objective. Determine if the Reserve Component Automation System software suite could be modified to provide wartime computer support.

This experiment would use Reserve Component Automation System software in Army wartime computers, as well as develop new software or modify existing commercial software to satisfy anticipated wartime requirements and add it to the Reserve Component Automation System software suite. This would provide reserve component units with a "go-to-war" system they could use during peacetime training and take with them when deployed to a theater.

Question. What modifications to the Reserve Component Automation System software suite would be necessary to provide full battlefield operating systems support for reserve component units using Army wartime computers?

- What modifications would be necessary for the Reserve Component Automation System software suite to be used in the theater of operations on Army wartime computers?
- To what extent would these modifications support combat operations?
- How much would these modifications cost?

Experiment 4

Objective. Determine if Reserve Component Automation System computers with modified software suites (Experiment 3) would provide wartime support.

In addition to developing operational software for Reserve Component Automation System computers, this experiment would use the Reserve Component Automation System computers themselves as "go-to-war" systems. Upon mobilization, units would take with them their Reserve Component Automation System computers outfitted with applications to support the unit's administration and operations while on active duty.

Question 1. Can Reserve Component Automation System computers be equipped with software to provide both administrative and operational support to units in a theater of operations?

- What are the legislative or policy barriers to using Reserve Component Automation System computers in a theater of operations?
- How durable would Reserve Component Automation System computers be in a theater of operations?
- What modifications would be necessary for effective operations?

Question 2. Should Reserve Component Automation System computers that could provide both administrative and operational support accompany units to the theater of operations?

- How well can Reserve Component Automation System computers with current software suites be linked to Army battlefield systems to provide operational support in a theater of operations?
- How much would it cost (or save) to use Reserve Component Automation System computers and modified software suites to provide wartime support?

Experiment 5

Objective. Determine if the Reserve Component Automation System could be linked to Army wartime computer systems in peacetime.

This experiment would determine if the Reserve Component Automation System computers and the integrated peacetime and wartime software suite could be linked to the operational systems of active forces so that mobilized reserve component units would be integrated into the total Army systems without having to get active-force computers and having to learn to operate active-force systems.

Question. Should the Reserve Component Automation System be linked in peacetime to Army wartime computer systems so no transition would be necessary during mobilization?

- Would linking Reserve Component Automation System computers with modified software suites to existing systems of the active force in peacetime be feasible?
- What would the benefits be in terms of administration, training, and operations?
- How much would it cost (or save)?

In addressing the specific data elements for all of these experiments, the following factors should be considered.

- Adjusted incremental cost of modifying the Reserve Component Automation System to contribute to wartime operations. This cost would also reflect savings that would accrue from not having to procure a separate computer system for wartime operational support.
- Utility of the Reserve Component Automation System in a wartime support role. All estimates of benefits should be based on comparisons with the baseline data from the first experiment.
- The extent to which the wartime Reserve Component Automation System allows reserve component commanders, staffs, and units to integrate all of the battlefield operating systems relevant to the

unit's role in the army-in-the-field.

- Extent to which the wartime Reserve Component Automation System speeds up the decision process of reserve component commanders and staffs.
- Extent to which a wartime Reserve Component Automation System improves the ability of reserve component commanders and staffs to perform their wartime missions.

Implications

The results of this pilot program would provide a basis for assessing the potential of the Reserve Component Automation System to provide wartime support. Analyses of the costs and benefits of each modification would indicate whether or not it makes sense to expand the Reserve Component Automation System.

5

Descriptions of High-Priority and Highlighted Pilot Programs

This chapter provides fuller descriptions of the four high-priority pilot programs that warrant priority attention and the four highlighted pilot programs that address cultural concerns. The descriptions are intended to furnish the Department of Defense with a broad understanding of the committee's approach to these pilot programs and their constituent experiments. The level of detail is designed to provide (1) enough information to convey an understanding of the purpose of the pilot program and (2) a possible starting point for implementing the pilot program. Thus, the descriptions should be regarded as plausible ways of conducting the various programs rather than hard and fast prescriptions for conducting them. In the event the Department of Defense decides to conduct any of these programs, a specific plan for implementation will have to be defined and specific responsibilities assigned for various aspects of each pilot program.

HIGH-PRIORITY PILOT PROGRAMS

Increased Training Time through Technology

Objective. Determine how distance-learning technology for individual training at home could improve the readiness and effectiveness of reserve component units.

Problem

Limited training time and funds often make it difficult for part-time reserve personnel to complete skill training to qualify in their assigned positions. The purpose of the pilot program would be to increase training time for individual personnel enabling them to complete more of their individual skill training at home. This would free up more time for collective (unit) training of reserve component units. With distance-learning technologies, individual training could be available at home or another convenient location.

Collective training is essential to achieve and maintain unit readiness. Annual training is the best collective training for most units. Unfortunately, this is also when many unit members are sent to service schools. The absence of key team members limits the effectiveness of unit training and increases the post-mobilization training time necessary to bring the unit to full readiness. Under this system, reservists often find it difficult to qualify in skills that require lengthy courses of instruction, although these skills may be in high demand. Another problem with the present system is retraining members of the Individual Ready Reserve quickly in skills that are in short supply to support a mobilization for a major-theater war.

Distance-learning technologies, which are available now and will certainly improve substantially in the next decade, could make it possible for reservists to complete a larger part of their individual training requirements at home or another convenient place, effectively increasing the total amount of training they could receive each year and enabling them to participate more fully in collective training, especially at annual training. It may be necessary to offer some incentives to motivate reservists to undergo individual training on their own time.

Home-based training would require that the trainee have a computer. Although, many reservists own their own computers, personnel in the junior ranks, who need skill training the most, are the least likely to own their own computers. This pilot program would evaluate the costs and benefits of issuing computers to reservists who pursue their studies from home. It will also explore the advantages and disadvantages of a variety of other incentives.

Description

This pilot program would determine the cost effectiveness of providing government computers and necessary peripheral devices to reserve enlisted personnel so they can pursue skill training at home. All military services would participate in the program. The target groups of the program would be: junior enlisted personnel who have just completed initial training and are trying to qualify in job-specific skills at the next level; reservists who have qualified in a skill at entry level but need to take lengthy courses to qualify for more advanced skill levels; and members of the Individual Ready Reserve who want to continue training in their skills or learn different skills that are in short supply in their services.

Experiments

There would be three experiments in this pilot program. Experiment 1 would evaluate using distance learning to speed up initial-skill qualification of recent graduates of initial training. Experiment 2 would evaluate using distance learning for reservists who have already qualified in a skill at the entry level and want to qualify in the same skill at a higher level or in a different skill. Experiment 3 would evaluate using distance learning for members of the Individual Ready Reserve who volunteer to take skill enhancement or refresher courses. The focus of Experiments 2 and 3 would be on skills that are in high demand and require lengthy courses of instruction. For each experiment, data would be gathered on actual course performance and from surveys of students and, in some cases, their immediate supervisors.

Experiment 1

Objective. Determine if distance learning would make it easier for recent graduates of initial training to qualify at the entry level in their skills.

The initial entry training for every new reservist consists of basic combat training and initial-skill training. Upon completion of initial entry training, reserve recruits are still not qualified for a skill code. This means that many recruits have to complete their initial-skill training after they are assigned to units. For active military personnel, this is not an undue burden because the additional training can be obtained on the job or by attendance at short courses. However, it may be difficult for reservists to complete the requirements in the limited training time available. This experiment is designed to determine if allowing reservists to complete part of their initial-skill qualification requirements at home would ease this problem.

In each service, a control group and a test group of recent graduates of initial entry training would be selected at random. Each group would consist of 50 people. The control group would pursue skill training for an initial-skill code in the normal fashion for their respective services. The test group would be issued computers and appropriate peripheral materials and entered into courses that could be completed at home. Members of the test group would complete the instruction at their convenience according to the course schedule, and examinations would be conducted at armories under controlled conditions. The results of the test group and control group would be compared. Credit would be given for successful completion.

All of the skills for this experiment would be selected from the Department of Defense Occupational Code Section I, Electronic Equipment, Repairers, Sub-Section 101, Communications Radio. The similarities of skills used in the experiment would provide a basis for comparing the results. Examples of the kinds of skills that would be appropriate for this experiment are listed below.

- Army skill code 29E, communications-electronics radio repairer
- Navy skill code 1415, shore communications maintenance technician
- Marine Corps skill code 2E41, ground radio repairer
- Air Force skill code 304X, ground radio communication specialist

The objective of this experiment would be to determine how reservists respond to this kind of training for several incentives, ranging from faster skill qualification to cash bonuses. The principal data generated would be the qualification rates of the test and control groups. Surveys of the participants and of a sample of control-group reservists would solicit reactions to the program and suggestions for improving it.

Question 1. Did distance learning shorten the time it took reservists to qualify in their skills?

- How many days did it take for each reservist to qualify for an entry-level skill code after leaving initial entry training?
- What was the average time for the group to qualify for an entry-level skill code?
- What was the distribution of qualification times?

Question 2. How effective and efficient was the distance training?

- What was the examination score of each reservist?
- What was the relationship between the time to complete training and the examination score?

Question 3. Will reservists participate in this kind of program?

- How many reservists did not complete the training?
- What were the reasons?
- What did the participants like about the program?
- What did the participants dislike?

Question 4. Which incentives would be most effective?

- How many reservists would complete the course with no incentive but faster skill qualification?
- How many would complete the course with the loan of a computer?
- How many would complete the course with the reward of a computer?
- How many would complete the course with a cash bonus?
- How many would complete the course if paid for their time?
- How many would complete the course if they received retirement credit?

Experiment 2

Objective. Determine how distributed distance-learning can enable reservists to qualify for specialties that currently require long courses in service schools.

This experiment would test using distributed learning for reservists who need to upgrade their skill levels or be retrained in different skills. A control group and a test group selected from each service would attend a long course for a particular skill and skill level. Each group would consist of 50 reservists already scheduled to attend these courses. Members of the control group would complete the required course at resident classes in service schools. Members of the test group would receive all or part of the instruction at home. Each member of the test group would be provided with the necessary computer and peripheral materials, such as modem, Internet service provider, and instructional video tapes.

The emphasis in this experiment would be on completion of the courses rather than on how long it takes to complete them. Both groups would be required to pass the same final examination or otherwise qualify for the appropriate skill code and level. This experiment would be targeted at long lead-time skills that are in heavy demand, such as information technology and intelligence.

Question 1. How did the method of instruction affect time to complete the course?

- How many students took the course?
- How many students completed the course?
- How long did it take each student to complete the course?

Question 2. How did the students perform?

- How well did students perform on course examinations?
- How did the supervisor evaluate the performance of each student upon return to duty?

Question 3. Will reservists participate in this kind of program?

- How many reservists did not complete the training?
- What were the reasons?
- What did the participants like about the program?
- What did the participants dislike?

Question 4. Which incentives were most effective?

- How many reservists would complete the course with no incentive but faster skill qualification?
- How many would complete the course with the loan of a computer?
- How many would complete the course with the reward of a computer?

- How many would complete the course with a cash bonus?
- How many would complete the course if paid for their time?
- How many would complete the course if they received retirement credit?

Experiment 3

Objective. Determine the effect of distributed distance learning on the utility of the Individual Ready Reserve.

Although the total number of reservists in the Individual Ready Reserve may equal or exceed the total demand, the Individual Ready Reserve is not likely to have the required numbers of reservists with the particular skills to replace skilled personnel. Ideally, members of the Individual Ready Reserve could be retrained in peacetime to offset identified skill shortages. This experiment would use distributed distance learning to enable members of the Individual Ready Reserve to complete courses of instruction in high-demand, long lead-time skills. In this experiment, 50 volunteers from the Individual Ready Reserve of each service would be issued computers and peripheral devices to enable them to take the course at home. The courses would be designated by their respective services.

