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THE

MILITARY

TECHNOLOGY REVOLUTION

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A STRATEGIC
FRAMEWORK

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FINAL REPORT OF
THE CSIS STUDY GROUP
ON THE MTR

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CENTER FOR STRATEGIC
AND INTERNATIONAL STUDIES
WASHINGTON, D.C.

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P R E F A C E

This report is the product of a six-month study involving six senior CSIS analysts, several visiting military fellows, and over 75 outside experts. With so many people involved and so many issues to be examined and debated, the process was not always clean or tidy. But the study design fulfilled its basic purpose by producing dozens of helpful insights, subjecting drafts of the report to careful outside critiques, and providing a forum for an exchange of views among nearly 100 military officers, government officials, and academics.

CSIS owes a large debt of gratitude to the members of the Study Group. These experts and officials gave generously of their time and knowledge at meetings beginning early in the morning and often lasting as long as three hours. They received no compensation other than an occasional warm breakfast and, we hope, the knowledge that the final product is better for their participation. In this sense, the Study Group embodied a true spirit of public service.

We are especially grateful to the contributions of the current group of CSIS military fellows, six active-duty officers (one from each service and two from the National Guard) who chose to spend one of their allotted academic years in the unfamiliar setting of an academic think tank. They quickly became an indispensable part of our work, conducting their own long-term studies (on such topics as U.S. participation in peacekeeping operations and the security situation in Asia) and playing important roles in CSIS efforts such as this one. Our military fellows attended all the MTR meetings, reviewed drafts on their own in separate sessions, and refused to allow us to lapse into lazy generalities or questionable assertions. Their assistance was of inestimable value.

It is important to emphasize, however, that *this report reflects only the opinions of CSIS staff*. We have taken great pains to include as many suggestions and ideas as possible, but in the end the responsibility for the arguments, conclusions, and suggestions in this report rests solely with the CSIS analysts who drafted it and conducted the study. Though many certainly would have done so, no other participants were asked to give permission for their names to be used in connection with the report.

Within CSIS, the Project Director and Managers relied heavily on George Carver, the John M. Olin Senior Fellow, and on James A. Blackwell, who was during much of the study Director of Political-Military Studies (Dr. Blackwell departed before the report was drafted). Both gave wise counsel and advice on substantive and administrative matters.

This study was conducted under a government contract originating in the Office of the Assistant Secretary of Defense for Acquisition. We are delighted to acknowledge the financial support of the office of Mr. Frank Kendall, Director for Tactical Programs, OASD(A); and the cooperation of the BDM Corporation, which sub-contracted a portion of a larger MTR study to CSIS. Dr. Palmer McGrew and Dr. John Milam at BDM were especially helpful in making the project happen and sharing the results of concurrent work by BDM.

Chapter 5 summarizes the study's overall conclusions. Readers looking for a brief survey of the report should turn there, recognizing that they will not capture the depth and breadth of analysis that supports our various conclusions.

I

THE STRATEGIC CHALLENGES OF THE 1990S

Beginning roughly in 1989, the security context that shaped U.S. defense planning for 40 years has undergone a fundamental revolution. Virtually every *standing assumption* of U.S. national security policy from 1945 through 1985 has been turned on its head. Nations that were our sworn enemies are now our friends, and clamor to be our allies; some of our closest allies during the cold war are now seen as economic competitors who threaten U.S. national interests. While many overarching U.S. national interests and broad foreign policy tasks have remained the same, the threats to those interests, and the means of pursuing those tasks, would today be almost unrecognizable to a U.S. military planner in the depths of the cold war.

In short, the context for military planning has changed completely. Those who plan U.S. military forces must deal with a new world and establish, almost from scratch, what military capabilities are available, what missions best employ them, and by what criteria their effectiveness now needs to be judged.

THE CONTEXT FOR THE MTR

This study attempts to survey this new world situation and draw conclusions about the military forces the United States will need in the years ahead to meet its demands and challenges. Our major focus is not numbers—budget numbers, or numbers of divisions or air force wings—though what follows will have relevance to such questions. This study, instead, focuses on one broad but specific concern: which technologies, doctrines, and types of forces likely to be available to the U.S. military will have a revolutionary effect on U.S. military capability, and which will have only a marginal effect?

This study concentrates on capabilities associated with the Military Technical Revolution (MTR). This term refers to many aspects of military forces besides technology; in fact, it is a timely combination of innovative technologies, doctrines, and military organizations that is reshaping the way in which wars are fought. Some argue that this shift is truly revolutionary, on the scale of such epochal changes as the invention of gunpowder or the advent of mechanization.

Our study is not concerned with the largely semantic question of whether modern military technology represents a truly revolutionary or a merely evolutionary advance. Although current technologies, doctrines, and organizations certainly have the

potential to effect a revolution in military affairs, such a revolution is by no means guaranteed. Rather, the emphasis here is more pragmatic: which new technologies, doctrines, force structures, or other elements of military operations are likely to have the greatest impact on military capabilities in the next years and decades?

To answer this question, we must first resolve the most basic issue—what the U.S. military establishment is likely to be tasked with over the next decades. That is the purpose of this first chapter. Once these basic missions have been defined, subsequent chapters will consider them in detail and discuss the contribution of new technologies to each. The analysis that follows assumes a time horizon of about 15 years: the discussions of international politics, U.S. interests, and types of military operations all attempt to lay out issues that will be relevant roughly through the year 2010.

It is important to keep in mind throughout the chapters which follow that this report is an introductory one. Its purpose is to outline the MTR and provide a few suggestions about the early directions it has taken and should take. Much current thinking about the MTR lacks a consistent structural framework and a clear definition of the issues involved; it is these dimensions that this study aims to provide.

CHANGES IN INTERNATIONAL POLITICS

The new security environment has a number of distinguishing characteristics. The formerly dominant bipolar power structure now exists only artificially, in the nuclear balance. By every measure of usable power, economic and political as well as military, the world is at a thoroughly multilateral stage, albeit with a single and unquestioned lead actor: the United States. But more and more states in the developing world have the ability to challenge U.S. and allied military forces, a fact demonstrated repeatedly by Saddam Hussein's Iraq.

From an intense focus on a single global threat, Western defense planning has moved to the more complex and varied task of analyzing and preparing for regional crises and wars involving a kaleidoscopic variety of potential aggressors and victims. In part it has done so because such operations may be more likely today than during the cold war, when the risk of escalation to superpower war lurked in all regional conflicts. This shift demands, among other things, forces that are more flexible and agile than those deployed during the cold war. It also requires better intelligence on the developing world, where most immediate military missions lie.

U.S. and allied military forces also face a growing list of missions in operations short of war. Demonstrations of force, deterrent signals, peacekeeping and humanitarian duties, and possibly peace-enforcement missions—none involves a declaration of war or, in many cases, even the recognition of hostilities, but each calls for the use of military forces to serve political ends. With more regional actors needing to be

deterred or reassured, more operations short of war have been required in recent years.

Finally, more is being expected of international organizations than at any time since 1945. Today the United Nations (UN) alone has undertaken a dozen major missions which together involve over 44,000 troops and total budget of over \$2.5 billion. Discussions are under way to establish a UN military force of some kind, and whatever their outcome, every major military power, especially the United States, must deal with this collectivization of peacetime military operations.

THE SCOPE OF U.S. INTERESTS

In this new world, the United States will need to rethink the nature and scope of its national interests. Those interests will dictate the missions for U.S. forces in the coming years, which in turn will determine what kind of military forces the United States requires. Apart from defending national interests which become threatened, the United States will also continue to assume a number of overarching burdens—because to do so is in the U.S. national interest, and because any U.S. government will take pains to demonstrate its reliability and credibility as an international actor.

The most fundamental U.S. national interest has always been and remains *protection of the U.S. homeland*. Guarded by oceans on its eastern and western flanks and with essentially friendly, as well as militarily weak, nations on its northern and southern borders, the United States has not faced any serious threat of foreign invasion since the War of 1812. During the cold war, Soviet nuclear forces could have destroyed the United States, but Russia is today counted as a friend of the United States. One current task is relevant, if only in a hypothetical sense, to this interest: *nonproliferation*. In the years ahead, U.S. leaders will be increasingly concerned with halting the development and spread of weapons of mass destruction.

Eventually, through the diffusion to the Third World of nuclear weapons and intercontinental missiles, proliferation could create new threats to the U.S. homeland; already it poses additional risks for U.S. contingency forces.

Second, and perhaps of overriding importance for the next several years, U.S. policy makers will seek to promote the *economic prosperity of Americans*. U.S. economic policies will support this goal directly; foreign and defense policies will do so indirectly, helping to promote the regional stability and establish the U.S. influence supportive of U.S. economic performance. In a military sense, this may involve a number of specific tasks. Most important, the United States will continue to play a stabilizing role by remaining involved in geopolitical alliances around the globe, and by reinforcing those coalitions in peacetime through military exercises and forward presence—though possibly by very different means than it does today. By this

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presence, the United States will promote regional stability and will gain political leverage useful in trade and economic negotiations aimed at securing U.S. access to foreign markets. This economic mission will also require defense of international sea-lanes and Middle East oil, both of which remain vital to the world and U.S. economies.

Third, U.S. policy will aim at promoting *democracy abroad*, a major theme of the Clinton administration. Of special concern are Russia and the nations of Eastern Europe, whose transition to stable democracy is indispensable for long-term peace in Europe. Military forces may play only a marginal role in this process, meeting with their counterparts in new democracies and emphasizing the role of civilian control. In some cases, however, military interventions of various degrees might be conducted to advance democracy, particularly now that the world community appears willing to place limits on national sovereignty in the area of human rights.

Fourth, the United States and other major world powers are increasingly concerned with enforcing *norms of behavior*. These norms could include internal as well as external standards, such as some minimum respect for human rights. Such enforcement could take the form of a major multinational intervention, as in Korea in 1950 or Iraq in 1990-1991, or a peacetime effort to force adherence, as has been proposed for the Yugoslav conflict. The United States and its partners in the United Nations will seek to establish an international consensus against aggression, and to make that consensus stand when tested.

Fifth and finally, through its military commitments and operations the United States will seek to defend perhaps its most ephemeral interest of all: its *reputation*. It is clearly in the U.S. interest to be known as a reliable ally, a contributor to regional stability, a defender of international law, a supporter of peaceful conflict resolution, a feared adversary, and a nation committed to the common good. Such perceptions work to the benefit of the United States in ways that are both direct and indirect, both short- and long-term. In a world characterized by the exercise of political influence and "soft power," the importance of a positive reputation and image cannot be overlooked. It provides moral and political legitimacy for all other U.S. foreign policies.

CONTINGENCY EXAMPLES

Several broad, generic foreign policy priorities will therefore establish missions for the U.S. military in the years ahead. These missions will be manifest in specific contingencies, several of which are discussed below. This list is not intended to provide a complete catalog of all such conflicts; it is merely representative.

At the top of the list, in terms both of the threat it would pose and the response it would demand, is the resumption of some form of global threat. This is the *reconstitution* mission, which encompasses threats that would require the United States

to embark on a major new military buildup. This possibility exists largely in regard to those large states where experiments are under way in democracy and free enterprise, most notably today Russia and China. Not only would vital U.S. national interests be at stake, but U.S. leaders have pledged through bilateral and multilateral defense treaties to defend many of these states that would be threatened by a return to expansionism in such states.

The military requirements imposed by reconstitution depend on one's assumptions about the warning time of a new global threat. If U.S. military planners can expect strategic warning to be measured in periods of at least several years, then the West need devote few resources to it; we will have ample time to build up when a threat arises. But if warning might be shorter—less than two years, for example—or if Western leaders cannot be expected to make profitable use of the warning they may receive, then the United States must place a greater emphasis on retaining the capabilities for a global conflict.

A lesser but still significant challenge—*large-scale regional conflict*—awaits U.S. military forces in the developing world, where a number of states possess large armies and burgeoning ambitions. Iraq has already challenged world opinion and continues to do so today; if Saddam Hussein rebuilt his military and launched another attack on Kuwait, few in the United States would oppose U.S. participation in a military response. This need to prepare for a regional conflict on the scale of Desert Storm recurs in regard to other aggressive states—Iran and Iraq and North Korea in Asia.

In other regions of the world, the United States might be involved in punitive military actions designed to enforce international principles and rules. Such operations are already under way against Iraq and might increasingly be viewed as necessary in the former Yugoslavia. These missions, increasingly known as *peace enforcement operations* (distinct from the meaning of the term in the UN Charter), would require far less military force than a regional contingency. Of the various developments that might trigger the need for peace enforcement in the months and years ahead, a spread of the Balkan war to the two key regions of Kosovo and Macedonia looms especially large. But peace enforcement is a broad and ill-defined field: given the violent context and use of force, for example, the U.S. intervention into Somalia could also be defined as a peace enforcement effort, one that required over 20,000 ground troops.

To this list must be added traditional *peacekeeping and humanitarian operations*, where the fighting has been largely contained and the role of outside forces is merely to monitor the situation and provide a guarantee of the peace process. A number of



COALITION FORCES ATTACK
IRAQI POSITIONS.

venerable UN peacekeeping efforts are under way in the Middle East; recently they have been joined by large-scale—and increasingly ill-fated—UN deployments in Angola and Cambodia. Light infantry usually constitutes the basis of peacekeeping forces; humanitarian missions will call for the protection and distribution of food and medical services and supplies, providing strategic lift, building infrastructure, and, at a minimum, a military coordination function for civilian relief agencies.

Finally, in every region of the world and at every level of conflict, U.S. forces also conduct important *military operations in support of political interests*. In Europe, U.S. troops operating within the North Atlantic Treaty Organization (NATO) symbolize the American interest in and commitment to European security, promoting the use of NATO for peacekeeping and regional contingency operations, drawing Eastern Europe and Russia into the Western community of nations, reassuring friends and allies. U.S. military deployments play an even more important role in Asia, making Japanese rearmament unnecessary, deterring North Korea and reassuring the South, and encouraging China to continue to play a constructive regional role. In those and other regions, U.S. reassurances play an important role in forestalling proliferation. From Baghdad to Bosnia, U.S. forces send political messages through their presence and operations. They reinforce alliances by conducting exercises and military-to-military contacts, and they bolster the image of the United States as a reliable partner in world peace, an image critical to our influence as a great power.

MILITARY OPERATIONS FOR THE FUTURE

The preceding analysis leads us to the typology appearing in Figure 1.1, which summarizes the kinds of military operations that are likely to occur and for which we must begin planning today. Within each type of operation, a host of specific tasks or missions could be conducted, ranging from air interdiction to amphibious assaults to civil affairs to air traffic control. Any specific crisis might require a combination of one or more of these operations, either simultaneously or in phases, and each operation would need to be backed up by a number of supporting functions, such as strategic lift or space communications.

As the figure suggests, these operations can be reduced to two basic types. Combined-arms operations involve those missions for which modern technologies and doctrines were developed—large-scale, mechanized warfare of the sort that was expected in Western Europe and that, to a degree, was fought in Desert Storm. This is the subject of chapter 3. But most common, both today and in the future, is the second type of military operation—a response to tensions or outright conflicts involving irregular, infantry-based forces. Such crises, which exist today in Bosnia, Somalia, Angola, Cambodia, and a dozen other countries around the world, may demand a U.S. response.

FIGURE 1.1: FUTURE MILITARY OPERATIONS: A TYPOLOGY

COMBINED - ARMS OPERATIONS

(traditional, large-scale, mechanized operations)

■ RECONSTITUTION

If Russia becomes hostile once again and poses a threat to Western Europe, the United States is currently bound by treaty to respond. This task encompasses homeland defense, to the degree that it is a relevant or necessary task today. Unlike other contingencies, it would require a large-scale buildup of U.S. forces and the preparation for a war of truly global potential.

■ REGIONAL CONFLICT

If North Korea strikes south, the United States is committed to provide at least some level of assistance in the context of an international effort. If Iraq attacks Kuwait again, the world coalition will undoubtedly respond once more. If a Libyan/Algerian coalition threatens sea-lanes in the Mediterranean, NATO and the world will use force to ensure safe transit. Some of these conflicts might not draw the United States in directly but would call for U.S. resupply of one or more participants or for a concerted effort at conflict limitation.

■ FORWARD PRESENCE AND DETERRENCE

For some years to come, the United States will remain involved in political alliances that require forward deployment of troops, or visits and exercises by mobile U.S. forces, to signal a commitment. Regional crises could also create the sudden, unexpected need for deterrent signals displaying credible capabilities with combined arms.

