While transformation means different things to different people, there are two main schools of thought on this subject. One identifies transformation exclusively with the revolution in military affairs (RMA) and the other perceives it more broadly, as a process of adapting the Armed Forces to the security challenges of the post-Cold War era.

Transformation is not synonymous with modernization. According to the U.S. Air Force Transformation Flight Plan, the former leads to major improvements in warfighting capabilities and the latter involves incremental upgrades. There is no single metric or framework that distinguishes among concepts that are transformational and those that are not. "In the end, determining what is transformational comes down to qualitative judgement calls by informed senior leadership."

To indicate that transformation is a matter of judgement implies that the process of defining it will continue to be debated by the military, with clear implications for service cultures, budgets, and programs. Subtle semantic and conceptual differences remain key to this struggle. Each service has an idea of future warfare, and rhetorical confusion is likely as various actors invoke terms differently. In the end, definitions alone will not resolve differences over transformation.

Intellectual Origins

During the 1980s the Soviet Union came to the realization that the United States was on the verge of a technological leap. Marshall Nikolai Ogarchov referred to military-technical revolution. The concept was subtly changed in the Department of Defense by Andrew Marshall of the Office of Net Assessment. The new term, revolution in military affairs, was intended to suggest that more than technological advances were involved. It included not simply systems, but new doctrine and organizations. As the current Secretary of Defense, Donald Rumsfeld, has said, "All the high-tech weapons in the world won't transform the U.S. Armed Forces unless we also transform the way we think, train, exercise, and fight." (1)

Controversy over an American RMA intensified in the early 1990s. A number of questions were raised. What is RMA? What sort of revolutions have occurred in the past? What lessons do previous revolutions hold for transformation? Could a revolution be deliberately fostered?

Some issues have been resolved and several points of contention better defined. It is clear that there are instances when the maturation of technology, or the confluence of apparently discrete changes, produces a quantum leap. But a continuing debate over whether change is evolutionary or revolutionary, even with regard to the same process--incremental change resulting eventually in dramatic consequences--has led some to conclude that the issue is about semantics.

Two definitions have emerged. Some conceive of RMA as a relatively rapid change on the operational level of war usually brought about by harnessing new technologies to new concepts of operations. The introduction of Blitzkrieg and aircraft carriers are popular examples. Others have identified what they call military revolutions, epochal upheavals in which a society is transformed. As two noted historians have observed, "Military revolutions recast society and the state as well as military organizations." (2) While most planners regard the revolution in military affairs in a limited operational sense, innovators such as Vice Admiral Arthur Cebrowski, USN (Ret.), envision that a new epoch, the information age, is emerging and that the basic rules of conducting warfare will be changed. This is a conception of revolution in the larger sense.

There seems to be a better chance of controlling and shaping RMA on the operational level. How should the military take advantage of revolution? The research on innovation has suggested the value of stimulating open debate and sponsoring and protecting revolutionary thinkers on lower levels. Organizations can grasp the essence of such a revolution through genuine experimentation and refining concepts based on realistic assessments of lessons learned.

Recent thinking has focused on the implications of advances in computing and information technology. The former Vice Chairman of the Joint Chiefs, Admiral William Owens, USN (Ret.), was among the first to suggest that the Armed Forces could achieve information superiority. By integrating a system of systems, a picture of the battlespace measuring 200 miles on each side could be created. Linking command, control, communications, computers, intelligence, surveillance, and reconnaissance ([C.sup.4]ISR) systems can provide information superiority--or dominant battle-space knowledge--and enable a quantum leap in operations. The fog of war would be dissipated. (3)

But some doubt that the revolution is going in the right direction. Williamson Murray and Macgregor Knox point to an "astounding lack of historical consciousness" by the utopians. (4)

Perhaps the most striking claim of contemporary Beltway pundits is that technological innovation, particularly in information technology, will purge the conduct of war of the uncertainties and ambiguities of the past. For those happy powers that set the technological pace, war will become an essentially frictionless engineering exercise.... The utopians' 'face of battle' is a bank of computer displays, and in their fond imaginings war is nothing more than dealing out punishment in doses precision-calculated to send political signals to keep the natives under control. (5)

Others argue that real transformation is looming in irregular warfare--an area that is ill suited for the high-tech revolution in military affairs which the United States is pursuing.