Question 1. How effective was the distance learning?

- How many students completed the course?
- How did the students perform on course examinations?
- How long did it take each student to complete the course?

Question 2. Why did the students volunteer to take this course?

- What were the reasons for doing the training?
- What were the expectations of each student?

Question 3. How did students like the course?

- How did each student rate course content?
- What did the participants like about the course?
- What did the participants dislike?

Question 4. How many reservists would complete the program if incentives were offered?

- How many reservists would complete the course with no incentive but faster skill qualification?
- How many would complete the course with the loan of a computer?
- How many would complete the course with the reward of a computer?
- How many would complete the course with a cash bonus?
- How many would complete the course if paid for their time?
- How many would complete the course if they received retirement credit?

Implications

Because reserve components are part time and have limited training, increasing their training time can only have a beneficial effect. If the experiments of this pilot program are successful, distance learning could be used to provide better, more timely training for reservists.

Advanced Distributed-Learning Technology for Maintenance Personnel

Objective. Determine how advanced distributed-learning technology could be used to improve maintenance by reserve components (and active components) in war-fighting and peacetime missions.

Problem

Active and reserve component maintenance personnel typically are given some formal training, acquire experience “on the job,” and then are given training updates for new and modified equipment either in formal courses or “on the job.” Both active and reserve maintenance technicians are having increasing difficulty maintaining their skills to make repairs and/or make modifications to “original equipment” because of the complexity of new systems and the occurrence of failures of different components rather than repetitive failures of the same parts.

The incorporation of advanced learning techniques, proven new technologies, and real-time mentoring into Department of Defense maintenance procedures could improve the effectiveness of both active and reserve component maintenance technicians with less formal training. The Department of Defense and a large automobile manufacturer are currently participating in a collaborative effort to improve the integration of available technologies and distributed-learning tools. Their goal is to develop or set standards by example (i.e., the standards will evolve as industry and customers adopt the most efficient or effective alternatives).

The automobile manufacturer, in conjunction with a computer firm, has developed and demonstrated a wearable computer with user-friendly software that responds to verbal commands. With this technology, repair facilities can download the latest software and diagnostic changes from Detroit overnight, or more rapidly when required, eliminating the need for mailing computer or compact discs. Repair technicians (mechanics) can diagnose problems and make repairs without entering keyboard commands. The portable display monitor (with visual aids and short film clips) can be located with or on the vehicle being repaired, and technicians can dictate notes or memos after repairs for transmittal to Detroit (with no keyboard required). No computer or communication attachments to the vehicle being repaired are required, so the system can be used with existing or "legacy" equipment.

The most important aspects of advances in advanced distributed learning for reserve components are: (1) the possibility of using new tools with existing or "legacy" systems, and (2) the potential of maintenance technicians becoming more effective and productive with less formal training. With this technology, reserve component maintenance personnel could become "as good as" active maintenance personnel even though they have less time available for formal training.

Description

This pilot program could demonstrate that the adoption of advanced distributed-learning and mentoring tools for reserve component personnel would result in more effective and more productive (i.e., more capable and more fully qualified) maintenance technicians. The experiments would be designed to gather information on: (1) the value of advanced distributed-learning tools for the remote training of reserve component personnel; and (2) the benefits of recruiting individuals into the reserve components who use advanced learning tools routinely in their civilian occupations (e.g., maintenance technicians in automobile/truck/heavy equipment dealerships and repair facilities and in aircraft maintenance and repair facilities).

Experiments

This pilot program would involve three experiments. Experiment 1 would determine the effectiveness of technicians using advanced distributed-learning tools. Experiment 2 would compare the effect on performance of formal and informal training with advanced distributed-learning tools. Experiment 3 would assess the differences in performance between reserve component users and commercial users of advanced distributed-learning tools transferring from one system to a different but similar system. The data on the effectiveness of reserve technicians from Experiment 1 could be compared with data from Experiment 3 on how commercial technicians with advanced distributed-learning experience perform on military equipment. In all of the experiments, the principal measures would be (1) the ability to diagnose causes of failure and (2) the time required to find and replace failed parts.

Experiment 1

Objective. Demonstrate how advanced distributed-learning tools could improve diagnoses of maintenance problems and reduce times to repair or replace faulty components.

The first experiment would compare the use of advanced distributed-learning tools to traditional tools for repairing reserve component equipment. The experiment would involve Army and Marine Corps reserve component units responsible for maintenance of trucks, other wheeled vehicles, or heavy equipment and Army, Navy, Marine Corps and Air Force reserve component units responsible for maintenance of H1 or H60 helicopters. The Navy has funds to provide the H1 maintenance data in a format that could be used with advanced distributed-learning equipment.

The units being compared would have the same equipment (e.g., the family of medium tactical wheeled vehicles in the Army and Marine Corps and the H1 helicopter for reserve components in all services where reserve components have appropriate maintenance units). The objective of the experiment would be to compare the ability of reserve component technicians using advanced distributed-learning tools to detect problems and repair equipment with the ability of control reserve component technicians using traditional tools to perform the same or similar functions. The control units would be reserve component personnel with the same formal training who perform essentially the same functions on the same equipment on a day-to-day basis.

The data collected would include (1) how well technicians were able to diagnose the cause of a maintenance problem; and (2) how long it took to repair or replace the faulty components. Qualitative data on the maintenance technicians' opinions of the utility, ease of use, and overall benefit of the new tools would be collected for use by future decision makers.

Units in all of the reserve components should participate in this program. The experiment with wheeled vehicles could be run with units in the Army National Guard, the Army Reserve, and the Marine Corps Reserve. If maintenance of the H1 helicopter is included, the experiment would be beneficial to the aircraft maintenance community in the Navy and Marine Corps Reserves, as well as the Army and Air Force. If software data were available, or could be made available, for H60 aircraft components, other reserve units could also participate, thus increasing the range of data.

Question. What was the effect of advanced distributed-learning tools on the performance of reserve component technicians?

- How many repairs or replacements of parts were necessary?
- How long did it take to diagnose the problem and determine which parts had to be repaired?
- How long did it take to order parts?
- How long did it take for parts to arrive?
- How long did it take to make the equipment operational?

Experiment 2

Objective. Determine if formal training (compared to self-training) with advanced distributed-learning tools would improve the ability of reserve component maintenance personnel to diagnose the causes of maintenance problems and repair or replace faulty components.

This second experiment would compare the results of the reserve component technicians using advanced distributed-learning tools without formal training to reserve component personnel using the same tools with formal training. This experiment would also involve a few reserve component units responsible for the maintenance of trucks, other wheeled vehicles, heavy equipment, or aircraft. All participating units would be responsible for maintaining the same equipment (e.g., the family of medium tactical wheeled vehicles in the Army and Marine Corps and the H1 helicopter). In this experiment, however, the objective would be to compare the ability of reserve component technicians who have had formal training with the ability of reserve component technicians who have had no formal training. The purpose would be to examine the "self-teaching" capability of these tools.

The data to be collected would include (1) how well technicians were able to diagnose the cause of a maintenance problem; and (2) how long it took to repair or replace the faulty components. Qualitative data on the utility, ease of use, and overall benefit of the new tools would also be collected for use by future decision makers.

Units in all of the reserve components should participate in this experiment. The experiment with wheeled vehicles could be run with both National Guard and Reserve units in the Army and with Marine Corps reservists. If the H1 helicopter is included, the experiment would be applicable to the aircraft maintenance community in the Navy and Marine Corps Reserves and, perhaps, the Army and Air Force as well. If software data is available, or could be made available, for H60 aircraft components, other reserve component units could participate, thus increasing the range of data.

Question. What is the impact of formal training on the performance of reserve component technicians?

- How many repairs or replacements of parts were necessary?
- How long did it take to diagnose the problem and determine which parts were needed to repair the equipment?
- How long did it take to order parts?
- How long did it take for parts to arrive?
- How long did it take to make the equipment operational?

Experiment 3

Objective. Demonstrate how diagnostic and repair skills based on advanced distributed-learning tools could be rapidly convertible to the maintenance of other equipment.

This experiment would assess how well reserve component technicians could work on commercial systems and how well commercial technicians could work on military systems, both using distributed-learning tools. One purpose of this experiment would be to assess the ability of individuals to adapt their experience with one system to a different but similar system. A second purpose would be to determine if skilled civilian technicians who routinely use advanced distributed-learning tools would be more effective reserve or guard members than individuals with less experience. (If so, these civilian-sector employees could be targeted for recruitment into specific types of guard and reserve units.) Having commercial technicians work on military systems with no additional special training would provide some data and experience to evaluate. This experiment could be limited to land vehicles if commercial aircraft appropriate for work with advanced distributed-learning tools are not available.

The data to be collected would include (1) how well technicians were able to diagnose the cause of a maintenance problem; and (2) how long it took them to repair or replace the faulty components. Qualitative data on the utility, ease of use, and overall benefit of the new tools would also be collected as subjective input for future decision.

The Army and Marine Corps units participating in experiments 1 and 2 should also participate in this experiment. Civilian volunteers from the automobile manufacturer's test sites working with the Department of Defense would be contracted on a one-time basis to provide a civilian baseline for comparison.

Question 1. Does the use of advanced distributed-learning tools improve reserve component and commercial technicians' ability to repair unfamiliar equipment?

- How many repairs were necessary?
- How long did it take to diagnose the problem and determine which parts were needed to repair the equipment?
- How long did it take to order parts?
- How long did it take for parts to arrive?
- How long did it take to make the equipment operational?

Question 2. How do reserve component technicians using advanced distributed-learning tools (data from Experiment 1) compare with commercial technicians using the same tools (data from this experiment)?

- How many repairs were necessary?
- How long did it take to diagnose the problem and determine which parts were needed to repair the equipment?
- How long did it take to order parts?
- How long did it take for parts to arrive?
- How long did it take to make the equipment operational?

Implications

This pilot program would demonstrate the effect of advanced distributed learning on the capability of reserve component maintenance technicians to maintain equipment at a high level of readiness. The program would also show how formal training with advanced distributed tools would affect the ability of reserve component technicians to deal with unfamiliar equipment. The findings of this pilot program could lead to an increase in the use of advanced distributed learning in schools and in units. If the program was expanded to include active component technicians, it would also provide data on the relative performance of reserve component and active component maintenance technicians.

Streamlined Administrative Processes

Objective. Determine how advanced information management and administrative technology can be used to improve the readiness and integration of the reserve components.

Problem

The mobilization of reserve component units and individuals currently consumes more manpower and time than it should, primarily because some of the personnel management, pay, and record-keeping systems used by active forces, reserve components, and individual reserve units are incompatible. The Army reserve component units, for example, cannot use their peacetime computers and software for mobilization; hence they must transfer data via various stopgap measures and ad hoc procedures. Meanwhile, individuals are processed for active duty as if they were first-time members of their service. The soldier-readiness processing takes an inordinately long time. As a result of these inefficiencies, less time can be spent on post-mobilization training, and many people must be assigned to computer terminals to transfer data.

Description

This pilot program would involve two experiments, one focused on mobilizing Army reserve component units and one focused on activating individual reservists. Both experiments would explore the use of new technologies to overcome hardware and software incompatibilities to accelerate the transfer of data across the reserve-active divide. The goal is to obtain systems interoperability quickly. This pilot program would focus on the Army; however, the Department of Defense could also develop experiments germane to system incompatibilities in the other services.

Experiments

The first experiment would focus on using new technology to accelerate the transfer of personnel data from the reserve component unit to the mobilization station. The second experiment would focus on using new technology to accelerate the processing of reservists for active duty and qualifying them for overseas deployment.

Experiment 1

Objective. Demonstrate how active and reserve component pay and personnel data systems could be linked at the time of mobilization.

