NATIONAL DEFENSE UNIVERSITY

NATIONAL WAR COLLEGE

Revolution and Evolution

Understanding Dynamism in Military Affairs

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A Revolution in Military Affairs is a major change in the nature of warfare *brought about by the innovative application of new technologies which, combined with dramatic changes in military doctrine and operational and organizational concepts, fundamentally alters the character and conduct of military operations.*[1]

Pundits and analysts overuse the term *Revolution in Military Affairs*. This essay seeks to draw distinctions among three fundamentally different types of change in the nature of military affairs. Different dynamics imply different optimal responses to the challenge of change. To the extent that the term *Revolution in Military Affairs* can be systematically disaggregated, a better understanding of its resulting components may be possible. This enhanced comprehension could lead to more efficient allocation of scarce resources—a critical consideration in a period of rapidly expanding scientific and technical knowledge, uncertainty about national security threats, tight fiscal constraints and great enthusiasm in some circles for *information warfare*.[2]

Rapid advances in scientific knowledge and technological capabilities have over the past century injected unprecedented dynamism into development of armaments, creating considerable ferment in military doctrine and organizational concepts as well. Efforts to analyze these phenomena and offer appropriate courses of action to national security planners spawned such terms as *Military-Technical Revolutions* (MTRs) and *Revolutions in Military Affairs* (RMAs). *Revolution* is a heavily loaded word, implying a major upheaval and a dismantling of existing order. Analysts attempting to convince policymakers of the need to redirect resources, change doctrine or alter force structures

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[1] Science Applications International (1996), http://sac.saic.com/rmapaper.htm "The Revolution in Military Affairs," p. 1 The definition is attributed to the Office of the Secretary of Defense.

[2] This term, too, has means different things to different people Some prefer to refer to information-based warfare See pages 8-11.

may be tempted to overuse *revolution,* as *evolution* and *change* do not deliver the same connotative punch to the target audience

The definition which heads the preceding page is noteworthy because it has no time dimension. The "innovative application of new technologies" can be introduced over generations, and the "dramatic changes in military doctrine" apparently can take place simultaneously with or in sequence to the technological change. This definition also carefully sets "innovative applications" off from the dramatic doctrinal changes, giving the impression that the two phenomena might not always be interdependent in a RMA. However, in fact, a RMA does not take place until new technology is integrated into doctrine and organizational concepts.[3] Andrew Krepinevich defines a RMA as:

> What occurs when the application of new technologies into a significant number of military systems with innovative operational concepts and organizational adaptation in a way that fundamentally alters the character and conduct of conflict.[4]

Krepinevich goes on to stress that the impact of this synergistic change generates a substantial—"often an order of magnitude or greater"—increase in the combat potential and military effectiveness of armed forces. In concrete terms, that means that a unit (e.g., ship or infantry regiment) that has benefited from a RMA should be ten times as capable as a similar unit which has not experienced the revolution. In concrete terms, a post-revolutionary ship should be able to defeat ten pre-revolutionary vessels.

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[3] While technology usually forms the basis of a RMA, the desire to have a capability can produce a doctrine which then drives the RMA's technological aspect. For example, LTC Earl Ellis of the USMC described the basic concept of amphibious warfare in 1920/21, years before the technologies needed to implement a doctrine based on those concepts existed. The Marines subsequently developed many of the technologies in order to be able to apply the doctrine (LTC Steven Lynch's presentation to Seminar L of NWC Course 5602) However, such instances of doctrine driving technological development are rarer than those in which a new technology creates the conditions which call for the formulation of new doctrine and organizational concepts.

[4] Andrew F Krepinevich, "Cavalry to Computer: The Pattern of Military Revolutions," in *The National Interest* (Fall 1994), p 30.