These concerns notwithstanding, the notion that we are in the midst of a revolution of some sort rapidly won acceptance in official circles. As early as 1995 the annual report of the Secretary of Defense made a two-paragraph reference to "the so-called revolution in military affairs."

Official Acceptance

The promise of the information revolution was taken up by the Chairman with publication of Joint Vision 2010 in 1996. This document recognized that technological change could enable new levels of performance across a full range of military operations. Information superiority would be enabled by four operational concepts: dominant maneuver, precision engagement, full-dimensional protection, and focused logistics.

JV2010 provided a short-term vision with specifics to be worked out later. It was followed by Concept for Future Joint Operations in 1997, and JV2010 was revamped as JV2020 in 2000. But just what this vision meant in terms of acquisition programs was left undetermined.

Acceptance of the revolution in military affairs gained ground with the Quadrennial Defense Review (QDR) and National Defense Panel report, Transforming Defense, which both appeared in 1997. QDR largely reiterated a two-major theater war posture and appropriate force structure. It also acknowledged the existence of a continuing RMA and asserted that transformation "centers on developing the improved information and command and control capabilities needed to significantly enhance joint operations."

The National Defense Panel accepted that a revolution was underway and urged that transformation should be pursued to stay abreast of changes in the conduct of warfare:

We are on the cusp of a military revolution stimulated by rapid advances in information and information-related technologies. This implies a growing potential to detect, identify, and track far greater numbers of targets over a larger area for a longer time than ever before, and to provide this information much more quickly and effectively than heretofore possible. Those who can exploit these advantages--and thereby dissipate the fog of war--stand to gain significant advantages … [DOD] should accord the highest priority to executing a transformation for the U.S. military, starting now.

The annual report of the Secretary of Defense for 1997 moved from positing a so-called to an emerging RMA and described the core concepts of JV2010. Transformation loomed large in the annual report for 1998, declaring that DOD "has embarked on a transformation strategy to meet the challenges of the 21st century." The Pentagon now embraced RMA, which was seen as critical to defense strategy. Three chapters were

focused on "Transforming the U.S. Armed Services for the 21st Century," with one given over to RMA and JV2010. For the first time, there was a chapter on new operational concepts.

Network Centric Warfare

A further conceptual development emerged from ideas on integrating disparate elements of the fleet--or network centric warfare (NCW). The Navy had been thinking about networked fleet operations since the late 1980s. The concept was simple on one level, highlighting the advantages of the revolution in information technology. Borrowing from work originally done by futurists and business leaders, advocates argued that networks were the wave of the future. (6)

Networking large numbers of disparate and dispersed sensors, shooters, and deciders can generate information superiority. Massed precision effects can foreclose options and shock an enemy into collapse by increasing the speed of command and facilitating the self-synchronization of the component parts of the Armed Forces. Critical in this new era is how components of organizations will be linked. In this sense, the new way of conducting operations is network centric rather than centered on tightly integrated stand-alone weapons platforms coordinated through a vertical chain of command. If networks are the organizing principle for the information age, network centric forces should usually defeat forces still organized for the industrial age.

NCW can be understood on different levels. Strategically, it is a theory of epochal change in warfare in the information age. On the operational level it is about integrating sensors, shooters, and deciders to achieve new degrees of effectiveness. Finally, NCW can be seen as the elaboration of an approach to warfare that emphasizes devolved command and control. Relying on metaphors borrowed from evolutionary biology and complexity theory, it proposes a solution to the command and control problems generated by the increasingly complex nature of modern war. The concepts of self-synchronization, co-evolution, and complex adaptive systems in particular are seen to offer insights into the new ways military organizations will operate.