This experiment would help determine whether "quick fixes" could be used to link reserve and active force pay and personnel data systems, how much these "fixes" would cost, and how much time and effort they would save. The experiment would involve two different quick fixes and the status quo as a control system. The experiment could be conducted with reserve component units of any size, but the most obvious candidates would be combat brigades of the Army National Guard. Also, the Army has two relatively new integrated active-Army-and-Army-National-Guard divisions (one at Fort Riley and one at Fort Carson) that could benefit from participation in this experiment. This description is phrased in terms of brigades, parent-division headquarters, and the major Army command responsible for delivering mobilized reserve component units to regional commanders. (The most obvious Army command for this first experiment would be the U.S. Army Forces Command, Fort McPherson, Georgia.)

The experiment would apply two different hardware and software "fixes" to a practice mobilization of Army National Guard brigades, with the third brigade of each integrated division using current processes to provide baseline data. (The experiment could be performed in both integrated divisions to increase the reliability of the results.) The technologies tested would be selected from the many emerging systems for bridging different software programs and would be purchased and installed by private contractors. The experiment would address the following questions for each method of data transfer.

Question 1. Did interoperability accelerate the processing of personnel in each brigade?

- How long did it take to transfer personnel data from the reserve component system to the active component system at the mobilization station?
- How many errors were there in transmitted personnel data?
- What was the percentage of data errors?
- How many disruptions or failures were there during the transfer of data?
- How much time was lost during the transfer period because of system failures?

Question 2. How much did the system cost?

- What was the investment cost for the new system?
- How many personnel were required to operate the system?
- What were the costs of installing, maintaining, and rehearsing the system in peacetime?
- What were the operating costs of conducting data transfer upon mobilization?

Question 3. Does either of the systems tested merit service-wide adoption?

- How did the tested systems compare in terms of cost effectiveness?
- What would the cost of installing the system Army-wide be?

- What remaining problems would still have to be addressed?

Experiment 2

Objective. Investigate how the entry of reservists into active duty can be accelerated.

New technologies, or existing systems used in new ways, might accelerate the entry of reservists into active duty, including soldier-readiness processing for overseas deployment. This processing involves ascertaining the condition of reservists and screening them to ensure that they meet statutory and regulatory requirements to be placed on active duty and deployed. For example, reservists are required to have family support plans that make adequate provisions for the support of their dependents.

This experiment could be conducted with four company-sized units. The participating units should have the same organization and mission structure to eliminate differences in reporting requirements. Members of a control company would be processed for mobilization using current systems. Members of one test company would be equipped with a "smart card" containing all necessary soldier-readiness processing data. The mobilization station for the test company would be equipped with smart-card readers. A second test company would use an expanded version of the existing Reserve Component Automation System. The mobilization station for this company would have to also be equipped with Reserve Component Automation System computers or compatible equipment and software.

A third test company would be mobilized with the help of a centralized mobilization assistance unit assigned to its mobilization station. The assistance unit would be linked electronically to the mobilizing company as soon as the mobilization order was received. Equipped with compatible existing or purchased computers, the mobilization assistance unit would be able to transfer the data early. At the same time, the assistance unit would work with the mobilization station to resolve issues relating to different interpretations of mobilization requirements. In effect, the assistance unit would provide authoritative help to the company as it moves through the mobilization process.

Question 1. How long did it take to process each company?

- How long did it take to complete processing for all unit members?
- How long did it take to complete processing for 80 percent of the unit members?
- How long did it take to complete processing for 50 percent of the unit members?
- What was the average time to complete processing for an individual?

Question 2. How long did the processing for each unit delay the start of post-mobilization training?

- How many hours after M-Day[1] did post-mobilization training begin?
- How many soldiers were processed and available for training at the end of each day after M-Day?
- What proportion of company strength was processed and available for training at the end of each day after M-Day?

Question 3. How much effort did processing require on the part of the mobilization station?

- How many total staff hours were required to complete processing of the company?
- How many personnel were required for processing company members?
- What was the cost of installing various technologies for the different test companies?
- What was the peacetime cost of the mobilization assistance unit for the third test company?

Question 4. What was the quality of processing results?

- What was the error rate for processing?
- How many processed personnel were qualified for active duty and deployment?
- What proportion of processed personnel were qualified for active duty and deployment?
- How many complaints, reassessments, and reversals of initial disqualifications were there?
- What was the proportion of complaints, reassessments, and reversals of initial disqualifications?

Question 5. Should any of the new processing methods be adopted Army-wide?

[1]M-Day is the day mobilization officially begins.

- What are the estimated benefits in terms of earlier availability of reserve component units?
- What is the estimated cost of adopting the processing system Army-wide?

Implications

The goal of both experiments would be to overcome differences in computer and software systems among active and reserve component units through "bridging" technologies and other quick fixes. Time saved in processing could translate directly into an earlier start for post-mobilization training. Hence, mobilization would be faster and reserve component units would be available earlier for integration with or in support of active components.

Telesupport and Remote Staffing

Objective. Demonstrate how information and communications technologies could be used to provide remote support and expertise to improve the readiness, effectiveness, and integration of the reserve components in war-fighting and peacekeeping missions.

Problem

A major constraint on using reserve components is that their members serve part time and are geographically dispersed. In the past this constraint could only be overcome by converting individuals and units to full-time status and physically relocating them to the site of an active unit or area of need. Revolutionary changes in warfare and in information and communications technologies will ease this constraint.

Providing specialized skills in overseas deployment areas is expensive and difficult, both logistically and politically. This problem is parallel to the problem of providing medical care in rural areas. With telemedicine, key information (e.g., x-rays, cardiac data) can be transmitted to specialists at medical centers who can provide diagnoses and recommendations in real time. The telemedicine concept is already being used in the military community (e.g., in naval intelligence), where it is called virtual staffing, and in the commercial world, where it is called telecommuting. Technological advances in the coming years will make remote staffing much more effective and easier to implement.

In an increasingly sophisticated technological world, competition with the commercial community for skilled personnel has become a serious problem. With remote staffing, specialized expertise could be accessible on an as-needed basis (perhaps in the home or workplace, as well as in the traditional armory). For example, the director of public utilities for a major city could play a similar role in a reserve component civil affairs unit. Another approach would be to combine electronically a group of part-time reservists to provide full-time support. Remote staffing could also ease the problem of retaining reservists with expertise who are now lost when they move to a new area.

Remote staffing offers many benefits for the Department of Defense, such as (1) providing support while reducing the size and vulnerability of units deployed overseas; (2) allowing active component forces to concentrate on mission-essential tasks; (3) providing access to a wide range of individuals with special expertise and training; (4) increasing the integration of reserve and active components; and (5) helping to retain members of reserve components. However, remote staffing will have to be demonstrated and publicized to promote its acceptance in the total force.

Description

Remote staffing is a proven concept that does not require a program to prove its general efficacy. This pilot program could be categorized as a "catalyst" for increasing the acceptance of the concept by the U.S. military. Acceptance is a subtle process that can best be approached from the bottom up rather than the top down. Thus, the committee believes the Department of Defense should ask each of the military services and their corresponding reserve components to suggest areas of application for remote staffing. Pilot programs could then be structured around the suggested applications.

One aspect of remote staffing that should be considered is the potential vulnerability of communications and information technologies to enemy disruptions using information warfare techniques. Enemy actions could include, for example, jamming or spoofing transmissions between U.S. forces overseas and their U.S.-based remote staffs. These kinds of risks, and hedges against them, are topics that should be addressed by active components as well as reserve components. The Department of Defense might or might not choose to address them as part of the experiments in this pilot program.

Experiments

Whatever pilot program (or programs) the Department of Defense decides to pursue should include experiments structured to answer the following types of questions.

Question 1. Which functions (e.g., command, personnel, information [including intelligence], operations, communications, civil-military operations, logistics [including supply, transportation, maintenance, health care], and research and development) could benefit from remote staffing?

- Identify military-conflict functions for which remote staffing could be useful.
- Specify applications within the military-conflict functions to which remote staffing can be applied.
- Develop concepts of operations for each application of remote staffing.
- Clarify the benefits of remote staffing for conducting military operations.
- Estimate the costs of each remote staffing application and the cost-avoidance of each application.

Question 2. What would the appropriate role for reservists be in remote staffing for each function selected for an experiment?

- Identify the attributes of military personnel relevant to their participation in remote staffing.
- Indicate the availability of reservists with skills and experience that would be useful for remote staffing of the function in question.

Question 3. What would the effect of using remote staffing for specific functions be on reserve components?

- Estimate the effectiveness of using reserve components as members of remote staffs.
- Estimate the effect of using remote staffs on reserve component recruiting and retention.
- Indicate possible personnel policies for reserve component personnel assigned to remote staffs.

Question 4. What effect would remote staffing for the function in the experiment have on the effectiveness of deployed forces?

- Assess the effect of remote staffing on in-theater performance.
- Determine if actions by remote staffs are timely.
- Identify the skills and experience made available by the use of remote staffing.
- Indicate the reduction in deployed manpower (in the theater of operations) made possible by the use of remote staffing.
- Identify ways to ensure that remote staffs are responsive to the theater commander and do not become an additional layer of bureaucracy.

The pilot program should have an overall sponsor; subsponsors should be selected for experiments in specific functions. Some examples of applications that could be considered for experimentation are listed below. Additional applications can be developed.

- Intelligence. Remote staffs could provide (1) expert interpretations of imagery and sensor signals, including photographs, infrared, radar, and sonar signals; and (2) detailed, specific information on the physical and human geography of the area of operations.
- Maintenance. Remote staffs could provide specialized knowledge of specific, low-density items of equipment (analogous to on-line help for computer users).
- Legal Support. Remote staffs could provide legal counsel and assistance.
- Supply. Remote staffs could receive requisitions for supplies, relay them to the appropriate national inventory control center, and monitor the filling of orders and shipment of goods in response to requisitions.
- Civil Affairs. Remote staffs could include personnel with experience in similar civilian jobs (e.g., the director of public utilities mentioned above).

Implications

The concept of remote staffing has many obvious benefits for the Department of Defense, including improved integration and effectiveness (e.g., access, use, and retention) of the reserve components. The Department of Defense would most certainly benefit from experimenting with the ramifications of the widespread use of remote staffing.

HIGHLIGHTED PILOT PROGRAMS

Reserve Component Battle-Staff Officer Performance

Objective. Demonstrate how interactive distributed-simulation technology could be used to improve the readiness and effectiveness of reserve component battle staffs for war-fighting missions.

Problem

A major point of contention between the Army and the Army National Guard is the level of training of the battle staffs (commander and staff) of the Guard's combat maneuver units. The activities of battle staffs are extremely complex and require high skill levels, which can only be achieved by frequent repetition. Because of the part-time status of the Guard and the geographical dispersal of component elements of a unit, the Guard battle staffs have few opportunities to exercise their skills. Thus, relatively long post-mobilization training times have been necessary. Computer-based courses (distributed via compact disk or the Internet) are now available to train individuals in the skills necessary to a battle-staff officer. The Army is exploring improved methods to conduct effective battle command and staff training (DA, 1999a); these methods could be used for the Army's reserve components as well as its active components. Simulations (e.g., JANUS)[2] are being distributed to Guard units to enable them to exercise these skills collectively. Currently, these simulations require that members of the battle staff be in the same physical location.

As technology advances in the next decade, members of the battle staff will no longer have to be collocated during exercises. Because full battle-staff exercises require so many resources, each battle officer should be as highly skilled as possible before the start of the exercise. This might be achieved by enabling small groups of two or three officers to refine their interactions first, and then moving to full simulations, such as JANUS, that involve the battalion commander and staff. Once the physical limitations have been removed, officers will be able to able to train together, for example, in groups of two or three, from their homes.

[2]JANUS is a series of land-combat models with limited air and naval operations, primarily sponsored by Lawrence Livermore National Laboratory and the Army's Training and Doctrine Command.

