Part Four

Planning at the Operational or Campaign Level
CONVENTIONAL CAMPAIGN ANALYSIS OF MAJOR REGIONAL CONFLICTS

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In conducting future military planning, it has become increasingly important to approach many aspects of defense analysis from a "campaign perspective"—that is, one that examines the many military operations that may be necessary from the time crisis begins to the time conflict terminates, and that highlights the many capabilities that may be needed to accomplish these operations. Only this sort of approach can give visibility to the many military mission capabilities needed by U.S. forces. It is not enough that the United States have some aggregate level of armored divisions and tactical fighter wings. Indeed, the precise number of carrier battle groups appears to be less important than whether U.S. forces have the full spread of capabilities needed for deploying and employing forces in a range of diverse circumstances.¹

Though U.S. forces will be engaged in a wide range of other activities in future years, the threat of aggression in regions where U.S. interests are involved has emerged since the end of the Cold War as the primary driver and shaper of the U.S. military posture.² This paper describes in some detail a "typical" military campaign of the sort RAND has used extensively in assessing capabilities, at different budget levels and under different defense programs, for responding to major regional conflicts. In the conflict analysis, this campaign must account for such diverse factors as political-military setting, geographic and environmental factors, U.S. mobility assets, the many components of a combined-arms force, and the challenge of deterring or coping with weapons of mass destruction. Such a campaign-oriented style of analysis is now a central feature of defense planning.

In future regional crises, the possible use of weapons of mass destruction could loom ominously over combat operations. The United States will need the capability both to deter and, more significantly, to prevent the use of such weapons. This will require a multidimensional approach to achieve any prospect of success. Here, we focus primarily on conventional operations.

In addition, it is likely that the United States will be engaged in a wide range of military activities besides state-to-state military conflicts. These activities could include such demanding operations as counterrinsurgency, combating terrorism, peace

¹A useful overview of such an analytic approach can be seen in Bowie, Frostic, Lewis, Lund, Ochmanek, and Propper (1993).

²See Aspin (1993). For a perspective on the other types of missions that the U.S. military may be called upon to perform, see Bracken (1993) and Builder, Lempert, Lewis, Larson, and Weiner (1993).
enforcement, and providing humanitarian assistance. They could involve large numbers of U.S. and allied forces for long periods—and the assets needed to prosecute them are not necessarily lesser included cases of major regional conflict. Clearly, adequate numbers of specialized force elements will be needed to deal with these demanding situations.

This paper, however, focuses on major regional conflicts, since the most costly defense programs and force structure decisions stem from planning for such conflicts. We begin by setting out the characteristics of regional conflicts: potential threats, warning and response, geographical and physical factors, and force characteristics. We go on to describe the three phases of regional campaigns: initial operations, combat operations, and postconflict stability operations. Later we discuss enemy counterstrategies, and we end the paper with some observations.

CHARACTERISTICS OF REGIONAL CONFLICTS

A first step in analyzing potential major regional conflicts is to determine which countries are and which might become potential threats, what warning signs to look for, and what responses to make in order to forestall such conflicts. If warning indicators suggest the possibility of conflict, then characteristics of the region that will influence the shape of battle, such as geographic and physical factors, must be assessed. The shape of the conflict will also depend on the types of forces both sides can bring to bear and the availability of those forces over time. Below we describe each of these characteristics.

Potential Threats

Major regional conflicts (MRCs) typically involve nation-to-nation warfare (a characteristic that often distinguishes them from peacekeeping and peacemaking operations). These conflicts can pose serious threats to U.S. and allied national interests and provide the motivation for U.S. involvement. Such conflicts feature interwoven political, military, and economic objectives among all participants.

As we write this in the environment of 1994, two key theaters figure centrally in U.S. planning: Korea and Southwest Asia. In the latter theater, U.S. interests revolve primarily around maintaining unimpeded access at reasonable prices to the region’s unparalleled oil resources and protecting key friendly nations. In Korea, U.S. interests involve security commitments to South Korea, Japan, and other important actors in the Pacific Rim, and the vast range of economic and political ties that have developed in that region since the end of World War II.

For a nation to constitute a serious threat to its neighbors and U.S. interests, it must possess land, air, and perhaps naval forces of adequate size, sup-
ported by a logistics base and infrastructure capable of maintaining these forces in the field. As can be seen in Figure 1, the size of the military threats facing the United States and its allies has changed dramatically from the Cold War period. The largest powers (excluding a resurgent Russia and a militant modern China) may field roughly 500,000 personnel and 10 mechanized/ armored divisions (combined with an equal or greater number of infantry divisions). Typically, these ground forces are supported by air forces ranging from 500 to 1000 fighter and attack aircraft and, perhaps, a coastal navy equipped with small surface combatants and a few submarines. The exact nature of these forces, of course, will vary from case to case.

This picture could change over time. Developments in Russia and China, for example, raise the potential for regional conflicts adjacent to these regions—and the possibility for even larger-scale military operations. But because of the time needed for these nations to move to a threatening political stance, reinvest in modern military forces, and develop into a coherent military threat, the United States and its allies should have sufficient political, economic, and military warning to respond appropriately. This means that the United States must possess the ability to expand its force structure and support base should a more sizable regional or global threat reemerge.

![Military Capabilities of Regional Powers at the Close of the Cold War](image)

**Figure 1—Military Capabilities of Regional Powers at the Close of the Cold War**

The regional threats challenging U.S. interests and threatening U.S. allies are not located adjacent to the continental United States. This adds two key characteristics to planning for regional warfare. First, U.S. forces must plan to operate in conjunction with indigenous and allied forces. This places a premium on interoperability, i.e., familiarity with doctrine and training before the onset of conflict and, perhaps, possession of the same types of equipment. Second, the bulk of U.S. military power must deploy to engage threatening regional powers. This heightens the importance of U.S. mobility forces.

Indications, Assessment, and Response

In many ways, responding to a regional conflict is a race against time. An aggressor would like to build up forces, launch an invasion, and accomplish his objectives before the United States can bring its power to bear. By attending to indications and warning signals, the United States may be able to respond with a series of preparations that significantly reduce the aggressor's chance of success—to the point where a prudent enemy planner would be deterred. Deterring aggression is most in keeping with U.S. strategy and goals, since it meets U.S. national security objectives at the least cost in blood and resources.

Precise definitions of warning and response were developed for the Cold War era. In broad terms, strategic warning was warning prior to an attack; tactical warning was warning after the start of hostilities.3 In this new era, we believe that warning/indication categories must be redefined, and for purposes here, we have employed three broad categories: political, strategic, and tactical.

Political indications involve a broad assessment of U.S. national interests, threats to those interests, and the correct interpretation of indicators of intent for aggression.4 In essence, the United States seeks to assess which nations might threaten its interests (as well as those of its allies) and the time at which such threats may prove credible. The indicators associated with political warning are the construction of offensive military forces, the buildup of a military infrastructure, and political actions in conflict with U.S. policy (such as support of terrorist groups, sales of weapons to hostile nations, threats against neighbors allied to the United States, claims against neighboring territory of governments friendly to the United States, attempts to undermine allied governments, and so on).

U.S. responses to political indications might be the formation of coalitions with nations that are threatened or have goals compatible with those of the

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3See, for example, Department of Defense Dictionary of Military and Associated Terms, JCS Pub. 1-02, December 1989.

4Such factors play an important role in the development of formal military strategy. The latter is laid out in such documents as Powell (1992).
United States, the establishment of joint and combined training exercises, the shaping of the U.S. military posture to deal with identified potential adversaries, the construction of general campaign plans, and the development of basing facilities, prepositioning materials, and, where possible, a military support infrastructure. For example, political indications today have placed great emphasis on military planning for conflict in Southwest Asia and Korea. In the future, an emergent European or Asian continental threat might compel the United States to expand its political alliances and forces—and possibly develop and introduce new weapon systems.

Strategic indications consist of signals conveying an aggressor’s intent to conduct military operations against U.S. and allied interests. This may be signaled through increasingly overt political actions (such as the announcement of grievances, territorial claims, demands for financial compensation, harassment of foreign nationals, seizure of economic assets, etc.). Such actions may be rendered more threatening by increases in military readiness (such as calling up reserve elements, increasing training, breaking out combat supplies and stocks, and stepping up surveillance and intelligence activity). The critical signal, of course, is the physical movement of combat forces into positions to conduct offensive military operations.5

Assessing and responding appropriately in a timely manner to indications at the strategic level has historically proven problematic for a variety of reasons. For example, apparently overt military preparations generally take place within the aggressor’s territory and do not violate the sovereignty of neighboring nations. Readiness exercises can be used (and historically have been used) to camouflage overt war preparations. The problems in responding to indications become apparent in retrospective examinations of past conflicts, where strategic warning signals were often present but were overlooked or wrongly assessed. One need only review such situations as the Japanese attack on Pearl Harbor, the North Korean invasion of South Korea in 1950, the Soviet assault on Czechoslovakia in 1968, the Egyptian attack across the Suez in 1973, the Argentine invasion of the Falkland Islands in 1982, and the Iraqi invasion of Kuwait in 1990 to see examples of failures to respond to strategic indications.6 On the other hand, successes in responding to strategic indications often have yielded deterrence—and hence may have gone unnoticed in the history books.7

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5 An important step in the process is the buildup and movement of ground forces, which require weeks or more to accomplish and are generally observable.

6 For more on the failure of strategic warning, see the excellent discussion in Davis (1988:26-47).

7 For example, in 1960, Israeli responses to operational warning deterred Arab forces from launching an attack.
A failure to respond to strategic indications generally occurs due to the desire not to be provocative and further inflame a crisis. Such a situation can be seen in Figure 2, which provides a brief historical synopsis of political and military events preceding the 1991 war in the Gulf. Despite continuous buildup of Iraqi forces from July 16 on, Kuwait, in order not to be provocative, reduced alert several days after initial movements of Iraqi troops, and the United States did not move ships to the Gulf until late July. In this case, the desire not to be provocative resulted in a failure to deter.

As the indications develop that an aggressor may be contemplating military operations, a series of military actions can be taken to enhance the ability to respond. These actions are comparatively inexpensive next to the cost of countering an invasion. Such actions include increasing surveillance and intelligence activities to gauge the true intent of an adversary (and send a signal of concern), enhancing the readiness of the mobility system (aerial, sealift, staging bases, and port reception units), updating mobility and operational plans, making elements of the command-and-control system operational, and preparing combat forces for mobilization and deployment.

These actions increase the ability of U.S. forces to deploy rapidly—and may serve as a deterrent to aggression. If these do not have the desired effect, the next level of action may be to deploy deterrent forces. Historically, the United States has relied on moving naval assets into position. In more recent years, the deployment of airborne radar and surveillance aircraft (such as the Airborne Warning and Control System or AWACS), which can be moved into position

| Political Events | | | | |
|------------------|------------------|------------------|------------------|
| Iraqi letter to  | Iraq threatens        | Arab diplomatic  | Geneva OPEC     |
| Arab League      | use of force       | initiatives      | meeting         |
| July 16           |                   |                  |                 |
| Kuwait on         | Kuwait reduces     | UAE requests      | Six U.S. Navy   |
| full alert        | alert             | U.S. support     | ships to Gulf   |
|                   |                   |                  | for modest      |
|                   |                   |                  | show of         |
|                   |                   |                  | concern         |
|                   |                   |                  |                 |
|                   |                   |                  |                 |
| Military Events   |                   |                  |                 |
| Iraqi forces mass on border |


**Figure 2—Desert Shield Timeline**

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For the U.S. Navy's perspective on this, see Department of the Navy (1993).
in a matter of hours, has emerged as an important policy tool. These aircraft offer warning capabilities, increase the defensive posture of allies, and signal U.S. concern. Another step to increase U.S. capabilities to meet a regional threat is to deploy reception forces (such as personnel and equipment to unload aircraft and ships). All of this would precede the actual movement of combat forces (with the exception of naval vessels). While this is occurring, combat forces based in the United States and forward areas can be readied for deployment.

Geographical and Physical Factors

To analyze the performance of forces in major regional conflicts, the influence of key geographical and physical factors must be assessed and incorporated. These factors affect both the U.S. ability to bring sufficient forces to bear and the capability to sustain operations in an area where the United States may not have a large peacetime military presence. Political and economic pressures are combining to reduce the number of U.S. forces permanently based abroad. Accordingly, mobility and sustainment forces are emerging as an increasingly critical component of the U.S. joint force posture, and their adequacy can be assessed only when viewed from a “campaign perspective.” Mobility and sustainment are greatly affected by the distance to the campaign region, the environment in that region (terrain, weather, etc.), and the military infrastructure available in the region. Each of these is discussed below.

Distance. The arrival of forces in the theater is a function of

- Their peacetime locations.
- The distance of these locations from air and sea ports of embarkation.
- The physical distance and routing forces must transit to get to the theater (either by air or sea).
- The throughput capacity of embarkation, staging, and destination bases.
- The capacity of airlift and sealift fleets.
- The types of forces being moved.

For more distant areas (such as Southwest Asia), forces deploying by air depend heavily on a system of staging bases for refueling, maintenance, and crew rest. Similarly, the arrival of forces in a theater depends on the capacity of the reception facilities (which is a function of physical assets and personnel), the

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9See, for example, Forty Five Years of Global Reach and Power: The United States Air Force and National Security, 1945–1992, Headquarters, United States Air Force (SAF/OSX), 1992. These aircraft, along with other key elements of the command-and-control system, facilitate combat operations if they become necessary.
distance of these ports and airfields from the locus of fighting, and the transportation network found in the region.

Figure 3 provides an overview of the deployment process. In many ways, the process is a classic transportation problem in which constraints at any node as well as the capacity of the overall system affect the desired outcome—force closure. A range of sophisticated operations-simulation techniques, including linear programming, is available to provide insights into deployment capabilities. 10

The Environment. The environment—the terrain, weather, and cultural features (e.g., cities, canals, roads, etc.) in which operations are to be conducted—has always shaped the character and outcome of campaigns and must be integrated into the analysis of regional conflict. Napoleon’s and Hitler’s plans for conquering Russia fell victim in part to the hostile environment (distance and winter weather). The success of Rommel’s bold flanking

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10 For an overview of alternative deployment strategies, see Dadant (1984). See also Kassing (1994).
maneuvers in North Africa in World War II stemmed in part from the terrain and weather. And although the environment in Southwest Asia enhanced the performance of airpower in Desert Storm, the same factor rendered airpower nearly ineffective during the opening days of the Battle of the Ardennes in World War II (Craven and Cates, 1951, chap. 19).

Weather can also have an important effect on terrain. For example, heavy rains can render fields and other areas impassable to vehicles, restrict lines of sight, and reduce the effectiveness of whole classes of weapon systems and sensors for periods of time (such as lasers, imaging infrared systems, and so on). Detailed data bases on historical weather patterns in various regions are typically employed in simulation models to simulate the effects of weather on combat. For example, if we are simulating airpower operations in a theater with a rainy season, data on average cloud ceilings, line of sight, and so on can be used to assess whether or not aircrews can sight various targets and what sorts of altitudes may be employed for effective combat operations. These considerations in turn can influence effectiveness, survivability, and aircraft combat radii.

These same considerations also play a key role in assessing ground combat performance. For example, traffickability along avenues of approach may change dramatically depending on whether the ground is sodden or frozen (as is often seen in Korean combat simulations). In fact, the construction and planning of ground campaigns often centers not just on enemy forces, but on terrain, traffickability, obstacles, and weather.

Regional Military Infrastructure. The usable military infrastructure of the region is an important factor in the conduct of modern military operations. In fact, the existing infrastructure in many ways shapes the course of a campaign.

By infrastructure we mean such things as airfields, ports, surface transportation networks, reserve stocks of fuel and storage facilities (as well as fuel distribution networks), electrical power, regional communications facilities and networks (both civil and military), and the quantity of prepositioned stocks of military equipment. Military planners and analysts must thus conduct a detailed assessment of the regional military infrastructure from two different perspectives: (1) the compatibility of U.S. and allied forces with the infrastructure in the region, and (2) the effect of the infrastructure on the enemy’s ability to conduct a campaign. Understanding the infrastructure is important for determining what equipment and capabilities the United States and its allies must possess or acquire.11

11 For additional perspectives on the influence of the regional military infrastructure upon military operations, see Bowie (1984:14-25, 44-65).
Force Characteristics

The size and composition of forces deployed to a major regional conflict are determined by a number of factors. Existing operational plans provide a useful starting point. However, consideration must be given to unique contemporary factors, such as the capabilities of allied and indigenous forces in the region, current and potential new weapon systems owned by the adversary (e.g., long-range precision attack assets and submarines), changes in the size of adversary forces and capabilities, and environmental factors.

Planning and analyzing regional conflicts involve selection of key force elements for deployment and use. These forces are drawn from all components of the U.S. military. Each situation is unique and requires forces tailored to the demands presented. For example, if indigenous forces possess sizable ground forces, the joint force commander may elect to first deploy air and naval forces to the theater. Similarly, the status of prepositioned equipment and stocks affects the commander's choice of early-arriving forces. But a core set of capabilities will prevail in a wide range of situations and over time. Let us consider the forces in the order in which a deployment in a short-warning scenario might occur: naval forces, air forces, and ground forces. In some cases, the existence of forward-based forces and differing threats and environments may change the order in which forces arrive. We will address these factors in greater detail below.

Naval Forces. Maritime forces offer many unique qualities. Typically, naval forces are operating around the world during periods of peacetime—and can be concentrated in areas of interest even in periods of ambiguous warning without interfering with the sovereignty of nations in the theater. These forces are assembled into task forces, often organized around an aircraft carrier. The latter provides sea-based airpower for both protection of sea lines of communication and power projection ashore.

Accompanying the carrier are a number of surface combatants and submarines. These vessels are important for projecting power ashore when equipped with sea-launched missiles, such as the Tomahawk Land Attack Missile (TLAM) and/or a modified variant of the Army Tactical Missile System (ATACMS). Additionally, the surface combatants provide protection of the fleet with air defenses. These air defenses could also be extended to provide initial ballistic missile defense over air bases, ports, lodgement areas, and the fleet when tied to spaceborne surveillance systems. To allow these forces to maintain a sustained forward presence, naval task forces are typically supported by underway replenishment groups. And accompanying the task force are submarines, minesweepers, and an array of airborne surveillance systems (such as P-3 Orions) to open and sustain sea lines of communication for the movement of sealift vessels.
The exact composition of the battle groups, location, and commitment time are important factors in analyzing the conduct of the campaign. When faced with a rapidly developing situation, there is a premium on forces available at the start of a conflict.\footnote{See, for example, Petrìn (1991). For a differing perspective on the relative contributions of land-based and sea-based airpower using different assumptions, see Ochmanek and Bordeaux (1993).}

**Air Forces.** Land-based airpower consists of several key elements: a set of command, control, and targeting aircraft as well as key ground facilities for surveillance and battle management; aerial refueling and airlift aircraft for mobility; and long-range bombers and fighter/attack squadrons for power projection.

Airborne targeting and control aircraft provide surveillance of the aggressor’s air and ground operations and can be used to allocate and direct forces to areas of interest. These typically consist of such assets as E-3B/C airborne warning and control aircraft, the Joint Surveillance Target Attack Radar System (JSTARS), which can locate enemy ground force dispositions and movements, RC-135 aircraft for collecting electronic intelligence, and other specialized reconnaissance and surveillance assets (to include unmanned penetrating vehicles and satellites).

In terms of mobility assets, aerial refueling aircraft increase the range of operations and endurance of aircraft and have emerged as a common resource for land- and sea-based aircraft, as well as for allied aircraft. In addition, tankers serve an important role in deploying forces to the theater. Strategic airlift aircraft are necessary for the rapid movement of combat forces to the theater. Tactical airlifters are needed to move forces and supplies from arrival locations to operational areas and bases.

In terms of power projection capabilities, long-range bombers provide early attack capability (since they are relatively independent of bases in the theater of operations for the initial stages of combat). Fighter and attack squadrons must perform a range of missions such as air superiority (to include suppression of surface-based defenses) and the attack of strategic targets and enemy ground forces. As was seen in the Gulf War, the composition and capability of the land-based fighter/attack force and its arrival schedule have emerged as increasingly vital factors in analyzing the potential outcomes of the campaign, due to their enhanced lethality.

**Ground Forces.** Ground combat power is essential to the conduct of regional theater warfare. These forces are needed to protect key rear areas, selectively engage and channelize enemy forces (trading space for time until the situation is stabilized), continue engagements during the buildup period and thus reduce enemy forces, and finally, launch a decisive counteroffensive.
The early-arriving ground forces, with the exception of those possessing prepositioned equipment (such as the Marine Expeditionary Brigades) are light forces that can be transported by airlift. The personnel from armored and mechanized forces can be flown in to "marry up" with prepositioned equipment. Critical specialized combat support units, such as those equipped with ballistic missile defense batteries, armed helicopters, and long-range precision firepower, rocket and missile artillery, are also candidates for high-priority deployment via airlifters. These units should be capable of high volumes of precision firepower and tactical mobility to trade space for time.

Succeeding echelons of army forces, which come principally by sea, consist of the heavier armor and mechanized units and combat service and combat service support to sustain all elements of the joint force in the field. These succeeding echelons also constitute the forces designed to regain lost territory and secure long-term wartime objectives.

**Force Availability.** An important consideration in selecting forces is their availability—i.e., the time required to make them ready for deployment and operations. The times required to ready forces vary widely. For example, naval forces at sea are ready immediately. An active-component fighter squadron with a mission capability needed at the outset of a campaign and earmarked for operations in a specific theater (e.g., an F-117 unit) could be ready to deploy within hours. The same holds true for the lead brigade of the 82nd Airborne and selected elements of the 7th Transportation Group. Reserve units naturally take longer to ready for deployment. Reserve air units may not be called for several weeks to a month, and after call-up might take a week or more to prepare for deployment. And perhaps the most time-consuming is preparing a reserve-component armored (or mechanized) division for deployment—the time to prepare heavy reserve ground units may extend for months.13

Typically, active forces are the most ready. However, with the current structure of the U.S. military, selected reserve units will participate in operations from the outset. For example, army transportation elements and airlift and tanker crews are essential to operations from the outset of a deployment.

**CONDUCTING REGIONAL CAMPAIGNS**

With the available force structure, the geographic and environmental structure of the region, and the military characteristics of the enemy in mind, the planning and analysis of a regional campaign can begin. The typical starting point is to outline a reasonable set of conditions. But to explore the true di-

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dimensions of the "scenario space" (Davis and Finch, 1993), these conditions must be extended to ascertain the impact that key parameters can have on the capacity of enemy and allied forces.

Figure 4 provides an overview of one such study plan conducted at RAND using this approach. C-day is the time at which U.S. forces deploy. D-day is the time when armed conflict begins. Thus D = C + 5 represents the case where U.S. forces have five days to deploy to the theater before the outbreak of conflict. The plan was to vary days from the start of conflict (shown on the timeline), the mix of ground and air forces that could be applied (the two squares across the front of the box), the type of land forces used (the squares on the right side of the box), and the level of threat (the vertical squares). Each of these variables affects the rest. For example, some land force alternatives are not available until a certain number of days have passed, i.e., until they have been deployed to the region. And the effectiveness of a particular alternative depends on the level of threat. As the complexity of the figure suggests, the greater the number of variables, the greater the length of time required to conduct the analysis.

The regional conflict we use as an example begins with an aggressor invading a neighboring state with mechanized ground forces supported by infantry, air, artillery, and possibly ballistic missiles. This invasion would be opposed
first by a combination of indigenous and allied forces together with U.S. forces that are stationed in the area and/or deployed forward as the crisis develops.

When faced with an invasion, the joint force commander must establish (and prioritize) a set of objectives. These typically include the following:

- To deploy sufficient forces to the theater.
- To secure a lodgement to protect arriving forces. Protection must be provided around key ports, airfields, along lines of communication oriented toward the battle area, in the air above the lodgement, and along air and sea lines of communication leading into the theater itself. In the past, the primary immediate threat was posed by enemy aircraft; in the future, the United States must be increasingly concerned with protecting the lodgement from cruise and ballistic missiles as well.
- To contain the enemy’s capability to conduct offensive operations. Containing the enemy’s offensive capability entails such actions as halting invading armies and establishing a sufficient degree of air superiority to deny the enemy the ability to conduct coherent air attacks (with either aircraft or missiles). Once the enemy’s offensive capabilities are reduced, time becomes an ally as the joint force commander moves to bring a fuller range of combat power to bear.
- To reduce the aggressor’s capability to defend his forces and critical military resources. This involves attacks on dug-in forces, sustained ground force engagements, continued disruption of lines of communication and supply, attrition of air and missile forces through attacks conducted at depth across his territory, denial of command-and-control capabilities and facilities, and strikes against war reserves and supporting military infrastructure.
- To launch a decisive counteroffensive. The purpose of the counteroffensive is to regain lost territory and seize sufficient assets to deny the enemy the capability to repeat past aggressive actions. The counteroffensive features ground forces (supported by air assets) taking territory and seizing control of enemy forces. It also includes strategic attack operations designed to deny the enemy the capability of aggression in the future.
- To establish postconflict stability. This phase, while not actually part of the conflict, may involve long-term commitment of forces.

Operations to accomplish each of these objectives are described below. These operations fall into three groups: (1) precombat operations, which include deployment and establishing a lodgement; (2) combat operations, which include containing the enemy’s offensive capability, reducing his defensive ca-

\[14\] The influence these objectives can have on U.S. strategy and forces can be seen in Thaler (1993). The “strategies-to-tasks” framework was originally developed and refined by Lieutenant General Glenn Kent (USAF, ret.).
pability, and launching a joint counteroffensive; and (3) postconflict stability operations.

**Phase I: Initial Operations**

**Deployment.** The time required to deploy U.S. forces is a critical element in the assessment of their combat contribution. Analyses must factor in the contributions of the joint “mobility triad”: airlift, sealift, and prepositioning (both sea-based and land-based). Each element of the mobility triad offers unique advantages and disadvantages. To support U.S. national strategy requires capitalizing on each method’s virtues to compensate for its limitations. Airlift forces are the fastest mobility asset, but the cargo that can be carried is limited by weight, size, and volume. Sealift provides high volume, but is much slower than airlift. The limited volume of airlift and the slow speed of sealift in turn heighten the importance of land-based and sea-based prepositioning. Land-based prepositioning is responsive, but limited in terms of flexibility. Sea-based prepositioning is slower to respond than prepositioned land-based supplies, but is much more flexible. Figure 5 provides an overview of a notional deployment to highlight the capabilities of the various mobility force elements.¹⁵

The amount of time afforded to the United States to deploy forces before combat begins shapes the character of planning and analysis of regional conflict. If an adversary were to provide several weeks of buildup time, the United States could deploy sufficient forces to provide a formidable defense (and an equally formidable deterrent). However, deployment of significant combat capabilities (such as land-based fighters and ground forces) during this period may be precluded by the sensitivities of regional allies and internal U.S. domestic constraints.

Though these constraints may prevent the deployment of some combat forces, important steps can be taken to improve the speed with which U.S. and allied forces can be deployed and begin conducting combat operations. Surveillance and reconnaissance assets like AWACS and JSTARS could be deployed to observe enemy movements and force dispositions. Similarly, orbits of space systems could be repositioned. And the backbone of an effective combat force—a command, control, communications, and intelligence network—

¹⁵Two major upswings in sealift delivery are shown in Figure 5. The first represents the initial arrival of sealift vessels, the second represents the movement of ships after their initial delivery back to the United States for a second loading. Generally, heavy combat forces are moved in the first cycle and a growing portion of sustainment and combat support material in subsequent sailing cycles.
could be readied and perhaps deployed. Teams for air and sea ports could be positioned forward or moved to the theater to prepare reception facilities and enroute staging bases. Airlift and sealift fleets could be brought up to higher readiness rates. And it may be possible to bring selected defensive forces into the theater (e.g., ballistic missile defense batteries and air defense aircraft). The degree to which these preparations are possible affects the theater deterrent posture and early combat capabilities.

The joint force commander's ability to achieve his objectives is governed by force availability in the theater of operations. Figure 6 provides an overview of the arrival of forces within a theater of operations and how this helps determine the timing of operations in a campaign. For approximately the first month following the decision to deploy U.S. forces, operations must be conducted with forces already stationed in the forward area, those that can utilize equipment prepositioned on ships or on land in the area of interest, and those that can be airlifted in sufficient numbers to conduct effective combat operations. During this period, U.S. forces must secure a lodgement and, if an enemy has launched offensive operations, halt and contain the incursion in conjunction with allied forces.
The objective in this early part of the campaign is to halt invading armies and to stop air and missile attacks in order to limit the loss of territory and key facilities. This requires a careful balancing of mobility priorities. In essence, planners must maximize the use of forces that can respond and fight quite rapidly, particularly if circumstances have prohibited the deployment of combat forces. These units include forward-based forces, forces that rely on land-based prepositioned equipment (if available), forces that are transportable by air, and forces that are supplied by maritime prepositioning assets. Setting deployment priorities for these force elements is complicated by situations where combat is deemed imminent. In such circumstances, the United States must deploy not only forces, but such critical items as adequate quantities of munitions, logistics stocks, and perhaps fuel as well. All these elements of a warfighting force compete for the limited set of mobility assets. For example, planners must decide not only whether to send a squadron of attack aircraft and their maintenance support elements, but also what level of munitions stockage must be sent for that unit.

After roughly a month, sufficient forces should be available in theater to contain the aggressor’s offensive operations. Additionally, sealift begins delivering heavy land combat forces in growing numbers. While forces continue to build up, there are sufficient forces to defend, but probably not enough to go on the offensive. Additionally, the support forces needed for sustained offensive operations are arriving in the theater. Therefore, during this period, sustained operations against enemy military forces, resources, and facilities should continue in order to draw down the enemy’s strength.
This period of buildup and sustained engagement continues. After several months, sufficient combat and support forces are available for joint counteroffensive operations. For these operations, forces must be positioned to support the joint force commander’s scheme of maneuver and operation for the offense. Additionally, the logistics support system in the theater must be stocked for the high demands of counteroffensive operations.

In this phase, intratheater movement of personnel and supplies also assumes heightened importance. For example, arriving ground forces must be moved to positions where they can engage the enemy. Munitions need to be distributed to air bases, troops in the field, and ships at sea. These all increase the importance of intratheater movements, which are typically conducted by C-130 airlifters, trucks, and helicopters.

**Establishing a Lodgement.** Establishing a lodgement somewhere in the area of operations is a prerequisite for conducting military operations. The dictionary definition of a lodgement is “the action of making good a position on an enemy’s ground or obtaining a foothold.” Major regional conflicts require a sizable lodgement because it will be the support head for hundreds of thousands of personnel and their equipment.

The crucial objective of a lodgement is to establish an initial operating area and protect arriving forces. Ideally, the lodgement should be located far enough from the battle area to remain relatively unmolested. But even under the most benign conditions, forces must be allocated for protection of the lodgement area.

The lodgement area should include operating space for air, land, and naval forces, ports and air bases to receive forces and supplies, and for the transportation infrastructure to move ground forces to the battle area. In some situations, U.S. and allied forces may use several lodgement areas. As Figure 7 shows, the lodgement area expands over time. First, forces move into a few select ports and airheads. A port with a sizable cargo-unloading capacity is essential for handling sealift vessels. For an airlift airhead, a base with large runways, parking ramps, and fuel supplies is needed (these tend to be international airports in most nations). In selecting air bases for the deployment of combat aircraft, obviously those with developed passive defenses (i.e., shelters) would be considered first.

As additional forces arrive in theater, the lodgement expands (as Figure 7 shows) in a series of steps until it can accommodate a defensive force. Over the longer term, the lodgement provides the support for joint counteroffensive operations.

Arriving forces may often have to depend upon indigenous forces (or navy forces adjacent to the lodgement) for protection in the first critical days. Additional protection could be airlifted in rapidly—this would include light ground forces for security and surface-to-air defenses and air superiority fight-
Figure 7—Establishing a Lodgement
ers to protect against enemy aircraft, cruise missiles, and ballistic missiles. Ideally, the joint force commander would seek to expand the lodgement area so that forces could be dispersed to deny the enemy lucrative targets and so that adequate operating and maneuver areas are available for arriving forces.

The real campaign may not be so simple, of course (Davis and Finch, 1993). For example, the potential for contested entry must also be considered when analyzing the establishment of a lodgement. Such operations are far more complex and risky. In essence, the need to insert forces in such a manner would mean that the enemy had achieved operational surprise and had overrun the first objective areas before U.S. forces arrived—or had managed to defeat the initial U.S./allied contingent.

When faced with a contested entry, the joint force commander has two main options. The first is to establish a lodgement even farther to the rear, perhaps even beyond the range of the aggressor’s offensive forces. The lodgement could even be located in an adjacent nation. Subsequent operations would aim to isolate occupying enemy forces in an interdiction campaign (thus denying them supplies), conduct direct attacks (to reduce the aggressor’s forces), and launch strategic strikes (to bring home the costs of war and affect the enemy’s calculus). Forces would then be built up in this rear area lodgement to advance forward to retake the initial objective area.

The second option is to make an opposed landing in the vicinity of the aggressor force, either from the sea or from the air. As seen from the landings in the Pacific during World War II and Grenada, such operations are extremely challenging to plan and execute, and they run the risks of heavy casualties. Even under these conditions, it would be desirable to have a staging base in reasonable proximity to provide air cover for the operation.

**Phase II: Combat Operations**

Once a relatively secure operating area has been established, the joint force commander focuses on engaging the enemy. Depending on the urgency of the situation, the friendly forces may have to be committed to combat immediately upon arrival in the theater. The joint force commander would have three phased objectives:

- Contain the enemy’s capability for offensive actions.
- Reduce the enemy’s defensive capability.
- Conduct joint counteroffensive operations.

**Containing the Enemy’s Offensive Capability.** An enemy may use his land forces to invade the territory of an ally (and may complement these with irregular force operations, such as those conducted by terrorist and guerrilla
bands). He may use air and missile forces to attack the opposing forces and military infrastructure. And he may perhaps employ naval forces to project power in the seas adjacent to his territory.

These offensive capabilities must be contained simultaneously through the judicious employment of leading-edge ground, sea, and air forces. Successful containment depends upon the successful establishment of a lodgement and the continued buildup of combat forces in the theater. To contain the enemy's offensive capabilities, the joint force commander would have the following objectives: halt the invading armies; gain air superiority; and conduct strategic attacks to destroy essential components of the opponent's offensive warfighting capabilities. The weight of effort devoted to each task would, of course, depend on the operational conditions in the theater. For example, if the enemy ground offensive collapsed, more attention could be given to air defense and strategic attack.

_Halt the Invading Armies._ Many potential aggressor nations in the world have invested heavily in ground forces. The reasons are straightforward. Relative to air and naval forces, armies are less expensive, useful for nation-building, and often essential for sustaining authoritarian regimes. In addition, they are critical for taking and holding territory in a world where territorial disputes often lie at the heart of regional conflicts.

When faced with an invading army, the United States and its allies would attempt to trade space for time. Indigenous land forces would be joined on the ground with light and prepositioned U.S./allied ground forces. The details are important when assessing the status of early defensive battle. Enemy force positions, their scheme of maneuver and avenue of attack, the lines of communication the adversary would employ to sustain the offensive, and the size and positioning of indigenous forces—all play a role in shaping the battlefield. Arriving U.S. and allied forces would join indigenous forces to conduct a retrograde covering force operation and would probably be placed to avoid the catastrophic defeat of indigenous forces early in the campaign. Simulations of these engagements can be conducted with varying degrees of fidelity to understand potential battle outcomes.\(^{16}\)

As Figure 8 shows, a combination of critically positioned and tactically mobile land forces, together with land-based and sea-based airpower as needed, would first blunt the invasion and then attempt to bring it to a halt. U.S., allied, and indigenous land forces could reduce the enemy's forces and blunt the invasion by manning a series of defensive positions, sequentially withdrawing

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\(^{16}\)One useful "high-level" methodology is contained in Allen (1992). For a detailed examination of brigade-level battles combining the effects of attack helicopters and fixed-wing airpower, the JANUS model offers great utility.
Figure 8—Halting the Invading Armies

to new positions in the rear, and engaging in counterattacks where appropriate
to complicate the enemy's offensive scheme of maneuver. Such retrograde
operations could use terrain and man-made obstacles such as minefields to slow
the invasion and channelize the enemy.

The natural complement to the land force scheme of maneuver is the applica-
tion of long-range offensive firepower. This could be provided by rocket and
missile artillery (e.g., MLRS/ATACMS) as well as bombers and fighter/attack
aircraft. While ground forces engage the leading elements of the enemy invading
force, long-range firepower could concentrate on follow-on echelons and
convoy carrying critical sustaining supplies such as food, fuel, and ammuni-
tion. Potentially, deeper attacks could be conducted against the lines of com-
munication coinciding with the avenues of attack. Defending forces could cre-
ate these chokepoints at times by attacking bridges and blocking roads and
other routes.

A joint command structure and control system is essential for integrating
long-range firepower with the scheme of maneuver. Joint planning and
employment of air and surface forces are particularly important in the early
phases, since the relatively small number of arriving forces must be applied
properly in order to take advantage of their synergies. For example, land forces
could concentrate at the point of contact to blunt leading-edge units and cause

\footnote{See Cardwell (1992) and FM 100-5, Operations, Headquarters, Department of the
Army, 1992.}
follow-on echelons to mass. These in turn would emerge as lucrative targets for appropriately equipped airpower, which offers lethal firepower but has less persistence. Long-range rocket and missile artillery could then provide a more persistent complement to airpower. In some cases, it could also be more responsive to tactical needs.

Long-range firepower on land or aboard ships could be used to attack enemy forces deep or, when fired from rear areas, to engage enemy forces in the forward area. In some situations, long-range rocket and missile artillery and airpower could be used to cut off forward echelons from follow-on forces and supplies—thereby limiting the time over which they can sustain an attack. In addition, such isolations can assist defending ground forces in localized counteroffensives.

The effectiveness of these fires is heavily dependent upon a surveillance, reconnaissance, and battle management system to designate enemy units and support forces in the attack. Until this command-and-control system is established, the effectiveness of long-range rocket and missile artillery will be marginal. Airpower’s effectiveness also depends on an effective dynamic battle management system, but not to the same extent as rocket and missile artillery, since the presence of a “man in the loop” allows combat aircraft to acquire enemy force elements and adjust delivery of firepower.

The combination of ground, sea, and air forces to halt the invading armies through attrition and maneuver could, if successful, bring the invasion to a stop. The point at which the invasion stops depends, among other things, on such factors as the attrition inflicted on the advancing force, the buildup rate of friendly forces, and the capabilities of the opposing forces. Historical norms for a successful defense involving ground forces at the level of a few divisions can be achieved at a 1:3 defense ratio, though terrain, weather, and firepower can affect the situation dramatically. In other cases, a defense may not be possible until friendly forces on the ground are equivalent to those of the invader. Air and long-range artillery also have an important impact on the outcome of battle by disrupting and reducing enemy forces. And in some cases, the increased lethality of airpower and rocket and missile artillery may make it possible to halt an invading force with a minimal ground force commitment. Figure 9 illustrates the combination of effects. When the invasion is halted, time becomes an ally of the United States and its allies.

Gain Air Superiority. Regional powers may possess means of conducting offensive operations other than ground forces. U.S. and allied forces can be threatened on the seas and on the land by aircraft, ballistic missiles, and cruise missiles. As has been consistently highlighted by history since the advent of modern airpower, air superiority—control of the air—provides strategic, operational, and tactical freedom of action while denying these advantages to the opposing side. Without control of the air, all land, sea, and air forces must at-
tempt to operate exposed to air attack, something increasingly difficult to do in the face of modern airpower. As Rommel once wrote after experiencing air attack against his armored forces, "Anyone who has to fight, even with the most modern weapons, against an enemy in complete command of the air, fights like a savage against modern European forces, with the same handicaps and with the same chance of success." Simply put, denying the enemy air superiority is a prerequisite to the effective conduct of joint theater operations and would be a top priority of any joint force commander.\(^\text{18}\)

Control of the air may be reached through several means:

- Establishing a robust air defense network (including defense against cruise and ballistic missiles).
- Suppressing enemy air defenses.
- Denying enemy aircraft the use of their own airspace.
- Destroying enemy airfield facilities, cruise and ballistic missile launch facilities, and their command-and-control network.

Ideally, these tasks should be accomplished simultaneously, but the phasing and weight of effort devoted to each task depends on the resources available.

and the degree of threat posed by each element. Success in one area abets efforts in the others. For example, reduction of an enemy’s air attack potential through strikes against airfields and the C$^3$I system reduces required effort in the air defense area. Similarly, defense suppression efforts increase the effectiveness of strikes against airfields and a wide range of other targets.

Setting up key elements of an air and missile defense system may be possible before the outbreak of conflict. For example, surface-to-air missile (SAM) batteries (or antiballistic missile systems) are solely defensive in nature and could be brought in to protect allied territory and signal U.S. resolve and intentions. Prepositioning these assets or moving them during periods of crisis particularly offers benefits due to the weight of these units (and the strains their movement would place on the limited airlift force).\textsuperscript{19} Similarly, AWACS and other command-and-control aircraft could be deployed to watch the unfolding situation. Finally, air superiority aircraft can be moved early and, if not present at the outset of conflict, can be deployed rapidly with small impact on the airlift flow (since their support packages and munitions are fairly light).

Figure 10 shows a concept for the establishment of a robust air and missile defense network to protect allied and arriving forces. When analyzing the ca-

\textsuperscript{19}For example, to move a Patriot missile battalion (which consists of one headquarters battery and six firing batteries, each of which possesses eight launchers) would require 55 C-5 sorties or 175 C-141B sorties and one C-5 sortie. Such numbers represent commitment of half the USAF’s C-5 force or almost three-fourths of the C-141B fleet.
pability of an air defense network, attention must be paid to the number of aircraft and SAMs available, the airspace to be defended, the number of avenues of approach, the ability to sustain the defense around the clock, and the capabilities and numbers of offensive adversary aircraft and missiles. Concepts for providing missile defenses are similar to air defense operations except that the time scales are much faster, ranges are longer, and space-based sensors may provide the early warning instead of airborne or surface-based radars.

Indigenous assets, if available, would provide some initial protection. These could be supplemented by fighters from forward-deployed carriers. Surface-to-air and ballistic missile defense batteries could provide missile and point defense of critical operational zones. Arriving air-to-air fighters would flesh out the defense network. Additional aircraft are needed to perform critical force protection missions (i.e., escort and fighter sweeps) and bolster the air defense network if the enemy possesses the capability to mount massed attacks.

The time required to build up a capable air defense depends on a number of factors, such as the number of air-to-air capable squadrons deployed, the capability of SAM systems, the ability of AWACS to concentrate forces in critical areas, the success of offensive counterair missions in constraining the enemy’s ability to conduct massed attacks, and the qualitative superiority of U.S. and allied air-to-air forces.

While the ability to defend friendly airspace is important, offensive counterair operations, which take the fight into the enemy’s territory and attack his capability at its source, are needed to gain control of the air in a theater. Offensive counterair operations involve fighter sweeps into enemy territory to engage opposing aircraft in their own airspace, and strikes against airfields, missile sites, and the command-and-control system. By doing this, friendly forces can reduce the enemy’s offensive capability at its source—and continue that process through sweep and offensive counterair until the enemy is no longer capable of mounting significant offensive air threats to U.S. and allied forces. In addition, attack aircraft could attack enemy ballistic missile launchers—or, if equipped with appropriate armaments, missiles in boost phase—to reduce the number of ballistic missiles that confront terminal defenses.

Suppression of enemy surface-to-air defenses (SEAD) is also an integral part of achieving air superiority. This involves operations against SAM batteries, gun sites, radar sites, and air operation and control centers. Such operations require lethal suppression (which involves delivering ordnance against threat sites) and jamming (which temporarily denies the adversary the ability to control his forces and guide weapons, by disrupting his communications and radars). Typically, these missions are associated with dedicated aircraft systems, such as Wild Weasels. However, land- and sea-based rocket and missile artillery can play important roles, particularly against fixed targets. For exam-
ple, in the Gulf War, army missile systems were employed against some elements of the Iraqi air defense network.

