

ANDREW F.KREPINEVICH, JR.

Keeping Pace with the Military-Technological Revolution

Pentagon planners must reexamine all their systems, structures, and strategies to be ready for the battles of the future.

President Clinton took office in the midst of a revolutionary shift in the international security environment. Reacting to the collapse of the Soviet Union and the Warsaw Pact, the administration's new civilian leaders at the Pentagon undertook a "Bottom-Up Review" of U.S. military requirements to set the guidelines for the administration's \$1.3-trillion, five-year defense program.

Despite its protestations that we must look to the future, the Bottom-Up Review is mired in the thinking of the past. It focuses most of its efforts on preparing to refight what retired General Colin Powell has called "the Cold War battle that didn't come" instead of analyzing how U.S. defense posture could be reoriented to address future security challenges.

Engaging in old thinking would be risky enough if the Department of Defense (DOD) had to concern itself with only the security challenges brought about by the geopolitical revolution. But there is another revolution that U.S. defense planners will ignore at their peril. DOD needs to consider the potential effects of an emerging military-technological revolution that will have profound effects on the way wars are fought.

Growing evidence exists that over the next several decades, the military systems and operations, and, in some respects, the organizations and force structures that dominated the major military establishments during the Cold War will be superseded by new, far more capable means and methods of warfare and by new or greatly modified military organizations. Exploiting this military-technical revolution should be an integral part of the Pentagon's long-term strategic planning process.

Stimulated by the accelerating rate of global technological change, military-technological revolutions are taking place with increasing frequency. Because they radically change the nature of the military competition in peace and war, they have profound consequences for global and regional military balances. And because military-technological revolutions can occur in relatively short periods of time, they often lead to the unexpected and seemingly rapid decline of

dominant military organizations that could not or would not adapt to the changing environment.

History's lessons

The most recent military-technological revolutions—two in this century and two in the last—demonstrate that the advantage in warfare goes to those nation-states that can most effectively utilize new technologies. Perhaps the best example in this century was the Nazi *blitzkrieg*, made possible by advances in internal combustion engines, aircraft design, radio and radar, and other technologies in the two decades following World War I. Although all major military organizations had access to these technologies, only the Germans used them to initiate new operational concepts and innovate organizationally.

Citing the Gulf War as evidence, some U.S. officials and military strategists, including Secretary of Defense William Perry, maintain that a revolution in warfare has already occurred. They are mistaken. U.S. operations in that war did not meet the criteria for the advent of a military revolution. Neither dramatic doctrinal changes nor major new force structures or organizational innovations were demonstrated. The war was essentially fought with forces trained and organized to fight the Soviets in Europe.

The Gulf War did, however, provide a glimpse of the revolutionary potential of emerging technologies and military systems. For the first time, the importance of space systems to effective military operations was demonstrated on a large scale. In addition, the effectiveness of precision-guided munitions such as the Tomahawk cruise missile, the importance of the global positioning system to coordinate military operations, the value of stealth aircraft, and the potential value of theater missile defense were demonstrated.

Operation Desert Storm can be compared to the Battle of Cambrai on the western front in November 1917 in which the British, using wireless communication to coordinate large numbers of planes and tanks, overcame the quagmire of trench warfare and broke through the German lines on a 12-kilometer front within hours. The British were surprised by the dramatic breakthrough and, indeed, had made no plans to exploit it. In retrospect, it is clear that the potential for far greater success at Cambrai was compromised by the immaturity of the new technologies and systems employed. For instance, there were numerous tank breakdowns, limitations on aircraft bomb loads, and constraints on the wireless's range, portability, and reliability.

A strong case can be made that U.S. military leaders were also surprised by the unexpected speed of the coalition victory in the Gulf, the one-sidedness of the combat, and the remarkably low number of casualties incurred. Their surprise was due, in part, to the fact that they had greatly underestimated the military potential of these new tools of war.