Description

This pilot program would involve an experiment to compare the performance of the battle staffs of two battalions of the same brigade of an Army National Guard combat maneuver unit in a JANUS-assisted command-post exercise. The officers in the baseline battalion would train in the normal command-post exercise manner. The officers in the experimental battalion would be given the appropriate simulation software and hardware to use the simulation in a distributed mode. A schedule of simulation exercises would be established and implemented, enabling the officers in the experimental battalion to train in groups of two and three. A JANUS command-post exercise would then be conducted to compare the performance of the baseline and experimental battalions. The exercise would encompass terrain and a scenario that are not familiar to either battalion.

Experiments

The experiments would compare the performances of the two differently trained battle staffs in attack and defend scenarios.

Experiment 1

Objective. Determine if the experimental battle staff performs better than the baseline battle staff.

Question 1. How do the scores on the Army's test-and-evaluation program differ for the control and experimental groups?

- What is the percentage of correct responses for the entire baseline staff?
- What is the percentage of correct responses for each staff position on the baseline staff?
- What is the percentage of correct responses for the entire experimental staff?
- What is the percentage of correct responses for each staff position on the experimental staff?

Experiment 2

Objective. Determine how (and how much) the experimental battalion battle staff used the fully distributed simulation.

- What were the total training times for each complete battalion battle staff ?
- What were the total training times for each position on the battle staff?

Implications

Improving the training of Army National Guard battle staffs could ease the apparent or real friction between Guard units and active Army units.

Best-of-Type Competitions

Objective. Determine if the readiness and wartime effectiveness of reserve component units could be improved by initiating Army-wide competitions for reserve and active attack-helicopter (and potentially other) units.

Problem

For years the Air Force has conducted competitions, such as Gunsmoke and William Tell.[3] These competitions, which have included both active and reserve component units and individuals, have frequently been won by reserve component units. More important, these competitions have brought active and reserve components together and have built respect for reserve component capabilities. They have also been useful in the development of new tactics and employment concepts. The drawback to these competitions is that they are costly to conduct and involve only a very small percentage of either force. As the range, lethality, and capability of weapons increases, fewer physical facilities and ranges will be able to accommodate these competitions.

With rapid improvements in information technology, including high-fidelity virtual and constructive simulations, the scope and frequency of competitions could be increased. The proliferation of simulations, as well as simulation and training devices, could make expanded competitions between active and reserve component units possible. These competitions could be used to improve the readiness and effectiveness of Army reserve component units. In addition, they could be useful in determining if other beneficial effects of competitions, such as those in the Air Force, might apply to the Army (e.g., bringing active and reserve units together and helping to develop new tactics). Finally, the competitions may furnish data that could help to correlate readiness ratings or implement new readiness indicators.

[3]Gunsmoke and William Tell are gunnery competitions for tactical fighters. Gunsmoke takes place at Nellis Air Force Base, Nevada. William Tell takes place at Tyndall Air Force Base, Florida. Both competitions measure the ability of pilots to drop bombs accurately and shoot rockets and precision-guided weapons against ground targets.

Description

Information and simulation technology could be used to create a pilot program for active Army units and Army National Guard units to establish unit competitions based on missions, mission-essential task lists, or specified types of units. The competitions would probably be most useful in areas where combat crews (e.g., attack-helicopter crews) can compete. If the results of these competitions are promising, competitions with other types of units could be considered. The reserve components would be the agents of change in the design and application of the competitions. As the competition process was developed and tested by the reserve components, active units could be brought into the program to compete with them. Throughout the pilot program, unit-readiness ratings and performance in live exercises could be monitored to corroborate readiness ratings and subsequent performances in competitions.

This experiment, would involve a range of competitions between active component and reserve component Army units (e.g., attack helicopters first, followed potentially by artillery, tank gunnery, infantry squad performance, battle staffs, and possibly computer networked "virtual" units). With the growth and fidelity of distributed simulations, these competitions could include a wide range of geographically separated units. The committee notes that the process of getting ready for the competitions offers many benefits even before the competitions begin, and the sharing of experiences after the competitions offers more benefits.

Experiments

There would be five experiments in this pilot program. The specific questions addressed in each experiment would be developed by the active Army and Army National Guard components after a review and discussion of the competitions conducted by the Air National Guard and Air Force Reserve.

Experiment 1

Objective. Determine how information technology and simulations could be used to develop a standardized system of unit competitions between geographically separated active and reserve component units.

Experiment 2

Objective. Determine how constructive simulation technology could be used to create realistic operational environments for competitions, reduce the cost of competitions, and make competitions available to more active and reserve component units.

Experiment 3

Objective. Determine if the results of competitions could be used to establish a correlation between readiness ratings and success in competitions.

Experiment 4

Objective. Determine if and how the results of simulation-based competitions and unit performance in live exercises could be correlated.

Experiment 5

Objective. Determine if the results of competitions could be used to establish predictive readiness indicators.

Implications

The data produced from this pilot program could indicate how technology could be used to conduct competitions between reserve and active units. The technology might also be used to enhance and verify the readiness and effectiveness of reserve component and active-force units. Ultimately, the readiness and effectiveness of both reserve and active components could be improved by competitions.

Reserve Peacekeeping Battle Laboratory

Objective. Determine how reserve component units now being used extensively for "operations other than war" can be better trained and better integrated with the active components.

Problem

The Army may not have an adequate process for developing applications of new technologies to enhance the function of peacekeeping. Any pilot program designed to address this issue would have to be closely aligned with the Army's overall process of defining its next-generation war-fighting needs, especially the "Strike Force" concept and the associated research, development, and training strategies.[4]

In the last six years, the United States has deployed its forces in a wide range of operations other than war—in Bosnia, Macedonia, Haiti, and Somalia, for example. Reserve component units have been essential participants in these operations by providing skills in civil affairs, psychological operations, military policing, and logistics. In the near future, elements of the 49th Armor Division (Texas Army National Guard) are scheduled to deploy in Bosnia. Yet the Army does not have a battle laboratory dedicated to studying the special challenges of operations other than war. Furthermore, no systematic research has been done into the problems of recruiting and retaining reserve component soldiers when they are used almost as frequently as active-unit soldiers in these operations.

Description

An excellent way for the reserve components and active components to work together more effectively would be for reserve components to become more active in the Army Training and Doctrine Command Battle Laboratory. The reserve components could become a major focus of the element of the battle laboratory dedicated to improving the effectiveness of land-force peacekeeping operations. As a part of the existing battle laboratory process, whatever was found to be important for peacekeeping would be cost-effectively integrated into equivalent war-fighting recommendations. The basic concept involves a small core of full-time members of the reserve components who would

[4] The strike force will have five missions: "high-end" decisive operations, early entry operations, "peace enforcement," deter-contain crisis, and humanitarian assistance (DA, 1999b). Initial training products being developed by the Army will support training for the strike force headquarters and staff on the last three missions.

screen candidate technology-based proposals and then arrange for unit-level reserve component elements to perform field evaluations. Individuals who had participated in peacekeeping tours would be especially well qualified to participate in this program. The comparatively short field evaluations could be well within the capabilities of part-time reserve component units. In addition, the extensive reserve component optical cable hookup (connected to the Army commercial satellite network) could be used for discussions with active and reserve units deployed for peacekeeping around the world.

Before implementing this concept, a pilot program should be undertaken to establish its feasibility and effectiveness. The pilot program would involve two stages: (1) the development of organizational, operational, and facilities requirements; and (2) a six-month miniprogram operated with a skeleton staff.

Both the Army National Guard and Army Reserve components should be offered the opportunity of sharing responsibility with active components for the pilot program. The responsible parties and the U.S. Army Training and Doctrine Command Battle Laboratory would develop the details of how the peacekeeping group would interface with the war-fighting battle laboratory group. Representatives of both groups would then work out the details of the pilot program, including the establishment of specific criteria and objectives for judging the results.

Experiments

The experimental battle laboratory would focus exclusively on the demands of operations other than war, especially the effectiveness of reserve component personnel and their integration with active components. Like other battle laboratories, this one would be part of the U.S. Army Training and Doctrine Command, however, the National Guard Bureau or the Office of the Chief Army Reserve (or both) under a joint arrangement, would be responsible for creating and staffing the laboratory. The laboratory could be linked to the Joint Readiness Training Center at Fort Polk, perhaps even located near it, where conceptual and operational testing could be conducted. The laboratory would be staffed by reserve component and active component personnel, both full time and part time.

Implications

Even though the most demanding future military contingency will be a major-theater war, the most prevalent use of the Army in the next decades will probably be for peacekeeping and other nonwar operations. These operations also entail personal danger. Integrating the needs of peacekeeping forces with the needs of war-fighting forces is especially important to ensure that focusing on one task does not cripple the Army's ability to perform other tasks.

Continuous Land Warfare

Objective. Determine how reserve component personnel can augment active units to enhance their ability to operate continuously.

Problem

Sensors, night vision aids, and precision weapons have enabled U.S. forces to "own the night" (i.e., operate effectively and aggressively against enemy forces around the clock and in adverse weather). With advanced technology, weapons systems are becoming increasingly reliable and maintainable, enabling continuous combat operations. Many weapons systems and their supporting elements can now function for extended periods of time without maintenance. Technological superiority, however, has also created a dilemma. Not surprisingly, these new equipment capabilities can strain the physical abilities of both combat and support personnel. This limitation could be critical in the first days of a conflict when the United States has only early-entry forces and their equipment in the area.

The early days of a combat operation are often characterized by a rush to get manpower and equipment on site as soon as possible. Because available airlift capability is finite it is usually faster and easier to transport personnel than it is to move in heavy equipment.

Early entry forces, especially equipment-intensive units, could be augmented with trained personnel to increase their early war-fighting capability. Augmentation could include (1) combat support elements, such as artillery, attack helicopters, and intelligence gathering by unmanned aerial vehicles; or (2) combat service support elements like transportation (to move ammunition and other supplies forward), engineers (who can create barriers, for example), and teams who can repair battle-damaged equipment.

Augmentation of personnel could also be valuable during sustained combat operations. This would seem to be a natural way to exploit the inherent value of the reserve components, particularly those who could be shipped into the theater of operations well ahead of their equipment.

Reserve component personnel may be coming from units that do not use the same equipment as the active units they will augment. This may necessitate simulation training on the types of equipment used by the active units. To enable reserve component individuals, teams, and staffs to work closely with their active component counterparts, they will have to train together and participate in distributed simulations.

Description

Determining the viability of individual, team, or small-unit augmentation concepts and whether reserve component units and personnel can function in this capacity will require a carefully constructed pilot program. The program would determine what type of units (or functions) would benefit the most from augmentation, at what level (e.g., individual, team, or unit), when augmentation would be most effective, and what type of additional training, if any, would be needed.

Augmentating personnel to maintain the continuous operation would be most effective where there is an accumulation of highly effective equipment that is difficult to transport into theater, such as artillery and attack helicopters. Operating this equipment around the clock would provide critical war-fighting capability to early entry forces. Active component personnel who operate equipment in combat service support units, such as transportation, logistics, engineers, medical, and communications, could be augmented by reserves to furnish around-the-clock support.

The level of augmentation will depend on the equipment and the degree of coordination and synchronization required. In some situations, the augmentation of a small number of key individuals will provide the necessary depth without creating a burden. In other situations, a larger functional team or crew will be required. In some other situations, entire units that can take over the operation of equipment may be advantageous.

Maintaining high-tempo operations on a near-continuous basis is a complex challenge at all echelons. Combat support and combat service support units must be as mobile as the combat units they support. Augmenting personnel in units that are continually on the move is extremely difficult. Given the fluid environment of land warfare, augmentation may be more practical for units that operate beyond the line-of-sight of forward units.