*Conduct Strategic Attacks.* Early destruction of the enemy's leadership, command-and-control assets, lines of communication, and other key warfighting capabilities can help ensure a decisive victory in war. Strategic attacks both reduce the enemy's ability to conduct war and affect his strategic and operational calculus.²⁰

The planning and conduct of strategic attack operations is a complex undertaking and will have to be phased based on the availability of assets capable of mounting such operations and the competing needs to attack forces in the field. Over the short term, the objective of such attacks would be to destroy the enemy's offensive capabilities—these operations would have direct relevance for air superiority missions and the halting of the invading army. For example, by focusing on the enemy's command-and-control network, the adversary's ability to maneuver and mass forces in the field and the air, and to execute missile attacks, could be degraded. Over the medium term, such operations would be aimed at reducing defensive capabilities. As the enemy's ability to conduct immediate operations is diminished, then the priority of these attacks could further shift to striking the support structure and lines of communication needed to sustain military operations. The targets that might be attacked in this phase include arms factories, weapon storage areas, and other installations.

Portions of the bomber fleet, long-range fighter force, and standoff weapons would conduct the bulk of these attacks. This attack force would combine stealth assets; saturation with cruise missiles and decoys; and manned aircraft capable of defending themselves penetrating at low altitude protected by defense suppression and air-to-air forces. This combination of different attack assets and penetration profiles would greatly complicate an enemy's defense problem, particularly as his air defense network was suffering from the effects of offensive counterair operations.

The ability to conduct strategic attack operations has changed fundamentally with the advent of precision weapons. These weapons create opportunities and new challenges. The opportunities made available are the efficient destruction of targets and the ability to minimize collateral damage and casualties. But because attack points can be attacked with precision accuracy, there is a growing requirement to know where key elements of the enemy's warfighting potential are located. This in turn puts new demands on surveillance and reconnaissance systems, as well as on the interpretation of intelligence data, par-

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²⁰One of the most influential works emphasizing the importance of strategic attack operations is Warden (1989). This played an influential role in the development of the "Instant Thunder" air campaign plan for the Gulf War.
ticularly to support standoff weapons (where a person is not available to see the exact location of the target). In addition, the ability to precisely strike aim-points without flattening entire installations in turn raises many challenges regarding bomb damage assessment. For example, a penetrating munition may leave only a small hole in the wall of a bunker, but the facility may be destroyed inside.

Enemy responses to countering a U.S. strategic air offensive may include active defenses, dispersal, camouflage, deep underground facilities, and placement of assets near or in locations where domestic or international constraints could prohibit striking (such as hospitals and schools).

Because the effects of strategic air offensive attacks may not be readily apparent for long periods and at times may have unanticipated consequences, it is difficult to assess the value of these missions, particularly during conflict. For example, during Operation Desert Storm, a considerable effort was made to destroy Iraqi C3 sites. Despite intensive targeting, communications from Baghdad to the forces in Kuwait seemed to flow unhampered. However, when the ground offensive began and forces had to maneuver, Iraqi communication requirements suddenly accelerated; the degraded system could not support the new operational tempo and collapsed.

Reduction of the Enemy’s Defensive Capability. Once actions have been taken to minimize the offensive threat posed by an adversary, time becomes an ally. Two operations continue: the buildup of forces and combat support assets within the theater and, through sustained engagement, the reduction of the enemy’s capability to defend. The latter involves continuing probing actions on the ground to keep the enemy off balance, sustained engagement with tube, rocket, and missile artillery across the depth of the immediate battle area, and sustained strikes by air forces against forces in the field and the supply lines that sustain them. In addition, ongoing strategic air offensive operations contribute to the overall reduction in defensive capabilities. Much as a siege in an ancient walled city did, these measures tax the enemy psychologically in addition to destroying military assets.

The overall process is illustrated in Figure 11. Continued strikes reduce the enemy’s effective force capabilities while friendly forces build up in combat capability. The degree to which the enemy’s defensive combat capability must be reduced is based on a number of factors. These include the size of his force posture at the time he was forced to halt his invasion, the character of the terrain, the nature of the weather, his ability to construct defensive positions, and his passive defensive capabilities, such as camouflage, deception, and dispersal. Ascertain the status of enemy forces—and hence the point at which friendly

\[21\] For an in-depth analysis of the impact of the 1991 coalition strategic air campaign, see Keaney and Cohen (1993).
forces can launch a counteroffensive—depends critically on accurate intelligence. At some point (a theaterwide ratio of perhaps 2:1), the correlation of forces would permit friendly forces to launch a joint counteroffensive.

Joint Counteroffensive. The culmination of combat operations for regional conflicts involving U.S. and allied forces is a joint counteroffensive campaign to regain lost territory, seize control of the aggressor's critical warfighting assets, and neutralize opposing combat forces. While it is possible that a regional aggressor might call for a cease-fire, or cede the gains of his aggression as U.S. and allied forces build up in the theater and apply pressure through sustained engagement, a joint counteroffensive may be necessary to evict opposing forces, seize territory, and destroy enemy combat capabilities, thus creating conditions to end the conflict. The counteroffensive phase involves air, land, and sea forces in addition to logistics support for operations. Land forces typically play the predominant role in dislodging the aggressor.

The planning, timing, and determination of the forces needed for counteroffensive operations depend on many factors. Generally, a counteroffensive operation follows the defensive and sustained engagement phases described in the previous sections. Accordingly, the successes encountered in these phases, as well as ground combat force composition and deployments, shape the character of the final phase.

Each situation is unique and must be specifically laid out on the actual terrain over a defined frontage. Several quantitative relationships are available to assist in estimating the size of the ground forces needed to conduct counteroffensive operations. These relationships consider the factors shown below:
• Committed enemy force strength
• Enemy reserve force strength
• Geographical frontage
• Effective military frontage
• Friendly force disposition committed to:
  — Main attack sectors
  — Holding sectors on the front
  — Reserves

Additionally, the size and effectiveness of firepower assets in the theater help to determine the size, deployment, and composition of land forces for counteroffensive operations.

The strength of forces on either side is sometimes quantified as equivalent divisions (EDs), armored division equivalents (ADEs), division equivalents in firepower (DEFs), or division equivalents in manpower (DEM). The relative strengths of opposing forces are generally derived from weighted averages of the units, weapons, and personnel contained in the combat forces. These factors can also be degraded, or enhanced, based upon the states of training, equipage, and sustainment.\textsuperscript{22}

Geographical frontages depend on the size of the theater and the territorial area that enemy forces choose to contest. These frontages also reflect the positions where the battle was actually stabilized by indigenous and friendly forces. The effective military frontage is a function not only of the geographical area, but of the type of terrain as well. The category of terrain (ranging from open through mixed, rough, and closed zones) may reduce the effective frontage or, conversely, increase the frontage covered by a division up to a factor of three.

Many factors (e.g., force dispositions, terrain, obstacles, and firepower) determine what is needed for the offensive. Let us first describe calculations that apply for nations lacking the ability to maneuver long-range fires with aircraft or artillery.

\textit{Traditional Concentration for Attack.} The joint force commander would have to make a number of choices affecting the size and type of the forces needed to conduct a decisive counteroffensive. The number and location of main attack axes must be determined, along with an estimate of the relative force advantage needed to break through defensive positions and contend with enemy reserves. These factors depend on the types of defenses, the terrain, and the size and location of the enemy's reserves. Finally, the joint force commander needs to decide the forces, or force ratios, to be employed in the sectors not

\textsuperscript{22}See Allen (1992).
positioned along the main axes of attack. These forces will initially be called upon to defend. As breakthroughs occur and the enemy forces face the prospect of envelopment, the forces off the main attack axes may also join the forward thrust.

Figure 12 shows a notional ground force deployment prior to the joint counteroffensive. Typically, planners concentrate forces along the main thrust axes and position reserves to exploit breakthrough operations. Concentrations are generally positioned in sectors where enemy weaknesses have been identified.

A wide variety of analytical tools and methods are available to determine the forces needed to conduct offensive operations. Generally, planning for offensive operations is an iterative process, beginning with the planner's experience and coarse-grained tools to estimate the force size, composition, and disposition and then proceeding to the development of multiple courses of action. The courses of action are based on detailed map and terrain studies. Computer campaign simulations are increasingly used to evaluate the feasibility of various
options. The ultimate product of the campaign analyses is a counteroffensive operations plan that details force dispositions, objectives, and the joint force commander’s scheme of maneuver and fire.

Figure 13 is an example of a planning tool that can be used in determining the forces needed to launch a counteroffensive. This figure is a graphical representation of a set of equations developed for this purpose (Davis, 1989). This example represents a specific set of conditions—a nine-sector front with two main attacks selected for the main axes of attack. For this example, the commander planning the offensive has opted to accept a 2:3 disadvantage in the holding sectors (those areas where he won’t immediately attack) and wishes to place a sixth of his force in reserve. The enemy has placed a third of his force in reserve as a hedge against breakthroughs along the front.

Using Figure 13 or other nomograms tailored to the anticipated operational conditions, the planners can see at the time when the theater force ratio is brought to 1.25:1 (friendly/enemy) through the buildup of friendly forces in the theater and the sustained attrition of enemy forces, the ratio of forces on the main attack sectors exceeds 5:1. This provides a margin of safety over the doctrinal ratio, as shown by the upper horizontal line on the graph, needed to break through prepared defenses in mixed terrain. If the defenses were weaker, like those characterized by deliberate defenses in flat terrain, an even more
substantive margin of advantage would exist over the doctrinal norms. Further, the offensive commander would retain an advantage of 2:1 after the enemy committed his reserves. Tools such as this aid in establishing initial force planning estimates.

Calculations such as these represent a starting point. More refined planning estimates must be introduced to develop campaign plans for the actual terrain. These will be based on the latest intelligence estimates of enemy force strengths and dispositions. Because enemy force strength and disposition change during the course of the early phases of the conflict, a process to assess the battle damage inflicted by friendly forces on the enemy is essential for refining campaign planning and determining when conditions are favorable for the initiation of counteroffensive operations.

The likelihood of an enemy successfully defending against counteroffensive operations is increased if the adversary can efficiently position his ground combat forces, develop strong defensive positions along the front, provide firepower to cover defensive positions, reduce allied forces, and move reserves to critical locations along the main attack axes. These actions are made easier if the enemy is able to use surveillance assets to observe allied movements and positions.

Implications of Deep Fires. The discussion to this point could have applied to warfare for many years past. But the calculations are being changed by the growing capability to see deep into the enemy’s territory and conduct operations with airborne and special forces deep in enemy territory, and to attack enemy forces and logistics with precision and mass using airpower and standoff weapons fired from land, sea, and airborne platforms. Similarly, if the opposing forces still possess these capabilities after the defensive and sustained engagement phases, a joint counteroffensive could be very difficult to conduct and might result in an inordinate number of casualties or failure to achieve the objectives of the counteroffensive.

The denial of surveillance assets to the enemy through strategic attack in the defensive and sustained engagement phases (as well as through deception) degrades the latter’s defensive capability and, in turn, directly enhances the counteroffensive capabilities of the allied forces. Though each campaign is unique, Figure 13 can be used to illustrate the effects. If the enemy is unable to determine troop dispositions and movements due to the loss of surveillance assets, then defensive positions may be poorly placed. Therefore, allied forces would have to overcome lower levels of defenses, which is similar to moving to the lower horizontal line in Figure 13. This reduces the forces required both on the main axes of attack and in the theater overall. Even if the joint allied commander prudently elects to conduct the counteroffensive with decisive forces to retain a safety margin, the calculation begins with a lower baseline figure.
During the sustained engagement phase, airpower, artillery, and missiles progressively reduce the enemy's combat power and supplies for sustainment. This reduces the number of ground forces needed for successful offensive operations, since the forces required are generally computed based on the relative combat power of both sides. Additionally, airpower, missiles, and deep operations conducted prior to the counteroffensive phase could be used to reduce and immobilize operational and theater reserve forces. Immobilization of reserve forces could prove to be easier to accomplish than their destruction, due to their vulnerability to attacks on fuel supplies, lines of communications between the reserves and the front-line battle area, and the vehicles needed to move reserves into position.

A counteroffensive would contain several stages, each of which has phased objectives. Both ground and air forces are integrated into a plan to achieve these objectives. The immediate goal of a counteroffensive is to breach the enemy's front-line defenses and deny remaining enemy reserves the opportunity to enter the battle. The assault on the front-line defenses is principally the mission of ground combat forces assisted by artillery and close support from helicopters and fixed-wing aircraft. The isolation of reserves from the battle area might be accomplished in the sustained engagement phase and assured as the offensive begins with deep operations and airpower. These forces should be an integral part in the joint force commander's scheme of fire and maneuver.

Objectives of the latter phases of the counteroffensive include the isolation and defeat of the enemy's front-line ground forces and destruction or neutralization of operational and theater reserves. The movement to seize territory and to fix, isolate, and destroy reserve forces throughout the battlespace may be accomplished in a series of steps, depending on the distances to be covered. The time and transportation assets needed to move supplies forward could be limiting factors, and these must enter into computations regarding rates of advance and the attainment of subsequent objectives. Calculations of logistics requirements are a critical factor in the ultimate success of combat operations. Similarly, because of the magnitude of the forces, assets, and supplies needed for offensive operations, under most situations the buildup of combat support and combat service support forces in the theater of operations is the limiting constraint on the timing of counteroffensive operations.

Airpower and deep operations with air mobile and special forces are part of the joint theater commander's plan of fire and maneuver to isolate enemy forces in the battle area. This can be accomplished through an interdiction campaign along the egress routes and direct engagement of forces beyond the range of logistically constrained offensive ground combat forces. Eventually, territory is seized and the aggressor's combat power destroyed and contained. This introduces the final phase of regional conflict.
Phase III: Postconflict Stability Operations

Winning a conflict produces a distinct set of challenges and requires different types of military forces. The demands on military forces following the successful termination of a conflict are to establish stability in the territory that has been seized, and perhaps throughout the aggressor nation, depending on the outcome of the conflict. Stability operations are defined as those necessary to establish conditions under which a legitimate government can function.

The scope of demands presented by stability operations depends on the conditions under which the conflict is terminated. The size of the territory occupied, the degree to which the population is amenable to control, the size of the population, and the extent of remaining opposition are all factors in the scope of stability operations. In addition to controlling any remaining opposition, it might also be necessary to reestablish services and infrastructure within the conquered territories. The types of forces needed for stability operations are light and mobile land forces that can accomplish police and control functions, engineers to rebuild the needed infrastructure and population support functions, and combat service support troops to provide sustainment to defeated enemy forces and the population. These forces are different from the mechanized land and airpower forces needed to conduct an offensive.

Another role of forces used in postconflict stability operations is to control and police a populace. The magnitude of the task, accordingly, is a function of the size of the population and the degree of control needed. Figure 14 illustrates the requirements posed in stability operations in the postconflict phase. The horizontal axis shows the size of the population, and the vertical axis shows the number of troops required to control it. The lines on the graph represent the level of effort required to maintain security. Because stability operations are policing activities, there are some precedents to draw upon. For example, the United States is policed at an average of two police personnel per 1000 population. Large cities in the United States are typically policed at a rate of four per 1000.

We also have several historical precedents from past military stability operations, as shown in Figure 15. The American occupation of Germany following World War II was planned to be conducted at two per 1000 population. This was a relatively easy venture, because the population accepted order. As of November 1993, Somalia was currently being policed at a level ranging from six to eight per 1000. This was a situation in which there is a higher degree of instability. In Northern Ireland, the British are faced with an unstable situation where there is a constant terrorist threat. British forces in Ulster (including the constabulary) maintain a ratio of twenty per 1000, and this presence has been maintained for years. Even higher on the scale is the Israeli policing of Gaza and the West Bank.
Figure 14—Relationship of Forces Needed for Stability Operations

Figure 15—Historical Examples of Forces Used in Stability Operations

These historical precedents illustrate that force presence for stability operations is a function of the area, the population size, and the degree of unrest and threat present. The force requirements could be quite high and may be exac-
erbated in the future by population growth and by the increasing urbanization of the world. Further compounding the demand for force needs is the fact that the duration of such operations may be long.

The forces used to conduct stability operations are generally light combat forces. Combat support and combat service support forces are needed to support the light forces and perhaps supply the population. Additionally, a logistics pipeline must remain in operation to sustain stability operations.

COUNTERSTRATEGIES

This discussion of major regional conflicts has stepped through the phases of this highly stylized campaign as if it were a methodical process. Unfortunately, conflict, like all human undertakings, does not always proceed as planned. This is particularly true in wars where an opponent’s nation is at stake. War is a two-sided contest; the opponent will strive to win and thwart the attainment of campaign objectives by the United States and its allies in a variety of ways. Because of this, no analysis of a major regional conflict is complete without consideration of the opponent’s strategies and counterstrategies.²³

An opponent’s strategy and capabilities will vary through the course of a campaign. So will his goals. Because of the relative strength of the United States, a principal objective of any regional aggressor would probably be to avoid a direct confrontation with U.S. military forces. If a confrontation cannot be avoided, prudent aggressors will search for asymmetrical strategies and objectives that avoid pitting their forces against American/allied military strength. Finally, if U.S. and allied strength is brought to bear, regional aggressors could seek means to frustrate the accomplishment of U.S. objectives while minimizing their own losses. The choices available to potential regional aggressors are a mixture of political, economic, and military counterstrategies.

The first counterstrategy may be to delay and deter a U.S. response. As we have discussed earlier, the opening period of a regional conflict—particularly in those areas where U.S. forward presence is minimal—is critical, and success depends on the rapid deployment of sufficient forces to join indigenous military units in halting an invasion and containing the aggressor’s offensive power. Therefore, a first step of a political/military strategy for a regional aggressor might be among the following:

²³For a discussion of how various nations are responding to the lessons of the 1991 Gulf War, see Garrity (1993). For reactions of the Russians, see Lambeth (1992). For games attempting to suggest what future opponents will do, see Bennett, Fox, and Gardiner (1994).
• Mask intentions to threaten U.S. national interests and to conduct war on neighboring states.
• Use political and economic pressure to dissuade neighboring states to allow access to the region.
• Appeal to American and allied public opinion that U.S. involvement is unnecessary and unwise.

These actions, either individually or in combination, could delay the introduction of critical U.S. force elements into the region.

Once the commitment to deploy and use U.S. forces in a regional conflict is made and access is granted, the opponent’s strategy might shift. Emphasis then could be given to the employment of forces to achieve a fait accompli or present U.S. forces with a much more difficult forced-entry scenario. Simultaneously, a regional opponent might pursue the rapid acquisition of critical areas by invasions of neighboring states and demonstrations of will and power through the destruction of key high-value assets by strategic or terrorist attack.

Delaying the deployment of U.S. forces while aggressively conducting a land invasion is another avenue open to an opponent. This might be accomplished in a twofold manner. Political pressure could continue to be used to deny access to staging losses and areas, and attacks could be conducted on key nodes of the air and sea lines of communication.

Attacks on the air and sea lines of communication could have telling effects on the rate of closure of U.S. and allied forces. The critical facilities are the following:

• The aerial ports of debarkation (APODs) or those airports where large transport aircraft can land and unload forces and cargo.
• The sea lanes that approach major ports in the region of conflict.
• Seaport facilities in the theater.

The number of such areas will of necessity be limited, and each will have some vulnerability to attack by an opponent. In the process of planning and analyzing a campaign in a major regional conflict, the potential effects of enemy interdiction of nodes in the air and sea lines of communication must be considered and measures to overcome enemy actions carefully evaluated.

An aggressive and prudent opponent might also divert a portion of his offensive capability to destroy or counter high-value U.S. assets in the early stages of the campaign. By concentrating a selected force on assets that are singularly important to the successful accomplishment of U.S. goals, an opponent might gain needed time or cut into the resolve of the U.S. public and military leaders. We have already mentioned the potential value of attacks on the nodes in the
air and sea lines of communication in slowing the rate of deployment. The psychological impact of sinking a military prepositioning ship carrying munitions for aircraft or the equipment for a Marine or Army brigade could be important.\textsuperscript{24} Similarly, an air or missile attack on an APOD filled with strategic airlift aircraft and supplies could be very damaging. Other critical U.S. force targets could be

- An aircraft carrier or other valuable ship.
- AWACS, JSTARS, or aerial refueling aircraft.
- Concentrations of U.S. force personnel or command facilities.
- A high-value stealth aircraft like the B-2.
- Operational U.S. air bases and the destruction of aircraft, fuel, and munitions.

Some of these critical target sets may be attacked with ballistic or cruise missiles. Additionally, air and terrorist attacks are relevant to some of these critical U.S. force elements. One cannot predict in advance the total effects of the enemy’s destruction of key U.S. assets and people in the early days of a campaign. Such events might undermine U.S. resolve—or serve to increase it.

U.S. forces possess qualitative and quantitative advantages over most regional adversaries. If measures to dissuade the United States and its allies from intervention, or if measures to slow the rate of deployment are unsuccessful, then the picture changes for the adversary. As forces build up in the theater, the aggressor’s chances for a direct military victory lessen. The strategic options for the regional aggressor lie in consolidating his gains and stalemating the situation while inflicting casualties and damage on U.S. and allied forces to increase the price of involvement.

After sufficient U.S. forces have arrived to stabilize the military situation, the enemy has a different set of options. One might be calls for cease-fires in place interspersed with dispersed, fleeting attacks. Missile and limited air attacks could also become part of an indirect strategy for a regional aggressor to consolidate his gains, sustain his forces and morale, and wear at the will of the United States and its allies.

Another option is the use of weapons of mass destruction (e.g., nuclear, chemical, and biological weapons). Such use anytime in a conflict could produce a large number of casualties among the U.S./allied forces and among the

\textsuperscript{24}For example, the sinking during the Falklands War of the Atlantic Conveyor transport vessel, which carried almost all British transport helicopters, forced British forces to walk from the landing site to the Argentine stronghold at Port Stanley—and greatly increased the length of time needed to complete the British joint counteroffensive.
civilian population of the invaded state. However, employment of such weapons would leave the attacker open to potential ripostes in kind.

A third option would aim at preserving enemy forces by dispersing them in an orderly fashion, moving out of the conquered territory, and reconstituting for guerrilla warfare in the aggressor's own nation where the knowledge of the terrain may favor his forces. A sustained guerrilla and terrain campaign following a regional conflict without a decisive end could be very taxing on the U.S. and allied forces' capabilities. The pressure on the U.S. ability to sustain operations in this type of warfare would be magnified if those operations had to be conducted in the aggressor's territory, and if his forces had been disengaged and dispersed early enough that his population and his forces still had a strong will to resist. This presents a situation with an indeterminate end that may be better suited to an adversary's long-term objectives than to those of the United States.

OBSERVATIONS

The discussion in this paper examines the conditions of major regional conflict in the post-Cold War era. The nature of major regional conflicts is shaped by the changed balance of military power and the reductions in U.S. overseas military presence. These factors indicate that future regional conflicts will be conducted in distinct phases, with different campaign objectives associated with each phase. The duration of the combat phase can vary with different responses by the aggressor, but it will always be bounded by the time required to deploy U.S. forces into the theater of operations.

The discussion has been presented without respect to a particular region or enemy. However, analysis and planning for regional conflict must be done with a specific opponent in a specific region, because the specific forces, facilities, and location are important. Though many now speak of the uncertainty of the post-Cold War security environment, regional threats five to ten years in the future are not uncertain. There are only two areas where potential opponents with sufficient military forces pose a threat to U.S. national interests today; these are Southwest Asia and Korea, which should serve as a focus of near-term U.S. planning efforts. While planning for the bulk of the military structure is determined in large measure by the needs established in regional conflict scenarios described in this paper, there are a number of unique force capabilities that must be determined and provided for. Examples of unique capabilities are defenses against ballistic and cruise missiles, and light infantry forces for operations in urban and jungle environments and for peace-enforcement operations.
Shaping military forces for new challenges takes a long time, owing to the lead times required to develop strategies and alliance structures appropriate for new threats and to procure sufficient numbers of new weapons and systems to support these new strategies. At present, it appears the United States will have adequate strategic, economic, and political indicators to shift its planning focus, provided an adequate level of forces is maintained to provide the bedrock for new strategic commitments. Understanding the nature, objectives, and phasing of regional conflicts, together with the range of strategies an opponent may employ, is crucial to planning these operations and deriving estimates of future required force levels and capabilities.

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INTRODUCTION

The problems that the United States and its nominal allies are experiencing over the increasingly vexing conflicts in Bosnia and Somalia, as well as the ambiguous aftermath of the Gulf War, illustrate the difficulties that the country can expect to face in navigating the largely uncharted waters of the post–Cold War world. Defining the nature and extent of U.S. interests in the evolving world and evaluating the tools available to protect those interests are likely to remain challenges to U.S. policymakers for some time. Military forces remain among those tools that might be employed in some situations. Defining the sort of military force that can meet the country’s needs in the post–Cold War world, and still be affordable in times of increasingly austere budgets, is the dominant problem facing U.S. military planners today. Choosing a bomber force and deciding how to employ it are parts of that problem.

The ability of long-range bombers to deliver large, diverse payloads virtually anywhere in the world in a matter of hours has given them a key role in U.S.
military strategy for several decades. As Figure 1 suggests, long-range bombers have long figured significantly in planning for both nuclear and conventional operations. In fact, in the aftermath of the Cold War, heavy bombers should have the easiest time of all of the strategic nuclear forces in making the transition to a largely conventional role appropriate for the "new world."

Actually, a series of RAND analyses predating the end of the Cold War showed that even then, conventional rather than nuclear requirements should dominate bomber structure decisions. However, the end of the Cold War represented an unmistakable "wake-up call." If their range-payload advantage (see Figure 2) could be exploited effectively, long-range bombers could offer unique advantages for worldwide power projection, particularly in the early phase of a distant conflict.

The analysis of heavy bomber operations has evolved as well, in the decades since operations analysis was first applied to strategic bombing in World War II.1 During the Cold War, estimating the potential effectiveness of using long-range bombers in nuclear operations against the Soviet Union provided semi-

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Figure 1—Long-Range Bombers Can Bring Substantial Firepower to Bear Virtually Anywhere

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1For a contemporary discussion of the early doctrinal debates on use of bombers and institutional evolution that led to the creation of the U.S. Air Force, see Brown (1992:29–67) and Sherry (1987).
The Use of Long-Range Bombers in a Changing World 395

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>Unfueled Ferry Range (nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-16C</td>
<td>2-4 MK84</td>
</tr>
<tr>
<td>A-6</td>
<td>4 GBU-10</td>
</tr>
<tr>
<td>F-15E</td>
<td>2 GBU-24</td>
</tr>
<tr>
<td>F-111F</td>
<td>24 MK82, 27 M-117</td>
</tr>
<tr>
<td>B-52G</td>
<td>84 MK82 (3 bays)</td>
</tr>
<tr>
<td>B-1B</td>
<td>24 MK82, 27 M-117</td>
</tr>
<tr>
<td>B-52H</td>
<td>80 MK82</td>
</tr>
<tr>
<td>B-2</td>
<td>36,300-lb cruise missiles</td>
</tr>
<tr>
<td>747-200</td>
<td>36,300-lb cruise missiles</td>
</tr>
<tr>
<td>747-400</td>
<td></td>
</tr>
</tbody>
</table>

*Potential cruise missile carriers based on converting widebody commercial aircraft for military use.

Figure 2—The Range-Payload Advantage of Heavy Bombers

In the 1960s, the systems analysis art was still in its infancy. Since then, both the breadth and style of bomber analysis have changed. Increasingly complex computer simulations are replacing the equations and simple computer models. Dramatic improvements in computer hardware in recent years have made such detailed models practical analytical tools and put them within the reach of a much larger group of analysts. While the resulting precision has decided advantages, it also comes at a price.

An important challenge for bomber analysts is weighing those advantages and costs as they pursue the primary purpose this sort of analysis serves: to inform the choices of decisionmakers who have to worry about how bombers ought to fit into overall U.S. military strategy and what kind of bomber force the United States ought to have in the future, given all of the other competing demands for resources. Specific issues include:

- How can long-range bombers be employed most effectively? What critical roles can they play?
- How many of each type of bomber should the United States retain?

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2For discussions of the use of operations analysis in World War II, see Wilson (1968:45–54), Koopman (1946), and Morse and Kimball (1987). For a personal recollection of early efforts to apply analytical methods to a bombing campaign, see Dyson (1979:19–32). See also Weapons Systems Evaluation Group (1950).
What would the implications be of further reductions in the current bomber force?

What additional improvements need to be made in the bomber force to make it effective in coping with future contingencies?

The purpose of this paper is to describe (1) the principal issues in employing long-range bombers and structuring a bomber force for the post–Cold War era, (2) the analytical approach that my colleagues at RAND and I have employed in analyzing bombers over the last several years, and (3) some lessons learned about how such analysis has changed—for better and for worse. To those ends, this paper covers these topics: bomber analysis in a "new," uncertain world, structuring a bomber force for the new world, critical decisions for the future bomber force, and observations on the analysis process.

**BOMBER ANALYSIS IN A "NEW," UNCERTAIN WORLD**

Moving away from the old focus on strategic nuclear war or major conventional war with the Soviet Union and its allies requires refocusing both mind-sets and analytical tools. Some things are actually easier. The intensity of the air defense environments is generally greatly reduced. Even countries with relatively high-quality defenses are less likely to have the numbers and density of air defenses of the former Soviet Union, except perhaps in very limited areas. In addition, the defenses are less likely to be effectively integrated. That makes decomposing the defenses—for example, separating SAM and airborne defenses—much easier. Similarly, the less extensive offensive forces could make analyzing traditional kinds of land combat somewhat easier than the old Warsaw Pact or even the Desert Storm cases.

On the other hand, more fundamental issues are much more difficult to deal with. For example, a much broader range of possible conflicts and scenarios must be examined. Determining the right issues and measures of effectiveness is a much less obvious task than it was in the more familiar stylized scenar-

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3I want to acknowledge the contributions of numerous colleagues at RAND who have worked on the series of bomber studies that provided the "meat" for this paper. Classification restrictions prevent me from citing most of their work directly. The best I can do is thank Dave Frelinger, Jim Quinlivan, Bart Bennett, Preston Niblack, Don Stevens, Edward Harshberger, Joel Krivsky, Dana Johnson, Joe Alt, Dave Balsille, Myron Hura, Bob Smith, Gary Liberson, Bruce Davis, Greg Born, Ruth Berg, Karl Hoffmayer, Jim Bonomo, Ken Saunders, Dave Spencer, Mark Bolstad, Mary Chenoweth, David Novikoff, Roy Gates, Corinne Repogle, and Amanda Giara for all of their work on bombers over the last few years at RAND. Needless to say, they are not responsible for any sins of omission or commission on my part in this paper, particularly with respect to observations on how to do bomber studies.
ios. Political nuances, alliance considerations, and other less tangible issues are likely to be more important.

In short, analyzing bomber effectiveness in the “new world” requires a lot more basic thought than repeating the old world analysis in slightly different variants. In our initial forays into this arena, we have found that a lot of trial and error is inevitable in defining the right level of detail to use in addressing various aspects of the overall problem to produce an analysis that is “good enough” to provide useful guidance to policymakers. There is still considerable room for art and judgment in addition to science. This section describes what that means in terms of the altered military picture, constructing a bomber analysis, and our analytic approach.

The Altered Military Picture

Choosing the Right Enemies and Conflicts. Figure 3 illustrates how drastically the worldwide military picture has changed following the dissolution of the Soviet Union. The figure shows the inventories of tanks and combat aircraft that various countries around the world possess. The former is one measure of a nation’s capability to invade its neighbors rapidly and effectively. The latter represents a potential capability both to defend its airspace and to attack critical targets in other countries. The former Soviet Union was in a class by itself in both categories.

![Figure 3—Worldwide Military Capabilities Remain Significant](image)

RAND#1:35-30-0194
The rest of the countries shown in Figure 3 have much smaller military establishments and are clustered near the origin on the left-hand plot. The right-hand plot shows an expanded view of the area near the origin to allow comparisons among the rest of the countries. For example, before Desert Storm, Iraq had one of the largest armored forces in the rest of the world and had a substantial air force as well. It was, in some ways, a “mini-Soviet” force relying heavily on Soviet equipment, doctrine, and training. That actually made Iraq seductive as a potential adversary for U.S. planning purposes because it seemed tailor-made for U.S. military forces that were originally designed to deal with a larger, more capable Warsaw Pact force in Europe. In fact, it was one of the few military situations in the world where old-world solutions might be applied successfully if the enemy was unwise enough to allow the United States and its regional allies the time to prepare properly. That, of course, is precisely what Saddam Hussein did, and his reward was an overwhelming military defeat.

On the other hand, using Iraq as a planning surrogate before the invasion of Kuwait was not entirely self-serving for the United States. Iraq was representative of a generic class of enemy that could both seriously threaten fundamental U.S. interests and tax its capabilities to respond:

- Iraq displayed the characteristics of a classic hegemonic power ruled by a dictator who owed much of his power to the Iraqi military.
- Even before its invasion of Kuwait, Iraq had demonstrated a willingness to use military force in its long war with Iran and its ruthless suppression of its own ethnic minorities, such as the Kurds.
- Iraq bordered on countries that were nominally allied to the United States (i.e., Saudi Arabia and Kuwait), controlled resources vital to the United States and its allies (i.e., oil), and were militarily much weaker than Iraq before the Gulf War.
- Iraq was developing nuclear weapons, as well as other types of weapons of mass destruction, and relatively long-range delivery systems that could eventually have allowed it to extend its control—directly or indirectly—over a larger share of Persian Gulf oil. Iraq would become richer in the process and control a resource vital to the West, assuring itself a “place at the table” as an important permanent player on the international scene and one potentially hostile to the United States, particularly if Saddam Hussein managed to successfully adopt the mantle of pan-Arab nationalism.
- Iraq was so far from the United States geographically that the United States would have trouble responding in a timely manner to Iraq’s use of force.

For all of these reasons, a situation similar to that in Southwest Asia before the Gulf War was—and is—one generic class of conflict that is both very demanding for U.S. military forces and potentially important to U.S. interests. Forces that could deal with this sort of stressing generic scenario should also be more
than adequate to deal with many less demanding situations as "lesser included" cases. Identifying stressing cases and dominant solutions is one of the general principles in planning for an uncertain world.

Obviously, no single scenario should be the basis for U.S. planning, particularly in such an uncertain and volatile environment. For one thing, even a legitimate-looking scenario might be dismissed by policymakers as too hard, too improbable, or too unique to be the focus of military planning. Moreover, situations are likely to be different enough so that even "lesser" cases may really not be lesser included cases of a major campaign such as a large-scale conflict in Southwest Asia. Accordingly, the analysis needs to be rich enough to include combinations of conditions that will stress different aspects of U.S. capability. Predicting where the U.S. equivalent of the Falklands campaign might occur is virtually impossible, particularly since even some of the more modest-looking military powers shown in Figure 3 should not be casually dismissed. For example, several countries have armored forces that include more than 1000 tanks, which is about the size of the U.S. 7th Corps that took three months to deploy to the Gulf in Desert Shield. Thus, depending on circumstances, including the political climate in the United States at the time, even minor military powers should not be taken too lightly.

The Proliferation of Advanced Air Defenses. As noted above, the intensity of air defense environments, generally, is reduced. However, conducting raids worldwide or operating in the early stages of a distant campaign when enemy air defenses are still relatively intact is likely to be increasingly difficult for bombers. Figure 4 suggests why. High-quality air defense systems—"lookdown" fighter aircraft, high-performance SAMs, airborne surveillance systems—are becoming increasingly available even in the Third World, and this proliferation is likely to accelerate in the future. In 1980, only a few countries in the Third World had any high-quality systems for air defense. These countries were generally superpower client states, and the motives of the suppliers were at least as much political as economic. Moreover, at the time, the United States and the Soviet Union could keep a relatively tight rein on their main clients, although countries like Iran had already broken away from their former patrons. A controlled situation was already becoming less controlled.

By 1990, the picture had changed considerably. First, more suppliers were in the market. Second, the suppliers, including the United States and the Soviet Union, were increasingly motivated more by economic than by political concerns: Selling fighter aircraft is a source of revenue for all, and of hard currency in particular for the former Soviet states. As a result, more and more countries are in a position to acquire high-quality air defense systems. This trend is likely to accelerate as still more suppliers get into the market, some potentially hostile countries have money (e.g., oil money), and regional security
becomes more problematical because of the perceived end of the Cold War and the disintegration of various Cold War military alliances that had maintained a measure of regional stability. The net result is that heavy bombers will have to be concerned about air defenses virtually anywhere they may need to go in the future.

Of particular concern to heavy bombers are the following:

- Modern airborne interceptors, even in small numbers, unless countered by arms or the use of stealth.
- Even small numbers of modern SAMs employed either as terminal defenses of high-value fixed targets or as mobile defenses covering invasion forces.
- Airborne surveillance systems, such as the U.S. airborne warning and control system (AWACS).
- Low-frequency early warning/ground control intercept (EW/GCI) radars in critical locations.

On the other hand, with the disappearance of the Soviet threat, life should get easier for bombers because:

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**Figure 4—High-Quality Air Defenses Worldwide**

<table>
<thead>
<tr>
<th>Air Defenses</th>
<th>1970</th>
<th>1980</th>
<th>1990</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Airborne interceptors</strong></td>
<td>MI.G-15, 21</td>
<td>F-10A, F-10B</td>
<td>F-15E, F-16,</td>
<td>SU-27 European</td>
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<td></td>
<td>F-5, 5</td>
<td>F-15A, F-15B</td>
<td>F-16C, F-16D</td>
<td>fighter aircraft?</td>
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<tr>
<td></td>
<td>Mirage III, 5</td>
<td>Mirage 2000</td>
<td>F-16C, F-16D</td>
<td>Japanese FSX?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Air intercept missiles</strong></td>
<td>AIM-7, 9</td>
<td>AIM-9B</td>
<td>AIM-9C</td>
<td>Countermeasure-resistant missiles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Surface-to-air missiles</strong></td>
<td>HAWK</td>
<td>HAWK</td>
<td>Roland</td>
<td>SA-10 class?</td>
</tr>
<tr>
<td></td>
<td>SA-2, 3</td>
<td>SA-6, SA-9</td>
<td>Stinger</td>
<td>Patriot class?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SA-13, SA-14</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>SA-5</td>
<td></td>
</tr>
<tr>
<td><strong>Surveillance systems</strong></td>
<td></td>
<td></td>
<td>AWACS</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>AWACS variants</td>
<td></td>
</tr>
</tbody>
</table>

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**Threat to bombers:**

- Minimum
- Moderate
- Severe
• "Enroute" SAMs and other ground-based defenses should not be much of a problem unless bombers try to fly low in dangerous areas.

• Densities of air defenses do not, in general, approach those of the former Soviet Union and Warsaw Pact.

• Third World pilots are usually not well trained, and air defenses do not normally operate as efficiently and effectively as those of the West's former adversaries.

In general, small bomber forces of the future can afford very little attrition, so preparing to deal with future air defenses is crucial to planning the bomber force.

**Constructing a Bomber Analysis**

Over the decades that analysts have been working bomber problems, a "school solution" has emerged about how to do a bomber study. A certain number of obligatory steps and subanalyses are an intrinsic part of the standard approach. Figure 5 illustrates this process as it applies to the "old world" case of a strategic nuclear attack on the former Soviet Union. Indeed, the basic issues—basing and support of the bombers, readiness and responsiveness, range and payload capability, survivability, and effectiveness in destroying targets of interest—never really change. However, the relative importance of different pieces of the problem and the difficulty and appropriate level of detail in analyzing various aspects of bomber operations vary considerably. Moreover, our experience suggests that even when there is general agreement on the major thrust of the analysis and the issues to be addressed (admittedly, an unusually agreeable situation), there is still considerable room for argument about exactly what tools to use, how to use them, and what to make of the results. That's why the science and art of systems analysis—the critical judgment necessary to make analysis "correct," credible, and useful—remain critical even in constructing a classical bomber analysis in the old world where life was simpler.

The world of conventional operations is much less tidy; this was so even in the old world. Figure 6 illustrates some of the critical steps in the analytic process for assessing bomber operations in a spectrum of conventional campaigns and gives a sense of the overall flow of the analytical process. Even a conceptual diagram of the process is much less straightforward than in the strategic nuclear arena. The analysis is much more iterative. More choices are involved. There are more potentially competing and complementary weapon systems to consider, which in turn lead to a more complex set of alternative operational concepts and force structure options to evaluate. Also, although some analyti-
Figure 5—Steps in a Classical Bomber Analysis: Strategic Nuclear Attack on the Former Soviet Union
Figure 6—Analyzing Bombers for Conventional Power Projection

cal tools are applicable both in the conventional and nuclear arenas, we found mismatches as well. "Force fitting" models designed for one world into the other sometimes caused massive headaches and produced analytical results of dubious value. As the "new world" evolves, we expect this problem to increase. Some conventional, and even nuclear, scenarios that we may have to worry about in the future are likely to be quite different from anything we have had to deal with in the past, and our thought processes and analytical methods are going to have to change accordingly.

One thing that has changed in the military systems analysis community over the last several decades is the growing number of large-scale computer simulation models employed in various phases of air campaign analysis, including the employment of bombers. In the past, really large-scale computer models were primarily used for relatively specific applications (e.g., penetration of Soviet air defenses, detailed modeling of nuclear weapons effects, design of the Single Integrated Operational Plan [SIOP]). They were employed mainly by organizations with the resources to invest in suitable computers, programmers, and analysts to develop and use them. The Advanced Penetration Model (APM) is an example of models of this genre. APM used to be the staple "official" model used by the Air Force for analyzing strategic bomber effectiveness in penetrating Soviet air defenses. "War stories" about the trials and tribulations of using APM abound in the defense community.
The revolution in computer technology over the last decade or so has caused a sea change in the way much of the defense community does analysis. The vast increases in computational capability have brought large-scale computing within the reach of a much larger segment of the defense community. As a result, modeling particular kinds of military problems (e.g., SAM engagements) in much greater detail and more routinely employing large-scale exchange models, which incorporate more refinements, have become much more practical. Accordingly, the kinds of analysis that used to be performed with simpler, more satisfying analytical models now tend to be done using families of higher-fidelity, computer-intensive models.

Figure 7 shows some of the computer models that we have used in our recent bomber studies in just the penetration part of the analysis. Table 1 describes some of the features of these models, such as the required inputs and the kinds of outputs they produce, in more detail. Just sorting through the "alphabet soup" of models of various sorts can be a considerable challenge, and selecting the appropriate model for specific applications can be an art in itself.

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4Some examples of models of this genre include Schultis (1978:1357, 1979:1431), Jacobson (1977), Cunningham (1973), and various unclassified appendixes to classified reports describing methodology for analyzing different aspects of the air defense penetration problem.
Table 1
A Taxonomy of Penetration Models

<table>
<thead>
<tr>
<th>Types of Analysis</th>
<th>Scope</th>
<th>Inputs</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenomenology</td>
<td>System or subsystem characteristics that impact a particular kind of phenomenon</td>
<td>Aircraft wire frame, Aircraft performance, Sensor physics, Automated logic, Countermeasures, Environment</td>
<td>Detection ranges, Scenes</td>
</tr>
<tr>
<td>One-on-one</td>
<td>Site or combined system effects</td>
<td>Aircraft performance, Weapon characteristics, Cognitive processes, Countermeasures, System tactics, Environmental effects</td>
<td>Tracking distributions, Engagement envelopes, Probabilities of kill</td>
</tr>
<tr>
<td>System integration</td>
<td>Mission components and effects</td>
<td>Platform functions and interactions, C3I, Aggregate countermeasures, Mission tactics, Aggregate environmental effects</td>
<td>Mission effectiveness, Survivability measures</td>
</tr>
<tr>
<td>Campaign</td>
<td>Force exchange</td>
<td>Aggregated platform features, Missions/postures, Resource allocation, Force mixes, Strategies</td>
<td>Force effectiveness, Impact of allocation strategies</td>
</tr>
</tbody>
</table>

since they differ dramatically in scope and level of detail. Even more important, wiring them together, either literally or figuratively, to produce a coherent analysis is one of the highest forms of the systems analysis art.

The models themselves vary considerably in their demands on computers and analysts. Run times on modern computers can vary from minutes to hours to days for a single case, depending on the particular models and the scope of the case being examined. More important, they typically require considerable care and feeding to employ effectively. Preparing input data for individual cases can take days even with the data largely in hand. Collecting those data
can take months and may even be impossible, driving analysts to improvise and hope that they can later identify any impact on the results of less-than-ideal inputs.