Krepinevich suggests a useful standard—the order of magnitude—for judging a candidate for the title of RMA. However, a practical problem quickly arises in most cases one might investigate. Most commonly-accepted historical RMAs[5] took place over decades, if not generations, and consisted not of a single defining moment but rather of iterative and frequently interactive development over a period spanning a technology's introduction to its maturation. One side tended to respond symmetrically to advances it detected on another, either by developing similar capabilities or by building defenses against the offensive threat. While a 35,000 ton dreadnought of 1910 might easily have sunk an entire flotilla of 900 ton frigates from 80 years before, such a lopsided engagement was not likely to take place. By 1910, all the seagoing Great Powers had steam-powered, metal-hulled men-of-war armed with rifled guns capable of firing large, explosive shells long distances.[6] But the dreadnought was not a revolutionary creation. Rather, it was the culmination of a trend that spanned four generations. The revolution of steam and iron took place with respect to initial conditions but not with respect to the status quo at any given moment; it was more evolutionary than revolutionary.

Another problem, which is becoming steadily more acute, is determining how to bracket a period. Analysts generally include the submarine and torpedo in the Naval Revolution that produced the dreadnought. However, a very solid case could be made that two distinct RMAs took place and that the second, involving the submarine and

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[5] (1) The Infantry Revolution, in which Europe re-learned the value of infantry, forgotten in the fall of Rome, (2) the Artillery Revolution, (3) the Revolution of Sail and Shot, (4) the Fortress Revolution, (5) the Gunpowder Revolution, (6) the Napoleonic Revolution, (7) the Land Warfare Revolution, (8) the Naval Revolution, (9) the Mechanical Revolution (airpower and mechanized armor), and (10) the Nuclear Revolution. See also Geoffrey Parker, *The Military Revolution: Military Innovation and the Rise of the West, 1500-1800* (Cambridge Cambridge University Press, 1988), pp. xiv-xvii and 1-3

[6] Krepinevich, *op.cit.,* pp 35-36. Krepinevich writes, *inter alia,* that the "*mature phase* (emphasis added) of this revolutionary period found Britain attempting to sustain its position against a new challenger..."

carrier-based aviation, was far more revolutionary, both in terms of its impact on naval doctrine and the speed with which it took place. Building dreadnoughts did not stop gun duels or convince admirals that battle lines were outmoded. Warships still did pretty much what they had done in Nelson's time; they fired projectiles at one another.[7] These huge gun platforms essentially symbolized naval establishments' desires to do what they had always done, but with more speed and firepower.

What fundamentally changed naval doctrine was the introduction first of large numbers of submarines (1915-1918), and then development of carrier-based aviation (1930s). Submarines could deny an adversary control of the sea even if one's own ships were denied it – a major change in the nature of maritime war. The submarine-launched torpedo could sink the biggest and most expensive battleship[8] if it was not well protected by escorts and could send to the bottom more merchant ships than most countries could build. Carrier-based aviation could project the fleet's power a much greater (close to an order of magnitude) distance than was possible with even the most powerful guns. To combat submarines, navies had to build many more destroyers and use them to convoy merchantmen, in addition to protecting capital ships—a significant change in tactics and doctrine that also required new organizations. The rise of carrier-based aviation on one side forced the other to take symmetrical action (build carriers) or risk having his navy annihilated by warplanes whose base (a carrier) his battleships'

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[7] Battle zones did become larger as guns' range and accuracy improved, and the ships themselves were much better armored and faster than were 19th century wooden-hulled men-of-war, but the changes in doctrine and tactics were fundamentally evolutionary rather than revolutionary

[8] Battleships were hugely expensive and intended primarily to sink other battleships, so that cruisers and destroyers could hunt down smaller warships and merchantmen without fear of 16-inch guns But the battleship was vulnerable to the far less expensive submarine, and submariners' success against capital ships called into question long-established cost/benefit calculations that supported building big ships.

guns could not reach. Today, the commander of a U.S. carrier battle group is usually someone who was originally trained as an aircraft pilot, and ballistic missile submarines can devastate targets thousands of miles away and far inland. In short, the submarine and the airplane in under three generations more fundamentally changed character and conduct of war, especially naval war, than did the 80-year evolution of the battleship.