The first phase of this pilot program would develop and test concepts for augmenting some elements of combat support and combat service support units to facilitate near-continuous, high-tempo operations. The second phase of this pilot program would address alternative times for augmentation and their relation to critical events. If the first two phases are successful, a third phase would experiment with applications of distributed learning, exercises, and simulations to determine how reserve component personnel, teams, and units might be used to augment their active component counterparts effectively.

Experiments

Before the experiments begin, the Department of Defense should assess what types of combat support or combat service support units or functions would be most amenable to augmentation. The experiments described below would proceed with these types of units.

Experiment 1

Objective. Determine the most effective level of augmentation (i.e., individual, team, unit).

Question 1. How do the following factors affect different types of units?

- How long does it take to achieve full assimilation of augmented personnel?
- What is a reasonable cycle-time for augmentation?
- What is the logistical and operational impact of each kind of augmentation?
- What are the overall effects of augmentation by individuals compared to augmentation by teams or units?

Question 2. How much improvement in mission effectiveness can be achieved through augmentation at the individual, team, and unit levels?

Experiment 2

Objective. Determine reasonable times or critical events requiring the assignment of augmentation personnel.

Question 1. Should personnel be augmented prior to deployment, immediately upon entry into a theater of operations, or subsequently based on anticipated use?

- How much augmentation is reasonable early in an operation?
- Does the timing of the augmentation enhance or inhibit unit cohesion?
- Should added training, if needed, take place prior to deployment or in-theater?

Question 2. Would personnel augmentation be more effective if coordinated with critical events, such as the commencement of an operation or a pull-back for reconstitution?

- Would augmentation be effective for operational units, or should it be limited to units held in reserve?
- What level of added training or orientation would be required for augmentation in an operational unit?

Experiment 3

Objective. Show how distributed-learning exercises and simulations could be used to facilitate augmentations. (This experiment would only be developed further and carried out if the results of the first two experiments were encouraging.)

Implications

This pilot program could provide the Army with a viable means of extending continuous operation to preserve critical initial momentum. This pilot program could produce a template for a range of augmentation possibilities, as well as the types of preparation, training, and theater-orientation necessary for augmentation personnel.

6

Conclusions and Recommendations

CONCLUSIONS

National Security Environment

Conclusion 1. Four significant trends important to the U.S. military that are expected to continue are: (1) increasing globalization of business, with relatively rapid transfers of technology; (2) increasing access by unfriendly foreign governments and nongovernmental entities to relatively sophisticated weapons and weapons of mass destruction; (3) tensions among and within nations that could require the rapid deployment of U.S. military capabilities; and (4) increasing pressure to reduce U.S. defense spending.

Conclusion 2. The future missions for reserve components could range from very small missions, such as small peacekeeping operations, to major missions, such as the augmentation of active forces in major-theater wars.

In addition to working with active components in fully integrated operations, reserve components could also be assigned the primary responsibility for providing the bulk of the forces to carry out some military missions, such as homeland defense against missile attacks (similar to their long-standing participation in the air defense of the United States).

Conclusion 3. In all likelihood, reserve components will be asked to respond rapidly for most future combat missions involving major force units. Mobilization times are likely to be measured in weeks or days rather than months for deployments overseas or for reserve components remaining in the United States to support other forces overseas.

Technological Environment

Conclusion 4. Advanced technologies will have a profound effect on the capabilities of both active and reserve components between now and 2010.

Most of the impact of advanced technologies related to combat systems, such as precision-guided weapons that can be used in all types of weather, will be common to both the active and reserve components. In most respects, the effects on both components will be positive. However, if advanced technologies are deployed unevenly among the active and reserve components, integration could be adversely affected.

Conclusion 5. Communications and information technologies have the most potential for improving reserve component capabilities compared to the capabilities of the active components.

Communications technologies are providing substantial increases in bandwidth every year (i.e., vastly increasing the capacity to move large volumes of data quickly). Information technologies are providing dramatic increases in computing power and the capacity for worldwide access to information by users on either secured or unsecured intranets. The incredible brawn and speed of these technologies will give individuals unparalleled control over goods, services, and activities, all but eliminating the barriers of time and distance. Therefore, communications and information technologies will be especially important for improving the integration of reserve and active components, improving the readiness of reserve components for action, and enhancing the ability of reserve components to carry out future missions.

Effect of Technologies on Reserve Components

Conclusion 6. Capabilities of the reserve components can be increased (1) by improving their readiness for rapid deployment or (2) by creating remote organizations that can support deployed forces.

Improving the readiness (and integration) of reserve and active components will depend on: (1) readiness to deploy more rapidly (e.g., better trained individuals on call-up, faster administrative processing, more efficient post-mobilization training); or (2) creating remote organizations with sufficient communications capability to support deployed forces from the continental United States.

Conclusion 7. Communications and information technologies are the technical keys to improving the readiness of reserve components to serve alongside active components.

Innovative uses of technology—for example, increasing the availability of information workstations and providing training for reserve components in their duty locations or even in their homes—could free more weekend and annual training time for improving unit proficiency. New types of simulations will also improve training for the reserve components, which will make integration with active components easier. In addition, the interval between mobilization and deployment can be shortened by taking advantage of uniform, rapidly updateable databases and database management systems.

Conclusion 8. As available communications bandwidth increases, more remote support units could be used to support deployed forces from their home bases. The increased use of "remote staffs" will be one of the most important effects of technology on integration.

Other Conclusions

Conclusion 9. The pilot programs described in this report (and others that could be developed) can be of great value to the Department of Defense.

Pilot programs, tests, and experiments offer relatively low-cost opportunities for exploring the use of technologies and demonstrating the feasibility of innovative concepts. Pilot programs could also improve the integration of reserve and active components by improving their confidence in each other's capabilities through increased interaction on several levels in a nonthreatening environment.

Conclusion 10. In addition to pilot programs, the Department of Defense could take other steps to improve reserve component capabilities and integration.

In some areas (e.g., administration) the Department of Defense could immediately implement good business practices. In other areas (e.g., the stability of small units over time), the Department of Defense will have to gather data on existing practices to determine whether or not changes in policies or the implementation of pilot programs would be beneficial and cost effective.

RECOMMENDATIONS

Recommendation 1. The Department of Defense should implement selected pilot programs to provide decision makers with better information on issues affecting reserve components.

The four high-priority pilot programs selected by the committee should be included in the initial set of programs. The Department of Defense should give second priority to planning and conducting the four highlighted pilot programs and should also consider the other pilot programs discussed in this report. The significant increase in the use of reserve components should be accompanied by a significant increase in experimentation in the use of new technologies to ensure that reserve components are ready and trained to operate in concert with active components.

Recommendation 2. The Department of Defense should develop and consider implementing additional pilot programs on an ongoing basis.

The development and initial evaluation of reserve component pilot programs should be conducted jointly by elements of reserve and active components. The Department of Defense could use a selection process similar to the one used for deciding which Advanced Concept Technology Demonstrations will be funded.

Recommendation 3. The individual military services, using currently available communication and information technologies, should integrate information on reserve and active component personnel.

The services should reengineer the processing of information on reserve components and the processing of reserve component personnel upon call-up to eliminate cumbersome and unnecessary transitions between reserve component and active component systems and to minimize the time spent on administrative procedures.

Recommendation 4. The Department of Defense should take immediate action to improve the management of the Individual Ready Reserve and extend the Army's Reserve Component Automation System for use beyond peacetime.

Rather than conduct pilot programs in these two areas, the Department of Defense should employ available technologies to help fill units more rapidly before deployment and to use the existing peacetime computer system after mobilization. If necessary, Congress should be asked to change the law and provide funding.

Recommendation 5. The Department of Defense should instruct the military services to collect data on the stability of reserve component and active component personnel—specifically, the stability of individuals in small units.

The data should be collected in consistent form using standard definitions. The Department of Defense should consider including this data in an integrated database with unit performance data, thereby providing a basis for data mining to search for hidden relationships between best practices and small unit performance. The data should cover, for example, members of tank crews, battle staffs at the battalion or other levels, and maintenance teams for sophisticated equipment. Once these data have been collected and analyzed, the merits of alternative means of improving the stability of individuals in units should be assessed, especially in units where stabilization is essential to performance.

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Appendices

Appendix A

Committee Meetings

FIRST MEETING

January 20–21, 1998
Washington, D.C.

Meeting objectives: conduct administrative business, including introductions, discussions of composition and balance for new members, introduction to the National Research Council, committee and report procedures, and administrative support; receive briefings; conduct panel discussion on "future utilization of Reserve Forces"; discuss statement of task with sponsor; discuss project plan and report realization; establish meeting objectives, location, and date for the next committee meeting.

Panel Discussion

Future Utilization of Reserve Forces

COL Mark Chmar
National Guard Bureau

COL Jeffrey Barnett
Office of Assistant Secretary of Defense
(Strategy and Threat Reduction)

Edward Mahen
National Defense Panel

Bill Vogt
TASC, Inc.

Presenters

History and Organization of Reserve Components
Dan Kohner
Office of Assistant Secretary of Defense
(Reserve Affairs)

Sponsor Expectations
Joel Resnick and COL Pat McAleer
Office of Assistant Secretary of Defense
(Reserve Affairs)

SECOND MEETING

February 23–24, 1998
Washington, D.C.

Meeting objectives: discuss the technological environment in 2010, service and reserve component requirements for 2010, and military associations' perspectives; receive briefings; discuss and approve report concept draft; assign writing responsibilities; determine meeting objectives, location, and date for the next committee meeting.

Presenters

Overview of the Reserve Forces
Terrence O'Connell III
Office of Secretary of Defense

Overview of the U.S. Army
COL Richard Payne
U.S. Army Training and Doctrine Command, Future Battle Directorate

Overview of the U.S. Navy
RADM John Byrd
Office of Chief of Naval Operations Strategy and Policy Division

Overview of the U.S. Coast Guard
Paul Redmond
U.S. Coast Guard Headquarters

Overview of the U.S. Army Reserve
BG James Helmly
Office of the Chief Army Reserve Reserve Component Perspectives

Overview of the U.S. Naval Reserve
RADM John B. Totushek
Office of Chief Naval Reserve

Overview of the Air Force Reserve
LtCol Bob Shaw
Office of Chief Air Force Reserve Operations and Plans

Overview of the Office of the Joint Chiefs of Staff
COL Paul Herbert
Strategic Plans and Policy - J5

Overview of the U.S. Marine Corps
COL Michael Fallon
Marine Corps Combat Development Command, Science and Innovation

Overview of the U.S. Air Force
LTC Allison Hickey
Chief of Staff, Air Force Long Range Planning Office

Overview of the Army National Guard
BG Michael Squier
National Guard Bureau, Army National Guard Directorate

Overview of the U.S. Marine Corps Reserve
MAJ Donald Bauza
Deputy Chief of Staff for Manpower and Reserve Affairs

Overview of the Air National Guard
COL Richard Joyce
Communications and Information

Work of IDA on Guard and Reserve Issues
Mr. John Brinkerhoff
Institute for Defense Analyses

Work of the RAND Corporation on Guard and Reserve Issues
Thomas McNaugher
RAND Corporation

Panel Discussion

Military Reserve Associations

MajGen Edward Philbin, ANGUS, retired
National Guard Association of the United States

MG Roger Sandler, AUS retired
Reserve Officers Association

RADM Thomas Hall, USN, retired
Naval Reserve Association

THIRD MEETING

April 13–14, 1998
Washington, D.C.

Meeting objectives: complete composition and balance discussion for members; discuss chapters 1 and 2; consider analysis of technologies; consider potential tests and experiments; receive briefings on types of technologies appropriate for the report and provide an example of optimal integration; determine meeting objectives, location, and date for the next committee meeting.

Presenters

Israeli Reserves—How They Stay Ready
MG Zeev Livne
Embassy of Israel, Military Attaché

Future Technologies
George Singley
Hicks Associates, Inc.