Analyzing and interpreting the results of most large-scale simulation models typically requires time, effort, and experience as well. Even running the models successfully requires a certain amount of training and experience. As a practical matter, that means training and maintaining a cadre of analysts who are not only knowledgeable in substantive areas (e.g., air-to-air combat) but also able to use various community-standard models successfully. (Indeed, experience with particular computer models is becoming obligatory on résumés of military systems analysts!) Thus, there is a substantial "buy in" price in analyzing bomber operations using these sorts of tools. For example, of the two dozen or so analysts at RAND who have been involved in bomber studies in the last few years, roughly one-third have been primarily involved in the care and feeding of big computer models, and another half dozen have devoted a good deal of time to actually running the models and interpreting their results.

Actually using the models as analytical tools has drawbacks as well. There is a substantial tradeoff between investing resources in using big models and doing more thinking and "real" analysis with simpler tools. The analytical opportunity costs, in terms of the number of cases considered and overall insight into the effects of the key variables in the analysis, can be substantial when big models are employed.

Our Analytic Approach

Our approach to structuring a bomber force for the "new world" was to try to examine a wide range of conventional conflicts; identify kinds of problems, if any, that long-range bombers were particularly well suited for solving; and then use those cases as a basis for structuring a conventional bomber force robust enough to deal with a reasonable range of unpredictable future contingencies. We tried to apply the following general principles:

- **Work out enough particular cases that one can generalize from the specific.** That is, provide a spectrum of force structure options associated with a set of generic scenarios derived from considering larger numbers of specific cases to inform decisionmakers' choices about the kinds of capabilities they might want to buy and the consequences of their choices.

- **Emphasize the cases that matter.** All cases need not be worked out in equal detail. In fact, they should not be, considering the time and effort involved in analyzing individual cases. Rather, the trick is to analyze a large number of cases quickly to identify those that drive the results and focus more de-
tailed analytical effort on them. (Frequently, that means topical cases are not the ones that turn out to be important. For example, Korea did not prove to be a stressing or unique case for bombers, although the defense community as a whole has been focusing large amounts of effort on Korea recently.)

Table 2 shows some of the cases that we considered in analyzing conventional bomber operations. To add richness, they included cases from both the old and the new worlds. Each represents a different kind of tactical problem to solve—armor in prewar Iraq; infantry in Iran as well as a generally growing military capability in all areas; a mature, balanced military with a spectrum of capabilities in North Korea; potential for weapons of mass destruction and appropriate delivery systems in a number of countries. Most have potentially threatening air defenses, although they vary in character among countries. What they all have in common, however, is their great distance from the United States. If the United States continues to reduce its military presence overseas, as it was certainly doing before Desert Shield, then a timely military response to crises is likely to be increasingly difficult.

Conflicts such as Bosnia and Somalia are new to the list. The air defense environments are relatively benign, with the possible exception of low-altitude flight in areas where simple short-range air defense systems exist in numbers. The more fundamental problem in those cases is determining what, if anything, bombers could successfully target that would either affect the outcome of the military conflict or persuade combatants to give up the struggle. Properly equipped bombers could easily destroy a lot of things—vehicles on the road, fixed installations of any sort, perhaps some sorts of troop concentrations. However, making the case that such attacks matter is problematical at best. Moreover, if the opportunity for meaningful use of bombers should arise, conducting these sorts of operations is less stressing for the bomber force than other generic classes of missions that should already be “on the list.”

Potentially interesting targets in some conflicts remain elusive for bombers or anything else. The U.S. performance in finding and destroying Scud mobile missiles in Desert Storm was abysmal. As weapons of mass destruction and advanced delivery systems continue to spread, interest in destroying them is likely to increase. If technology eventually permits, bombers might be employed either to find and destroy mobile missiles on the ground or perhaps to attack missiles in flight. That sort of mission could provide yet another basis for structuring the bomber force, if bombers proved to be the solution of choice. The technological possibilities and potential operational concepts are too immature to be of much use in structuring the bomber force for the immediate future, however.
Table 2
Some Typical Conventional Cases Considered

<table>
<thead>
<tr>
<th>Case</th>
<th>Distance from United States (nmi)</th>
<th>Potential Target Sets</th>
<th>Air Defense Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Old world&quot; cases:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe: Post-CFE</td>
<td>3500–5000</td>
<td>Interdiction targets, air defenses</td>
<td>Very large</td>
</tr>
<tr>
<td>Iran</td>
<td>6500</td>
<td>Hard bridges, airfields</td>
<td>Small, repeated attacks required</td>
</tr>
<tr>
<td>Pacific</td>
<td>6600</td>
<td>Airfields, ocean choke points</td>
<td>Small, repeated attacks required</td>
</tr>
<tr>
<td>NATO Northern Flank</td>
<td>3000</td>
<td>Ships, ocean areas, loading sites, airfields</td>
<td>Moderate, repeated attacks required</td>
</tr>
<tr>
<td>Vietnam (&quot;Linebacker III&quot;)</td>
<td>7200</td>
<td>Lines of communications, airfields, storage areas</td>
<td>Moderate</td>
</tr>
<tr>
<td>&quot;New world&quot; cases:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iran</td>
<td>6500</td>
<td>Complete spectrum of military and economic targets</td>
<td>Moderate-large</td>
</tr>
<tr>
<td>Iraq/Kuwait–Saudi Arabia (pre-Desert Storm)</td>
<td>6000</td>
<td>Armor, special weapons facilities, air defenses, command structure</td>
<td>Large</td>
</tr>
<tr>
<td>North/South Korea</td>
<td>4800</td>
<td>Spectrum of military targets</td>
<td>Large</td>
</tr>
<tr>
<td>Bekaa Valley</td>
<td>5400</td>
<td>Buildings, air defenses</td>
<td>Small</td>
</tr>
<tr>
<td>Libya</td>
<td>4800</td>
<td>Plants, buildings, artillery positions, &quot;value targets&quot;</td>
<td>Small</td>
</tr>
<tr>
<td>Bosnia</td>
<td>4500</td>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td>Somalia</td>
<td>7000</td>
<td></td>
<td>Small</td>
</tr>
</tbody>
</table>
Implications for Bomber Force Planning

In general, we employed this sort of "scenario screening" process to try to answer the following kinds of questions:

- What are interesting generic cases that provide a basis for structuring a future bomber force?
- Are there cases where bombers offer unique advantages over other types of forces?
- Should some cases be eliminated from consideration because they are either "too hard" or because bombers don't matter much one way or the other?

Eventually, a policymaker will have to make a value judgment about which of the cases where bombers might contribute matter enough to him to justify investing in a particular kind of bomber force.

STRUCTURING A BOMBER FORCE FOR THE "NEW WORLD"

Addressing these questions requires examining the potential roles of bombers and their effectiveness in those roles, how potential targets drive force structure, the importance of weapons, the survivability of bombers, and the necessary bomber force structures to support a spectrum of overall concepts for U.S. power projection abroad. Then the analysis must consider cost projections and cost-effectiveness comparisons among various bomber options and between using bombers and alternative approaches to reduce policymakers' choices to a set of value judgments. This section deals with the first set of issues. The final section of the paper discusses the analytical challenge for dealing with the cost-effectiveness issues.

Critical Roles for Long-Range Bombers

The Leading Edge Role. The potential use of long-range bombers to bring firepower to bear early in a distant conflict to buy time for other forces to arrive predated the end of the Cold War. Even during the Cold War, heavy bombers could have played an important role in major conventional campaigns against the Soviets and their allies if they were used properly. For example, B-52s could have been first on the scene in places such as the mountain passes of northern Iran in the old Cold War scenarios that worried about a possible Soviet thrust into Southwest Asia to capture oil fields vital to the West. RAND analysis in the 1980s showed that a modest-sized bomber force, if armed with the proper weapons, could have delayed the attackers long enough
to give U.S. forces a chance to move into the theater and "get in the game" rather than face an outright defeat. Moreover, bombers with high-quality conventional weapons might have been the only practical alternative to using nuclear weapons. Similarly, long-range bombers might have been employed effectively in other regions, such as NATO's northern and southern flanks, where U.S. and allied forces were outgunned, and the rapid application of massive firepower against various kinds of enemy forces could have made a difference.

With the end of the Cold War and the apparent trend of withdrawing most U.S. troops from overseas bases, the potential value of using long-range bombers in the initial phases of a major campaign as well as for limited raids worldwide became much greater. Even before the Gulf War, RAND analysis highlighted the importance of this role for long-range bombers. Key objectives early in any such campaign typically include some combination of the following:

- Deter a potential enemy from acting, if possible.
- Deny the enemy an easy victory or opportunity to increase the "entry price" to the war drastically, particularly by stopping or at least seriously slowing a fast-moving offensive (i.e., a blitzkrieg-like invasion).
- Blunt a slow-moving offensive.
- Look committed and competent enough to persuade regional powers in particular to cast their lot with the United States and its allies rather than remaining neutral or supporting the other side.
- Earn and maintain the support of the American public and decisionmaking elites.
- Prevent the enemy from hampering the flow of U.S. and other supporting forces into the theater.
- Destroy any potentially valuable enemy assets that could be easily or quickly moved or hidden.
- Destroy any support facilities that could have an immediate impact on an enemy's ability to wage war.

The details will, of course, vary from campaign to campaign. The most demanding problems are those where the enemy controls the operational tempo of the campaign, and the United States and whatever allies it has must be able to counter the enemy action. The most obvious example is the need to counter an invasion, where failure means having to displace an entrenched enemy later at much greater cost. Similarly, the United States must preserve whatever bases it needs in the region to move forces into the theater. Typically, that means preventing an enemy from destroying critical airfields or
ports or otherwise interfering with air or sea "bridges" into the theater. Finally, there may be a few select targets that are so important to the enemy's immediate war effort or have such critical long-term value and are "perishable" (i.e., could be moved or hidden quickly) that they warrant an early attack.

All this must be done in a very delicate political environment. Losses must be kept to an absolute minimum to keep the American public on board. The action must look effective and decisive to persuade jittery nations in the region that by siding with the United States, they will be backing a winner. On the other hand, the action should not look too heavy-handed to keep other allies on board. This could be a tall order.

With a limited U.S. presence on the ground in most parts of the world and weak indigenous forces in some critical areas, dealing with these problems could be quite challenging. Moving ground forces and land-based tactical air forces into a combat zone takes time and at least some safe local bases from which to operate. Naval forces can do some things if they are already on the scene. If not, ships could take days or even weeks to arrive, depending on where they are when the conflict erupts and what kind of military operations are needed. If massive and/or sustained firepower is needed, naval forces may not be adequate in any case.

By contrast, long-range bombers can bring massive firepower to bear virtually anywhere in the world in a matter of hours from relatively safe bases in the United States or elsewhere outside the immediate conflict area. Moreover, long-range bombers can sustain operations as long as the weapons, stockpiles, logistics support structure, and replacement crews at their operating bases hold out. This capability for long-distance, massive, sustained strike operations is what long-range bombers bring to the party.

The Gulf War Experience. What happened in the Gulf War—and what did not happen, but could have—crystalized both the problems that future conflicts could pose and the potential that heavy bombers offer in the early stages of major conflicts. Figure 8 shows the rate at which U.S. forces arrived in the theater. Recall the problem that was on everyone's mind at the time: What if Saddam Hussein doesn't stop with Kuwait but instead keeps on moving into Saudi Arabia? If he had, stopping the kind of armored invasion that he could have mounted would have required the United States and its coalition partners to be able to mount a major interdiction campaign against Iraqi armor. It was several weeks after Iraq's initial invasion of Kuwait before the United States had enough tactical aircraft in the theater to mount that level of interdiction campaign. Adequate ground forces would not have been available until much later. Even then, the weapons and command-and-control structure to sustain interdiction operations on a continuing basis were not yet in place, so the defensive interdiction campaign would have been sporadic at best.
Figure 8—Potential Role of Long-Range Bombers in the Initial Phases of a Major Theater Campaign

The problem could have been considerably worse. The first U.S. tactical aircraft on the scene came from two carriers that were in the region and were able to reach the theater within a few days. Ironically, one of those carriers was on its way out of the Arabian Sea when the crisis broke, and it was ordered to return to the Persian Gulf area. Had the crisis developed a few days later, the buildup of theater airpower would have been even slower. Since the U.S. carrier fleet is limited in size—and getting smaller—relying on carriers to cope with the initial phases of a major theater campaign tacitly assumes that the United States has at least a few days’ notice that a serious crisis is brewing, to make sure that at least one carrier could reach the area. Getting enough carriers on station to provide massive firepower, if that were needed, could take anywhere from days to weeks, depending on the circumstances, and might even prove totally impractical.

By contrast, heavy bombers could have been there on the first day of the war and, assuming capabilities that they may obtain in the future, could have brought the kind of massive firepower to bear that could have halted an armored invasion as well as destroying any other key targets necessary to defeat the Iraqi thrust. However, such a task would be quite demanding for bombers:

- They would have to have good enough weapons to be effective against a variety of targets, particularly armored vehicles in this case.
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They would have to be able to operate relatively autonomously for a period of time in a hostile environment, which means they could not rely on fighter support to defeat air defenses, surveillance aircraft to help locate targets, or nearby bases to refuel and rearm.

As it happened, Saddam Hussein chose not to press his advantage and eventually suffered a crushing military defeat. A future Saddam Hussein, learning his own lessons from the Gulf War, might choose differently. If so, bombers could be the primary instrument in preventing a quick military victory and a political fait accompli. However, the demands on the bomber force will be considerable, as the rest of this paper will show.

How Effective Would Bombers Be in the Leading Edge Role? Figure 9 shows three approaches that the bombers could use in this role. The first relies on fighter escorts and air defense suppression assistance from other aircraft. This is the kind of thing that coalition forces did in Desert Storm in conjunction with massive defense suppression attacks and might be able to do again under similarly favorable conditions. The weakness is that it requires theater bases for the fighters. Thus, it may not be a practical option at the outset of a war.

The second possibility relies on using standoff aircraft that employ cruise missiles with sufficient range to keep the aircraft beyond the reach of the enemy’s air defenses. This approach should be effective against known fixed targets, assuming that adequate intelligence support and mission planning capa-

Figure 9—Alternative Operational Concepts for Bomber Forces
bility for the weapons exist. That is, of course, what B-52Hs did at the outset of Desert Storm. They flew from Barksdale AFB in the United States and launched long-range cruise missiles at power generation, transmission, and military communications facilities in Iraq. However, any need to attack movable targets—countering an armored invasion, for example—would introduce a whole new set of problems. Even assuming the cruise missiles themselves could be made effective (i.e., in-flight target location updates of some sort to compensate for the long missile flight times), the bombers still need to be able to locate the targets. If they rely on JSTARS, for example, the JSTARS aircraft would probably be vulnerable to long-range SAMs or airborne interceptors if it got close enough to enemy armor to be effective. That means fighter protection for the JSTARS, which in turn means theater bases or possibly aircraft carriers on the scene. Thus, standoff cruise missile carriers could be effective operating autonomously against fixed targets, but not against movable targets like invading armies unless some sort of survivable target acquisition system could be provided.

The third approach would be to use B-2s, which, by contrast, could operate autonomously against a large spectrum of targets of interest, if they prove sufficiently stealthy. In particular, the B-2's radar has the potential capability to detect and locate large moving targets like armored divisions on the march, so it would not require the assistance of other aircraft like JSTARS. Unlike individual vehicles—mobile ballistic missile launchers or mobile command posts, for example—in invading armies are hard to hide, are easy to identify well enough to attack, and must keep moving (i.e., invading) to be effective. Also, the B-2 should not need external assistance in suppressing defenses. As a result, the B-2 is particularly well suited for use in the initial stages of a campaign, and that rationale, although controversial, was a more convincing argument for the B-2 than its nuclear role even during the Cold War.

Another Role: Massing Firepower Against Tactical Forces. As a campaign progresses and more U.S. forces arrive in the theater, the role of heavy bombers can evolve in different ways. One possibility is releasing the heavy bombers for use elsewhere if near-simultaneous conflicts were to break out. A more standard use for heavy bombers is to continue to provide massive firepower when the situation demands. Supplying massive firepower is a fundamental advantage that heavy bombers offer even if other forces are present.

The United States has, of course, used bombers that way in the past, sometimes effectively, sometimes not. However, deciding how best to apply that massive firepower has been a subject of continuing controversy since the days

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5For recent analyses of the effectiveness of conventionally armed heavy bombers in Vietnam and elsewhere, see Johnson (forthcoming) and Clodfelter (1989).
of Giulio Douhet and Billy Mitchell. RAND analysis has, for a number of years, highlighted the potential value of using bombers against tactical forces.

For example, consider how heavy bombers could have been employed most effectively in NATO's central region during the Cold War days. The dominant problem that NATO faced in the central region was halting an armored invasion by a numerically superior Warsaw Pact force: failure meant defeat no matter what else happened in the theater; success meant victory. Recognizing this, NATO focused its attention for decades on trying to provide its tactical ground and air forces with suitable weapons to defeat armor. By contrast, SAC's doctrine at the time called for using B-52s to attack fixed targets deep in the Warsaw Pact's rear area. Not only would the B-52s not have survived repeated sorties into the Warsaw Pact's rear area if they had to penetrate Pact air defenses, but these attacks would also probably have had little effect on the outcome of the war. By contrast, arming the bombers with cruise missiles that NATO was planning to buy for its fighter forces and using those missiles for relatively shallow attacks to help concentrate massive firepower against armored columns and air defenses, along with selected attacks on key bridges and other chokepoints, would have had a much more direct effect on the war and would have freed fighter sorties for other missions.

RAND analysis showed that conventional B-52 forces of the size that the United States was considering at the time, if equipped with proper weapons and operating in conjunction with other NATO forces, could have halted a Warsaw Pact armored invasion. *Using bombers this way runs directly counter to the strategic bombing doctrine that has governed the employment concepts for long-range bombers since their inception.* However, more flexible thinking about the most effective way to use bombers is going to be even more important in developing a joint arms concept of military operations to deal with the exigencies of the emerging world.6

**Other Potential Roles.** Other roles might emerge for bombers that are difficult to plan for in advance. For example, the proliferation of weapons of mass destruction and theater ballistic missiles is receiving a considerable amount of attention these days. So far, nobody has come up with a satisfactory way to deal with this important problem, although all sorts of possibilities are being vigorously examined. Long-range bombers could possibly play a role in defeating mobile ballistic missiles. Ironically, this is a variant of the old strategic relocatable target (SRT) problem that didn't make much sense in the old strategic world but might in the new world where the missiles could become a

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6For hints of the brewing doctrinal and tactical dispute, see Warden (1989) for a view that is popular in many parts of the U.S. Air Force. For a comparison from a naval perspective of Air Force and Navy approaches to using airpower in the Gulf War, see Friedman (1991:169–196).
centerpiece of an enemy's capability rather than merely a footnote. On the other hand, absent a viable operational concept, there is little basis for using this class of mission to structure the force.

**How Potential Targets Drive Bomber Force Structure**

Given these two major roles, what are the potential targets and how effective would bombers be against them?

**Determining What Matters.** The essence of analysis of conventional bomber effectiveness is determining what matters for a range of classes of conflicts and its meaning for bomber force structure. The analytical tools available range from elaborate campaign models to simpler models to common sense. The problem is much more complex than the old SIOP-style analysis, where the main measure of effectiveness was the number of targets of various sorts, perhaps weighted by value assessments, that could be destroyed. Here, making some estimate of the overall effect of destroying particular kinds of targets is an integral part of the analysis. Moreover, the need to reattack some classes of targets periodically affects force structure, and the timeliness issue is particularly important in structuring the overall bomber force.

What follows shows some of the flavor of our analysis. In general, we come to very different conclusions than, for example, Colonel John Warden did in his influential analysis of planning air campaigns (Warden, 1989) or the notions of "strategic paralysis" that are currently in vogue in some circles. That in turn leads us to different views about structuring bomber forces than the conventional wisdom in the Air Force suggests. That conventional wisdom was shaped by old world attitudes, however, and this is an appropriate time to reexamine them.

**Establishing Target Classes.** Figure 10 shows how we categorized and divided potential bomber targets for the purposes of analysis. We defined three major categories of targets:

- **"Strategic" fixed targets:** Installations that are important to a nation's long-term military potential and its economic well-being, but do not, in general, have much short-term impact on its ability to make war. (National command centers are a potential exception.)

- **Fixed tactical targets:** The set of installations in fixed locations that might actually contribute to an ongoing war. Targeting priorities will obviously vary from case to case.

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7For a discussion of "strategic paralysis" as an objective for the employment of airpower, see Barlow (1992). RAND is conducting research to assess strategic paralysis issues and options in some detail.
"Strategic" fixed targets | Fixed tactical targets | Mobile tactical targets
---|---|---
National Command Centers | Airfields | Armored forces
Nuclear facilities | — Shelters | Infantry
Chemical/biological weapons facilities | — Parking areas and shelters | Ships
Missile and aircraft production facilities | — Runways | Mobile SAM sites
Other munitions production facilities | Command, control, and communications | Mobile offensive missiles
Power plants | EW/GCI | Mobile C^3
Chemical plants | Fixed SAM sites | |
Refineries/POL | Fixed field fortifications | |
Port facilities | Fixed offensive missile sites | |
| Critical lines of communication (e.g., highway bridges) | |

Figure 10—Potential Target Classes for Heavy Bomber Attack in Conventional Operations

- **Mobile tactical targets:** The set of mobile or relocatable targets that could have an impact on an ongoing war. Again, some kinds of targets are going to be more valuable than others in particular situations.

The problem for structuring the bomber force is not to determine a rigid hierarchy of targets for bombers to attack. Rather, it is the opposite. In specific future situations, a theater commander on the scene (or, perhaps, a political leader if the issue is sensitive enough) will have to make the call about what is most important to attack at any particular moment in the conflict. The problem for force planners is to try to make sure that the commander has the right aircraft and weapons available to give him the flexibility to do whatever he needs to do. The challenge is doing that in a fiscally constrained world. The analytical problem is to identify what factors drive the size and/or the quality of the bomber force and its weapons. Of particular interest are:

- Target sets that could be "weapon sinks" and drive force requirements (tactical airfields and field fortifications are examples).
- Target sets where the kind of massive firepower that bombers can supply matters.
- Target sets that must be attacked at a particular time and perhaps in large numbers because of the operational tempo of the campaign (invading armored forces are an example).
• Targets that require high-quality or special weapons to destroy (various kinds of underground bunkers are typical examples).

• Small sets of targets that could dramatically affect the outcome of a campaign if destroyed at the right time. (Examples are very hard to define, the conventional wisdom to the contrary notwithstanding. Saddam Hussein is the usual example cited. Even in cases where this could be true, the effect on force structure, beyond assuring that it includes effective weapons, is generally nil.)

• Other targets that must be attacked at the right time to have an impact (weapon storage sites and nuclear facilities where critical nuclear materials could be removed quickly are examples).

Attacking Fixed Targets. In our analysis of some of the “old world” cases involving fighting Soviet forces on several fronts outside Central Europe simultaneously, fixed target sets were major factors in sizing the bomber force. The most demanding sort of air campaign against fixed targets we identified that had reasonably high military leverage was a sustained attack against moderately large numbers of airfields. If such an attack were comprehensive enough to include attacks on runways, support facilities, sheltered aircraft, and aircraft in the open, large quantities of high-quality, diverse weapons could be required to attack a number of bases, particularly if the enemy were able to repair damage to airfields rapidly enough to require periodic reattacks. However, the need for this level of attack on enemy airfields is more typical of the old world than the new. Even the former Warsaw Pact air forces might not have been formidable enough to justify an attack of this scale. Thus, only an emerging regional superpower that relied heavily on its air force would be likely to warrant a large bomber attack on air bases early in a campaign and, therefore, require a large number of bombers devoted to attacking fixed targets. We see no such threats on the horizon now.

In fact, a general characteristic of the sorts of countries that the United States is likely to collide with in the new world is that they do not have large numbers of valuable fixed targets. Granted, that could appear to be the case because the United States has never bothered to look hard for targets in most countries. We found a few cases where destroying a relatively small set of targets might offer considerable leverage (generally attacks against chokepoints in unfavorable terrain to delay an invading force), but when those unusual situations occurred, a small, properly equipped bomber force would have been sufficient for the task.

Simply on first principles, Third World countries in particular don’t have large numbers of valuable “strategic” targets, and few of those that do exist need to be attacked in either a timely way or en masse. Thus, air campaigns
against these sorts of fixed targets should never stress the size of a future bomber force as long as the bombers have suitable weapons.

The same general message applies to attacks against most kinds of fixed tactical targets, although there are a few wrinkles that are worth discussing briefly. We generally allocated some bomber attacks early in a major campaign to suppressing selected elements of enemy air defenses and attacking a few major command-and-control installations. However, we usually found that only relatively limited defense suppression attacks were likely to be either necessary or particularly effective during the initial phases of the campaign when stealthy aircraft and cruise missiles were carrying the load before the bulk of U.S. forces reached the theater.

Command-and-control attacks are more problematical, even though the conventional wisdom says that they should have a very high priority. (One also needs to distinguish between a "command-and-control" attack used as a euphemism for trying to kill enemy leadership per se and a real command-and-control attack that is intended to degrade the enemy's military capability.) There are several general problems with designing command-and-control attacks:

- Defining an enemy's command-and-control network (and, therefore, understanding how to attack it) is an extremely difficult intelligence problem in any case and virtually impossible in the sort of future time frame that would be of use to force planners.
- Measuring the effects of command-and-control attacks is extremely difficult, except perhaps in very specific, structured situations.
- The size of potentially effective command-and-control attacks bifurcates. If a small number of critical nodes can really be identified, then the attacks should only require a modest number of appropriate weapons. If not, the necessary attacks could be massive.

As a practical matter, a battlefield commander is likely to try to attack at least a modest number of key command-and-control sites in hopes that such attacks will disrupt the enemy's warfighting capability, so force planners need to provide forces that allow him that option. On the other hand, planning forces on the assumption that such attacks would be adequate to defeat an enemy in lieu of direct attacks on its forces would be extremely risky. As a result, the possible need to attack critical command-control sites should have little effect on the overall size of future bomber forces, although it does reinforce the need for combinations of stealth and standoff weapons.

Attacking Mobile Forces. Mobile targets come in a variety of flavors, as Figure 10 shows. Of the possibilities, the class of targets that is probably most
useful for structuring a portion of the future U.S. bomber force is advancing armor.\textsuperscript{8} There are several reasons why:

- An armored invasion against an ill-prepared adversary gives the attacker control of the operational tempo of a campaign and must be countered effectively to avoid a decisive defeat that could be difficult and costly to reverse.

- In the early days of a campaign, the only option available might be long-range bombers for countering the armored advance because Army forces might not have arrived in necessary numbers and Navy forces, if present, would lack the firepower necessary to halt the advance.

- Invading armored forces in division strength are relatively easy targets for appropriate sensors to detect, unlike, say, mobile missiles.

- Large formations of armored vehicles make ideal targets for the kind of massive firepower that bombers can deliver.

Figure 11 shows why suitable armed bombers are an attractive option for countering an armored invasion.\textsuperscript{9} The figure shows “before” and “after” computer simulation images of an Iraqi armored division in a tightly packed formation advancing into Saudi Arabia. The image on the right shows the results of an attack by three B-2s armed with inertially guided tactical munitions dispensers (TMDs) carrying Skeet submunitions.\textsuperscript{10} Over half of the combat vehicles in the division were destroyed within seconds, which should not only be enough to stop that division, but also, according to standard rules of thumb, damage it so heavily that it could not be reconstituted. Each damaged vehicle

\textsuperscript{8}For a more thorough unclassified treatment of the use of heavy bombers against armored forces, see Buchan et al. (1992).

\textsuperscript{9}These particular simulation results were generated using the JANUS model. JANUS is a high-resolution, stochastic, two-sided, closed, interactive, computerized, ground combat simulation/wargame used for combat developments, doctrine analysis, tactics investigation, scenario development, field test simulation, and training. JANUS is used at more than 24 sites within the United States Army, and by RAND, the Institute for Defense Analyses, and Lawrence Livermore Laboratories, where JANUS was first developed.

Other models were also employed in the armor-interdiction analysis. These included GAMES, a model used widely in Army circles, and two simpler in-house models.

\textsuperscript{10}Adding inertial guidance packages to gravity weapons like bombs and TMDs provides a cheap means for increasing their accuracy. It allows the bomber crew to control the pattern of their weapons, thereby employing them much more effectively against an area target such as an armored division. Skeet is a “smart” submunition that uses infrared sensors to detect hot spots on vehicles and home in on them. The Air Force’s Air Combat Command proposes to begin procuring limited production quantities of Skeet submunitions this year.
was hit by several Skeet submunitions, typically about five, thereby effectively removing any ambiguity about damage levels to vehicles. Thus, heavy bombers are particularly effective against armor because they can concentrate massive precision firepower against a class of target that is both vulnerable to that kind of attack and important to destroy in a timely manner.

Effects on the Overall Campaign. We found that the level of interdiction capability described in Figure 11 would be sufficient to halt an armored invasion of Saudi Arabia by Iraq virtually in its tracks. In its absence, the sort of ground forces that Iraq possessed at the outset of the Gulf War could have captured key ports, airfields, and oil fields in Saudi Arabia in a matter of days even if Saudi forces on the scene fought effectively and consistently against them. If the Saudi resistance had collapsed as the Kuwatis did, the situation could have been much worse. That is why the armor interdiction mission is so important and why it should be a high-priority mission for bombers if they are the only ones on the scene. We could identify no other target set that bombers could attack that could solve this problem or have an equally dramatic effect on this class of campaign.

Moreover, using a one-division/day interdiction rate for planning purposes is not a bad standard for major theater campaigns based on historical experience. Defeating armor at that rate would have halted any armored invasion in history except the U.S. invasion of Iraq in Desert Storm. Even there, however, the
cost of the U.S. victory would have been much higher if the Iraqis had had this sort of interdiction capability, and the prospect of such losses might have given the United States pause in considering such an operation. Moreover, had the allies spread their offensive over more invasion corridors, they might even have been defeated by such an interdiction capability. In the emerging world, relatively few countries could mount this level of armored invasion against a relatively unprepared foe. Thus, having a bomber force that could, among its other capabilities, destroy an armored division per day should both provide a unique and important warfighting capability and act as a powerful deterrent in the new world.

The Importance of Weapons

Every RAND study of the effective use of airpower in the last decade has emphasized the importance of high-quality weapons. That is true for bombers as well as fighters. Figure 12 shows generically how the relative effectiveness of various kinds of weapons improves against various kinds of targets as weapon accuracy increases. It also shows what various kinds of guidance technologies can achieve. In general, we found that the technical capability exists to allow conven-

![Figure 12—Conventional Munitions Effectiveness](image-url)
tional weapons to destroy virtually any target of interest as long as its location and nature are known precisely. The issue is finding the most cost-effective weapons to procure. We found that bombers offer several advantages in this regard.

Matching bombers and weapons is one of the most critical issues in structuring a bomber force for the new world. Figure 13 emphasizes some of the key issues:

- Bomber payload capacity for various types of weapons.
- Weapon standoff range.
- Programmatic status of various weapons.

As the figure shows, there are substantial payload advantages for the bomber if it can penetrate to within a few miles of its target. If the bomber has to stand off more than a few miles, the volume and shape of existing and planned weapons as well as the carriage possibilities on the bombers severely limit the number of weapons that the bombers can carry. Once that threshold has been crossed, increasing the standoff range of the weapon has little or no effect on the bomber. Another advantage of employing gravity and very-short-range glide weapons is that cheap technological improvements can dramatically improve their effectiveness. We found, for example, that adding inertial guidance kits can make existing stockpile bombs and munitions dispensers very effective at a very low cost without the need to initiate entire new weapons programs.

Programmatic status is an important consideration as well, especially given current fiscal constraints that make beginning new programs particularly difficult. Recently, the Joint Standoff Weapon (JSOW) and the Joint Direct Attack Munition (JDAM) have been established to provide bombers and fighters with new short-range weapons. (Their characteristics are summarized in Table 3.) In addition, TSSAM and ALCM-C, medium- and long-range conventional cruise missiles, respectively, have emerged out of the “black” world.

\[11\] This has less to do with the laws of physics than with artifacts of the design of the various bombers—especially their bomb racks, rotary launchers, and bomb bays—and both existing and planned weapons. If the need were great enough, new weapons with modest (i.e., 50–60 nmi) standoff range could probably be designed that could be carried in larger numbers on the bombers. At some point, that might be justified. However, at the very least, new weapons programs would be needed, a difficult process in the current fiscal environment. Moreover, significant modifications to the bombers would probably be needed to permit them to use their payload capability more efficiently. Some of our current research addresses these issues and will analyze how major an effort would be required to modify the bombers.
### Figure 13—Bomber Weapon Options

#### Table 3
**JSOW and JDAM Weapon Systems**

<table>
<thead>
<tr>
<th>Weapon Name</th>
<th>General Description</th>
<th>Dimensions</th>
<th>Warhead</th>
<th>Performance Range (nmi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>JSOW(^a)</td>
<td>Unpowered, GPS-aided standoff weapon</td>
<td>160 x 16.51</td>
<td>1000-lb class 24 Skeet submunitions</td>
<td>15–50 nmi</td>
</tr>
<tr>
<td>JDAM(^b)</td>
<td>Inertial/GPS-aided bomb</td>
<td>154 x 18.1</td>
<td>-2000-lb high explosive</td>
<td>-18 nmi from high altitude</td>
</tr>
<tr>
<td>JDAM-II(^c)</td>
<td>Inertial/GPS-aided bomb</td>
<td>90 x 10.6</td>
<td>502-lb high explosive</td>
<td>-18 nmi from high altitude</td>
</tr>
<tr>
<td>JDAM-PID(^d)</td>
<td>Inertial/GPS-aided bomb with terminal seeker</td>
<td>&gt;154 x 18.1</td>
<td>-2000-lb high explosive</td>
<td>-18 nmi from high altitude</td>
</tr>
</tbody>
</table>

\(^a\)Joint Standoff Weapon (JSOW).  
\(^b\)Joint Direct Attack Munition (JDAM). A 1000-lb warhead is planned for the F-22.  
\(^c\)for the U.S. Navy.  
\(^d\)JDAM Product Improvement Program (restructure of the former JDAM-III program).
ALCM-C was used successfully by B-52s in the early hours of Desert Storm. Key questions remain, including the following:

- Does a moderate-range cruise missile such as TSSAM have adequate range to allow current bombers to stand off beyond the range of future enemy air defenses?
- Will limiting the buy of ACMs to 640 allow enough ALCMs to be converted for conventional use (i.e., to ALCM-Cs) to eliminate the need to develop a new long-range conventional cruise missile?
- Is the current emphasis on large (e.g., 2000-lb) bombs warranted, or should more emphasis be placed on improving the capabilities of smaller (e.g., 500-lb) weapons?
- Are JSOW and JDAM the right weapons for all the bombers?

Figure 14 further illustrates the importance of high-quality weapons in attacking a spectrum of fixed targets effectively and efficiently. The figure shows the relative numbers of bomber sorties necessary to destroy a comprehensive set of "strategic" targets in a representative Third World nation. The comparisons are striking. The best bomber—the B-2—would need roughly three times as many sorties to destroy a particular set of fixed targets if it had to employ "dumb" 500-lb iron bombs than any appropriate combination of new or old bomber and high-quality weapons. Notice also that there is very little difference

![Diagram: "Strategic" fixed targets in a representative Third World military power]

**Figure 14—Bomber Weapon Effectiveness Against Fixed Targets**
in sortie requirements among the high-quality weapon options. The slight differences include some interesting wrinkles, however:

- The most efficient combination shown is the B-2 armed with inertially guided 500-lb bombs, which are both smaller and less accurate (but much cheaper) than the cruise missiles or precision-guided weapons used in the other cases. The reason is that this target set, which is typical of many that we examined, contains a number of relatively large facilities that could be attacked very efficiently with controlled patterns of moderately accurate small weapons, exactly the kind of payload that a penetrating heavy bomber can deliver! This highlights the potential value of cheap upgrades to small bombs for bombers.

- There are no compelling reasons not to rely primarily on standoff cruise missiles to attack most fixed targets in the early phases of future wars, particularly in view of the small B-2 buy currently authorized. That would make effective use of current bombers.

These general findings are consistent with the experience of Desert Storm, where B-52s dropped nearly a third of all the bombs used in the war but did much less measurable damage to particular targets than the F-117s did with many fewer laser-guided bombs. Effective in the normal sense or not, the B-52 raids apparently did scare the wits out of dug-in Iraqi troops, prompting many to surrender. Perhaps General Chuck Horner, the CENTAF commander in the Gulf War, was correct when he observed that this sort of massive terror bombing might harden the will of civilian populations, but it certainly seemed to break the will of military forces. With more accurate bombs (but not necessarily anything nearly as accurate as laser-guided bombs), the bombing might have proven physically as well as psychologically effective. Even with current accuracies, bombs delivered in large quantities can help open corridors for offensive ground forces.

Survivability of Bombers

Survivability of bombers is likely to become even more important than usual in the future:

- With a bomber force of limited size and, at most, one open production line (i.e., the B-2 line), losing bombers would have both immediate and long-term impact on U.S. military capability.

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• Losing bombers in the early phases of a conventional war could have an immediate impact on the perceptions of all concerned about who was likely to win (and, therefore, which side to choose, whether to become involved, etc.), what the cost was likely to be, etc.

As a result, the United States is likely to be especially risk averse in using its bomber force, particularly in either the early stages of a conflict or in raids (e.g., Libya) where the primary objective is to send a political message. Since it is precisely those kinds of operations for which bombers are particularly well suited, those are the stressing cases on which bomber survivability analysis should focus. As noted earlier, bomber survivability is much less an issue in the later stages of a conflict when the enemy’s air defenses have been beaten down and the bombers can expect considerable help in penetrating what defenses remain (e.g., escorts, jamming).

The details of bombers’ capability to penetrate specific air defenses remain classified. However, Figure 15 shows the kinds of results one could expect from notional bombers facing generic classes of air defenses in two different kinds of countries that might “bound” the likely situations that the United States might have to deal with in the future. The details of the postulated air defenses vary considerably, but both have at least a small number of modern airborne interceptors and enough modern SAMs to provide terminal defenses for at least a few key installations.

Figure 15—Notional Penetration Capability of Bombers Against Future Air Defenses
The key variable in Figure 15 is how close the bombers can get to their targets without running excessive risks. That equates to the amount of standoff range that their weapons need. Recall from Figure 13 that there are substantial payload advantages if the bombers can approach to within a few miles (i.e., 5–15 nmi) of their targets. Beyond that, there is a substantial payload penalty to pay. Moreover, the cost of the weapons generally increases substantially. Both the payload penalty and the weapon costs are relatively insensitive to the actual standoff range required once the initial threshold has been exceeded. However, there could be a major programmatic issue if bombers needed a new long-range cruise missile to stay out of harm’s way.

There are several general messages from Figure 15. The first is the impact of stealth. The three notional stealth bomber designs shown permit the bombers to fly to within a short distance of targets deep in the homelands of the two countries shown. Even the least stealthy of the three bombers would have to rely on standoff weapons of only modest range to attack their targets directly or suppress critical defense sites near them. Thus, they could take maximum advantage of their potential payload capability and rely mainly on weapons that are currently in development.

The details of stealth technology remain highly classified. However, enough material has been presented in the open literature to help explain in general terms why these results come out the way they do. Key elements of stealth include the following:

- Attention to all the ways that an aircraft could be detected (e.g., radar, infrared sensors, visual sighting, acoustic signature, etc.).
- Use of radar absorbing materials (RAM) to absorb as much incident radar energy as possible.
- Shaping the body to direct reflected radar energy in relatively harmless directions. (Bistatic radar systems could, in principle, be a problem, but constructing an effective defensive system based on bistatic radars would be extremely expensive and operationally difficult.)
- Locating the engine nozzles so that the aircraft appears "hot" only from a very limited range of viewing angles.

Despite some enthusiasts' unfortunate claims to the contrary, stealth technology does not represent anything like a "Romulan cloaking device" that renders aircraft invisible. Rather, it does two things:

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• Stealth dramatically reduces the ranges at which sensors can detect a vehicle from a wide variety of viewing angles.

• Stealth allows long-range detection in only a few directions and hard presses any defenders that do detect the vehicles from these angles to do anything about it, by making it difficult to maintain a track and engage the stealthy vehicle.

The net effect of stealth is to minimize the number of engagement opportunities that the defense gets rather than allowing engagements to occur and focusing on defeating the defenses each time, which is how current bombers try to survive, by relying on electronic countermeasures to defeat enemy weapons, for example. Actually, stealth could reduce the effectiveness of some defensive weapons in any engagements that do occur by reducing the effectiveness of some kinds of fuses and seekers. However, that should be considered more a "bonus" effect than a fundamental aim of stealth.

That is why stealthy bombers do so well in situations such as those illustrated in Figure 15. They survive by:

• Avoiding the dominant area air defense threat, which in most countries is airborne interceptors.

• Routing around, or detecting and avoiding, modest numbers of high-quality SAMs that might be encountered on the way to targets.

• Flying above the coverage of antiaircraft artillery (AAA) and short-range SAMs that could be numerous and difficult to avoid at low altitude.

• Using short-range standoff weapons to attack targets defended by high-quality SAMs.

Nonstealthy bombers do not fare nearly as well, as Figure 15 shows, precisely because the defense gets too many chances to engage them. Even the modest numbers of modern airborne interceptors that most Third World countries are likely to have in the future could pose a formidable threat to nonstealthy bombers trying to penetrate deep into hostile territory without assistance. Differences in bomber characteristics (e.g., radar cross-section, speed) make some difference in the degree of risk, as Figure 15 indicates. However, if the risk of bomber attrition is to remain very low in the early stages of a conflict, nonstealthy bombers need long-range cruise missiles for deep attack regardless of the details of the defenses, the relative size of the country being attacked, or the exact characteristics of the bomber. Identifying that kind of "simple truth" is precisely the objective of this kind of analysis.
Implications for Bomber Force Structure and Operational Employment

Given the preceding considerations of roles, how targets determine force structure needs, and the importance of weapons and survivability, what are the necessary bomber force structures to support a spectrum of overall concepts for U.S. power projection abroad?

Planning for the "New World." Nuclear arms control could potentially have seriously restricted the bomber force structure options for conventional operations. However, neither the START I nor START II agreement appears to limit U.S. possibilities for maintaining an effective bomber force for either nuclear or conventional operations in the new world. Even before the old world finally died out, our analysis showed that conventional rather than nuclear mission requirements were dominating the calculus of structuring the bomber force. During the transition, we found four generic classes of situations that dominated bomber force structure considerations:

- **Limited raids.** Raids of the Libya variety require a small number of long-range bombers with high-quality weapons. For most scenarios, bombers with long-range cruise missiles would be adequate, probably even preferable. For operations demanding more flexibility, stealthy B-2s might be the system of choice. In either case, force size is not a driving factor but quality is, because of the risk to the aircraft and the need for effective weapons and targeting systems.

- **Selective attacks on a spectrum of key fixed targets.** Analyzing those relatively unusual situations where attacking a modest number of fixed targets could be militarily decisive early in a campaign suggested that about one wing of long-range cruise missile carriers or B-2s would probably be an adequate force. If this is the only way bombers were to be employed, such a force might be sufficient. Interestingly, the specific cases that led to this generic class of scenario were more typical of the old world than the new.

- **Major regional conflict with a major regional power.** This class of conflict typically places serious demands on most elements of U.S. military forces. A large-scale armored invasion might be part of such a conflict. If so, that is probably going to be the driving factor in determining bomber requirements and should certainly be the dominant factor in planning for generic levels of conflicts. This is the kind of situation to which most of the previous analysis of armor interdiction with bombers applies.

- **Major regional conflict with a regional/global superpower.** The difference between this level of conflict and the previous one is the quality of the opposition. It is more typical of the kind of threat that the Warsaw Pact used to pose to NATO, complicated by the fact that in the future, there might not be a comparable military force in place to face the initial assault. For the bomber force, this level of conflict basically requires the ability to deal si-
multaneously with an armored invasion and the need to attack a substantial number of fixed tactical targets. (Airfields make good planning surrogates and may actually be the most critical targets to attack early on in this sort of campaign.) *It is unclear whether this kind of threat will ever emerge again in the world, and how much weight U.S. planners ought to give to the possibility in making force structure decisions.*

Policymakers could then choose a bomber force based on the class of conflict they wanted to prepare for. Analysis can inform those choices to a degree, but ultimately, value judgments are required.