Road to revolution

Because we are in the early stages of the new revolutionary period, it is difficult to predict with a high degree of precision its length or how it will influence warfare. Still, it is possible to speculate with some confidence on the revolution's path and its nature. The transition rate to this revolution's mature stage will be a function of the level of military competition in the international system, the strategies pursued by the major players, and the following four elements that characterize the emerging military-technical revolution.

Technological change. Three areas of technological progress offer the potential to revolutionize the nature of warfare. All are derived, in whole or in part, from the revolution in information technology that is transforming societies and the global economy. First, there is the potential to locate, identify, and track a far greater number of targets, over a far greater area, over a much longer period of time, and with much greater effectiveness than in the past. It is also possible to order and move target information much more quickly and effectively than ever before. This advantage may be extended by denying an enemy the information it requires to target and engage friendly forces effectively. Widening dramatically the "information gap" between friendly and enemy forces will be of increasing importance in future operations. The battle to establish information superiority will likely occur in a dynamic environment, involving the use of countermeasures, counter-countermeasures, and so on.

Second, and complementing these dramatic increases in information capabilities, are major improvements in the range, accuracy, and lethality of conventional munitions. These advances will allow many targets to be bombed at extended ranges (sometimes called "ranged fires" or "deep strikes") over a wide area with high confidence of destruction or neu-

U.S. defense posture is still geared to fighting the last war—the Cold War battle that didn't come.

tralization in a relatively short period of time. Warfare then will become more of a competition between “hidiers” and “finders.” Targets that can be identified and tracked will run a high risk of being destroyed, not only at or near the front lines (an increasingly anachronistic term) but over the entire breadth and depth of an enemy state or theater of operations.

Third, advanced computer-simulation techniques are being developed to train and equip forces far more effectively and efficiently than ever before. This will permit military organizations to maximize the effectiveness of their human and material resources.

Better-trained soldiers and greater automation in military operations will permit military organizations to conserve perhaps their most precious asset—time. Indeed, time will be at a premium on the future battlefield. To the extent that friendly forces are able to translate raw data into usable information and to move that information quickly and display it clearly to those that can best exploit it, their advantage will be increased, since it will reduce the stress on and enhance the effectiveness of friendly reconnaissance, surveillance, and target acquisition and long-range strike systems.

Military systems development. To increase military potential dramatically, technologies central to the emerging military-technological revolution will need to be incorporated into significant numbers of military systems or munitions. In addition, the ability to integrate military systems into and across networks of systems (or system architectures) will be fundamentally important.

For advanced military organizations, these changes will require an unprecedented level of organizational cooperation and integration. For instance, it would be inappropriate for DOD to develop an extended-range, surface-to-surface advanced tactical missile system without considering how it would be integrated—not only with the Army’s doctrine for deep-strike assets and long-range reconnaissance capabilities but also as part of an overall approach designed to integrate Army military operations with Navy, Air Force, Marine Corps, and allied military organizations’ systems and doctrines.

The “sunrise systems” in the new era will be those that help military organizations establish and exploit information dominance. In contrast to the military systems that dominated the Cold War era, these systems will tend to be smaller to avoid detection and destruction; rely more heavily on stealth technologies and on electronic warfare and other passive-deception measures; and trade reduced physical protection for increased mobility. In addition, they will rely on automated operations and on nonlethal disabling of enemy capabilities; employ non-line-of-sight fires; survive on a “lean” logistical support system, minimizing exposure to enemy deep-strike systems; and be designed with open-ended architectures, enabling them to quickly incorporate improvements in military capabilities.

At the same time, some major Cold War-era military systems will play a less central role, although these “sunset systems” could still make significant contributions to military effectiveness. They would follow the path of battleships, which were superseded by carriers as the centerpiece of the world’s most powerful fleets a half-century ago but nevertheless were employed by the Navy in important roles in the United States’ three major post-World War II conflicts.

