ANOTHER VIEW OF THE REVOLUTION IN MILITARY AFFAIRS

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July 15, 1994

FOREWORD

In April 1994, the Army War College and the Strategic Studies Institute hosted the Fifth Annual Strategy Conference. The theme of this year's conference was "The Revolution in Military Affairs (RMA): Defining an Army for the 21st Century." Jeffrey R. Cooper presented the following paper as part of an opening panel which sought to define the RMA.

Mr. Cooper urges defense planners to determine what strategic--as opposed to operational--benefits might be derived from the RMA. He contends that making the internal reforms that will be required will be as challenging as coming to terms with the operational and strategic implications of the new technologies.

The first requirement is to understand the parameters and dynamics of this particular revolution in military affairs. Mr. Cooper puts the RMA in historical perspective by discussing the relationships among technology, socioeconomic, and political change, and their implications for warfare during the Napoleonic era, the mid-19th century, and World Wars I and II. He argues that, in the past, dramatic technological change affected warfare in different ways.

Mr. Cooper warns that by using the RMA to define a "technical legacy" we make three errors. First, such an approach could lead to a fruitless search for a "silver bullet" technology on which to build the RMA. Second, the focus on technology could shift attention away from the critical issues of purpose, strategy, doctrine, operational innovation, and organizational adaptation. Finally, committing the first two errors will compound the problem by wasting very scarce defense resources on new programs and projects which may have little or nothing to do with the strategic situation.

Military professionals and defense planners alike need to remind themselves that while technology can provide new capabilities, the strategic equation is not necessarily driven by technological innovation.

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SUMMARY

Along with increased interest in the Revolution in Military Affairs (RMA) have come pressures to move out quickly with a Department of Defense (DoD) initiative despite different, if not divergent, views concerning the character and implications of an RMA on the part of many decision makers and analysts. In this observer's view, too much attention has been paid to identifying the key technologies for the RMA and too much time is still wasted on RMAs as technologically-driven phenomena, perhaps because of the original MTR terminology[1]. Furthermore, far more emphasis than warranted has been placed on using the RMA to defeat another heavily mechanized regional hegemon like Iraq (and doing it better), rather than on preparing to address new challenges, including potential emerging major competitors.

These polestars for attention seem to represent a misunderstanding of the nature and phenomenology of RMAs as well as a fundamental misreading of the lessons from earlier RMAs on implementation and exploitation. RMAs are not merely more clever or even more elegant technological breakthroughs than are evolutionary military innovations; these revolutions are more profound in both their sources and implications. Moreover, while all revolutions are marked by discontinuous change, this RMA, fueled by the "Information Revolution," may have potential for more sweeping and fundamental changes than most of its historical cousins. The truly revolutionary implications of these deep changes must be recognized by decision makers in determining the content and course of an initiative to exploit the RMA.

Therefore, using an RMA initiative, intentionally or unintentionally, primarily to define a "technical legacy" makes three crucial errors:

• It misdirects effort toward a probably fruitless search for "silver bullet" technology on which to build the RMA;

• It misdirects attention away from the critical issues of, and relationships among purpose, strategy, doctrine, operational innovation, and organizational adaptation that are the essential issues for an RMA;

• In committing the first two errors, it compounds the problem by being astrategic since it risks wasting very scarce defense resources on new programs that may be irrelevant to future security challenges.

This course would be particularly unfortunate since it would squander the rare opportunity presented by the changes in technological conditions to enable an RMA that could appropriately forge America's military for the evolving geostrategic environment, one that is also being reshaped by fundamental changes in the underlying political, economic, and socio-cultural conditions.

For DoD to successfully pursue an initiative to exploit the RMA, fundamental questions concerning the process of an RMA, the strategic objectives for this initiative, the specific technical and operational content to be pursued, its potential military utility on the battlefield, and the means for its implementation will all need to be answered. Moreover, before decision makers can properly proceed, they will also need to know:

• What strategic benefits can be expected from the RMA;

• How they can use this initiative to reform DoD internally in order to address future challenges;

• What are the potential organizational and structural implications and consequences (not the least of which are the bureaucratic and budgetary impacts).

This monograph proposes some hypotheses for a number of these key issues concerning the RMA. It tries to illuminate key issues from the decision maker's perspective, focusing first on the potential role of an RMA in U.S. national security planning. By addressing these issues explicitly, we can clarify this critical set of questions: the strategic purpose and utility of an RMA and what is expected from the RMA initiative. Having addressed teleology, we can then turn to the second set of issues, defining the appropriate character of our implementation of the RMA and the content of its component elements to meet the spectrum of relevant military objectives at the operational and tactical levels. With the purpose and content of the RMA characterized, the third set of issues concerning the means of effective implementation and exploitation can be addressed. Finally, some of the more significant implications of these potential changes will be highlighted.

ANOTHER VIEW OF THE REVOLUTION IN MILITARY AFFAIRS

Introduction.

Since the subject was raised within the American defense community,[2] the Revolution in Military Affairs has been the subject of at least three summer studies, many conferences, numerous papers and briefings, and a host of war-gaming exercises. As a result of these efforts, DoD is now investigating an RMA initiative. But while the community seems to agree on a number of important issues, concord on other critical points is lacking.

First, almost all participants in the debate now accept that RMAs are more than just new military technologies or systems and involve complex operational and organizational issues; but few agree on the priority among these four elements and identity of *the* key driver (if only one exists). *Second*, while there is agreement that this RMA is but the latest in a historical series of RMAs, little attention has been paid to the broad strategic implications that placing this RMA in its long-term historical context suggests for future changes in the conduct of warfare. *Third*, while the community largely agrees that there is an RMA to be pursued, whether it is already in progress, is about to start, or is mature and about to end all have adherents. *Fourth*, more problematically, there is no agreement concerning the character of this RMA--i.e., a specific definition of this RMA, not merely identification of constituent technical elements; and, therefore, there is no substantive roadmap for proceeding. Indeed, reviewing the current literature and debates, it appears that there may be several different RMAs that are being discussed (not unlike the parable of the blind men and the elephant). *Fifth*, agreement does exist that a focus on careful implementation will be needed since RMAs are, by nature of the potential operational and organizational changes, antithetical to existing cultural norms and bureaucratic structures. However, few agree on an overall approach to implementation, much less on the initiative's critical next steps needed for successful exploitation of the RMA--i.e., on the procedural roadmap.

Unfortunately, even less agreement exists on two other important, higher-level questions; and these questions carry divergent implications for those issues on which seeming agreement is in hand. The first of these concerns the relevance of the RMA to the evolving U.S. national security problem, and as specific aspects of this question:

• The relevance of the RMA to a broad spectrum of conflict types and intensities that the United States may face;

• The military benefits, at both the operational and tactical levels, across this spectrum of conflict;

• An assessment of whether the RMA is the most appropriate instrument for addressing these evolving problems;

• The strategic implications and consequences (both intended and unintended) of pursuing this initiative; and finally,

• A determination as to whether this RMA is in our long-term national interest.

The second question concerns the role and utility of the RMA as a potential organizing principle for future defense policy, programs and bureaucratic relationships. In particular, what are potential implications of the RMA, with its probable stress on greater force integration and joint command of operations, for future roles and missions of the Services, and what are the divergent implications for each of the Services?

By clearly identifying the key issues for resolution, it is hoped that DoD can (1) define the strategic purpose of the RMA initiative; (2) refine what is expected from the RMA in terms of strategic, operational, and tactical objectives; and (3) assess what is the most appropriate content of this RMA to meet this spectrum of military need. Only with the purpose and content of the RMA accurately characterized can understanding the phenomenology of previous RMAs then assist in determining the most effective means for implementation and exploitation of this revolution. Thus, the two most critical questions that must be answered before agreement can be reached to pursue an RMA (and the concomitant issue of *how best* to do so) are the *purpose* and the *nature* of the RMA to be pursued--what are the character and the core elements of *this* revolution. This monograph is not intended to provide definitive answers to these important questions, a treatment worthy of volumes; but it does propose hypotheses for these important RMA-related issues that can serve to frame the debate for decision makers.

Choices for the Decision Maker

The RMA is a complex subject, and there are multiple ways that decision makers may choose both to view the RMA and to pursue an RMA initiative, all with potentially divergent implications. Explicit identification and proper assessment of the options for proceeding appear essential for real progress. Defining the objectives for an RMA initiative involves two related but really distinct sets of issues: one related to how the RMA is perceived by decision makers, and the second related to what the RMA really is. This section will discuss the choices that arise from the multiple ways top-level decision makers may perceive the RMA; the question of what the RMA is will be discussed later. From the decision makers' standpoint, these different perspectives on the RMA include: a teleological focus that can be either external or internal[3]; focus on specific challenges or types of threats versus focus on the RMA as a process to adapt to broader and continuing environmental changes; employing the RMA as an instrument for organizational development versus using the RMA as a filter for new technologies; and, finally, the choice of whether to pursue an RMA versus what RMA to pursue.

Depending on their perspective of external or internal objectives for the RMA, decision makers can be separated into two broad groups (that are not, however, necessarily mutually exclusive). The external perspective focuses on the potential role of the RMA as a means of attaining strategic objectives in the evolving geostrategic environment, one in which the United States is likely to face a new set of security challenges. The internal perspective, on the other hand, sees the potential utility of the RMA as an organizing principle for DoD that can assist in determining future policy, programs, and bureaucratic relationships--in essence, as a tool to shape the department, if not the larger community, to the evolving strategic realities, including long-term fiscal pressures and reduced priority accorded to national security by decision makers and the American public. But while both are

valid, how the RMA is used to achieve internally-directed objectives appears to depend critically on the choices the decision makers take with respect to the external objectives for the RMA. To assure strategic relevance, moreover, the RMA must address the basic national security challenges at hand--how best to deal with the diverse types of competitors that may emerge over the longer term. These challenges may include old problems posed by new competitors, new problems posed by old competitors, and new problems from emerging competitors (that we may not yet be able to even articulate, much less specifically characterize)[4].