IRREGULAR OPERATIONS

(infantry-based operations employing unconventional forces and primarily low-technology weapons)

■ PEACE ENFORCEMENT

Various shades of tasks more demanding than peacekeeping can be imagined. The Somali deployment would fit in this category, as would outright counterinsurgency operations in, for example, Peru. Drug enforcement operations also fall under this category, as would limited precision strikes in support of "counterproliferation."

■ PEACEKEEPING AND HUMANITARIAN RELIEF

This is already under way in a host of countries and regions, from Cambodia to the Middle East to Angola. It includes the operations short of war in the irregular category.

One task of this study is to determine the best role for MTR technologies and doctrines in these types of military operations. In larger-scale, combined-arms warfare, there is little doubt that the MTR has a role to play; chapter 3 will focus on how it can be most decisive. For irregular operations, the subject of chapter 4, the initial question is whether the MTR can make a significant contribution and, if so, what it is; a subsidiary issue is the extent to which military operations here can be considered a "lesser included case" of more major war.

These two types of military operations are also helpful in emphasizing the seamless transition required between combat and operations short of war. Strong connections exist between, on the one hand, forward presence and regional contingency operations; and on the other, peacekeeping and peace enforcement. In both cases, while engaging in the mission short of war (forward presence or peacekeeping), U.S. forces must be ready to move into combat operations (regional war or peace enforcement) rapidly and effectively.

SETTING PRIORITIES

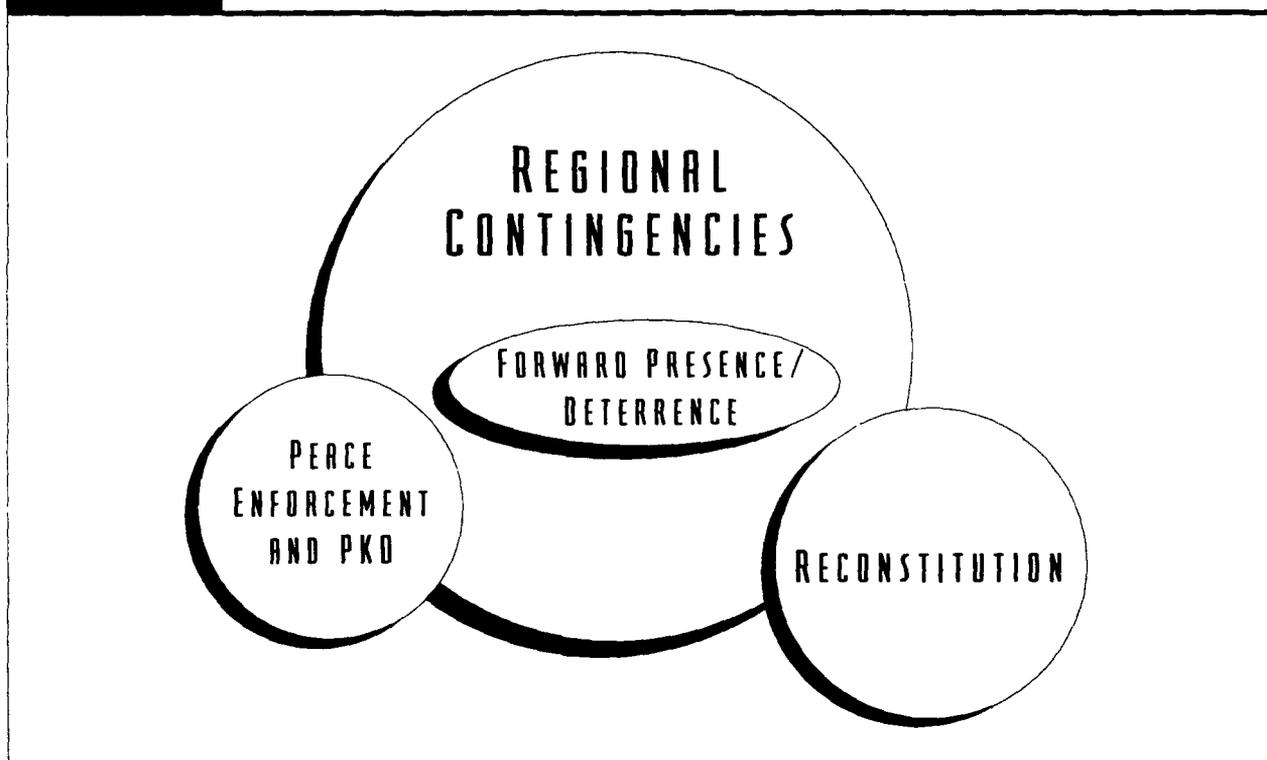
U.S. military planners cannot give equal emphasis to all possible contingencies. They possess neither the resources nor the force structure to build comprehensive capabilities for reconstitution, regional conflict, peacekeeping, and forward presence all at once. U.S. defense policy has always attempted to make some prioritization of potential missions. This is, then, the first major issue approached by this study: Of the types of military operations cited above, which should dominate U.S. military planning?

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A close analysis of the nature of various contingencies faced by U.S. forces and the U.S. interests at stake in them suggests that *U.S. military forces ought to be designed and their development prioritized with primary emphasis on regional conflicts*, with a corresponding effort to make MTR technologies more relevant to irregular operations.

This is true for several reasons. First, our examination of deterrent and forward presence missions uniformly suggests that those capabilities best suited to *winning* a conflict are also best at *detering* it. In short, what wins deters; forces that can convince a potential aggressor that it might lose a conflict do the best job of encouraging that aggressor not to go to war, provided that the state believes that the United States is able and willing to act. MTR technologies are uniquely designed to convey the impression of a U.S. willingness and ability to engage in such conflicts because they hold a promise that the United States can win—at relatively lower cost, with somewhat less collateral damage, and with a greater degree

FIGURE 1.2: PRIORITIES IN MILITARY MISSIONS



of strategic flexibility. Deterrent missions are, in this sense, a lesser included case of war-fighting missions; if U.S. forces are designed to win regional wars, they will also be designed to deter them. Yet, historically, conventional deterrence generally does not work very well. Differing national perceptions, the subjective nature of rationality and decisionmaking, the difficulty in extending and communicating deterrent signals, and a host of other factors make deterrence one of the most difficult challenges in foreign policy. Nonetheless, to the extent that it can be successful, deterrence can best be accomplished with U.S. military forces designed to win the conflict whose outbreak the United States is attempting to prevent.

Second, the maintenance of a military capable of winning large-scale regional conflicts is the best way to keep alive the core of a military capable of responding to a revived global threat. A professional, highly trained military with the human and industrial capital necessary to remain ready for regional wars will be better able to gear up for a larger conflict than a military designed to fight lower-intensity wars. This may still be far from sufficient to fulfill the reconstitution mission. But one thing is clear: so long as a careful defense industrial policy is developed to complement regular military planning, preparing for regional conflict would do a better job of preserving the foundations of reconstitution than any other affordable military policy.

Third, the United States will certainly be involved in conflicts of lesser intensity—peacekeeping, peace enforcement, and the like, which we term “irregular

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operations." However, large portions of the U.S. military should not be tailored specifically for such conflicts. For one thing, they usually pose a far less significant threat to U.S. interests than do regional conflicts. An Iranian or Iraqi attack on Persian Gulf oil fields, or even a North Korean strike south, would endanger fundamental U.S. and world interests and place U.S. prestige firmly on the line. Unless the United States itself chooses otherwise and invests some irregular operation with vast symbolic importance, as we did for a time in Vietnam, few lesser-intensity conflicts will claim such standing.

Another factor recommending against designing military forces exclusively for irregular operations is that of flexibility. Forces designed for combined-arms operations have some relevance for irregular operations; the reverse is not the case. As in Somalia, troops trained for large-scale, mechanized warfare can perform low-intensity missions with some degree of success. The same would not be true of peacekeeping troops thrust into a major regional contingency.

Nonetheless, in the years ahead the U.S. military may operate in far more irregular than combined-arms environments, and it therefore makes sense to build as much irregular capability into future weapons and forces as possible. This is especially true because, if the MTR succeeds, potential adversaries, aware that they cannot win at the combined-arms level, may resort to more insidious irregular operations to frustrate U.S. aims. The goal will be to modify MTR technologies, doctrines, and force structures in ways that do not detract from their combined-arms war-fighting and deterrent missions but that add greatly to their capabilities in irregular operations. A prominent example is special-operations forces, which can perform a wide variety of missions in lesser-intensity warfare. In a broader sense, however, little research exists on how this might be done; chapter 4 contains a few ideas, but clearly more work is needed on how to make MTR capabilities more relevant to irregular operations.

CRITERIA FOR MILITARY FORCES

Political and economic constraints will require U.S. leaders to conduct their wars in a particular fashion, with new and sometimes very stringent rules of engagement. The criteria spelled out below will be used as a yardstick of sorts for measuring the effectiveness of the military forces discussed in subsequent chapters.

- Construct a force out of much lower budgets—as low as \$220 billion (in 1993 dollars) by 1997. This condition has two elements. One deals with force structure: U.S. planners must assume that they will possess no more, and possibly less, than the force levels envisioned by Secretary of Defense Les

Aspin in papers he released before the November 1992 election (in the range of 15 active and reserve army divisions, 12 navy aircraft carriers, and 18 active and reserve air force wings). The second element concerns procurement: current and prospective defense budgets will not support significant purchases of big-ticket weapons systems.

■ **Fight in a nuclear, chemical and biological (NBC) world.** Given the risks of NBC proliferation, U.S. forces should have a capability for avoidance, defense, and active suppression of such weapons—if possible, conventional arms. This requirement is not new, but it will become increasingly relevant in the coming years.

■ **Tend to the U.S. image.** In general, future military operations will demand an emphasis on low U.S. and allied casualties and low collateral damage in the target country. When the U.S. interests at stake in a crisis or war are less than obvious to the public, the promise of a less destructive operation will allow U.S. leaders to wield their military instrument more effectively.

This will not require that the United States suffer no casualties or that it cause no collateral damage. This criterion, like the criteria that follow, will vary in relevance or importance given the nature of the conflict and the U.S. interests at stake. Nonetheless, even in major regional engagements and certainly in *peacekeeping* or other unconventional missions, the American and world publics will expect relatively clean operations, cheap in terms of U.S. lives lost—especially to friendly fire, given the bad publicity it generates—and the damage done to the local society.

The doctrine of overwhelming force, as articulated by Chairman of the Joint Chiefs of Staff Colin Powell during and after the Persian Gulf War, is another way of accomplishing this goal. By putting into place forces with the capability of rapidly and decisively defeating the enemy, U.S. leaders can minimize U.S. casualties, collateral damage, and the length of public commitment required to prosecute the war.

■ **Fight a CNN war.** U.S. forces must be capable of responding to media demands for instantaneous information, and of using the rapid transmission



U.S. MARINES CONDUCT CHEMICAL DEFENSE DRILL IN FORWARD POSITIONS NEAR AL-JUBAYL, SEPTEMBER 1990.

of data to its advantage. This magnifies the importance of tending to image considerations, the first criterion, especially in terms of the friendly fire problem. But it also suggests the need for greater information dominance and for some thought about how modern, real-time news reporting can be used to U.S. advantage in future military operations.

■ **Shape multilateral operations.** Because nearly all military operations will be coalition enterprises, the United States must determine its best contribution to coalition warfare or multilateral operations short of war and must design its military forces with this task in mind. U.S. leaders must determine what capabilities they will contribute to international operations, and what sort of influence in the operation they hope to gain by their participation. An important element of this criterion is for the United States to build competence among potential coalition partners.

■ **Conduct overseas presence with far fewer overseas bases.** As the U.S. foreign basing structure declines, overseas presence missions must become more self-sustaining. To do so, they will need to rely on innovative forms of strategic mobility (such as the use of prepositioned equipment and supplies) and on regular visits by air or naval forces or on rapid deployment forces. Various options exist to fulfill this criterion; chapter 3 will discuss the relationship between strategic agility and the MTR.

■ **Maintain readiness.** A major priority for the U.S. military establishment in the years ahead will be to avoid the typical result of the end of a war: the slashing of military readiness, training, education, and the like, which produces a large but "hollow" force of low morale and effectiveness. This mandates that operations and maintenance budgets not be cut or diluted by missions unrelated to readiness; investment in new training technologies; and a reconsideration of the role of the National Guard and Reserve in contingency operations.

■ **Preserve some level of defense industrial base.** Vigorous debates are under way about the degree to which the United States must preserve a defense industrial base and the best ways of doing so. Nonetheless, the basic task remains valid. U.S. leaders have always demanded, and even in an interdependent world will continue to demand, the ability to produce certain especially critical defense products indigenously. This requirement will affect debates about weapons and force structure; in analyses of U.S. attack submarine requirements, for example, the impact of competing plans on U.S. shipbuilding industries has weighed heavily.

THE CONTEXT FOR MILITARY PLANNING

The preceding analysis has established the general context for U.S. military planning in the years ahead, the period in which MTR doctrines, technologies, and force structures will be debated and acquired. It will be a challenging period, full of new headaches and unconventional operations, one that does not offer an immediate threat to justify military budgets and provide a focus for military planning. This uncertainty will greatly exacerbate the problem of choosing among competing technologies and weapons systems. With so many missions to be considered, many of them new or at least still unfamiliar, no choices will be easy. The next two chapters will suggest some criteria by which those choices might be based.

2

THE MTR CONCEPT

Revolutions in military affairs are not a new phenomenon. Throughout history, advances in technology and strategy have revolutionized the way wars are fought. Each revolution, however, is different. Some favor the offense, some the defense; some stem from the introduction of a new weapon, others from a novel idea about how wars can be fought.

Our first task, therefore, is to define and understand the current revolution in military affairs. This chapter lays out the rationale for and the constituent elements of today's MTR; it discusses the theories, capabilities, technologies, and doctrines that hold the potential to change completely the way wars are fought. Subsequent chapters will choose those elements that will be most revolutionary or offer the most profound advances and that therefore deserve funding priority.

Our presumption is that, in the time frame of this report (the next 15 years), only the United States has the capability to achieve the MTR. Other states may acquire pieces of the whole—precision weapons, for example, or innovative force structures—but only the U.S. military will be able to integrate all the elements of the MTR into a cohesive whole. The question of what specific aspects of it other nations might obtain, when they might do so, and what implications that would hold for U.S. forces is an important one.

This assumption adds urgency to possibly the most basic question about the MTR: why the United States needs such capabilities at all. Unlike many past military efforts, the MTR cannot be justified on an assessment of the threats to the United States and its interests. With the collapse of the Soviet Union and the concert of interests among major powers, this is a largely threatless moment globally, yet a highly unstable and dangerous world at the regional level. Existing U.S. forces can deal with those nations and trends that currently endanger U.S. interests; they did so, for example, in the Persian Gulf War.

The case for the MTR will not, therefore, rest as much on needs as on comparative advantages. Three stand out. First, the MTR will increase the combat effectiveness of U.S. forces, dramatically increasing the speed and decisiveness with which they can win conflicts or conduct operations short of war. If such capabilities can be obtained with current and prospective defense budgets, then it certainly makes sense to develop them. Second, the MTR helps hedge against the rise of a new global threat, representing a capability, a way of conducting war, that no challenger will be able

to match in the foreseeable future. And third, MTR technologies will help U.S. defense planners deal with the constraints, both budgetary and political, on military policy in the years ahead. The MTR allows militaries to do more with less, and to conduct military operations at less cost.

WHAT IS REVOLUTIONARY

Before considering the elements of the MTR, it is necessary to decide what is truly revolutionary in a military sense. Do the advances offered by new technologies and doctrines warrant the term? What is the difference between a revolutionary advance and one that is merely evolutionary?

To some degree this distinction is a semantic one. If a given set of technologies and doctrines provides an enormous military advantage, then in one sense it hardly matters what terms one uses to describe them. The capabilities will convey a great military advantage and are therefore desirable. Nonetheless, for our purposes it will still be helpful to have some specific notion of how a revolutionary advance might be defined. Such a definition would facilitate the choices that are the focus of later chapters by pointing toward some technologies, doctrines, and force structures that are revolutionary, whereas others are merely evolutionary or incremental in capability.

Various advances in military technology or doctrine are commonly understood to be revolutionary. The invention of gunpowder or nuclear weapons, the advent of mechanization, and other developments completely reshaped the nature of warfare. At certain times, new capabilities have made offensive warfare, on either a strategic or tactical scale, nearly impossible because of the costs involved; other shifts in military thought have helped render the battlefield fluid again. Sometimes revolutions counteract each other; often technology and doctrine pull in different directions.

Throughout history, revolutions in military affairs have generally shared several aspects in common, and it is those commonalities that point us to the central nature of an MTR. In one sense, an MTR can be defined as a *fundamental advance in technology, doctrine, or organization that renders existing methods of conducting warfare obsolete*. Advances in firepower made uncovered infantry operations much less effective; mechanized warfare did the same for nonmotorized infantry warfare. Guerrilla warfare rendered many conventional tactics ineffective for a particular class of wars.