Concepts of Operations

Speedy maneuver and precision strike hold the potential for rapid collapse of enemy forces while simultaneously protecting friendly forces. This emphasis on a rapid tempo of operations is most clearly articulated in the concept of rapid decisive operations (RDO) developed principally by U.S. Joint Forces Command (JFCOM). It is defined as the essence of military transformation, whereby:

The U.S. and its allies asymmetrically assault the adversary from directions and in dimensions against which he has no counter, dictating the terms and tempo of the operation. The adversary, suffering from the loss of coherence and unable to achieve his objectives, chooses to cease actions that are against U.S. interests or has his capabilities defeated. (7)

The Air Force is foremost in developing a linked concept, effects-based operations (EBO). While RDO refers to how operations are conducted, EBO refers more to the purpose of operations. JFCOM refers to it as "a process for obtaining a desired strategic outcome or effect on the enemy, through the synergistic, multiplicative, and cumulative application of the full range of military and nonmilitary capabilities at the tactical, operational, and strategic levels." In other words, the Armed Forces may use indirect and second- or third-order effects to achieve their aims against an enemy. In many respects EBO is a continuation of a longstanding effort to achieve decisive victory through airpower. Such notions are expressed in terms like parallel warfare and thinking about an enemy as a system using the concentric ring metaphor. (8)

Some analysts have been impressed by shock and awe, which is accepted in some circles as an intrinsic part of RDO. When faced by overwhelming U.S. capabilities, an enemy will simply collapse. It will be shocked and awed and cease to function. It will no longer need to be eliminated; the sheer psychological impact of American predominance will suffice.

While it is hard to disagree with a general preference for RDO and EBO over attrition and slugfests with enemy fielded forces, some cautionary notes have been sounded. One basic tenet of the new approach to war is that a rapid tempo of operations becomes the key to victory. The aim is to operate within the decision cycle of the opponent so the opposing forces will lose coherence and be rapidly dismantled. This is intriguing and plausible, but an unproven theory. There are bound to be situations when speed is irrelevant or counterproductive, particularly on the strategic level. (9)

Information Age Warfare

Service efforts at transformation have occurred on a wide front, but three general areas may be distinguished: networking (particularly [C.sup.4]ISR systems) to generate a common operating picture; a shift to an expeditionary orientation, often with major organizational changes or shifts in weapons platforms; and continuing modernization of existing weapons and platforms and a search for more appropriate platforms.

The development of a common operating picture and networking more generally has been most evident in the Navy. Efforts to defend the fleet in an anti-access and area denial situation led to further development of Aegis radar and cooperative engagement

capability. The Army sought to digitize its armored vehicles to provide a common operating picture for all units, and the Air Force has shifted from centrally planned and cumbersome air tasking orders to the capability for in-flight targeting of both manned aircraft and cruise missiles. In the 1980s, Marine Corps doctrine adopted ideas that were derived from complexity theory and a concept of command and control that stressed decentralization and mission-type orders.

Each service has shifted to an expeditionary orientation. This is transformation in the sense of dealing with a new strategic environment. When the Air Force realized that it could not count on well-established forward bases, it reorganized into expeditionary air forces. The Navy understood that a deep-water strategy of assuring maritime control against the Soviet Union was redundant and began to focus on the littoral and land attack. Both services increasingly saw their job as kicking in the door through massive strikes during the early stages of a joint operation.

Enemy anti-access and area denial strategies would be dealt with partly by networking sensors, shooters, and deciders throughout the fleet and providing vessels with a new complement of semi-autonomous unmanned vehicles to detect local threats. Moreover, the Air Force would concentrate on the suppression of enemy air defenses and establishing air superiority.

Army efforts focused on digitizing heavy divisions. However, as the expeditionary aspects of the strategic environment became clear, pressure mounted for capabilities to deploy forces more rapidly. The inability of Task Force Hawk to rapidly deploy attack helicopters to Kosovo in 1999 was symbolic of a lethargic service. There was speculation that the Army was verging on strategic irrelevance. Today the goal is deploying anywhere around the world in days rather than months. The Army has been conducting experiments with a medium-weight interim brigade combat team as well as a wheeled combat vehicle known as the Stryker.

The Army and Marine Corps were concerned with rapidly inserting highly maneuverable forces. The Marines developed a concept known as operational maneuver from the sea, eventually defined as expeditionary maneuver warfare. Its tactical application, ship to objective maneuver, is intended to alter amphibious operations by obviating the need to seize and build up beachheads. Instead forces would move from over the horizon directly to targets deep inland.

Platforms

A third general area of transformation, force modernization, may be the most contentious. As the Armed Forces developed new concepts of operations to exploit RMA, the appropriateness of traditional platforms had to be reconsidered.