The second perspective, focused on the internal objectives, involves how the DoD leadership intends to use the RMA initiative to shape the future direction of the department once it understands the external purposes for the initiative. These internal choices include whether the RMA can provide a conceptual basis for future strategy; for prioritizing R&D efforts and acquisition programs; a legitimization of change as a way of life (i.e., a way to institutionalize a "permanent revolution"); a rationale for altering roles and missions; a framework for reorganizing bureaucratic structures; or merely an additional filter (as with strategic competitiveness) in the policy process. Indeed, much of the interest in the RMA seems to stem from the potential role an RMA could serve as an organizing principle (or rationale) for the wealth of technology opportunities now appearing, even amid the poverty of budgetary resources for defense needs. Overall, is the RMA as process a generally applicable tool or suited only to specific issues? For many of these purposes, the *idea* of an RMA may be just as important as detailed content since its primary use is as a motivating instrument. Pursuit of an RMA initiative will have significant implications for doctrinal development, operational requirements, force posture, and R&D strategy; and these will create opportunities for major institutional and bureaucratic changes.

The ability of an RMA to address potential disparate security challenges turns on whether it is an idiosyncratic event or a process. If the RMA is a *specific* event that synthesizes particular technologies, military systems, operational innovations, and organizational adaptations to address effectively existing challenges, can it also meet emerging problems? Given the apparent agreement that there is an RMA and that this RMA is but one in a historical series, there are two potential answers to this issue. One, that an RMA is a specific solution to a particular strategic problem, in which case it may not be relevant to emerging challenges. Or two, that RMAs are organic to the broad geostrategic milieu, arising from the general nature of the stage of socioeconomic development and technologies, in which case this RMA will retain its relevance as long as new challenges will also arise from that same general milieu.

If, on the other hand, the RMA is a process for synthesizing strategically appropriate responses, then it can play a longer-term role even if the strategic environment changes dramatically, presenting fundamentally new types of military problems. In this latter case, however, the important question must focus on the broad character of RMAs--not on the mission-specific tasks nor the collection of advanced technologies and military systems supporting them in a particular RMA-- since these elements can only usefully be defined as the future circumstances unfold. Analysis of these issues can provide the answers to whether an RMA initiative (or a strategy based on the RMA) can serve as an overall approach to potential competitors; whether an RMA will be

consistent with long-term U.S. security interests; and whether an RMA will offer benefits in nontraditional missions such as drug interdiction and peacekeeping.

A final but related analytical issue concerns choice; not only what objectives decision makers may select, but whether or not there is a choice in pursuing the RMA. Should we pursue the RMA for its own sake? Because it can be done? Because it promises substantial advantages in addressing our evolving security challenges? Or finally, because we may have no choice since potential competitors may decide to pursue the RMA regardless of our course? The obverse point is equally important, are we currently good enough to answer potential challenges without the RMA; and if so, why should we disturb this present situation? In this regard, the example of the impact of the *Dreadnought* on the naval balance and subsequent competition before World War I may provide a cautionary note to proceeding before we understand both the purpose and implications of the RMA. By essentially starting the competition from scratch, *Dreadnought* obviated the utility of the large British investment in previous battleship and heavy cruiser fleets.

Issues of Strategic Purpose

In order to address the issue of *purpose*, it is essential to understand the range of potential situations in which the RMA might need to be relevant. These issues, therefore, must be addressed in the context of *what* wars may be fought and *how* they will be fought, not only the more usual question of *who* our principal adversary will be. In the new geostrategic environment, what will U.S. strategic objectives be: will the United States employ force only in response to specific acts of aggression or in defense of particular interests, or will it to use its military power more generally--to shape the strategic environment, to defend liberty and promulgate values? Will the United States be strategically defensive or strategically offensive during this period? Indeed, in this new international structure three questions emerge. First, who defines the rules of conflict? Second, will the United States be able to define the nature and level of conflict? And third, what constraints can be applied to the conduct of warfare?[5] These questions strike at the heart of whether the United States will have the choice of selecting the types of conflict in which we engage and at how competitors may decide to contest our power or determination--and, therefore, the purpose, role, and utility of an RMA.

The controlling factors may be not only the nature of the evolving competitions but also the very real constraints of size, budgetary pressures, and economic linkages reshaping U.S. military posture and the issue of what impacts these will have on on key competitors. With the collapse of the Soviet Union, it is unlikely in the immediate future that the United States will face a new challenger of that caliber. Rather it will have to deal with significantly smaller opponents either singly or in concert. Moreover, in the wake of both the Soviet collapse and the Gulf War, it is also especially important to recognize that the previous U.S. concern for the adverse asymmetry in force size no longer pertains and that U.S. technical advantages need no longer be considered to be merely a necessary qualitative offset to the quantitative advantages possessed by probable opponents. While several nations like China and India continue to possess large conventional force structures, it is likely that in future regional conflicts forces in coalition with the United States will be as large (and almost certainly better equipped

and trained) as those of any regional adversary. Furthermore, and often not explicitly recognized, the collapse of the Soviet threat to Western Europe also implies that regional adversaries (the old "half-war" contingencies) must now be prepared to face a United States unconstrained by the need to retain the most formidable parts of U.S. force structure for the European (the classic "one war") contingency that previously dominated our thinking. Even while we may plan on a "two-war" capability, any opponent must be prepared to face the full weight of whatever U.S. military power exists.

Three other, perhaps more subtle, factors are also at work in shaping the strategic environment. First, the collapse of the Soviet Union also removes the only major power capable both of sponsoring regional opponents at distances from their borders (and threatening the United States with strategic forces) and of supplying them with the most advanced conventional weapons and technical assistance on concessionary terms.[6] Second, in a major regional contingency, the United States can apply a range of nonmilitary strictures (such as embargoes and boycotts) against the opponent to further constrain his war effort without fear of opposing superpower intervention to undercut these actions. Coupled with the clear technological, doctrinal, and tactical superiority that was demonstrated during the Gulf War, these factors taken in combination suggest that the United States will possess demonstrable military dominance over regional contenders for the foreseeable future. Third, the likelihood that the United States will fight in future conflicts as part of coalitions not only increases the array of forces an opponent will confront, but also opens significant new vulnerabilities for the United States. The implications of coalition warfare, including political sensitivities, allied casualties, and concern for collateral damage, will have substantial impacts on how these campaigns are conducted. Indeed, these "softer" factors may be as important in planning coalition warfare as the more obvious issues of force integration, standardization and interoperability, and allocation of roles and missions.

These factors suggest that very few rational opponents are likely to wish to challenge (or be capable of challenging) us in a contest with mass theater-wide, multidimensional forces--given the very credible demonstration of U.S. capabilities displayed in DESERT STORM. Therefore, new opponents may decide, if they are determined to challenge us, to pose different problems, challenges that an RMA narrowly focused on the DESERT STORM scenario and based on technologies demonstrated in that conflict may be less capable of addressing successfully. For example, our next opponent could pose the problem of how to respond quickly despite his actively contesting our force deployment, while he may possess nuclear or other weapons of mass destruction (WMD) and long-range delivery systems capable of threatening not only U.S. forces, but allies, and third countries who control essential transit and staging facilities. Moreover, even if an opponent holds the same strategic objectives, he may be able to pursue them through different strategic concepts. Thus, overt cross-border invasion is not the only way of seizing neighboring territory; coups, destabilization, insurgencies, fifth columns, and blackmail are also among the traditional bag of tricks for aggressors.[7] And in these cases, the United States could find itself on the operational offensive against nonmechanized forces already deployed in very difficult tactical environments.

Alternatively, an enemy may also decide to pursue a different set of strategic objectives--damage, disruption to civil society, or interference with key global links, and use different strategic concepts--long-range attack, clandestine forces, urban warfare (as currently in Bosnia and formerly in Beirut), terrorism, or subornation and blackmail of civilian populations, using modern communications to bypass the government itself.[8] While there may be concern that "we don't do windows" (jungles, mountains, cities), even in those mission areas that we do, the next opponent may force us to do things so differently that we don't accomplish these missions very well either--for example, by employing large numbers of light forces, using mines densely on the battlefield, or contesting operations in littoral waters with mines, small but lethal fast attack boats, or conventional submarines. Current national strategy and defense planning largely ignore these potential problems in their narrow focus on heavily-armed, largely mechanized, and quite technically sophisticated regional hegemons. Before the United States commits itself to an RMA initiative, it is essential to decide on which parts of the conflict map to focus our exploitation efforts.

The Evolving Conflict Map. Unless either Mexico or Canada unexpectedly transforms itself into an aggressive regional threat, by definition the United States will not in the near-term be the direct object of aggression by a regional power, such as Iran, Iraq, and North Korea. Therefore, we will fight conflicts with them at extended distances, and, with the exception of regional threats that acquire intercontinental strike systems, without direct threat to our national survival.[9] As we did in the Persian Gulf, we will have to transport and support our combat forces; however, unlike in that conflict, we may not have the luxury of six months of force buildup. Our opponent may actively contest our deployment and force buildup, directly or by applying pressure on allies and neutrals that control critical transit and staging facilities. Indeed, it is highly likely that with the lesson of that war in mind, the next regional aggressor may choose to strike quickly, before we can bring major forces to bear; and he may choose a strategic concept that allows him to do so. In addition, he may choose: forces that create lower signatures during his mobilization and buildup phases than armored and mechanized divisions; forces that can move to strike quickly at the target's strategic centers of gravity; or forces that are more difficult to target as he consolidates his position. Given the current strategic focus on a narrow set of regional contingencies, likely to be conducted in unprepared theaters, often without the benefit of in-place heavy infrastructure, logistics support and predeployed forces, the real challenge for U.S. military strategy may not be decisively defeating an opponent once we engage, but projecting power in a timely and responsive manner. Therefore, a key operational challenge will be the need to enhance our ability to move to the theater quickly while improving our capability to wage intense, short-duration combat to destroy enemy forces. The significant change from pre-deployed forward forces to a force projection military waging expeditionary campaigns requires that we alter our entire campaign paradigm, and it should focus our near-term attention on the problems of designing a force capable of rapidly deploying real combat power to a contingency theater against active opposition.

Unfortunately, not all lesser opponents are Iraq, as we had already discovered in Vietnam. Some opponents may be less susceptible to damage and pain, against either their military forces or civil societies (as we discovered during the Korean and Vietnam conflicts).[10] For many

regional opponents, however, their military forces may be among the most modern and highest value assets (both in terms of equipment and human capital) they possess. Like the armies of the Italian city-states, they may be too valuable to risk in actual combat. Thus, some opponents may choose strategic concepts and means of execution that are explicitly limited and stylized, to which the large-scale and intense violence of a DESERT STORM-type clash may appear to be neither proportional nor appropriate either to their limited strategic objectives or to their constrained means of combat. And while the United States may currently be transfixed on the problem of stopping rapid cross-border acts of aggression, potential regional opponents may have other objectives that can be better served by alternative strategic concepts, particularly in light of their own vulnerabilities to the type of warfare demonstrated in the war against Iraq.