An advance is also revolutionary when it *exercises a critical effect on some fundamental aspect of strategy*. If we think of classical military strategy as the fundamental concept found in Napoleon, Clausewitz, Jomini, Mahan, and dozens of others—that victory comes from concentration of one's forces at a critical point to win a decisive battle—then past military revolutions modified that strategy in basic ways.

The new firepower characteristic of World War I transferred the advantage in concentration of force to the defense, rendering large-scale offensives extremely difficult and costly. World War II's mechanized warfare made maneuver, concentration, and a decisive battle possible once again, an effect later dissipated by the nuclear revolution and guerrilla warfare.

Finally, *a true revolution in military affairs is achieved by a combination of technology, organization, and doctrine.* One without the other more often constitutes an evolution. It was only when mechanized forces were combined with appropriate doctrines and force structures, for example, that their revolutionary aspects became apparent.

This brief survey of terms points beyond arguments about whether new technologies, doctrines, and organizations *currently* represent an evolutionary or a revolutionary step. By the criteria outlined above, advanced technologies and innovations in doctrine and organization clearly have the *potential* to revolutionize warfare. Like all dramatic advances in the implements and theories of war, however, the MTR also holds the potential to be squandered, to be so disrupted by pork-barrel politics, interservice squabbling, and poor Department of Defense (DoD) decisions that its full effects never become evident. New technologies and doctrines offer exciting opportunities, but there are also persistent challenges to their implementation.

"...ADVANCED TECHNOLOGIES
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WARFARE."

ELEMENTS OF THE MTR

The various technologies, doctrines, and force structures that collectively are known as the MTR have several key elements. As we will see below, it is the combination of these various elements that is particularly effective, and in this sense the MTR is an integrative process rather than a divisible set of weapons systems and ideas. Nonetheless, it is possible to lay out the individual aspects of the MTR. The elements, displayed in Figure 2.1, are divided into three broad categories: integrating frameworks, enabling capabilities, and executing capabilities.

Significantly, *each element includes both offensive and defensive aspects.* It is nearly as important to understand an opponent's doctrine, for example, as it is to develop one's own. It may be even more useful to deny an enemy the effective use of information than to guarantee it for one's own forces. And although smart weapons can aid U.S. forces, defending against an enemy's missiles and warheads, with active or passive measures, is a crucial task.

Critical to each of the categories listed below will be the quality of military personnel. More than ever before in peacetime, the United States will need a

well-educated, highly motivated military capable of understanding the concepts of the MTR and motivated enough to put them into practice. Personnel policies are needed that offer sufficient benefits, challenges, and opportunities to attract the quality of personnel necessary.

FIGURE 2.1: ELEMENTS OF THE MTR

INTEGRATING FRAMEWORK

Doctrine

Organization

ENABLING CAPABILITIES

Information Dominance

Command and Control

Simulation and Training

Agility

EXECUTING CAPABILITIES (STRIKE SYSTEMS)

Smart Weapons

Major Platforms

Exotic Weapons

At the level of ideas, of integrating theories and structures, the framework of the MTR has two critical components. One is *doctrine*. The new capabilities and technologies characteristic of the MTR must be employed in a fashion that maximizes their advantages. To do so, to match means against military ends effectively, requires a sound doctrine. Past revolutions have witnessed doctrinal as well as technological advances: for example, in World War II the new fleets of armored and motorized vehicles were employed in mechanized blitzkrieg warfare; the expansion of guerrilla wars required new doctrines for counterinsurgency operations; and the nuclear revolution gave rise to a whole new field of doctrine—nuclear strategy.

In an ideal world, doctrine would be developed first and inform all other decisions, dictating what kinds of military forces need to be deployed and what equipment they require. Of course, the process is interactive; only by knowing what technologies will be available, both now and in the future, can the authors of doctrine know what their forces might be capable of and devise tactics to take advantage of those capabilities.

It may be too early to tell exactly what operational concepts will characterize this MTR. Even flexible, deep-strike notions such as AirLand Battle and Follow-On Forces Attack may give way to much more radical ways of approaching warfare, a few of which are spelled out in chapter 3. The traditionally sharp distinction between battles and wars, between tactical and strategic operations, is becoming blurred, with military doctrines relying on simultaneous attacks across an entire enemy nation to paralyze its military efforts.

The other aspect of the MTR's framework is *organization*. The structure of all defense-related organizations, from combat units to DOD offices, must evolve in ways supportive of MTR technologies and doctrines. From an operational standpoint, organizational issues show up most clearly in force structure. It could be, for example, that the sorts of ground units best suited to implement the MTR are small, independent, all-arms combat teams using stealthy vehicles and precision munitions. Naval forces might make increasing use of stealth, both by making surface ships smaller and harder to find and by using submarines for a broader range of missions. The Air Force might extend the mix of aircraft down to the squadron level. Or the military as a whole might adopt much more radical force structures than those, combining ships, aircraft, and ground units into innovative packages.

Within the Department of Defense, much must change as well. The current acquisition, strategy, and doctrine systems fragment MTR capabilities into anachronistic understandings of mission areas. This report will not attempt to lay out a complete reform plan, but chapter 5 suggests some initial ideas.

Falling within the broad category of enabling capabilities is the third element of the MTR, *information dominance*. This element includes such technologies as high-tech sensors, radar, high-resolution photography, motion detectors, thermal and infrared detectors, and night vision equipment. In the future, such sensors might become much more powerful and pervasive, creating a vast array of information constantly flowing back to real-time intelligence fusion centers. Working as an integrated network, these sensors provide an unprecedented amount of information about the battlefield. Once the information is gathered, it must be coordinated and disseminated, a task that calls for tough, lightweight computers and software linked into an integrated network.



LANDING CRAFT FROM AMPHIBIOUS TASK FORCE LANDS MARIES DURING EXERCISE IMMINENT THUNDER. NOVEMBER 1990.

"DENYING INFORMATION
TO THE ENEMY CAN
BE JUST AS IMPORTANT AS
ACQUIRING IT."

Denying information to the enemy can be just as important as acquiring it. If opposing forces are deprived of nearly all important information about the war, their operations will be confused and ineffective, much as happened to Iraqi units in the Persian Gulf War. Information denial can be done passively, through the use of stealth, concealment, and hard-to-detect electronic signals, or it can be done more thoroughly through active means: the use of electronic warfare to jam enemy communications, employing smart weapons that home on enemy radars or radios, concentrating early attacks on enemy command and communications nodes (as in the Gulf War), and, more radically, using such advanced techniques as electromagnetic pulse weapons to wreck the enemy's electronic systems and computer viruses to incapacitate its software.

Once the enemy has been located and U.S. commanders have made decisions about their moves, the next step is to orchestrate the response of U.S. forces. This requires effective use of the fourth element of the MTR: *command and control*. Using advanced computers, communication networks, radios, and other technologies linked together into coherent command and control grids, the modern joint commander can be in constant and instant contact with every subordinate element of the force. Certain surveillance systems, such as AEGIS radar ships and aircraft such as the joint surveillance target attack radar system (JSTARS) and the airborne warning and control system (AWACS), also perform command and control functions, serving as battle management platforms for theater commanders. There is also an important denial aspect to command and control, achieved by many of the same technologies.

The fifth element of the MTR, *simulation and training*, works to match the human abilities of the process with its technological capabilities. High-technology simulation systems are producing a revolution in training even as MTR systems are creating a revolution on the battlefield. Modern computers can re-create a firefight, battle, or theater of operations in simulation laboratories, allowing troops to understand the concepts and flow of modern war without actually experiencing it. In this sense, along with doctrine, simulation and training provide soldiers with a *vision* of and confidence in what they will be attempting to accomplish on the battlefield.

But simulation technologies can do much more than prepare troops for war. They can save money by reducing the need for huge exercises or live-fire drills. They can provide a realistic test bed for new doctrines and organizations, a means of playing one idea against another and slowly winnowing away the ineffective ones *before* a war begins rather than after. And, perhaps most dramatic of all, simulators will eventually allow the military to test new weapons before they are deployed or even built.

The sixth element, *agility*, includes those capabilities, systems, and technologies designed to get a force into the field and sustain it there, tasks traditionally known as mobility and sustainment. It comprises things that can make those tasks easier—

smaller and more reliable vehicles, directed-energy weapons that do not rely on ammunition, and so on—as well as the platforms (sealift ships or transport aircraft) that actually do the job.

The seventh element of the MTR, and of itself the broad category of executing capabilities, is *strike systems*. This element or category encompasses any weapon or class of weapons designed to reach out to the enemy and do some harm. It consists of three primary subcategories: smart weapons, major platforms, and exotic weapons.

Smart weapons include a host of guided, precision, and self-activated weapons that range from missiles (the guided Tomahawk, Hellfire and Maverick, the Army's tactical missile system (ATACMS) and multiple-launch rocket system (MLRS) and the Navy and Air Force's advanced cruise missiles) to individual warheads (the Copperhead guided artillery shell, laser-guided bombs, cluster munitions, and others) to smart antiarmor mines. This sub-category also encompasses an ability to defend against enemy smart weapons. The proliferation of cruise and tactical ballistic missiles, from small battlefield versions to large, long-range systems, magnifies the importance of new missile defenses. These might increasingly employ a new-generation of systems, such as lasers and hypervelocity missiles. Finally, here too we find an element of denial; advances in smart weapons should allow U.S. and allied forces to deny the use of the air and sea to enemy forces.

The second component of MTR strike systems are major military platforms. New and advanced planes, ships, tanks, and other combat platforms are changing the way wars are fought. Stealth will play a major role in all these systems: already stealthy aircraft such as the F-117 fighter have proven stunningly effective, and the day of stealthy ships and ground vehicles is not far off. Major combat systems will benefit from a host of other technological advances in the years ahead, ranging from more reliable, smaller, lighter engines to light yet strong armor plating. It is important to remember as well that smart weapons are useless unless they can get to the target: one of the factors limiting the use of precision weapons in the Persian Gulf War was a shortage of platforms with the requisite electronics and designator systems to use them. Upgrade to major platforms should focus in this area.

Increasingly, MTR strike systems can encompass a third category—exotic weapons. Nonlethal technologies, such as warheads designed to cause temporary blindness or disorientation, can help render an opponent unable to fight without actually killing its soldiers. Space-age weapons, such as laser beams and directed energy weapons, might revolutionize the way in which firepower is delivered on the battlefield.

A HOLISTIC APPROACH

Each element of the MTR is important, and any one alone would have a significant impact on warfare. Stealthy F-117 fighters, for example, played a major

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role in the Persian Gulf War, as did JSTARS surveillance aircraft and precision warheads. What is special about the next generation of technologies, however, and what might render it an MTR, is the way in which those technologies work together, the synergistic or holistic effect of the range of MTR technologies operating alongside more traditional conventional weapons. It is the *combination* of unprecedented advances in information dominance, command and control, major military systems, smart weapons, well-trained and motivated personnel, and effective organizations and doctrines, all working together across service lines, that makes the coming era in crisis management and warfare potentially so different from the past.

The Military Technical Revolution calls for a complete rethinking of the ways in which wars are divided into various, discrete mission components and parsed out among various services, branches, and weapons systems. The MTR is about integration, synergy, and flexibility. All of this, of course, runs against service parochialism; it recommends an increasingly joint force—and a force whose jointness extends lower in the chain of command than ever before, which can avoid artificially *joint operations* even as it pursues a useful *coordination of service efforts*. This is not to suggest that the four services should be merged, only that they must work together more closely and effectively than ever before to bring the MTR to fruition.

Stealthy aircraft, for example, would lose much of their effectiveness if they did not have precision weapons to deliver when they reached their targets. Even with precision weapons, if they were not adequately targeted before their missions and controlled during them, the same aircraft would be only marginally more effective than existing ones. Without motivated, talented pilots, those aircraft would be useless. Only these various capabilities working together will have a truly revolutionary effect.

This is especially true of the interplay between technology, doctrine, and organization. Without a coherent joint doctrine to guide their employment and an effective organization to focus their effects on the battlefield, even the most advanced technologies will not reach their full potential. Before any technologies are integrated with one another, trends in doctrine, organization, and technology must be examined and reconciled. In a sense, decisions on doctrine therefore become a precondition and guidance for integrating the research and development of new technologies.

To a great extent, therefore, the use of traditional mission areas as an analytic tool is counterproductive to the MTR. It encourages thought in precisely the kind of reductive categories and boxes that the MTR is designed to overcome. We must think of the MTR in terms of the broad capabilities we wish to acquire, rather than in terms of specific missions such as close air support or amphibious assaults. It could be that

the MTR could achieve the same goals as those missions without using the same weapons.

Put another way, what the MTR is truly after is the unraveling of specific systems and technologies from past constraints of their organizational context, and their recombination into a more coherent and mutually supportive whole. Today, U.S. military doctrine prescribes the use of various technologies in ways that may not respond to the evolution of technology or the unique abilities of those particular systems. A full application of the ideas of the MTR would involve taking those cutting-edge technologies and reshaping them into new kinds of forces. The goal is flexible, all-arms task forces that represent the seamless combination and application of all elements of the MTR. Such forces may look very different from traditional armored or mechanized divisions or brigades, naval task forces, or air wings.

OPERATIONAL IMPLICATIONS

If the full potential of MTR technologies and doctrines is realized, the implications for warfare will be profound. Such a change could justifiably—although not indisputably—be termed revolutionary. This section summarizes a few of the MTR's most profound implications for combat.

It is important to recognize at the outset that many aspects of war will not change even if the MTR occurs. Most of the determinants of success in war, from courage and willpower to small-unit initiative and cool decisionmaking under fire, have little if anything to do with technology. War is at base a human affair, not a technological or scientific phenomenon; its human aspects will always predominate. High-quality military personnel are therefore the bedrock of all military activity. Nonetheless, the technologies, doctrines, and organizations of the MTR will exercise an important effect on the conduct of war; together they can help U.S. and allied forces maximize the performance of their troops while destroying the effectiveness and morale of enemy forces.

In the most basic sense, the MTR will partly *lift the fog of battle* that has bedeviled military operations since the beginning of organized warfare. It is the uncertainty, the lack of clear information about the enemy and one's own forces, that hinders the effectiveness of military operations. In many ways it is the fundamental fact of war, that introduces a major element of chance and risk into the enterprise.

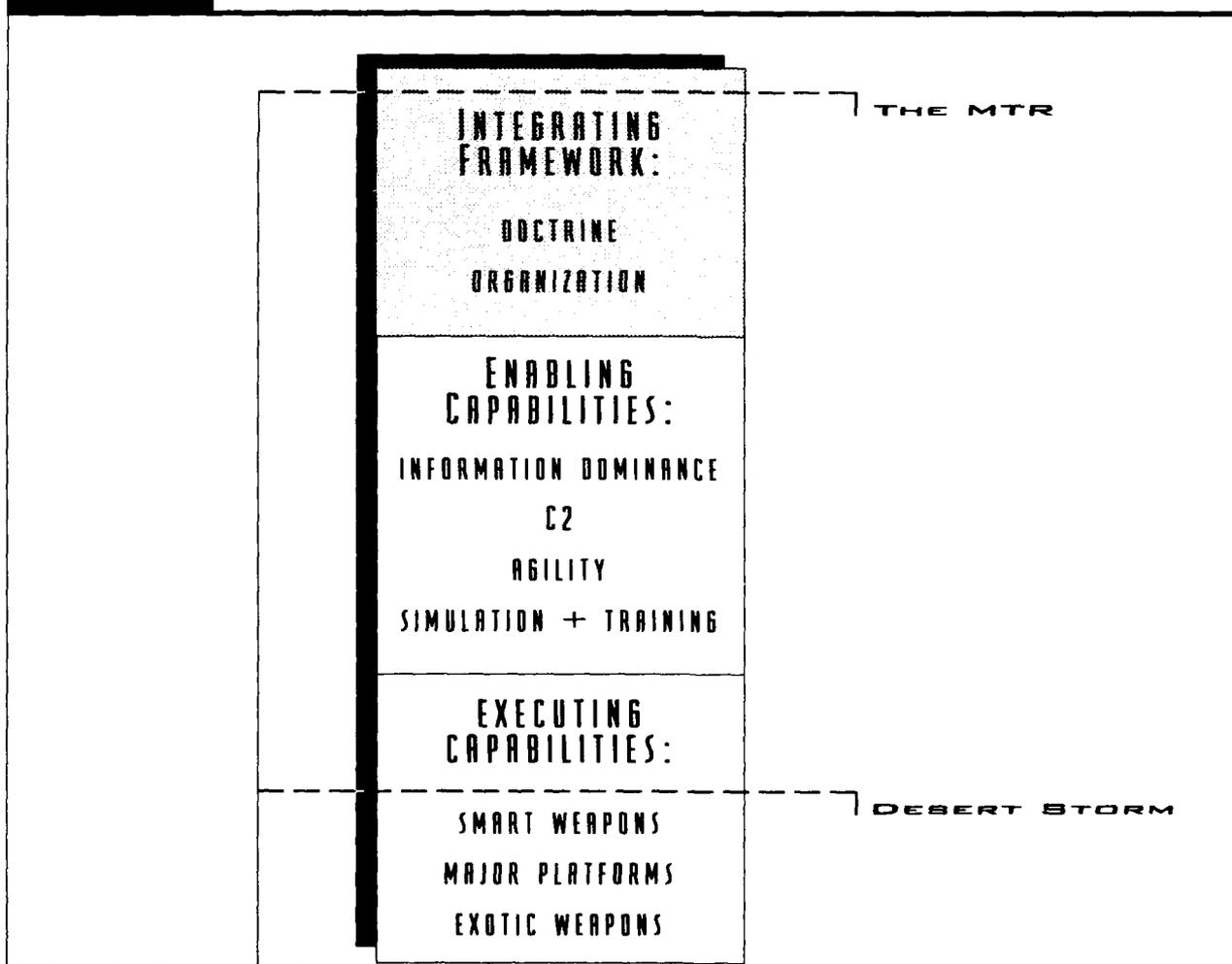


M1 ABRAMS TANKS MOVE FORWARD WHILE VULCAN PROVIDES AIR COVER.