The new world is likely to prove quite different from the old one in ways that we can anticipate only imperfectly. Probably the key factor for the bomber force is developing the flexibility inherent in the aircraft to do a range of things so that they can cope with any situation, recognizing that bombers are not likely to be much help in solving some kinds of military problems. These include guerrilla conflicts or low-intensity conflicts of the Somalia and Bosnia variety, except for punitive attacks, which are basically subsets of the generic cases described above.

Similarly, in places such as Korea, there are other options available that might be better or at least adequate, although bombers could play a role as they have in the past. The point, from a force planner’s perspective, is that these are lesser included cases of more stressing generic scenarios and, therefore, are not of much use in structuring the bomber force.

**Structuring the Bomber Force.** Figure 16 shows the numbers of bombers that recent RAND analysis found to be appropriate for dealing with various

![Graph showing the number of B-2s required for conventional operations](https://example.com/graph.png)

*Figure 16—Number of B-2s Required for Conventional Operations*
generic classes of scenarios if the bomber force were composed largely of B-2s. With a limited buy of B-2s, a more complex, integrated mix of bombers will be required.

**Structuring the Bomber Force for Fixed Targets.** In general, considering the spectrum of diverse kinds and levels of conflict, the variations in types of fixed targets to be attacked, the problems of operational tempo of a campaign, and the spectrum of related considerations, a maximum of about 50 properly armed bombers should be adequate for even the most demanding conflicts that are likely to arise in the new world. Moreover, cruise missiles should be able to handle the bulk of the most demanding missions against fixed targets in the initial phases of conflicts.

**Structuring the Bomber Force for Armor Interdiction.** The B-2 would be the bomber of choice for large-scale armor interdiction early in a conflict because its stealth allows it to get close enough to the targets to take maximum advantage of its payload capacity and its onboard sensors should be adequate to find the armored columns without compromising its location. Thus, the B-2s could be first on the scene and even sustain operations from U.S. bases if necessary, operating as shown in Figure 17.

However, getting three B-2s over the target at the right time (i.e., when the attacker chooses to advance) could be a considerable challenge, depending on the circumstances, and could require many more B-2s. Figure 18 shows the cascading effects of various factors that determine the overall size of the bomber force necessary to support the level of armor interdiction in the simulation. Simple counters by the enemy—spreading formations and interspersing

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**Figure 17**—Operational Concept for a B-2 Interdiction Campaign in Southwest Asia
support vehicles with combat vehicles—could triple the number of B-2s needed over the target. To be able to strike any time the enemy chose to move could triple the number of bombers required to be available for the mission.\textsuperscript{14} Having the capacity to conduct operations from bases in CONUS until bombers could move to forward bases could double it again. Adding another 10–20 percent to the overall bomber inventory to account for bombers that are in depot for long-term maintenance, are being used for training, have been lost over the years, or are otherwise unavailable for combat could lead to a requirement to purchase 60 or more B-2s for the mission alone.

Since the B-2 buy is currently capped at 20 (see Figure 19), the question is, How effective could those 20 be, and how can this mission be best accomplished? There are two possible paths to explore. The first is to use better technology to improve the capability of the limited number of B-2s in the planned force. The second is to use other forces to supplement their firepower.

\textsuperscript{14}It is possible that the B-2 will prove not to be stealthy enough to operate safely in daylight; that remains to be proven one way or the other in the test program. However, halving the size of the B-2 force on the assumption that B-2s could operate only at night guarantees an enemy freedom of operations for half a day no matter how stealthy the B-2 turns out to be and telegraph that message in advance. For example, the Iraqis would have had more than ample time to overrun Saudi Arabia before the United States could have responded with tactical forces even if they could only have operated safely during daylight hours.
Improved technology might be able to reduce the growth of the bomber force shown in the lightly shaded area at the bottom of Figure 18. In essence, the bomber force is being forced to grow to compensate for the limitations of the Skeet submunitions and the targeting systems on the bomber. Basically the submunitions are being forced to search too large an area looking for suitable targets, and that triples the number of bombers required in this particular example.

Better technology might be able to increase the efficiency of the attack and reduce the number of bombers required. One possibility is using better submunitions. Our initial examination of the possibilities for “buying back” effectiveness suggests that an improvement of at least a factor of two could be achieved, thereby reducing the required B-2 force to about 30. More precise targeting of Skeets might achieve the same effect, but that would place additional demands on the sensors and targeting systems on board the bomber. At some point, however, the continuing competition between sensors and countermeasures is likely to become critical.

Whether using still-better technology could “buy back” the whole factor of three, thereby making a force of about 20 B-2s fully effective, remains to be determined. That is about the limit that better technology could achieve. The other factors shown in Figure 18 reflect operational constraints that are not really amenable to technological “fixes.” Compromises there could seriously affect the overall operational effectiveness of the force.
Moreover, even under the best of circumstances, a force of only 20 B-2s would leave virtually no margin for error in performing even this single type of mission. In practice, it might be possible to maintain only two rather than three B-2s on station for armor interdiction. While that would be potentially very useful, it might not achieve the mass of firepower necessary to be really decisive. Moreover, it would give short shrift to other potentially important missions, such as selective defense suppression, that B-2s might be called on to perform.

The solution to this problem lies in finding ways to use the different bombers, and perhaps other early-arriving forces, together to help each other in an integrated operational framework. That approach also provides an overall framework for structuring the whole bomber force.

**Operational Employment of a Mixed Bomber Force.** Figure 20 shows a basic division of labor among the different bombers that would result in getting the maximum mileage from a constrained bomber force even in a very demanding scenario:

- B-52s armed with cruise missiles to attack time-critical fixed targets early on. (B-1s could be used instead if they were successfully modified to launch cruise missiles.) A maximum force of about 40 or so might be needed for a

![Figure 20—Possible Bomber Operational Concepts for Large-Scale Conventional Conflicts](image-url)
single very demanding theater, but fewer would be adequate for most "new world" situations that are likely to emerge. That sort of force could also inflict considerable punishment on a country, apart from any direct military impact, if it were employed against "strategic" targets.

- Twenty (or more) B-2s could be employed against armored forces if necessary to halt an armored blitzkrieg and selected defense sites. This force could also inflict serious damage on advancing infantry. (Ironically, a dispersed advancing infantry force can be more demanding to attack with bombers than armor because the area that needs to be attacked is so large and the "value" is so distributed. In general, we found that a very large bomber force could be needed to stop a large infantry force if usual measures of effectiveness were applied. On the other hand, the psychological shock value of constant bombing and dropping of antipersonnel mines could have a disproportionate impact on an infantry force.)

- B-1s could supplement the B-2s in the interdiction role if they could be made effective and survivable.

The first two points are relatively straightforward and were discussed earlier. The last point, however, is at the crux of the problem of how to "make do" with a limited B-2 force. The issues are:

- How to make the B-1 effective and survivable.
- How to use the B-2 to help the B-1.

**Using the B-1 for Interdiction.** There are several key ingredients to using the B-1 effectively in this role to supplement the B-2:

- Engaging the armored force beyond the reach of the invader's homeland air defenses.

- Targeting the armored force.

- Avoiding or defeating whatever organic air defenses accompany the armored force.

- Minimizing encounters with any airborne interceptors that are operating autonomously providing air cover for the invading force.

Solving the first problem basically requires suppressing any long-range radars or fixed, long-range SAM sites that are near enough to the invader's borders to support the invading force. That is relatively straightforward.

The second problem is much more complex because it requires both the B-2 and the B-1 to operate in new and different ways. The B-2 bears the burden of finding the targets not only for itself but for the B-1 as well. Then, the B-2 has to play a JSTARS-like role and guide the B-1s to their targets. That requires appropriate communication links aboard the aircraft and adds a new dimension to the duties of both aircrews.
Dealing with the organic air defenses of an invading armored force could be challenging as well, depending on the quality of those defenses. It is also the driving factor in determining the kinds of weapons that the bombers need to carry and ultimately, the size of the force required.

Figure 21 shows three generic levels of ground-based air defenses that the B-1s might have to face in engaging an armored division along with the consequences for the bombers. Virtually all armies have at least short-range, low-altitude, air defense systems—anti-aircraft artillery (AAA), shoulder-launched infrared SAMs, and the like. As the first case in Figure 21 illustrates, the most effective counter to these kinds of defenses is simply to fly above them. That has the added advantage of allowing B-1s to carry a full load of gravity weapons instead of having to pay the payload penalty for using standoff weapons.

There is a more fundamental message as well in the low-altitude air defense portion of Figure 21. *Flying high may be preferable to flying low in a variety of situations in the new world.* Short-range, low-altitude, air defense systems are already present virtually everywhere in the world, and higher-quality systems
such as Stingers are proliferating rapidly.\textsuperscript{15} In general, these systems are less effective individually than their longer-range counterparts (although there are exceptions), and they are able to defend less territory. On the other hand, if they are sufficiently numerous, these systems could collectively "get lucky" and bring down an occasional penetrating bomber, particularly since some of the defensive counters that aircraft typically employ might not be completely effective against some ground-based defenses in the close quarters of a low-altitude engagement. In the old world of trying to penetrate the Soviet Union or the Warsaw Pact, the high- and medium-altitude air defenses were so good and so numerous in many key areas toward the end of the Cold War that flying low and taking a chance of a random encounter with a low-altitude tactical SAM or AAA system appeared to offer the best hope of surviving, particularly on a one-time-only SIOP mission.

In the new world, the calculus is frequently going to be different. In some cases, countries may simply lack high-altitude air defenses. In others, those defenses may be effectively suppressed. For example, a situation could come up again as it did in Desert Storm, where the massive initial defense-suppression efforts and complete U.S. air supremacy allowed U.S. bombers relatively free rein flying at high altitude. That is why arming all the bombers with inertially aided TMDs and bombs to give them weapons that are cheap and effective, even if dropped from high altitude, is an attractive option.

On the other hand, high-quality, mobile, medium-range SAMs such as the Russian SA-6 and the U.S. IHAWK are proliferating as well, and they could be used to defend armored divisions. If they are, then as Figure 21 shows, non-stealthy bombers such as B-1s will no longer have the luxury of flying high and very close to targets with impunity. Since minimizing risk to bombers is crucial to getting by with a modest-sized bomber force, the prudent course would be to rely on modest-range standoff weapons such as JSOW to stay outside the coverage of the medium-range SAMs. However, that means reducing the effective payload capacity and increasing the overall number of bombers required by a factor of about three to six. Also, if the standoff range increases too much, the effectiveness of the attack is going to decrease as Figure 22 shows, thus requiring either better submunitions, more bombers, or both.

As higher-quality, longer-range, mobile SAMs proliferate, the problem could get much worse. The only practical option is to suppress the long-range SAMs, probably by launching defense-suppression weapons from the B-2, allowing the B-1s to attack the armored columns with JSOW-class antiarmor weapons.

\textsuperscript{15}Lory Arghavan of RAND has analyzed proliferation of air defense systems of various sorts in a to-be-published study.
Figure 22—Sensitivity of the Attack’s Effectiveness to Weapon Flight Time

Even if EW/GCI radars and ground-based air defense control centers near the border that could direct airborne interceptors can be destroyed, airborne interceptors operating autonomously near the invading armored columns could still pose a threat to the bombers, particularly to the B-1. The operational problem is actually quite complex, depending critically on the actual geometry of the engagement. The B-1 needs to be able to enforce the most favorable geometry in any engagement to give it the best chance of surviving any possible encounters with modern fighters.

Using the B-2 to Support the B-1. One possibility for doing that is using B-2s in the area to “direct traffic,” managing the air battle with their stealthy radars in much the same way that an Airborne Warning and Control System (AWACS) does in a more conventional air battle. Basically, the B-2 scans the area for enemy fighters and locates and tracks any that it finds. When the coast is relatively clear, it calls the B-1s, which are orbiting at a safe distance, and directs them along the safest route to the target. Typically, the B-1s would fly low over relatively friendly territory, approach the targets from the safest azimuth, launch their weapons, and leave along a path selected by the B-2s that were orchestrating the engagement.

That is a tall order for both the B-1 and B-2. Different types of bombers have never before been used on combined operations. Moreover, the B-2 would have to play a JSTARS and AWACS-like role in addition to delivering weapons itself. That goes far beyond anything the B-2 was originally intended to do and would pose considerable challenges to both the bombers’ human crews and their technical capability. Although the bombers probably have the potential capability to do these new kinds of missions, technical modifications
would undoubtedly be required, and considerable practice would be necessary to demonstrate that the operational concepts were really practical. *This kind of innovative use of bombers is probably the key to success in the new world.* The operational complexity is also part of the price for buying only a small force of B-2 bombers.

**Bombers and Other Forces: Competition and Cooperation.** As the U.S. military shrinks in size, competition for resources is inevitable. One likely result is a sharpening of distinctions among appropriate roles and missions (i.e., who does what) both among and within the various services. Figure 23 illustrates the kind of trade that is going to be made more often. It compares the total potential killing capacity of B-2 bombers and a new stealthy medium-range attack aircraft, the AX, based on aircraft carriers, against armored vehicles in the early stages of a conflict when no other forces were available. The basic assumptions are the following:

- The bombers are based in CONUS, and the carriers on station are already in place at the start of the war and in range of their targets.
- The aircraft have comparable weapons (i.e., Skew antiarmor submunitions).
- Each aircraft carrier carries one full wing of AX attack aircraft as part of its total complement of aircraft.
- Both can sustain operations as long as necessary.

The comparison considers the potential AX aircraft designs, all of which have much more range-payload capability than current A-6 and F/A-18 naval attack aircraft. The figure shows that 14 B-2s could produce about the same total firepower as three carriers worth of the largest AX aircraft considered, six carriers worth with the medium-sized AX, or nine carriers worth with the smallest of the AX designs. That means, in the latter case for example, it would take three-fourths of the currently planned carrier fleet using a new aircraft to deliver the same firepower as 70 percent of the currently planned (and largely paid for) B-2 fleet in this particular mission.

In the larger scheme of things, this suggests that heavy bombers are better suited for massive attacks against ground targets than carrier-based aircraft. A better role for carrier-based aircraft if the carriers were already on the scene would be extended air defense command-and-control in support of long-range bombers.

In a similar vein, B-1s could replace other tactical aircraft in some types of long-range interdiction and deep-strike missions, operating in conjunction with other aircraft in the area. We have only begun doing these trades, so we do not know how they will come out. However, retaining additional B-1s and putting them at risk along with other tactical aircraft could be a cost-effective option in the current fiscally austere environment.
Figure 23—Comparison of Stealthy Long-Range Bombers and Stealthy Naval Medium-Range Attack Aircraft in an Early Armor Interdiction Role Using Skeet Submunitions
Other Considerations. There are a number of other factors important to bombers that this discussion has barely touched on. For example, tankers are critical to bomber operations and are going to be much in demand for any future crisis where U.S. forces have to deploy overseas. In general, we found the critical element to be access to overseas bases for tankers. If tankers can only use CONUS bases, the numbers required could quickly become prohibitive.

Logistics support, maintenance, spare parts, and predeployed or rapidly deployable weapons stockpiles are going to be important as well. That could be a particular problem for the B-1, since it was never really intended to fly sustained conventional missions.

CRITICAL DECISIONS FOR THE FUTURE BOMBER FORCE
An Integrated Approach to Bomber Modernization

Figure 24 shows a "mini-roadmap" charting the critical issues that the Air Force needs to address over the next few years in modernizing its bomber force to cope with problems that might emerge in the new world. The key for both conventional operations and nuclear war, if the danger were to reemerge, is
providing appropriate weapons for the bombers along with whatever supporting systems are necessary to make them effective.

One particularly critical early decision is adding inertial guidance kits to all current bombs, particularly the 500-lb MK82, and TMDs. Adding inertial guidance kits only to 2000-lb bombs would miss an opportunity to use the force more effectively. Equipping all three bombers to carry these weapons would allow the United States to conduct another Desert Storm–type operation in which bombers operated in a relatively benign environment, but this time the improved weapons would make the bombers much more effective. Best of all, the cost of this improvement would be quite modest.

Mixing and matching the other bombers and weapons suggests the following critical pairings:

- A short-range, standoff weapon (e.g., JSOW) for the B-1.
- A longer-range defense suppression missile for the B-2.

Improved antiarmor submunitions (i.e., better than Skeet) and runway attack submunitions would greatly improve the effectiveness of the entire Air Force and other services as well. If nuclear use of bombers is to be retained as a serious future option, the penetrating bombers need a high-performance, short-range, standoff weapon such as the Short Range Attack Missile (SRAM) to defeat modern terminal defenses. Given the cancellation of SRAM II, either the safety problems with SRAM-A are going to have to be solved or a new missile is going to have to be developed. Since others covet the current SRAM boosters for other applications (e.g., tactical ballistic missile defense), “benign neglect” could be a risky approach to this issue.

A similar problem could exist in the nuclear cruise missile world because of the limited buy of ACMs. Converting more of the current ALCMs to conventional cruise missiles like the ones that B-52s launched in Desert Storm would reduce the stockpile of existing nuclear cruise missiles still further. Even preserving the nuclear certification of some of the bombers could become an issue as they are modified for more demanding conventional missions. At some point, a conscious decision should be made about the future nuclear role of bombers rather than allowing the capability to wither away implicitly.

However, the Air Force has to face two major decisions:

- Retire or not retire one of the three bombers.
- Develop a new long-range cruise missile.

The order and logic of the decisions are important. The choices on these questions would be considerably easier if the Air Force also had the option of procuring a larger B-2 force.
If the Air Force chooses to eliminate either the B-1 or the B-52H and procures only 20 B-2s, then the bomber must be a long-range cruise missile carrier to minimize the risk to the bomber force while still providing it with some capability to play a useful role in the critical early stages of a conflict. With a bomber force this small and with little hope for building more in a reasonable amount of time, minimizing the risk to the bombers is central to preserving the long-term military capability of the United States. That means, among other things, that a sizable force of long-range conventional cruise missiles is particularly important. As a practical matter, that means developing a new long-range cruise missile, because converting nuclear ALCMs to conventional ALCMs could produce a force of only a few hundred to a thousand or so conventional cruise missiles at most.

Over the long term, thousands of cruise missiles are likely to be necessary for conventional operations. For example, combinations of attacks against key time-urgent tactical fixed targets, particularly airfields, bridges, weapon-storage sites, and air defense installations, could quickly absorb hundreds of cruise missiles, even thousands in a prolonged campaign. Moreover, considering the time necessary to develop, produce, and field new weapons, either the cruise missile inventory needs to be large enough to deal with several wars, or production lines have to be open and have adequate capacity to build large numbers of cruise missiles quickly. Thus, ALCM-C is an interim solution at best.

Without long-range cruise missiles for nonstealthy bombers, there is a great risk that the United States could have a couple of bad days in a major conventional conflict and lose the bulk of its heavy bomber force with no timely way to rebuild that national capability. That is particularly true if the United States decided to use the bombers early on in the traditional way against "strategic" targets.

A force of 20 B-2s and a substantial number of cruise missile carriers would have considerable capability and should be considered the core of any future bomber force. It could attack most critical fixed targets as well as a modest number of mobile targets even in the early stages of a campaign. It could handle modest armored interdiction campaigns but probably could not entirely halt an armored attack of the scale that the Iraqis could have mounted against Saudi Arabia immediately after they overran Kuwait. Improved antiarmor submunitions would be particularly important to develop and procure.

The size of the cruise missile carrier force depends primarily on whether part of the force is to be preserved for nuclear operations alone, as planners during the Cold War would undoubtedly have preferred, or the nuclear cruise missile carriers are to be used to launch conventional cruise missiles as well. In the former case, all the remaining bombers (either B-52s or B-1s) should probably be retained. In the latter, about half the current force of either bomber would probably be adequate.
Using B-52s as cruise missile carriers and retaining B-1s for other duties opens up some new operational possibilities and avenues for analysis. Retaining all three bombers in appropriate numbers could provide capability, flexibility, and “breathing space.” With the B-52s playing the role of cruise missile carriers and B-2s hitting key mobile and other high-leverage targets (as well as orchestrating the rest of the air battle), theater commanders have more options to put the B-1s at risk and take advantage of their large payload capacity.

There are two possibilities:

- Adding 20–50 B-1s equipped for armor interdiction could provide enough additional interdiction capability to give the bomber force enough firepower to handle even sizable armored invasions.
- Keeping additional B-1s might allow savings in other areas if the B-1s could replace other systems.

The second point is quite important and represents the kinds of trades that will increasingly be the coin of the realm as budgets continue to tighten, competition intensifies, and cooperation increases among the services.

If more B-2s (say, a total force of 40–50) were available, the need to retain B-1s and invest in a new long-range cruise missile would be greatly reduced. With JJDAM-class weapons and TSSAM-like cruise missiles for special applications, a B-2 force of that size supplemented by a modest number of properly armed B-52s would be a more effective force in a broad spectrum of scenarios. Moreover, forgoing the new long-range cruise missile and retiring the B-1 (including eliminating the need for additional modifications to make it fully effective in conventional operations) would defray a substantial fraction of the cost for purchasing the additional B-2s. Still further savings might be possible if this bomber force could replace other types of forces for other missions.

The most pressing need is for a new way of thinking about how to employ bombers as flexible tactical aircraft. New operational concepts, some of which we have begun to explore, will be necessary. Joint operational concepts will need to be explored as well. Those, in turn, will raise new technical issues about the capabilities of bombers and improvements that might be needed. Examples include:

- B-2 sensor performance, computer hardware and software, cockpit displays, crew workload.
- Weapon system integration.
- B-1 electronic countermeasures.
- Mission planning.
Old, familiar issues like B-1 electronic countermeasures (ECM) will probably have to be revisited in a different context. The B-2 needs to demonstrate that it can locate targets and deliver short-range weapons while still remaining stealthy enough to elude defenses. Beyond that, it will have to perform new types of missions (e.g., locating targets for other aircraft and helping them avoid defenses) if its potential capabilities are to be fully utilized. New, more fundamental questions, like what bomber crews need to do their jobs in a more demanding, less familiar role, will have to be addressed. We have just begun new research to try to get a better handle on these problems.

OBSERVATIONS ON THE ANALYSIS PROCESS

The process of doing bomber studies is going to have to change, too. Life was much simpler when all we had to worry about was determining the ability of bombers to avoid an initial attack, penetrate Soviet air defenses, and deliver nuclear weapons against targets in their SIOP mission. But, even proceeding with that relatively classical analysis, we discovered some potential dangers in the analytical process that the new emphasis on using large computer models tends to exacerbate. We don’t consider these to be particularly cosmic revelations; rather, we regard them as refinements to the list of classical pitfalls in systems analysis. For example:

- Reliance on large computer models can be as much of a curse as a boon. The effort and time required to collect the requisite information, run the models, and interpret the results can actually reduce the scope and usefulness of the analysis.

- Demands of the models will tend to overwhelm even the largest computers, both in terms of processing capacity and data storage. No matter how fast computation capability grows, demands of models will grow faster. (We used to make the lights in Santa Monica blink on and off routinely, not to mention infuriating colleagues who were competing for computer time, when we tried to run several large models—say, STRAPEM and ESAMs—at the same time.) Even the most capable computers cannot solve the combinatorial problems inherent in trying to analyze exhaustively all potential cases. And even if they could, just wading through the computer output

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16 The issue for B-1 ECM is no longer whether it is good enough to make penetrating B-1s as effective as stealthy bombers on the one hand or cruise missiles on the other. Now the question should be, Given that B-1s are going to be put at risk to some degree, can an effective ECM suite be devised, and is it worth the cost? That question is actually a harder one to answer.

17 For discussions of the traditional pitfalls in systems analysis, see Quade (1968) and Kahn and Mann (1957). Insights based on more contemporary experience with military systems analysis are included in several chapters of Hughes (1984).
would be a daunting task. Thus, choosing the right cases to run is still the essence of the systems analysis art.

- Data-hungry models can seriously limit the number of cases that can be run and the range of sensitivities that can be tested. Basing an analysis on a few very detailed cases can lead to seriously erroneous policy-level results. It is far better to consider a much broader range of cases treated in varying levels of detail.

- Third-order effects can swamp first-order effects. A particular problem with relying heavily on large models is their very level of detail. Just the mechanics of setting up runs and getting correct results requires that all the details be correct. Even reaching agreement on what constitutes “correct” results can be an arduous (and onerous) task. That gives undue weight to resolving relatively trivial issues at the expense of focusing on more important parameters. (Unfortunately, the computer doesn’t know that the clutter rejection capability of a SAM is much more important in policy-level studies than the coefficient of a third-order term in a guidance loop!) Moreover, the lack of transparency in many computer models can compound the difficulty of interpreting even correct results. As a result, there is a great danger of missing the forest for the trees and risking really misleading policymakers.

- Developing the proper level of detail at the appropriate level in the modeling hierarchy is critical to effective analysis. Although this sounds like a first principle, we found that many widely used models violated it routinely. For example, we generally found that one-on-one engagement models sometimes needed to be even more detailed and campaign-level models much less detailed than they are currently. One major campaign-level model that we employed extensively incorporated just the wrong amount of detail: it modeled engagements in so much detail we could only analyze a modest number of cases, but the engagement analysis was not detailed enough to avoid obvious errors. The result was a model that allowed us to consider too few cases and sometimes produced erroneous results on those cases. We had to modify the models extensively and use them with great care to avoid these problems.

- Use of detailed models can lead to an excessive concentration on the present (or near-present) at the expense of the future. Since detailed models usually require very precise information about weapon characteristics, defense locations, terrain, or similar very specific parameters to run, there is a strong tendency to rely heavily on data about current systems, defense deployments, etc. That is a potentially fatal flaw in analyses that are intended to inform decisions about future force structures, for example, since the future weapons characteristics and force deployments cannot be known with that degree of precision. Similarly, no future force structure or policy choices should ever turn on “quirky” characteristics of weapon systems or assumptions about enemy force deployments. Thus, unless great care is exercised, the very detail in
the large models can be self-defeating in doing sensible policy analysis. Overall results should be explainable in terms of "simple truths."

Thus, even in analyzing the relatively well-behaved old world, we found that we had to use considerable care in doing useful analysis with a collage of high-fidelity models. Some of the specific approaches that we found useful included:

- **Decomposing even fairly integrated problems into manageable pieces, analyzing the pieces, and then reintegrating them.** This process allows using different models for different parts of the problem and permits extensive sensitivity analysis to address specific issues (e.g., saturation of local defenses). Obviously, doing the analysis this way requires great care in both the initial decomposition of the problem and the eventual reintegration of the pieces to make sure that nothing gets lost. However, proceeding this way proved to be considerably better than the alternative.

- The availability of straightforward but powerful tools like large-scale spreadsheets greatly facilitates "wiring together" the individual analyses of disparate parts of the problem.

- "Desensitizing" the analysis is as important as subsequent sensitivity analysis. For example, that means making sure bomber and cruise missile routes, placement of defenses, and offensive and defensive tactics are representative of interesting situations—that is, good but not necessarily optimal. In other words, both sides should be allowed to play the game well. Neither should succeed or fail based on either heroic efforts or gross incompetence.

- Even analyzing the old-world large-scale conventional wars, perhaps involving the use of long-range bombers, generally requires using different sets of models. In particular, one can use campaign-level penetration models such as STRAPEM, but these are not particularly well-tailored tools. On the other hand, land-combat models that permit measuring the effects of a bombing campaign on the course of a ground battle are frequently necessary to analyze how bombers should be employed and to determine what kind of force is appropriate.

Finally, our experiences underline the problems for analyzing cost-effectiveness in the new world:

- Evaluating equal-cost and equal-benefit solutions, while sometimes possible and always tidy from an analytical point of view, may be inadequate in the broader policy arena. Real alternatives may have neither equal costs nor equal benefits and don't lend themselves to a mechanistic approach. Then the task of analysis is to identify the respective costs and benefits of each real option as well as possible to inform policymakers' choices.

- In general, cost-benefit analysis will be less tidy than in the past. Options will have to be evaluated in more of an operational context. For example,
bombers that arrive early in a conflict solve one set of problems and then would probably be available to play a role later in the campaign. Thus, a direct cost-effectiveness comparison between, say, early-arriving bombers and late-arriving army theater missile systems would miss critical elements of the capabilities of the systems. Similarly, comparisons involving multirole systems (e.g., aircraft carriers), which will increasingly be the rule rather than the exception, must be conducted at a high enough level to capture all the disparate roles of different systems adequately.

In spite of all the advances in computers and modeling, bomber analysis remains an art, untidy at best. In the future, as bomber analysis becomes more integrated with overall tactical operational analysis it will become even more untidy. As the new world evolves, the key in the bomber world will be flexible machines and flexible thinkers.

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Chapter 14

A FIRST LOOK AT OPTIONS FOR POLAND

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The Central European nations are now in the process of shaping their military strategy and forces for the future. The United States has an interest in promoting a stable military balance of power in the region, one that leaves these nations with enough military force to protect their borders, but with insufficient strength to threaten their neighbors. This paper examines the potential force requirements for one of these nations, Poland. It uses a scenario of a Russian attack to evaluate four widely different defense concepts. The defense concepts are adapted from previous RAND research on NATO's defense requirements.

INTRODUCTION

European security in the years ahead will be affected importantly by the defense agendas pursued by East European nations. This is especially the case for the northern tier countries of Poland, Hungary, and the former Czechoslovakia, but also for the Balkan nations. Formerly heavily armed members of the Warsaw Pact, most of these nations are fledgling free-market democracies with as yet no discernible military identity. Major force reductions in all cases are being compelled by economic circumstances and by the Conventional Forces in Europe (CFE) Treaty, but all of the nations will continue to field military forces of some sort. The forces that they will deploy, and the defense strategies that they embrace, will affect Europe's stability in what promises to be a tumultuous era ahead. If these nations disarm to the point of creating a power vacuum across Eastern Europe and the Balkans, the entire area will be left vulnerable to outside pressure and aggression. But if these nations choose to arm themselves too heavily, they will pose threats to each other, and stability will be threatened for entirely different reasons.

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This research was conducted as part of a study on the future of East European defense policies and military forces and was sponsored by the Office of the Secretary of Defense. Results were briefed to senior Polish defense officials at a conference cosponsored by RAND at Warsaw in March 1993.
The United States and its NATO allies have an interest in promoting a stable military balance of power in this region, one that leaves these nations with enough military force to defend their borders, but insufficient strength to appear threatening to their neighbors. This interest is especially keen because some of these nations have expressed a desire to draw closer to NATO, perhaps even to become members of the alliance. That desire is no stronger anywhere than in Poland, the largest and, arguably, the most important of the East European nations from the viewpoint of NATO security interests.

When Poland was a member of the Warsaw Pact, its defense planning was conducted by the Soviets. The mission of Polish forces was clear: to support a Soviet attack into Western Europe. That was to be accomplished in western Poland by fitting Polish divisions into an overall attack scheme across the inter-German border and, in the east, by providing the transportation network to move troops and supplies from the Soviet Union to the forward combat areas. Likewise, Polish defense doctrine was forced to march in lockstep with that of the Soviet Union: the purpose of its forces was to conduct offensive operations using mass and shock to cause breakthroughs for exploitation by follow-on forces in order to encircle and destroy the opponent’s forces quickly.

Now, of course, Poland’s security environment has changed considerably. The Warsaw Pact, along with the Soviet Union, has ceased to exist. Poland is not a member of any security alliance, and although that status may change in the future, it must now decide—with its own interests in mind—what its defense policies are to be. These defense policies are no doubt going to have a decidedly defensive flavor compared to the policies that were followed by the Warsaw Pact. But restructuring the Polish military to give it a more defensive orientation will take resources that are in increasingly short supply as Poland devotes a larger share of its GDP to meet its domestic needs. Moreover, perhaps the most radical change that has occurred for Poland is the makeup of its neighbors. A few years ago, Poland was bordered by three nations, none of which exists today. Gone are the Soviet Union, Czechoslovakia, and the German Democratic Republic—replaced with Russia (Kaliningrad), Lithuania, Belarus, Ukraine, Slovakia, the Czech Republic, and the Federal Republic of Germany. To analyze Poland’s defense needs for its new security environment, the following questions need to be answered:

- What threats to the security of Poland’s borders need to be considered?
- Are there deficiencies in current Polish military capabilities in meeting those threats?
- If deficiencies exist, what defense concepts can correct them?
- Of the promising defense concepts, which are the most practical to implement?
The purpose of this paper is to provide preliminary answers to these questions.

ILLUSTRATIVE PLANNING SCENARIO

Poland is surrounded by countries of varying geographical size and population (see Figure 1). Although the likelihood of conflict between Poland and its neighbors is believed low for the foreseeable future, for defense planning purposes it is prudent to consider the possibility of conflict occurring with one or more neighboring states.

Poland's neighbors possess military forces of varying potential. Figure 2 displays two measures of ground and air force capabilities as depicted by the maximum allowable numbers of ground force equipment (tanks plus armored combat vehicles plus artillery pieces) and air force equipment (combat aircraft plus attack helicopters) according to the CFE Treaty (see IISS, 1992).

Figure 2 can be divided into three regions. The first region contains those countries—Lithuania, Belarus, Czech Republic, and Slovakia—that do not

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1 Lithuania is not a party to the CFE Treaty. However, its equipment levels are included in Figure 2 for completeness.
pose a threat to Poland’s territorial integrity, and thus, for our purposes, can be ignored. The second region consists of two countries—Germany and Ukraine—whose force levels are individually about twice the size of Poland’s. That numerical superiority is somewhat misleading because it does not take into account certain disadvantages and advantages that the attacker and defender have, respectively. For example, if Ukraine were to attack Poland, it would likely need to leave significant force levels behind to protect its own borders, greatly reducing the force size that it could employ in an attack. Similarly, because it is generally believed that a defender would normally enjoy an advantage in exchange ratio over an attacker, the attacker might need an overall initial force advantage of greater than 1.5 to 1 (3 or 4 to 1 along the main axis of army level advance) in order to prosecute successfully a campaign (this assumes comparably capable forces and the absence of surprise).

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2This does not mean that special forces might not have to be configured to protect against minor border incursions by small groups of irregular troops from these or other countries, but these force requirements are apt to be minor in comparison to those that are needed to halt a major invasion.

3As long as Germany is firmly anchored to the West through NATO, Poland should have no fear of attack from that quarter.

4This assumes that Ukraine and Russia are not in a state of cooperation that would allow Ukraine to prudently employ all of its forces in an attack on Poland.

5The relationship between force-ratio requirements at theater, main-sector army, and tactical levels is discussed in Davis, Howe, Kugler, and Wild (1989).
Moreover, an attacker would have to assume that the population of the defender nation would participate actively and directly in the defense of its country, thereby resulting in the attacker expending more force than would be needed to prosecute an attack against regular military units. Consequently, an attack by either Germany or Ukraine on Poland might well not succeed.

The third part of the figure consists of the Russian data point. Overall, Russian strength is about five times that of Poland's in both the ground and air force categories. That strength is sufficient so that Russia could leave a strategic reserve behind, have enough force to ensure security of its lines of communication into the Polish theater, and have more than enough force left over to exceed the 1.5 to 1 attack criterion. Therefore, for illustrative planning purposes, we select a Polish-Russian scenario\(^6\) for investigation.

**Scenario Details**

While we do not have operational details on how the Poles would defend against a major attack, a remarkable lead article in a respected Polish General Staff journal provides some insights (see Balcerowicz, 1992). The article describes a plan to form territorial forces and to integrate them with regular army units in an active defense, and to improve the defensive preparation of the territory. Figure 3 illustrates where major and secondary lines of defense might be located to counter an attack from the east or the west. The Poles have recently expanded their military districts from three to four in order to provide more balanced protection of the perimeter of their country. In the event of a major attack from, say, the east, the first strategic line of defense would be manned by forces from the two eastern districts, while forces from the western districts would move eastward and man the second strategic line of defense. It is this general scheme of operation that we employ in our analysis of Polish capabilities to defend against a Russian attack.\(^8\) Figure 4 summarizes the attack and defense scheme for this illustrative planning scenario.\(^9\)

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\(^6\) However, this is not a worst-case scenario from the Polish point of view. Russia could reach an agreement with Ukraine or Ukraine and Belarus to perform a joint attack against Poland.

\(^7\) A scenario and analysis of a Ukrainian attack on Poland is currently under investigation at RAND.

\(^8\) See Szyna (forthcoming) for an analysis of the journal article.

\(^9\) A definitive analysis of Polish defense needs should examine a variety of scenarios that vary by the amount of mobilization time available, warning time available, location of the attack, and so on. Our purpose in using a single illustrative planning scenario was to provide an initial screening of quite diverse defense options. The more promising concepts, however, should be subjected to a more definitive analysis later.
Figure 3—Polish Strategic System of Defense

The Russian and Polish orders of battle are shown in Figure 5 for divisions, equivalent divisions, combat aircraft, and attack helicopters. The force levels are CFE-constrained. All of the Polish forces are assumed to be available for the defense. About half of the 50 divisions the Russians are assumed to have at the turn of the century are assumed to participate in the attack, with the re-

10 An equivalent division is defined as combat power, measured in terms of numbers and types of equipment, using the 1990 U.S. 1st Armored Division as the standard.
Russian forces invade through Belarus
- Goal is the capture of roughly half of Poland including the industrial heartland

Polish forces defend at the border and main defense line
- Goal is to stop attack short of Warsaw and Ostroleka

Figure 4—Illustrative Planning Scenario

Figure 5—Static Force Balance
mainder withheld for a strategic reserve and to protect the lines of communication through Belarus.\footnote{Belarus is assumed to be neutral and does not attempt to prohibit passage of Russian forces and supplies.}

Figure 6 shows the array of Russian and Polish ground forces prior to the attack. Russian forces are divided between two main axes of attack. It is assumed that there is sufficient warning time that Polish forces are able to reach their wartime positions in time to construct deliberate prepared defenses to a depth of 10 km at the first defense line and to a depth of 15 km at the main defense line. Six of the ten Polish divisions man the forward defensive positions to delay and attrit the attacking forces with the remaining defenders situated at the main defense line that is protecting Warsaw and the Polish heartland. Polish territorial units\footnote{An important innovation as part of the new Polish defense concept is the formation of regional territorial forces (see Szyna, forthcoming). The territorial units would cooperate closely with regular army units, would defend specific objects, and could engage in guerilla operations in areas seized by the aggressor.} are situated between the two main defense lines. If Polish troops located in the forward defense line cannot hold against the attacking force, they would plan to fall back as best as they could to help man the main defense line. The main defense line is located approxi-
mately 150 km behind the forward defense line. For the purposes of this analysis, we assume that a successful defense has been achieved if the main defense line is not breached.

The contribution of air forces plays an important role in the assessment of both sides’ capabilities. Russian medium-range bombers escorted by fighter aircraft are employed for offensive counterair. Russian and Polish fighter-bombers are split about evenly between the close air support (CAS) and battlefield air interdiction (BAI) missions, while attack helicopters are used solely for CAS. Polish fighters are employed mainly on air defense, although some are also used as escorts for aircraft conducting the BAI mission.

Methodology

The principal methodological tool used to evaluate the base case outcome and to compare alternative improvement options was the Integrated Theater Model (ITM) that was developed as part of the RAND Strategy Assessment System (see Bennett, 1993). ITM, as its name implies, is an integrated air and ground theater-level combat model that operates at the operational level of warfare. Ground forces are followed at the level of divisions and independent brigades. ITM is designed specifically to examine the operational level of maneuver. The ITM commands allow the user to direct the maneuver of ground forces so that counterattacks, envelopments, and flank attacks can be explicitly modeled. ITM includes concepts of phases of battle (such as preparation, assault, breakthrough, and exploitation and pursuit). The model predicts breakthroughs and assesses increased losses to the defense under conditions where such breakthroughs traditionally have occurred. It assesses breakthroughs where the density of defending forces is too low, where a static defensive line is penetrated, or where an infantry force with limited mobility is overrun.

Combat adjudication is accomplished taking into account the type of contact between forces (e.g., front-to-front), the character of the battle (determined by the current activity of each side and the preparations that the defender has made), the nature of the environment (the type and width of terrain and any placement of mines on the battlefield), and the composition of forces (combined arms effects). The final stage of combat adjudication is the calculation of fire support effects coming from fixed-wing combat aircraft, attack helicopters, and artillery. ITM then simulates close combat and determines the kills achieved and the movement of the opposing forces.
Base Case Results

Tables 1 and 2 show some of the detailed results of the base case. Not surprisingly, given the preponderance of Russian forces, the simulation suggests

Table 1
Base Case Results—Ground Forces

<table>
<thead>
<tr>
<th></th>
<th>Polish Forces</th>
<th>Russian Forces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial EDs</td>
<td>4.4</td>
<td>16.0</td>
</tr>
<tr>
<td>Attrition by day 5&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>By ground</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>By combat aircraft</td>
<td>0.7</td>
<td>0.4</td>
</tr>
<tr>
<td>By attack helicopters</td>
<td>2.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Repaired during conflict</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Final EDs</td>
<td>0.4</td>
<td>14.1</td>
</tr>
</tbody>
</table>

<sup>a</sup>The main defense line was breached at D+5. At that time, the combat simulation was stopped.

Table 2
Base Case Results—Air Forces

<table>
<thead>
<tr>
<th></th>
<th>Polish Forces</th>
<th>Russian Forces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial aircraft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combat aircraft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air-to-air</td>
<td>163</td>
<td>301</td>
</tr>
<tr>
<td>Air-to-ground</td>
<td>185</td>
<td>701</td>
</tr>
<tr>
<td>Multipurpose</td>
<td>75</td>
<td>167</td>
</tr>
<tr>
<td>Total</td>
<td>423</td>
<td>1169</td>
</tr>
<tr>
<td>Attack helicopters</td>
<td>30</td>
<td>388</td>
</tr>
<tr>
<td>Attrition by day 5&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>By air-to-air</td>
<td>110</td>
<td>6</td>
</tr>
<tr>
<td>By ground-to-air</td>
<td>52</td>
<td>130</td>
</tr>
<tr>
<td>By air-to-ground</td>
<td>132</td>
<td>0&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Final aircraft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combat aircraft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air-to-air</td>
<td>38</td>
<td>299</td>
</tr>
<tr>
<td>Air-to-ground</td>
<td>74</td>
<td>685</td>
</tr>
<tr>
<td>Multipurpose</td>
<td>38</td>
<td>163</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>1147</td>
</tr>
<tr>
<td>Attack helicopters</td>
<td>9</td>
<td>274</td>
</tr>
</tbody>
</table>

<sup>a</sup>The main defense line was breached at D+5. At that time, the combat simulation was stopped.

<sup>b</sup>Polish air forces did not attack Russian airbases.
that the main defense line could be breached in less than a week of combat. This occurs for two principal reasons:

- The Russians have an initial 3.6:1 advantage over the Poles in ground combat capability. Even though the Polish ground forces have an exchange ratio advantage over the Russians as they attempt to penetrate through the prepared defenses at the border (and later at the main defense line), it is not enough to offset the Russian advantages in numerical strength and firepower. The initial exchange ratio is 0.5:1 (Polish losses/Russian losses) in the forward defense line. Even with that favorable exchange ratio, the Russian force ratio grows in its favor. Moreover, that line is breached in one day, and from then until D+3, when the main defense line is reached, the exchange ratio rises to 3.4:1 in the Russians' favor. The Poles are pushed out of the main defense line in two days. The force ratio at the time that the main defense line is breached has grown to 35:1 in the Russians' favor with the virtual annihilation of the Polish ground forces.

- The Russians have about an overall 3.7:1 numerical advantage in air-to-ground aircraft, including attack helicopters. For attack helicopters alone, the ratio is greater than 10:1 in the Russians' favor. This means that even if the Poles could achieve a favorable exchange ratio for ground-to-ground operations while in prepared defense positions, the ratio would be reduced substantially over time due to the overwhelming superiority of the Russians in air-to-ground attack capability.

We now turn to a discussion of defense options for improving Poland's capability of successfully defending against an attack of this magnitude.

ALTERNATIVE DEFENSE IMPROVEMENTS

The defense planning problem facing Poland—attempting to halt an armored attack within a relatively short distance of the border while outnumbered—is reminiscent of the problem faced by NATO when the Warsaw Pact existed as a formidable alliance and posed a direct and immediate threat. Defense of NATO against a Warsaw Pact attack was studied seriously for nearly forty years, beginning with the establishment of force goals adopted by the North Atlantic Council in early 1952.\textsuperscript{13} For our initial examination of possible ways to improve Poland's current defense posture, it is worthwhile to revisit some earlier RAND work.