Furthermore, the canonical set of threats (focused on regional hegemons) represents a very small portion of the potential conflict map that may evolve. And on its face, these threats also appear to be those for which the current operational and organizational posture of the American military is best suited. Unless we believe that no more serious and challenging threats will emerge over the next several decades, we do need to recognize that we will face a major, even if not a "global" opponent, during this future.[11] How or whether a peer competitor emerges is likely to be related both to the evolution of the role of war in interstate relations during this period and to the ability of dominant U.S. military power to deter the emergence of a challenger. However, potential peer competitors do have choices about how they challenge us. While they could seek to do so with the tools of this RMA (the parallel approach), they might attempt to challenge us with mass and older technologies. In either case, the RMA would appear to be germane to these potential contests.

However, the very length of time it may take for a new peer competitor to emerge suggests that the utility of an RMA exploited today with a very narrow focus may no longer be evident at the time a challenge does emerge.[12] The new competitors could attempt to identify the *next* RMA and confront the United States with a whole new set of operational and technical challenges. And it is not clear that if they choose foreign ground (a different strategic concept, a different purpose, a different set of tools), how an RMA narrowly focused on DESERT STORM will necessarily be relevant. Especially since a peer competitor will almost certainly be a major economic power and tightly integrated into the global economy, his inherent degree of societal vulnerability may lead him to pursue his strategic objectives through means that are clearly limited,[13] using the implicit "rules of the game" in an attempt to protect himself from U.S. escalation to more violent forms of conflict.

As one speculative look into the far future, a potential future challenger to the system might decide not to engage the United States or other coalition members militarily, but to strike directly against the diverse network of international linkages that support the increasing globalization (and therefore homogenization) of commerce, culture, and politics. This opponent would be interested in destroying not the military power but the very fabric of the international system and striking at its core values, especially if these values are fundamentally hostile to deep cultural, religious, or ideological principles. Thus, such a challenger might choose to go directly against

the linkages that bind major trading partners and regions. As an historical example of this path, it is worth recalling post-Napoleonic France's challenge to British naval mastery. Having determined after the costly loss at Trafalgar that British naval supremacy could not profitably be challenged directly, the French looked at waging a guerre de course against what they perceived to be the glue of the British Empire and of British economic superiority--worldwide trade. The obverse was that trade links of an island nation forced to import food and most raw materials, and also dependent, in return, on earnings from its manufactured exports, were perhaps *the* critical source of vulnerability--as was to be demonstrated during both World Wars. It is interesting to contemplate what an attack today against commerce, both sea- and air-borne, might look like (and how effective it might be) if waged with modern technologies and innovative operational concepts.

While the United States built forces to maintain sea control against a traditional naval opponent such as the Soviet Union, this mission area is now seen as very low priority with the turn in attention to "littoral warfare" and force projection from the sea. But even if the United States were to maintain the force capabilities and effective operational concepts in the interim, how relevant would they be for maintaining sea control against covert forces, perhaps operating large numbers of diverse types of modern commerce raiders? Similarly, could the United States protect the critical routes of commerce against an opponent intent on waging war against international aviation or telecommunications?

In addition to classic challenges, there may be other types of threats emerging in this evolving strategic environment. Indeed, these conflicts seem more probable than larger-scale, more traditional types of wars. At the other end of the conflict spectrum, there are likely to be a series of low-intensity, but not necessarily low-technology, conflicts resulting from the continuing diffusion of power and disintegration of existing states. These conflicts may involve both state and nonstate challengers. Moreover, nonstate challengers, like those in Somalia and Bosnia, may appear with fundamentally different objectives as well as strategic concepts of execution. Rather than attacking a neighbor for territorial aggrandizement, nonstate opponents might be tempted merely to inflict pain, and thereby destabilization, on opposing societies. If the object is pain, not publicity, we may find it difficult to identify the proper target for our response. Alternatively, the opponent may choose to strike from a posture that makes it impossible to avoid large-scale collateral damage to innocent populations in preemptive or retaliatory strikes.[14] These types of challenges may well call for a different focus from an emerging RMA. A shift in focus for near-term operations to the lower end of the conflict spectrum, the increasing importance of peacekeeping/ peacemaking operations, the complications of multinational coalition operations, and the "CNN effect,"[15] are likely to produce pressures for limited U.S. casualties and requirements for constraining collateral damage as well. Can the RMA also provide useful capabilities against this more diverse array of possible challenges? Finding a successful path through the thicket of conflicting budgetary and policy pressures may be extremely difficult, but it also has the potential to be a key benefit if the RMA is properly conceived.

Changes in the Conduct of Warfare. Periodic fundamental changes in the nature of war and the conduct of warfare appear to date back far

into history.[16] Examples of previous RMAs can help place this RMA in historical context. While there may be even earlier examples, such as development of the Macedonian phalanx and Roman legion, modern examples begin with the Napoleonic RMA (the "nation in arms")--utilizing for the first time in modern history the vast resources of a newly industrializing nation to equip and support a mass army. This RMA was contemporaneous with three other key upheavals: a political revolution that spawned democracy and the rise of the republican nation-state; a socioeconomic convulsion stemming from the Agricultural Revolution; and an economic sea change resulting from the spread of the Industrial Revolution to France. The result of the Napoleonic RMA was no less vast: not just the ability to conquer *a neighbor*, but to seize a continent--or in more modern terms, the means to wage a *theater-wide* campaign.

Since the Napoleonic RMA, many observers believe that, prior to the one now under discussion, there have been four other significant military revolutions. The first of these (encompassing both the American Civil and the Franco- Prussian Wars) built on the railroad and the telegraph to extend, at the strategic level, the reach, mobility, communications, and logistics support consistent with the new continental scope of military operations. It also built on the second stage of the Industrial Revolution (such as "the American system of manufactures," i.e., interchangeable parts) to introduce more effective and lethal weapons, including the Minié-ball, breech-loaded artillery, and the "needle gun." The World War I RMA incorporated mass production technologies to equip multimillion man armies to increase mechanization for support logistics, and to employ factory products like the machine gun and barbed wire. This RMA turned the operationally mobile warfare of the previous revolution into fixed, positional, and relatively static, attrition warfare. The art of generalship was lost, replaced by the capacity of manpower rich states to supply soldiers and the means to destroy the other side's soldiers.

The third of these post-Napoleonic RMAs was the dual revolution in the inter-war period based on efficient internal combustion engines, tactical and strategic aircraft capabilities, and the radio to reintroduce strategic and operational mobility, maneuver, and initiative. On the one hand, these factors allowed the Germans to develop *Blitzkrieg*, directed at an operational solution to the problem of waging a rapid campaign to avoid getting bogged down in a two-front war in Europe, as happened in World War I. On the other hand, this same technical foundation supported an RMA by the U.S. Navy that combined carrier aviation, amphibious assault, and long-range submarine operations (supported by strategic bombing from seized forward island bases) to bring about the strangulation of our island opponent. U.S. strategy for the Pacific conflict recognized that the American strategic problem was to employ our vast industrial resources to bring about the decisive defeat of Japan on its home territory. Finally, the last of these four was the nuclear/long-range strike RMA based on atomic weapons and intercontinental strike capabilities that focused on the ability to destroy the economic, political, and social fabric of the modern nation-state, along with the enemy's military.

Few RMAs cause the kind of deep changes that the Napoleonic RMA did in both the nature of war and the conduct of warfare. That was a revolution set in train by a combination of fundamental economic, political, and social forces. It altered the scale of forces by the employment of the mass army (up to 500,000 by 1812) and, at the same

time, it shifted the conduct of warfare by changing the scope to continental operations. But more importantly, changes in the underlying conditions set in train by the three contemporaneous upheavals made military forces relatively cheap; and despite the improvements in firepower enabled by industrialization, modern nation-states were able to field and support more forces than any opponent could kill--thus leading to attrition warfare since Clausewitzian- style strategically decisive victories were rarely obtainable through *coups de main*.[17] This 150-year period marked an era of military expansion with the shift to mass armies, continental or global scope of operations, and dependence on attrition warfare due to the difficulty in staging strategically decisive battles.

This era may now have come to a close. It was ended both by the nuclear/long-range strike RMA and by the lethally effective conventional operations that are now emerging from the nascent RMA. This next long-term cycle derives from not only a new era of expensive military forces, but also from a period in which the relative cost of killing is falling rapidly. The combination of rapidly escalating costs of major military systems, together with the enhanced lethality, will culminate in smaller, more valuable forces, along with a recovered ability to effect decisive victories. The result of this combination of factors fundamentally alters the underlying terms for military forces; and this has dramatic implications for the future of warfare as well as the scale and scope of conflicts. This next RMA appears to possess many of the properties of a Napoleonic RMA. It may mark the closing of that era in warfare dominated by large military forces and equally large scopes of military operations. This RMA may usher in a new period of military contraction and a return to wars fought for limited objectives by valuable forces too precious to waste in mass, attrition-style warfare.

These cyclic changes in the scale of military forces and operations appear to have a cousin in similarly cyclical changes at the strategic/political level. It is essential that strategy at both the grand and military levels be appropriate to the environmental circumstances, as much including the socio-cultural and economic dimensions as the political.[18] The same underlying forces--of nationalism, agricultural revolution, and industrial revolution--that allowed Napoleon to create his RMA also altered the objectives, and thus both the nature of war and the conduct of warfare. Napoleon moved modern warfare from "limited wars" fought by absolute monarchs, usually ended with contractual agreements of only modest gains and losses, to wars fought for unlimited ends, such as the destruction of the opposing state or regime, under the rubric of "unconditional surrender."[19] While subsequent RMAs have further raised the scale, broadened the scope, increased the intensity, and heightened the tempo of tactical operations, they have stayed within this fundamental politico-strategic framework. Thus, to the extent that this century has been dominated by conflicts not only between nation-states but between ideological systems, it has been a period of "total war." The circumstance of ideological conflict implied that "absolute ends" were proper and "total means" legitimate.[20] The Soviet notion of exploiting the vulnerability of the rear mirrored Douhet's earlier concept for attacking the enemy's will through strategic bombing. Under these conditions of "total war," there was no functional distinction between attacking the enemy's forces on the battlefield and attacking the enemy's forces by destroying the industrial base (and by extension, the entire political, economic, and social base) that supported them--*nor was there a difference in*

legitimacy.

