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**INNOVATION AND EXCELLENCE IN C4I—CANADA'S KEYS TO THE
REVOLUTION IN MILITARY AFFAIRS**

By/Par Cdr S.W. Yankowich

Abstract

Advances in technology combined with global social, economic and political transformation are engendering a contemporary Revolution in Military Affairs (RMA) that is profoundly affecting the way in which war is conducted. With its genesis defined by the organizational structures and operational concepts applied during the Gulf War, and further refined during the Kosovo and current Afghanistan campaigns, the new RMA is characterized by information dominance and the speed with which a commander is able to observe, assess and respond to a complex and rapidly changing situation. While history suggests that the final impact of this military revolution has yet to be determined, given the current observable character and the known social, economic and political trends influencing the direction of the RMA, the Canadian Force's strategy for exploiting its potential should be based on proficiency in two core competencies: the ability to innovate in response to constant transformational change; and excellence in Command, Control, Communications, Computer and Intelligence (C4I) capability.

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Part One—Introduction

Over the past decade, few issues have evoked such passionate discourse as the putative Revolution in Military Affairs (RMA). Proponents of the RMA argue that continuing rapid advances in precision weapons, communications, surveillance and information systems technologies are profoundly affecting the conduct and effectiveness of military operations. Many of these proponents suggest that technology, when combined with new operational and organizational concepts, will ultimately eliminate friction in war by providing commanders with the capability to conduct simultaneous, high intensity and non-linear operations anywhere within a large battlespace area. Admiral William A. Owens—former vice-chairman of the U.S. Joint Chiefs of Staff— elucidates this utopian vision:

> The technology that is available to the U.S. military today and now in development can revolutionize the way we conduct military operations. That technology can give us the ability to see a battlefield as large as Iraq or Korea—an area 200 miles on a side—with unprecedented fidelity, comprehension, and timeliness; by night or by day, in any kind of weather, all the time.[1]

The dramatic and one-sided victories obtained by U.S. led coalition forces in the 1991 Gulf War and the 1998 Kosovo War reinforce Owen's vision; furthering an "American technological mania," which sees manifestation of the RMA being predicated on the acquisition of advanced weapons systems and platforms.[2] Critics of this view, however, contend that while technology is transforming the modern battlefield, this transformation represents nothing more than an evolutionary progression of military

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[1] Admiral William A. Owens and Ed Offley, <u>Lifting the Fog of War</u>, (New York: John's Hopkins University Press, 2000) p. 4.

[2] Patrick Morgan, "The Impact of the Revolution in Military Affairs," <u>Journal of Strategic Studies</u>, Vol 23 (March 2000), p. 134. pp. 132-162.

capability. They argue that the RMA "is a dangerous fallacy that does not pay heed to historical verities" and is unduly focused on technology.[3] While both arguments have merit, they reflect too narrow an interpretation of the nature and consequences of a true military revolution.

A Revolution in Military Affairs is a vastly complex social, economic and political occurrence. It combines technological innovation with fundamental changes to operational and organizational concepts to create order of magnitude gains in the military effectiveness of armed forces.[4] While military organizations are constantly changing the methods, equipment and organizational structures with which they conduct the business of war, it is the scope of the impact of the combined effect of these changes—as opposed to the speed at which they take place—that distinguishes an RMA from normal evolutionary progression of military capability. Hence, an RMA involves more than incremental change: "it represents a moment of transformation,"[5] that fundamentally alters both the nature and the face of war.[6]

There have been as many as ten Revolutions in Military Affairs in the past 600 years. [7] Some occurred relatively abruptly, while others were more evolutionary in nature, requiring several decades to take hold. Most were the consequence of a combination of several interrelated factors and resulted in the development of new

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[3] Sean Maloney and Scot Robertson, "The Revolution in Military Affairs: Possible Implications for Canada," International Journal, Vol 54 (1999), pp. 443-462, p. 445.
[4] Michael J. Vickers, "The Revolution in Military Affairs and Military Capabilities," War in the Information Age, ed. Robert Pfaltzgraff and Richard Shultz, (Washington DC: Brassey's Publishing, 1997), p. 30.
[5] Lawrence Freedman, The Revolution in Strategic Affairs, (London: International Institute for Strategic Studies, Adelphi Paper 318, 1998), p. 7.
[6] Maloney, p. 446.
[7] Andrew Krepinevich, "Cavalry to Computer: The Pattern of Military Revolutions," The National Interest, Vol 37 (Fall 1994), pp. 20-42, p. 31.