During the 1970s and 1980s, RAND devoted a substantial portion of its national security research resources to topics related to the defense of NATO's

\textsuperscript{13}For an excellent historical discussion of NATO's efforts to establish concepts for defense of the Alliance from the beginning to the end of the Cold War, see Kugler (1993).
Central Region. These topics ranged from studies of individual detailed force improvements, such as increasing the survivability of NATO's air bases to conventional and chemical attacks, to studies of broad theater-level defense concepts. It is the latter category that is most relevant for the subject of this paper. One of the RAND studies, conducted in the early 1980s (Levine, Connors, Weiner, and Wise, 1982), surveyed numerous proposals for defending NATO. From the results of that survey, a few defense options that captured the key features of many of the proposals were identified and analyzed (Weiner, 1986). It is these options that form the basis of four initiatives that we will apply to the Polish situation in an analogous way. The four options and their particular implementation scheme for this study are:

- Increase forces
  - Add more Polish divisions
- Reconfigure existing forces
  - Distributed area defense
- Significantly improve defensive capabilities
  - Barrier defense
- More reliance on airpower
  - Interdiction belt

**Add More Polish Divisions**

This option is probably the most straightforward way of dealing with the imbalance of Polish and Russian forces. Adding divisions (and supporting artillery units) could increase the size of the Polish force to such a level that it could defend successfully at the main defense line, at least as simulated by the ITM. Polish ground force strength was increased by an ED at a time until the attack on the main defense line stalled. The additional EDs were added to the main defense line in keeping with the original defense concept. The attack stalled when between 6 and 7 EDs (13 and 16 divisions) were added. Results are shown in Table 3.

There are two principal advantages to the option of adding more Polish divisions. First, standing forces are a visible deterrent. Unless the attacker can create conditions such that the defender’s standing force cannot be brought to bear at the point of attack, e.g., by a surprise attack that allows the attacker to achieve its objectives before the bulk of the defender’s force can engage in combat, the attacker is likely to be deterred by a simple comparison of relative force strengths. Second, standard force elements, such as mechanized and armored divisions, have been tested in actual combat. Their effectiveness in bat-
Distributed Area Defense

The distributed area defense force consists of numerous, small, semi-autonomous fire units operating in the northeastern portion of Poland opposite the main direction of the Russian attack. Figure 7 shows the area of operation of the fire units. Each fire unit is committed to defend a specific sector. Their effectiveness is achieved by attacking enemy forces all along the axes of advance rather than positioning large forces directly ahead of the attacking formations. The fire units are backed up by mobile reserve divisions located immediately behind the area that the fire units occupy. In this case, the mobile reserves are located at the main defense line. The sole purpose of the fire units is to reduce the invading force by attrition to a level so that it can be repulsed by the mobile reserves. Regular Polish mechanized divisions are demobilized to provide the personnel to man the fire units.

14 Although the illustrative planning scenario examined here is of a Russian attack through Belarus, the fire units might also protect simultaneously against a secondary attack from Kaliningrad.
Weiner (1986) examined this concept in detail. That study considered two kinds of complementary fire units: direct-fire and indirect-fire systems. The direct-fire units would be equipped with antitank weapons with limited antiair capability to counter suppression attacks by attack helicopters and would operate in and around urban and forest areas. The particular weapon system investigated was a man-portable laser beam rider missile system. The indirect-fire unit would possess a self-contained, precision, indirect-fire system. The system investigated in the prior study was an armed reconnaissance scout vehicle chassis equipped with a telescoping pole and two missile-launcher racks. The system operates from concealed positions in woods or urban areas.

The concept was evaluated (in an era before ubiquitous computer graphics) using human participants for command decisions, a three-dimensional terrain board with a scale of 1:10,000 (see Figure 8), and several computer programs. The terrain board represented a 20 km by 25 km area immediately to the west of the (then) inter-German border. For the Polish analysis (with an area of 300 km by 100 km), we used the same density of fire units as was used in the NATO–Warsaw Pact case.15

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15 The terrain in the part of Poland where Russian forces are attacking is less urbanized than the terrain board data. There is, however, substantial forest that should provide much the same channelization and opportunities for ambush.
For Poland, this amounted to about 7700 fire units with 5000 direct-fire and 2700 indirect-fire units. About 4 2/3 Polish divisions need to be demobilized to provide the 50,000 troops to man the fire units. That would leave about 5 1/3 divisions or 2 2/3 EDs to provide the mobile reserve force. If we assume that the Poles can successfully defend at the main defense line if the theater-level force ratio is no greater than 1.5, then the fire units need to attrit 12 Russian EDs. The rule of thumb is that there are about 1000 armored vehicles in one ED, meaning that the fire units need to kill 12,000 vehicles for the distributed area defense concept to be successful.\(^\text{16}\)

The rate of the number of vehicles required to be killed per day per unit depends upon how rapidly the attacker moves through the area defended by the fire units and the fraction of the fire units encountered by the attacker. Figure 9 shows the required rate of kills as a function of those two parameters. For example, if the attacker takes two days to traverse 100 km and if he concentrates his axes of attack such that only one-quarter of the fire units are able to engage, then each fire unit needs to be able to kill about 3.5 vehicles per day.

\(^{16}\)All the combat vehicles in a unit do not have to be killed before the unit becomes ineffective. The fraction that do need to be killed for a unit to have to be withdrawn from combat depends upon the particular circumstances, but most analysts assume that when a unit has suffered around 30–60 percent casualties it will need to be withdrawn and reconstructed before it can fight again. Here, however, we take a more conservative approach and assume that the casualties are concentrated rather than being spread nearly uniformly across the attacking force.
The results from the prior study of a two-reinforced-regiment attack across the 20 km by 25 km area suggest that each engaged fire unit could kill 2.3 vehicles in a three-hour period.\textsuperscript{17} Therefore, the kill rates shown in Figure 9 do not seem unreasonable to achieve. The results are summarized in Table 4.

The principal advantages of the distributed area concept are that (1) it makes use of the potential high leverage that can be provided by technology and (2) it is not a threatening force posture because it is inherently defensive in nature.

Its principal disadvantages are that (1) the concept of distributed defense for large-scale operations is unproven, (2) the units need to have access to secure supplies and hiding places in order to be effective over a considerable period of time (perhaps up to several days), and (3) the simultaneous autonomous operation inherent in the operation of thousands of small-sized units may lead to degradation of overall system performance because of uncoordinated fires. Additionally, a determined attacker with enough artillery and air-to-ground capability might be able to punch through faster than the calculation suggests. With regard to the latter topic, Russian air superiority could be particularly

\textsuperscript{17}The contribution of attack helicopters in locating and destroying the five units was considered in deriving the results of the earlier study.
Table 4

Effectiveness Estimates

<table>
<thead>
<tr>
<th></th>
<th>Day Conflict Stopped</th>
<th>Main Defense Line Breached?</th>
<th>Ground Losses</th>
<th>Final Force Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base case</td>
<td>D+5</td>
<td>Yes</td>
<td>2.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Add divisions</td>
<td>D+10</td>
<td>No</td>
<td>14.0</td>
<td>10.1</td>
</tr>
<tr>
<td>Distributed area</td>
<td>D+2</td>
<td>No</td>
<td>12.0</td>
<td>1.8&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup>Combat was stopped when the force ratio fell to 1.5:1.

<sup>b</sup>EDs associated with personnel of divisions that were disbanded to obtain personnel to man all fire units.

worrysome for the defense. The fire units would need at least a limited organic air defense capability. Finally, the use of dismounted infantry as a way of "eating through" the distributed area defense needs to be analyzed. That tactic would involve much slower movement of the attacker but would require some anti-infantry capability in the fire units.

**Barrier Defense**

Weiner (1986) reviewed several proposals and studies of various types of barriers for improving NATO’s defenses. As a result of his survey, he found that:

- Barriers require widths of several tens of kilometers, especially against modern, precision weapons.
- Barriers must be backed up by mobile reserve forces.
- Barriers should consist of interlocking rather than individual positions.
- Barriers should make extensive use of underground facilities including “pop-up” capabilities for sensors and weapons.

As a consequence of these findings, he concluded that the key characteristic of a successful barrier is that it should be a modern Maginot Line, i.e., reinforced concrete and steel interconnected fortifications in depth with major weapon systems, including advanced surveillance and precision fire weapons, throughout the length of the zone. That type of barrier applied to the Polish defense situation is illustrated in Figure 10.
Figure 10—Barrier Defense

We assumed that the barrier would be manned by territorial forces organized for this purpose leaving the regular Polish army units as the mobile reserve. The air campaign for this situation was the same as described earlier except that one-half of the Russian CAS and BAI sorties and all of the attack helicopter sorties were assumed to be employed in the attempt to breach the barrier. Following Weiner, we investigated various exchange ratios that the barrier would have to achieve so that a successful defense could be mounted by regular Polish units at the main defense line. We found that an exchange ratio of between 6:1 and 7:1 would be sufficient. Results are shown in Table 5.

The principal advantage to the barrier defense is that it provides potential high leverage, i.e., a force multiplier, to an outnumbered and normally outgunned defense.

The potential disadvantages are several. First, a fortified barrier of the type described here will be expensive. Land will have to be acquired. Displaced persons will have to be relocated. Construction costs for a sophisticated barrier system will be high. Second, the type of barrier described here requires about
### Table 5

**Effectiveness Estimates**

<table>
<thead>
<tr>
<th></th>
<th>Day Conflict Stopped</th>
<th>Main Defense Line Breached?</th>
<th>Ground Losses</th>
<th>Final Force Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Russia (EDs)</td>
<td>Poland (EDs)</td>
</tr>
<tr>
<td>Base case</td>
<td>D+5</td>
<td>Yes</td>
<td>2.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Add divisions</td>
<td>D+10</td>
<td>No</td>
<td>14.0</td>
<td>10.1</td>
</tr>
<tr>
<td>Distributed area</td>
<td>D+2</td>
<td>No</td>
<td>12.0</td>
<td>1.8</td>
</tr>
<tr>
<td>Barrier defense</td>
<td>D+8&lt;sup&gt;c&lt;/sup&gt;</td>
<td>No</td>
<td>10.5</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Combat was stopped when the force ratio fell to 1.5:1.

<sup>b</sup>EDs associated with personnel of divisions that were disbanded to obtain personnel to man all fire units.

<sup>c</sup>Barrier assumed breached at D+8.

<sup>d</sup>Casualties to barrier defenders (~60,000 troops) were not evaluated.

60,000 troops. This, a fortified barrier may be vulnerable to attack by airpower with precision weapons or vertical envelopment. Finally, ever since the Maginot Line fell, barriers—justifiably or not—have not enjoyed a good reputation.

### Interdiction Belt

The final improvement option is the use of airpower to attrit, slow, and disrupt the attacking force so that the Polish ground forces are able to establish an effective defense at the main defense line. This concept—called the interdiction belt—would ideally employ airpower in two phases: (1) to create chokepoints along the lines of communication (LOCs) used by the attacking forces and (2) to proceed with follow-up attacks against enemy units as they attempted to transit the “belt.” Figure 11 shows one possible location of the interdiction belt—just to the east of the Polish-Belarus border.

Because it was beyond the scope of this study to conduct a LOC analysis, we only employed airpower in Phase Two operations, i.e., in direct attack of

<sup>18</sup>We did not demobilize active units in order to provide the personnel to man the barrier. To do so would have raised the required exchange ratio to about 8:1.

<sup>19</sup>The exact location would depend upon where it is most efficient to cut the LOCs.
enemy units.\textsuperscript{20} We also assumed that the firepower contribution would come from NATO countries.\textsuperscript{21} Specifically, we assumed that the interdiction aircraft were F-16Cs and F-15Es. F-16Cs were assumed to kill one armored target per sortie (Shlapak and Davis, 1991) and F-15Es four targets per sortie.\textsuperscript{22} Aircraft were added in increments of 120 until a satisfactory result

\textsuperscript{20}This assumption leads to an overestimation of the number of aircraft required to successfully interdict the enemy units, i.e., to inderdict them to the extent that Polish ground forces can mount a successful defense at the main defense line, because it does not take into account the bunching of targets behind chokepoints.

\textsuperscript{21}NATO could also contribute ground forces for the defense of Poland in addition to or instead of air forces. However, NATO would have to overcome the malpositioning of ground forces for that option to be viable. The logistics lines to support NATO ground force operations in Poland for ground units normally based in Germany could be as long as 750–900 km (Fox and Bordeaux, 1993). Consequently, because of firepower's mobility we chose it as the more likely NATO contribution to Polish defense in the early stages of a Russian-Polish conflict should NATO choose to become involved.

\textsuperscript{22}The difference between the effectiveness of the F-16 and F-15 is due to payload considerations.
occurred. We found a successful defense could be mounted when between 120 F-15s and 360 F-16s and 120 F-15s and 480 F-16s were available.\textsuperscript{23} Results are shown in Table 6 for the case when a total of 600 aircraft were added.

One advantage of this option is that it focuses air attacks on a relatively small area. Thus, it should be possible in peacetime to preplan the use of airpower to create chokepoints on specific LOCs. Furthermore, because the attacks take place at a shallow penetration distance outside of Polish territory, air losses should be minimized.

A disadvantage is that the effectiveness of the concept may be sensitive to weather conditions. From the Polish point of view, another disadvantage is that the Poles must rely on the participation of outside forces for their defense. This is contrary to the Polish desire to possess a self-sufficient defense capability.\textsuperscript{24}

OTHER CONSIDERATIONS

Each of the options described above was evaluated according to its effectiveness. For two of the options—added Polish divisions and the interdiction belt—achievement of a successful defense was measured in terms of the num-

<table>
<thead>
<tr>
<th>Effectiveness Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day Conflict Stopped</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Base case</td>
</tr>
<tr>
<td>Add divisions</td>
</tr>
<tr>
<td>Distributed area</td>
</tr>
<tr>
<td>Barrier defense</td>
</tr>
<tr>
<td>Interdiction belt</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Combat was stopped when the force ratio fell to 1.5:1.
\textsuperscript{b}EDs associated with personnel of divisions that were disbanded to obtain personnel to man all fire units.
\textsuperscript{c}Barrier assumed breached at D+8.
\textsuperscript{d}Casualties to barrier defenders (~60,000 troops) were not evaluated.

\textsuperscript{23}F-15Es were used to a limit of 120 aircraft, which is the maximum number that could be available given the projected U.S. inventory.

\textsuperscript{24}On the other hand, reliance on outside assistance means that the Poles do not have to rely solely on their own resources to mount a successful defense.
ber of additional divisions or combat aircraft required. For the other two options investigated—distributed area defense and barrier defense—achievement of a successful defense was measured in terms of the effectiveness of individual units, in the case of the distributed area defense, or of the unit as a whole, in the case of the barrier. Each defense option was constructed to be equally effective, i.e., each option was able to achieve a successful defense at the main defense line. Because the options are equally effective, we must use other criteria to aid in the selection of the most promising option or options.

Five factors seem particularly important for this analysis of Polish defense needs: (1) the compatibility of the option with the CFE Treaty, (2) the cost of implementing the option as measured by the number of needed personnel and levels of other resources, (3) the confidence level associated with the effectiveness of the option, (4) the flexibility or usefulness of the option for scenarios or situations not considered in the present analysis, and (5) whether the defense option requires assistance from another country for its implementation.

A qualitative evaluation of how the four defense options score for each of the five factors is shown in Figure 12 in a stoplight fashion.

Adding Polish divisions scores poorly on two counts. First, Poland would have to violate the CFE Treaty in terms of both treaty-limited equipment and personnel in order to equip and man the additional divisions. The additional large amounts of equipment and personnel would require very large additional

![Figure 12—Evaluation of Options](image)
defense outlays\textsuperscript{25} not only to equip and man the units but also to train them. Otherwise, this defense option scores well with the other factors. The capabilities of standard divisions are well known, and their mobility means that they can be used to protect Poland's borders at any location.

Distributed area defense scores poorly on the confidence factor. The use of small autonomous units on the scale envisioned has never been tried before, and thus there will be considerable uncertainty about whether such units can stand up to an armored attack of the magnitude postulated here. Otherwise, the distributed area defense scores well with the other factors, although there may be some costs incurred as new weapons are procured that are suitable for the use of the fire units. However, those costs might be offset by no longer having to modernize the demobilized divisions that provided the personnel to man the fire units. Moreover, because the fire units will train on specific terrain so that they will be familiar with hide locations, munitions resupply point locations, likely attack routes, and so on, they may not be able to be deployed to an unfamiliar area and still operate effectively if the attack should come from a different location and direction.

The barrier defense fails on several grounds. It will be prohibitively expensive to acquire the land and especially to construct the fortifications. A barrier has little flexibility unless it is based on the country entirely. A barrier that protects only a portion of Poland's borders will have little or no utility to defend against an attack from a location and direction different from the one it was designed for. Finally, barriers have had a checkered history with regard to their effectiveness and do not instill confidence in many military minds. The Maginot Line is an example: although it was never penetrated by a direct assault, the ease with which it was circumvented is often pointed to, rightfully or not, as an example of the folly of overreliance on a fortified barrier.

The interdiction belt as implemented here with the use of NATO airpower scores high on all factors except self-sufficiency. With this concept the Poles must rely on outside assistance. Frankly, except for the untried concept of distributed area defense, it appears unfeasible for the Poles to defend themselves alone against a threat of the magnitude investigated here. So although the Poles would prefer to have the capability to defend themselves, the unfeasibility of achieving that goal makes the self-sufficiency factor less important and maybe even irrelevant in selecting a viable option for enhancing Poland's defense.

\textsuperscript{25}Recall that this option would require more than double the number of existing Polish divisions.
OBSERVATIONS

This paper has described a first look at Poland’s defense needs after the Cold War. It has examined a single illustrative planning scenario: a large-scale Russian armored attack. Other scenarios need to be examined to obtain a more complete understanding of Poland’s defense needs. In particular, attention should be paid to scenarios that have a greater likelihood of occurring—most if not all of which would involve smaller force levels than were investigated here. These less-intensive combat situations would influence decisions about force structure. For example, the means for detecting border incursions by small groups of forces and for rapidly moving small, elite units to counter those incursions should prove especially valuable in those cases. However, for determining the overall shape of Polish defense needs, the situation analyzed here should be adequate, given the current political-military situation.

From the results of the analysis, we draw the following general observations:

• Currently, Poland is not well positioned to protect its borders against a serious attack by Russia. This follows from an inspection of the relative force strengths and compositions and is reinforced by the model results of a specific scenario.

• During the period of the NATO–Warsaw Pact confrontation, an enormous amount of time and intellectual effort was spent on examining different, and sometimes radical, defense concepts for successfully defending against a large armored attack in NATO’s central region. With the dissolution of the Warsaw Pact and the breakup of the Soviet Union, that body of research has fallen into neglect owing to the simple fact that there is no military threat to those borders. However, that knowledge may be directly relevant to the defense problems of NATO’s neighbors to the east.

• The analysis of the four improvement options showed that it will take a Herculean effort for the Poles to defend successfully on their own against an attack of the size examined here. Straightforward options to remedy the situation would violate the CFE Treaty, be too costly in terms of personnel and other resources, or a combination of both. The one attractive option examined that involved the use of only Polish forces was the reconfiguration of standard army units into numerous antitank teams. That option is consistent with the Polish desire to make more and better use of territorial forces. Additionally, such restructuring should not alarm Poland’s neighbors because those units would have a strong defensive orientation. While the simulation shows that this restructuring can result theoretically in a self-sufficient capability, a great deal more analysis of possible countermeasures is needed in order to weigh the risks involved before wholesale restructuring takes place.

• The one option investigated that involved outside assistance was the contribution of NATO airpower. Ground force assistance from NATO, or a
combination of air and ground force assistance could have been analyzed also. But because Poland is not a member of NATO, forces belonging to NATO member countries would not be based in Poland before the outbreak of hostilities. Once a crisis had occurred, or when it had been determined that combat was imminent, NATO would need to deploy forces into Poland if it agreed to assist Poland. Because of their mobility, air forces would be able to deploy faster, and because of their long combat radius, they would not have to move as far into Poland as ground forces in order to engage the attacker’s forces. A significant but not unduly large number of NATO aircraft are required to assist Polish forces in defending against the magnitude of the attack examined here.

- The results of the analysis point to the direction of what might be an optimal mixed solution: a combination of restructuring a portion of Polish ground forces and the contribution of NATO airpower.

- Obviously, the longer Polish ground forces can delay the attacking force from reaching the main defense line, the longer NATO airpower will have to attrit, slow, and disrupt the attacking forces. If the Poles are concerned about the kind of attack analyzed here, they should give consideration to acquiring these capabilities. In this regard, the West German experience of the past few decades should be instructive.

- In order for NATO airpower to be effective, a wide range of measures from basing and protecting NATO aircraft at Polish bases to conducting air operations with NATO and Polish forces needs to be considered by both Poland and NATO so that the potential contribution of NATO airpower can be realized in possible future operations. An option not discussed here, but which would alleviate some of the need for access to Polish bases, is the use of long-range aircraft such as the B-2.

This analysis has only scratched the surface of the problems associated with configuring defenses to meet the new challenges that Poland is facing. Yet the general outlines of a possible solution are apparent.

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Chapter 15

NOT MERELY PLANNING FOR THE LAST WAR

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This paper describes insights from a lengthy series of game-structured exercises attempting to avoid the usual sin of preparing to fight the last war. In these exercises, Red teams were tasked to develop aggressive strategies to prepare for future regional conflicts involving the United States, strategies that would reflect lessons learned from the Persian Gulf War by U.S. adversaries. The teams began by identifying their military objectives and deciding how U.S. strengths might impede those objectives, then turned to defining approaches for countering those strengths. Blue teams (U.S. and allies) responded to these Red approaches, looking for appropriate countermeasures. Not surprisingly, the Red strategies sought to avoid the circumstances that made the dramatic U.S. victory against Iraq possible. These involved a broad mix of initiatives at the strategic, operational, and tactical levels of warfare. The paper argues, for example, that the United States should expect conflicts in which: the context makes it difficult for the United States to intervene or to enlist the support of regional allies; acts of aggression are deliberately quick and limited; operations involve infantry in cities, mountains, and forests rather than heavy forces on long road marches; and the weapons and tactics used make it difficult for the United States to engage without suffering significant casualties. The paper also argues that weapons of mass destruction in the hands of regional states will cast a long and unpleasant shadow over future contingencies, requiring major changes in U.S. operations and sometimes making intervention doubtful.

INTRODUCTION

Analysts, like generals, often spend much of their time planning for the last war. The imagery of Operations Desert Storm and Desert Shield is still strong in our minds, and it is hardly surprising that so much current effort is going into studies that contemplate something akin to a replay of the Gulf War.

In this paper, however, we describe an effort to deviate from that standard pattern. For several years, RAND has conducted an effort on the future of
Initially, it focused on the implications of the current military-technical revolution, which was to a large extent demonstrated in the Gulf War. Subsequently, it has focused on the lessons presumably derived from that war by current and future U.S. adversaries.

This research has employed a mixture of human gaming and analysis (the overall results of this research are documented in Bennett, Gardiner, Fox, and Witney, 1994). The gaming has usually involved a mixture of some civilian analysts and a large number of serving or retired military officers, typically at the rank of Lieutenant Colonel/Colonel (Army, Air Force, Marines) or Commander/Captain (Navy). We conducted nine such games at RAND on major regional contingencies, and three on lesser regional contingencies. Four dealt with the Persian Gulf (these games are described in some detail in Bennett, Cecchine, Fox, and Gardiner, 1993), three with Europe, one with Korea, and one with concurrent conflicts involving Korea, the Persian Gulf, and Cuba. Within this series we have considered the use of disabling technologies, future technologies, and some other special items. The project team was also heavily involved in several dozen other war games at the National War College and the other Senior Service Colleges, including games focused on the problems of regional nuclear powers, and the Global Series of war games played at the U.S. Naval War College each summer.

The most important contribution of the games we have played is that we have forced ourselves to look at the other side. We have looked at how other militaries might react to U.S. forces and doctrine. We have focused on the two-sided character of war.

In this paper we focus largely on the future of warfare games and the insights gained from them. Having learned in other games that players representing the United States and its allies (a Blue team) had difficulty, in the af-

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1This work has been sponsored by Andrew Marshall, OSD's Director of Net Assessment, who has long been interested in ways to encourage thinking about nonstandard scenarios and "soft" factors in warfare.

2However, even in this focus, we considered a broader range of issues such as strategy and doctrine, as suggested in Gardiner (1992c,d).

3Disabling weapons are intended to prevent the employment of military forces, rather than to destroy them; as a result they are sometimes referred to as nonlethal weapons. For example, a chemical that causes fuel to turn to jelly would be a disabling weapon because it would prevent movement of opposing vehicles. While transforming fuel to jelly should not kill opposing forces directly, it could lead to their death because they become isolated from supplies or because they face other threats. Thus such a technology is only nonlethal in terms of direct effects. See Gardiner (1993a,c).

4Besides the authors, the project team has included John Bordeux, Arthur Bullock, Margaret Harrell, Robert Howe, Mark Hoyer, Carl Jones, Bruce Pirtie, John Schrader, Barry Wilson, and Nicholas Witney, all of RAND.
termath of the Gulf War, recognizing any serious opposition threat, we organized most games so that a single team played both the Blue and Red roles (Red representing the appropriate U.S. adversaries). The team began by assuming the role of the Red military; they were instructed to prepare for a future war with the United States. In the various games, the Red team was often briefed on the outcome of strategies that played to the U.S. strengths, as had Saddam Hussein in the Gulf War. The Red team was then asked to formulate creative approaches that did not cater to those strengths. To do so, they could consider the range of strategies and operational art that might be applied and could develop force structure and acquire new technologies (within constraints) that might occur over a number of years. The players then assumed the role of a Blue team and developed responses to the various threats postulated for Red.

To describe the insights gained from this work, we first review some key features of the Gulf War and then describe the broad lessons that potential future adversaries of the United States presumably learned from that war. We then provide a survey of the project team’s observations, each discussed in a separate section: (1) warfare will be highly uncertain and variable (even more than conventional wisdom already recognizes); (2) adversaries will seek new patterns of warfare to oppose the United States; (3) these patterns will involve highly asymmetric strategies in which the adversaries avoid confronting U.S. strengths, instead playing on U.S. weaknesses; and (4) weapons of mass destruction will cast a shadow over almost all future contingencies.

THE GULF WAR AND ITS IMPLICATIONS

The Gulf War was the paradigm of what U.S. forces, as currently equipped, trained, and structured, do best. It provided the perfect showcase for the U.S. ability to bring to bear overwhelming conventional power in a coordinated, combined-arms fashion, with a precision made possible by advanced guidance technologies and superior surveillance and target-acquisition capabilities (Department of Defense, 1992). It was the ultimate demonstration of the doctrine of overwhelming force in action and of the invincibility of U.S. power in a conflict of this type.

Yet there are many reasons to believe that the results of Operation Desert Storm were unique to the warfare environment in which it was waged. The national command authority was willing to approve the use of overwhelming force. The United States was at the absolute top of the Cold War buildup. Every combat arm had significant technological advantages. There were no major distractions of U.S. attention and plenty of time to prepare. Allies were willing to defray U.S. costs. Also, a highly developed infrastructure was well supported by theater allies. The initiative was entirely with the coalition after
Iraq had seized Kuwait. In addition, the terrain was favorable, being mostly flat with dry soil. Moreover, we faced a nearly friendless opponent whose forces proved to be highly unbalanced and whose personnel proved to be dispirited and demoralized even before the fighting began. Also, Iraq pursued a passive and entirely conventional operation. While Iraq had a number of chemical weapons, it had no nuclear warheads.

Moreover, it is important to remember that even if this warfare environment were duplicated, the dynamics of warfare imply that what succeeds once may not be equally successful again:

As in any game from football to chess, each contestant is possessed of an independent will and can only be controlled by the other to a very limited extent. With each side seeking to achieve his objectives while preventing the other from doing the same, war consists in large part of an interplay of double-crosses. The underlying logic of war is, therefore, not linear but paradoxical. The same action will not always lead to the same result. The opposite, indeed, is closer to the truth. Given an opponent capable of learning, a very real danger exists that an action will not succeed twice because it has succeeded once (van Creveld, 1989: 319).

Sun Tzu also recognized the folly of trying to repeat previous successes when he stated, in The Art of War:

Do not repeat tactics that have gained you one victory, but let your methods be regulated by the infinite variety of circumstances.

HOW, THEN, SHOULD WE THINK OF THE FUTURE?

Much of U.S. thinking about the future of warfare seems fixed on developing capabilities and how they will allow the United States to be even more decisive in future conflicts than we were in Operation Desert Storm. Many of the new technologies being pursued are impressive and will give the United States revolutionary capabilities in areas such as global surveillance and communications, precision strike, air superiority and defense, sea control and undersea superiority, advanced land combat, and nonlethal weapons (five of the science and technology thrusts introduced in Director of Defense Research and Engineering, 1992).

At the same time, any prospective opponent could gauge U.S. strengths from Operation Desert Storm. Prospective opponents appear to be adjusting their approaches to warfare in ways that the United States is likely to find challenging. Indeed, whoever next decides to embark on behavior that could
lead to conflict with the United States (by threatening either our vital interests or the peace) is likely to have as a prime objective avoiding any repeat of the Gulf War scenario. He will no more seek to confront U.S. power on U.S. terms than David would have gone out against Goliath with a sword and shield.

As we look to the future, we need to weigh the impact of U.S. military advances against the likely actions that opponents could take to counter U.S. strengths. We are forced to contemplate what opponents could do to counter U.S. strengths, since we may not be able to predict with any precision what they will do. We need to paint as negative a picture as possible to cover the range of possible opposition actions, recognizing that in most cases we will not face that full range because neither the planning nor the implementation of plans by prospective opponents is likely to be flawless. We also must recognize that we could miss key themes, especially starting from U.S. mind-sets; thus we should expect some substantial surprises in future conflicts—e.g., the surprise of threats we had not expected and threats we had expected that did not materialize. Thus, we are forced into an era of managing uncertainties and developing approaches for handling especially the most dangerous ones.

Much of our work to date has focused on major regional contingencies (MRCs), such as might occur in Korea, the Persian Gulf, or Europe. We have only recently extended our thinking to lesser regional contingencies (LRCs) such as Somalia and Bosnia. Figure 1 illustrates the range of scenarios we have considered. As shown, we divided the possible contingencies into three categories:

1. MRCs in which the United States would likely to sense a vital interest (with Korea and the Persian Gulf having primacy in current defense planning).
2. Other MRCs in which the United States would be more likely to play a peace-enforcing role.
3. LRCs in which the United States would probably also play a peace-enforcing role.

UNCERTAINTY AND VARIABILITY OF WARS

The range of potential contingencies in Figure 1 suggests that future threats are highly uncertain with respect to the identity of the opponent, his objectives and strategy, the qualities of the technologies available to him, his force
structure, and the skill with which he will apply his forces.\textsuperscript{5} By comparison, although the certainties were greatly exaggerated, the historical Soviet threat was nonetheless \textit{relatively} certain in many dimensions—primarily with respect to the order of battle, weapon holdings, weapon quality, and operational style. While much of historical defense planning and analysis focused on “expected” conditions, the recent course of contingencies suggests that ignoring what will often be vast uncertainties is a serious peril.

Conditions encountered in future contingencies can be expected to vary enormously from possible theater to possible theater; the variables include weather, terrain, infrastructure, the degree of possible allied involvement on either side of the conflict, and the coherence and motivation of the adversary’s forces. These conditions define the warfare environment that we would experience in a given contingency. To better clarify the kinds of differences that might be expected, Table 1 contrasts conditions in the historical Central European environment and the Korean theater, where U.S. forces would fight as part of the Combined Forces Command (CFC).

During the Cold War, the United States focused considerable effort on understanding the Soviet Union, its objectives, its technologies, its force

\textsuperscript{5}This is not to say that some key aspects of these contingencies cannot be foreseen. For example, the two MRCs of principal interest still involve Korea and the Persian Gulf.
Table 1
Differences in Warfare Environment (An Example)

<table>
<thead>
<tr>
<th>Major Issue (Example)</th>
<th>Historical Central Europe</th>
<th>Korean Theater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context of conflict</td>
<td>Adversary aggression</td>
<td>Adversary aggression, adversary civil war, or ally initiative?</td>
</tr>
<tr>
<td>Objectives (U.S.)</td>
<td>Survival and freedom of NATO countries</td>
<td>Aid regional ally</td>
</tr>
<tr>
<td>Strategy (Adversary)</td>
<td>Defeat U.S./NATO forces in the field (selectively defeat weak partners)</td>
<td>Deter U.S./Japan involvement by creating &quot;strategic events&quot;</td>
</tr>
<tr>
<td>Operations (Offensive ground concept)</td>
<td>Penetration and envelopment of defending forces to destroy them; secure terrain objectives</td>
<td>Suppression and rapid penetration of defending units to secure terrain objectives</td>
</tr>
<tr>
<td>(Offensive air attack concept)</td>
<td>Use offensive counterair to suppress NATO air forces; establish local air control where possible</td>
<td>Suppression of CFC air forces with special operations forces and missiles; threaten Seoul and support ground forces when possible; use of ambush tactics defensive</td>
</tr>
<tr>
<td>(Chemical use)</td>
<td>Low chance, moderate preparations</td>
<td>High chance, low preparations</td>
</tr>
<tr>
<td>Resources (Assault forces)</td>
<td>Heavy forces with artillery support</td>
<td>Infantry with artillery and special operations forces support</td>
</tr>
<tr>
<td>Performance (Adversary's training)</td>
<td>Not as good as NATO in air or ground training</td>
<td>Highly inferior in air training, although tactics appropriate; superior to South Korea in ground training?</td>
</tr>
<tr>
<td>Allied cooperation (Defensive alliance)</td>
<td>Large group of allies who clearly perceive a mutual threat</td>
<td>ROK firm, U.S. likely firm, other regional actors may delay in participation</td>
</tr>
<tr>
<td>Other factors (Ability of terrain to support armor)</td>
<td>Good—extensive road network and many good off-road options</td>
<td>Poor—mountains channel terrain, few roads, rice paddies deny most off-road options except when ground freezes</td>
</tr>
</tbody>
</table>

structure, and its doctrine. It was argued that Soviet doctrine and weapons would be used by almost any adversary the United States might face and, therefore, could be the focus of U.S. defense thinking. In the future, prospective opponents will be more diverse, and the United States must generally confront
them with reduced intelligence resources because of budget constraints. As a result, at least some of the Blue players in our games anticipated surprise and sought a C3I system sufficiently robust to respond appropriately. Not only should the United States anticipate surprise in the form of inadequate or ambiguous warning, it may also be surprised about important details of the opposition’s force structure, military technologies, and operational characteristics. For example, Stingers or SA-16s appearing by surprise could be devastating to helicopter-intensive operations or the airlift. A covert, last-minute emplacement of mines could wreak havoc in any amphibious operation expected to be straightforward, or new kinds of missiles or tactics might seriously reduce our efforts to suppress enemy air defenses. Such surprises could cause significant reversals in the conflict and undermine U.S. will. Many Blue players feared that the United States would not be prepared to adapt to such new conditions. For example, as opposition lethality increased, the Blue players felt uncomfortable adjusting to low-density, nonlinear combat environments.

NEW PATTERNS OF WARFARE

In the wake of Operation Desert Storm, and with the dissolution of the Soviet Union and the sharp subsequent reductions in the militaries of the new states that the Soviet Union used to comprise, the United States has become the world’s predominant conventional (and nuclear) military power. While a number of countries still field more ground force divisions, the United States has major advantages in force quality, combined arms capabilities, alliances and strategic mobility. Despite planned reductions in U.S. military forces, it appears that technological innovation will help the United States sustain these advantages well into the next decade.

Potential adversaries can recognize this edge. Thus, in our games, the adversary typically does whatever he can to avoid a conflict of the Persian Gulf type. Based on these games, we expect that the prime aim of an adversary will be to ensure that U.S. conventional forces cannot be brought decisively to bear. He will be acutely aware both of U.S. strengths and of the fact that the preferred U.S. pattern of warfare would involve several weeks of unopposed deployment, followed by the establishment of operational dominance (via air su-

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6 By a pattern of warfare we mean the objectives to be pursued, the sequence of actions planned, and the general strategy and operational art that a side proposes to follow.

7 Unfortunately, some current and prospective U.S. adversaries appear determined to pursue irregular (guerrilla) warfare, a form of warfare in which the United States is not predominant. RAND is working on characterizing U.S. peace-enforcing efforts to better understand the differences that irregular warfare makes to U.S. power projection.
periority, sea control, and attack of strategic targets), setting the scene for counteroffensive and decisive war termination (Figure 2 illustrates this preferred U.S. pattern of warfare). He will realize that the pattern for the successful application of U.S. force requires time, cooperative allies in the region, and an enemy willing to present and identify himself. The intelligent adversary will seek to deny all these factors to the United States, and he may be able to do so because normally he will have the initiative. He will be aware of the possibilities open to him to counter U.S. capabilities in asymmetrical fashion at the operational level; for example, in trying to counter U.S. airpower, he might follow the logic shown in Figure 3, working backward from his objective to the campaigns, battles, and engagements that might be expected to accomplish it. This "threat menu" defines a number of ways an opponent might attempt to overcome U.S. airpower, such as campaigns that focus on limiting the number of U.S. aircraft in a theater area, reducing the number of sorties that the aircraft can fly, and/or limiting the effectiveness of sorties against targets. In turn, the adversary could limit the number of sorties by attacking airfields or national logistics (for example, destroying petroleum distribution and refining capabilities) or by timing a battle to occur in bad weather. Attacks on our air bases are a particular concern, since U.S. air forces will likely be concentrated on a small number of bases.

We refer to this as a threat menu because we believe that most opponents would choose multiple battle and engagement approaches, hoping to increase the potential of countering the U.S. capability. For example, an adversary

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8C-day is the day in a crisis when U.S. force deployments begin into a theater, and D-day is the day when combat begins in a theater.
might target U.S. airfields while interdicting the regional fuel supply and fielding a range of surface-to-air missiles with which to defend his forces and infrastructure. He might also attempt to prevent naval forces from coming within aircraft range of theater targets by sea-denial efforts including mines, antiship missiles, and other threats to interdict U.S. naval forces or at least deny sea
control for some period of time. In our gaming, we use the threat menu to show the range of possible threats that could be posed against U.S. forces, then temper the list by considering what specific adversaries might be able to do and how the United States might respond, as discussed in the upcoming section on asymmetrical battles.

While such operational-level reactions to U.S. warfare patterns are important, most adversaries will realize that their most effective responses will be made at the strategic level. The adversary will likely adopt a strategy to deter U.S. intervention, to reverse it if it occurs, or, over a longer period, to wear out U.S. resolve and interest.

The United States is vulnerable to such actions because it no longer perceives a threat to its survival, as it did during the Cold War. Such a threat simplifies strategy: survival is an absolute imperative. The lack of such a threat implies that the objectives of U.S. military operations will be limited in the future. (For example, in Desert Storm the U.S. objective was to restore Kuwaiti independence, the flow of Gulf oil, and the regional balance of power; the United States did not perceive a threat to its national survival.) In turn, limited objectives imply that the United States will have to address basic tradeoffs when becoming involved in future conflicts: Are the losses and risks it will incur justified by the gains it may achieve? How many American lives and how much cost is the United States willing to trade, over what period of time, to ensure the security of any specific foreign power or to bring stability back to a given region? Limited U.S. objectives thus set a framework against which opponents can operate to deter U.S. involvement or cause a decision to terminate involvement. Ultimately, only the U.S. President and Congress will make this decision, which will be heavily influenced by how they personally feel about such tradeoffs and by how they react to the judgments of the media and public opinion. Thus, even who these leaders are makes a difference.

In our games, the perceived strength of the United States meant that prospective opponents in MRCs could not plan to win in conventional regular combat that lasted long enough for the United States to effectively project forces (i.e., beyond about one month). Thus, U.S. military power was seen as conveying a high level of deterrence against prospective opponents. (This perception was extremely strong among most of the senior officers who have been involved in our games. It was undoubtedly affected by the Desert Storm experience and was perhaps stronger than warranted.)

The potential military approaches that each side might employ include such options as

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9See Gardiner (1993d). Another military approach would be to punish the opposing country, perhaps through strategic attacks. While such an approach seems to have worked in the context of crisis coercion (e.g., the attack a few years ago against Libya), it
- Destroying or neutralizing the opposition army (along the lines recommended by Clausewitz), which could apply for U.S. actions in a few MRCs when U.S. interests are high and the opponent has significant but attackable forces (e.g., Desert Storm).

- Seizing complete control of the opposing country, when its forces are small and easily overcome (e.g., Grenada or Panama). Even small local forces may be difficult to overcome if they assume guerrilla tactics; thus, this option probably will not be readily available to the United States.

- Attacking the opposition strategy (as recommended by Sun Tzu), when the opposition’s forces are either superior or not very vulnerable and/or his national interests are low (e.g., U.S. participation in Bosnia or Somalia). This approach seeks “strategic events” that will cause the opponent to change strategy.

Each option involves a different pattern of conflict. Because of U.S. military strength, most opponents will find only the third approach feasible; thus, the United States will normally find itself defending against “strategic events.” Such strategic events will capitalize on U.S. limited objectives and thus will be aimed at causing the United States to appraise intervention in terms of the balance between the costs and benefits. The battle in Mogadishu on October 3, 1993, was a case in point, when elite U.S. rangers suffered scores of casualties. The political aftermath even included calls for the Secretary of Defense to resign.

As this example from Somalia illustrates, a major change has occurred in public expectations that casualties will be very low (e.g., tens or hundreds), in part because they will be avoided by use of precision weapons. U.S. casualties could thus become a major focus for the opposition in creating strategic events: The U.S. will to participate in a nonvital conflict may be seriously affected if casualties do not conform to these expectations. Yet casualties could be significantly higher in future contingencies because of enhanced weapon lethality, increased requirements for infantry (as opposed to mechanized) operations, nonlinear or urban battlefields and operations against the U.S. rear areas, irregular (guerrilla) combat operations by opposing forces, and the potential use of weapons of mass destruction.

Against this background, our gaming and analysis have suggested a range of methods by which the adversary who foresees or engages in conflict with the United States could (and probably will) try to improve his chances of success. It is convenient to consider these methods under six headings:

is less clear that such an approach would stop, let alone reverse, the hostile actions of an aggressor (indeed, the strategic bombing of Desert Storm apparently did not have such an effect). We have, therefore, not yet pursued this approach in any detail.
1. Preparation for conflict with the United States.
2. Disruption of U.S. abilities to form coalitions.
4. Manipulation of the strategic context.
5. Manipulation of the strategic environment of the military campaign.
6. Manipulation of the operational environment of the military campaign.

The adversary will be able to mold contingencies using these methods because he will have the initiative in the conflict, at least at first.

**Preparation for Conflict with the United States**

Potential future adversaries might seek to reduce U.S. military power and influence in two ways:

- By affecting U.S. interest in military affairs (long time scale) with the intent of reducing the size and capabilities of U.S. military forces.
- By disrupting U.S. strengths (political, economic, and military).

The results of these two methods would often be at odds. For example, if the world oil market faced a constant terrorist threat against oil shipments, U.S. attention and resources would probably be diverted to deal with such threats and thus be less available for major regional contingencies, but U.S. interest in military affairs would be heightened. The challenge for the opponents would thus be to find the proper mix of efforts.

Our Red players generally concluded that an apparently benign world environment would be most advantageous to their interests, because the United States would then tend to focus inward. The U.S. domestic budget would tend to rise at the cost of further military cuts apparently warranted by the lack of international threats. To the extent that U.S. economic recovery did not occur or was slow, the resulting military cuts could become large and generally irreversible (at least within a few years), reducing the ability of the United States to intervene in future conflicts.