The "Information Revolution" and the change to post-industrial
economies also seemed to presage significant changes not only for the
means of warfare, but also for the objectives of war. Increasing
globalization of commerce, decreasing economic returns to scale,
near-real-time global telecommunications, the rise of centrifugal forces
within the nation-state, among other trends, all raise questions as to
the future objectives of interstate conflict, the appropriate strategies
for pursuing national objectives under these conditions, and the
operational means for conducting war. The old Clausewitzian objectives
for military operations (destroy military forces, capture the territory,
seize the leadership) largely mirror the key factors that underwrote the
sources of strength of the newly industrializing economies. And these
factors, what economists call the classic factor endowments of land,
labor, and capital, also happened to be contemporaneous and coterminous
with the sources of power of the classic 19th century nation-state. With
the increasing integration of the industrial economies and their
financial systems (and, at the same time, the decreasing importance of
most traditional physical resources and raw materials), many of the
classical notions of the objectives for conflict and the means to pursue
them may be in the process of changing. Particularly in the absence of
deeply-seated ideological conflict, one may speculate that rather than
"total war," more limited objectives will be the norm.

Post-industrial (or information-based) economies build on
information or knowledge as the fourth critical factor endowment. This
carries at least three other significant implications for assessing the
future security environment. First, this new factor endowment is not
dependent on unchangeable physical resources nor on large, fixed capital
investments that have long depreciation and pay-back periods. As a
result, economic power built on this foundation can be developed far
more quickly. Second, this source of strength is also far more agile and
adaptable, and can respond with shorter time constants to changes in the
environment; it may well be capable of greater surprises. Third, this
factor is also more mobile and potentially more transferable; and power
growing from it may be subject to greater diffusion.

Implications for the RMA.

To formulate appropriate new strategy and operational concepts
informed by the RMA, we must address the nature of war as it may evolve
under these circumstances. The concept of "limited war"[21] arose during
the cold war in order to differentiate regional conflicts to be fought
both for limited aims and with limited means, from the conflict that
involved a central challenge to the existence of the two superpowers,
which ran the risk of attendant escalation. The twilight of the cold war
may have produced with the Gulf War the first "unlimited war" in
Osgood's terms--a regional conflict in which a superpower was
unconcerned by the potential for escalation to central conflict with the
other superpower. In this case, while the objectives (on our side) were
limited, the United States employed almost unlimited means against Iraq
(with the exception of nuclear weapons). This combination of essentially
unlimited means for achieving limited ends, with the acquiescence of the
losing side, may make lessons from that war dangerously idiosyncratic.

It is likely that future conflicts, especially those involving
multinational coalitions, will demand a closer linkage and greater

proportionality between objectives and means in order both to limit the probability of escalation by the losing side and to maintain the political cohesion of multinational arrangements.[22] The move away from an era of total war will limit both means and ends. These limitations may once again raise the traditional distinction between enemy forces on the battlefield and the civil/industrial base. Thus, at the strategic level, whether an RMA that is perceived by a variety of audiences to bring to bear essentially unlimited military power is appropriate under an environment dominated by limitations on objectives is not clear.

Another difficult problem that the United States must confront is one of the complexity of the future conflict map. Multiple potential future threats make it necessary to maintain a range of capabilities to address challenges by potential and as yet unidentified peers at the highest end of the warfare spectrum, while staying prepared for conflicts with less technically capable opponents. The United States must also maintain the mid-term capabilities needed to decisively defeat regional hegemons, including ones that may possess nuclear capabilities. Even if we accept that this RMA can create the conditions for decisive victory in a dense, mechanized theater of war, can it produce the same results in a less dense, non- mechanized, low-intensity, localized conflict? Furthermore, if these revolutions derive from the integration and *synergy* of the four component elements, can "piece parts" be pulled out and applied effectively on a discrete basis, and still be a "revolution?" If the RMA cannot be applied as discrete pieces, should we not define the broader challenges within the focus of this RMA? Whether we can build off a common base of strategic needs and technical tools to appropriately tune the RMA in the exploitation phase to address these dissimilar challenges may, in the new security environment impacted centrally by fiscal constraints, ultimately define the military utility of the RMA as well as the strategic benefits for the decision maker.

To frame the issue most starkly, if the current RMA is nascent (and, based on historical evidence, it will probably take nearly 20 years to completely implement), should it be narrowly focused on a current problem (defeating mechanized regional hegemons) that may no longer be relevant when it comes to fruition or should it be broader and address threats that may evolve in the future? This question is crucial, especially if these Revolutions are not existential (they define themselves and only require recognition) but instead are purposeful creations of human guidance that can be directed towards particular strategic objectives and operational implementations.

Understanding Military Technical Revolutions.

Sophisticated observers recognize the complexity of an RMA--that it is more than just clever new technology. They identify four component elements: operational innovation, organization adaptation, evolving military systems, as well as emerging technologies.[23] Fundamental issues for decision makers are to understand what constitutes a real revolution in military affairs, to recognize the implications of an RMA occurring, and to determine a standard by which will they measure an RMA, either to discern whether it exists or to know how well it has succeeded.

Types of RMAs. Reviewing previous revolutions in military affairs suggests that the issue is complex because there may be three distinct models for these types of fundamental military innovation, thereby complicating both definition and recognition. The first type of RMA is

impelled by new, purely military technology, driven by fundamental scientific or technological inventions or developments. This is the type of RMA that has tended to dominate most people's understanding and led to the common perception of RMAs as technology- driven phenomena. It may also be the least frequent kind of RMA, with perhaps the recurved bow and the gunpowder revolution the only other examples of this type. This RMA was well-exemplified by the nuclear/long-range strike revolution created from the synthesis of nuclear weapons and intercontinental strike capabilities.

However, these revolutions present choices as to *what* strategic purpose and *how* to apply these new technologies. The choice of how to apply the clearly revolutionary technological innovation is whether as evolutionary improvements for executing existing missions or to create revolutionary change in the conduct of warfare. But historically, most technical innovations, especially the truly revolutionary ones, have been initially applied enhancing performance in the service of old objectives, without altering the fundamental conduct of warfare. For example, one could well argue that nuclear weapons merely allowed the fulfillment of Douhet's concepts for strategic air warfare. Spectacular technical breakthroughs, such as those that offer "order of magnitude" improvements in effectiveness or efficiency of existing missions, may well mask the need for more fundamental and far-reaching changes, in the same way that too many or too cheap resources are a breeding ground for economic inefficiency.

The second type of RMA, driven by operational and organizational innovation to redress a strategic problem, is well illustrated by the German *Blitzkrieg* developed in the inter-war period. While this type of RMA may not involve change in basic strategic objectives, it clearly involves fundamental change in the conduct of warfare, emphasizing not technological but more usually organizational and operational innovations. Because this type of RMA tends not to be resource-intensive, historically it has often been created by the defeated in the previous conflict. And importantly from today's perspective, because it is less hostage to long development and costly acquisition cycles, it may offer the best opportunity to address our near- and mid-term problems.

The third type, of which the Napoleonic RMA is the classic example, is driven by fundamental economic, political, and social changes outside the immediate military domain. These forces enable deep-seated and fundamental transformation of both the nature and the conduct of warfare. However, because these changes begin outside the military domain, they may be the most difficult to recognize and the most complex to adapt to military purposes.[24]

Revolutions (whether political, economic, socio-cultural, scientific, or military), by definition, imply discontinuity and change. In the case of an RMA, it is the discontinuous increase in military capability and effectiveness that sets an RMA apart from the normal evolutionary accretion of military capabilities, whether from technology insertion or operational innovation. A revolution is not merely an existential condition. Without recognition and exploitation, both necessitating human action, there is no technological revolution. Creating a revolution is more, therefore, than pushing the frontiers of science or the boundaries of military systems; it must be a positivist process that requires adaptation by the organism (or organization) for

exploitation to occur. Thus, arguing that the introduction of new technology itself creates an RMA seems to be a misreading of the phenomenology of revolutions. Revolutions, moreover, possess a internal dynamic different from evolutionary development. Revolutions are a recognition that conditions have changed and represent a legitimation of innovation and change, and a call to push at the boundaries. Separate from the process of institutionalizing the revolution, the idea *itself* of a revolution creates new conditions, including threats to existing structures (and bureaucracies).

In addition to an agreed objective function that flows from purpose, determination of a standard for assessing RMAs requires criteria by which to make the measurement. Here an interesting epistemological question arises that affects both purpose and measurement: Is it sufficient to measure against the old norms, or does dealing with a revolution itself require defining new norms in order to capture the *essence* of the revolution?[25] Evolutionary innovations, even extremely clever ones, can be measured effectively with existing measures of effectiveness (MOEs) since the paradigm or model has not been altered. Evolutionary innovations, no matter how clever, merely applique new methods and means while revolutionary innovations create new paradigms. Truly innovative developments often do not only enhance the ability to execute existing tasks, but also attempt to perform new functions or meet new needs. Unless these new functions are captured in the assessment, innovative developments often do not appear to offer significant operational enhancements.[26] As the context is altered by revolutionary innovation, however, the old MOEs are clearly not appropriate in measuring the new model of operations. Perhaps they are no longer even relevant to altered objectives.

If the latter is true, then it follows that the entire analytical construct must also be altered to correspond to the new paradigm, affecting objective function, criteria, measures of effectiveness, as well as modeling and simulation tools. Thus, the nature of the RMA is not only a critical definitional problem, but an analytical one as well; and, therefore, widespread interest in a new revolution in military affairs strongly suggests the immediacy of the need for new analytical tools.

The Process of Revolution. Successful military innovation is a *process* that involves far more than just conceiving or developing new technologies and operational concepts.[27] Not only must the new capabilities be physically developed and their superiority demonstrated, but successful implementation of these innovations requires that they be integrated into the military force structure and operational concepts. Adoption of innovation demands more than just the ability to equip a force or military service with innovative weapons. Organizations, operational patterns, and decision processes must also be modified to implement the innovation as an integral element of the service's ethos.