Stryker brigades lack the full survivability and lethality of heavy Army armored divisions. But the argument, based on concepts of network centric warfare, is that speed, striking power, and precision, enabled by a common operating picture, will enable them to hit targets and move before enemy fires can damage them, making up for any shortfall in survivability.

The Navy move to a littoral orientation implied that ship designs and force structure of the Cold War may no longer be optimal. But just what a new fleet might look like was the subject of controversy. Some thought that the carrier had seen its day; it was too vulnerable and had too little sustainable combat power. On the other hand, growth in the strike power of the fleet and increased defensive capability of the Aegis systems argued for the continued utility of these large and flexible platforms. The idea of an arsenal ship designed to launch large numbers of cruise missiles was briefly explored in the mid-1990s. And as the challenge of littoral combat became clear, the Navy experimented with the streetfighter concept, a small and expendable network-centric combatant that could be fielded in large numbers to achieve maritime supremacy in the littorals.

For the Marine Corps to achieve ship to objective maneuver, a triad of new vehicles was needed: the landing craft air cushion, advanced amphibious assault vehicle, and V-22. The concept relied on new means of transportation to bypass defenses and strike targets before an enemy could mass forces to attack. The vulnerability of the triad would be offset by information superiority and self-synchronization. Cancellation of any of these vehicles would put this concept at risk.

For the Air Force, anti-access environments make stealthy aircraft crucial. Hence the F-22 remains the centerpiece of its transformation plans. Current thinking sees unmanned aerial vehicles like Global Hawk primarily as reconnaissance vehicles. Although developing unmanned combat aerial vehicles, the service remains focused on manned fighters.

Networking current platforms is a great leap forward, but it is problematic whether legacy platforms are most appropriate for the twin challenges of the expeditionary era with anti-access and area denial problems and the information age with a promise of lifting the fog of war. An irony of network centric warfare is that platforms still matter. Critics charge that the services are continuing to modernize forces rather than transforming them to fight in new ways.

From RMA to Transformation

DOD thinking during the Clinton years manifested a growing concern with exploiting RMA and a recognition that it would involve a far-reaching transformation of the military. But there was little coherence or real sense of urgency.

As a candidate, George Bush was committed to skipping a generation of new technology. He cited "a revolution in the technology of war" in a speech at the Citadel in September 1999 and argued that "the best way to keep the peace is to redefine war on our terms." He promised to back transformation with resources. At the same venue two years later, he returned to the same theme: "The first priority is to speed the transformation of our military."

But translating the inspired but vague concepts of JV2020 into actuality is a central issue. Rhetorical battles over the revolution in military affairs and transformation were not fully resolved, and their meaning in terms of doctrine, training, and acquisition remained unclear. This challenge was addressed in the QDR report, which defined six operational goals:

* protecting critical bases of operations (homeland, forces abroad, allies, and friends) and defeating chemical, biological, radiological, nuclear, and explosive weapons and their means of delivery

* assuring information systems during attack and conducting effective information operations

* projecting and sustaining forces in distant anti-access or area-denial environments and defeating anti-access and area-denial threats

* denying enemies sanctuary by providing persistent surveillance, tracking, and rapid engagement with high-volume precision strike, through a combination of complimentary air and ground capabilities, against critical mobile and fixed targets at various ranges and in all weather and terrains

* enhancing the capability and survivability of space systems and supporting infrastructure

* leveraging information technology and innovative concepts to develop an interoperable, joint [C.sup.4]ISR architecture and capability that includes a tailorable joint operational picture.

The joint community and services have endeavored to make transformation a reality since the mid-1990s. They differ in their perceptions of progress and specific concerns. These six goals offer a common sheet of music. It remains to be seen whether everyone will sing from it.

There is clearly insufficient integration of service perspectives on this subject, and some observers perceive simply a rhetorical repackaging of modernization. Others believe that not all the services are candid enough for transformation to succeed. The need for joint oversight of the kind provided by JFCOM and the Office of Force

Transformation is obvious. Whether it can move the services away from their attachment to current platforms and weapon systems remains unknown.

Transformation efforts that are focused on linking everyone via a common operating picture indeed constitute a revolution. But this is only one step on a long road with few signposts. New challenges will arise that counter the American RMA. And as the next revolution takes form, based on robotics, nanotechnology, unmanned vehicles, directed energy weapons, and biotechnology, the Armed Forces will have to rush to move from the current RMA and transformation process. Honest experimentation and nurturing innovators will be the keys to remaining ahead of the game. As always, history will be the judge.