MTR technologies will allow greater progress than ever before in giving a commander accurate, real-time information about the battlefield and the command and control architecture to act on that information. It is possible that modern sensors may someday provide a detailed picture of a theater, down to the location of individual tanks and squads of soldiers. Information processing centers will gather this vast amount of information, synthesize it, and display it in a useful fashion. And fully integrated, joint, real-time command and control technologies will enable the commander to respond to the ebb and flow of a battle on a moment-to-moment basis.

The potential comparison with previous wars is stark. In the nineteenth century, messages to distant military units had to be carried across the sea by sailing ships. Commanders had little reliable information about the enemy, and once they did get information and decided to act, their command and control systems were slow and ponderous. In World War II, the connection between surveillance of the enemy, information synthesis and analysis, ordering a friendly unit into action, and the

FIGURE 2.2: PROGRESS OF THE MTR



engagement of the enemy was a tenuous one; often it would take hours or days for the full chain to be complete, and even then mistakes were common. As late as the Persian Gulf War, U.S. intelligence about the number and location of Iraqi troops in the Kuwaiti theater was far from perfect, damage assessment was a slow process involving as much art as science, and coalition units occasionally found themselves misplaced on a confused battlefield.

By reducing the surveillance-synthesis-assessment-command-strike loop to a matter of minutes, the MTR has the potential to create a reliable process for managing—and, more than that, for controlling—a battle from one moment to the next. This is not to say that systems will not fail, command centers will not be destroyed, or mistakes will not be made—the friction of war will persist. Any human endeavor will be imperfect, and in the end the MTR represents merely a further step in a long-standing trend of improved surveillance and command and control. But that step is a gigantic one, which many military experts view as revolutionary. It will render old ways of conducting battles obsolete; forces with the ability to manage a battle with such a degree of detail and speed will overwhelm adversaries without such a capability. A hint of this effect was present in the Persian Gulf War.

Given these facts, it is apparent that enemy countermeasures that threatened the sanctity of this information loop would be of deadly importance to U.S. forces. Electronic warfare, missiles designed to bring down flying command posts, special forces targeted against command centers or communications down-link stations, and perhaps especially antisatellite weapons could, together or individually, blind U.S. forces and ruin the effects of the MTR. Careful attention must be given to defeating such countermeasures and, if that fails, to dealing with their effects. The MTR information loop, for example, should never depend on single, vulnerable sites for data collection or relay; enough redundancy must exist to guard against single-site failure.

A related but distinct aspect of the MTR is its implications for another fundamental tenet of military strategy: the notion of *concentration of force*. The MTR will allow firepower to be concentrated without the gathering of military forces themselves and indeed may make such concentrations dangerous. Long-range strike systems, ranging from fighter-bombers to tactical missiles, when combined with the sort of surveillance and command systems discussed above, will allow a commander to orchestrate near-instantaneous fire down on every important target on the battlefield. The strike systems themselves can be widely dispersed—aircraft at distant air bases or on aircraft carriers at sea, ATACMS and MLRS missile launchers sprinkled around the battlefield in small detachments, attack submarines loitering offshore firing sea-launched cruise missiles. When an enemy tank unit or command center is located, the combination of a real-time sensing and command network and the great precision of the MTR weapons will give a U.S. commander the ability to call down a rapid strike without ever having to concentrate friendly military units opposite the enemy unit.

" [THE MTR] WILL
STRIKINGLY ACCELERATE
THE TEMPO OF WAR. "

As the MTR improves the military information loop and allows flexibility in the concentration of military effect without massing forces, it will strikingly accelerate the *tempo of war*. The pace of military operations will increase to an unprecedented degree, placing great stress on information and command and carrying major implications for other aspects of military policy. An accelerated tempo of operations will compress warning time and require much more rapid decisionmaking. It will affect deterrence: forces capable of reacting more rapidly will be able to send more effective deterrent signals. And at some point, the frightening speed of MTR operations might increase the pressures for the conventional equivalent of a nuclear launch-on-warning policy in crises.

Technologies and doctrines representative of the MTR will also have a profound effect on the *balance between destructiveness and lethality*. The trend in warfare over at least the last 200 years has been dominated by the increasing destructiveness of warfare and weapons. Greater lethality was achieved through the application of overwhelming firepower. This trend began in the Napoleonic war, intensified through the Civil War and World War I and II, and culminated in the development and use of nuclear weapons. The advent of precision weapons represents a break in this trend as it allows greater degrees of lethality to be achieved without corresponding increases in destructiveness, both as collateral damage to civilians and as the requirement to annihilate an enemy's forces in detail. This fact carries dramatic implications for the use of force as an instrument of a U.S. foreign policy.

If the MTR offers dramatic advances in the operational conduct of battles, it may have an even greater impact on the *definition of a theater of war*. For centuries, battlefields have been neatly divided into front lines of contact (the tactical arena), the battle zone (operational), and rear areas (strategic). Service responsibilities have largely been divided on the basis of the definition of these zones. Since the advent of mechanization and air forces, the tactical and operational spheres have been steadily expanding. These lines have now been blurred to such a degree that the distinction has become largely academic.

The same MTR information and strike systems that can so effectively and precisely destroy tanks can also be used to pinpoint attacks on the enemy's infrastructure. By striking throughout enemy territory in the initial stages of the war and attacking modern communications nodes, power sources, and the other building blocks of a technological society, MTR systems could thrust the enemy into darkness and, by delivering a devastating shock to the enemy nation, bring all significant military operations to a sudden halt.

Coalition attacks in the Persian Gulf War represented the first true test of such a strategy. It worked surprisingly well, in part because of Iraq's somewhat rudimentary

social infrastructure; against a fully developed country, many more attacks would be required and the effect might be less complete. Moreover, the debate between proponents of close and deep MTR battles—between those who would concentrate attacks on the enemy's military forces and those who advocate operations throughout its entire country—has just begun. But in the long run, the MTR clearly holds the potential to blur, or permanently erase, the distinction between tactical, theater, and strategic war. In the future, a telephone switching center in a nation's heartland might be as likely a target on the first day of the war as a tank on the front lines. And insofar as this prospect already exists for developing nations considering a war against the United States, MTR systems augment deterrence immeasurably.

With the advent of the capabilities outlined above, the U.S. military may increasingly search for *systemic weaknesses* in its adversaries. Advances in information technology and simulation may allow U.S. forces to identify relatively small target sets that can cripple an adversary's will or ability to fight. This approach requires viewing an opponent as a system of interlinked pieces: if those pieces can be unhinged at critical points, then the entire system may collapse. This target set will likely be different for each adversary and operation to fit U.S. and coalition political objectives. Dictatorships, for example, may be more vulnerable to such focused attacks than a more dispersed society.

Together, these consequences will exercise a devastating *psychological effect* on opposing forces. Much of war is psychology, morale, and motivation—the intangible aspects of combat. As hinted at in the Persian Gulf War, the MTR's combination of information dominance, precision attack, and decisive tactics can destroy the will, and in a practical sense the ability, of an enemy to fight without destroying all of its equipment or killing most of its troops. The MTR may allow military forces to implement Sun Tzu's famous dictum: "supreme excellence" in war, he wrote, is not "to fight and conquer in all your battles," but rather lies in "breaking the enemy's resistance without fighting."

Finally, the MTR holds powerful implications for the traditional military principle of security, which deals with enhancing one's own freedom of action by reducing vulnerability to hostile acts, influence, or surprise. The survival of information dominance and command and control capabilities is paramount under an MTR regime. Satellite systems should be survivable and replaceable, command and control nodes dispersed and redundant. The current preference for theater-based intelligence assets, command centers, and battle management platforms may have to be reexamined if potential opponents devote greater resources to weapons designed specifically to attack such high-value systems. One solution may be synthesis and command stations in the continental United States (with prudent redundancies) that can be linked in real time to theater forces.

The Military Technical Revolution has the potential fundamentally to reshape the nature of warfare. Basic principles of strategy since the time of Machiavelli—the confusion and chance inherent in military operations, the concentration of forces to achieve a decisive victory at a critical location—may lose their relevance in the face of emerging technologies and doctrines.

One question remains: Which of those technologies and doctrines are most important? That is, which reside at the core of the MTR rather than the periphery? It is to this issue that we now turn.

3

COMBINED - ARMS OPERATIONS

The purpose of this and the next chapter is to set priorities among the various MTR technologies, doctrines, and organizations. It will be difficult to make definitive choices. Revolutions in military affairs tend to be integrative, holistic phenomena, and the present MTR is no exception: for it to achieve its full potential, some investment must be made in each of its constituent elements. Nonetheless, it is possible to identify which of those elements deserve greater emphasis than the others, and which specific systems within each area are especially important.

This chapter examines the first of the two types of military operations summarized in chapter 1—traditional, large-scale, high-technology, combined-arms operations involving relatively modern militaries. Virtually all traditional military theory, from that of Machiavelli through Napoleon, Jomini, Clausewitz, Mahan, Liddell-Hart, and Douhet, to name a few, has focused on conflicts involving these kinds of forces. For all of modern history, military establishments have aimed primarily to fight this kind of war or its antecedents. As demonstrated again in the Persian Gulf War, combined-arms warfare remains highly relevant to U.S. military planning; chapter 1 argues that it ought to be the primary focus of that planning.

The use of the term *operations* rather than combat or warfare is meant to emphasize the increasingly important role of operations short of war in U.S. foreign and defense policy. With no major global adversary and only a few desultory regional ones, the United States will probably be more occupied with peacetime activities than combat in the decade ahead. This is not to rule out large regional conflicts like the Persian Gulf War; indeed, this chapter will suggest that the bulk of U.S. military planning and procurement should aim at preparing for them. But even as U.S. leaders keep their military forces ready for combat, they will use them for a host of operations short of war; that fact mandates some consideration of the military requirements imposed by such operations.



A DRIFTING MINE NEAR USS MISSOURI
BEFORE DETONATION.

This study utilized several methods for looking at these questions. We first conducted a general survey of the MTR and its constituent technologies, defining the scope of choice. We examined weapons currently in the U.S. inventory, those under research and development, and proposals for next-generation technologies not yet on the drawing board. Our review extended to doctrine as well—the evolution of thinking on warfare within the U.S. military and in the military academic community.

With the aid of a large and expert working group, we then conducted discussions on five subjects designed to produce criteria for our decisions: the strategic challenges facing the United States, the relative importance and nature of specific military mission areas, a set of general criteria for U.S. military forces; the standards for revolutionary military advances discussed in chapter 2, and the requirements created by a group of seven specific contingencies (see Figure 3.1). Group leaders from those seven contingency discussions shared and discussed their results, and the project staff drew on their various conclusions.

MTR PRIORITIES

As emphasized in this report, the MTR is a holistic enterprise. None of its constituent elements can be separated out entirely; any setting of priorities among those areas will be only relative, not absolute. Nonetheless, our purpose—and the increasingly dire task of the Department of Defense—is to make choices. Granted that the MTR must be viewed as a coherent package, which parts of that package should be procured more rapidly? Which will have a more fundamental effect on warfare?

This and the next chapter begin, in a very elemental way, the process of prioritizing within U.S. military planning, and in particular among MTR capabilities. Throughout this analysis, the overriding theme—the heart of the MTR—is battlespace control. Its ability to overcome the fog of war (or at least part of it) and control the battle down to the level of individual tank rounds and artillery shells is the MTR's most revolutionary contribution. It is this development, more than the contribution of any individual weapon system or precision munitions, that will change the way wars are fought.

"...THE HEART OF THE MTR
IS BATTLESPACE CONTROL."

With these thoughts in mind, the results of our varied analysis suggest a rank ordering for the seven elements of the MTR (see Figure 3.2). The primary message of this ordering—and, by extension, of this report as a whole—is that the integrating framework and enabling technologies are most fundamental to the MTR and deserve greater emphasis than executing technologies. The following sections define, defend, and rationalize this choice. They also spell out its implications in more specific terms—what sort of weapons systems the United States should focus on in the years ahead.

FIGURE 3.1: CONTINGENCIES EXAMINED

NOTE: In every contingency involving the potential for major regional conflict, the discussion groups examined the requirements of deterrence as well as war-fighting.

RECONSTITUTED IRAQ STRIKES SOUTH.

In this scenario, set in the fall of 1997, Iraq has managed to wriggle free of most international sanctions and to neutralize the Arab world with increasingly strident anti-Western propaganda. Saddam Hussein has kept his regional ambitions and rebuilds a three-division Republican Guards corps in southern Iraq. He prepares to invade, planning to slice through Kuwait and push along Saudi Arabia's eastern coast.

MODERNIZED IRAN MOVES AGAINST SAUDI ARABIA.

By 2003, fortified by the support of fundamentalist governments in Algeria, Egypt, Yemen, and Sudan and by the sympathetic help of Gaddafi's Libya, Iran has become increasingly belligerent. Tehran has acquired a host of modern technologies, including nuclear weapons. Iraq has lost control of its southern regions to pro-Iranian Shiites. Iran masses forces opposite southern Iraq near the Shatt al-Arab; Iranian submarines move to the mouth of the Persian Gulf. Saudi Arabia and the other Gulf states appeal for U.S. and UN assistance.

NORTH KOREA THREATENS SOUTH.

In the fall of 1993, Kim Il Sung dies and an unstable transition of power begins in North Korea. Several groups vie for power, including a militant faction of nationalists with strong ties to the armed forces. North Korean military units along the demilitarized zone begin operating at a higher tempo. South Korea and the United States warn the North against attacking. On the verge of a critical inspection of North Korean nuclear facilities by the International Atomic Energy Agency (IAEA), the North expels all IAEA personnel and rejects further contacts with the agency.

CHINA THREATENS TAIWAN.

This scenario, occurring in the winter of 1996, stipulated that opposition forces calling for independence come to power in Taiwan. China reiterates long-standing pledges to reunify the country by force if Taipei takes such a step, and forces throughout southern China move to high levels of alert. As the crisis proceeds, Taiwan seeks recognition in the United Nations as an independent state to lay the groundwork for international support, and the United States attempts to mobilize an ad hoc coalition to deter Chinese aggression.

UNITED NATIONS DETERS SERBIA.

With the Balkan war continuing in Bosnia in the spring of 1993, peace talks having failed, and Serbian leaders speaking of an imminent "final solution" to the Bosnian problem, the West decides to act. A UN resolution authorizes enforcement of the no-fly zone with NATO aircraft, airstrikes on Serbian airfields or other Serbian military targets if Serb forces continue on the offensive, and deployment of ground forces into Macedonia to head off an expansion of the war.

UNITED NATIONS ENFORCES THE PEACE IN CAMBODIA.

By the summer of 1994, the Cambodian peace accord has been revived and a new Cambodian government reconciles all elements except the Khmer Rouge. The Khmer break off and form their own government, occasionally launching harassing raids into protected territory. The UN peacekeeping force grows to nearly 30,000 and is tasked with monitoring the cease-fire within Cambodia, guarding against Khmer Rouge raids and launching punitive attacks against the Khmer when raids occur.