Considered as a process, a revolution consists of five steps. First, the conditions must be right for a revolution to occur. For a military technological revolution this probably implies not only the existence of new technologies that could be exploited, but also altered objective conditions in the geostrategic situation that make the world ripe for change.[28] An RMA involves a new appreciation of both "strategic needs" and "strategic opportunities." The combination of these two conditions presents the opportunity for new problems to be solved,

whether or not they have previously even been recognized as problems, what might be called "latent demand." For example, when IBM developed the first personal computer (PC) in the early 1980s, no one forecast the exponential explosion of personal computer use that has occurred--and most importantly, no one understood or predicted the uses to which the PC would be turned or the changes these would produce.[29] But clearly, in retrospect, there was a large unrecognized (i.e., *latent*) demand for the capabilities that were then about to be made available. The second step in the process, then, is the *recognition* of a revolution in the making. The understanding that the appearance of new technical potentials and objective conditions defines new boundaries allows new problems to be identified that can only then be addressed.

The third step is acceptance or *validation* that a revolution is in progress: that the problems which were formerly beyond the horizon are now within our grasp and, therefore, worth addressing. The role of decision makers here may be key. Their acceptance can serve to validate the fact of the revolution, but their inattention can, on the other hand, delay the acceptance and, therefore, slow exploitation of the fruits of the revolution.[30] It is only after this step that adoption and adaptation can begin to occur; it is with this step that Kuhn's paradigm shift begins. Again, drawing on the PC example, it is at this step that the spreadsheet is invented and defines an entire range of problems that can now be solved. It is not that the fundamental problems themselves did not exist before; but because they were beyond the bounds of easy solution, they existed outside the cognitive framework. Now with both the tool and the need identified, these problems can be tackled by anyone with a few thousand dollars, even if they didn't have the technical skills or mathematical expertise previously required to model complex financial situations. The fourth step involves the careful specification of the new problem (or problems) that will be addressed (even if not solved) and the initial understanding of the implications that resolving these issues will have;[31] it is this stage that starts the *institutionalization* of the revolution. Finally, the fifth stage involves the active *exploitation* of the revolution and the widespread understanding of its consequences.

This view of the process of revolution suggests that these five steps should be separated into two phases: first, a phase of "strategic synthesis" that redefines the world and the problems that can be addressed; and second, an exploitation phase, an "operational/tactical synthesis" that defines how the problems will be addressed. This exploitation phase is probably best carried out not as a sequential series of activities (operational innovation, organizational adaptation, and military systems evolution), but concurrently. It needs to integrate these elements in order both to reduce the time cycle and to best obtain synergy among the complex interrelationships of these elements--a process similar to the "concurrent engineering" now in vogue in the commercial sector. The strategic synthesis, however, must precede the exploitation synthesis for the process to be properly tied to national strategy--for it should be only at this point that the decision makers can determine the strategic choices available and the overall directions and priorities to be taken in order to address key strategic problems.

It is important to note that a strategic synthesis can occur even in the absence of technical capabilities to drive or exploit it; and this would appear to confirm the existence of two distinct, sequential phases in the RMA process. Examples from previous Soviet practices would

tend to reinforce this point. Changes to organizational structures in response to changing perceptions of the strategic problem, such as the creation of the Strategic Rocket Forces (SRF), the *Protivovozdushnaya Oborona* (PVO), and the *Protivokosmicheskaya Oborona* (PKO), each occurred prior to Soviet capability to satisfy the technical requirements for executing the missions assigned to these new organizations. However, the organizational adaptation to the altered strategic perception (the strategic synthesis) in each case led to the creation of a doctrinal foundation which, in turn, led to the creation of system requirements, i.e., the *idea* defined the technical demands.

A review of the elements of the inter-war aviation revolution also illustrates the point. The technical capabilities for (or "core competencies" in): improved aircraft engines, aluminum structures, and monoplane designs did not tell decision makers whether to build pursuit aircraft, strategic bombers, long-range escorts, or carrier-based torpedo or dive bombers. "Core competencies" by themselves represent what we *can* do; but without strategy and a campaign plan, we can't determine whether they are what we *should* do.[32] Moreover, even having identified the specific instrument to be built, is it to be applied within the present strategic context or used to overturn that context and create a new strategic approach?[33] This also suggests that any attempt to identify "core competencies" for the U.S. military before the strategic synthesis is completed is doomed to failure. Indeed, the search for core competencies can only occur as part of the exploitation phase since it is only with a strategy that one can determine whether our capabilities are relevant.

The technical invention step may not be very different, whether a particular military innovation is evolutionary or revolutionary. However, the complete process for implementing innovation (and especially the *exploitation* step) has striking differences in these two cases, especially in those measures that are required for getting the organization to *adopt* the innovation. Evolutionary innovations, which offer improved means of accomplishing existing objectives, can be appliqued onto the existing model of warfare,[34] thereby minimizing dislocation and disruption to the organization, as well as to its sponsors and constituencies. This is, in fact, how the British and French actually applied the superior armored capabilities they developed during the inter-war period. In this case, since the calculus can clearly demonstrate either increases in effectiveness or reductions in cost for accomplishing the existing set of tasks, and the costs of disruption are minor,[35] the organization itself often becomes the strongest proponent for adoption of the evolutionary innovation.

In the case, however, in which revolutionary innovations are introduced, the situation becomes more complex and the path to adoption more difficult exactly because of the procedural and organizational implications of revolutionary innovations. *Blitzkrieg* represented this type of challenge to successful implementation.[36] Fundamentally, *Blitzkrieg* did not introduce any new critical technologies; rather it integrated armored forces, tactical aviation, and the radio into a new matrix provided by innovative operational concepts and organizational structures. With revolutionary innovation, fundamental change to the existing paradigm is guaranteed; and, therefore, (unlike the case of a Pareto optimum) while the overall benefits may be extremely large, there will be entities within the organization, and sponsors and constituencies external but linked to the organization, that will pay

the price of these disruptions and dislocations. Thus, resistance to profound change is likely to be increased the more profound and discontinuous is the change. In particular, the potential effects of RMAs on the conduct of warfare and operational concepts for future campaigns suggest that attention also needs to be paid to how the services may differentially use these innovations for organizational advantage: not just for increased resources, but for a larger allocation of future roles and missions.

The Character of This Revolution in Military Affairs.

While there appears to be general agreement in the community on the character of previous RMAs, there seems to be substantially less agreement either on the character of this RMA or on its role in future U.S. strategy; these differences are critical to the choices decision makers face.

The Roots of This RMA. Whatever the specific character of this RMA now under consideration, it builds heavily on concepts first put forward in the late 1970s and early 1980s in the series of papers by Marshal N. V. Ogarkov, including his seminal 1982 paper.[37] Ogarkov worried about how to conduct *decisive* operations in the European Theater of War (TVD), a theater that was exceptionally dense with heavily-armored mechanized forces, and overwatched by theater nuclear forces on both sides. Operational concepts such as the Independent Air Operation, the Operational Maneuver Group (OMG), and the high intensity battalion flowed directly from his strategic appreciation that tempo and striking power were essential for solution of the problem.[38] He and his colleagues identified many of the critical operational/tactical elements now being discussed for the new RMA; but perhaps most importantly, he correctly understood that a revolution was in the making. In the Soviet case, the *idea* for the RMA clearly preceded the technical capabilities to implement and exploit the concept. This example reinforces the important understanding that a revolution should start with the strategic problem, not the technologies or military instruments--a classically Marxist deterministic approach in which doctrine is derived from the geopolitical conditions.

Ogarkov's real concern, however, was that, by the early 1980s, the United States may have solved his strategic problem by synthesizing the four constituent elements of an RMA that have been previously noted (technologies, evolving military systems, operational innovation, and organizational adaptation) into a *whole* that was more powerful than the parts.[39] In particular, he pointed to future U.S. technical capabilities to exploit the revolution as well as the limitations on the Soviets' own technical capabilities.[40] In Ogarkov`s terms, the most impressive capability demonstrated by the United States during the Gulf War was probably the ability to conduct tightly synchronized, highly integrated joint operations *across the extent and throughout the depth of the theater*, striking both the enemy's strategic centers of gravity and the enemy's operational forces, in order to produce decisive results[41]--the very capability he had feared that the United States would be able to turn against the Soviets in the European TVD.

Some Current Views of This RMA. A useful place to begin examining current American views might start with what constitutes the most prevalent perception of this new RMA. Many observers see this RMA defined by the technologies demonstrated during the Gulf War: stealth,

precision weapons, advanced sensors, C^{4}I, and use of real-time (or near-real-time) space systems. They believe that these technical capabilities will allow the United States to dominate large-scale, high-intensity conventional battlefields contested by opponents possessing sizable armored and mechanized forces. In general, those who hold this view of the RMA believe that this type of combat, baselined in the Bottom-Up Review scenarios focused on Iran, Iraq, and North Korea, will be the dominant challenge for the United States for the foreseeable future. Those who take this technologically-driven approach also, in general, view this RMA as ready for implementation, but with significant life left to run from enhanced technology developments. Indeed, those who hold this view also believe that with minor tweaking, the core technologies can also address the other potential problems, such as low-intensity conflict or special operations.

Other observers take a broader, more functionally-oriented view, focused on generalized capabilities flowing from the "Information Revolution": the integration of advanced sensors, C^{4}I, brilliant weapons, and simulation--i.e., the fusion of long-range fires and information as the core of this RMA. Many view these new technical capabilities as allowing the United States to move towards a "cybernetic" approach or to implement the Reconnaissance-Strike Complex (RSC) concept (first conceived by Ogarkov), or its newer incarnation, the Reconnaissance-Strike-Defense Complex (RSDC).[42] In their view, this would allow the United States to destroy almost any target on the battlefield instantly (as long as it yields a usable signature). Some others have focused more on sensors and communications capabilities and defined this RMA as "Information Dominance"; and the terms "Information Warfare" or "Information-Based Warfare" are being widely used. All these views take a bottom-up perspective, flowing from either the key technology components or their integration into complex systems; and they lead perhaps to too narrow an assessment of this RMA either as merely bits and pieces or as only clever technology evolution. These views, moreover, fail to capture the essence of revolutionary impacts, and almost certainly mistate the historical lessons of RMAs in general, and for this RMA in particular (discussed below).