Technologies in the Intelligence Arena
Luke Rentschler
Defense Intelligence Agency

Potential Tests and Experiments—Data Connectivity
Pamela Combs
INTERSOLV

Potential Tests and Experiments—Advanced Distributed Learning
Michael Kendall and Donald Johnson
Office of Assistant Secretary of Defense (Personnel & Readiness)

Barriers to AC/RC Integration
MajGen Sam Carpenter
Office of Secretary of Defense

RC Soldiers Perspective on Technology
Ruth Phelps
Army Research Institute

Technologies in Army After Next
John Gully
Defense Advanced Research Projects Agency, Tactical Technology

Potential Tests and Experiments—Information Networking
Stewart Personick
Bell Communications Research, Information Networking Research

FOURTH MEETING

June 22–23, 1998
Woods Hole, Massachusetts

Meeting objectives: complete composition and balance discussion for one member; receive briefing; review preliminary draft of report; finalize first initial draft with focus on chapters 3–6; consider future data-gathering requirements; confirm meeting objectives, location, and date for next meeting.

Presenter

Potential Pilot Programs
Gen Paul F. Gorman, U.S. Army (retired)
Independent Consultant

FIFTH MEETING

September 16–17, 1998
Washington, D.C.

Meeting objectives: receive briefings; discuss future technologies in depth; review, refine, and score pilot programs, tests, and experiments; review and revise chapters 3–6; draft the conclusions and recommendations; consider off-site visits; confirm meeting objectives, location, and date for the next committee meeting.

Presenter

Sponsor Expectations
Jennifer Buck
Deputy Assistant Secretary of Defense for Reserve Affairs

Panel Discussion

Technologies of the Future

Summer Studies
Donald Latham
Defense Science Board

Accelerated Consequence Management
COL John Silva
Defense Advanced Research Projects Agency Office

Virtual Reality
Annette Sobell
Sandia National Laboratories

Bioengineering
Stephen W. Drew
MERCK Pharmaceutical

SIXTH MEETING

November 3–4, 1998
Washington, D.C.

Meeting objectives: discuss and approve report structure and general content; review, refine, and rescore pilot programs, tests, and experiments; refine the conclusions and recommendations; confirm meeting objectives, location, and date for the next committee meeting.

SEVENTH MEETING

January 28–29, 1999
Washington, D.C.

Meeting objectives: review and discuss concurrence draft procedures; review and discuss work plan; review, discuss, and approve preliminary concurrence draft of report.

Appendix B

Descriptions of Other Pilot Programs

This appendix contains detailed descriptions of eight of the pilot programs summarized briefly in Chapter 4. Although these programs were not highlighted in the report, the committee believes they all merit serious consideration by the Department of Defense. Each description includes a list of the issues addressed; an overview of the program content, including experiments; and a discussion of implications.

The purpose of these descriptions is to clarify the objectives and general thrust of each pilot program and to provide a starting point for planning. Thus, these descriptions should be regarded as plausible ways of conducting the programs but not hard and fast prescriptions.

CADRE UNITS FOR PEACEKEEPING OPERATIONS

Some Army reserve component units (e.g., psychological operations, civil affairs, and military police) are in such high demand for peacekeeping and stability operations that they have been deployed repeatedly in recent years, raising the possibility of growing dropout rates in the years ahead. This pilot program would evaluate the adequacy of deploying cadre units at one-quarter strength and filling them at the time of mobilization with active and reserve component volunteers who had received some training through distance-learning techniques.

Objective. Demonstrate how technology could be used to improve the effectiveness of the reserve components by reducing multiple deployments in peacekeeping operations.

Problem

Under the burden of continuous, intensive peacekeeping operations, certain units in both the active and reserve components have been assigned to multiple rotations, placing a heavy peacetime burden on those soldiers and probably creating problems for recruiting and retaining personnel for both military components.

Description

This pilot program would select two overused categories of deployable units (e.g., military police and civil affairs) and attempt to identify a procedure acceptable to both active and reserve components for deployments and for assessing the results of experiments. The Army Reserves should probably undertake the civil affairs experiment, the Army National Guard the military police experiment, and the Army Research Laboratory the assessment of the results of the overall program. Distance learning could be used to prepare both the cadre and volunteer augmentees for their missions.

Experiments

The idea of the program would be to deploy cadre units at one-fourth strength (rather than fully manned) and to supplement these units to full-strength status with volunteer active and reserve personnel who have received pre-assignment training (remote or *in situ*) provided by the reserve components.

Experiment 1

Objective 1. Determine how effectively fully augmented military police cadre units carry out their peacekeeping missions.

- How knowledgeable are augmented personnel about the functions necessary to accomplish their mission?
- Do they have the skills to carry out their missions?
- How willing are they to undertake their assigned missions?
- How determined are they to fulfill their missions?
- How well were the missions accomplished?

Objective 2. Determine if augmentation reduced the overall tempo of operations.

Objective 3. Determine if this arrangement would improve the retention and stabilization rates of otherwise overused units.

Experiment 2

Objective 1. Determine how effectively fully augmented civil affairs cadre units carry out their peacekeeping mission.

- How knowledgeable are augmented personnel about the functions necessary to accomplish their mission?
- Do they have the skills to carry out their missions?
- How willing are they to undertake their assigned missions?
- How determined are they to fulfill their missions?
- How well were the missions accomplished?

Objective 2. Determine if augmentation reduced the overall tempo of operations.

Objective 3. Determine if this arrangement would improve the retention and stabilization rates of otherwise overused units.

Implications

The results of this pilot program could be used to evaluate using cadre units to alleviate the problem of overused active and reserve components. The results might also suggest how other inequities resulting from continuous, high-level, peacekeeping responsibilities could be redressed.

RESERVE COMPONENT PARTICIPATION IN THE AFTERMATH OF INCIDENTS INVOLVING WEAPONS OF MASS DESTRUCTION

One mission of the reserve components is to help manage the consequences of attacks with weapons of mass destruction in the United States. This pilot program would focus on the establishment of reserve component units in major cities comprised of technical specialists who can diagnose a situation immediately after an incident and call in appropriate experts. Locating and using these units in major cities might attract experts who, not wanting to leave their home areas, might otherwise not volunteer to serve in the reserve components.

Objective. Determine if part-time Army National Guard units that are not co-located with full-time National Guard teams assigned to the weapons-of-mass-destruction defense missions could improve the efficiency of full-time teams by providing on-site assessments of incidents.

Problem

Under the current response plan, a network of 10 National Guard teams, each manned with 22 full-time personnel, would be quickly deployed to emergency areas in the United States in the event of an incident involving weapons of mass destruction. Ten teams distributed over the entire United States constitutes, at best, a marginal quick-response force. Considering the possibility of simultaneous, multiple incidents, as well as the possibility of false alarms by a panicky local populace, on-site assessment teams would have a real advantage.

Description

This pilot program would explore the efficacy of locating National Guard units in urban areas where individuals with specific skills could be called upon to respond rapidly to unlikely but potentially very dangerous incidents. These units would provide unit identities for individuals who could be called upon as individuals or in small teams to augment local police, fire, and medical officials in the event of an emergency. Each National Guard response unit might have a small number of full-time personnel, one or more of whom would always be on call and could respond immediately to a call from local authorities. The designated individuals and teams could be trained via distance-learning techniques and simulations. The on-site team would provide the larger weapons-of-mass-destruction unit with an immediate estimate of the situation, which could reduce the probability of false alarms and identify needs for special equipment and/or trained specialists, as well as for other personnel.

Experiments

Objective. Determine the best way for part-time units to improve the effectiveness of full-time National Guard units.

Experiment

The experiment would be conducted with National Guard units based in two or three cities other than the home stations of the full-time teams. After simulated incidents, the part-time teams would coordinate with local authorities, make a quick estimate of the situation, and report to the full-time team responsible for that area.

Question 1. Did the local authorities find the assistance of the part-time team helpful?

Question 2. Was the information provided by the on-site team to the full-time team helpful?

Question 3. Did the full-time team modify its original deployment plan as a result of the information provided by the on-site team?

Implications

This program could provide the National Guard with data for effectively carrying out an important mission. Involving local specialists in a National Guard mission on a part-time basis could enable the National Guard to retain qualified personnel and increase public support for and confidence in the National Guard as a whole. Maintaining a high state of training and readiness with part-time personnel who use their skills in their day-to-day employment might be easier than trying to maintain the same level of readiness with full-time personnel who might use these skills only in response to a real incident.

INFORMATION TECHNOLOGISTS IN THE TOTAL FORCE

In the future, the Department of Defense's doctrine and tactics will rely increasingly on information dominance. However, the private sector will continue to take the lead in the application of new information technologies, and few information specialists are likely to choose active component duty given the attractiveness of civilian jobs. This pilot program would explore innovative ways of using information technologists in the reserve components to make service more attractive. A subsequent experiment could then evaluate incentives for attracting such individuals to the reserve components.

Objective. Determine how reserve components and active forces could improve their readiness and effectiveness by maintaining trained, ready, militarily aware information specialists.

Problem

The communications revolution will enable the U.S. military to deploy a relatively small force to a combat theater and link that force to technical experts based in the continental United States—so-called remote support units—for help in a wide variety of areas, such as maintenance, software modification, and medical treatment. In other words, the new technologies will enable U.S. forces to take some problems to the experts rather than taking the experts to the problem. This would enable reserve component units to participate in conflicts of all sorts more quickly than if they had to be deployed to the theater. Reservists, however, may be no more available or effective for some tasks than civilians on contract in case of emergency. The military should determine the best way to organize and tap into available expertise.

Description

Expertise from remote sources could be organized in several ways: (1) in reserve component units of a specific kind (e.g., a maintenance unit or an information warfare cell); (2) individual reservists with specific expertise, either in the Individual Ready Reserve or the Active Reserve; (3) civilian experts organized into reserve component cells for the purpose of providing remote support when reserve component cells are deployed away from home. A pilot program to determine the best way to ensure the availability of support from information technologists would explore using all three organizations across a range of specialties (e.g., hardware, software, computer security). An experiment involving computer security is described below.

Experiment

One active unit would be linked to experimental volunteer units of experts in computer security organized in the three ways outlined above. Before the experiment begins, all three groups would be given training in the general duties of remote staffs. The active unit would be put through high-intensity operations, perhaps at the National Training Center, to simulate crisis or combat conditions. The performance of the remote staff units would be monitored and assessed. The baseline arrangement would be a unit operating on its own or a similar unit with attached support. The Army's Forces Command could organize this experiment, but the Atlantic Command might be the most appropriate command headquarters, given its responsibility for joint testing and experimentation.

Question 1. How effectively were remote computer-security organizations able to get expertise to the active unit when it was needed?

Question 2. How important was the quality and timeliness of the computer-security support to the accomplishment of the mission?

Implications

This pilot program could shed light on whether expert information technologists organized in different ways could support active forces engaged overseas. A subsequent experiment could evaluate incentives for attracting information experts into the reserve components or civilian organizations.

UNMANNED VEHICLES

> Advanced unmanned aerial vehicles have great potential not only for war but also for operations other than war (e.g., reconnaissance, communications). Today they can be operated remotely within a theater of operations (e.g., Bosnia). In the future, technology will enable control of unmanned vehicles from halfway around the globe. Reserve component personnel could participate in the operation of advanced unmanned aerial vehicles. This pilot program would involve a series of graduated experiments to determine if unmanned vehicles could be operated by reserve component personnel.

Objective. Determine if the use of advanced technologies for unmanned vehicles, sensors, communications, and computers would improve the effectiveness and integration of reserve components with the active components while furthering technically advanced unmanned operations in the 2010 to 2020 time frame.

Problem

As advanced sensor technology and advanced computing and communications improve, the use of remotely operated unmanned systems is bound to increase. These vehicles could be operated from the theater of operations or from halfway around the globe, and they could be used to carry out the full spectrum of missions.