Operational innovation. Incorporating advanced technologies into weapons and systems is a necessary but not sufficient condition to effect a military-technological revolution. Breakthrough operational concepts are needed as well. Major changes are likely in the following areas:

First, we will likely see a dynamic competition centered on creating or denying an information advantage through a variety of means such as establishing before a conflict begins specific target sets or packages comprising what is perceived to be an adversary’s strategic and operational centers of gravity. These targets would be accorded the highest priority for quick destruction at the onset of hostilities.

Second, as a consequence of the requirement for higher levels of integration, a progressive blurring of space, air, land, and maritime operations will occur. Some command layers will be eliminated. Comman-

ders at lower levels will have opportunities to tap directly into a military organization's (or coalition's) information and fire-support architectures. A major challenge for senior commanders will be to determine quickly how the demand for information and fire support from their subordinate "consumer" commanders should be met if it exceeds the supply, which seems likely.

Third, there will be a continuation and perhaps acceleration of the trend toward simultaneous operations. The potential exists to strike directly, more effectively, and more rapidly than ever before at targets believed to constitute the enemy's strategic center of gravity.

Fourth, military commanders will increasingly focus on nonlethal, discriminate, and electronic neutralization of targets, rather than their destruction by fires.

Fifth, space will increase in importance as a major medium for conducting and supporting military operations. In the Gulf War, military forces relied heavily on space systems for their command, control, communications, and intelligence.

Finally, there will be an increased emphasis on non-line-of-sight fires, since it will be advantageous for military organizations that can establish information dominance to avoid direct-fire engagements.

In most instances, accomplishing these missions will entail joint operations among the military services and combined operations among the forces of a coalition. Many operations will be "full-dimensional" in the sense that they will involve air, ground, sea, and space elements.

Organizational adaptation. Executing dramatically different operational concepts and doctrines almost always involves the need to create new organizations. The British Army's failure to do this during the 1920s and 1930s squandered many advantages. Although they developed cutting-edge technologies, systems that exploited these technologies, and brilliant innovative concepts for their application, the British failed to effect the organizational change necessary to create their own *blitzkrieg* capability.

Dramatic improvements in military effectiveness can be derived not only from reorganization of the military forces but also from changes in the way a state operates its defense industrial base, selects its service members and trains them, and deploys its forces and sustains them. Pentagon planners should study the example of how commercial industry has restructured itself in response to the information revolution and increased global competition.

Implications for the United States

Why should the United States care that a military revolution is likely under way? No comparable military power now exists, nor is a great power challenger likely to arise in this decade or perhaps even in the next. The United States also clearly leads in mastering the technologies, developing the systems, and executing operations at the high levels of integration that seem likely to characterize the coming military regime. Because so much has occurred already in the U. S. military, many in the United States believe that the revolution has already run its course or that, if it has not, it will progress only when the United States decides to pursue it.

Nothing could be further from the truth. It is far from certain whether the United States can maintain its current dominant advantage in military power beyond the near-to-mid-term future or whether it can effect the kind of organizational changes necessary to stimulate innovation and execute new operational concepts. Indeed, if history is any indicator, the United States and its allies have not been granted a Pax Americana but only an opportunity to retain their current comparative advantages in military effectiveness by positioning themselves to move on to the next military regime if more and more states, especially those in the Third World, choose to master the elements of the Cold War military regime.

There are several reasons why the United States should, in conjunction with its allies, develop a strategy for competing in this period of revolutionary change. First, with rare exceptions, great-power challengers, or a coalition of challengers, historically have arisen relatively quickly to offset a dominant military power. What the United States does, or fails to do, in moving to realize the potentially dramatic improvements in military effectiveness will influence whether potential competitors are deterred from entering the competition as well as how they pursue the competition.

Second, because of the growing rate of weapons proliferation and military-technology diffusion to the Third World as well as the globalization of the de-

Planning should aim to eliminate unnecessary overlap and redundancy among the Army, Navy, Air Force, and Marine Corps.

fense industry, it is clear that beyond the near-term we will see the emergence of more formidable Third World challengers. Indeed, Third World states with military ambitions and the means to support them are focusing on acquiring late-model Cold War-era technologies as well as some key “sunrise systems.”