Furthermore, these characterizations of the RMA are input-oriented, rather than measuring outputs--they do not characterize the RMA in terms of dramatically increased capabilities. This, therefore, raises the question of how to distinguish an RMA from clever military innovation: by the newness of its constituent elements or by the discontinuous "revolutionary" leap in capabilities? And how are the new capabilities produced by an RMA to be differentiated from simply "good execution?" If, in fact, an RMA is identified by the ability to solve a critical strategic problem through substantially increased effectiveness from new operational capabilities, then it must follow that a focus on the "piece parts" fails to capture the essence of the revolution.

Towards An Output-Based Definition. DESERT STORM demonstrated that a key advantage of U.S. forces was the ability to execute complex, orchestrated, high-tempo, simultaneous, parallel operations that overwhelmed the enemy's ability to respond. This advantage was built not only on advanced sensors and smart weapons, but perhaps more importantly on forces supported by modern C^{4}I systems and technologies that allowed the United States to collapse previous spatial and temporal constraints on simultaneous operations, whether combined arms or joint. These new

capabilities will represent a fundamental advantage for the United States compared with any potential opponent and, therefore, should be a central focus in future resource and planning decisions. DESERT STORM may be but a foretaste of true *coherent operations*, but impressive nonetheless in the demonstration of the power of coherence and simultaneity.[43] At the operational level, the impact of these *coherent operations* is to overwhelm the opponent's ability to command and control his forces, denying him the ability to respond to our campaign plan and operations, and forcing him at the limit to execute only uncoordinated preplanned actions. The number and tempo of these simultaneous parallel operations by themselves produce saturation effects that simply overload the enemy's command system and provide American forces with ample exploitation opportunities.[44]

Therefore, at the operational level perhaps a good working definition of this RMA would be as follows: a (massively) parallel series of synchronized integrated operations conducted at high-tempo, with high lethality and high mobility, throughout the depth and extent of the theater, intended to force the rapid collapse of both the enemy's military power and the enemy's will. The power of this RMA would allow the United States the operational-level flexibility to allocate forces and fires in real-time between holding, breakthrough, and exploitation operations; and this allows concentration of effort to defeat enemy forces in detail at our choosing. However, due to the simultaneous parallel operations, the high mobility, the high lethality, and the capability for sustained high tempos of operation, so many enemy units can be defeated in detail simultaneously that the operation may resemble a more classic *coup de main* executed in a single main-force engagement.[45]

At the tactical level, the combination of high lethality and real-time information produces a deadly increase in unit effectiveness due to the short time constants of action by individual units (similar to Colonel John Boyd's concept for air combat of acting inside the enemy's observation/orientation/ decision/action cycle). While "information dominance" is increasingly discussed, perhaps a deeper understanding would focus on "cycle-time dominance" at the tactical level and "command dominance" on the operational level. Altering the time constants of decision and action to permit increased simultaneity and enhanced coherence will require collapsing the traditional distinctions between strategic, operational, and tactical as well as the command pyramid.

The "Information Revolution" enables this RMA by facilitating the shift to this type of seamless, high tempo parallel operational doctrine; it is an enabler in the same way that the Agricultural and Industrial Revolutions enabled the Napoleonic RMA. It provides two critical capabilities: first, the ability to ascend a *cognitive hierarchy* that starts with data, then provides *information* by correlating data, then *knowledge* based on situational awareness, and finally *understanding* built on the capability to predict and project forward consequences-- and thereby improve decision making; and second, the ability to communicate those decisions in real-time with a high degree of assurance that the integrity of the message will be maintained--thus enhancing the action part of the cycle.[46] *Coherent operations*, enabled by the new ability to ascend the cognitive hierarchy, will allow, for the first time, turning C^3I from a supporting coordination function to a capability for real-time orchestration of

combat power focused on the decisive point. It will provide the tools to reinforce the traditional role of the commander in exercising command during the battle.[47] And moreover, the impact of this RMA may also alter the advantages traditionally held by the initiator of conflict over the responder, and thus the historic balance between the offense and defense.

Implications for Utility. The very success of the Gulf War (following six months of preparation allowed us by Iraq) may mask the changing phenomenology of our evolving security problems, and, therefore, the utility of this RMA in those circumstances: not massive, theater-level combat between two large, well-equipped *in-place* forces, but prompt response to regional contingencies in which we will not have the benefit of a substantial forward force presence. Is the current goal in exploiting this RMA, therefore, still overly burdened by a cold war mindset formed by guarding the Inner-German Border (IGB) for 40 years or is it truly consistent with the evolving strategic conditions?

The RMA, once correctly defined, can serve the decision makers in a number of ways: as a filter for choosing new technology and programmatic initiatives; as a new organizing principle for force posture and roles and missions decisions; as a lever for bureaucratic change and control; or even as a means for institutionalizing change through a "process of permanent revolution." However, the maturity of the RMA is an important consideration for decision makers attempting to determine both how to use the RMA and how to implement it. What are the different implications if this RMA is in its formative stages, and therefore has considerable life yet to run, or if this is a mature revolution, even if it is relevant to near-term problems? Understanding this factor is critical for judging our competitive position and assessing the ability of potential competitors to engage us with these tools (or to assess their interest in doing so). If, as many observers appear to agree, this is a revolution in its early stages, with much headroom left for improvement in the individual constituent elements, then a relevant question is the degree to which improvements at this level would enhance the overall effectiveness of the RMA--how much edge is necessary to maintain strategic dominance in intense mechanized warfare?

An alternative view is that a DESERT STORM-type RMA is a relatively mature revolution whose relevance and advantages may both be receding. If we follow the logic of Marshall Ogarkov, this is a revolution that has been proceeding for nearly 20 years, but has only reached fruition now as the technical tools to implement it have become available. Will adoption of a mature revolution lock us into a set of old technologies with limited potential for further dramatic improvements? (And moreover, it is a revolution aimed at a specific context that may now be disappearing just as we are able to address it.) A mature revolution would pose several potential implications: first, that the asymmetric capabilities we now hold are likely to be transitory since the sources of technical advantage may already be diffused and beyond our control; second, that challengers are in a position to absorb the operational innovations that the United States has made rather than having to invent them afresh; third, some may also be able to mimic U.S. organizational adaptations (which are open to inspection) if they can overcome their own cultural and bureaucratic impediments;[48] and fourth, that future challengers may choose, rather than countermeasures to this RMA (parallel development, direct counters, passive counters, or

asymmetric counters), to alter their overall strategic concept and come at us in ways that limit the relevance and utility of this RMA.[49] Of course, it may be that even if it is mature, it will remain relevant and the United States will be able to maintain a substantial and useful margin of advantage; but this issue requires analysis, not assertion.

Implications of This RMA.

The potent increases in operational effectiveness from this RMA can only be obtained by adopting substantial changes in operational concepts and organizational structures that will allow coherence to be maintained across spatial and temporal dimensions, as well as among forces of different types. Existing organizational structures, which are themselves the product of adjusting to the gross imperfections of previous C^3I capabilities, reinforce the tight linkage between *command* and *control*; and moreover, these structures are built around and reinforce the classic distinctions between strategic, operational, and tactical operations.[50] The existing hierarchy of operational levels and the corresponding levels of command will need to be reexamined, rethought, and redefined as part of creating a new warfare paradigm. Critical among these modifications will be changing the nature and location of the decision-making processes that result from the exercise of command and control of military forces in combat.

The existing warfare paradigm: (1) distinguishes among discrete *strategic*, *operational*, and *tactical* levels of operation; (2) is based heavily on preplanning; and (3) separates the overall operation into discrete phases. Implementing *coherent operations* will require that capabilities for command of simultaneous operations be increased and that the current spatial and temporal distinctions among these types of operations be removed. Moreover, shortening the critical time-constants for decision and action will require decentralization of command authority and a concomitant relaxation of control from the higher levels. But these alterations to the existing distinctions between strategic, operational, and tactical operations will require that the traditional focus, functions, and roles of the commanders in the existing hierarchical (and authoritarian) structure also be modified so that the nature and character of the decisions and actions correspond to the new paradigm.

Thus, it may be worthwhile to benefit from the experience already in the commercial sector on the impacts of these types of changes. Many of the critical enhancements portended by *coherent operations* are already reflected in changes in the organizational structures and decision and operations processes found in the commercial sector, including changes in the role of management and the locus of decision making in organizations. They are designed to improve dramatically the speed of both decision and execution; the key elements in competitive advantage. These changes affect the character of and requirements for *command* and *control* at each level of the organizational hierarchy. Military organizations, operational patterns, and decision processes will have to be similarly modified in order for the U.S. military to capture the potential for enhancing combat effectiveness offered by *coherent operations*.

Relieved of the classic span-of-control constraints by new technologies, organizational structures are being flattened and managers are being refocused to improve rather than impede flows of critical

information. Low-value-added activities are being discarded and new foci for decisions at each level in the corporate hierarchy are being developed. "Delayering" and flattening of existing hierarchies are designed to move the locus of decision making closer to those who execute the critical decisions in order to speed up the ability of the institution to respond to unexpected conditions and opportunities. These changes have been upsetting to commercial organizations and to the people affected; and it has taken far longer than anticipated for the benefits from infusing modern "information technologies" to show up in the form of increased productivity and organizational effectiveness. Recent research suggests that the transformation has been so lengthy exactly because these organizations initially attempted to use the new technology to increase efficiency in performing the old tasks, rather than "re-engineering" the entire process based on the new capabilities.

Finally, perhaps the most fundamental change required to exploit the new RMA is the alteration in perspective from improving the individual elements of combat power (and measuring those enhancements) to integrating and focusing the power of the "whole." Integration of the whole rather than enhancement of the parts is the central pillar of this RMA; then the campaign plan and joint operations become the defining level for measuring effectiveness. Assessing the full impact of *coherent operations* on a force projection military in future contingency operations cannot be accomplished by retaining the present emphasis on "stovepipe" operations, or "piece-parts" analyses, of forces executing an old-fashioned campaign model first invented by General John J. Pershing.

These changes suggest many of the restructuring activities that will be required if the U.S. military is to seize the opportunities presented by the RMA. Therefore, the services must be prepared to go beyond the DESERT STORM model to investigate and to exercise new operational as well as organizational concepts. These will include a complete redesign of the traditional campaign paradigm, so that it can define the direction and character of the RMA initiative and understand the potential implications of an RMA that will fundamentally alter doctrine and organizational concepts as well as future system requirements.