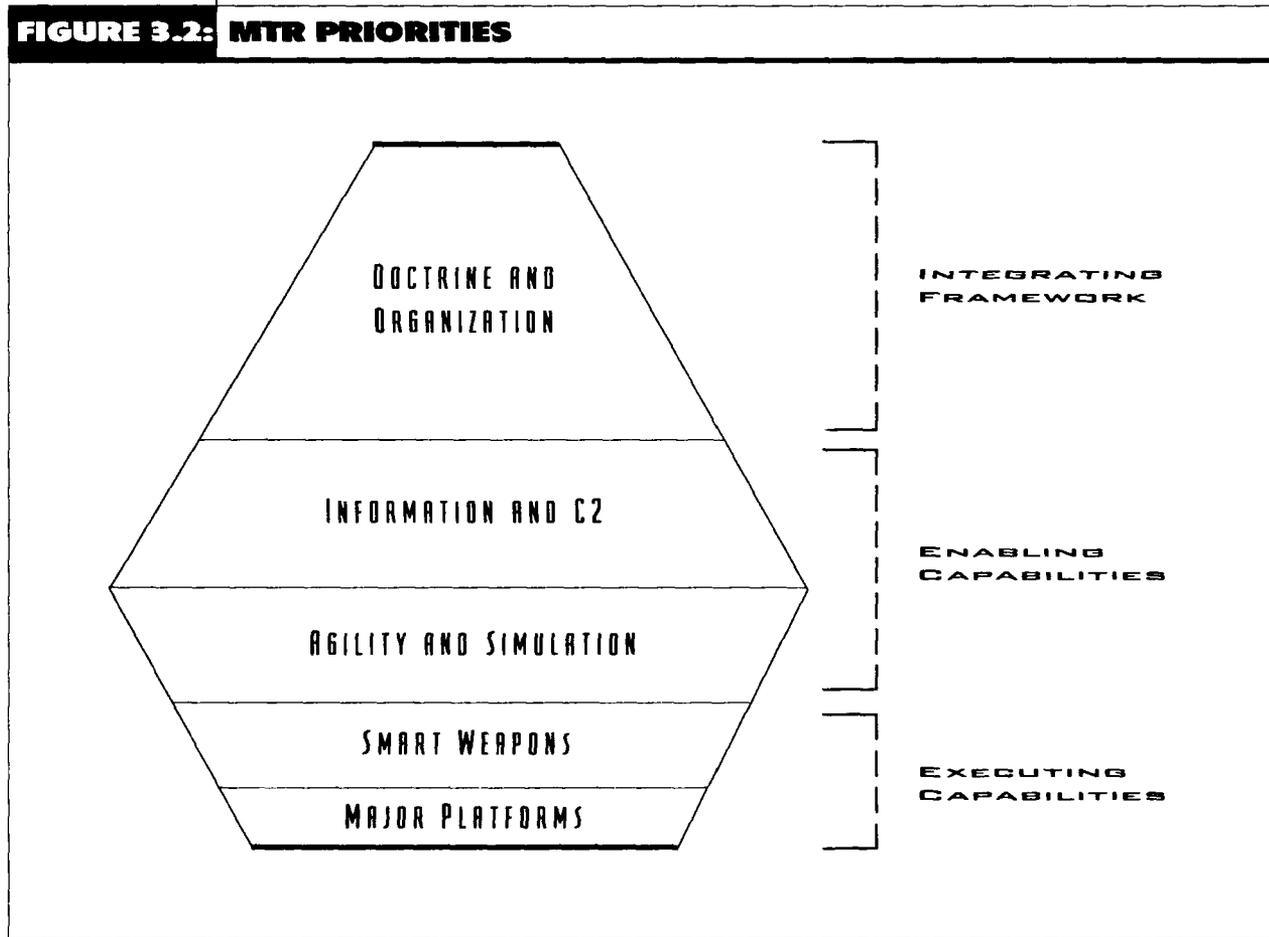
TYPHOON DEVASTATES SRI LANKA.

In the spring of 1994, a massive typhoon devastates the island of Sri Lanka, mandating a rapid international response. In the wake of the storm, tens of thousands of people need food, medical care, and shelter.

Neither doctrine nor organization is on the same budgetary scale as major procurement items. The cost of establishing joint doctrinal centers to supplement the service centers and sponsoring doctrinal studies at war colleges and civilian universities is measured in the tens of millions of dollars. Reorganizing combat units or DoD offices usually requires more time and effort than pure money. Reforming doctrine or organization will not require that the military slash its force structure or abandon a major combat system—though it may *allow* such steps by creating smaller, more lethal forces guided by effective doctrines.

Historically, moreover, investments in doctrine and organization have lagged behind acquisition of weapons systems. Additional work is most urgently needed today in those areas before definitive solutions can be proposed. This chapter and the following one offer only very general thoughts on possible MTR doctrines and organizations, in part because thinking on these two subjects has not advanced very far.

FIGURE 3.2: MTR PRIORITIES



Yet doctrine and organization are arguably the MTR's most important parts. They lay the foundation for acquisition and force structure by establishing the basic principles on which MTR systems will fight—and deter—war. This became clear in our analysis of various contingencies, where operational concepts, which flowed from the doctrine and organization of the forces, dominated thinking about U.S. responses to provocations and threats.

A revolution in warfare will occur only when the potential of new technologies is harnessed under the guiding principles of a new war-fighting doctrine. The full potential of mechanization, air power, and radio communications, for example, was not realized until applied by the Germans in a doctrine of blitzkrieg warfare. The aircraft carrier did not realize its full potential until it was applied under a distinct naval doctrine that rendered the battle line obsolete. To be fully effective, MTR technologies must be blended with new doctrines and organizations, all informed by the lessons of recent wars. Because of the growing pace of technological development, moreover, both doctrine and organization must be flexible enough to adapt rapidly to new technological capabilities.

Preparing U.S. forces to fight in the twenty-first century will require a more radical approach to doctrine than traditional service methods. The first iteration of these new service doctrines reveals their inherent weakness—the continued development of doctrine from the bottom up and a resultant division of doctrine into service paradigms. Granted, each service has unique military capabilities and unique requirements and may play a predominant role in any one military contingency. But a reformulation of U.S. war-fighting doctrine may therefore require the rethinking of traditional service missions, capabilities, and systems.

It is too early to tell where this rethinking will take the U.S. military's doctrine in the years ahead. Many options are available, many paths open. But the nature of the MTR and of the potential threats U.S. forces will confront suggest a few lines of departure:

- **A fully joint doctrine.** Construction of a truly joint war-fighting doctrine for the U.S. military is still in its infancy, but the release of Joint Publication 1, *Joint Warfare of the Armed Services*, in November 1991 ushered in a new era. For the elements of the MTR to work together in full harmony, U.S. military doctrine must become a completely joint enterprise. In the end, this may mean the subordination of individual service schools and centers of doctrine to joint schools and centers.

"...THE INTEGRATING
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"FOR THE ELEMENTS OF
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JOINT ENTERPRISE."

■ **Disengaged combat.** For a variety of reasons, close contact with enemy forces may pose special risks to U.S. units in the years ahead. The spread of weapons of mass destruction may mean that forward-deployed U.S. units would be under imminent risk of chemical, biological, or even nuclear attack. U.S. lift shortfalls may mean that, today, lighter forces would have to absorb the brunt of early enemy attacks, creating a mismatch of firepower and protection on the front lines. And the predominance of shorter-range weapons in the arsenals of the developing world means that enemy lethality will be greatest on or near the immediate battlefield—a risk as true for aircraft (witness the danger posed by antiaircraft guns in the Persian Gulf War) and ships as for ground units. Together, these factors may encourage the U.S. military to develop doctrines that allow its forces, and particularly its ground forces, to spend less time in close proximity with the enemy. Longer-range, indirect fire weapons and stand-off munitions might bear the brunt of the fight.

■ **Nonlinear combat.** As precision and mass-destruction weapons proliferate, the modern battlefield will become a very dangerous place for large, massed combat formations. Future doctrine might require small U.S. forces to operate independently, down to the battalion level or even smaller. Commanders, controlling the battle with the help of MTR surveillance and command technologies, would mass fire, not forces. Airmobile combat teams would use helicopters to move rapidly on the battlefield, and the small ground units would be supported by long-range fire.

■ **Perpetual strike campaigns.** To improve the responsiveness of long-range supporting fire and provide round-the-clock strikes, mixed units of aircraft, ground units, and ships could be lashed together to attack a wide range of enemy targets. A JSTARS aircraft and drone reconnaissance planes would coordinate attacks on ground targets, while an AWACS and AEGIS ships watched the sky for enemy aircraft or missile launches. A dozen or so attack planes would remain constantly airborne. Offshore, missile-firing ships and submarines would launch salvos at enemy formations; on land, far from enemy combat units, Army ATACMS and MLRS batteries would join in the concentrated fire, and helicopters flying from mobile bases of operation would contribute as well. Portions of every element of the force would be active at all times, providing round-the-clock attacks.

These rough examples point to possible changes in the second integrating

framework area: organization. New types of military units, both small and large, can help revolutionize the way wars are fought. The broadest trend in force structure appears to be running in the direction of flexible, multiple-system combat teams, either within one service or across all four. On the ground, combat units increasingly represent mixtures of armor, artillery, deep-strike missiles, precision rockets, mechanized infantry, attack and transport helicopters, and other forces. The Air Force has already established composite wings with various types of aircraft, and composite squadrons may not be far behind. The Navy and Marine Corps are experimenting with innovative new force packages.

One existing type of unit might be increasingly important in an MTR context: special operations forces. Special forces can perform a host of functions on an MTR battlefield, supporting most enabling and executing capabilities. Small teams of soldiers infiltrated behind enemy lines can gather intelligence and attack enemy communications and command nodes to deny them effective information and command. By moving covertly ahead of the main force and seizing ports and airfields, special forces can augment agility; special forces themselves are an agile force, lightweight and fast-moving. With hand-held laser designators, special forces units can support precision strikes.

As the MTR continues, experimentation with force structure will likely become bolder and the force packages more radical. Ground units might become increasingly light, serving as spotters and target designators for distant precision weapons, employing direct fire only as a last resort. The proliferation of cruise missiles might force naval vessels to become smaller, faster, and more stealthy and agile; such ships might operate in twos or threes and use cruise or tactical ballistic missiles rather than aircraft to project power onto land. Submarines and short, stealthy ships might become the dominant sea vessels. Many layers of command might be removed to permit greater flexibility; battalions might report to corps, individual ships to fleet headquarters. Most combat aircraft might become cheap, pilotless drones, nothing more than delivery platforms for precision weapons.

Organizational changes will in many cases depend on advances in logistics and support. A primary reason why weapons systems today remain embedded in large, unwieldy units is that it is only in such units that they can obtain the proper supply, spare parts, repair, and other support. Reliability, ease of repair, and a light logistics train will therefore be at a premium, because advances in those areas will allow more dramatic experimentation with force structure.

Organizational reforms in combat units will be paralleled by similar changes in the decision-making structure of the U.S. defense establishment. To obtain the needed technologies for the MTR in the right order, the current requirements and acquisition system must be reformed. Chapter 5 examines this question in some detail.

Information—intelligence about the enemy, knowledge of one's own forces, targeting data, damage assessment—is quite simply the foundation of warfare. Without it, all other aspects of combat, from command and control to major systems, are irrelevant. There is little point to being able to order a tank platoon into battle, or to having the most advanced tanks in the world, if the enemy's location is unknown. Battle begins with information, and, most fundamentally, it is for this reason that the task of information dominance deserves top ranking among the enabling capabilities.

There are other persuasive reasons as well. Accurate intelligence is the foundation of combined-arms operations short of war. When conducting forward presence or military deployments intended to send a deterrent or reassuring signal, U.S. forces require sound information about the situation and their potential adversary. Better information collection and management will help determine when such operations are necessary and will point the way toward the best and safest means of conducting them. By dominating the field of information, U.S. forces can make combat unnecessary by remaining one step ahead of their potential adversary.

In peace and war, moreover, information is in many ways the key to successful coalition efforts, which may become the standard form of military operation in the future. In order to recruit coalition partners, the United States will need excellent intelligence about the intentions and capabilities of potential adversaries. Already, U.S. advantages in the realm of information have played an important role in forging and sustaining coalitions, in both peace and war: in Desert Storm, the worldwide effort to head off North Korea's nuclear program, and a host of other cases, the possession of key facts has enabled U.S. leaders to convince other nations of the need for multinational action.

This also suggests that information technologies meet an important criterion for U.S. military forces in the future. They provide a *unique U.S. contribution* to multilateral operations, one that no other nation can duplicate. More than tanks or planes, it will make sense in many cases for the United States to provide the informational technologies for a coalition deterrent or war-fighting effort. In this process, information sharing will be a continuing challenge—deciding what kind of intelligence and other data to share among coalition partners, and how quickly.

Information technologies also help the U.S. military operate in an environment of instant media reporting. There is no question that the informational technologies associated with U.S. damage assessment and surveillance, including bombsight cameras and combat film, improved the public image of the operations being conducted in the Persian Gulf War.

Finally, targeting information will be especially critical when U.S. contingency forces face threats from nuclear, chemical, or biological weapons. Given the inevitable imperfections of any passive defense, U.S. forces must be increasingly capable of counterforce missions, preemptive or during a conflict, against opposing nuclear, chemical, or biological arsenals. To do so they need information—information about the production sites, storage depots, and operational locations of such weapons.

Because of the vast amount of information gathered on today's battlefield, winning the information war requires more than adding sensors; it also demands improved fusion and interpretation of the facts that are gathered. Information technologies therefore include powerful, high-speed computer software designed to process and display relevant information from dozens, hundreds, or even thousands of sensors. These computers would in turn allow the creation of command centers where all the information on the battlefield is displayed and discussed; eventually, such information fusion can take place at a very low level, with battle management capabilities present on every ship, in every battalion or company headquarters, at every squadron.

All of the combined-arms scenarios examined in this study supported the general notion that information is the key to the battlefield. Each did so in its own way, but the general message was clear. In the Iraqi and Iranian attacks south, the suddenness of the assaults mandated an air campaign as the primary initial response; to be effective, such a campaign needed very rapid air tasking (complete turnovers within a few hours) and superb targeting and retargeting. In the Korean contingency, the rough terrain created a need for better ways of locating North Korean units, even when they were under trees or dug into earth. North Korean chemical and biological weapons, special forces, and potential nuclear capabilities also created special needs for information. The China contingency was simply huge, so large that surveillance and information synthesis became paramount. In all cases, participants in the study deemed information, both political and military in nature, to be critical in keeping the regional or global coalitions together.

Mastering the surveillance and information war is a two-part process. U.S. forces must deny information to the enemy even as they acquire it themselves. The interference with, or manipulation or disruption of, the enemy's information loop will be a critical adjunct to military operations in the future; perhaps the dominant field of battle for this effort will be in space, where many reconnaissance and communications platforms are located. In extreme cases, it could even substitute for more traditional forms of combat. An ability to deprive the enemy of accurate and timely information can be decisive in and of itself, another reason for the prominence of this category.

"INFORMATION... IS THE
FOUNDATION OF WARFARE."

If information is the overall context or canvas of battle, then command and control is the brush—the tool by which the commander makes his or her intentions known to subordinate commands and thereby directs events. As such, command and control resides, like information gathering and management, at the core of all military operations. Because it is necessary for all weapons and major systems to do their work, it appears next on our list of priorities.

Put another way, information and command and control form the core of battlespace control, which is in turn the fundamental advance of the MTR. Together, advanced surveillance and command systems create the potential for individual commanders to see the entire battlefield and to direct units and fire at will. MTR technologies may cause a reevaluation of the level at which decisions are made in battle. Moreover, improved speed and integration of command and control is a necessary response to advances in information technologies. If a force does not possess the ability to respond to targeting information quickly and effectively, then that information loses much of its utility.

Improvements in command and control will be nearly as important as information technologies for future coalition operations. *Information will be needed to bring multilateral groups together and keep them together; command and control will allow their military forces to operate effectively as a whole.* Like information, advanced command and control can in this sense be a unique U.S. competency that is offered to international efforts and organizations. This is just as true for operations short of war as it is for combat.

Again, our contingency discussions reinforced the importance of command-and-control elements of the MTR. For the quick-turnover U.S. air campaigns to work in the Iraq and Iran scenarios, U.S. commanders would need seamless damage assessment and command and control. Those wars likely would be coalition efforts, which again points to the need for command and control to support multinational forces. Korea represented another multinational effort requiring combined command and control, especially between U.S. and South Korean forces; those forces would need excellent battle management in the early stages of North Korean attacks, especially given the North Korean army's proximity to the demilitarized zone and its special forces units. In the massive, theaterwide effort of the China contingency, command and control lay at the heart of U.S. and allied operations.