Nevertheless, it must be recognized that advances in naval architecture flowing from the battleship race made the aircraft carrier possible and that many technological developments of the 19th century underlay the creation of the seagoing submarine. In an important sense, each RMA builds on those which preceded it, and none—even the most profound—is entirely independent of the broad lines of military history.

No RMA in history was more profound and none ever happened so rapidly as the Nuclear Revolution. Its impact was not limited to an explosion almost four orders of magnitude greater than anything the world had ever seen. The Bomb changed not just the character and conduct of war but also affected its nature by substantially altering the degree of risk a state faced when warring with a nuclear power. Much effort had to go into avoiding an escalation of conflict to levels where nuclear weapons might be employed. The indirect method became critical to pursuing national interests, as the principal nuclear antagonists (U.S. and U.S.S.R.) engaged in a Cold War designed to wear each another down and to lure each other into costly military adventures without risking all-out (nuclear) war. The Clausewitzian approach of mass on mass remained intact on one level (geostrategic theory) in the concepts of deterrence and Mutual Assured Destruction. But, the two superpowers had to turn to Sun Tzu for guidance on how to advance their respective national interests without being utterly annihilated in

the process.[9] Their respective allies had to think in similar terms, a major departure from the direct approach that had until then prevailed in Western strategic thinking.

Those skilled in war subdue the enemy's army without battle. They capture his cities without assaulting them and overthrow his state without protracted operations.[10]

The collapse of the Soviet Union ended the Cold War, but it did not end threats to U.S. national security. Conventional wars fought within the context of the Cold War were often costly but seldom quickly decisive except where one of the superpowers was operating within its acknowledged sphere of influence. The Gulf War, fought with the U.S.S.R.'s successor state (Russia) not opposing the Coalition against Iraq, was quick and decisive. It demonstrated the importance of hitting centers of gravity early and hard and of employing overwhelming power through joint force operations to break the enemy's will. At the center of Coalition (principally U.S.) strategy were emerging precision strike weapons, greatly improved C3 capabilities and new technologies for gathering and disseminating information. Numerous analysts conclude that the world has entered another RMA, this one focused on information warfare and precision-strike capabilities.[11] Have we, and, if so, what are the likely implications?

From the foregoing, I have identified three basic types of RMAs. Type One, of which the Nuclear Revolution is the only example to date, is both rapid and broadly

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[9] Sun Tzu, *The Art of War*, trans. Samuel B. Griffith (Oxford Oxford University Press, 1963), pp 66-69

[10] *Ibid.*, p. 79.

[11] Steven Metz and James Kievit, "Strategy and the Revolution in Military Affairs. From Theory to Policy" at http //carlisle-www army.mil/usassi/ssipubs/pubs95/mastrat/smrmass htm, and Robert E. Neilson, ed , *Sun Tzu and Information Warfare* (Washington· NDU Press, 1997), and Krepinevich, *op.cit.*, pp 40-42 , and Michael J. Mazarr, "The Revolution in Military Affairs A Framework for Defense Planning" (Carlisle, PA Strategic Studies Institute, 1994), pp 2-6, and many others.

encompassing, and it potentially affects the very nature of war. If introduced by a non status quo power, it is very likely to alter geostrategic balance. Type Two, of which the submarine/carrier Naval Revolution and Napoléon's early 19th century revolution in organization and logistics are examples, is marked by relatively rapid change which, if introduced by a non status quo power, is likely to alter geostrategic balance at least for a time. A Type Two RMA will affect the conduct and probably the character of war but will not affect its nature. The steam and iron Naval Revolution is an example of a Type Three RMA. Here, the "revolution" is more the result of rapid technological evolution and maturation than innovative breakthroughs in technology (*e.g.*, the atomic bomb) or novel concepts in doctrine and organization (*e.g.*, Napoléon). Status quo powers are most likely to be able to exploit Type Three RMAs initially because they tend to be the sources of the underlying technology. However, non status quo powers with forward-looking leaders and sufficient technological capability could employ them effectively as well, provided they have the resources. Except in rare circumstances, a Type Three RMA will not likely alter geostrategic balance, as the status quo powers will normally have access to the pertinent, usually mature or maturing technology and any related organizational and doctrinal concepts, even if they are slow to exploit them.