In some of our games, the players found that the many international frictions faced by the United States appear to be fertile ground on which to disrupt U.S. strengths. For example, the disagreements between the United States and its major trading partners on trade practices could be aggravated by appropriately timed revelations of "unfair" behavior (from a U.S. perspective) and perhaps amplified into trade warfare by the natural forces developing around the world. Such developments would have serious implications for the U.S.
economy but would generally not heighten U.S. interest in military affairs. U.S. willingness to become involved in foreign conflicts could also be reduced if it were to become entangled in some difficult and unresolvable lesser regional conflicts around the world. U.S. involvement in trade and military conflicts might then be turned to incite anti-American feeling among the populations of U.S. allies, putting stress on U.S. forward presence and its ability to form coalitions.

Some Red players also considered becoming involved in U.S. domestic politics. For example, cases could occur in which commitments of funds through third parties would affect American political campaigns. While such actions are risky, they could also bring significant returns because of the importance of who the U.S. decisionmakers are at the time of the conflict, and because the decisionmakers will also determine the size and character of the U.S. forces as they evolve during the preparation period. Indeed, for opponents who can afford to wait, the election of specific U.S. decisionmakers might be a more important condition for war initiation than any given force structure or technology change.

Disruption of U.S. Abilities to Form Coalitions

One key element of Desert Storm was the U.S. ability to form an international coalition. The political reasons for coalitions are likely to be compelling in many future MRCs—the benefits being greater international legitimacy ascribed to a collective action and the improved chances of maintaining domestic support if allies are seen to be bearing their share of the burden. The military arguments for acting as part of a coalition will also remain and may intensify. While in Desert Storm the major fraction of the military power came from U.S. forces, the United States is likely to find itself more dependent on coalition partners in future conflicts because of the reductions planned in U.S. forces and because those forces may continue to lack specialized resources to deal with some key threats. For example, the United States may still have to rely at least in part on coalition partners to support any kind of broad-scale naval mine-clearing operation. Regional allies will also be depended on for support infrastructure (including ports, airfields, and elements of resupply).

While not anxious to deal with this subject, the Blue players in our games usually came to recognize that they needed cooperation from regional countries to support their operations in any given theater, especially if the United States must deploy into a hostile environment. For example, if North Korea were able to heavily interdict South Korean airfields, airfields in Japan, Russia, and/or China would be critical to U.S. operations in Korea. The failure to
form an appropriate coalition could completely undermine U.S. willingness or capability to intervene.

The warfare preparations of Red players therefore included efforts to undermine or delay U.S. coalitions. Clearly, the United States needs to be proactive in forming and maintaining relations with key allies essential to resolving prospective future conflicts. To the extent that U.S. attention turns increasingly toward internal issues or toward more divisive economic and human-rights issues, maintaining such relations will become more difficult. Tradeoffs will be necessary, as well as keeping issues in different spheres separate. The United States cannot afford to treat nations as either with us or against us, good or bad.

The United States also needs to prepare for combined operations in future coalitions. U.S. coordination and preparation with prospective coalition partners are needed in peacetime to be effective in wartime.10 Without a sense for a threat in a given region, such preparations may not be made; thus, by maintaining a benign appearance as suggested above, prospective opponents can reduce the likelihood that we make such key preparations.

Formation of Anti-U.S. Coalitions and Coordinating Crises

Many prospective U.S. opponents around the world share common concerns and interests (in particular, a serious dislike of the United States) and thus have some basis for coalition formation. These common interests have appeared as part of weapon technology trades in the recent past, such as North Korean technological support of ballistic-missile and other weapon developments in Syria and Iran.11 The Red players in our games did not feel that

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10 In Desert Storm the United States resolved combined-operations problems in part by placing coalition ground forces with which U.S. forces were less well integrated into a single area of operations; the ongoing reductions in U.S. force levels may not allow such a luxury in the future. Clearly, the United States needs to better understand the forces of its prospective coalition partners: how they operate, what their strengths and weaknesses are, and how they differ from U.S. forces. Investments of this sort, supported by joint and combined exercises and training, can significantly improve the effectiveness of future coalitions and in some cases perhaps help the United States make intervention decisions (for example, if it becomes clear that the U.S. forces available are insufficient to meet limited U.S. objectives). A tremendous tension is evident in making such evaluations: If the United States properly evaluates the forces of a prospective ally, it will undoubtedly identify many deficiencies (even U.S. forces have deficiencies), but if these deficiencies become publicly known, confidence in the ally may be undermined to such a point that the United States is unwilling to support it.

11 Western intelligence sources report . . . a series of secret deals between the Stalinists of North Korea and the ayatollahs of Iran. Under the arrangement, Tehran is giving the Pyongyang government $500 million to help it develop a ballistic missile sys-
sufficient commonality of interests existed among prospective U.S. opponents for them to form a close alliance; they did, however, recognize the value of facing the United States with simultaneous contingencies and agreed that if (and only if) each party had reason to independently confront the United States, they would have every reason to do so simultaneously.\(^{12}\)

While the United States has the ability to pursue a major regional conflict in many regions around the world, it has only limited ability to do so in two or more MRCs simultaneously. This situation is implicitly recognized in the Administration’s recent “Bottom-Up Review” of U.S. forces for the post-Cold War world (Aspin, 1993), which sets as a goal the fielding of forces sufficient to fight and win two “nearly simultaneous” MRCs and notes that in consequence “our plans call for substantial enhancements to our strategic mobility,” including sealift and airlift. The review also notes that “certain specialized high-leverage units or unique assets might be ‘dual tasked,’ that is, used in both MRCs.” The implication is that the near-simultaneous eruption of two MRCs would pose some very severe problems. The United States might have to dilute its effectiveness in each theater area or allow the opponent in one theater to achieve its objectives while the United States attempted to resolve the conflicts sequentially.\(^{13}\) Such conditions raise the intervention risks for the United States and may undermine U.S. will (internal political resolve) to intervene.

**Manipulation of the Strategic Context**

For any regional power contemplating an aggression that risks a U.S. response, the first lesson from Saddam Hussein’s debacle must be to take pains with the political stage-management. In the force-structuring component of our games, we purposefully pressed Red players to acquire a range of sophisti-

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\(^{12}\)See, for example, Silverberg (1993:18). Much of the discussion on this subject, however, neglects the fact that most countries would have to be fairly desperate to begin a war in which they anticipate U.S. intervention against them. Such desperation might compel them to take actions (such as coordinating efforts with another “renegade” country) beyond those we might otherwise normally expect.

\(^{13}\)The “win-win” or “win-hold-win” strategies assume that the United States can indeed handle these kinds of circumstances. The players in our games were less optimistic, assuming that the opponents would fight the United States on an asymmetrical basis, as discussed below.
cated weapon technologies before conflict initiation. When the players were
then directed to engage the United States and its coalition, they concluded that
weapon acquisition took third place in importance behind the strategic context
and the concept of operations.

Events must be handled so as to provide the United States with the best
possible excuses and reasons not to intervene and strategic events that challenge
any decision to intervene. The strategic “target” of adversary action is the U.S.
will to intervene. While U.S. opponents might have some difficulty achieving
these effects, some of the political strategies they might attempt to employ are
the following:

- The situation should be presented as one in which U.S. intervention is de-
manded neither by national interest nor by considerations of principle. A
requirement would be to broadcast assurances relating to the well-being of
U.S. nationals or the continuing availability of important raw materials
(such as oil). It would also require an effort (possibly over many months in
advance) to convince U.S. public opinion that the victim of the aggression
did not deserve the spilling of any U.S. blood in his defense. This effect
might be achieved if the target country’s government were perceived as to-
totalitarian, oppressive, and/or in a state of anarchy (so that invasion could be
represented as a necessary restoration of law and order).\footnote{Most U.S.
adversaries cannot directly cause such perceptions in the United States,
but they may be able to contribute to them. For example, North Korea might attempt
again to destabilize South Korea, inciting riots to cause a harsh reaction by the South
Korean government that would project an image of anarchy and oppression.}

- Bearing in mind the time required by the United States to deploy into any
theater, the aggressor might be well advised to pursue a short war. He
would create the desired end state on the ground before the United States
could respond.\footnote{Reduced U.S. forward deployments exacerbate the problem of short warning.
Short warning limits ability to deny opposition objectives, instead driving the United
States to either a strategy of punishment or a large-scale counteroffensive. Since a coun-
teroffensive restoring the status quo ante would require far more U.S. force than a de-
fensive operation, inadequate forward-deployed forces would raise the cost of U.S.
invasion and might tip the balance in favor of not intervening at all.}

\footnote{For example, in the Gulf War the United States did not respond militarily until
after Kuwait had been captured. Historically, many analysts assumed longer U.S.
preparation times, in part to allow ground forces to deploy and participate in the con-

- With limited objectives, an opponent might forgo some preparations, if by so doing he
delayed the U.S. response. The United States needs not only the ability to perceive
military preparations, but also a more general understanding of the opposition’s intent

of less-than-perfect preparedness and more limited objectives.\textsuperscript{17} (An example might be the North Koreans seeking to move the DMZ toward the Han River and to transform Seoul into an "international city."
) In addition, the U.S. President might have to pause at the beginning of a conflict to build a consensus within the United States and internationally; such a pause might give opposition forces time to achieve their objectives unless regional allies could defend forward. As Hitler demonstrated in the 1930s, successful attainment of a series of limited objectives can in due course add up to the attainment of some very large ones. If a new situation favorable to the aggressor could be rapidly stabilized, U.S. intervention might be not only militarily more difficult but also politically more objectionable: "restarting the bloodshed."

- The aggressor would be best served by creating termination conditions that would be preferred to military intervention by at least some within the United States. These conditions should be achieved before significant U.S. intervention. Creating them might involve crushing the local military opposition, providing some form of legitimate political government for the captured territory, guaranteeing and demonstrating ready access to the captured resources (e.g., maintaining the flow of oil), and establishing prepared positions for forward-deployed forces from which to defend the captured territory.\textsuperscript{18}

- Ideally, aggression would be timed to take place when the United States was distracted by some significant crisis elsewhere.

The interesting question is, "What does it take to deter U.S. intervention?"

Historically, our analyses of deterrence have focused on deterring opponent (especially Soviet) action; in the future, we need to be able to address deterrence of the United States in order to prepare for, or perhaps forestall, contingencies that capitalize on such deterrence.

\textsuperscript{17}However, in some of our Persian Gulf games, U.S. strength caused the Red players to expand their objectives. They concluded that they could win only by "securing the entire Saudi peninsula," so as to make even a medium-term U.S. intervention very difficult. This usually meant occupying parts of the peninsula that they could reach quickly, and then heavily damaging other areas' airfields and seaports to deny their use to the United States.

\textsuperscript{18}Saddam Hussein clearly attempted to achieve some of these conditions in the wake of his attack on Kuwait. Still, he failed to prevent U.S. intervention, in part by being unable to achieve more fully acceptable terminating conditions (e.g., the lack of a legitimate successor Kuwaiti government) and in part because of the resolution of the U.S. President.
Manipulation of the Strategic Environment

In future conflicts, the United States will want a quick, decisive campaign, with relatively few casualties. Based on our Red team behavior, it seems likely that the adversary will seek to demonstrate that this U.S. game plan will not be achievable. Some skill will be required in the modulation of the level of violence. A strategic event involving some spectacularly heavy loss of U.S. forces at the outset of the conflict could lead to a U.S. withdrawal, similar to that following the truck-bomb attack on the Marine barracks in Beirut several years ago; on the other hand, it could precipitate a firm U.S. commitment similar to that following the Japanese attack on Pearl Harbor.\(^\text{19}\) To create the proper kind of strategic event, a smart adversary might follow a progressive approach, along the lines set out below.

The immediate imperative would be simply to demonstrate that “blood will flow” in consequence of U.S. intervention; this approach would be particularly effective if the initial aggression were carried out with relatively high casualties. For this purpose, losses by the regional participants, including the aggressor, would be as good or better than U.S. losses and perhaps even more effective if the United States caused some of the losses. Consider for example the shock felt in Britain at the sinking of the Argentinean cruiser _Belgrano_, with heavy loss of life, in the opening stages of the Falklands conflict. Civilian casualties would be particularly effective; perhaps the United States could be manipulated into shooting down another commercial airliner. Civilian casualties could also be maximized during the anticipated U.S. strategic air campaign by careful collocation of targets: every bunker should be beneath a Sheraton, every SAM battery on the roof of a mosque, and every chemical warfare factory beside an elementary school.\(^\text{20}\) The probability of creating a strategic event could be maximized by granting full access to the U.S. and international media. Even if American will were not significantly shaken, the support of any coalition would surely be complicated.

\(^{19}\) Some analysts have argued that a large part of the difference between these two cases is a clear U.S. sense of national interests and objectives in the Pearl Harbor case (the solution to stopping the Japanese was clear though difficult) versus a poor sense of the same issues in Beirut. The clarity of solution in future major regional contingencies will be muddled by perceptions of the Gulf War outcome (and despite the U.S. limited objectives): Did the United States really solve the Iraqi threat in Desert Storm, or did it simply provide a temporary resolution that will fester (while Saddam Hussein continues to control Iraq)?

\(^{20}\) A major uncertainty is the extent to which U.S. public opinion, and perhaps more importantly international public opinion, would allow collateral damage. The experiences of both the Gulf War and Somalia suggest that some collateral damage would be tolerated, but large numbers (hundreds?) of particularly innocent casualties might become a heavy burden.
The United States, too, might suffer casualties. In the early stages before the United States is fully committed, it would be better for the opponent to inflict casualties by "indirect" means, avoiding an incontrovertible "signature" and, therefore, not providing a clear justification, or target, for retaliation. Examples might be the use of naval mines or of third-party terrorist and/or special forces attack. As in the case of the attack on the American Marines in Beirut noted above, the lack of an obvious target against which to retaliate could deepen the sense of unease in the United States about just what its forces are getting into, more than it would inflame U.S. national desire for revenge.

If, despite such tactics, a significant U.S. intervention were to proceed, the adversary might need to create a strategic event with sufficient military or psychological impact to stop the intervention in its tracks and cause a reassessment by the United States (and/or its partners) of the wisdom of the course on which they had embarked. A really devastating series of terrorist attacks, perhaps even on the U.S. homeland, might achieve this purpose. The sinking of a major naval ship would be such a strategic event, if it could be done. An appropriate strategic event might be caused by the use of nuclear, biological, or chemical (NBC) weapons against U.S. or coalition forces in the field, concentrations of relatively less well protected coalition forces in rear areas, the homelands of regional coalition partners, or even, as ballistic and cruise-missile technologies proliferate, against the U.S. homeland itself. Any such strategic event would clearly be high risk—it might very well cause a "Pearl Harbor" reaction, leading to an ultimate "Hiroshima" and drive for unconditional surrender.\(^{21}\)

At the very least, it would achieve an "operational event" involving a significant time-out in a campaign that was developing badly.

In our games, the players normally felt that opponents would not attack targets within the United States even if they could (because such attacks would be likely to strengthen the U.S. will to respond). They also thought that opponents should consider only targets within the theater and en route to the theater. Few Red players in our games were willing to attack U.S. air forces in the United States (where the aircraft tend to be most vulnerable) because they anticipated that such attacks would solidify U.S. public opinion against the opposing power(s) and increase the likelihood and persistence of U.S. involvement in the regional conflict. We are less certain that opponents with different cultural norms and attitudes toward revenge would refrain from such attacks,

\(^{21}\)The U.S. response to casualties is also likely to be a function of the way in which the attrition occurs (e.g., the sinking of a cruiser by a mine may have a different impact than opposition forces shooting U.S. soldiers), the potential for recurrence (e.g., if one cruiser has been sunk by a mine, other ships could be as well), and who has suffered (e.g., U.S. servicemen being shot may be different from U.S. civilians being shot).
especially once the United States had pressed strategic attacks against their homelands.

Manipulation of the Operational Environment

At the operational level, opponents might be able to manipulate many aspects of future warfare. For example:

- The aggressor could force the United States to deploy into a hostile environment. In Desert Storm the United States could deploy into secure ports and airfields and enjoy the advantages of substantial host nation support. In future wars, prospective opponents will have significant incentives to threaten U.S. entry into the theater. At the lower end, such a threat might imply that the United States must deploy security and area defensive forces (such as Patriot missiles) early and face the increased risk of significant losses early in the campaign. Such changes could significantly lengthen the time required to put a complete defensive force into a theater, especially if the United States were also forced to operate through damaged facilities and to bring all of its own supplies (e.g., fuel). Moreover, the opposition players felt that airfields and port facilities were very high-density target areas that invited attack. At the high end of such threats, the United States might have to add several campaign phases in which it secured the required lines of communication and entry points before it could even deploy into the theater. If, for example, the Strait of Hormuz were closed by a combined threat of mines, land-based antiship missiles, aircraft, and submarines, it might take some time to neutralize these threats and even enter the Persian Gulf (let alone put substantial forces ashore).

- If the campaign developed into ground engagements, the adversary would be guided by the need to maximize U.S. casualties. He would aim for a nonlinear battlefield with inerminating of the sides’ forces and close contact with U.S. forces. This would make the targeting of his forces more difficult and U.S. fratricide more likely. The adversary might be willing to accept very adverse loss ratios to cause high U.S. losses (as in Vietnam). In addition, the cultures of at least some prospective U.S. opponents view revenge as acceptable and expected, which might prompt them to attempt to impose some direct losses on the U.S. citizens (recall Saddam’s use of hostages).

- Adversaries are likely to prefer fighting in urban terrain where, because of concerns about collateral casualties, the United States might have to limit its use of advanced munitions, especially area-effects weapons.

- An opponent would be conscious of the “seams” in the C³ of coalition forces; he might even seek to create conditions in which coalition forces erroneously attack each other (or appear to have done so).
• More generally, opponents are likely to seek infantry as opposed to armored engagements (in part by seeking enclosed terrain) because they reduce the advantages of U.S. armor and expose U.S. personnel more to attrition.

• If an adversary felt he could not win the conventional battle, he might resort to classical guerilla tactics. He would deny battle to U.S. forces when he did not possess an advantage and press battle selectively when he felt there was an advantage to be gained. In Somalia, General Aideed has shown himself the most recent exponent of this approach.

In essence, the opponent would attempt to create a battlefield environment more like Vietnam than the Persian Gulf. He would be seeking "operational events" in which U.S. failures to achieve objectives or the costs it paid led to a change in the operational approach. For example, some limitations the United States might have to face include the following:

• The abandonment of air bases, ports, or other facilities struck with persistent chemical weapons, since decontamination uncertainties might imply too great a risk against the requirement to minimize casualties.

• The abandonment of parts of the operating environment because of opposition threats. For example, U.S. air forces might choose not to operate below 10,000–15,000 feet because of air defense artillery and shoulder-fired SAM threats.

• The abandonment of many kinds of operations. For example, the United States might conclude that an amphibious assault could be too risky if the opposition was likely to possess nuclear weapons or even chemical or biological weapons. In our war gaming experience, amphibious assaults against enemy territory (e.g., against Pyongyang or Wonsan in Korea) were often staged as part of a U.S. coalition counteroffensive, in which a military threat was placed against the survival of the opposition regime. In our games, a nuclear response (or at very least a chemical response) was often employed (the opposition attempting to break the back of the U.S. threat and U.S. will before it could mature), especially since that response can be executed on the opponent's own territory or in its coastal waters (very different from striking coalition territory). This limitation complicated likely U.S. responses. Indeed, in some cases, Red players considered weapons prepared in the form of a nuclear land mine, which would be detonated by the incursion of U.S. forces.

From the opposition perspective, it would clearly be ideal if operational events could be created that also became strategic events. Thus, if North Korea could induce the United States to abandon its air bases in South Korea and, by so doing, cause a crisis of U.S. will to intervene in a Korean war, the operational development would serve overall North Korean objectives well. The opposition will recognize, however, that the outcome of such a strategic event
could be a renewed and expanded U.S. intervention (especially if many Americans were killed by chemical weapons or a nuclear attack).

In preparing to fight against the United States, potential aggressors are likely to recognize that if their operations are successful, they would have to trade their expected gains for the losses they might suffer. In particular, the U.S. emphasis on targeting strategic C3 suggests that it would attempt to threaten the survival of opposition regimes. In our games, most Red players viewed regime survival as ultimately their most important objective and thus found such a U.S. interest (and capability) very deterring; however, they were prepared in some cases to take extreme measures in response to such U.S. actions (see the discussion of third-party nuclear weapons below), hoping to dissuade the United States from pressing such threats. Such campaigns would create a mismatch in objectives, with the United States still having limited objectives but potentially having pushed its opponents into unlimited objectives. We must also consider alternative criteria for decisionmaking by future foes, such as cases in which U.S. opponents attack as a last desperate attempt to survive.

**ASYMMETRICAL BATTLES WILL CHARACTERIZE WAR**

Recent military discussions have described several alternative future battlefields. Russian writings have focused on a high-tech, symmetrical development along the lines of what the United States achieved in Desert Storm and is seeking with further developments of military technologies. Since few if any future U.S. opponents are likely to be able to respond symmetrically, we anticipate that future battlefields will develop asymmetrically. The extremes in

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22 The United States might also threaten the survival of the opposing regime by destroying its economic infrastructure. Indeed, almost any form of strategic attack is likely to escalate U.S. objectives to theater strategic from theater operational, though the United States may lack an overall approach to a theater strategic conflict resolution—which may become a problem, especially in maintaining domestic and coalition support, in future conflicts.

23 One might argue that North Korea may be approaching such a point, as its economy seems headed for failure; a similar perspective contributed to the Japanese initiation of their involvement in World War II. We have found that it is difficult for U.S. players to take this view, because they do not find themselves in desperate circumstances.

24 The importance of the asymmetrical battle first came to our attention in the work done by Lieutenant General Phil Shutler, USMC (ret.). General Shutler applied the framework of asymmetrical battle to describe the success of U.S. operations in the Pacific during World War II. He uses this idea of asymmetrical battle in a course he teaches at the National Defense University.
asymmetry may occur if a high-tech U.S. force is countered by a guerrilla force practicing irregular warfare. These alternatives have substantially different implications from each other and require differing analytic approaches, e.g., as outlined below.

The High-Tech, Regular Combat Battlefield

Recent Russian writings on the future of war focus on the developing high-tech, regular combat battlefield (see, for example, Dick, 1993). They believe that

future war will be dominated by precision weaponry, "information support" (i.e., reconnaissance and C3) and electronic warfare (EW), the three being integrated with synergistic effect into a combat system which will again fundamentally change the nature of warfare.

Long-range battle is not merely enjoying an increasing role but will become the dominant, and often an independent, form of combat in future war. Employing EW, fixed and rotary wing aviation, cruise and ballistic missiles and long range tube and rocket artillery with ACMs, key elements of the enemy’s tactical and operational groupings will be engaged throughout the depth of their deployment very soon after their detection by multifarious air and space based reconnaissance means. Effective strikes may be exploited rapidly by air and air-ground echelons—air assault, forward, raiding and enveloping detachments—to defeat or destroy the crippled and disrupted enemy and gain a tempo. What used to be thought of as the “main forces,” the bulk of the tank and mechanized troops, will essentially be reduced to the role of exploitation elements (as, indeed, they were regarded in the nuclear period). For safety, they may be held far from contact with the enemy “main forces” during the decisive “electronic-fire engagement,” and may, even on committal, engage in close combat for far briefer periods than hitherto (Dick, 1993:2).

Maneuver takes on a new role at two levels. Tactically, “units move frequently to increase their chances of ducking out from under an upcoming strike” (Dick, 1993:6). Operationally, the combination of air power (including helicopters), missiles, and long-range raiding and vertical envelopment has fundamentally changed the character of battles. For example, 

raiding forces in the enemy’s depth may not so much aid and support the advance of the main forces as be their cutting edge. After all, the main combat power of either side will reside in its long range weaponry and associated “information support” and command and control, which are deployed in the depth, and the destruction or disruption of these will confer a major, perhaps decisive advantage to the more successful side.
Defensively,
even if the defender were able to deploy huge numbers, it would not be possible
to create an insurmountable defence. No matter how well prepared in the engi-
neering sense, no matter how dense or deep, precision and ACM strikes will blast
breaches as assuredly as their nuclear predecessors (albeit without the latter’s col-
lateral damage and contamination which hindered exploitation). Moreover, ver-
tical envelopment will also be used to erode the cohesion of the defence. Rather,
operational defence will have to deploy half or even more of available forces in
the second echelon and rely on maneuver for success. After prolonged debate,
the Russian theorists are now coming to accept that only manoeuvre defence is
viable on the future battlefield. This will comprise firstly the manœuvre of fire,
obstacles (remote mining) and electronic strikes to inflict attrition and disruption
on the attacker while he is approaching the forward edge. When penetration—
accepted as inevitable—occurs, the defender will conduct delaying actions, with-
drawal to depth positions or counter-penetration where the attacker is strong,
and counter-thrusts where he is vulnerable. The aim will be to affect such a
change in the correlation of forces that the defender can seize the initiative and,
exploiting successful counter-strikes, go onto the counter-offensive (Dick,
1993:7).

A Reactive Approach

Dick (1993:13) concludes his description with some interesting comments:

It is, however, unlikely to say the least that Russia will be able to make the tech-
nological or the economic progress in the foreseeable future that will be required
to keep the country in the first rank of powers able to conduct high-tech, high
intensity conflict. Once again, as in the twenties and thirties, theory is marching
well ahead of practical ability. More disturbing still for Russia, however, is the
fact that her military thinkers seem to be devoting their talents to the study of
the sort of war Russia is perhaps least likely, as well as least able, to fight. Little
work appears to be done on the mid and, particularly, low intensity conflict that
is certain to trouble the country.

If the Russians are unlikely to be able to pursue the high-tech approach, we
can expect few others will have that ability, although the Swedish approach to
the high-technology battlefield is an interesting complement and counterpoint,
as described in Gardiner (1993b).

An alternative way of addressing U.S. military power can be referred to as
the “reactive” approach. The foregoing analysis assumed a smart adversary
might try to manage American responses by avoiding U.S. strengths and ex-
ploring U.S. weaknesses. Similar considerations could inform his approach to
military planning. For example, the adversary would be likely to avoid air
combat with the United States (a symmetrical response) and instead seek to
destroy U.S. aircraft on the ground or apply passive defenses to his targets to make them difficult to destroy using aircraft. His exploitation of U.S. weaknesses would create asymmetrical battles. A similar approach might be expected to exert some influence on the force structure he adopts and the military technologies he pursues, over time.

This argument should not be overstated: no regional power will be guided in these matters solely or even primarily by the prospect of conflict with the United States.\textsuperscript{25} Regional powers are influenced in their military decisions primarily by regional considerations. Desert Storm may have demonstrated that a conventional air force will be of little use to a regional power up against the United States, but it does not follow that a country such as Iran will not wish to maintain such an air force to assist in dealing with its regional opponents. Also, it should not be assumed that if a regional power chooses to pursue NBC weapons or ballistic or cruise-missile technology, it will be doing so primarily to confront the United States; such proliferation is likely to continue to be fueled, as in the past, by regional rivalries and ambitions and by the imperative of regime survival.

**Countering U.S. Strengths**

Nevertheless, aggressive regional powers can be expected to concentrate on developing capabilities that advanced military powers will find hard to deal with. They should not be expected to do so by matching U.S. capabilities, in large part because many U.S. capabilities are highly advanced (they cannot be matched in the short term) and are also cultural in many cases. For example, U.S. airpower is as much as anything a function of issues such as training approaches, the responsiveness of personnel to training, the willingness and ability to delegate authority and support independent operations, and the ability to assimilate a complex situation rapidly and determine an appropriate course of action. Thus, even if U.S. opponents acquired Flanker or Fulcrum aircraft, they would not be likely to pose a major air threat against U.S. air forces (at least in the short term).

Other ways do exist to counter U.S. strengths.\textsuperscript{26} Opponents can often find a wide range of counters, many of which do not require high levels of skill. Opposition acquisition of key weapon technologies and the fielding of appropriate weapon systems could significantly impact both opposition and U.S.

\textsuperscript{25} However, countries like North Korea that face established U.S. alliances or declared interests might be strongly influenced by the likely requirement to deal with the United States if they were to attack a neighbor.

\textsuperscript{26} The counter capability logic is developed in more detail in Gardiner (1992a), Bennett (1993c), and Fox (1993b).
doctrine and, by implication, U.S. force structure. For example, how would the United States respond to an opponent with a large cruise missile force equipped with sensor-fuzed weapons designed to defeat current armored/mechanized forces and doctrine (a capability postulated by several of our Red teams)?

Because these counters are not symmetrical with U.S. capabilities, U.S. analysts have tended to discount them in their analyses (if the United States has chosen not to pursue these approaches, how important could they be?), even though the capabilities they target (such as U.S. intelligence dominance) are often highly concentrated target systems that are relatively fragile and susceptible to damage. But some intelligence indicates that efforts by prospective opponents to acquire a range of key weapon technologies are already underway. Goliath must expect David to choose his own weapons and must be ready to engage in asymmetrical battles.

The threat menu illustrated in Figure 3 assists us in this process. It provides a framework for us to focus on the kinds of potential threats and to decide which are significant and serious enough that they need to be considered in formulating potential threat environments (which make up a part of the warfare environment discussed above) and in developing intelligence-collection requirements for a given theater.

Technologies Can Also Work Against the United States

As this analysis shows, the reactive approach may involve more or less high-tech capabilities; that is, technology does not uniformly favor the United States and in some ways can be selectively used to effectively counter its capabilities.

The implication is that the future holds a different kind of military competition. Rather than the historical pattern of competition in largely symmetrical areas (e.g., tanks versus tanks or fighters versus fighters), analysts should expect opponents to pursue a few different technologies in a combined-arms approach to deal with U.S. strengths (and not just for a single "silver bullet" to defeat U.S. forces). This complicates analysis because it largely invalidates simple symmetrical capability comparisons (such as the traditional tank-versus-tank

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27Sensor-fuzed weapons are large packages carrying many submunitions that can each acquire a vehicle and attack it independently. Other examples might include the FOG-M wire-guided antitank/antiaircraft missile, exploitation of U.S. assets such as the GPS system to perform highly accurate long-range bombardment, or the use of nuclear explosions in the outer atmosphere to threaten the U.S. C3I.

28The intelligence community representative to the RSAS Working Group has consistently pointed out that while U.S. intelligence collection platforms and communications systems tend to be relatively secure, the command and intelligence facilities in the theater are often relatively vulnerable, especially to well-orchestrated agent, special operations forces, or ballistic missile attacks.
measures) and requires a battle or campaign orientation in order to make meaningful comparisons.

For example, Red players in our games examined the various antiarmor weapons they might develop, ranging from sensor-fuzed weapons to ATACMs to infantry weapons such as the FOG-M.\textsuperscript{29} They believed that if these technologies could be acquired in sufficient numbers, they might be able to neutralize the strengths of U.S. armored forces, including their mobility and ability to maneuver.\textsuperscript{30} They recognized that such capabilities might force the United States to reconsider the Army force structure (which is now projected to consist primarily of heavy armored and mechanized units) and Army doctrine and force employment concepts, although they hoped that the United States would be slow to recognize their new capabilities and not begin to adjust until problems developed on the battlefield.

The Red players recognized that the Iraqi use of ballistic missiles in Desert Storm showed how the possession of some weapon technologies by an opponent could force the United States to rethink its capabilities and operations. But they viewed such impacts as almost purely strategic and sought weapons that would cause combined operational and strategic impacts. The Russian Scud-D could be such a weapon. It reportedly has a 45-meter CEP (the radius of a circle within which half the missiles will land), a runway-penetration, submunition warhead with a 125-meter radius of effects, and an antipersonnel submunition warhead with a 250-meter radius of effects.\textsuperscript{31} Similarly, they wanted to acquire sophisticated, deep-water mines; even if they could scatter only a few of these throughout the waters within 500 or so miles of the theater, the belief was that such weapons could cause a strategic disaster to U.S. forces or cause the United States to stand off for a protracted period while deep-water mine hunting proceeded.

As a general proposition, Red players sought to acquire weapons that were relatively simple to employ (e.g., cruise missiles as opposed to manned aircraft) and yet would challenge the United States with significantly increased lethality. They anticipated slow or no U.S. reaction to such developments. Even if the

\textsuperscript{29}Fiber Optic Guided Missile, which has both antiarmor and air defense capabilities.

\textsuperscript{30}While the Red players attempted to disperse these weapons to make them less vulnerable, they did not systematically examine the relative vulnerability of their projected forces compared to U.S. forces. That effort must still be pursued.

\textsuperscript{31}These Scud parameters are described in \textit{Jane's Strategic Weapon Systems}. Runway cratering would not be the only desired effect against airfields; rather, such submunitions could also be effective in damaging unsheathed aircraft, maintenance facilities, petroleum pipelines and storage, and crew facilities.
United States responded to a more lethal battlefield by reducing force density, they might achieve their objective of preventing the United States from bringing to bear a force of critical mass sufficient to rapidly defeat their forces.

The Low-Tech, Irregular Combat Battlefield

Another approach, more correctly an extreme of the reactive approach, would involve the U.S. opponent pursuing the kind of low-tech, irregular combat battlefield that the United States experienced in Vietnam or more recently in Somalia. This kind of battlefield could occur in environments where U.S. opponents have little or no armor, having instead a predominantly infantry force structure.

Recognizing that the United States can operate on the high-tech plane, less capable adversaries would avoid direct U.S. power, taking the initiative only in circumstances where they perceived some advantage or were required to defend some vital asset. We refer to this characteristic of irregular warfare as the "ability to deny battle" (Gardiner, 1993d). This approach would allow opponents to manage attrition and maintain more satisfactory loss exchange ratios, where otherwise U.S. firepower would be devastating. Here opponents could focus on creating engagements when U.S. and/or coalition forces were particularly vulnerable, engagements that might become operational or strategic events if U.S. and/or coalition forces sustained relatively high losses. As a result of this mode of operation, long periods of low/no intensity combat operations might occur, even if U.S. forces were attempting to perform active offensive roles, and then a sudden surprise of a major engagement could happen in which U.S. forces might sustain significant losses. Only high concentrations of force in an area might be sufficient to prevent such attacks, and even then an opposition sniper or the detonation of a truck bomb might negate U.S. efforts to maintain control of the situation.

In contrast to the high-tech battlefield described above, the low-tech battlefield is one in which the United States cannot be expected to maintain information dominance. Many of the U.S. intelligence systems are excellent at determining the locations of large weapons like tanks and armored personnel carriers, but have much more difficulty locating infantry, especially infantry that may often not wear uniforms and may appear from cover suddenly, only to disappear almost as suddenly. While the United States has had some luck historically in following key personnel through their use of communications systems, the news reports from Somalia suggest that General Aideed, who eluded U.S. capture for months, did so because of his avoidance of phones and
other systems we could monitor, instead choosing to communicate by messenger and low-power radio transmissions.\textsuperscript{32}

The opponent who pursued irregular warfare would generally have the initiative in combat operations against the United States.\textsuperscript{33} This case might be even more true in peace-enforcing situations where the rules of engagement might often constrain U.S. forces to fire only when fired upon. Moreover, such an opponent might be able to largely negate the effectiveness of advanced U.S. weaponry by denying targeting information or by putting targets in areas the United States was reluctant to strike (because of concerns about collateral damage). The more options the opponent had for hiding forces, the more difficult would be U.S. combat operations, making the availability of reasonable hiding places a key characteristic of such warfare (thus a desert would be a less ideal terrain for irregular operations than a heavily forested or urbanized area). In this context, irregular warfare would clearly be a stronger defense: opposition forces would be able to intermix with friendly populations and employ known hiding locations.

The Combined Battlefields of the Future

We anticipate that the future battlefield experienced by U.S. forces will evolve as some combination of these approaches. In part, the combination will be a function of the force structure of U.S. opponents and of the terrain in which they operate. Few U.S. opponents will be able to field forces capable of the high-tech operations described above. However, since the United States will certainly have such capabilities, consideration of the high-tech battlefield does provide a framework for contemplating prospective U.S. strengths and weaknesses.

If many prospective U.S. opponents fall closer to the low-tech image, then the United States can expect significant irregular combat confrontations, since in such confrontations it appears to have the least relative advantage. This situation will be particularly true when U.S. forces play a peace-enforcing role,

\textsuperscript{32}A recent report indicated that the relatively rapid response of Somali guerrillas to U.S. ranger operations occurred because Aideed followers near the Mogadishu airport used oil drums (following the ancient African tradition) to communicate that ranger teams had taken off and appeared to be heading for guerrilla targets. "Inside Mogadishu," \textit{Time}, November 8, 1993, p. 17.

\textsuperscript{33}The United States may be able to gain the initiative by identifying and striking targets with high value to the opposition (for example, locating the opposition leadership and attacking it). However, such operations are likely to confer the initiative only transiently and, to the extent that U.S. forces must expose themselves in an area of heavy opposition presence to perform such actions, may quickly yield the initiative to the opponent in some cases.
giving the opponents the advantage of carrying out largely defensive actions against the U.S. forces. To the extent that U.S. forces are introduced to stop an aggressor, that aggressor is less likely to be able to base his operations on irregular warfare because of the difficulties of power projection in this kind of warfare. Therefore, in such circumstances, the United States may be able to gain much better control of the battlefield (against a low-tech opponent forced to fight predominantly regular warfare to achieve his objectives). 34

Whether dealing with a high-tech or a low-tech battlefield, in some ways the outcomes will be the same. In both cases, the battlefield will be nonlinear, with lower densities of forces than historically anticipated. In both, opposing forces will need to hide to survive, making rapid target acquisition and delivery of fires necessary for the United States to destroy them. And in both, the key U.S. forces will often be long-range weaponry, which the opponent will want to attack directly. This situation will be facilitated by the likelihood that such weaponry may be relatively concentrated in a few locations (such as airfields, artillery, and attack helicopter bases).

Across the types of battlefields, the command-and-control system of the future battlefield must be highly robust and adaptive. If the United States is to fight at low densities in nonlinear combat, it must be prepared for significant devolution of authority necessary to pursue what could be very complex conditions when viewed in the aggregate. The United States must also be prepared to somehow integrate the complex situation into a coherent picture and apply supporting fires and other assistance in a meaningful manner. Poor C3 may mean that fratricide will increase to an intolerable level or that the United States will continue fighting the enemy of the last battle even after he has evolved and has begun to fight differently.

NUCLEAR, BIOLOGICAL, AND CHEMICAL WEAPONS 35

Nowhere will the asymmetries in approaches be more pronounced than in the respective readiness of the United States and potential regional adversaries to introduce the shadow of NBC weapons, and even their use, into a crisis. It is argued above that regional proliferators will not set out to acquire nuclear

34The example of Vietnam may raise a question about this statement, and yet the difficulties faced by the United States in Vietnam were caused in large part by the combined internal/international character of the conflict, in which Viet Cong forces in particular could operate largely based on the “defensive” dimension of irregular warfare discussed above.

35The results of some of our games in this area are reported in Gardiner (1993e) and Fox (1993a). Some of RAND’s other work in this area is found in Millot, Molander, and Wilson (1993); Molander and Wilson (1993); and Bennett (1993d).
weapons specifically for confrontation with the United States. But many may conclude that it would be foolish to get into such a confrontation unless so equipped. This argument applies with equal force to chemical and biological weapons, which are too often forgotten in the analysis of regional contingencies and may more than compensate for their lesser effectiveness by their relative ease of acquisition.

Historically, the United States viewed its strategic nuclear weapons as the ultimate deterrent force in the world, extending at least some degree of protection to any country coming under the U.S. nuclear "umbrella." However, the Red players in our games paid scant attention to U.S. strategic nuclear weapons; they doubted whether the United States would use such weapons in any of the conditions considered (even after the Red players' own use of nuclear weapons) and thus felt largely undeterred by them. This issue clearly needs further study, and real-world adversaries might well behave differently.

Viewing NBC from the Adversary's Perspective

The attraction of nuclear weapons for many actual or aspirant proliferators may extend beyond the potential they offer for regional domination and become the ultimate means for ensuring regime survival. Nuclear weapons provide the regime with a deterrent to attacks against it or a counter to those attacks should they occur (again, with the focus on attacks from regional powers more often than on attacks from the United States). In some cases, the intimidation and deterrent motives may be hard to disentangle; possession of nuclear weapons may provide a secure basis for expansionist policies, putting a ceiling on any losses should adventurism miscarry.36 Either way, whether the dominant impulse toward acquisition is aggressive or defensive, proliferators will rightly feel that their new status has an impact on the regional balance of power.

They may also believe that, balance of power and insurance considerations apart, nuclear weapons will furnish them with the means to decisively affect the course of any conflict in which they find themselves actually engaged, whether

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36In the games, Red players contemplated using nuclear weapons (and perhaps other weapons of mass destruction) to threaten their neighbors (either explicitly or in a veiled manner) if a U.S. lodgment or U.S. basing were allowed; they also considered directly threatening a U.S. lodgment or other initial deployment with nuclear weapon use. The Red players felt particularly aggressive in these areas when they had a dozen or more nuclear weapons and could thus expend some in such efforts and still retain a capability for guaranteeing regime survival. They generally concluded that having a dozen or more nuclear weapons was a significantly different condition from having only two or three.
with the United States or a regional power—that is, the ability to create strategic events.

**U.S. Responses to the Nuclear Shadow**

It is perhaps more likely than not that any future regional contingency in which the United States finds itself involved will be overshadowed by an explicit or implicit NBC threat. The threat might be more in terms of potential than actual use, bearing on the crisis in the following ways:

- The possession by the adversary of an NBC arsenal might be a strong disincentive for the United States to become militarily involved in the first place—especially if use, whether by terrorist or missile means, is credibly threatened against the U.S. homeland.

- Potential coalition partners, especially those geographically closest to the adversary, might be more difficult to enlist, fearing nuclear strikes from the aggressor.

- The possibility of tactical use might seriously inhibit U.S. deployments and might cause major changes in operational planning. In general, the United States would have to avoid concentrations of forces that could become a target for weapons of mass destruction. Concentrated deployments through a limited number of debarkation ports might have to be avoided; intense air operations from a small number of in-theater bases might have to be replaced by more dispersed and/or longer-range operations; amphibious landings might have to be ruled out as presenting too concentrated and attractive a target.\(^{37}\)

- The United States might have to reconsider its doctrine of conventional theater/strategic attack, since it threatens the existence of the aggressor's regime, and the aggressor is likely to look to nuclear weapons to assure that survival. That is, serious attacks against the aggressor's leadership might trigger a nuclear response intended to change the U.S. strategy and remove the threat to the aggressor's regime. The United States would, therefore, need to consider other alternatives, to include abandoning conventional theater/strategic attacks in such a situation, limiting such attacks to non-leadership targets, or preparing to preemptively destroy the aggressor's nuclear weapons before starting its attacks on the aggressor's leadership.

- Even after a successful conventional campaign, coalition war aims might have to be circumscribed to avoid threatening the adversary's ultimate survival and thus potentially triggering a Samson response (the opponent self-destructing and attempting to take U.S. forces with him).

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\(^{37}\)Many players in our games have referred to such U.S. amphibious landings as "nuclear magnets."
When facing an adversary armed (or possibly armed) with nuclear weapons, the United States will be likely to focus a significant portion of its strategic attack effort on preemptively destroying the opposing nuclear weapons conventionally. This effort could divert a nontrivial fraction of the total attack away from other valuable targets.  

U.S. Responses to Attacks by Regional Nuclear Powers

As suggested above, the actual use of NBC weapons would be a high-risk strategy for the adversary. It should not, therefore, be regarded as excluded. As a major “strategic event,” it might disrupt the whole political momentum of the U.S. response. It could certainly be expected to induce a pause on the battlefield, while Washington and other coalition capitals digested the implications. It might sow discord among coalition partners, as arguments ensued as to the appropriate response. An adversary might calculate that it would, in effect, be a “no-added-cost” option: given an increasingly advertised U.S. tendency to view nuclear weapons, as much as chemical and biological weapons, as lacking both utility and legitimacy, the adversary could hope that the U.S. response to his own NBC use would merely be continued prosecution of the war against him by conventional means. The United States needs to consider whether it should take action to strengthen the perception of regional nuclear powers that their use of nuclear weapons will prompt a U.S. nuclear response. The war games provided some interesting insights into this issue. In most cases, the Blue players concluded that a response with nuclear weapons would not inflict much more damage on the opponent than continued conventional operations because of the lethality of U.S. conventional munitions. Moreover, in the common case where opposition use of nuclear weapons is a desperation move, the Blue teams did not perceive the need to respond with nuclear weapons in order to achieve their operational objectives. Some Blue players contemplating a nuclear response feared that the U.S. public might react negatively to a U.S. nuclear attack in the context of a limited war that the United States appears to be otherwise winning. Therefore, in an attempt to maintain U.S. coalitions and in trying to preserve the international consensus against the opponent that has used nuclear weapons, many Blue teams did not respond with nuclear weapon use. In part, Blue teams had difficulty identifying appropriate targets for nuclear weapon use (often because of the conventional damage already done). Moreover, the fact that it might take several dozen tactical nu-

38In Desert Storm, about 10 percent of the total air-to-ground sorties were directed against NBC targets and the associated Scud launchers; in retrospect, a number of NBC targets were missed (mainly because of inadequate intelligence), and few Scuds were destroyed.
clear weapons to neutralize an opposing army division surprised many players. Often, the Blue players threatened a heavy nuclear response to further nuclear weapon use by the opponent and increased the conventional campaign against opposition strategic targets (especially remaining nuclear weapons and associated C$^3$I).