In implementing the RMA and transforming the "conduct of warfare," perhaps the real innovation will be found at the level of the campaign plan. The transformation will be in determining in which elements, in what sequence mission tasks are combined, and in how rapidly they are executed, rather than in the individual concepts for these mission tasks (what the military calls tactics, techniques, and procedures). This type of campaign needs to be viewed as an integrated, seamless process in which time constants of the individual pieces are critical to the effectiveness of the overall plan. Indeed, the analogy between this campaign paradigm to "just-in-time production" or "agile manufacturing" and the older campaign model, with its pre-planning, clearly delineated phases, and reliance on reserves, to an inventory-based manufacturing process is striking.[51]

Conclusions.

Despite the difficult definitional issues in characterizing this RMA, the most important determinations that must be made concerning the RMA initiative are not analytical (epistemology), but of purpose

(teleology). Decision makers have three problems, all of which involve crucial choices. First is the strategic purpose of the RMA, which depends on the perception of the nature of the future strategic environment. Second is its role in U.S. defense planning, which flows from that prior determination of purpose. Third is to ask what is the best way to exploit our particular implementation of this RMA?

First, while it appears that an RMA based on DESERT STORM would fulfill Ogarkov's search for an operationally decisive instrument for TVD-level planning and operations over the IGB contested by NATO and Warsaw Pact forces, it is not apparent that this strategic problem remains relevant. What is not answered is whether that RMA also would be an appropriate and effective instrument for achieving strategic objectives other than the military dominance of a theater of war, for operations at levels below a theater of war, or for conflicts with nonmechanized, non-Soviet-style opponents. A new strategic synthesis is needed to translate the relevance of the RMA beyond our traditional cold war problem. Consistency of means and ends is important. A revolution in military effectiveness may succeed, and may even be dominant at the tactical and operational levels, but may not produce strategically decisive results unless it is exactly and appropriately related to strategic purpose. While the German *Blitzkrieg* was an appropriate operational solution to the problem of waging a rapid campaign in Europe to avoid getting bogged down in a two-front war as in World War I, it would not have been a relevant response to either the Japanese or U.S. strategic problems in the Pacific theater. More importantly, *Blitzkrieg* may well have been an appropriate operational concept in service of an inappropriate strategy. The real German strategic problem, however, may have been the *prospect* of a two-front war, an event they themselves guaranteed by their attack on the Soviet Union. Completing the new strategic synthesis is essential if the RMA is to be appropriately linked to the strategic purposes relevant to the evolving geostrategic environment.

Second, as an internal instrument, the RMA can serve many different roles. Among them are: a screen for budgetary control, a process for institutionalizing change, a tool for assuring that the Department of Defense is structured to fight *future* wars, and a lever for changes in roles and missions. However, these key roles depend less on the specific internal details of the RMA (deciding between technologies, systems, innovations, and organizational changes) than on correctly capturing the *Gestalt* of this RMA.

In addition to the changing nature of the strategic problems that the United States will face, design of U.S. forces must also address operational and tactical level problems that will certainly change in scale, if not in intensity and duration. While the advanced technologies coupled to largely existing operational concepts and organizational structures were used with great success in DESERT STORM, the Gulf War displayed many idiosyncratic features; and it may well represent the final act of the old strategic environment in which massed, armor-heavy forces represented the critical component of the threat. Although DESERT STORM focused on a major regional challenge, the fact that Iraqi forces were equipped and largely trained along classic Soviet lines, as well as the extended period in which the United States was able to put in place an extensive infrastructure, stockpile huge amounts of logistics, and deploy a diverse array of extremely large combat forces, made this campaign perhaps resemble more traditional cold war contingencies than

potential uncertain regional contingencies occurring on short notice into largely unprepared theaters of operations.

If part of the overall effectiveness of this RMA depends on the impact of overloading the enemy's command system, will these advantages still pertain as the operational venue is reduced in scope and scale?[52] Another facet of this issue is whether effective operations at lower echelons employing the constituent tools of the RMA remain a military technical revolution. Finally, a third facet is how much of the impact of this RMA will be due to effective execution which is, in turn, highly dependent on realistic training and exercises. This latter question is exceptionally important for resource allocation decisions between force size, quality, and readiness; and it is also important to our understanding of how to preserve our present competitive advantage.

Finally, in light of the real costs of fundamental organizational change needed to accommodate new operational concepts, the third critical problem is to define an implementation concept that allows this fundamental alteration to both the existing warfare as well as the command and control paradigms; this course must maximize the likelihood of the change being adopted and internalized by the military institutionally, not simply grafted onto old stock. Perhaps more importantly, coupled with the very real fiscal pressures, the success itself of DESERT STORM may accelerate demands to reshape and restructure the American military; and real questions arise whether the potential of an RMA can be seized simply by appliquéing new technologies and systems onto existing structures and concepts or can even be understood and appreciated with the analytical tools developed for the previous environment.

It may be that a dual focus and, therefore, a two phase RMA is required, one that addresses both near-term and far-term strategic problems. Accepting that an RMA is composed not only of technologies and evolving military systems, but also of operational innovation and organizational adaptation, it may be that the major focus for this RMA in the near- to mid-term should lie in these two latter areas so that a common base of technologies and military systems may be able to serve the needs of both the high and low ends of the conflict spectrum-- without draining already stressed budgets. And in light of three issues identified in this monograph--relevance to future U.S. strategic problems, the likely challenges to be presented by future opponents, and maturity of this RMA--a case can be made that a major focus of an RMA initiative should be not only to exploit fully the current technical capabilities by creating an appropriate operational and organizational matrix with the *next* RMA. To identify and allocate sufficient resources to forging an RMA *beyond* that is more appropriate to the evolving set of challenges only now dimly perceived on the strategic horizon.

Given the increasing globalization of technology sources, it is probably self-evident that over the longer-term (but more debatable in the near-term) the United States will lose the asymmetric advantages we now hold in the underlying technologies needed for this RMA. Improved intelligence collection and analysis in these areas (especially against allies and potential suppliers of the critical technologies) should yield significantly better understanding of these rates of change to allow us to better gauge our relative competitive position. The possibility that challengers may develop totally new operational concepts is clearly speculative, but "gray design bureau" and "plan

orange" type games may be extremely useful to explore the possibilities.[53] The degree to which challengers may absorb, or develop on their own, the critical operational innovations and organizational adaptations that are key to the RMA may be the most difficult questions to resolve since they will require both an exceptionally good understanding of the dynamics of an RMA (which is not yet in evidence) and careful analysis of the complex relationships between an RMA and the socio-cultural and economic factors of a wide range of potential competitors. Recent history suggests that these questions will seriously stress our intelligence and analytical communities.

How the operational and tactical levels of warfare are conducted (disregarding politics for the moment) determines roles and missions, the traditional focus of the military services; and an RMA would undoubtedly bring about substantial changes in the current alignment of roles and missions among the services. However, without the benefit of a completed strategic synthesis, current attempts to redefine roles and missions appear too early to have useful impact; these changes appear to be elements that should occur only in the second phase of the revolution--when the operational approach has been determined and the path for exploitation has been clarified.

In summation, using an RMA initiative, intentionally or unintentionally, primarily to define a "technical legacy" makes three crucial errors. First, it misdirects effort toward a probably fruitless search for "silver bullet" technology on which to build the RMA. Second, it misdirects attention away from the critical issues of, and relationships among: purpose, strategy, doctrine, operational innovation, and organizational adaptation that are the essential issues for an RMA. Third, in committing the first two errors, it compounds the problem by being astrategic since it risks wasting very scarce defense resources on new programs that may be irrelevant to future security challenges. This course would be particularly unfortunate since it would squander the rare opportunity presented by the changes in technological conditions to enable an RMA that could appropriately forge America's military for the evolving geostrategic environment; one that is also being reshaped by fundamental changes in the underlying political, economic, and socio-cultural conditions.

Notes:

1. When exploration of this subject by the American defense community first began, the term commonly employed was the "Military Technical Revolution" (MTR). Unfortunately, MTR denotes too great an emphasis on *technology*. Therefore, much of the interested community now uses the term Revolution in Military Affairs, which focuses on *revolution*, and clearly places *technology* in a supporting role.

2. The U.S. defense community owes a debt of gratitude to Mr. Andrew Marshall, the Director of Net Assessment, OSD, for identifying this important subject and pressing efforts to have the community begin an RMA initiative.

3. An external perspective focuses on outer-directed *strategic* objectives while an internal perspective focuses on inner-directed issues such as adapting the organization and overcoming structural barriers to innovation.

4. It may also be that one objective held by some analysts for the RMA is not to address specific challenges from the diverse array of potential competitors, but to attempt to use the RMA to maintain the aura of unchallengeable, overall U.S. military and technical dominance by shaping perceptions, by "casting long shadows," whether the RMA is an appropriate solution to the specific challenges or not.

5. Does the nature of conflict result from natural laws (the technical and environmental conditions that Karl Marx called the "sub-structural forces") or from the interplay of sociopolitical and economic factors (the evolving geostrategic interests)? Is the conduct of warfare affected by the stage of social development of the participants or can it be imposed by a key actor?

6. While Russia and other former Warsaw Pact nations may be prepared to sell advanced weapons at prices that are very low by Western standards, it is less likely that they will, or can, make those sales as "loss leaders" for political or ideological influence.

7. For example, Hitler's "peaceful" annexation or "reunification" of Austria, the *Anschkluss*, in 1938.

8. Carl Builder of RAND has written and discussed the latter concept.

9. This issue, however, has a more complex, and darker side for U.S. planning. While the Gulf War, and similar future conflicts, may represent only limited threats to interests, and therefore limited stakes, for the United States (or potential coalition partners), the regional aggressor may perceive his "strategic interests" or even his very survival (national or regime) at risk once the United States engages with unconstrained military power, even in pursuit of "limited" objectives. In light of the conventional military capabilities demonstrated by the United States in that war, and especially the damage inflicted by the "strategic" air campaign, we should not be surprised if our opponents contemplate the use of their "strategic" weapons--whatever they may be. Therefore, it is likely that we may be forced to employ more limited means in achieving limited ends by the consequences of not doing so.

10. It is an interesting question to explore this relationship between vulnerability and stage of socioeconomic development; it may well be that nations like Iraq are the most vulnerable, having grafted a thin veneer of modernity onto fundamentally less-developed societies, and thereby creating an exceptionally fragile infrastructure that does not respond well to stress.