The most fundamental strategic challenge to the U.S. military is to convert the Military Technological Revolution into a Revolution in Military Affairs.[12]

Without doubt, the world is at least on the verge of a RMA linked to information-management technologies. The potential exists for a Type Two RMA that could benefit

[12] Martin Libicki, CDR James Hazlett, et.al., at http //198 80 36 91/ndu/inss/strforum/z1106 html. "The Revolution in Military Affairs," p. 1

U.S. national security—if innovation is rapid enough and appropriate steps are taken to prevent hostile powers from exploiting significant U.S. vulnerabilities. A Type One RMA does not seem plausible, given widespread dissemination of information-management technology and the maturing of these technologies. A new order-of-magnitude breakthrough in information technology, with obvious and significant military applicability, would be the prerequisite for a Type One RMA.[13] But a Type Three RMA (incremental changes spread reasonably symmetrically throughout the world) cannot be ruled out.

Ironically, the overwhelming U.S. lead in information technologies discourages the kind of risk-taking needed to expand that lead. Policymakers' recognize that a steady flow of resources into information technology will, for now, maintain the U.S. lead, and they fear that direction of resources to visionary or speculative projects might produce no useful result and consequently considerable political embarrassment.[14] Another small sign that a Type Three RMA may be before us is the relative computer poverty of the National War College. If information technology is to be exploited fully within the Armed Forces, the future top leadership of the Services should be integrating computer technology into their work environment more fully and more creatively than is possible given present resources. However, the American entrepreneurial system offers hope for a RMA more profound, rapid and far-reaching than a Type Three would offer.

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[13] One possible area for such a breakthrough might be virtual reality, but the known laws of physics and slow development of robotics technologies cast doubts. The 1977 short story, "Ender's Game," later published in novel form as *Ender's War* (Orson Scott Card, New York. T. Doherty Assoc., 1985) tells the story of a young tactical genius who, thinking he is playing a training simulation, is actually guiding the human fleet against its interstellar enemy through use of a communications device (ansible) which transcends light speed In achieving what he thinks is an imaginary victory, young Andrew ("Ender") Wiggin goes beyond the rules of civilized conflict and gives new meaning to the term "total war "

[14] "Bureaucrats everywhere judge themselves by their efforts to gain prestige or power for their institutions Unless changes could conceivably bring further advantage to their own bureaus, bureaucrats will endeavor to work for the status quo." Karel van Wolferen in *Foreign Affairs* (Sept/Oct 1993), p 57.

Even if the military is bureaucratically inclined to avoid risk and protect existing institutions, the private sector will continue to develop cutting-edge technologies for non-military use. Synergies between non-military and military information technology applications are apparent,[15] and feedback through companies' research and development operations provide myriad opportunities for conceptualization and innovation outside of the "box" of current acquisition and development requirements

The moment that defines a RMA is when planners go beyond using a new technology to accomplish longstanding tasks more effectively (*e.g.*, using tanks to break holes in infantry lines) and start applying the new technology in entirely new ways (*e.g.*, using tanks to spearhead offensives and then attack the enemy's rear areas to create circumstances favorable to a battle of encirclement). We are more conscious today than ever before of the importance of RMAs. A Type One or Type Two RMA generated by another power could upset the military status quo, with profound implications for U.S. national security. An open and vigorous debate on how best to proceed in the development and deployment of military information technologies remains critical to finding the optimal mix of innovation and cost-effectiveness.[16] Openness to new ideas will always be essential, but we must not allow vision to outpace understanding. The world of military affairs is, ultimately, a supremely practical one with potentially terrible consequences for those who make mistakes.