In the cases where the Blue teams did use a nuclear response, they tended to escalate the level of nuclear violence. Thus, in one exercise played by 12 teams in which the Red team used one or two nuclear weapons against U.S. forces or theater infrastructure, the seven Blue teams that responded with nuclear weapons used an average of 16 weapons, and the numbers ranged from 4 to 50. Some Blue teams have used a nuclear response to serve as a deterrent against other Third World nuclear powers, or have been anxious to respond to the perceived outrage of the U.S. public. Interestingly, Blue players who had dealt with nuclear weapon use in recent games appeared considerably more prone to respond with nuclear weapons when the problem was posed in a second game.

In this specific context, we should note that games may be an inadequate framework for addressing some issues associated with weapons of mass destruction. Just as the media and public response to the use of Scud missiles in Desert Storm far overwhelmed any expectations, so might use of “strategic” weapons of a future war, forcing the United States to take different actions. It is difficult to infuse game players with the emotionalism of threatened nuclear weapon use, or the carnage of actual nuclear weapon use, in order to properly capture the reactions that might actually occur.

**Delivering Weapons of Mass Destruction**

While various delivery means may be employed with nuclear weapons, most regional powers working on nuclear weapons seem to have chosen ballistic missiles.\(^{39}\) However, we also see some evidence of interest in cruise missile technology in many countries and suspect that cruise missiles may become an alternative delivery means during the next decade.\(^{40}\) The choices here are important; much effort has gone into controlling ballistic missile proliferation because of its clear tie to nuclear weapons, while much less emphasis has been placed on cruise missile proliferation. Cruise missiles appear to be the preferred delivery means for chemical or biological weapons and for some newer

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\(^{39}\) This choice is in part due to a lack of confidence of these countries in their air forces and the fact that they have not yet mastered cruise-missile technology.

\(^{40}\) A “Pentagon study said Syria, Iran and China are aggressively developing cruise missiles—the first ones are expected operational by the year 2000.” “News Highlights,” DoD’s *Early Bird*, February 1, 1993, p. 16.
munitions such as fuel air explosives, because such missiles make it much easier to disperse these munitions in appropriate patterns around targets. Thus, we would expect substantial efforts to develop and deploy cruise missiles that could carry weapons of mass destruction.

CONCLUSIONS

Despite its military power, the United States may face severe challenges in future major regional contingencies. If the reactions of our Red players are reliable, the old deterrent effect of strategic nuclear weapons appears to have little effect on prospective regional adversaries. Instead, they may perceive that they can achieve their objectives by proper exercise of operational initiative, by making the cost of U.S. intervention high, and by otherwise appropriately setting the political context and parrying U.S. military strengths for at least some period of time. If so, we may see a repeat of the conditions surrounding World War I, in which to wait was to fail (see Tuchman, 1962). At the very least, the context for deterrence has changed, and the United States must seriously reconsider how it may or may not play a role in future major regional contingencies.

War appears to be evolving and perhaps evolving quite rapidly. The battlefield of the future could well be quite different from the battlefield of the Gulf War or a battlefield that we might expect to see today. Military analysis must begin to comprehend these potential changes.

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Many of the insights from the future-of-warfare games have been discussed in a RAND newsletter, originally called the *RSAS Newsletter*, later renamed *Military Science & Modeling*. In particular, see:


EXTENDED-COUNTERFORCE OPTIONS FOR COPING WITH TACTICAL BALLISTIC MISSILES

Richard Mesic

This paper describes recent RAND work on concepts for attacking theater ballistic missile (TBM) systems—either before launch or shortly thereafter ("extended-counterforce options"). It describes how RAND assessed the performance of the Desert Storm "Scud hunt" in 1991, developed analysis tools such as simple computer simulations, and applied these tools in a systems analysis of options for coping with a wide variety of possible future TBM threats. Finally, the paper presents observations from that analysis and suggests directions for exploring operational concepts and systems initiatives that could enhance the country's counter-TBM capabilities over the years ahead.

INTRODUCTION

Tactical ballistic missiles (TBMs) became a pressing military issue in the Gulf War when Saddam Hussein mounted his Scud attacks against Israel and Saudi Arabia. He had threatened to use missiles and had hinted that they might be armed with chemical warheads. Before the actual attacks, however, U.S. military planners had largely discounted their significance because of the Scud's low accuracy. As a result, when dealing with Scuds became a political imperative as Saddam Hussein used them as a terror weapon to bring Israel into the war (Atkinson, 1993), the U.S. response was largely ad hoc. It was also largely ineffective, even though the Patriot part of the response seemed very effective at the time.¹

While Iraqi use of TBMs in 1991 presented only a marginal military threat, the attacks demonstrated that TBMs constitute a plausible and potentially severe future military threat—especially if we remain as unprepared for countering them as we were in the Gulf War.² If Saddam Hussein had armed his

¹Shaver (1994) discusses ballistic missile defense.
²For a very interesting historical perspective on the beginnings of the TBM problem, see Irving (1964), which describes England’s World War II struggle with the German V-1 and V-2 threats. There are amazing parallels between the problems England faced
Scuds with chemical or nuclear warheads, the course of the Gulf War, if not its outcome, would have been quite different. Future adversaries might be more reckless and lethal. Indeed, planners are increasingly realizing that in the very near future, U.S. ability to forge effective political and military coalitions and to project power in major regional conflicts (MRCs) could be critically impaired by the presence of TBMs—especially if armed with chemical, biological, or nuclear weapons of mass destruction (WMD) (Milliot, Molander, and Wilson, 1993).

RAND began studying this issue in 1991, when it was asked by OSD's Deputy Director for Tactical Warfare Programs (TWP) to review and analyze the Desert Storm performance of U.S. forces in several mission areas, including what had become known as the Scud hunt in Iraq. Following this initial Desert Storm "lessons learned" study, concluded in the fall of 1991, RAND was asked by the Air Force and OSD to extend the research to consider future threats and responses.³

The purpose of this paper is to describe our work on these matters and to explain key issues and options. It describes how we assessed the Desert Storm experience, developed computer simulations, and applied systems analysis to explore future threats and possible counters. This exercise was a necessary first step in addressing the appropriate investment balance among various elements or "pillars" of an overall theater missile defense (TMD) architecture (Mestic, 1994). One consequence of our work was the development of the concept of "extended counterforce," which includes attacking TBMs and their support systems on the ground and TBMs in their boost or postboost ascent phase, primarily with aircraft weapons.⁴

When RAND undertook this work, TMD research and development was primarily focused on terminal and midcourse defense with systems such as improved Patriot and the Theater High Altitude Area Defense (THAAD). Counterforce and attack of missiles in boost phase and later in the ascent phase in the 1940s and the problems the coalition faced in the Gulf War fifty years later. The counterforce tactics in both wars were similar, with similar lack of success.

³Giles Smith led the overall team of the initial Desert Storm research. I was the principal investigator for the Scud-hunting work, with support from Jerry Siles and Kurt Rogers. Our subsequent work has been in a project led by David Vaughan. He, I, and Joel Kvitky have collaborated on most of what this paper discusses, hence, my frequent use of "we" throughout.

⁴Classical "counterforce attacks" focus on striking weapon systems before they are launched or on destroying launchers to prevent reloads. Attacks on the missiles in flight have been considered "defense." However, since some of the same manned-aircraft systems can be used for counterforce and attack of missiles early in flight, this paper uses the concept "extended counterforce" to include both.
was largely neglected. Counterforce itself was considered to be a “straightforward” byproduct of established air interdiction tactics and systems, and ascent-phase intercept was seldom considered. Our research demonstrated that effective extended-counterforce operations, to the extent that improvements are feasible, will require substantial focused development effort. Such operations share many critical elements with air-interdiction missions, but they also involve many new and stressing requirements. They may also be critical to overall counter-TBM effectiveness, because systems like Patriot and THAAD have distinct limitations (Larsen and Kent, 1994, Mesic, 1994, and Shaver 1994).

THE SCUD HUNT OF DESERT STORM

Study Approach

RAND was charged with evaluating the effectiveness of the 10,000 or so Desert Storm aircraft sorties (10 percent of the total) that were specifically directed at finding and destroying Scud systems on the ground—the so-called Scud hunt. The assessment was to help OSD respond to a series of specific congressional questions on the performance of U.S. weapon systems in the Gulf War.

At the time, there were no published reports or other readily accessible materials to help us understand what was attempted in the Scud hunt, assess how effective those actions were, or, most important, analyze the reasons for the successes and failures. Furthermore, there was no accepted precedent, because the Desert Storm Scud campaign was truly an extemporaneous affair. We decided to adopt a two-track approach that involved both empirical work and modeling. The empirical work included interviewing the air crews and reviewing standard wartime documents such as logs and mission reports. The modeling work amounted to building simple computer simulation models. These efforts were complementary and interactive. The interviews helped us build the simple models, and exercising the simple models helped us focus interview questions and the search for data. We developed a story based on anecdotal evidence, mostly pilot first-person reports, and used the quantitative models to help fill in the gaps and resolve the conflicts in the anecdotal and record data. Table 1 lists our primary data sources, which represented a broad cross-section of organizations involved in Scud operations and related systems and technology development.

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5 The one notable exception to this was the ARPA Warbreaker initiative, which was focused on advanced technologies for finding and killing TBMs in deep hides.
Table 1
Background/Information Gathering

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Operations in the Scud Hunt

Let me now review briefly the operations used against Scuds. Fixed Scud-related targets were included in the attack plans developed before the strategic air campaign started. However, mobile Scud systems (TELS and the missiles they carry) were not. The Scud hunt against the field-deployed TELS was planned and started several days into the war as the importance of the Scud threat became apparent.

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61 I use the term TEL to stand for both the Russian-made transporter-erector-launchers and the Iraqi-built tractor-trailer missile-erector-launchers usually called MELs.
The Scud hunts proceeded as follows (Atkinson, 1993; DoD, 1992:225ff). Many types of aircraft (B-52s, . . . A-10s; F/A-18s, . . . S-3s) were involved, but the bulk of the effort was carried out by F-16s and F-15Es in the southeast and western areas of Iraq, respectively. Because of their APG-70 multimode radar and LANTIRN pods (low-altitude navigation and targeting infrared for night) the F-15Es were the most capable system for attacking TELs.

Except for daylight reconnaissance missions flown by A-10s along roads, the Scud hunts were conducted at night. Over 80 percent of the Scud launches occurred at night, no doubt because the Iraqis felt more secure operating under cover of darkness. The Scud-hunting tactics combined (1) hunter-killer operations in geographic "Scud boxes" and (2) combat air patrol (CAP) operations with targeting cues furnished by external assets such as special operations forces (SOF) and launch detection satellites (DSP) (DoD, 1992, app. K). The attack aircraft generally operated at medium altitudes (15,000 to 20,000 feet) to avoid the unsuppressed antiaircraft artillery (AAA) and shoulder-fired infrared surface-to-air missile (IR SAM) threats.

In the cued operations, the aircraft were given target locations, typically by voice, and the pilots would fly to the target area, attempt to find the target believed to be a TEL, and then attack it with the most appropriate munitions on board.

Analysis issues surfaced immediately in our interviews with the flight crews. The most apparent was the obvious discrepancy between the pilots reporting hundreds of TELs killed and intelligence information strongly indicating that the Iraqis had an order of magnitude fewer TELs altogether. How could this difference be reconciled? The air crews were highly professional, but in this war as in earlier ones, their perceptions were highly optimistic. Unfortunately, hard data on these matters were unavailable during the course of the study, so we had to explain the inconsistencies and estimate what really happened by relying heavily on analytic models in the form of computer simulations.7

**Modeling and Analyzing the Campaign**

After our project team understood generally how the Scud hunts were conducted and had analyzed characteristics of the relevant sensors and weapons, we began to develop the simulation models. At this point, the work could literally have been performed with a pencil on the back of a small envelope, but we adopted a modular building-block approach that allowed us to add complexity and fidelity as we gained knowledge about threat operations, tactics,

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7Subsequently, UN teams in Iraq to destroy residual weapons have been able to prove a more complete picture of Iraqi Scud operations. Their reports confirmed the conclusions of our work, to the effect that Scud hunting had been ineffective.
and systems. Figure 1 shows a schematic diagram of the model, which was implemented as a BASIC program on a Macintosh IIci. The model was event driven, with extensive parameterization and Monte Carlo processes. The model included detection, discrimination, and attack of TELs amidst clutter.

The most basic "notable event" for the Scud hunt was the generation (through a Monte Carlo process) of a targeting cue. These cues might come from an offboard sensor system or from a sensor on board the search aircraft. These cue events had a few basic parameters in common, even though the processes through which they were generated and the parameter values were different from case to case. The common parameters were (1) probability $P_d$ that a threat activity (e.g., launch, movement to a launch site, preparation to launch) would be detected; (2) false alarm probability $P_{fa}$ (or, more precisely, temporal and spatial density of false reports over the search area); and (3) probability of target kill $P_k$ based on several factors, including the probability that the cue got from the source to the attack aircraft, cue time delays from the detected event, distance of the CAP aircraft from the cue, uncertainty area associated with the cue, and finally, the reliability and lethality of the munitions.

Detection events were based on a search process that was simulated as a Poisson process. For a Poisson process, the probability distribution of the waiting time $t$ between "detection events" is $P_d(t)$, where:

$$P_d(t) = 1 - e^{-RTI}$$

and where $R$ is the search rate (in square kilometers per hour) and $D$ is the density (number per square kilometer) of both real and apparent targets (i.e., Scud TELs and "clutter" targets).

Given a random detection, the probability $P_{Scud}$ that the object was a Scud TEL is then:

$$P_{Scud} = D_S / (D_S + D_C)$$

where $D_S$ is the density of Scuds and $D_C$ is the clutter-object density.

Given a detection, we assigned baseline parameter values for the discrimination-decision probabilities as follows (based on the limited experimental data available to us at the time). If the notation $P(S/C)$, for example, stands for the probability of declaring the detection to be a Scud given that it is actually a clutter object, then:

$$P(S/S) = 0.25; P(C/C) = 0.1; P(S/C) = 0.9; P(C/S) = 0.75$$
As a baseline, we assumed that the probability of a kill given an attack decision was 0.9.

Other events the code recorded and assessed were (1) aircraft attacks (on both real TELs and false targets such as natural or cultural clutter, including commercial tractor-trailer trucks); (2) weapons used; (3) time (the sortie ended after the aircraft on-station fuel was gone—approximately 1.5 hours—or the weapons were all expended); and (4) kills of both false targets and TELs.

As mentioned earlier, we built placeholder modules for all processes known \textit{a priori} to be relevant, even if our initial modules consisted of nothing more than parameter values (e.g., the discrimination probabilities above). For example, there was a “target detection module,” even though we were not able initially to model the detection process, which involved unavailable data (e.g., TEL signatures in the various relevant spectral bands, sensor characteristics and modes, and background clutter). Later, these modules were refined as data became available.

Finally, we used Monte Carlo methods to assess the performance of the systems given random processes and uncertainties in scenario dynamics and systems operations. We typically ran a scenario 1000 times, which was about all the Macintosh IIci could handle in a few minutes. Statistics were recorded as these scenario replications were run, so that we could see quantitatively how effective the simulated systems worked. The measure of effectiveness (MOE) was Scud TELs killed per aircraft sortie. The code would generate an average value for this number and a measure of its variability (standard deviation) over the given number of trials.
As the model was developed, we checked it by running cases that we could evaluate by hand. As the code grew, its modular nature let us check each extension rather simply, even though the code as a whole was becoming much more complex. This ability to incorporate new information and adapt tactics was a key feature of the simulation approach. The underlying math was quite simple.

Initial Results

When we ran the simulations initially, using our baseline assumptions about parameter values, the results indicated that the typical Scud hunt sortie was probably unsuccessful. In fact, we estimated that the chance was less than 1 percent that an F-15E sortie would detect and kill a Scud TEL if it were exposed in the search area while the F-15E was searching for it. Of course, these first quantitative estimates depended on highly uncertain data, so the results were heavily caved. For example, we had to estimate the probability that the F-15E’s multimode air-air and air-ground APG-70 radar operating in the ground-imaging synthetic aperture radar (SAR) mode would detect an exposed TEL if it was in the radar’s field of view. Similarly, we had to estimate the associated false alarm rate based on past data-collection experience with SAR systems similar to the F-15E’s. The false alarm rate proved to be the most important and uncertain parameter in the simulation.

Given the large uncertainties, we focused on sensitivity analysis. We often plotted results in a “spider chart” as shown notionally (due to security classification of the actual results) in Figure 2. A spider chart plots the MOE (e.g., Scud kills) versus changes in various parameters P1, P2, . . . . The baseline case is the spider’s body, with each parametric excursion forming a pair of legs. If these legs were nearly horizontal over a reasonable range, as with P2 in the figure, then the results were insensitive to that parameter. On the other hand, if the legs showed considerable positive or negative slope (e.g., P1, P3, and P4), then that underlying uncertainty was critical. If a parameter was critical and the uncertainty was large, the study team focused parallel project activities on resolving those uncertainties.  

Given the quick-reaction nature of RAND’s initial Scud hunt study, it was impossible to resolve many of the critical uncertainties, but the results supported the heavily caved “best guess” that the hunts were likely unsuccessful, together with the reasons behind that judgment. The problem areas iden-

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8In some cases a more complex approach is needed, as when the parameters are potentially correlated or their combined effects are nonlinearily dependent on the individual parameter values.
Figure 2—Spider Charts Show Sensitivity to Parametric Excursions

tified implied priorities for both near-term measures and longer-term RDT&E initiatives. The improvements we suggested were evolutionary. That is, we did not seek or discover promising new systems concepts or technologies that could confidently solve the problems we identified, but we did find several affordable modifications to deployed systems that would improve their capabilities in future scenarios similar to Desert Storm.

Details remain classified, but the Scud hunts were unsuccessful because the systems had inherent limitations (for Scud hunting) that were not well understood during the war. Tactics were ad hoc, but they were not the limiting factor. The limitations were intelligence shortfalls and operational and technical performance limitations of the surveillance sensors, attack-aircraft sensors, and processing systems. We know TELs were detectable for a time before and after a missile was launched, but those periods were brief and the TELs were often outside the coverage of systems such as the airborne Joint Surveillance, Targeting, and Reconnaissance System (JSTARS). So the first shortfall was surveillance coverage deep inside Iraq. If a TEL was detected, the sensors typically could not recognize it as such—sensor resolution limits were inconsistent with target discrimination. Therefore, the TELs (a very small fraction of all large vehicles in the area) were lost in the background traffic, and other vehicles (including decoys) were often mistaken for TELs and attacked. Finally, when cues were generated (e.g., by DSP), the responsiveness of the battle management/command, control, communications, computer, and intelligence systems (BM/C4I) and CAP aircraft was inconsistent with effective attack prosecution. The aggressive and innovative crews did their best with what they had, but
what they had was designed for other missions and was not up to the mission of finding and destroying Scud TELs.

SYSTEMS ANALYSIS ON COUNTERING TBMs

The Desert Storm analysis was a historical problem: How well did the coalition do, and what were the lessons learned? After that analysis was completed, RAND was asked by the Air Force and OSD to think about the TBM problem more generically. How might the threats evolve, and how should the country best prepare to counter them? The approach we used was a classic systems analysis that built on the insights developed from Desert Storm, but that examined a wide variety of future threats, scenarios, operational concepts, and costs.

Threat Operations

For analysis purposes, we assumed that the system to be countered incorporated a stressful mix of modes as follows:

1. Ground mobile TELs, logistics support, and C³ systems.
2. Garrisons to accommodate peacetime operations.
3. A series of crisis and wartime technical support/resupply bases, hides/shelters, and presurveyed launch positions.

Although other basing possibilities exist, including such options as very hard underground silos or ship-launched ballistic missiles, they will not be discussed further in this paper for the following reasons. First, fixed targets such as silos are potentially vulnerable to very accurate conventional weapons and probably would not be attractive to our future adversaries (although Desert Storm attacks on soft fixed launchers were much less effective than originally believed). Also, fixing the missiles in silos would, coupled with their limited range/payloads, reduce flexibility. Second, we judged it less likely that our adversaries will develop TBMs based on aircraft, ships, or submarines, and we noted that even if such threats develop, attacking them will be special cases of U.S. counterair and naval operations. In what follows, then, we discuss only the mobile-missile threat.

The threat's TBM concept of operations (CONOPS) would depend on the mission and scenario context. If the TBM mission were peacetime or crisis coercion, then the threat CONOPS would emphasize measures to protect the missile systems from preemptive strikes. If the mission were warfighting, then the CONOPS would include measures to assure timely and effective missile
salvos. The threat operations would have three distinct phases: peacetime, crisis, and war.

The peacetime CONOPS would accommodate training, security, survivability, and readiness needs. It would be designed to assure a smooth transition to crisis and wartime modes (if they differed). Day to day, some fraction of the TELs might be deployed to field sites for training or survivability. Additionally, the process of preparing additional wartime sites and "hides" (i.e., hiding places) could continue. From time to time, there would be field exercises to test the systems and crews. Occasionally, operational tests would include missile launches (perhaps with flight data telemetry).

Although some hides and launch positions would be used in peacetime exercises, wartime operations would probably not be limited to these sites. New launch sites could be covertly surveyed as required, and ad hoc shelter potential could be exploited (e.g., wartime use of hides in urban areas might be planned but not exercised).

The TBM CONOPS in a crisis would be the transition to a wartime posture for survivability and effectiveness. TELs and support vehicles would leave their garrisons and deploy to wartime technical support field sites or hides within range of their targets. The command authorities would, no doubt, be careful about maintaining positive control.

During the war, the CONOPS would be to launch strikes as ordered, while avoiding detection and attack. Launches would probably occur in salvos to maximize shock value, while saturating defenses such as Patriot. These launches could be preplanned, minimizing the need for communications between leadership and the missile batteries, or they could be in response to battlefield dynamics, in which case a more responsive BM/C^4I system would be required.

TELs and crews would remain in the hides or technical support field sites to which they were dispersed until ordered to launch. Since the launch of a missile presents a strong signal, the launch site would be considered unsafe immediately after launch. Consequently, the crews would "shoot and scoot" to a hide. Still, the TELs and support vehicles would be exposed and in motion for some time before and after launch. If, for example, they shot from very near the hide they had been occupying, they might wish to abandon that hide and travel to a new one some distance away after launching. Or if they wanted to continue to use the hide they occupied before launch (because it contained reload missiles and other support assets, for example), they would drive a safe distance away before launching the missile, dashing back to the same hide afterwards. (It is possible that the Iraqis used a variation on this theme, using "temporary hides" between the launch sites and their main hides/resupply sites.) If possible, these launches would be scheduled to minimize detection
potential (e.g., at night, in bad weather, or during predictable gaps in satellite or airborne surveillance coverage).

While this characterizes the general CONOPS, the details are more difficult to pin down and would be important to counterforce operations. These include the following:

- Hide characteristics (number, location, type, vulnerability, detectability).
- Launch timelines (transit to launch area, prelaunch preparations, launch, takedown, transit to hide). The total timeline might be between 15 and 45 minutes, with 30 minutes as a nominal figure.
- Missile range and likely targets (hence possible deployment areas).
- Reloads. If there were a TEL for each missile, the TELs would be expendable after launch, meaning that only the crews and necessary support systems would have to escape to a hide. If there were more missiles than TELs, the TELs would be reloaded by some sort of resupply vehicle or from hidden stores of missiles.
- C3 systems (centralized or decentralized using land lines, including fiber optics, radio at diverse frequencies, couriers).
- Other radio frequency emissions (e.g., weather radars).
- Stealth, camouflage, cover, and deception (CCD), and decoys (hides, TELs, ...).
- Defenses (soldiers, AAA, shoulder-fired IR SAMs, radar SAMs ...).
- Special weapons (e.g., nuclear) and handling procedures.

It should be recognized that the actual wartime TBM CONOPS might not be very well known to U.S. planners. The simple reason is that the TBM missions and systems have a lot of operational flexibility that can be invoked without compromising effectiveness. For example, other than short wartime moves for survivability against counterbattery threats, TBM systems can remain hidden well in the rear. The equipment is relatively indistinguishable from normal background-clutter objects such as large commercial or military trucks and other vehicles. TELs do not have to engage enemy forces or occupy and hold territory as do tanks and armored personnel carriers. They do not have to be in relatively predictable locations (other than as dictated by range limitations) as do, for example, mobile SAMs, which are typically deployed near the assets they are defending.

A System Structure for Studying the Problem

The threat model we used was not a “validated” threat in the formal sense, but rather something we synthesized to capture the essence (and uncertainties)
of describing the future land-mobile TBM threat. We thought first in terms of the Scud-like systems of Desert Storm, but we considered many variations and uncertainties to capture critical issues that should affect planning for future threats.

The key to the analysis was the description of a set of candidate extended-counterforce CONOPS. "Counterforce" includes systems and tactics aimed at significantly reducing or eliminating the enemy's ability to conduct threatening offensive operations with TBMs by attacking:

- The fixed TBM support infrastructure (industry, transportation systems, supply depots, garrisons, fixed launchers, shelters, and command, control, communications, and intelligence/targeting centers [C3I]).

- The mobile/transportable systems elements in the field (TELS, missiles and warheads, missile resupply and maintenance vehicles, crew vehicles, C3I vans, and security/air defense forces).

In addition (hence the phrase "extended counterforce"), we considered Air Force operations against the TBMs in flight (boost and, possibly, early mid-course or "ascent phase") and other "forward area" Air Force operations that might enhance the effectiveness of non-Air Force "rear area" active defenses (e.g., warning and sensor cueing).

In the analysis, we assumed the following: The peacetime extended-counterforce CONOPS would be intelligence operations in preparation for possible crisis/war time missions. The specific intelligence operations would be tailored to the threat area, but certain general features would be common.

- Overhead imagery and electronic intelligence (ELINT) would identify fixed TBM infrastructure assets such as fabrication sites, test ranges, fixed launchers, supply storage, garrisons, training areas, field launch sites, road networks, and some C3I facilities.

- Terrestrial radars, airborne imaging, and ELINT would monitor missile tests and exercises, giving U.S. planners an understanding of the threat CONOPS and technical capabilities.

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9It is common in the defense community to use "ascent phase" to mean the period after boost phase but before apogee. However, the boost phase is also a period of ascent, so we have deviated from that common but unfortunate jargon. The distinction between the boost and postboost portions of ascent phase are important. Boost-phase intercepts occur while the rocket is thrusting when lethality is very high and it is obvious whether the missile, if hit, has been killed. Later ascent-phase intercepts would occur exoatmospherically. They may be less stressing technically and economically than boost-phase intercepts (e.g., more engagement time and easier end-game homing outside the atmosphere), but lethality is uncertain, damage assessment may be difficult, and some debris (including warheads) might still follow a ballistic path to friendly areas, confusing the defenses and causing damage.
• Human sources (HUMINT) would monitor the flow of critical technologies and equipment, watch and exploit the international flow of TBM technical and military specialists, infiltrate TBM operational commands, and recruit in-country agents.

• These diverse types of information would be fused into a useful intelligence product describing:
  — Numbers and disposition of weapons of mass destruction.
  — Missile system technical features (reaction time, range/payload, range flexibility, missile-boost intensity profiles, CEP, TEL mobility, reliability).
  — Order-of-battle data.
  — Multispectral signatures of dispersable assets (e.g., TELs and decoys).
  — Location and vulnerability of critical facilities (e.g., storage bunkers, fixed launchers, command posts, communications facilities, etc.).
  — Wartime threat CONOPS (C³, dispersal plans and deployment areas, potential hide sites, lines of communication, numbers of vehicles in a battery, CCD, air defenses, security forces, etc.).

In a crisis, the TBM intelligence focus would need to be sharpened and surveillance intensified. If possible, sources should monitor TBM deployment areas to detect and track dispersing TELs, warheads (particularly weapons of mass destruction), and other equipment to their field hides. The intelligence systems would also monitor C³ sources to build a threat picture and provide strategic and tactical warning. Preemptive strikes might be necessary. Obviously, the potential for success would be strongly dependent on the quality of the intelligence picture.

The wartime CONOPS would include missions against fixed TBM assets, mobile systems in the field (before and after launch), and in-flight missiles. The general structure of the operational concepts that we explored is illustrated in Figures 3 and 4. This logical decomposition helped us identify possible counterforce paths, with their unique systems and operational requirements, and helped us perform an overall "completeness check" on the counterforce concepts.

Arrayed along the top are bubbles representing the possible states of the TBM threat. Arrayed in the left column are bubbles representing the critical generic extended-counterforce processes to be accomplished. The rectangular cells then indicate the specific processes applicable to each state of the threat. For example, MTI stands for "moving-target indicator," a system such as JSTARS that can detect and track moving vehicles in a clutter background using Doppler processing. Similarly, MTID stands for "moving-target identification," a notional system that can both detect and discriminate between TELs
Figure 3—TBM Extended-Counterforce Event Structure (Prelaunch)

Figure 4—TBM Extended-Counterforce Event Structure (Postlaunch)

and other moving vehicles. Extended-counterforce CONOPS must have a feasible path following the arrows from the top row to the bottom row. Figure 3 covers prelaunch phases of TBM operations; Figure 4 covers postlaunch phases.

Assessing the potential ability of current and programmed systems to effect these CONOPS was, then, the study's objective. The systems and issues shown in Figure 5 constituted a baseline that stimulated consideration of up-
graduated systems (and some new systems). By and large, we focused on evolutionary extension of existing platforms because of fiscal realities: The services may be forced to do the best they can with what they have. In any event, this was a good place to start. The discussions in the next section provide a general overview of the structures and the systems and issues as they figure in prelaunch, postlaunch, and boost-phase or ascent-phase intercept operations.

**Prospects for Prelaunch Counterforce Operations**

The requirements and means for attacking fixed targets are not unique to the TBM threat. Since many of the TBM-related targets would be hardened and proliferated (e.g., weapon storage bunkers), the most efficient means of attack is likely to be air-delivered precision-guided munitions (PGMs) such as laser-guided bombs. An important precursor to the TBM CONOPS would therefore be operations against C3I systems to blind or paralyze the air defense systems, followed by offensive counterair (OCA) and suppression of enemy air defenses (SEAD) missions to achieve air supremacy, so that the interdiction missions against fixed TBM facilities could be carried out at acceptable attrition levels.

The extent to which attacks on the fixed infrastructure could meet U.S. overall counterforce objectives will vary from theater to theater and scenario to scenario. The prognosis in general, however, is not very hopeful, for the fol-

<table>
<thead>
<tr>
<th>Detect and track</th>
<th>Identify and handoff</th>
<th>Kill</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prelaunch operations:</strong></td>
<td><strong>Intelli (NTM,...,</strong></td>
<td><strong>SOFs</strong></td>
</tr>
<tr>
<td>+ Fixed infrastructure</td>
<td>+ Battlefield surveillance</td>
<td>+ Mines</td>
</tr>
<tr>
<td>+ Dispersed/mobile elements</td>
<td>- JSTARS</td>
<td>+ Attack platforms</td>
</tr>
<tr>
<td>- Support</td>
<td>- ASARS</td>
<td>- A-10, F-15E,...</td>
</tr>
<tr>
<td>- Missiles/TEIs</td>
<td>- Other</td>
<td>- Cruise missiles</td>
</tr>
<tr>
<td>+ SOFs</td>
<td>+ SOFs</td>
<td>- TBMs</td>
</tr>
<tr>
<td>+ Implants/mines (LOCUs)</td>
<td>+ Implants/mines (LOCUs)</td>
<td>- ATACMS</td>
</tr>
<tr>
<td>+ Aircraft platforms</td>
<td>+ Attack platforms</td>
<td></td>
</tr>
<tr>
<td>(manned, RPIs, UAVs)</td>
<td>- A-10, F-15E,...</td>
<td></td>
</tr>
</tbody>
</table>

**Boost and postlaunch operations**

+ DSP,...
+ Battlefield surveillance
- AWACS?
- TPS-69 or 75
- CB
+ SOFs
+ Implants/mines
+ Attack platforms

**Kill**

+ SOFs
+ Mines
+ Attack platforms
+ Misile
+ Airborne laser

Study focus on items in italics.

**Figure 5—Architectural Elements for Countering Mobile TBMs**
ollowing reasons. First and most important, it is very likely that the TBM mission-critical systems would be dispersed to wartime hides before the war starts. Second, killing these fixed targets might not be easy. They would likely be hardened and distributed and have built-in redundancy (particularly C\textsuperscript{3}I). Finally, intelligence might be poor, causing U.S. planners to focus on the wrong subset of fixed targets.

Once dispersed and in a "warfighting" posture, mobile TBM systems are a formidable challenge. Prewar intelligence might identify likely dispersal areas and constraints, finding suspected hides and presurveyed launch positions, identifying road networks and travel patterns, and so on, but currently conceivable counterforce CONOPS would still have to commit significant assets to finding the targets. This would involve detection and identification in the face of CCD countermeasures and air defenses. Once found, mobile systems would need to be tracked or killed promptly or they would be lost, so attack timeliness is an issue. Finally, all of this must be done with expensive systems that might be in short supply (e.g., surveillance aircraft) and which, therefore, could not tolerate much defensive attrition by airborne interceptors, SAMs, and AAA.\textsuperscript{10}

**Attack Operations on Fixed Targets.** Various weapons might be used to attack fixed targets. If the targets were localized accurately (in a common coordinate system so that mapping and other localization errors were reasonable), indirect fires from MLRS or tube artillery might be used. Air-delivered weapons might be used for deeper targets. The weapon choice and effectiveness would depend on scenario-dependent factors (range, \(P_e\), availability, survivability, and an assessment of the likelihood that the target does, in fact, consist of important TBM assets).

If there were too many potential targets to attack them all, then the CONOPS should include some sort of "occupancy check" or target verification prior to attack. This could be done in a variety of ways. However, assuming that none of the surveillance and intelligence assets that were used to develop the candidate targets can help (for example, the target planner cannot have an SOF soldier take a look), the best near-term approach would be to have an aircraft such as the F-15E fly near the target and image it using its APG-70 radar in the SAR mode or image it with LANTIRN. Unfortunately, due to the resolution limit of the F-15E's SAR, target discrimination capability will be limited, but it might be good enough, given other indicators. If a more

\textsuperscript{10}Army systems such as ATACMS may also be able to play a role in TBM counterforce missions, but range limitations vis-à-vis 600-km Scuds, reaction time lags, and long missile time-of-flight currently limit effectiveness potential. The Army is addressing these issues, but at the time of our study it was our judgment that only airborne systems had significant extended-counterforce potential.
positive target ID is required, the F-15E would have to approach closer (say to within a mile or less from a 10,000-foot altitude) to image it with LANTIRN.\textsuperscript{11}

**Attack Operations on Mobile Targets.** A variety of sensors might detect a TEL in motion. Possibilities include:

- Covertly implanted sensors at key road junctions or in suspected deployment areas. These could be unmanned seismic/acoustic, chemical or radiation detectors, or IR/visible imaging systems, or they could be manned lookouts with long-range passive imaging systems. If unattended ground sensors could detect and discriminate TELs, it might be a small additional effort to turn these sensors into lethal mines. Other possibilities would be to attach tags covertly to the TELs so that U.S. systems could follow the vehicles to their hides to wipe out their "nessy," or detections could be communicated to a central commander who would order other systems such as tactical aircraft to respond.

- Aircraft-based moving-target indicator (MTI) radars (on manned aircraft such as the TR-1 and JSTARS or on unmanned UAVs and RPVs). As JSTARS demonstrated in Desert Storm, MTI systems can be very effective. The problem is that the current MTI systems have limited discrimination potential (an exception might be wheeled versus tracked vehicles, due to the unique 2X doppler from the tracks).

It is conceivable that technology will support an effective moving-target identification (MTID) capability in the future,\textsuperscript{12} but for now, how might our limited (nondiscriminating) MTI systems be used?

One approach is a form of gatekeeping. Suspected hides that, for whatever reason, target planners could not or did not want to destroy, could be surveilled by airborne MTI systems. Any traffic that was spotted would be, by association, a TBM system. Another approach would be to watch possible deployment areas and track vehicles suspected of being TBM-related—either because of the distinctive number of vehicles in the group or because the vehicles were in an area where non-TBM systems would not be expected to be seen. However, depending on the quality of U.S. intelligence, this area surveillance mode might filter out anywhere from most to almost no "possibles."

Given a possible TEL track, the CONOPS would be to track it until it stopped, at which point the spot would be imaged by other onboard sensors or by another platform and sensor cued by the MTI aircraft. The imager might be a SAR or millimeter wave (MMW) radar system with good all-weather,

\textsuperscript{11}Second-generation FLIRs may improve effective ranges by a factor of two or more.

\textsuperscript{12}The Navy's S-3 patrol aircraft currently has an "imaging MTI" system that exploits the known target motion (e.g., the pitch and roll of a ship at sea) to create low-resolution images.
day/night capability or an electro/optical (E/O) system for which weather might be an issue. To be of value, the image would need to have adequate resolution to identify the target. In theory, SAR images of this quality could be obtained from various sources. A variety of other imaging systems could be imagined, but the baseline CONOPS would use platforms such as either JSTARS or the TR-1, due to availability and responsiveness limits on other conceivable platform options (including all satellite systems).

The analysis issues here all relate to the detection characteristics of the MTI ($P_d/P_{fa}$), search rate, processing capacity, coverage areas (standoff [for survivability] and range limited), and data fusion potential (in the MTI platform and offboard in a central BM/C4I system). The same issues must be addressed for the necessary spot imaging of targets once they stop.

Since the JSTARS/ST-1 cannot attack the targets they detect, they must pass cues through a BM/C4I system to other systems that can prosecute an attack. If confidence in the track were high or traffic were light, an aircraft such as the F-15E might be vectored to the contact before it stopped (i.e., before it could be positively identified). More likely, however, the attack aircraft would be cued only after the TEL stopped and was fairly confidently identified. As with the attacks on fixed targets described earlier, the F-15E could acquire the target with its SAR or LANTIRN and, depending on the surface-to-air threat, might stand off as far as possible and drop weapons or first approach for target ID confirmation using LANTIRN.

Clearly, as in earlier cases, given a target's coordinates, a variety of weapons might be used to kill it. In this case, however, we assumed that the TEL might have been spotted on the way to a launch position. This implies that there would be a very short time to get to it before its missile was launched (a few minutes for advanced threats, up to 30 minutes for a current Scud).

An alternative prelaunch-kill CONOPS would be to use the strike aircraft as both detection systems and kill systems (recon-strike). For example, as was attempted in Desert Storm, F-15Es could fly over suspected launch areas and search for exposed TELs using their SAR and/or LANTIRN. They would attack contacts that satisfied their attack criteria. (In Desert Storm the criterion seemed to be "if it is a blip in the suspected Scud area, kill it." Target discrimination was not attempted, partly because AAA and IR SAM concerns kept the aircraft high (above 15,000–20,000 feet) and as far from the targets as possible.) The analysis issues center around sensor search rates, $P_d/P_{fa}$, and probability of recognition, $P_r$. These will be influenced by rules of engagement (minimum altitude, for example) and the scenario-dependent clutter.\textsuperscript{13} Clutter includes "cultural" objects (e.g., commercial tractor-trailer trucks) and natural

\textsuperscript{13}There is a possibility that the unique, potentially very large signature from the TEL with the missile erected vertically might be exploitable.
features that might fool the sensor operator (the assumption is that in the near term the only "automatic" target cueing/recognition [ATC/ATR] would be done visually by the pilot or weapons system officer [WSO]; in the future, data-processing technology may improve this capability, making it truly "automatic").

Prospects for Postlaunch Counterbattery Operations

Ballistic missile launches are difficult to hide from launch-detection satellites. So if in the future the United States fails to some extent in its prelaunch counterforce operations (as seems very likely), the fallback might have to be postlaunch counterbattery operations, using the very observable launches to localize the launch point.

Counterbattery attacks might be important from several perspectives. First, the enemy might intend to reload the TELs and use them again. This makes sense if the TELs are relatively complex and expensive. Unfortunately, as missile technology improves, the TELs could become less complex and costly, so that in the extreme, they might become "throwaways." Even if that happened, however, a counterbattery capability would have a negative effect on the crews, who might be less inclined to launch missiles if they knew they would be unlikely to survive.

The counterbattery CONOPS would start with a launch detection and resultant launch point estimate derived from backtracking the booster to the ground. This could be done with DSP by fitting the observed hits (spacing and intensity) to boost templates. Alternatively, the missile might be detected and backtracked by a radar on an aircraft or, less likely due to range limits, by a ground system such as the Air Force TPS-75 and the Marine TPS-59, or by the ship-based Aegis Spy radar. This initial TBM launch-point prediction (LPP) cue could be characterized by the launch-point uncertainty in CEP terms and its timeliness (time from launch to cue receipt).

If the LPP uncertainty were very small (say, a few hundred meters), this CONOPS would degenerate to the previous case, in which attacks were generated against prelaunch contacts. The LPP could be attacked with various indirect-fire weapons or aircraft. The only difference might be the timeline. The time from launch to movement away from the launch point might be very short, e.g., less than five minutes. When data-processing and cue-dissemination times are subtracted, the TEL might be running before the cue got to a shooter. Because of this, it probably would be necessary to use the initial cue to localize the TEL for detection and track by other area-surveillance systems such as JSTARS and/or to vector CAP aircraft such as F-15Es to the area where they would search for the TEL.
If the LPP were passed promptly to, for example, JSTARS, the CONOPS might be as follows. JSTARS would image the LPP uncertainty area at the highest possible SAR resolution in hopes of detecting the stationary TEL and support vehicles. The area to be imaged might be fairly large for current DSP capabilities, but great improvements are possible. A radar such as the TPS-75 with the “expert missile tracker” hardware and software modifications could reduce this area still further.

The location of possible TELs identified in these images would be compared with historical and real-time MTI data. The JSTARS operators would review their recorded MTI data in the LPP area to see if any candidate TEL hits corresponded to traffic patterns consistent with TBM operations. If the historical MTI data eliminated some of the imaged targets, then the next step in the CONOPS would be more effective. That step would be to focus the real-time MTI system on the suspected TELs to watch for movement. Here again, the operators would be looking for telltale patterns. Those contacts that passed these “reasonableness” filters would be tracked with the MTI system until they stopped. The stopped vehicles would again be imaged in the hopes of identifying the targets.

In the meantime, an attack aircraft such as the F-15E would have been vectored to the LLP area. When it arrived it would get the best data JSTARS had at that time. As JSTARS data were refined, this would be passed to the F-15E (either directly or through a command center such as an airborne command, control, and communications system [ABCCC]). This means that there might be possible TELs at a number of fixed coordinates and there might be possible TELs in motion. The F-15E would begin trying to sort these out, attacking targets that met the attack criteria.

How the F-15E could best operate, given these data, needs to be analyzed more carefully. For example, it may be that the F-15E SAR could not improve on the target ID capability that JSTARS provides (the two SARs currently have about the same resolution limits). This suggests that the F-15E might use the SAR for initial “target” acquisition. Once acquired, these targets would be attacked, probably using LANTIRN. In this case, the objective would probably be to attack targets from the maximum possible altitude and standoff range for survivability against AAA and IR SAM threats that might be colocated with the

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14 Of course, the feasibility of tracking small clusters of vehicles from JSTARS-like standoff distances depends on the nature of the terrain and other obstacles (e.g., cities). For example, the Naval Weapons Center’s “Line-of-Sight Handbook” shows that for a platform at 30,000 feet, the distance at which, on average, 50 percent of the ground targets would be visible is 250 km in flat terrain but only 50 km in “rough” terrain. If the criterion were 97.5 percent area visibility, these ranges would drop to 125 km and 25 km, respectively.
TELs. Therefore, it is unlikely that LANTIRN could contribute much to an improved target ID.