Up-and-coming military regimes will decrease their emphasis on mechanized, heavy land forces, naval forces that measure combat potential by the tonnage of their surface combatants, and air forces that revolve around advanced combat aircraft. These states will place far greater emphasis than in the past on equipping their forces with a handful of weapons of mass destruction, clusters of ballistic missiles, hundreds of cruise missiles, large quantities of sea mines, and diesel submarines. They will focus on obtaining access to satellite photography and establishing links with global positioning and communications networks. They will hope to combine these systems and residual forces from their current inventory and apply innovative operational concepts that allow them to present a far more serious threat than did Iraq in the recent Gulf War.

The information-led military-technological revolution is not being driven, as the nuclear military revolution was, by developments in a few top-secret U.S. laboratories. Rather, it is highly diffused, occurring as much, if not more, in the commercial sector as in the defense sector, and throughout the advanced industrial world. The United States may not actively pursue the revolutionary potential of these technologies, but other nations, including its potential adversaries, almost certainly will. Due to resource limitations, they may not have the ability to derive increases in military effectiveness on a scale comparable to the United States; but if the United States is an uninspired competitor, or an incompetent one, this may not be necessary.

Flawed blueprint

The geopolitical and the military-technological revolutions under way indicate that far greater emphasis should be placed on maintaining U.S. military capability in the long run than was the case during the Cold War. It makes little sense, after all, to invest heavily in near-term military capability in the early phases of a military-technological revolution. Why, for example, buy battleships when carriers are expected to displace them in the not-too-distant future?

Unfortunately, the Clinton administration’s Bottom-Up Review calls for a U.S. defense posture built more around the Cold War strategic environment than the world that is now emerging. Given tight defense budgets, less emphasis should be placed on maintaining force structure over the near-term future and more emphasis accorded to research and development of new military systems, doctrines, and organizations.

Assume, for example, that long-range precision strikes will be a dominant military operation in future conflicts. Substantial changes in U.S. defense planning would then be needed. It would make sense for the Army to reduce funding and emphasis on direct-fire and short-range systems (tanks, armored infantry fighting vehicles, and short-range artillery, for example) as well as the organizations built around them (armored divisions). At the same time the Army would increase its emphasis on long-range, precision-strike systems (satellites, unmanned aerial vehicles, attack helicopters, and extended-range missiles) and attempt to identify the new doctrines and organizations (a deep-strike brigade, for instance) that would employ the new systems in an optimal matter. This approach would apply to the other military services as well.

Another problem with the review is that it focuses on the most familiar threats to national security rather than the greater, longer-term ones. It calls for dedicating the bulk of U.S. defense resources to ensuring that two nearly simultaneous major regional conflicts (MRCs) can be waged at the same time although there is little evidence in recent history to suggest that the United States runs a significant risk of being forced to fight two wars at once. Effectively, this means planning to refight the Gulf War—the last

war—and thus risks consigning the U.S. military to the same fate as France in the 1920s and 1930s. While the French devoted most of their efforts to refighting World War I more effectively, the German military closely considered how rapid advances in technology were changing the character of conflict and planned accordingly.

In addition, with defense resources increasingly scarce, the review's emphasis on maintaining near-term capability could significantly crowd out investment in future military potential. This is particularly distressing since, according to an analysis by the Defense Budget Project, a five-year, \$50-billion shortfall exists in the funding for these military plans. The defense burdens projected by the review are simply unaffordable given projected resource constraints.

Although DOD has a number of interesting studies under way on the military-technological revolution, the bottom line for the Pentagon is the Bottom-Up Review. Its failure to pay adequate attention to the potentially profound influence that an emerging military-technological revolution could have on the determinants of military effectiveness and the parameters for an effective defense investment strategy risks wasting scarce resources and, worse, the nation's long-term security.