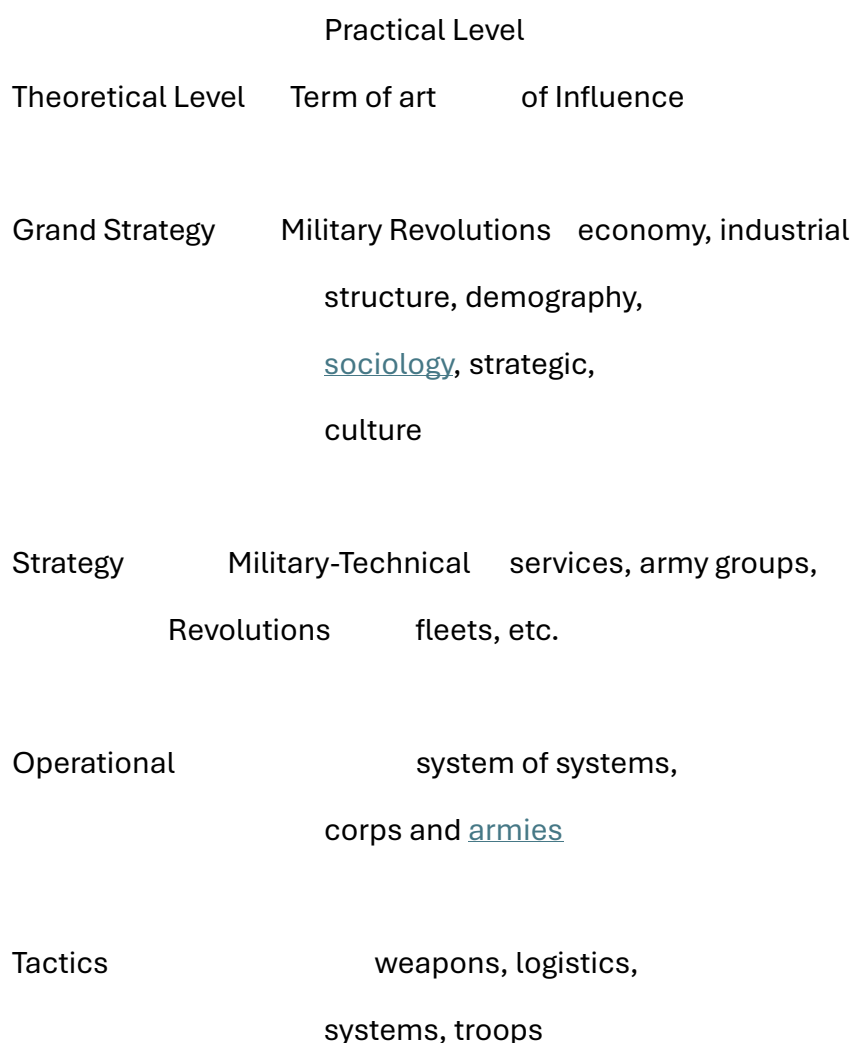Figure 1. Military Revolutions and Military-Technical Revolutions

Theoretical Level	Term of art	Practical Level of Influence
Grand Strategy	Military Revolutions	economy, industrial structure, demography, sociology, strategic, culture
Strategy	Military-Technical Revolutions	services, army groups, fleets, etc.
Operational		system of systems, corps and armies
Tactics		weapons, logistics, systems, troops

Figure 2. Military Revolutions and Revolutions in Military Affairs

Period	Military Revolutions	Revolutions in Military Affairs
17th century		
	Modern state and modern military institutions	Dutch and Swedish tactical reforms, French tactical and organizational reforms, naval revolution, British financial revolution, French reforms (after Seven Years' War)
Late 18th-19th century		
	French Revolution	National political and economic mobilization, Napoleonic warfare
18th-19th century		
	Industrial Revolution	Financial and economic power based on industrialization, technological revolution in land

warfare, revolution

in [naval warfare](#)