If the target locations of the fixed contacts and the tracks on moving contacts could be passed to the F-15E accurately enough (and there were no significant navigation, mapping, or reference system biases), the best target-acquisition mode for the F-15E might be to rely only on LANTIRN. The “target” the F-15E might find could be the exposed TEL or a suspected hide. Depending on altitude and standoff constraints that would be defense driven, the F-15E might be able to get close enough to the target to identify it. “Close enough” is probably a slant range of a few kilometers. If the only search/target acquisition system were LANTIRN, issues of the SAR performance against moving targets and the need for an MTI mode to find movers become moot.

Of course, if the F-15E had to search the LPP on its own (because it was outside JSTARS coverage, for example), then crews might find that the LANTIRN field of view/sweep rate was too small to be effective, so the F-15E might search primarily with the SAR, using the radar to cue LANTIRN for target “confirmation” and attack. In this case, an MTI mode might be desirable, particularly if the SAR and MTI modes can be interleaved.

As time goes on, the initial LPP would grow in size as the TELs fled. The search would end when the aircraft had expended its fuel or munitions (on possible TELs and hides such as buildings) or the TELs had probably reached their hides undetected (as little as five to fifteen minutes after launch).

The options here are many and complex, and most of them would require extensive efforts. The only near-term option we identified involved autonomous F-15E operations as described briefly in the summary section below. First, however, let us consider prospects for postlaunch kills.

Prospects for Boost-Phase or Postboost Ascent-Phase Intercepts

Both the prelaunch and postlaunch counterbattery CONOPS are very challenging and may prove to be too expensive to implement and too sensitive to responsive threat countermeasures. The sensors supporting these CONOPS need to have near-continuous availability and high search rates. The system must also be able to cull out false targets (a significant current deficiency). Finally, target contacts must be prosecuted within minutes. If these CONOPS prove to be unattractive, the shortfalls may suggest alternative CONOPS that might prove to be relatively attractive—in particular, boost or later ascent-phase TBM intercept.

The a priori logic behind shifting the focus to boost-phase or ascent-phase (BPI-API) intercept CONOPS (sometimes also referred to as “inflight”) is as follows:
• The enemy might be able to hide his TBM systems before launch, but it is unlikely that he could do much about masking the actual missile launches. When missiles were launched, U.S. sensors would no doubt see them.

• Tight timeline requirements against the TELs postlaunch based on launch detections might drive the United States to new hypersonic air-launched standoff missiles. These missiles would need some sort of terminal homing or area coverage with smart submunitions, which are technically risky and, therefore, expensive.

• Compared with the difficulty of the counterbattery system sketched out above, an in-flight intercept might be more attractive. The target signature of the in-flight missile is huge, the background clutter and decoy potential are nil, and the interceptor performance required for in-flight intercept is comparable to the missile performance required to attack the ground assets before they escape (3000–5000 ft/sec to ranges of 50–100 km).

With an in-flight intercept CONOPS that has intercept missiles (hopefully SRAM-sized or smaller) carried on CAP aircraft, a goal would be to minimize the number of aircraft needed to cover the likely launch areas. Thus, the issue is: How far out could the interception take place? The answer will depend on details that are still to be determined, but it is clear that boost-phase intercepts would not be possible if the intercept aircraft were cued by DSP. So the most likely solution would be to have modified air-air radars or simple IR sensors on board the patrol aircraft that could detect the missiles and target the interceptors.

SUMMARY AND CONCLUSIONS

Clearly, extended-counterforce options involve major technical and operational challenges. Nonetheless, they could prove exceedingly important. Attacks on fixed TBM infrastructure targets involve no special challenges. Our capability for such attacks will grow naturally as precision-strike capabilities improve (toward all-weather, high accuracy, long standoff, and high lethality). Attacks on time-critical mobile TBM systems are another matter and, as the paper has indicated, are likely to require a broad range of extended-counterforce measures for success.

Finding discrete mobile targets such as TELs in an uncertain clutter background is very challenging. Based on prior intelligence, counterforce operators would focus their search on the most likely deployment areas, but these could still be quite large and dispersed. The large search areas and brief exposure times of TELs imply that search rates will have to be very large. Furthermore, success will probably require a sequential, multilevel search-and-detection operation, followed by effective target-discrimination and recognition processes.
based on sensors operating on multiple platforms in diverse parts of the spectrum and using computationally intense automatic target cueing and recognition (ATC/ATR) to achieve a high probability of detection and a suitably low false-alarm rate. Relevant technologies and systems are being investigated in R&D efforts at ARPA and elsewhere, but are generally not yet mature.

The one bright spot is the ability to exploit the TBM's launch and boost signatures. A single IR sensor on a synchronous satellite can detect and track multiple ballistic missile exhaust plumes over the entire threat region in near real time. A radar, either on the ground or on an aircraft, can track the missile in flight at long range, as could an airborne IR sensor and laser ranger/tracker. The bottom line is that if TBMs are used, the launches should be visible. When the launch is seen, it is obviously too late to kill that missile on the ground, but several options still exist if the launch point can be localized quickly and the information passed to appropriate systems:

- Target the launch point, killing the TEL if it is still there. If there are multiple reload missiles per TEL (as there were in Desert Storm), this would be militarily important.

- Cue surveillance assets to the launch area so that they can find and trail the TEL to its hide site or resupply area. The hides can then be monitored or attacked by standard interdiction systems.

- Cue assets based on the launch signature and estimated trajectory data. Kill the TBM in its boost phase (high lethality and minimal problems of damage assessment) or later in its ascent (more dubious lethality and greater damage-assessment difficulties, but more time for the attack and little difficulty with atmospheric effects).

In considering the first two options, the study team concluded that the best, and perhaps only, near-term option would be to use F-15E aircraft on combat air patrol (CAP), as illustrated in Figure 6. The F-15Es would use their APG-70 air-air radar (with rather straightforward and inexpensive software modifications to detect and backtrack TBMs in flight). The range at which an F-15E might be able to detect the missile is, in fact, nicely balanced with the range at which the F-15E could subsequently fly to the estimated launch point and attack the TEL before it could escape. Alternatively, the F-15E could fly to the launch area and find the TEL using the radar in the SAR mode (if the TEL were still stationary) or find it with LANTIRN, even if it were moving. It could then be trailed, using either LANTIRN or the radar in the MTI mode. The running TEL or the hide/resupply site could then be attacked, or this in-
Figure 6—Possible Near-Term Autonomous F-15E Counterbattery Concept

formation could be handed off to another system for continuing monitoring and subsequent attack.

We performed a first-order force sizing assessment and investment strategy for this concept and found that it is feasible if it is possible to achieve "modest" intelligence successes in order to limit the potential launch areas that would need to be covered by these CAP aircraft. Although the next war is unlikely to look exactly like Desert Storm, it is nevertheless relevant to note that if this concept had been available, the same resources used in the unsuccessful Scud hunt could have been quite effective in counterbattery attacks. Instead of about 90 missiles launched, there might have been less than one or two dozen launched over the course of the war.

If the launch areas were larger next time, more dedicated aircraft would be needed for a high level of counterbattery effectiveness, but even if it was not possible to cover all launch areas, the counterforce operations could have some success, which would limit the enemy's operational flexibility and effectiveness. As a side benefit, this concept could be extended to a modest boost-phase intercept system, with the development of an intercept missile.

The options for attacking the TBM in flight all involve advanced capabilities that are not currently in hand. They have great potential value, however. Further, some of the critical elements of these options are the same as those required for the counterforce options described above.
Implications

Our quick-look study of extended-counterforce options had several implications for policy, programs, and operations:

- TBM extended-counterforce missions are not a lesser included case of current and projected airborne interdiction missions. Special programs are needed.\(^{15}\)

- While robust capabilities would require breakthroughs and major investments, nontrivial improvement of capability could be achieved with modest expenditures and minor modifications to deployed forces (as suggested in the discussion attending Figure 6).

- Investments in counterforce R&D and acquisition should be brought more "in balance" with other TMD initiatives within BMDO, under BMDO leadership and direction, and with BMDO funding. In parallel, the U.S. intelligence community should give these problems much greater emphasis.

- TBMs, particularly if armed with weapons of mass destruction, will have a dramatic effect on U.S. coalition building and power projection. U.S. leaders need to realize that prospects for extended-counterforce capabilities are inherently uncertain. Further, military leaders in a future MRC will likely not be able to predict confidently the success of counterforce operations (either preemptive in a crisis or in response to wartime threats). This means that we may have to accept greater risks or stay home.

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\(^{15}\)In the two years since Desert Storm, U.S. counterforce capabilities have not improved.
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Chapter 17

MILITARY ISSUES IN MULTINATIONAL OPERATIONS

Margaret Cecchine Harrell and Robert Howe

Given the increasing likelihood of U.S. military involvement in future multinational operations, there is a need to rethink the general preparation and employment of U.S. forces for such operations, including how the forces should be selected, organized, trained, equipped, deployed, sustained, and controlled. From assessing results of recent operations and from comparing current Army procedures and preparations with those of other nations, we conclude that there are important changes in doctrine and training that should be made. These changes do not require large-scale or fundamental changes in Army structure, but they will not occur unless given high priority and sustained attention.

INTRODUCTION

Recent years have seen an increasing willingness from the international community to intervene in what used to be considered purely internal matters. The 1990s have even seen a willingness to intervene with force. The examples in Iraq, Somalia, and the former Yugoslavia are breaking new ground and, if they indicate a trend, hold some profound implications for the United Nations, regional international organizations, the United States, and the U.S. Army. This paper describes some of the changes the Army may need to make if it is to be better prepared for and more effective in a wide range of multinational military operations.

There is a limited experience base for learning lessons relevant to the current era. Prior to World War II, one or more of the "great powers" would intervene when it felt that its interests were threatened, but the interventions were usually of a different character than the ones of interest today. Since World War II, the United Nations has conducted numerous peacekeeping operations, but although these have typically involved military forces, their purpose has almost

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always been to monitor compliance with a truce or a cease-fire agreed to between the parties before the commitment of forces. It was not anticipated that military action would be necessary to enforce or impose the agreement. Indeed, the UN force could be withdrawn if one or both parties revoked the agreement (this occurred in the Sinai in 1967). The situation is seldom so straightforward today.

UN interventions have often been long term and relatively open ended. The operation in Cyprus is approaching its 30th anniversary, and the observer group in Kashmir is approaching its 45th. The mandates that establish or extend such operations usually do not even address the subject of termination. The presence of the UN force sometimes appears to reduce the parties’ incentive to negotiate a solution, since the situation remains reasonably stable and the costs of the force are borne by others (e.g., in Cyprus and Kashmir). These loosely defined missions are tolerable when the cost is low. The United Nations Military Observer Group in India and Pakistan (UNMOGIP) is estimated to cost about $7 million per year, and there have been only six fatalities in its 45 years. The United Nations Protection Force (UNPROFOR) in the former Yugoslavia, on the other hand, is costing the UN over $900 million per year (plus unreimbursed costs by the participants), and there have been 59 fatalities in less than two years. The second United Nations Operation in Somalia (UNOSOM II) has had even higher costs in money and lives. Costs such as these in recent operations make open-ended commitments much more worrisome.

For the United States, the cost of most UN peacekeeping operations has been mainly financial, since the Cold War kept the military forces of the United States and the Soviet Union on the sidelines. While continuing to bear the ever-increasing financial costs, the United States is now under growing internal and external pressure to commit forces to a variety of operations. Whether and how to become more involved and whether and how to effect changes in the United Nations to make it more effective in these operations are very pressing issues but are beyond the scope of this paper. Our concern is with the implications of these peacekeeping/peacemaking operations for the United States military, and particularly the Army, if we do become involved.

In the next section we discuss multinational operations, the issues they raise, and the lessons available from other countries. We address these issues in the context of military activities that take place in preparing for and conducting any military operation, and we assess the impact of multinational, particularly peacekeeping, operations on them. The activities we address are selecting, equipping, training, deploying, organizing, controlling, and sustaining the force. In the final section we present some conclusions about those implications and the changes required for U.S. forces to participate most effectively in future multinational peace operations.
MILITARY ISSUES

For any military operation, there are certain classes of activities that must be conducted to accomplish the mission. The individuals or units to carry out the operation must be selected and trained, organized, and equipped. They must be deployed to the area of operations and sustained while deployed. They must be subject to good command and control while carrying out the mission and eventually being withdrawn. However, the emerging class of commitments for multinational peace operations appear to require some modification of current U.S. military notions of how to prepare for and execute missions.

Some activities, such as training, will require adjustments or additions for those units likely to participate in multinational operations. Other activities may vary enough to conflict with conventional experience and maximum military effectiveness. For example, at one point during the UN operation in Cyprus, the local population developed a particular animosity toward the British soldiers and were inclined to attack British patrols. To counter this, the operation commander integrated the patrols so that each nationality participating in the operation was represented on each patrol. The differing national doctrines and training standards probably would have reduced the military effectiveness and limited the response capability of the patrols. However, the multinational patrols had the desired effect of deterring attacks, so the potential reduction in effectiveness never was tested or became a problem.

If military operations exist as a continuum with conventional operations at one extreme and pure observer missions at the other, it is clear that the tension with conventional doctrine occurs around the middle of the continuum. This is evident in the control and organization of missions. When conventional combat is certain, the units should always operate as national entities at as high a level as possible for maximum effectiveness. For observer missions, combat is not part of their mission, and multinational participants can be integrated at a much lower level. In the middle, however, the situation will generally be unclear and hard decisions will be necessary.

In the next few pages we will discuss military activities as they pertain to multinational peace operations. As appropriate, we give examples from previous commitments under UN or other international auspices and present solutions that appear to have been successful. The purpose of this section is to provide the basis on which to draw lessons for the U.S. Army, which we will discuss in the concluding section.

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1M. Harrell recently visited a MINURSO (the United Nations Mission for the Referendum in Western Sahara) observer site in the Western Sahara that was staffed by sixteen officers representing a total of eleven countries and five continents.
Selection

Selection of individuals or units to participate in multinational operations is, arguably, the most critical step in the mission. There are significant variations among nations in the approach to this step. Even within the same nation the process and criteria have changed between operations. The process ranges from complete volunteerism by individuals to the involuntary assignment of existing units.

Prior to about 1990, virtually all multinational operations were classic peacekeeping or observer operations under the auspices of the United Nations. The staffing of these operations was characterized by the more or less complete exclusion of the United States, the Soviet Union, Japan, and China. Those who did staff the missions can be loosely divided into two categories: relatively well-to-do nations from Europe and the Americas who provided forces at considerable expense to themselves out of a sense of obligation, and Third World nations that, whatever their sense of obligation, found that the United Nations payments more than adequately compensated their expenses. The former tended to use volunteers, whereas the latter would more commonly send existing units, although there are many exceptions.

The Nordic nations provide a classic example of the use of volunteers. Those nations all have universal military service, so virtually the entire adult male population has basic military training. Each nation periodically asks for volunteers for UN missions and selects the proper mix of individuals for known or anticipated missions. These individuals are then formed into units as appropriate and trained prior to their deployment. Upon return from the mission the volunteers return to their civilian or military occupations, and other volunteers are sought for subsequent missions. This process is facilitated by common training procedures among the countries and by specialization in the conduct of certain training, such as that of military observers.

The volunteer process has worked quite adequately for low-intensity missions such as that of the UN Force in Cyprus. The forces involved are relatively small, operations are at the small-unit level, and the units are expected to avoid conflict under all but the most extreme circumstances, such as when they come under attack. The 1990s, however, have ushered in new types of multinational operation. Operation Provide Comfort, in the aftermath of Operation Desert Storm, for the first time found the international community imposing itself to provide humanitarian relief without the acquiescence of the country involved. The various operations in Somalia similarly found the United Nations entering more or less uninvited, with quite large force requirements. And in Cambodia, the UN Transition Authority was invited to supervise the transition, but the forces required to do so were far larger than for previous operations. Thus, some of the new missions have been large and non-
traditional. At the same time, however, the UN has continued to carry out more-traditional peacekeeping missions in Pakistan, the Middle East, Africa, and Central America. Thus there is now a broader range of missions.

This broader range of missions is causing a rethinking of the nature of the forces and operations needed. Norway and Denmark, which have traditionally relied on individual volunteers for individual missions, have recognized that this process is inappropriate for some of the emerging missions (i.e., those that go beyond classic "monitoring"), and thus they plan to form a standing force for missions in which hostilities can be expected and for which obtaining volunteers at the time might be difficult. At the same time, the United States is experimenting with individual volunteers from the Reserve Components to staff part of the Multinational Force and Observers in the Sinai, which, although not a United Nations force, has many of the characteristics of a UN peacekeeping force. Other nations, such as Finland and Sweden, plan to stay with their traditional process but recognize that they can do so only by restricting the missions for which they will provide forces. More generally, then, it seems that there is no single approach to selecting and preparing personnel for UN missions. In some cases, missions can be performed by individual volunteers, but in other cases standing units with appropriate training will be necessary.

Unit selection varies by country. The Nordic countries have traditionally formed standby units designed explicitly for UN missions. They continue to do this when the forces deployed leave them sufficient room under their legislated ceiling. The standing brigades being formed in Norway and Denmark would be in addition to these standby units. Canada predesignates the unit likely to deploy for the next peace operation. Interestingly, this unit is rarely deployed; generally there is sufficient preparation time to deploy other units. The U.S. selection process is complicated both by the wide variety of force types available and by the political implications of any warning or deployment order. Thus, the political tendency is not to designate a unit until employment of U.S. force is certain.

Discussions during this research indicated some limitations in the Army personnel records system. A number of cases were described in which individuals were identified serendipitously as having an ideal background for particular missions, after personnel-record screening had failed to identify them. The Army has an extensive system of personnel records that include, in principle, information on language skills and ethnic background. It was beyond the scope of our research to study whether the problem was in the completeness of the records or the technique used to search them. However, the rather exotic locales of some missions, and the rapidity with which they are sometimes mounted, establish the need for the Army personnel records system to identify
rapidly and reliably, for example, someone who grew up in Haiti and is presently serving in the United States Army.

Equipping

Equipping a force is a separate issue regardless of the selection process. Aside from activities such as Operation Desert Storm, more properly described as a war, multinational operations tend to have requirements for which almost no normal military unit is properly equipped. Truce-supervision or election-monitoring missions require little or no weaponry but may require proportionately enormous mobility assets, since the distances involved are usually very large in relation to the size of the monitoring force involved. Other, less benign, environments such as Somalia place different demands.

A unit required to perform convoy escort and protection, as well as security of relief workers and supplies, needs to be able to defend itself and its charges. Since it is trying to avoid open conflict, it should be able to rely on non-provocative passive protection as much as possible, so that not every incident requires response with firepower to protect the force. However, most armies of the world tend to have either light infantry or heavy mechanized forces. Neither is appropriate for the average peacekeeping or humanitarian relief mission.

In many scenarios, mechanized forces have weapons and vehicles that are more powerful than required for the threats they are likely to face. They place enormous demands on lift forces, are difficult to sustain, and lack the capability to see and be seen without excess risk to themselves or the adversary. Infantry forces, on the other hand, are useful for urban patrolling but lack the mobility to operate effectively outside of urban or other close environments. So, regardless of the type of unit selected for a mission, it will likely need to be reequipped to perform it. One of the better equipment decisions to date seems to be the armored HMMWV recently acquired by the U.S. Army for operations in Somalia. This vehicle combines occupant protection with all-around visibility and retains the option to deliver fire if necessary. It also overcomes a major flaw pointed out to us by some Nordic officers that their armored wheeled vehicles place the driver directly over the front wheels, where he is at much greater risk if the vehicle hits a mine. The armed vehicles with side gun ports used by the Botswana forces are also well suited.

Other less-expensive equipment is also needed by U.S. troops in preparation for multinational peace operations. U.S. forces in Somalia needed face shields and batons to passively protect themselves and provide crowd control and passive force protection; hand-held metal detectors for weapons searches; shorter-
barreled weapons for urban operations; and more communications equipment to accommodate the vast territory of Somalia.\(^2\)

Equipment issues have some serious implications for the United States and the United Nations. Many of the countries likely to provide forces for the United Nations lack the resources to provide themselves with the equipment to be effective in more demanding environments, and the UN procurement system is not designed to acquire and store equipment for future operations. Thus, the United States and its better-equipped allies are likely to find themselves under increasing pressure to provide equipment for large contingents from other nations. These demands could range from chemical protective masks and communications equipment to helicopters and other mobility assets. Although it is fairly simple to provide boots or guns to other contingents, even chemical protective masks require training for proper use. Further, although the lack of equipment will compromise a contingent’s effectiveness, some shortages are likely to limit the capability of U.S. forces serving in the same mission. For example, the United States was unable to use tear gas in Somalia as a defensive or crowd-control measure until the other UN contingents were supplied with chemical protective masks.

**Training**

Training military personnel for multinational operations has many dimensions, but the underlying requirement is a solid foundation of basic military training and the discipline derived from such training. With such a foundation, the additional requirements for multinational operations can be learned quite readily. Experience has shown, however, that contingents without such basic skills and discipline can become part of the problem rather than part of the solution in multinational, and particularly peacekeeping, operations.\(^3\)

Training requirements vary considerably by the type of mission. The closer the mission is to conventional combat, the less unusual training is required for U.S. forces. Lower-intensity operations such as observer missions and extended protection of humanitarian relief (for example, Iraq and Somalia) place

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\(^2\)The lack of proper equipment can also create morale problems, especially when other national contingents have equipment seemingly better that that available to U.S. forces. Some 10th Mountain Division soldiers resented the fact that the Tunisians had later models of the M-16 than they did, and that some contingents had bulletproof vests, whereas the Americans had standard flak jackets.

\(^3\)The *Washington Monthly* (1994) cites an example of the Bulgarian contingent in Cambodia, some members of which had been released from prison for the mission. Reportedly, some members of the contingent threatened the life of LTG Sanderson over pay issues, and on the flight home they wrecked the inside of their aircraft.
requirements on military personnel that differ from normal operations and hence require a degree of specialized training. In some cases the force must "unlearn" some skills and habits. For example, in active combat, military units on patrol attempt to avoid being seen while observing as much as possible. But in many peace operations, being seen is as important and perhaps more important than what the patrol sees.

There are a number of approaches used by different countries to train for United Nations or other multinational operations. Of these, the training conducted by the Nordic countries is the most formal and established. Each country conducts one specialized training course for the benefit of all and, increasingly, for personnel of other nations. Thus, the courses for observers, staff officers, military police, and logisticians are conducted by combined faculties so that common standards prevail. In addition, the four countries have formed a common committee for the development of training standards, which publishes a common training manual for troop training for United Nations operations. Unit training is generally conducted by the officers of the unit, with support from the specialized centers. The officers receive extensive orientation that usually includes a visit by the commander and key staff to the area to which the unit is being deployed.

Some other nations have developed various forms of specialized training facilities, in many cases patterned after those of the Nordic countries or the one developed by Great Britain to train units being sent to Northern Ireland. The United States has only recently begun to participate extensively in multinational operations with the United Nations and has developed no specialized UN training facility, although there are discussions about the desirability of doing so. However, the curriculum at both the JRTC\(^4\) at Fort Polk and the CMTC\(^5\) in Europe has been modified to give units a basic familiarity with such operations during their regular training cycle.

Given a general familiarity with the issues, and conventional combat skills, there are two kinds of specialized training that U.S. units or individuals deployed will require. The first includes the skills generic to these kinds of missions, such as negotiation and increased combined operations experience.\(^6\) This requirement is most likely to affect officers and noncommissioned officers. The second addresses mission-specific issues, including culture, rules of engagement applied to likely tasks such as cordon and search, and the human-

\(^4\) Joint Readiness Training Center.
\(^5\) Combat Maneuver Training Center.
\(^6\) Experience has shown that junior officers require more combined operations experience in the new multinational operations that may conduct combined tactical operations. In conventional operations, only the more senior officers required combined operations expertise.
tarian relief organizations (HROs) and other organizations in the mission area. In addition, the projected organization of the multinational force must be considered, to provide as broad as possible ability to work with the other national contingents. This training should be provided to deploying units, and it would also benefit significantly from the example of similar programs currently being conducted.

Deploying

In most past multinational operations, the force deployed either to a friendly country or to a situation in which the parties wanted their presence. Hence, the force went into a benign environment, and no special attention to deployment was required. Chartered civilian aircraft were usually quite adequate.

There is an increasing tendency for operations to involve environments that, if not openly hostile, carry at least a risk of immediate conflict upon entry. This has been demonstrated in the U.S. concern about security upon initial entry into Somalia and the more recent example of opposition to entry into Haiti. Given the risk of armed opposition, more and more attention will inevitably be paid to forced entry capability.

There are very few countries in the world with even a minimal capability for forced entry, and no other country approaches the United States in this regard. Hence, future operations are likely to see calls for the United States, and a few Western European countries such as France and England, to perform the initial entry and then to establish a secure environment for the deployment of other national contingents. Such an approach could involve acute sensitivities, however, since many of the likely sites for future operations are in areas with a history of European colonialism or U.S. interference. Further, such a policy would be counter to an important objective in multinational operations—spreading the burden and risk while demonstrating that the world is united behind the operation.

Organizing

Organizing can be separated into two different sets of issues: the organization of multinational missions, and unit organization. Organization of the mission headquarters staff and the geo-military division of tasks and territory is vital to the success of multinational missions, and it is loaded with very visible political obstacles. The force commander should be a good choice militarily and should also not appear to have political bias; staff elements must represent the variety of countries and continents involved without compromising head-
quarters capability. For example, staffing the headquarters intelligence element will be more important in the missions that resemble peace enforcement or conventional warfare, such as Somalia or Bosnia, than it is in traditional peacekeeping or observer missions, such as Cyprus and the Sinai. Because the United Nations does not have an intelligence capability, intelligence-critical missions such as Somalia must rely largely on the intelligence assets of the contingent countries, especially the home country of the intelligence staff officer. The UNOSOM II French U2\(^7\) was supported by an American Deputy U2. This arrangement provided sufficient intelligence input to the planning staff, but still only limited intelligence was releasable to some of the contingents involved in the mission.

Despite the international concern for political impartiality perceived vital to the success of many UN missions, there remains considerable U.S. concern about the command of its forces by foreign commanders. The belief that some foreign military leaders with limited military experience are politically appointed, as well as fears of different degrees of concern for troop safety, have produced a public reserve about U.S. soldiers operating under a non-U.S. commander. The UNOSOM II organization was designed to counter these reservations as much as possible. Although the force commander, General Cevik Bir, was Turkish, the American Major General Montgomery was the deputy force commander as well as commander of U.S. forces in Somalia. The U.S. combat troops in Somalia reported to Montgomery but not to Bir. Such a compromise may be useful in future missions also. The problems with the command situation in Somalia appear to have resulted not from the in-country command organization but from issues of control and command organization for U.S. soldiers that bypassed the established UNOSOM II and USFORSON\(^8\) commands.

Unit organization will become increasingly important if small units—e.g., brigades or battalions—continue to be deployed without their superior division or corps. These units will require increased self-sufficiency in areas such as maintenance, transportation, and civil-military relations, and they may require some revision in the U.S. Army approach to organizing for combat. The organization and control of the logistics elements may become increasingly important.

If the current experiment with using volunteers for the Multinational Force and Observers (MFO) in the Sinai is successful and the Army chooses to continue the approach of forming voluntary, ad hoc units for sustained missions, then organizing the force will become a greater issue. A type Table of Organization and Equipment (TO&E) must be developed and volunteers

\(^7\)The U2 is the intelligence staff officer for a United Nations command element.

\(^8\)U.S. Forces Somalia.
sought for the specific skills involved. These personnel must then be assembled, organized, equipped, and trained for the mission. This may well call for increased U.S. participation in the programs of other countries or, more likely, the creation of an element similar to the United Nations Training Centers in the Nordic countries.

Controlling

There are many special control issues in multinational operations. Some, involving differences of command-and-control procedure, intelligence sharing, language, and cultural differences, are due to the multinational nature of the operations. Others are due to the particular constraints under which UN forces must often operate, and they show up in such matters as rules of engagement.

Despite the established command structure of any UN mission, the actual control of any forces in a multinational mission will continue to be problematic. While countries agree to the established UN mission organization, most retain their option to "call home." Although all contingents formally report through their contingent commander to the UN force commander, most also report unofficially to their own national command. This arrangement is usually not problematic in traditional and stable missions. But those missions that experience creeping objectives or increasing threat will have a greater degree of problems with contingents that refuse the force commander's orders, or refer to their national command for approval. Ironically, it is in just these circumstances, such as seen in Mogadishu, that force commanders need to rely upon the contingents' response to directions.

Despite the established command structure of any UN mission, the actual control of U.S. forces will vary. Concern about the command of U.S. forces is reflected in the following statement by President Clinton:

My experiences in Somalia would make me more cautious about having any Americans in a peacekeeping role where there was any ambiguity at all about what the range of decisions were, which could be made by a command other than an American command with direct accountability to the United States.9

Some of the complexity of command issues can be seen in the Somalia experience, in which the U.S. Logistics Support Command and UNOSOM II staff were under the operational command of the UN, while the initial U.S. combat forces were under the tactical command of USFORSOM (with Major General Montgomery acting as the commander of U.S. forces in Somalia and also the deputy UN force commander under General Bir). The arrangements

were apparently not entirely satisfactory, since the issue of clear control of U.S. forces was addressed again as a new Joint Task Force to be commanded by Brigadier General Carl Ernst was contemplated in October 1993:

Key Pentagon officials said the decision was aimed at establishing clear U.S. control over U.S. forces . . . Montgomery's role has at times been clouded by his parallel title of deputy commander for UN operations in Somalia . . . the new structure would effectively strip Montgomery of his hands-on responsibility for U.S. warfighting in Somalia.10

These variations in control complicate planning, especially contingency planning. Furthermore, Generals Bir and Montgomery had some difficulty during UNOSOM II ascertaining whether certain contingents would participate in a response operation. For example, the Italian contingent declined participation in some operations and required coordination through political channels, the Pakistanis expressed reluctance,11 the French have been cited as "unable or unwilling,"12 and the Moroccans needed frequent approval from their home command.

Intelligence capabilities also complicate planning and the control of forces. U.S. units will receive intelligence from U.S. national assets with various levels of restriction placed on its dissemination. It can be expected that at least some other participants may have equally constrained information. Thus, some contingents may be expected to conduct activities without being told why. The strange bedfellows resulting from the process of obtaining participation in multinational operations are unlikely to produce a high level of trust and respect among the participants. Since the UN is unlikely to create a true intelligence capability, the problem of information sharing is a long-term issue, and procedures must be developed to limit the problems resulting from restrictions.

Some of the control problems in multinational operations can be alleviated by having liaison officers with local civilian agencies and HROs as well as among the militaries. However, the effectiveness of any mission liaison officer is restricted both by the intelligence issue mentioned above and by language and culture. These difficulties are alleviated somewhat because UN operations commonly use English as the lingua franca. However, while officers assigned to observer missions are usually fluent in English, the troops assigned to larger missions are likely not to be. The U.S. military has trained many personnel in language, and the Army in particular has a Foreign Area Officer (FAO) program involving not only language but extensive training in the appropriate culture. But the FAO program was never very large, and it has concentrated dis-

12 Elliot (1993:34).
proportionately upon Europe and the Far East, as has most of the non-FAO language training. Army Special Forces also contain many individuals with language and cultural skills, and unlike the FAOs, these skills are likely to be oriented more toward Third World nations in which peace operations are more likely. Like the FAO program, however, the Special Forces are not a large organization, and they have many missions.

The problems that can result from the limited availability of linguists are illustrated by the difficulty in locating Somali/English interpreters. It has been reported that only seven individuals in the entire U.S. military establishment were fluent in Somali in 1992. The Army used headquarters staff with foreign language skills as liaisons to the various contingents, but some liaisons depended completely upon the other contingent's English skills. Hence the liaison to the Moroccan contingent in Somalia once found himself under fire without any English-speaking noncasualties among the Moroccans.

Liaison is further complicated by the fact that many of the people with whom the military will have to deal will have little understanding of the military and may be actively antimilitary. This will likely be especially true of the volunteer nongovernment organizations, many of which were formed largely due to mistrust of or dissatisfaction with government agencies, including the military. In Somalia, the relationship between the humanitarian relief organizations and the United Nations command was based on coordination rather than an established chain of command. Some, including Admiral Howe, have suggested that there needs to be a clearer sense of who is in charge. Because the operations of the two are fundamentally different, despite increasingly similar objectives, coordinative relationships are frustratingly ineffective. However, HRO control of the military is obviously unlikely, and military control of the HROs would be equally unattractive to the HROs and in direct violation of some HRO charters. Hence, expanded participation in multinational operations will generate increasing pressure on the Army to expand its linguistic and cultural capability at a time when budget and manpower pressures make it organizationally difficult to expand anything, even if the number of personnel involved is small.

Rules of engagement (ROE) are a key aspect of controlling forces. In peace operations these tend to be quite elaborate and restrictive. The vast territory over which many peace operations extend, variations in communications equipment, varying national styles of operations, and different degrees of training among the contingents further complicate the application of ROE. Newly evolving missions such as the Somalia operations will include even more complicated ROE. Further, interpretation of the ROE will vary because of differences in training, and possibly different cultural biases about the people of the host nation.
In Somalia, the ROE depended upon perceived threat and proportional response. While the contingents responded within the ROE, there was a great deal of variation in interpretation. Anecdotally at least (with all the shortcomings of such information), the Pakistani forces were notorious for their more brutal responses; the Belgians believed in “smacking the people and then feeding them”;\textsuperscript{13} the Malaysians sometimes fired indiscriminately;\textsuperscript{14} and the Italians were the source of ill will amongst the UN forces for their soft treatment of the Somali people. Although there was considerable public concern that the U.S. forces might resort to the application of major force for which they are superbly trained, training vignettes and individual anecdotes indicated possibly excessive restraint by the U.S. forces—more than that required by the ROE or recommended for personal safety by the high command. In our discussions, we also found that even within the U.S. forces there were often considerable differences in the way the ROE were perceived at the various levels of command, with the lower echelons frequently interpreting them in a manner more restrictive than intended.

The control problems associated with multinational peace operations are not new, and are not likely to be resolved easily. The political issues of whether U.S. forces should be commanded by other than a U.S. officer have received considerable attention. The final decision is, to a large degree, external to military control. Regardless of the decision, the U.S. military must prepare for missions where the control of some contingents is uncertain, where language problems are likely, where intelligence resources are not communally available, and where contingency plans are both vital and uncertain.

**Sustaining**

Traditional peacekeeping/observer missions have not had elaborate logistical requirements. Because these missions rarely involve combat and are often small, the ammunition and other requirements are limited. Countries generally are expected to provide deploying contingents with 60 days of equipment and supplies, and then the UN is to provide most support while the countries continue to provide specialty and cultural items such as certain foods. But because of administrative problems, the transition to UN logistical support is frequently problematic even when costs are low and the environment benign. For example, reimbursement for items purchased by the countries is extremely slow and often depends upon local contractor support.

\textsuperscript{13}Anecdote by U.S. Army officers who had interacted with the Belgian forces in Kismayu.

Moreover, sustaining the newly evolving UN missions will be a substantially more difficult task than it was in the peacekeeping and observing missions of the past. Forces may be larger and heavier than before, and there may be more countries involved, with uncertain support from local governments and contractors. All of this suggests increased sustainment demands and difficulties, as well as substantial interoperability and distribution problems. Even if the contingents involved are self-sustaining for the first 60 days of the mission, it is doubtful that the UN system could manage the daily food, water, petroleum products, and maintenance support necessary during the balance of an extended mission. If, as in Somalia and as is more likely in future missions, many contingents deploy without initial support from their own country, the logistical problems will begin at the start of the mission.

Combined operations are likely to place heavy demands on a logistics structure that is staffed and stocked to sustain only the U.S. force. If accommodation is not made for these demands in advance, the quality of sustainment of U.S. units is likely to decrease. When contingents show up poorly prepared, the United States, or other lead countries, can be expected to provide for them. Regardless of past attempts to insist that contingents come well prepared for the mission, duties, and theater location, some countries continue to send poorly equipped and prepared contingents with little or no materiel, inadequate personal gear such as boots or coats, and limited or no rations. Regardless of any policy to do otherwise, it is likely that the United States will have to provide, at least initially, support for these other nations.

In contrast, when countries plan to sustain themselves, the United States will have to share airfield and port access. Many of the decisions on access are politically determined before deployment. Thus, countries may obtain airfield or port access disproportionate to their actual or planned troop involvement. Because future missions are likely to take place in less-developed areas, these agreements could stress already meager port and airfield facilities.

The United States may also expect to provide some support to the local people. Although there have always been civilian victims of military conflicts, the newer breed of mission that assumes or requires some degree of consent from the hosting people will increase the level of local assistance for several reasons. First, the goodwill of the people is important to the mission, and people are more receptive to militaries that bear clothing, other comfort items, and food. Secondly, the lack of a true rear area will increase the U.S. military exposure to such victims. Ironically, the U.S. military will likely have less difficulty if the mission objectives include such support, as provisions are likely to be provided by sources other than the U.S. military. If, however, humanitarian support is not a stated objective, it is likely that the U.S. military will find some of its own sustainment going to the local population.
The United States may expect some sustainment from the UN or some other regional organization sponsoring a mission. However, this sustainment is likely to be limited by bureaucratic delays and obstacles. The UN is unaccustomed to supporting missions with dozens of countries and thousands of personnel. The UN is also limited by the deficit of UN payments by member countries and by strict purchasing restrictions imposed by member countries. The UN requirement to select the lowest bidder resulted in such inadequate items in Somalia as fire trucks without hoses, spotlights without bulbs, and barbed wire lacking barbs. Further, the geographic restrictions for new suppliers resulted in multiple-month delays for equipment that could have been purchased and shipped within the week from the United States.

When the United States contributed the Logistics Support Command to UNOSOM II, many believed it was both a unique capability and vital contribution to the mission. However, the French contingent in Somalia depended on the UN only for water and fuel; it received weekly food and mail flights and 70 sealift containers monthly. Likewise, the Canadians received three C-130 logistics flights daily. While the U.S. logistic support is an excellent capability and a well-valued contribution to UNOSOM, many UNOSOM II staff acknowledged that other countries could provide similar support, and it seems apparent that a combined logistics effort of involved countries could also support the mission. While many attribute the impending failure of the Somalia mission to the scheduled U.S. departure, this is more because of the resulting political message than the withdrawal of logistical support. Even Admiral Howe acknowledges that the U.S. logistical support will be missed less than the U.S. communications capability. While sufficient sustainment is unlikely to result solely from UN logistical support of future missions, U.S. logistical support is not the only solution; other Western countries involved in the mission can provide mission sustainment. Regardless of the contributing countries, however, the interoperability issues and the involvement of less-prepared countries will continue to complicate any large-scale mission.

15This is, to a large degree, a U.S.-imposed restriction.
16From an interview with Major General Montgomery.
17Determined as a function of the site of the operation.
18From an interview with Douglas Manson, Director of Administration, UNOSOM II.
19From an interview with Admiral Jonathan Howe, Special Representative to the Secretary General, UNOSOM II.
CONCLUSIONS

It seems clear that there are a number of important measures, including procedural changes, that should be taken to improve the effectiveness of the U.S. Army in preparing for and conducting multinational operations. These should be a high priority. On the other hand, it is interesting to note that the measures needed would not require large-scale or fundamental changes in Army structure and training. The existing base is a good deal more appropriate than is sometimes realized. We may continue to have problems, however, since even though many of the measures we suggest don’t require fundamental change, that does not mean they will be easy.

With very few exceptions, the overriding concern in the performance of the tasks involved in such operations is either personnel selection or control of operations. Good leadership and disciplined troops are the key factors. Although multinational peace operations differ considerably from the conventional operations that the United States has most of its experience in, the U.S. Army can adapt for the opposite end of the conflict continuum. This is not to say that trained conventional forces are automatically prepared for peace operations, but rather that there are straightforward measures and means to accomplish the adaptation. It is interesting to note that some other countries have concluded that conventionally prepared forces can adapt to peace operations somewhat more readily than they adapt back.

The increase in the variety of likely U.S. military missions continues to add to military training and preparation requirements. Given these competing priorities, preparation for peace operations must entail minimum effort and maximum effect to still accommodate conventional readiness and strength. However, the adjustments required are relatively small and manageable, and many of the issues have already been addressed by other countries.

The United States has capabilities in several fields that far exceed those of any individual country and in some cases, such as strategic airlift, probably exceed the capability of the rest of the world combined. On the other hand, it does not have large numbers of infantry units and is likely to have even fewer in the future, while the armies of most countries are primarily infantry. Hence, it would behoove the United States to avoid commitment of significant-size infantry units that can be supplied by others and to expect to supply specialized forces in which it has a comparative advantage, such as aviation, intelligence, communications, and airlift. In some circumstances the ability to operate at night, which is present in most U.S. Army units, may also prove to be a capability that should be supplied to multinational peace operations.
One difficulty encountered when the decision was made to take part in the humanitarian effort in Somalia was the absence of detailed planning for such things as obtaining linguists. It appears that the limited amount of planning resulted from the concern that beginning to plan openly would indicate a decision to intervene and might in essence produce a political imperative. Since good planning would have entailed many actions which by their nature could not be kept secret, some essential planning was deferred until after the decision. However, it appears that the services and the Joint Staff could alleviate some of this problem by announcing openly which forces would be called upon if a decision were made to commit to a multinational operation in a particular region or in a particular time frame. The units on the list could then take such actions as necessary to prepare for potential deployment without co-opting the political process in doing so.

Even if such designation were made, however, it can be expected that at the time of commitment there would be changes in the troop list. Hence, all or at least many Army units need a broad familiarity with multinational operations.

The level of peace operations is increasing at the same time that the size of the active army is shrinking rapidly. There is, however, a large pool of prior-service personnel serving actively in the reserve components. Reservists have demonstrated in the past a willingness to be activated voluntarily when they can contribute. The Army has begun to explore ways to include these personnel in supporting long-term operations. It is unlikely that mobilization authority will be available for routine operations, and units can hardly be expected to volunteer en masse, given pressures of job and family. But for many support functions and for relatively low-intensity situations, units formed specifically for a particular deployment and then disbanded upon return might work for the United States as they have for the Nordic countries and others. Obviously, the role of such units would be limited, but if they can be used effectively it will reduce the burden on the active component that is heading toward being overcommitted. It will be necessary to create a support structure to recruit, train, and support such units, but indications are that this structure could be considerably smaller than the portion of the Army that would be relieved of the deployments. One caution, however, is in order. If the experiment is successful and expands to missions beyond the MFO, then individuals who volunteer for such units should volunteer for deployment as necessary rather than for specific missions or localities. The experience of the Nordic countries illustrates the difficulties that mission-specific contracts can cause.

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20 We recognize that there are objections within the Army to such a unit designation. However, we do not mean to imply that the unit so designated would have peacekeeping as its primary mission, but rather that it would serve in a similar capacity to the ready brigade of the 82nd Airborne Division and could plan accordingly.
There is a need for an organization responsible for determining doctrine, training, and equipment needs for units deployed in situations in which a unit's normal structure and equipment are inappropriate and for acquiring and storing special items of equipment. The need for such an organization was highlighted by the experience of the 10th Mountain Division in Somalia cited earlier. The light infantry was not designed for some missions and situations that it encountered, and it needed augmentation of vehicles and communications equipment to be effective in its area of operations. Such augmentation had not been predicted, and there was need for hasty training and doctrinal modification.

The suggested organization should not be one that simply collects after-action reports, but should be capable of ensuring that someone has the responsibility and authority to do something about deficiencies and to plan ahead. It should be a high-level organization because, in addition to monitoring doctrine and training, it should develop, procure, and store certain equipment packages that would be available equally to any deploying Army unit, be it the 10th Mountain Division, the 25th Infantry Division, or the 1st Cavalry Division.

The U.S. military, and the Army in particular, can expect to become increasingly enmeshed in multinational operations of various types. It is to be hoped that the ability of the United Nations, or perhaps regional organizations operating on its behalf, to plan and sustain such operations will improve. But this cannot be assumed, and the United States must be prepared to provide not only for itself but for other participants in the operation.

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