A strategic approach

Before it can become part of the military competition to come, the United States will first have to decide what its role will be on the world's stage. Assuming that we choose a significant role, we will then have to determine what our objectives will be in the competition. For instance, will we attempt to become predominant in all or some of the new operations? Or will we tend to follow the competition, seeking to match breakthroughs in some areas while pursuing advantages in others?

As many successful corporations have done in their strategic planning, the United States will have to decide what core capabilities it should (and can) maintain. Given limited resources, the United States may have to make trade-offs between those "businesses" (for example, nonnuclear strategic strikes and space control) that it would like to be in and those that it can afford to be in. This implies dropping out of or not pursuing some mission areas while working with allies to address others.

In short, what is needed is a thorough review of service roles and missions. A congressionally mandated commission has been established to examine the issue, and a similar effort is now getting under way in the Pentagon. Ideally, these efforts should eliminate unnecessary overlap and redundancy among the services. For example, do the Air Force, Navy, and Marine Corps need their own air wings, or can the capability be consolidated within one or two services? Properly done, such a restructuring would preserve our military capabilities while freeing up resources to develop capability in the new mission areas that will likely emerge from the military-technological revolution.

Furthermore, the increasing need to integrate military operations across system architectures and to give commanders at progressively lower levels access to both reconnaissance and deep-strike assets will place a premium on cooperation among the military services. Significant progress has been made in the area of joint operations. But it is likely only the beginning of what will be required in terms of service integration if the U.S. military is to realize fully the increases in military effectiveness that will be possible as the revolution matures. The character of this revolution all but ensures that the military services will have to innovate "in phase." For example, unlike the days when the Navy alone could transform the character of war at sea through its development of carrier aviation, technological advances now require that all the services be involved in such a transformation, for all the services can (or are potentially capable of) extending their military capability far out to sea.

In every major conflict that the United States has found itself engaged in during this century it has fought alongside allies. Thus, it makes sense that U.S. strategy address the roles that it and its allies will play in the future military competition. Will the United States and its allies exploit the revolution collectively? If so, will they do it in a coordinated or ad hoc fashion? Will there be a division of labor based upon mission or geographic areas? How these issues are resolved will be important in determining whether the United States will compete on its own or as part of a coalition. They also will determine how effective a competitor the United States is likely to be.

Finally, it must be emphasized that the above discussion does not advocate either a major U.S. military buildup or an increase in the resources currently projected for national defense. Neither is necessary or perhaps even desirable for the United States to position itself as an effective competitor. What is most critically needed is new thinking about how this military-technological revolution could develop and how the United States might exploit it to serve its long-term security interests. This approach puts a premium on innovation and experimentation and on a commitment to promote organizational agility in the military services.

It is encouraging to note that the U.S. military has done this before. During the period between the two world wars, operating on shoestring budgets, U.S. military services developed the concepts for fast carrier-fleet operations, modern amphibious operations, and strategic aerial bombardment. They did not, however, develop the forces. Rather, the services positioned themselves to exploit these new concepts if the need arose. They invested in maintaining access to future military potential rather than military capability. Such an approach would serve the United States well in this period of relative safety and uncertainty.

Recommended reading

Mary C.Fitzgerald, "The Soviet Image of Future War: Through the Prism of the Persian Gulf." Alexandria, Va.: The Hudson Institute, May 1991.

Andrew F.Krepinevich, "The Bottom-Up Review: An Assessment." Washington, D.C.: The Defense Budget Project, January 1994.

Andrew F.Krepinevich, Jr. "The Emerging Military Revolution: The Lessons of History." *The National Interest* (forthcoming, fall 1994).

Geoffrey Parker, *The Military Revolution*. Cambridge: Cambridge University Press, 1988.

Stephen Peter Rosen, *Winning the Next War*. Ithaca, N.Y.: Cornell University Press, 1992.