As with surveillance and information gathering, moreover, denying effective command and control to the enemy can be even more decisive than ensuring it for one's own forces. As demonstrated in the Persian Gulf War, decapitating the opposing command and control structure will plunge enemy forces into confusion and render

decisive action by them impossible. Denial of command and control is perhaps the most direct route to the psychological effects of the MTR, destroying the enemy's confidence, morale, and will to fight.

SIMULATION AND TRAINING

The focus of this study has been on the implications of ideas and technologies, but the human element is equally important. The use of simulation capabilities is beginning to radically alter the process and availability of training. Simulation was originally conceived as a way to improve crewman performance in specific tasks, such as gunnery or driving, without incurring the expenses of live firing and fuel costs. For commanders, simulation through gaming was a way to expose them to the countless variables and decisions in operational battlefield situations. The benefits of linking together various simulators to train entire crews, staffs, and support elements required for various operations was the logical progression of this technology.

Entire units, even widely dispersed ones, might soon be able to train together through simulation before they deploy to the field. Simulation technologies, including the evolving field of virtual reality, will allow mechanized units, from platoons to battalions, to practice moving and fighting together as a cohesive unit; aircraft strike packages, to exercise a mission together from various locations; naval elements, to work together as a battle group; and special operations forces, to rehearse a mission in minute detail. In preparing for a mission, these simulators can allow experimentation with various aspects of a mission in order to achieve optimum planning and flexibility.

The human potential of the military is also being realized by a revolution in training technologies and simulation. Through advanced training techniques, personnel are being sent into the field with proficiency levels far higher than ever before. In addition, those proficiency levels are easier to maintain and increase in field units through continuous training. Simulators and training programs embedded in weapons systems allow field personnel to train with their equipment and master skills without centralized training and education.

AGILITY

The importance of agility to U.S. military operations is self-evident. If U.S. and allied combat forces cannot get to the scene of trouble and supply themselves once there, then all investments in military hardware and all thinking about military doctrine will be irrelevant. Sufficient mobility assets can help avoid conflict by supporting operations short of war; the rapid arrival of a Marine Corps or Army

division in a trouble spot, for example, would send a powerful signal of commitment and resolve, and the deterrent effect of U.S. forward presence forces will be magnified if those forces can count on rapid reinforcement. Yet the United States is a long way from meeting the agility challenge. U.S. agility assets are not strong today, and many of them—from C-141 transports to naval supply ships to marine amphibious ships—are nearing the end of their service lives.

The Persian Gulf War provided little cause for comfort. Saddam Hussein gave the coalition over five months to build up in Saudi Arabia; the Saudis themselves boasted state-of-the-art airfields and ports and supplied vast amounts of logistics supplies, from trucks to oil; and one full U.S. corps came from Europe, aided by the well-established (if politically shaky) NATO logistics and transport system. All of these factors could be different in the future. In our Iraq and Iran contingencies, for example, the United States had little warning of the attacks and no time to build up in the region before hostilities began, most Saudi logistical facilities had been attacked, and bringing troops from Europe was not an option. In such cases, the twin problems of agility will pose a daunting challenge to U.S. leaders. Nor is there one obvious solution. Some military analysts call for the construction of new fleets of sealift ships and transport aircraft. Others object to the cost of new ships and planes and propose more indirect solutions, such as equipment prepositioning. The U.S. military is planning to do a bit of both. Meanwhile, the U.S. fleet of amphibious lift ships—which, unlike standard sealift vessels, are designed to deliver Marine units to enemy shores in a hostile environment—is growing older, and this fact poses another unique challenge to U.S. military planners.

In the short run, the United States will have little alternative but to invest heavily in conventional lift systems. In the longer run, however, the MTR holds out the tantalizing hope of easing the problem considerably through the development of smaller, lighter weapons capable of being transported in large numbers and of dominating future battlefields. Those closer to production might include armored vehicles a fraction of the size and weight of today's main battle tanks, but with the same antiarmor punch; engines with much greater reliability and fuel economy, and more modular designs for more rapid repairs; and lighter and smaller smart weapons. Even more dramatically, the MTR may alter the way in which U.S. forces conduct warfare, thus reducing the need for large-scale strategic lift.

STRIKE SYSTEMS

Strike systems are the lethal arm of the MTR, the capabilities that execute the battle once the information, command and control, and logistics are in place. They come in three primary varieties: smart weapons, exotic weapons, and major platforms.

The most important lethal element of the MTR are its *smart weapons*, the precision warheads and missiles that proved so effective in the Persian Gulf War. Although exotic weapons have the potential to revolutionize the application of force, most are too far off in the development cycle to offer large-scale benefits in the next 10 to 15 years, thus justifying a near-term procurement emphasis on smart weapons. Smart weapons earn a ranking ahead of the major platforms that deliver many of them and exotic weapons for a simple reason: even older platforms (such as the F-111 or conventional tube artillery) can join the MTR era when using precision weapons. Acquisition of smart weapons should therefore precede, in broad terms, acquisition of exotic weapons or major military systems.

Smart weapons are also the cutting edge on the battlefield of advanced information and command and control. The strike tools employed in combat must match the precision and speed of engagement of the surveillance and command technologies if the MTR cycle is to be complete, and smart weapons are the most important weapons systems for achieving that effect.

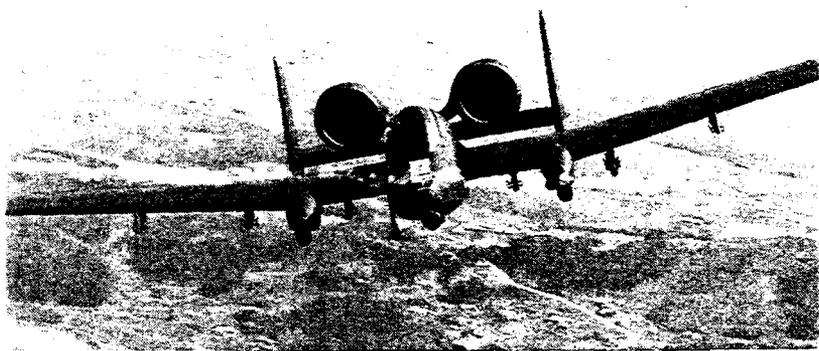
Very precise weapons also meet two other important criteria for U.S. military forces. As in the Persian Gulf War, they can single out military targets for destruction while leaving nearby civilian facilities nearly untouched; this works dramatically to reduce collateral damage and, as suggested in chapter 1, thereby "tend[s] to the U.S. image." By being so discriminating, and by demonstrating their discrimination and effectiveness in public forums, precision weapons also help to fight CNN wars, building public support and trust.

This category has a critical defensive aspect as well. Defending against enemy smart weapons—most notably today guided cruise and tactical ballistic missiles of various range and size—is as important as using such weapons to U.S. advantage. This points to the need for theaterwide missile defenses that are able to defend deployed U.S. forces from smart weapons attack.

This study's examination of specific contingencies reinforced the importance of smart weapons. In the Middle Eastern scenarios, precision munitions were critical to implementing the fast-turnaround, high-efficiency campaign to blunt the enemy ground offensive and to protecting the light ground forces that were put ashore in the early stages. In Korea, precision warheads were essential to blunt the initial North Korean attack and later to dig out North Korean units from dug-in positions. In the China contingency, the vast target array mandated precision in the use of force; no munitions could be wasted in such a massive contingency, especially where many of the targets were small and elusive.

Major military platforms hold second priority in the MTR's group of strike systems. They are the basic building blocks of all combined-arms military forces.

"ACQUISITION OF SMART WEAPONS SHOULD...PRECEDE. IN BROAD TERMS, ACQUISITION OF EXOTIC WEAPONS OR MAJOR MILITARY SYSTEMS."



A MILITARY PLATFORM: THE AIR FORCE'S
A-10 GROUND ATTACK AIRCRAFT.

Ships, aircraft, armored vehicles, and other systems carry the basic punch of modern militaries. Still, advances here are less likely to be profound than advances elsewhere, with the possible exception of stealth. Individual tanks, planes, and ships—as those systems have until now been understood—can only be made to go so fast, pack so much firepower, and take so much punishment. In the end, how they are deployed—which is a function of information and command and control—will de-

termine their effectiveness. An exception to this rule is that set of technologies that allows existing platforms to use smart weapons effectively; in the Persian Gulf War, for example, the United States did not have enough aircraft with the laser-designation and targeting equipment necessary to use certain smart weapons. Upgrades to provide such capabilities to most platforms are certainly required and justified.

More than procurement of new systems, what is truly required in the area of major platforms is a rethinking of their nature and role. It is an open question whether the tanks, aircraft, or naval combatants under development in 20 years will look anything like current weapons. On land, protection may become less relevant in disengaged battles and less possible in the face of smart weapons. At sea and in the air, comparably radical changes might take place in the types of platforms that perform military missions.

A notion that might have an important effect on thinking about major platforms is the idea of a “high-low mix” of technologies. In the Persian Gulf War, a few stealthy aircraft and a well-designed air campaign made stealth unnecessary for the force as a whole by knocking out the enemy’s air defenses. This concept must be considered more broadly and applied to a host of military problems, in part because the United States will not have the resources in the coming years to undertake across-the-board modernization. If a few copies of a new-generation platform could leverage the capabilities of existing weapons the way the F-117 Stealth fighter did in the Gulf, however, the high unit costs of low production runs might be justified.

The last type of strike system includes *exotic weapons*. Ranging from non lethal weapons to lasers to particle beams and a host of other exotic technologies, some technologies, such as laser designators and blinders, are being used even today. Severe technical hurdles remain in the way of large-scale deployment of most exotic weapons, many of which are also extremely expensive. It is unlikely that U.S. forces will make a transition to reliance on such weapons in the next 15 years.

One exotic system that may have increasing relevance in the next 15 years consists of nonlethal weapons. If U.S. forces were able, through electronic, electromagnetic, directed energy, or other means to incapacitate or render ineffective enemy forces without destroying or killing them, the U.S. conduct of war would be revolutionized. The whole calculus of costs, benefits, and risks would change for both the United States and its potential adversaries.

A NEW TYPE OF MILITARY

It is easy to see how each of the elements of the Military Technical Revolution depends on the others for its full effectiveness. Without adequate information and the command and control to act on it, the best troops will fight blindly. High-technology aircraft or tanks are useless without intelligent, well-trained troops to operate them. The best targeting data and the smartest pilots are useless without weapons with sufficient precision to make adequate use of such detailed information.

In general, however, the executing capabilities of the MTR—its aircraft, ships, combat vehicles, missiles, and smart weapons—are more dependent on the integrating framework (doctrine and organization) and the enabling capabilities (information dominance, command and control, simulation and training, and agility) than the other way around. Battlespace control, the goal of the MTR, relies, relatively speaking, more on the vision of military operations and the information, communications, people, and agility to conduct its operations than it does on the particular weapons systems used to strike enemy forces.

As chapter 5 will suggest, this conclusion directly challenges the acquisition priorities of the last 40 years, which have focused first and last on major weapons systems. If there is a single message of this chapter, and more broadly of this study, it is this: for the MTR to reach fruition, its theoretical foundations and enabling capabilities must be made equal to its high-technology weapons systems. Otherwise, this military “revolution” may never occur.

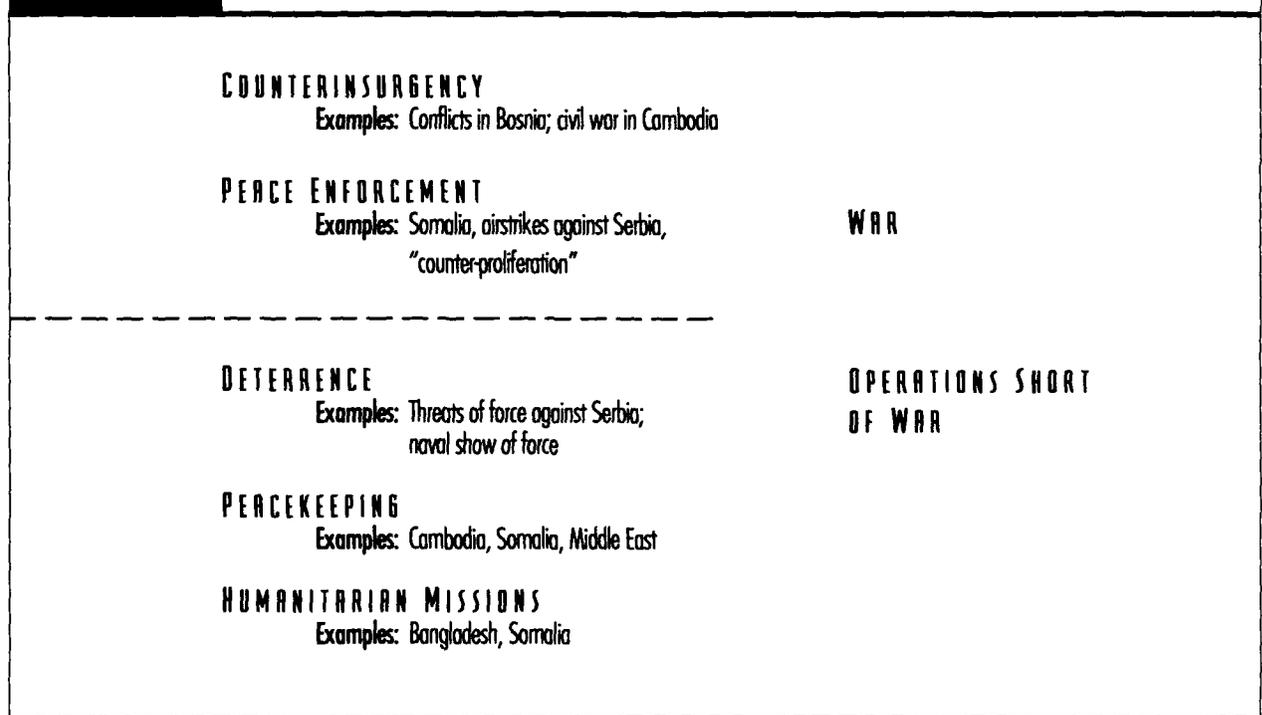
4

IRREGULAR OPERATIONS

This chapter examines the second type of military operations summarized in chapter 1. Most traditional terminology, such as low-intensity conflict and guerrilla warfare, carries intellectual baggage inappropriate for describing the broad spectrum of scenarios addressed here. We use the term irregular operations to send two messages: first, that the military missions involved in this area will not be of the traditional, combined-arms variety; and second, that the military will play many roles in operations short of war, from deterrence to peacekeeping.

Irregular operations range from humanitarian assistance in completely benign environments, to classic peacekeeping activities, to more rigorous—and deadly—peace enforcement undertakings, to traditional counterinsurgency. This spectrum of challenges is summarized in Figure 4.1.

FIGURE 4.1: IRREGULAR OPERATIONS



As this typology indicates, in irregular operations the line between peace and war is more indistinct than it is in combined-arms operations. Each category of irregular operations represents not a self-contained entity, but one point along a continuum for which military forces must be prepared. Peacekeeping operations can easily expand into peace enforcement, as would occur today in Cambodia and Angola if the United Nations attempted physically to contain the violence. A campaign of punitive raids aimed at peace enforcement, as some recommend against Serbia, could grow into a ground operation. Any deterrent signal can become a combat mission if deterrence fails.

THE U.S. ROLE

Military planning for irregular operations must therefore encompass a broad range of potential missions. But the United States may not choose to be heavily involved, or involved at all, in such operations, and different ends of the irregular operations spectrum suggest very different conclusions for military technology, doctrine, and force structure. A decision about what roles the United States will play in irregular operations is therefore a precondition for determining their implications for U.S. conventional forces.

The U.S. military will continue to be involved in *humanitarian* missions for a variety of reasons, the most pressing of which will be necessity: when an earthquake or a typhoon strikes or a famine emerges, military forces may be the only available means of providing rapid, large-scale assistance. But humanitarian missions have other uses as well. They help the military improve its image, sending a signal to the U.S. people and the world that the mailed fist of U.S. military force can also be a velvet glove of assistance. They promote coalition building by increasing peacetime contact among the militaries of many nations and through that process establish a rationale for formalizing common communications and rules of engagement. For civil affairs, psychological operations, and medical and engineering units, humanitarian missions can offer excellent real-world training and experience. And at some level they may provide U.S. military leaders with an argument for maintaining a slightly larger force structure than they might keep without such missions in their portfolio.