Early 20th century

World War I   Combined-arms tactics

and operations,

Blitzkrieg, strategic

bombing, carrier and

submarine warfare,

radar and signals

intelligence

Mid to late

20th century

Nuclear weapons and   Precision

ballistic missiles   reconnaissance and

strike, stealth,

revolution in

[C.sup.3]I, increased

lethality of

conventional munitions

The Secretary of Defense has described transformation as "not a single thing to be trotted out and looked at and inspected. Simply put, transformation is change. It's change in the way we fight, in the way we train, in the way we exercise, but especially, it's change in the way we think and how we approach our jobs." The Director of Force Transformation, Vice Admiral Arthur Cebrowski, USN (Ret.), has established five top goals in this regard:

* make force transformation a pivotal element of national defense strategy and DOD corporate strategy effectively supporting the four strategic pillars of national [military strategy](#)

* change the force and its culture from the bottom up through the use of experimentation, transformational articles (operational prototyping), and the creation and sharing of new knowledge and experiences

* implement network centric warfare as the theory of war for the information age and the organizing principle for national military planning and joint concepts, capabilities, and systems

* get the decision rules and metrics right and cause them to be applied enterprise wide

* discover, create, or cause to be created new military capabilities to broaden the capabilities base and mitigate risk.

Reconnaissance-strike complex and military-technical revolution were two terms originally used in the Soviet Union and by some analysts in the United States (especially within the Office of Net Assessment at the Pentagon) to highlight the consequences of improved and dual-use technologies on the conduct of war.

A revolution in military affairs (RMA) is defined somewhat more broadly, but still relates to the tactical and operational (perhaps even the strategic) levels. Andrew Marshall, Director of Net Assessment, is sometimes called the father of RMA--or at least of the term. He has defined these revolutions as "Fundamental, far-reaching changes in how advanced militaries either plan to conduct, or actually prosecute, military operations." Appearing before the Senate Armed Services Committee in 1995, Marshall elaborated on this concept:

The term revolution is not meant to insist that change will be rapid ... but only that the change will be profound, that the new methods of warfare will be far more powerful than the old. Innovations in technology make a military revolution possible, but the revolution itself takes place only when new concepts of operations develop, and, in many cases, new military organizations are created.

Military revolution is a concept suitable for grand strategy, defined by Williamson Murray and Macgregor Knox as follows:

Military revolutions ... fundamentally change the framework of war.... [They] recast society and the state as well as military organizations. They alter the capacity of states to create and project military power. And their effects are additive.

NOTES

(1) Donald Rumsfeld, "Transforming the Military," Foreign Affairs, vol. 81, no. 3 (May/June 2002), p. 29.

(2) MacGregor Knox and Williamson Murray, "Thinking about Revolutions in Warfare" in The Dynamics of Military Revolution, edited by Knox and Murray (Cambridge: Cambridge University Press, 2001), p. 7.

(3) Bill Owens with Ed Offley, Lifting the Fog of War (New York: Farrar, Straus, Giroux, 2000).

(4) Knox and Murray, Dynamics, p. 5.

(5) Ibid., pp. 178-79.

(6) Alvin and Heidi Toffler introduced the idea of an information age in the 1980s and early 1990s. Probably the Army caught on first that warfare was shifting from industrial to information age warfare. Networks rather than hierarchies would be dominant organizational forms. Whether or not this is an information age, there is clearly a payoff in investments in information technology. This suggests that shooters have greater value than sensors, that networks connecting sensors, shooters, and deciders are crucial, and that [C.sup.4]ISR will be central to transformation.

(7) U.S. Joint Forces Command, Joint Forces Command Glossary, http://www.jfcom.mil/Newslink/about/glossary.htm.

(8) John Warden, "The Enemy as a System," Airpower Journal, vol. 9, no. 1 (Spring 1995), pp. 40-55.

(9) Thomas Hughes, "The Cult of the Quick," Aerospace Power Journal, vol. 15, no. 4 (Winter 2001), pp. 34-45; Antulio J. Echevarria II, Rapid Decisive Operations: An Assumption-Based Critique (Carlisle Barracks, Pa.: Strategic Studies Institute, November 2001); Steven Metz, Armed Conflict in the 21st Century: The Information Revolution and Post-Modern Warfare (Carlisle Barracks, Pa.: Strategic Studies Institute, March 2000).

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