In the event that communications are disrupted into and out of an entire region of the United States, temporary emergency communications capabilities could be established by flying unmanned vehicles over the area. These communications-relay vehicles could reestablish links between local governments and national emergency-response officials, including members of the reserve components, as well as help residents and businesses reestablish normal activities. These or other aerial vehicles could be equipped with various sensors (e.g., to assess the extent of damage or identify contaminated areas). Other missions could include surveillance of U.S. borders. Stability operations overseas, including peacekeeping operations, could benefit from similar temporary communications or surveillance capabilities (e.g., some surveillance for peacekeeping operations is already being done by unmanned aerial vehicles). During war-fighting, commanders-in-chief or lower-level commanders may require supplemental communications or surveillance capabilities for a region of operations.

The United States is becoming increasingly concerned about even small numbers of U.S. casualties in conflicts overseas. Another serious concern is the prospect of captured U.S. military personnel being paraded through the streets of foreign cities. Unmanned aerial vehicles would eliminate the possibility of losing a pilot if the air vehicle were shot down. The military is also considering the use of unmanned combat air vehicles in regions that are heavily defended. In fact, unmanned vehicles may have some operational advantages over manned aircraft (e.g., their ability to pull very high g-loads that are beyond the limits of human endurance and their ability to operate in inhospitable environments). The Army is considering the use of unmanned ground vehicles as part of a future strike force with operators who would be out of harm's way. However, these operations are only visions at the present time. A great deal of work will have to be done to develop these technologies and their operational capabilities before they can be widely endorsed by the Department of Defense.

Description

Members of the reserve components would experiment with several advanced systems. The experiments would gradually increase in sophistication as they moved from homeland defense to small-scale contingencies to war-fighting operations to bringing about service-wide changes. The experiments would begin after members of the reserve components had become familiar with the operations of current unmanned aerial vehicles. The data-gathering and analysis would be performed under the supervision of the Office of the Secretary of Defense by appropriate elements of the reserve component, in coordination with the military services. The assistance of contractors would also be necessary. The Office of the Secretary of Defense would make the unmanned aerial vehicles or other unmanned vehicles available for the experiments.

Experiments

Experiment 1

Objective. Demonstrate how the use of unmanned aerial vehicles could increase the effectiveness of homeland defense by reserve components.

This experiment would involve communications relays and sensor-equipped unmanned aerial vehicles. The reserve component participants in these experiments would be chosen for their technical skills in computers, communications, and sensors, as well as their operational experience as Air Force or Navy pilots. They would work closely with the other personnel involved in homeland defense.

Question 1. Can reserve components adequately control unmanned aerial vehicles as part of their homeland defense mission?

- How many missions were flown without navigational error?
- What percentage of the information available to the unmanned aerial vehicles was reported correctly?
- How many unmanned aerial vehicles were damaged?
- How many missions had to be aborted?

Question 2. Can unmanned aerial vehicles improve the reserve components' defense of the homeland?

- How many messages were received with and without unmanned aerial vehicles in a simulated emergency?
- How long did it take get the unmanned aerial vehicle airborne and operational?
- What percentage of the simulated damage was reported correctly?
- What percentage of simulated illegal border crossings were effectively stopped?

Experiment 2

Objective. Demonstrate how the use of unmanned aerial vehicles could improve the effectiveness and integration of reserve components with the active components in small-scale contingencies.

This experiment would involve unmanned aerial vehicles operated by the reserve components over regions subject to possible U.S. military operations (e.g., peacekeeping operations); however, the reserve component operators would remain in the United States (or aboard U.S. ships), and the unmanned aerial vehicles would be flown remotely. The experiment would begin with an operation close to the United States, but the goal would be to develop remote operating techniques that could be used at global distances via satellite communications. The reserve component participants in these experiments would be chosen for their technical skills in computers, communications, and sensors, as well as their operational experience as Air Force or Navy pilots. They would work closely with other personnel involved in small-scale contingencies.

Question 1. Can reserve components control and operate unmanned aerial vehicles as a part of small-scale contingencies?

- How many missions were flown without navigational error?
- What percentage of the information available to the unmanned aerial vehicles was reported correctly?
- How many unmanned aerial vehicles were damaged?
- How many missions were aborted?

Question 2. Can remotely operated unmanned aerial vehicles enhance peacekeeping operations?

- How many simulated incidents, such as unauthorized movements of armor in an exclusion zone, were detected and reported?
- How many of the reports were erroneous?
- How long did it take for unmanned vehicles to react to an emergency?

Question 3. Can unmanned vehicles be operated effectively at very long distances by operators in the United States or aboard U.S. ships?

- What percentage of unmanned aerial vehicle missions was conducted without loss?
- What percentage of simulated incidents was detected and reported?
- What percentage of messages was relayed correctly?

Experiment 3

Objective. Demonstrate how using unmanned aerial vehicles could improve the effectiveness and integration of reserve components with the active components in wartime.

This experiment would require that reserve components fly unmanned aerial vehicles remotely from the United States (or U.S. ships) as part of exercises for regional war-fighting. The reserve component personnel would have superb technical skills in computers, communications, and sensors, as well as operational experience as Air Force or Navy pilots. The reserve personnel would be teamed with participants in prior experiments, as well as members of the command performing the war-fighting exercise.

Question 1. Can reserve components adequately control and operate unmanned aerial vehicles as a part of war-fighting operations?

- How many missions were flown without navigational error?
- What percentage of the information available to the unmanned aerial vehicles was reported correctly?
- How many unmanned aerial vehicles were damaged?
- How many missions were aborted?

Question 2. Do these operations provide the capabilities needed by commanders?

- By what percent was the commander's knowledge of the situation increased?
- What percentage of information was in time to be useful?
- By what percent did communications between commanders and their subordinates increase?
- What was the likelihood of an effective attack or defense?

Question 3. Can unmanned aerial vehicles be operated effectively at very long distances by operators in the United States or aboard U.S. ships?

- What percentage of unmanned aerial vehicle missions was conducted without loss?

- What percentage of simulated incidents was detected and reported?
- What percentage of messages was relayed correctly?

Experiment 4

Objective. Test whether reserve components could serve as agents of change in the use of unmanned vehicles in combat.

In this experiment, members of the reserve components would conduct operations with remotely controlled air vehicles in simulated combat conditions. Current fighter or bomber aircraft would have to be modified for such purposes unless advanced prototypes of unmanned combat air vehicles become available from Department of Defense research and development programs. A variation of this experiment would be to conduct simulated ground operations with remotely controlled ground vehicles.

The reserve component personnel would require superb technical skills in computers, communications, and sensors, as well as operational experience as Air Force or Navy pilots; if ground-based unmanned combat vehicles are included, reserve component personnel would require Army experience. Reserve personnel would be teamed with others involved in prior experiments, as well as with members of the active components and members of the research and development community who are working on advanced systems.

Question 1. Are the advanced technologies suitable for unmanned vehicles being used in combat, including operations at global distances?

- How many targets were detected by unmanned vehicles?
- How many targets were engaged by unmanned vehicles?
- How many targets were destroyed by unmanned vehicles?
- How many unmanned vehicles were lost?
- Compare the numbers for unmanned vehicles controlled by distant operators and nearby operators.

Question 2. What technical adjustments will be necessary for ongoing research and development programs?

- How many failures were caused by technical deficiencies, as opposed to training deficiencies?
- How many failures were caused by simulated enemy communications countermeasures?
- How many failures were caused by the simulated delivery of enemy ordnance?

Implications

This series of experiments would provide data for assessing the benefits of using unmanned vehicles to improve the effectiveness of integration of the reserve components across a wide range of missions. If the experiments show that remote combat operations are feasible, this would obviously lessen concerns about the loss or capture of U.S. military personnel during overseas operations. The results would also influence ongoing research and development programs on unmanned systems. The data could also be used to assess whether reserve components perform effectively in remote operations of this type; if so, the Department of Defense might decide to rely on integrated active component and reserve component units for these missions, with active components carrying out the elements of missions that require a manned presence overseas. Finally, if these experiments are carried out by reserve components, active forces could continue to perform their day-to-day functions.

BIOSENSORS

> Injury and stress naturally degrade an individual's performance. Personal biosensors, similar to the ones used for manned space flight, could be attached to military personnel in stressful situations (e.g., during training) to detect conditions that could affect performance and relay the information back to a command post where it could be interpreted remotely by reserve component specialists. Several experiments in this pilot program would focus on using this information effectively.

Objective. Test how biosensors could contribute to the effectiveness and integration of reserve components in a spectrum of missions.

Problem

Individuals in stressful situations (e.g., training for combat) may become less effective because of changes in their physical condition caused by fatigue, injury, exposure to chemical or biological agents, fear, etc. The degree to which these changes affect performance varies with the severity of the change. If the leaders of units in stressful situations are not aware of these changes they may not make appropriate decisions.

Description

Biotechnology has made many recent advances. The physical condition and location of each individual can now be monitored by sensors that are swallowed, implanted, or applied externally. The data on the condition of each individual can then be sent to a central point and the results consolidated to determine the individual's condition. Some of the information could be analyzed and would be available in near-real time. This pilot program would consist of experiments to determine how long it would take a reserve component professional (1) to receive information from the field and (2) to decide whether and/or when to send information back to the commander to use in the field.

Experiments

Experiment 1

Objective. Determine how effectively physical information generated in the field can be displayed in a remote location.

Question 1. How well do the sensors detect and report the condition of the subject?

- How accurately did they report the location of the subject?
- How accurately did they report the fatigue factor?
- What percentage of injuries was reported?
- How many false alarms were there?

Question 2. Was the information properly displayed?

- How many remote locations could receive and display data?
- How accurate were the displays?
- How long did it take for the data to be displayed?

Experiment 2

Objective. Determine the quality of the information received, and how long it took to analyze and report back to the commander.

Question 1. How closely did the analysis of received data match the actual conditions?

Question 2. How timely and how useful was the information given to the commander?

- How long did it take for the commander to receive the data?
- How much of the information was used by the commander?

Implications

Biosensors could improve the effectiveness of units, reduce casualties, and take advantage of the skills of remote, reserve component professional personnel.

TOTAL FORCE FOR THE TWENTY-FIRST CENTURY

It will be difficult for large, Army National Guard units to meet rapid deployment requirements. Large units generally require more post-mobilization training, and heavy equipment requires sealift and airlift. This pilot program would explore the capability, mobilization time, and integration potential of small, elite Army National Guard combat units, such as helicopter companies and special reconnaissance units, equipped with the latest hardware.

Objective. Test ways to get Army National Guard combat units to the scene of battle quickly enough to be of use to the total force.

Problem

At present, Army National Guard units are relatively slow in moving from their home bases to the scene of battle for two reasons: (1) they need several weeks of post-mobilization training to prepare for combat, and (2) moving their heavy weapons and equipment takes time, effort, and a substantial amount of strategic airlift or sealift.

Description

This pilot program would try to take advantage of the shorter training time for units smaller than brigades or divisions by creating small (company-sized), elite Guard units to fill special roles early in a conflict. The program would be tailored to meet the needs of the Army's new strike force and would be in keeping with the trend outlined in *Joint Vision 2010* and similar documents toward smaller combat units and a smaller theater footprint for the combat force as a whole. The experiment would prepare the Army National Guard for playing a larger role in future conflicts. The Army Forces Command should supervise the experiment.

Experiment

This experiment would involve small Army National Guard combat units, such as (1) elite helicopter companies and (2) special reconnaissance units, that could perform special functions early in a conflict. An elite helicopter company could serve as a link between U.S. and foreign militaries in coalition operations. The helicopters could be outfitted with communications and other bridging technologies. Special reconnaissance units would be equipped with precision target-detection and designation technologies as well as communications technology able to "reach back" to standoff firepower from all services. Other types of units could be evaluated as Army concepts evolve. In all cases, Guard units would be configured with the latest technology and given priority in established training regimes.