U.S. forces will also participate in *peacekeeping operations*, although foreign troops under UN command will retain the lion's share of this mission. Dozens of countries have contributed troops for UN activities around the globe. Most of these missions require only light infantry, supported by a few vehicles, some command and control systems, and a logistics base. In individual cases, the promise or commitment to ground troops may be important for symbolic or political reasons, as with the Clinton administration's February 1992 pledge to supply up to 10,000 troops for peacekeeping duties in Bosnia. But in general, other nations should continue to

provide most of the personnel for peacekeeping operations, with the United States contributing in areas of unique competence such as strategic lift, logistical support, intelligence, and command and control.

Finally, there are those operations involving combat or the threat of it: *deterrence, peace enforcement, and counterinsurgency*. To some extent, deterrence is a subset of war-fighting, because those capabilities best suited to winning a conflict are also best at deterring it. It remains highly unlikely that the United States will become involved in a large-scale counterinsurgency war; the Vietnam Syndrome, when applied to such conflicts, is very much alive, a fact clearly evident in the present U.S. unwillingness to become drawn into a ground war in Bosnia.

Peace enforcement, then, may well be the primary combat task for the United States in the field of irregular operations. This term encompasses any punitive or preventive military actions designed to safeguard peace or preserve social stability, or to respond to provocations such as terrorism or proliferation. It would include, among other things, precision air strikes to enforce the *no-fly zone* over Bosnia, punitive attacks on Khmer Rouge guerrillas who violate a Cambodian cease-fire, and the neutralization of armed gangs in Somalia.

A good example of a military mission that might fall under the category of peace enforcement is offered by the 1986 U.S. air strike against Libya. It is representative of a host of discrete strike operations that may be conducted in the future: aggressive counterterrorist operations (as in the Libyan case), preemptive denial of weapons of mass destruction, demonstration of a military capability for deterrent effect, and others. Many of the revolutionary capabilities for combined-arms operations could play a role in such a strike, as earlier systems did in the Libyan raid.

Peace enforcement will not be a uniquely U.S. mission. Indeed, especially to the extent that some sort of UN military force is established, the United Nations should assume a growing portion of this burden. In general, however, and admitting a strong continued U.S. role in humanitarian and peacekeeping efforts, this study's analysis suggests that the U.S. role in irregular operations will be most important, pronounced, and long-lasting in the area of peace enforcement.



U.S. SPECIAL FORCES CAN PLAY A MAJOR ROLE IN IRREGULAR OPERATIONS.

THE MTR'S ROLE

The security problems that underlie irregular operations are commonly dominated by vexing political, social, and economic dilemmas that, unlike the military

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threat posed by an enemy army, are not susceptible to the application of military force. As the United States learned in Vietnam, and as is so widely recognized with regard to the conflict in the Balkans, irregular operations must be fundamentally non-military efforts. In medical terms, the military aspects of irregular conflicts are only symptoms; the true causes lie elsewhere, in the broad factors that give rise to the instability or insurgency.

It would be wrong, nevertheless, to write off the potential application of the MTR to irregular operations. During the next 15 years, U.S. military forces will almost certainly be involved in far more irregular operations than combined-arms warfare. And many of the generic categories of MTR technologies, along with a few of its doctrines and organizations, *could*, with modifications, apply to lesser-intensity conflicts. A few obvious examples of these technologies are advanced sensors capable of searching for small groups of infantry, lightweight communications gear, and nonlethal weapons.

This study has argued that U.S. military forces should be designed primarily for combined-arms warfare. To the extent that elements of the MTR must be modified for irregular operations, therefore, those modifications should be done in ways that do not detract substantially from the military's capability for larger-scale, mechanized warfare. With careful advance thought and planning, however, the U.S. military should be able to acquire systems with greater applicability to the entire spectrum of conflict. The analysis that follows suggests that the natural progress of technology in several important areas will naturally render combined-arms systems more effective in irregular operations.

DOCTRINE AND ORGANIZATION

The importance of doctrine and organization is just as great for irregular operations as it is for combined-arms engagements. Because military force is seldom decisive in irregular wars, the overarching political, social, and economic strategy for addressing those conflicts—in effect, the doctrine for irregular operations—becomes critical. And to the extent that military or paramilitary forces are involved at all, they may need radically different force structures than do units designed for combined-arms operations. This, along with the need for structural reforms in the U.S. government aimed at better prosecuting lesser-intensity conflicts, points to the importance of changes in organization.

It is difficult to say which MTR doctrines or organizations might have relevance to irregular operations. The thinking about these issues has not kept pace with the MTR's technologies, and in any case there no single doctrine or organization will be

appropriate for all irregular operations. Many combined-arms doctrines and force structures, by their nature, will be totally irrelevant to less traditional conflicts. Only later, when MTR framework issues have been developed in greater detail, will their contribution—or lack of it—to irregular operations be apparent.

Even now, however, it is possible to suggest a few examples. A doctrine that called for decentralization of operations and decisionmaking on a nonlinear battlefield, and the technologies and force structures to support it, might find some application in the often confused, highly decentralized world of irregular operations. Joint, precision strike forces that coordinated the fire of naval, air, and ground units might be useful in peace enforcement efforts that called for punitive strikes aimed at compelling action by another nation.

One organization important to MTR combined-arms operations is clearly relevant to irregular ones as well. The agility, stealth, and precision of special operations forces makes them in many ways ideal tools for irregular combat operations. Special forces could perform irregular missions ranging from raids on guerrilla positions to hostage rescues to target designations.

SIMULATION AND TRAINING

Better training can significantly improve the effectiveness of U.S. forces involved in irregular operations. Relief and nation-building task forces that train together in peacetime and work regularly with the civilian agencies they will support in crises will know each other and their task better.

MTR simulation and training technologies have less to contribute here than in combined-arms operations—most of the unique instruction for irregular operations will have to do with political and cultural familiarization—but they can be used. Simulators can model police-type actions like riot control and pursuit of snipers or other hostile individuals. Once nonlethal weapons are developed and deployed in large numbers, simulators can help troops understand their effects and use them to best advantage. And advanced communications networks, including interactive video links, can help keep peacekeeping units familiar with ongoing crises and the tasks they might face. For example, civil affairs and psychological operations units in the U.S. Army reserve around the country units could report monthly or weekly to local high-technology communications centers to receive detailed briefings from Washington or elsewhere on missions they might face and the nature of societies into which they might be thrust. Training can also be used to increase the effectiveness of multilateral operations, as most peacekeeping or peace-enforcing undertakings will be.

"INFORMATION IS JUST AS
CRITICAL IN IRREGULAR
OPERATIONS AS IT IS IN
COMBINED-ARMS WARFARE."

Information is just as critical in irregular operations as it is in combined-arms warfare. In many ways, gathering information is the dominant aspect of operations in lower-intensity conflicts. Opponents in such wars are not powerful, high-technology armies capable of disabling U.S. MTR technologies; to the contrary, they are elusive, hit-and-run raiders who depend on concealment, knowledge of the terrain, and an ability to melt into the population. This was true in Vietnam, it is true in Somalia today, and it would be true in the former Yugoslavia if a UN or NATO force were committed there. The primary challenge in irregular operations is in *identifying* the enemy, not defeating it once it is found. This places a premium on surveillance and intelligence gathering rather than on war-fighting technologies.

The three irregular contingencies examined in this study—peacekeeping in Cambodia, peace enforcement against Serbia, and humanitarian relief in Sri Lanka (all fully international efforts)—bore out this point. In attempting to separate and track warring factions in Cambodia, for example, peacekeeping forces needed accurate information about their location, capabilities, and operations; the Cambodia group concluded that the most important MTR-related advances would be in the area of information collection. Similarly, in order to threaten Serbian forces in Bosnia or Macedonia, peace enforcement forces would require better surveillance, including the ability to locate and track small infantry units and to discriminate among a variety of targets. In Sri Lanka, international relief forces would need intelligence both on the political situation and on the areas of greatest devastation and need.

It is important not to overestimate the role technical intelligence systems can perform. Much of the information U.S. and coalition forces will require in irregular war is political or social in nature and best gathered through human intelligence. In our analysis of the various contingencies, for example, it quickly became apparent that rapid and accurate political assessments were especially critical, knowledge that an AEGIS ship or satellite would have been helpless to provide. The need for information in irregular operations, therefore, requires first and foremost a focus on human and political intelligence. It also points to the need for stronger standing country action teams that are capable of going into the field and supporting peacekeeping or peace enforcement efforts.

Special operations forces may be especially helpful in gathering such information. They specialize in regional areas during peacetime and can therefore be trained to a reasonably high degree of competence in the political and social situation they will be facing. Inserted quietly before the arrival of U.S. or UN troops, special forces can determine the political and military climate and take preparatory steps.

There are, however, limited roles for MTR-type surveillance systems in lower-intensity conflicts. Of course, the nature of the information being sought in irregular operations is very different from that needed in combined-arms warfare. Yet there are many areas of commonality, and the differences are small enough that a single group of surveillance technologies could have great application in both types of warfare.

The target signatures that current U.S. surveillance systems look for on a combined-arms battlefield—heat and motion from armored vehicles, radar emissions from anti-aircraft gun or missile sites, radio traffic, and so on—are of the same *type* as in irregular war; they are merely of a different order. A more sensitive thermal sensor could allow a passing aircraft to detect groups of soldiers as small as squads on the ground below, even in jungle or mountainous terrain. Motion detectors, perhaps dropped or installed in permanent locations, could give warning of the passage of otherwise undetectable units. Better artillery-location radars could give UN peace enforcement units the ability to find and shoot back rapidly at small mortars or other indirect-fire weapons used for harassment.

This is not to suggest that MTR surveillance systems designed for a combined-arms conflict could be used in all irregular operations without modification. That will be true of some systems, but many others will require technical or operational alterations before they are fully relevant to lower-intensity conflicts. The JSTARS aircraft, for example, is currently designed to detect and track mechanized forces on the move; a similar capability to follow groups of light infantry would probably require an entirely new aircraft or at a minimum, a redesigned platform with additional sensors.

One important point emerged from our consideration of the surveillance requirements of various scenarios: *the improvements expected from next-generation sensor technologies may benefit combined-arms and irregular operations almost equally.* Already today, in such systems as satellites, reconnaissance aircraft, and radar detection systems, U.S. forces possess the basic capabilities needed for information gathering on the combined-arms battlefield. The improvements created by further investment in this area—much more sensitive heat and motion detectors, the ability to look more reliably through clouds and jungle, the ability to define the battle down to small groups of soldiers—are just what is required to make high-technology surveillance systems more relevant to irregular war. A system that could find and identify not only tanks but also squads of soldiers would be of great utility for all types of warfare.

As in combined-arms warfare, moreover, in irregular war information technologies will constitute an area of unique U.S. advantage and, therefore, a logical U.S. contribution to the multilateral effort. Other members of UN peacekeeping or peace

"IMPROVEMENTS EXPECTED FROM NEXT-GENERATION SENSOR TECHNOLOGIES MAY BENEFIT COMBINED-ARMS AND IRREGULAR OPERATIONS ALMOST EQUALLY."

enforcement operations will have light infantry, medical units, ground transportation, and a host of other components. Only the United States will be capable of offering the kinds of high-technology surveillance technologies discussed here.

COMMAND AND CONTROL

Command and control will also play a major role in irregular war. It is the glue that holds together peacekeeping and peace enforcement operations and the international coalitions that conduct them. In general terms, the type of communications needed in irregular operations is the same as that required in combined-arms war: real-time, integrated communications nets that link together all military formations.

Our analysis of several irregular warfare contingencies supported this emphasis. Group discussions of scenarios in Serbia, Cambodia, and Sri Lanka all produced the same overwhelming theme: the clear need for real-time, common command and control networks and real-time language translation to support peacekeeping and peace enforcement operations. In the Serbian contingency, the possibility of punitive military raids and theaterwide conflict made reliable command and control especially important; in all three scenarios, difficult terrain and the inevitability of dispersed, isolated peacekeeping groups created the same requirements.

Advanced command and control is also a nearly unique U.S. competency, and therefore, like

information technologies, constitutes an appropriate U.S. contribution to multilateral operations. This is true in high-intensity warfare as well as in irregular operations.

The nature of irregular operations will impose several unique constraints on command and control systems. First, command modules for peacekeeping forces should generally be smaller and lighter than those for heavy combat formations; units in low-intensity combat will generally be small and infantry-based and must be capable of carrying their full communications suite around with them.

Second, peacekeeping missions are, and will likely remain, even more thoroughly multilateral in nature than conventional wars. Command and control for irregular operations must therefore stress the integration of many national forces. As this is not likely to be accomplished by peacetime acquisition of common systems (even between, for example, the French and German portions of the Franco-German brigade), it requires new thought about simple, reliable, stockpiled command and



APACHE HELICOPTER PREPARES FOR A MISSION.

control equipment that the United States can rapidly parcel out, or perhaps some technology designed to allow disparate communications networks to work together. This need also points the way to further research in the area of translation—either automatic or better electronic support to human translators.

On closer examination, however, it appears that what was true for information technologies also applies to command and control systems: although today's systems designed for combined-arms forces would not be optimal in irregular operations, the most useful *future developments* in technology will be equally applicable to both. One example is miniaturization: powerful, hand-held radios that are fully integrated into an overall command and control architecture will offer great benefits to combined-arms units while providing the indispensable communications element to lower-intensity operations. Measures designed to improve multilateral command and control are clearly essential for all military operations in this era of collective security and coalition efforts.

ABILITY

Even today it is apparent that agility assets will form a major part of any U.S. contribution to irregular operations. In peacekeeping and humanitarian missions across the globe, U.S. transport ships and aircraft are helping UN forces and civilian relief agencies do their jobs. This will continue to be true in the future, as large-scale strategic lift is likely to remain an area of U.S. dominance. A few mobility problems unique to irregular missions require special attention, such as the delivery of special forces units and the extraction of civilians from hostile environments.

Perhaps most important to agility in irregular operations will be improved mine warfare capabilities. On land and at sea, primitive and advanced mines hold the potential to disrupt U.S. and international efforts. Mine clearing has played a large role in coalition activities in the Persian Gulf for several years, and many less-developed adversaries undoubtedly recognize the usefulness of even old, cheap mines in slowing U.S. military movements. The DoD is giving this problem more attention, but it deserves even higher priority.

STRIKE SYSTEMS

The role for major weapons systems is naturally less in lower-intensity conflicts than in combined-arms operations. Nonetheless, a number of specific strike systems can aid peacekeeping and, especially, peace enforcement efforts in important ways. One category of systems is a new requirement, unique to irregular war; the other two are systems already mentioned as important to combined-arms operations.

The one major exception to this rule is the area of nonlethal weapons. Such

weapons offer an opportunity not only to limit U.S. casualties, but also to limit enemy casualties. Peacekeeping and peace-enforcing operations appear to present the prime operational environments for their initial employment. The environments are dominated by a concern to limit casualties, preemptively disarm combatants, and protect civilians. Among the technologies discussed were nausea-inducing ultra-low frequency sound and temporarily blinding flashes of light. Other nonlethal weapons seek to disable the implements of war or impede their use—such as circuit burning microwave blasts or directed energy blasts causing structural failure at the molecular level.

The full potential of such weapons is yet to be understood, and their employment could produce unexpected results. There is hope that the integrity and morale of adversary forces can be shattered before these weapons ever reach the battlefield, or that enemy soldiers can be preemptively incapacitated and disarmed, or that enemy emplacements can be rooted out of civilian areas with little collateral damage. But their use could result in unexpectedly high casualties, permanent side effects, or unforeseen collateral damage or environmental degradation.

The other two strike systems useful in lower-intensity conflicts were also important for combined-arms operations. In a number of contingencies, including those we examined, the need for precision strikes will arise for punitive or peace-enforcing reasons. To conduct such missions, standard precision weapons of the sort now in the U.S. inventory and under development should suffice. What would be helpful is a precision warhead designed for attacks against soft targets, such as infantry, trucks, open-air depots, and the like. In order to conduct such attacks, and to guard air corridors for relief supplies and military sustainment, air-superiority technologies will be important in irregular operations.

Finally, an expanded capability for littoral naval operations will be important in the years ahead. As in combined-arms operations, in irregular missions the U.S. Navy must be more capable of operating close to shores with great flexibility and a reduced degree of vulnerability to missiles or mines.

AN IMPERFECT BALANCE

The MTR can make only a limited contribution to irregular operations. In most cases, the roots of such conflicts are political, social, and economic in nature and do not admit easily to military solutions. Nonetheless, in a few specific areas, such as communications and nonlethal weapons, MTR technologies can greatly affect the conduct even of peacekeeping and humanitarian missions. MTR-type surveillance systems and smart weapons have great relevance to peace enforcement operations such as precision strikes and punitive raids. Along with some of the doctrinal and organizational reforms suggested above, the MTR will help revolutionize the conduct of irregular operations.