11. And despite the relative optimism expressed earlier, a major threat could emerge sooner. After all, it was only 10 years between the height of the Weimar Republic and the invasion of the Soviet Union in 1941. See Jeffrey R. Cooper, *Implications of a "Long Peace,"* Center for National Security Studies, Los Alamos National Laboratory, December 1991, for a discussion of other historical analogues for the period we have now entered.

12. This same problem bedevils the concept of "prototyping." While there is certainly utility in proving a new technology or piece of equipment, there is probably little sense in putting it "on the shelf"

to await a future conflict since it is likely to be obsolescent at that time. Thus, in this context, both prototyping and the MTR are better viewed as processes, not products--explicitly designed to maintain ferment in their particular areas.

13. As Dr. Daniel Gouré, Deputy Director for Politico-Military Affairs, CSIS, has aptly phrased it, "Nintendo Warfare."

14. This concept is not new. In fact, some had explored this notion in earlier years by suggesting that Pershings be deployed in German town squares in order to force the ugly choice of large-scale civilian deaths in a Soviet preemptive attack.

15. The "CNN effect" refers to the global, real-time news coverage that is becoming increasingly available and makes conduct of most military operations a matter of immediate public scrutiny.

16. For the purposes of this monograph, the term *nature of war* will be defined by the entities that engage in the conflict and the objectives over which they fight while *conduct of warfare* will refer to the modalities of the conflict, that is, how the war is fought. Thus, during the past century and a half, the nature of war has been defined by the fact that it has been fought by nation-states for political objectives; warfare has been conducted primarily by mass armies equipped with weapons provided by modern industrial technology. I do recognize that others use *nature of war* to refer to the immutable characteristics such as combat, leadership, valor, and blood.

17. I am indebted to COL Gary Griffin, USA, TRADOC, for this important insight. Dr. John Hanley has also touched upon this point in "Implications of the Changing Nature of Conflict for the Submarine Force," *Naval War College Review,* Autumn 1993.

18. The Soviet stress on the political dimension of war and the correspondence of military power with the "stages of socio-cultural development" recognized that strategy exists within a complex web of nontechnical factors.

19. See for example, J.F.C. Fuller, *The Conduct of War: 1789-1961,* 1961 (republication by the Da Capo Press, New York, 1992), pp. 15-25, for an excellent discussion of these changes.

20. See Fuller; the Peace of Westphalia in 1648 ended the Thirty Years War which was a religious conflict of absolute ends and total means, and opened a period of limited conflict objectives. Prior to *raison d etat* of the modern civil state, war in Europe was often fought for absolutist (if not Manichean) religious reasons resembling ideological conflict.

21. See Robert E. Osgood, *Limited War*, Chicago: The University of Chicago Press, 1957. As Fuller, p. 20, noted, this actually harkened back to pre-Napoleonic objectives of the "absolute" monarchs.

22. See, for example, Robert W. Tucker, "A Just War?," *National Interest*, Fall 1991. Indeed, domestic reaction fueled by the "CNN effect" to scenes of destruction on the "Highway of Death" was clearly one factor in curtailing coalition combat operations and probably can't be ignored in the future. The new Army FM 100-5 explicitly notes this

factor in planning and conducting future operations.

23. See Dr. Andrew Krepinevich's original 1992 study on the MTR prepared while he was in OSD/NA.

24. This would be consistent with the literature on technology innovation, transfer, and adoption by firms and industries. Directed, dedicated research, while the most costly, tends to be the easiest and quickest to apply. "Not invented here" developments often find internal sponsorship and adaptation difficult, even once their relevance and implications are recognized.

25. For example, if an RMA involves a fundamental shift from an attrition paradigm to one in which speed of execution is as important, then it should follow that the dimension of measurement should shift as well from questions of "how many killed" to "how quickly."

26. GPS is an extremely recent and relevant example of the problem. An older example was the Army's attempt until the 1930s to treat the machine gun as an artillery weapon.

27. There is an extensive literature on both military and civilian innovation that explores the phenomenology of the entire process, including the complex problems attendant on organizational adoption of the innovation, not just the step of technical invention.

28. The phenomenology of this cognitive dissonance is the same whether it is in the context of Kuhn's "paradigm shift" or the Marxist-Leninist formulation of "internal contradictions."

29. A classic problem in the literature on invention and innovation is the inability to predict the impact a new development may have not in meeting existing needs but in creating entirely new markets. Not only IBM and the "PC" in the early 1980s, but IBM and the mainframe computer in the 1950s, and the Air Force and GPS in the 1970s, are all good examples of unpredictable "latent demands" that could not be forecast in the existing framework. Without understanding of the type and magnitude of the change the invention would introduce, analysis in the existing context was irrelevant.

30. What is not clear, however, is whether their opposition can stop a revolution; historical analysis could answer this important question.

31. Given the peculiarly American approach to analysis (decomposition, assessment in detail, only then synthesis, and finally understanding of the whole), the process attendant on revolutionary innovation poses a difficult procedural reversal demanding a "holistic" or *Gestalt* approach *ab initio*.

32. The concept of "core competencies," developed at the Harvard Business School, is currently in use by organizational consultants attempting to reform or restructure private-sector companies; it attempts to identify those particular areas in which an organization is exceptionally proficient as the focus for its energies.

33. As Dr. Gouré has pointed out, the British invented the tank and employed it piecemeal in the Battle of Cambrai, within that existing

strategic context, to support the breakthrough of infantry against machine guns and fortified trench systems. The Germans, on the other hand, organized the tank into armored formations and integrated them with close air support to develop the *Blitzkrieg,* which created a new strategic context. This problem may affect the existing seven DDR&E "thrust areas"; without a stronger link to strategy appropriate to the new security context, pursuit of these areas will not necessarily provide important tools for strategic exploitation.

34. This paradigm or model includes division of roles and missions among the services, as well as campaign plans at the joint level, and force structure and doctrine within each service.

35. Thereby creating a Pareto optimum in which no party is made worse.

36. And adoption of *Blitzkneg* was strongly resisted by the German Army hierarchy.

37. Marshal N. V. Ogarkov, *Always in Readiness to Defend the Homeland,* March 25, 1982, is the key paper usually cited. Other shorter papers by Ogarkov date back to fall 1979; and a later important work was his 1984 May Day article.

38. "Battalions in Military Operations," *Military Herald,* 1985, for example, is a conceptual precursor to the high leverage brigade concept now being discussed by USCENTCOM.

39. See, for example, the 1982 FM 100-5, *Airland Battle*, and the Follow on Forces Attack (FOFA) concept, both based on the innovative ideas of Generals DePugh, Starry, and others; these could certainly have fueled Ogarkov's concern. These doctrinal changes indicate that the United States also had an intuitive understanding of the revolution that was about to occur; but like Moliere's character, the Army had been speaking prose (the RMA) but didn't know it.

40. Ogarkov, *History Teaches Vigilance,* April 1985. This appreciation, in turn, led to the support by much of the Soviet military for *perestroika* in order to create the internal preconditions for competing with the United States in this new technical era. Having watched the United States validate the RMA, many in the former Soviet military are likely to be convinced that the correctness of pursuing the path of "denuclearization" by political means and *perestroika* internally has been confirmed. Marshal Grachev, Yeltsin's Defense Minister, for example, has been an outspoken proponent of both elements.

41. For example, this was highlighted in the *Desert Storm "Lessons Learned"* Study conducted by the Center for National Security Studies, Los Alamos National Laboratory.

42. All these concepts owe much to Soviet work in "control theory" and automated processes.

43. See Jeffrey A. Cooper, *The Coherent Battlefield*, SRS White Paper, Arlington, VA, June 1993, for a more complete discussion of *Coherent Operations*.

44. These effects, in fact, resemble the conditions intended to be

produced by Soviet-style "Radio Electronic Combat."

45. Another benefit of the intense but rapid execution is the likely reduction in American casualties compared with a more drawn out, sequential attrition style operation.

46. Many commentators have returned to John Boyd's concept of the Observation/Orientation/Decision/Action (OODA) Loop in discussing the impact of the "Information Revolution." Almost uniformly, however, they have focused on the decision side of the cycle (observation/orientation/ decision) and neglected the very important implications of significantly enhanced "information technology" for the action element. Real-time, dependable communications have analogous effects to Boyd's key technical requirement for the pilot/aircraft combination, 3000 psi hydraulics, to link more rapid decisions by the commander to responsive actions by his unit.

47. The new C^4I technologies could also be used to create a new class of remote commanders, not unlike the British and French "Chateau Generals" in World War I, displaced physically but linked to the front by the telegraph. The wide band width and real-time processing capabilities may well tempt the military to this Faustian bargain.

48. An intriguing and important sociological issue is the relationship of an RMA to the society which fosters it--must it be organic to and consistent with the socio-cultural foundation--or can it be grafted onto alien stock?

49. As noted earlier, an opposing proposition suggests that much of the U.S. advantage lies beyond the four constituent elements in the ability to execute, which is built on training, exercises, simulation, and supporting elements such as logistics and maintenance--these factors may be even more difficult to replicate and have traditionally been neglected by most militaries outside the developed world.

50. See, for example, Colonel James G. Burton, "Pushing Them Out the Back Door," *U.S. Naval Institute Proceedings*, June 1993, and subsequent correspondence for views on the confusion in roles and command levels engendered by these changes in our understanding of the command functions at the strategic and operational levels of war. My own view is that the operational level is expanding as the capabilities to engage in Clausewitzian decisive combat are being recovered. As time replaces space as the critical factor, the concurrency and compression of future campaigns may provide opportunities for "tactical" engagements to become decisive.

51. Once this analogy is drawn, it is interesting to contemplate the disastrous experience of General Motors in automating and robotizing key production lines ("innovative operational concepts") rather than in "re-engineering" the entire production process itself and better integrating existing manual subprocesses.

52. A useful study would be to analyze the relationships between combat tempo, scope, and parallelism on the one hand, and the number and pace of command decisions on the other; while this smacks of previous Soviet interest in command norms and cybernetic control theory, they may well have intuitively understood this element as an important component of the emerging RMA.

53. It should be noted that the Japanese attack on Pearl Harbor was not an example of technological surprise, but of both operational and tactical surprise. The tactical surprise was that they could effectively deliver air-dropped torpedoes in shallow, contained waters.