Experiment 1

Objective. Determine how rapidly small elite combat units could be deployed and integrated with other deployed forces.

Question 1. How long would it take to mobilize elite Guard units?

- What was the interval between recognition of a need and an order to mobilize the unit?
- What was the interval between the mobilization order and readiness to deploy?
- How long did it take from deployment to readiness for action in conjunction with other units in the theater of operations?

Question 2. How effective was the elite Guard unit?

- Obtain effectiveness scores for the elite Guard unit.
- Obtain effectiveness scores for brigades or divisions with and without the Guard unit.

Implications

If successful, this program could shed light on ways to get the larger, more complex Army National Guard combat units to the battle quickly.

HELICOPTER UNIT INTERFACES WITH ALLIES

> The Army National Guard has had very few early entry combat assignments and thus has had limited opportunities to prove that it can successfully discharge these assignments. This pilot program would experiment with using Guard-operated, high-technology helicopters to provide battlefield information to allied forces.

Objective. Demonstrate how technology could be used to develop an important early-entry combat role for the Army National Guard.

Problem

The assignment of important early entry combat duties to the Army National Guard has been difficult for several reasons. The Army National Guard has insisted that its members not be used as "fillers" for primarily active forces. Active forces have been unconvinced that rapidly mobilized Guard units of substantial size can perform as well as active personnel in the critical early phases of a conflict. Successful performance cannot be proven without an appropriate assignment, which cannot be obtained without a demonstration of success. One way to resolve the issue would be to assign the Army National Guard an important early entry land-force assignment that is not already assigned to active component forces, such as providing allies with information and interfaces with U.S. "digitized" forces relayed by Comanche helicopters.

Comanche aircraft would be procured for designated Army National Guard units to enable them to self-deploy to a combat area and operate with our allies. In this way, accurate and timely information of enemy activity in allied combat areas would be input rapidly into the U.S. system for overall "digitized" control of the battlefield. This arrangement would not only provide U.S. allies with better information, but it would also demonstrate the capabilities of National Guard units in early entry combat.

The pilot program would not have been possible without the Comanche's new technologies, including a comparatively low-observable design, enabling intelligence to be gathered in ways that were not possible before. With the Comanche's digitized interface into the U.S. control system, information can be entered into the system in near-real time. The Comanche's features would minimize deployment requirements, which now compete with other early entry requirements.

Description

This pilot program would be conducted in two phases: a planning phase and small-unit trials. The National Guard Bureau should have overall responsibility for conducting the program. However, since the program would require the participation of both U.S. active and allied forces, representatives of these organizations should also be included.

Experiment

Objective. Determine whether properly equipped National Guard personnel can self-deploy to a combat area and operate with our allies.

In the first phase, a group of active and National Guard personnel would be formed to plan in detail how, from the U.S. perspective, the overall concept of Comanche support to allies could best be implemented. The team would then select one or two partners and determine the best method of meeting both U.S. and allied interests. The entire team, including allies, would then analyze the costs and benefits of the arrangement. Assuming the results of the analysis were positive, small-unit trials could be conducted using the Guard-operated Comanches in conjunction with an allied combat unit.

Implications

Because the Army will almost always be fighting as part of a joint or combined force, our allies must be integrated into the concepts of the new "digitized" force. Allied forces are unlikely to field compatible capabilities. Therefore, the United States will probably have to compensate for this difference in some way, perhaps through a series of pilot programs. At the same time, providing Comanche support to allied forces could be a way of testing using the National Guard to meet the readiness requirements of early entry forces.

TEST-BED FOR ACTIVE FORCE TRANSFORMATION

Future military operations, as described in *Joint Vision 2010*, will be strikingly different from current military operations. The development of, and transformation to, future doctrine will take years. As the military (particularly the Army) changes, it will have to decide when to deploy and fight using the former (abandoned) doctrine and/or when to change to the new (not yet mastered) doctrine. This pilot program would explore ways for evaluating new doctrine by reserve components.

Objective. Use the reserve components to accelerate the transition of the active forces to the new doctrine.

Problem

The anticipated transformation of U.S. military forces is based largely on the premise that advances in sensors, computers, and communications will provide them with superior knowledge of the battle space. Documents such as *Joint Vision 2010* hypothesize that these technological advances will lead to significant changes in the structures and operations of active military forces. At this point, however, the U.S. military has undertaken little experimentation on how differences in situational awareness *would* alter current military structures, organizations, and operations. The lack of experimentation is attributable to several factors, including a reluctance to commit significant active-duty forces to testing different organizations and operations. As a result, the United States could miss the opportunity to assess the effects of new information technologies during this period of relative strategic calm.

Description

This pilot program would use the reserve components, working jointly and often in a distributed manner, to experiment with and test different organizational and operational approaches to using information technologies. The program would, in effect, use a portion of the reserve components—the equivalent of a ground-force division and an air wing—as a test-bed. The participants would not test or evaluate advanced technologies for command, control, communications, intelligence, surveillance, and reconnaissance, but would experiment with and evaluate how current military organizations and operational styles could be changed to take advantage of new technologies.

A pilot program would be undertaken in stages in conjunction with the Joint Experimentation Master Plan recently drafted by the Atlantic Command. The initial stages would focus on defining organizational and operational options using distributed interactive simulations rather than field exercises. Subsequent phases would increasingly involve field exercises with a mix of reserve and active components. The later phases of the program would require integrating advanced platforms and command-and-control systems into reserve component elements.

Experiments

The pilot program involves two experiments. The first explores the extent to which distributed interactive simulations can support collaborative development by geographically separated reserve components. The second involves field exercises to test the concepts generated by the distributed interactive simulations.

Experiment 1

Objective. Determine how technology can be used to develop new organizational and operational concepts associated with dominant battle-space knowledge.

Current personal computers have the capacity to support war games based on differential situational awareness. The pilot program would enlist reserve component units to play and analyze these games to determine which kinds of deviations from standard operating procedures tended to have the highest payoff in combat success. This experiment would involve designating several reserve component combat units as a test-bed group. These units would be released from the normal training cycle and from mobilization plans for a period of two years. During that time, they would participate in an experimental cycle in which they would initially identify new operational schemes through the iteration of interactive games that differentiate the players in terms of battle-space awareness.

In the addendum to this pilot program, a potential interactive vehicle is described. This vehicle and others would provide the opportunity to play through a number of military contingencies, virtually and competitively. The Atlantic Command could provide the contingency scenarios and set the levels of battle-space awareness for the players, who could be either battle staffs or entire reserve component units. The focus and challenge to the players would be to develop different ways of conducting military operations, given the level of awareness U.S. military forces derived from the advanced systems for command, control, communications, computing, intelligence, surveillance, and reconnaissance that will enter the inventory in the next five years.

The insights and hypotheses generated from these games would be tested and demonstrated during annual active-duty training. The details of the experiment design could be developed by the J-9 element of the Atlantic Command in connection with the Joint Experimentation Master Plan. Data generation, collection, and analysis could be provided by private contractors or, alternatively, by the J-7 unit on the Joint Staff. The reserve component units involved in the experiment would be designated by the commander of the Atlantic Command under his authority for joint experimentation.

Question 1. How well can the reserve components serve as a test-bed for the development of alternative organizational and operational templates?

- How many ways were found to improve organizational and operational concepts?
- How stable were the reserve component units testing the new concepts?
- How well were the new concepts accepted by the active component?

Question 2. How can distributed interactive simulations be used to help in the development of operational concepts?

- To what degree was interactive simulation technology used?
- How much was the Internet used to support operational concept development?
- What was the fidelity level of the simulations?
- How well did interactive simulations correlate with actual field experiences?

Question 3. How well can the reserve component, working jointly across service specialties, collaborate in the development of operational concepts?

- How well was reserve component input accepted by the joint services?
- What percentage of reserve component-developed concepts was adopted?

The experiment would generate both individual game records and a one-year history of the reserve components' participation in the experiment. The game records would provide a basis for analyzing decisions and game moves. This, in turn, would provide an empirical basis for determining the willingness and ability of reserve components to adopt innovative operational and organizational behavior. The one-year history could be used as a basis for determining how well reserve components learned new ways of doing things.

Experiment 2

Objective. Determine how reserve components could test new organizational and operational concepts.

These experiments would be based on the results of Experiment 1 or on the new concepts from the Atlantic Command's Joint Experimentation Plan. In the first case, the units involved in concept development would be the logical ones to extend the concepts into actual field experiments. In the second case, either the same reserve components or others could serve as a test-bed. The units designated for the experiment would be released from their current mobilization and training commitments to allow them to focus on this experiment. They would adjust their training cycle to prepare for the exercise, which would actually take place during their annual two-week active-duty training period.

The experiment would provide insights into: (1) the ability of reserve components to test alternative organizational and operational templates, and (2) the ability of the reserve components, working jointly across service specialties, to collaborate in joint operational tests. The details of the experiment design could be developed by the J-9 of the Atlantic Command in connection with the Joint Experimentation Master Plan. The data generation, collection, and analysis would be provided by private contractors or the J-7 unit on the Joint Staff. The reserve component units involved in the experiment would be designated by the commander of the Atlantic Command under his authority for joint experimentation. An outside analytic institution should probably be brought in to analyze the experiment as a case study of the innovative capabilities of the reserve components.

Implications

The costs associated with this pilot program would be that some reserve components would systematically deviate from the training and readiness standards set by and for the active-duty forces. In the event of a national mobilization and a reserve component call up, units involved in the pilot program would probably start from a lower readiness status and face a more severe challenge than other reserve components in meeting active-force combat-readiness standards.

The pay-off of these experiments however, could, more than offset the potential risks. The basic benefit would be the accelerated transformation of the U.S. military to the higher level of military effectiveness predicted in documents such as *Joint Vision 2010*. If changes to the active components are delayed because of increased operational tempo and high-readiness requirements, then reserve components would be a useful test-bed for innovation.

The general implication of this pilot program would be to determine whether reserve components could be used as a test-bed for changes in the U.S. military. The program could establish a new and useful function for the reserve components in developing and testing new ways of organizing and operating. If the pilot program works, it may suggest that reserve components could, in fact, become agents of change, thus becoming the vanguard rather than the rear guard.

Addendum: Distributed Interactive Simulation, the Internet, and Personal Computers

In the last three years, the power and speed of personal computers has reached levels that could be met, as late as 1996, only by large, expensive computer systems similar to workstations. Thus, personal computers, in conjunction with the Internet, now offer a low-cost, accessible means of distributed collaboration in the development of military concepts. One (of several) recent efforts to exploit these emerging capabilities is the so-called "Node Game" developed under the sponsorship of the director of the Office of Net Assessment in the Pentagon.

Node Game is an interactive, personal-computer-based war game designed to explore the implications of dominant battle-space knowledge. It provides an easy-to-use, highly flexible, and widely distributed means of portraying, testing, and generating hypotheses for the operational effects of disparities in situational awareness in armed conflicts. The game focuses on the effects of differences in battle-space awareness, concentrating on how players react to those differences. Players can test operations and organizations to find the ones that enable them to take most advantage of a significant edge in battle-space awareness or to counter an opponent's edge.

Battle-space awareness is a relative, not an absolute, condition. Some elements of information will not be detected or, if detected, will not be accurately identified, or will not be accurately identified in sufficient time to react. In the Clauswitzian cliché, there will always be some "fog of war." What seems to count militarily is the difference in awareness between opponents. This relationship can be expressed, compared, and measured in three categories: comprehensiveness (how complete is the detected information), fidelity (how accurately was the detected information classified and identified), and timeliness (was the detected information provided in time to be of value). Based on empirical work by the Joint Staff and others, Node Game provides fairly accurate measurements of these dimensions for U.S. forces and reasonable estimates for other forces (including paramilitary forces).