5

THE SHAPE OF WARS TO COME

Taken as a whole, the analysis of the previous chapters points to one overriding conclusion. If the full potential of the so-called Military Technical Revolution is realized in the coming decades, the face of battle and the nature of warfare will both be completely transformed. Warfare in 2010 will look very little like it does today; the weapons, doctrines, force structures, and, most important, thinking of the U.S. military will have undergone the most radical revision of the century.

But none of this will happen—the nature of war will not change substantially, the advantages and implications of the MTR will emerge in only stunted and incomplete form—unless two conditions are satisfied. First, U.S. defense policy makers must set the right priorities within the MTR. And second, U.S. military and political leaders must create a decision-making and acquisition structure within the Department of Defense that is conducive to the implementation of an MTR—one of the most difficult things for military institutions to accomplish. It is almost axiomatic that, given the current system for designing doctrine, planning military requirements, and acquiring military equipment, the full potential of the MTR cannot be realized. An effective, joint acquisition system would be the most powerful weapon in the MTR's arsenal.

PRIORITIES AMONG MILITARY MISSIONS

This study has suggested that the U.S. military ought to be shaped largely with traditional, combined-arms operations in mind. These pose the most serious risk to U.S. interests, and potentially to the United States itself, of any forms of conflict likely to arise in the next 10 to 15 years. Moreover, pursuing MTR technologies in this area is the best way to capture two related requirements: keeping alive the capabilities necessary for a renewed global competition (the reconstitution mission), and conducting peace enforcement operations (including preemptive strikes against proliferators or terrorists).

Yet irregular operations will almost certainly outnumber combined-arms operations in the years ahead, and MTR technologies must be made more relevant to lesser-intensity conflicts. Chapter 4 suggested a few means of doing so without detracting from the basic, combined-arms war-fighting mission of the military. This conclusion is in no way meant to suggest that the MTR will be a panacea for missions

across the entire spectrum of conflict; indeed, this study has argued that technologies, doctrines, and organizations designed to fight a high-intensity MTR war will have only limited application to most kinds of irregular operations. But a better job can and must be done of rendering military technologies, doctrines, and organizations effective across the full spectrum of conflict.

As it approaches these missions over the next decades, the U.S. military will face a number of powerful constraints. These range from budgetary shortfalls, to the affect of media coverage on war, to the need to preserve a well-trained forces and some semblance of a defense industrial base. Together, these and other constraints call for a military that is able to squeeze more effectiveness and unit readiness out of smaller forces, to do so with fewer U.S. casualties and less collateral damage than in the past, and to operate either more independently than ever before (without the support of foreign bases) or more enmeshed than ever before in international coalitions and military forces. The MTR offers an opportunity to create just such a military.

THE NATURE OF THE MTR

The MTR is a holistic phenomenon that, more than any previous military revolution, represents the combination of a number of theories and enabling as well as executing capabilities. Its essence is integration, synergy, and the mutual dependence of various elements on the others for success. It is therefore difficult to



E-2C HAWKEYE REW AIRCRAFT.

slice off one or another component of the MTR as uniquely important or necessary; without the others, the effect on war of any single element of the MTR may be profound but could not rightly be described as revolutionary.

In the broadest sense, the MTR's goal is *battlespace control*. It does not seek to create horribly destructive new weapons, or startlingly fast aircraft, or any similar physical capability. Rather, the MTR aims at managing—and, more than that, at controlling—the battle on a real-time basis and down to an unprecedented level of precision. A military capable of battlespace control will easily and rapidly defeat any opponent

who chooses to fight a conventional, mechanized war without such a capability. Recognizing this fact, potential U.S. adversaries may turn increasingly to irregular operations to thwart U.S. interests, as many have done already.

These facts point to the four major conclusions of the study, conclusions that can

help guide DoD acquisition priorities. First, *the doctrine and organization that constitute the integrating framework of the MTR are its most important components, and yet the technological aspects of the revolution have outpaced, and displaced, its theoretical and structural aspects.*

It is possible to identify two types of military revolution. In one type, technologies alone have created some fundamentally new aspect of war and have, in a sense, revolutionized it, but there are no supporting doctrines or organizations to take full advantage of those technologies. An illustration might be the use of mechanized forces in the West up to 1940: France and Great Britain developed the tank but, despite the efforts of armor proponents such as Charles de Gaulle and B.H. Liddell-Hart, had little idea of how to use it decisively. Such revolutions are stunted, incomplete, fragmented; indeed it is probably not accurate to term them revolutions at all.

A true military revolution, on the other hand, marries advancing technologies to sound doctrines and organizations designed to maximize the effect of the new weapons. Germany had learned well from the prophets of mechanization, and its doctrine of *blitzkrieg* warfare and its fast-moving, all-arms combat teams brought the mechanized revolution in military affairs to full fruition.

Today the United States possesses most of the weapons and other technological systems needed for the MTR, or at least for an early version of it; but, as so often happens, doctrine and organizations have not kept pace with technology. The U.S. military is scarcely realizing the full potential of revolutionary weapons with mere modifications of years-old doctrines for conventional warfare on land, sea, and in the air. In a sense, this is a fortunate mismatch: doctrine and organization cost far less to reform than weapons systems, and if we needed the latter rather than the former, prospective defense budgets would hardly support their acquisition. Put another way, in a period of budgetary stringency, it makes sense to look for the most progress in the areas that cost the least—in this case, doctrine and organization.

This study's second major conclusion about the MTR modifies, but does not run completely against, the first. It is that *the heart of the MTR is information, and to the extent that new systems or technologies are acquired, priority should be given to the areas of surveillance and command and control.*

The revolution in military affairs currently under way is most significantly a revolution in *information*. For hundreds of years, the most fundamental aspect of war, its overriding constraint, was its confusion—the fog of war. Commanders have always had an imperfect idea of where enemy and friendly forces were at any moment, and once they have acquired information, they have suffered from unreliable systems of sending orders to their units. In the most extreme cases, hundreds of years ago, armies milled around the battlefield, often lost in smoke from guns and general confusion, and the outcome was dictated as much by luck as anything else. As late as the Persian

"...THE HEART OF THE MTR
IS INFORMATION."

Gulf War, the information loop of warfare—the connection between surveillance and tracking the enemy, intelligence fusion and interpretation, decisionmaking, and command of forces—has been obscured by misinformation and confusion; at best it has operated over the course of hours.

This represents, of course, a quantum improvement over previous wars, when the information loop hardly existed at all and took place over periods of days, weeks, or even months. But what the MTR promises, more than precision attacks or laser beams, is another such quantum leap: to imbue the information loop with near-perfect clarity and accuracy, to reduce its operation to a matter of minutes or seconds, and—perhaps most important of all—to deny it in its entirety to the enemy. A military with such capabilities would be nearly invincible in combined-arms operations for the foreseeable future.

More than anything else, these capabilities require further advances in information gathering and dissemination and in command and control. Chapter 3 laid out a number of specific examples; in essence, the goal is to acquire information about the enemy, transmit orders among one's own forces, and prevent the enemy from conducting the same process. New technologies that offer advantages in these areas include advanced sensors and radars; lightweight, rugged, and powerful communications nodes fully integrated into a comprehensive command and control net; and countermeasures such as electronic warfare equipment and radar or radio attack missiles.

The third conclusion is that, *within the realm of strike systems, smart weapons should have priority over major platforms*. This is the case for two basic reasons: smart weapons can be fired from older platforms, rendering those platforms perfectly suitable for MTR operations; and it is the precision of those smart weapons, more than any features of weapons platforms (with the exception of stealth), that plays the greatest role in supporting the operations of an MTR-capable force. Defenses against enemy smart weapons (such as tactical missiles) are especially critical, and the development of theater defense architectures deserves high priority.

This study's final conclusion is that, *without compromising their effectiveness in combined-arms operations, new efforts should be made to render MTR technologies, doctrines, and organizations relevant to irregular operations*. Such operations may constitute the bulk of the U.S. military's missions in the coming years, and to the extent that the MTR can contribute to them, it should.

IMPLICATIONS

Chapter 2 spelled out a number of the operational implications of MTR doctrines, organizations, and technologies. The information revolution discussed above will partly lift the fog of war for U.S. forces and thicken it for their enemies. The combination of this information revolution with smart weapons will lead to a new

understanding of the traditional military principle of mass, and as commanders mass their fire, they will increasingly do so not just against front-line enemy forces but against the entire national infrastructure that supports those forces. MTR technologies therefore force a redefinition of a theater of operations and argue for a systems approach to finding the enemy's critical vulnerabilities; by striking such points with precision weapons, the MTR breaks the link between destructiveness and lethality. Finally, as U.S. forces conduct these various operations, they will be protected by an unprecedented combination of defensive technologies supporting the basic military principle of *security*.

Taken together, the effects of the MTR may boil down to two fundamental principles: tempo and psychology. MTR technologies and doctrines will greatly increase the pace of warfare, accelerating military operations and compressing the time available for decisionmaking. And such intense operations will be sustained around the clock and through even the worst weather. If employed properly, high-tempo operations, weapons of stunning precision, and information denial—in other words, firm battlespace control—will have a devastating psychological effect on the enemy. As in the Persian Gulf War, many opposing troops will be unable to fight or will simply choose not to. The MTR will thus have reached the goal laid out centuries ago by Sun Tzu—"breaking the enemy's resistance without fighting," at least fighting as intensely as in past wars.

These operational results will have a number of profound effects on the nature of grand strategy and warfare. By its nature the MTR represents an important means of approaching the problem of *limited war*. From Korea to the Persian Gulf War, post-World War II U.S. combat operations have been uniformly limited in scope and in the degree of force the United States could apply. In Korea and Vietnam, these limits were imposed by the threat of escalation; in the Gulf, shaky Arab perceptions and U.S. public opinion dictated restraint. In these and other cases, fighting limited wars has proved to be a tricky business, fraught with battlefield constraints and confused exercises in war termination. These experiences have increasingly obscured even the simple definition of what constitutes victory in war.

MTR doctrines and technologies offer new solutions to these problems. Precision attacks against strategic information nodes throughout the opposing nation might paralyze enemy operations and create the conditions for a broad, unconditional surrender not dictated by events on the "battlefield" as it is traditionally understood. Nonlethal weapons might allow U.S. forces to "annihilate" enemy forces with significantly fewer enemy casualties than in the past.

With an MTR force, U.S. leaders will be increasingly free to conduct such operations without assuming massive risks. The MTR will render the military

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instrument more effective by reducing the costs of military operations, both to the United States and to its adversaries, and will thereby help mitigate the constraints on military operations imposed by media coverage and public opinion.

Ideally, of course, the United States will want to prevent rather than fight wars in the years ahead. The MTR capabilities outlined above have great relevance to the conduct of *deterrence*, reducing the degree to which U.S. security commitments, deterrent signals, and threats designed to compel actions by other nations are undermined by the lack of credibility of U.S. forward-deployed forces or the inability of the United States to get forces to the crisis spot. The MTR could convey the ability, through a series of strategic air and missile attacks launched from the United States or from ships at sea, to incapacitate an enemy's military force with few U.S. losses. The deterrent effect of such capabilities is obvious.

Finally, the MTR carries implications for ongoing debates about the *defense industrial base*. It suggests specific areas—the MTR capabilities outlined here as most important—where the base should be preserved. In the strike systems category, for example, this study would argue for preserving a defense industrial capability in smart weapons before doing so for ships or aircraft.

IMPLEMENTING THE MTR

This study's conclusions are relatively straightforward. Properly designed, the MTR could revolutionize U.S. military capabilities, make the smaller standing forces we will field in the future more powerful than any military force in history, hedge against the danger of a new global threat, and achieve a dozen other advantages. The justification for the MTR seems obvious, so clear that the chance of it being ignored hardly exists.

The successful implementation of the MTR is hardly guaranteed, however. Throughout history, revolutions in military affairs have faced stiff barriers, which frequently have diluted, or even completely dissipated, their effects. Tradition and inertia have exercised a powerful influence, hardening the resistance to innovative thinking and preventing organizational or doctrinal reform. Many MTRs face initial, practical barriers at the small-unit level; forces trained for one kind of combat take some time to adjust to a new form, and as the advocates of military revolutions have discovered throughout history, making a revolution come alive within the ranks of the military is a different endeavor from discussing it in theoretical terms. Most MTRs arise between wars, when defense budgets are low and resources do not exist to fund them adequately. As mentioned throughout this report, three key elements of any MTR—technology, doctrine, and organization—often develop unevenly; a mismatch between them can ruin an MTR's effectiveness.

Solutions to some of these problems have already been identified. Implementing the MTR at the unit level will require advanced training and simulation technologies that match the sophistication of the MTR weapons, and increasing degrees of military jointness at lower unit levels—a sort of “living” joint awareness, planning, and understanding extending across the four services from the lowest organizational levels. Budgetary constraints will force a look away from new platforms as the near-term means of implementing the MTR, which is actually fortunate. Doctrine and organization must begin to receive as much attention as weapons systems.

Currently, however, there is a broader difficulty, a systemic barrier within the U.S. Department of Defense to the full realization of the MTR: the U.S. requirements and acquisition process. The requirements process, by which the needs of the military are developed, is often slow to respond to new ideas and new possibilities. The acquisition system itself, while it has done a reasonable job of producing effective weapons systems, is not as good at supporting joint efforts or requiring various systems to be mutually supportive. It is geared to producing high-quality weapons one at a time, not systems that, though their coordinated effect, are greater than the sum of their parts. And that, of course, is exactly the goal toward which the MTR is working.

It is well beyond the scope of this report to prescribe a comprehensive defense acquisition reform scheme. But the need for change is clear, and it may require something as fundamental for the acquisition process as the Goldwater-Nichols Act was for military command arrangements. Perhaps the most important recognition in this context is that the MTR, as a dramatic and fundamental break from many past military traditions and practices, will come to fruition only if sponsored by dedicated, talented individuals within the military who inspire their subordinates and colleagues. In short, the implementation of any MTR will not be the result of *management*; it will require sound and energetic *leadership*. And the question of who will lead the MTR within the U.S. defense establishment remains an open one.

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A NEW KIND OF WARFARE

The Military Technical Revolution holds the potential to change the way wars are fought. For the time being, however, the MTR as a phenomenon, a comprehensive entity, remains only that: a reservoir of potential. A true revolution in military affairs has not yet occurred, for all the excitement about U.S. operations in the Persian Gulf War. For those who recognize the benefits of the MTR, that is a sobering conclusion. But it should also be an energizing one: more than at any other time in this century,

the architects of U.S. defense policy can acquire new capabilities that will revolutionize U.S. military operations and provide the United States with unquestioned military superiority for years, possibly decades, to come. This opportunity is a powerful and exciting one. Equally powerful, however, are the daunting barriers to realizing the MTR's full potential.

This report has attempted to sketch out the basic nature of the MTR and to point the way to some early acquisition choices for the U.S. Department of Defense. Along with several other recent studies, it is meant to be an opening salvo, not a last word. The debate about the MTR is only beginning; our purpose has been to energize and inform that debate.

As discussion of the MTR continues, five areas for further research stand out as particularly important. One, based on the findings of this study, would attempt to define in greater detail the specific doctrines, organizations, and technologies that offer the greatest rewards and advantages. This report has prioritized among generic areas of capability; later studies can look in more detail at those areas, those constituent elements of the MTR, to determine the technologies, doctrines, and force structures that would do the best job of providing the needed and desired capabilities.

Second, subsequent work must reexamine the defense acquisition system from the perspective of the MTR and suggest promising avenues of reform.

Third, U.S. work on the MTR is not occurring in a vacuum. Other nations are racing to acquire similar technologies and are doing their own thinking about promising doctrines and organizations. To ensure that U.S. military forces and those of our allies are prepared to defend against enemy strengths and take advantage of enemy weaknesses, U.S. military planners must keep careful track of the global diffusion of technology and continually assess its ramifications for U.S. work on the MTR.

Fourth, the MTR's potential contribution to irregular warfare must be investigated and assessed. Such a study might suggest ways in which planned MTR technologies or doctrines could be modified to make them far more effective in operations short of major, combined-arms warfare.

Finally, the unprecedented conventional warfare capabilities inherent in the MTR may hold dramatic implications for the scope and conduct of nuclear deterrence,



USMC AV-8Bs prepare to launch from USS Nassau.

both in the strategic (East-West) and regional context. MTR capabilities, for example, may affect the way in which the United States conducts its nonproliferation policies and the success it has with them. These subjects all need further study.

This is an ambitious agenda. Much remains to be investigated and decided about the MTR. But one thing is clear: we may well be on the threshold of a new era in warfare, a fundamental shift in the way military force is employed by nation-states. A more exciting moment, flush with so many opportunities and risks, could hardly be imagined.