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[15] The software for many military information technology systems is often taken "off the shelf," with only the systems integration component unique to the military user

[16] Mazarr, *op.cit.*, offers many thoughts on this subject, including specific recommendations on rethinking organizations and conducting missions reviews. Theodor Galdi examines individual planning and doctrine documents in "Revolution in Military Affairs? Competing Concepts, Organizational Responses, Outstanding Issues (Washington: Congressional Research Service, 1995, Publication 95-1170 F)

Theodor Galdi[17] proposes an Office of the Devil's Advocate for RMA Issues for just that purpose—"to serve as a counterbalance to the wishes of service leaders and assessments by advocates." While Galdi's idea has merit, such an office would also have to be able to advocate well-founded new ideas and concepts. Giving it Galdi's restricted role likely would only deepen bureaucratic conservatism at a time when the order of the day should be critical openness.[18]

As visionaries and planners look for ways to bring the U.S. military more rapidly into the Information Age, attention must be paid to potential U.S. vulnerabilities. As the premier user of information technologies and the state most dependent upon them, the U.S. is uniquely vulnerable to attacks by other states and by non-state actors, working on their own or with the support of antagonistic but not overtly hostile states.[19] U.S. financial centers and, by extension, the economy, could suffer particularly acute and systemic damage from a well-formulated, well-executed attack on computer systems. Moreover, information warfare will not work against an enemy who is not dependent upon information technology. An analogy to attempts during the Korean War to cut Chinese supply lines with strategic bombing, even though much of the materiel was being carried on soldiers' backs, is instructive. Wiping out an enemy's Internet communications will not matter much if the enemy is accustomed to using hard-copy mail or other communications systems not dependent upon computers that the U.S.

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[17] *Ibid.,* p 27

[18] By *critical openness,* I mean being open to but not bedazzled by new ideas—a willingness to test novel concepts rigorously but without prejudice

[19] Matthew G. Devost, et.al., "Information Terrorism: Can You Trust Your Toaster," in Robert E Neilson, ed , op cit , pp 63-67, posits a Serbian irredentist group's use of computer sabotage to cause American military aircraft to crash and to bring down U.S. computer systems, prompting a U.S. withdrawal from peacekeeping in Bosnia

might be able to disrupt. A similar caution is in order with respect to precision strike technologies. These weapons tend to be very expensive, so an enemy who could break down important targets into relatively cheap smaller targets with significant operational redundancy might be able to force the U.S. to expend huge resources for minor gains.

Finally, we do not know what information war ultimately will look like. Some argue that the battlefield of the mature Information Age will be "a joint killing field, virtually impenetrable to the other except at very high cost," thus suggesting wars of stalemate similar to World War One.[20] Such an outcome could be consistent with a Type Two or a Type Three RMA. Others, much more visionary, have gone so far as to paint a portrait of war conducted by attacking the enemy's information systems and, by implication, his economy, thereby sapping his will to fight without firing a shot (or at least not many shots). Sun Tzu[21] would have approved. This concept is, of course, the premise of Devost and his co-authors (Note 19). If brought to fruition it could be a Type One RMA, since it would imply a major change in the nature of war away from significant physical violence and toward destruction of intangible assets, such as databases and software.

Again, there needs to be an understanding that the U.S. is, at present, much more vulnerable to attacks of this nature than are most potential enemies. Moreover, history offers us no particular reason to believe that a state—even a computer systems-dependent U.S.—would respond to a concerted attack against its economy by suing for peace. Far more likely would be retaliation against the enemy by use of traditional means of violence. It is noteworthy that Devost's scenario involved an area (Bosnia)

not of vital interest to the U.S. However, no matter how unlikely we consider such a Type One RMA, the potential implications for the U.S. are awesome, so assignment of appropriate resources to remaining abreast of developments and possible challenges in this area would be money well spent. As the world's premier status quo power, the U.S. cannot afford to let another state (or non-state actor) steal the march.

[20] Martin Libicki, "Silicon and Security in the Twenty-First Century," quoted in Mazarr, *op.cit.,* p.42.
[21] "To subdue the enemy without fighting is the acme of skill." Sun Tzu, *op.cit.,* p. 77