strategic approaches to the use of force.[8] Thus, military revolutions are the implication

rather than the driver of profound change in military effectiveness. For this reason,

recognizing the existence, let alone the character of an RMA, prior to its full impact

becoming apparent, is a difficult task.[9]

Led by the United States, there is an emerging consensus that a new RMA is

currently underway. Contrary to popular opinion, however, its driving force is not

technology. While integration of rapidly advancing technologies is a key enabler of the

new RMA, its real impetus is the profound political, social and economic transformations

that have significantly altered the global security environment since the end of the Cold

War. The fundamental dilemma that is now confronting all western militaries, including

the Canadian Forces, is how to best realize the benefits of the RMA as part of an overall

national security strategy within an ambiguous and uncertain world order. This decision

is not straightforward. Despite the substantial increase in military effectiveness that is

portended by the current RMA, its relevance to the broad spectrum of potential conflict

types has yet to be established. Further, the context within which this RMA is occurring

as well as its broader implications for the nature and conduct of future warfare is far from

clear. "Despite the acceptance of the reality of the RMA," Steven Blank writes, "there is

still a great deal of uncertainty concerning its nature, extent, implications and utility for

all kinds of armed conflict."[10] Nevertheless, from a Canadian perspective, uncertainty

must not be used as an excuse for inaction. Former Vice Chief of the Defence Staff,

Vice-Admiral Gary Garnett writes,

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[8] Maloney, p. 446. Maloney identifies eight key factors that historically have been the impetus for an RMA: technological, organizational, cultural, ideological, social and financial.
[9] Captain James H. Patton, "The New 'RMA,' It's Only Just Begun," Naval War College Review, Spring 1996, Vol. 49, p. 25.

> We have at hand tremendous opportunities for a mid-sized power like
> Canada with finite personnel and material resources. Innovation will take
> place regardless of contrary views or limited budgets. The challenge that
> we face is to choose wisely and exploit affordable and effective
> technological, doctrinal and organizational change.[11]

Moreover, as noted in *Canadian Defence Beyond 2010*, the operational and strategic consequences of not actively embracing the new RMA are likely to be severe:

> If [Canada] does not move towards the future in a pro-active way,
> DND/CF may lose its relevance in terms of its combat capability, and by
> extension, its ability to support [Canadian] interests abroad.[12]

The Canadian Forces cannot afford to ignore the existence of the RMA nor its implication to the conduct of warfare. Yet, given the considerable ambiguity surrounding the identity and nature of future threats to Canadian interests, determination of an appropriate exploitation strategy is a challenging task. Nonetheless, by analyzing the character of the current RMA in the context of lessons learned from previous military revolutions, it is possible to predict how global political, social and economic forces will shape its direction and eventual form. The key to this process is to understand the capabilities, limitations and opportunities afforded by the current RMA, and to identify how potential adversaries might exploit these characteristics to undermine Canadian national interests.

Canada's response to the Revolution in Military Affairs has been criticized for being characterized by "uncertainty and delay."[13] While strategic policy documents like *Shaping the Future of the Canadian Forces: a Strategy for 2020* and *Canadian Defence*

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[10] Stephen Blank, "Preparing for the Next War: Reflections on the Revolution in Military Affairs," <u>Strategic Review</u>, Spring 1996, pp.17-25, p.17.
[11] Vice-Admiral Gary Garnett, "The Canadian Forces and the Revolution in Military Affairs: a Time for Change," <u>Canadian Military Journal</u>, Vol 2 (Spring 2001), pp. 5-10, p. 5.
[12] Canada, Department of National Defence, Director General Strategic Planning and Chief of Research and Development, "Canadian Defence Beyond 2010," (Ottawa: DND, May 1999), p. 41.

Beyond 2010 acknowledge both the existence and importance of the RMA to the strategic interests of the Canadian Forces, their recommendations are "vague on specifics"[14] and fail to articulate a clear, well defined way ahead.[15] *Strategy 2020*, for example, identifies eight change objectives for the CF. It does not, however, delineate how these change objectives should be prioritized and realized within a broader RMA exploitation strategy. The result is an unfocused approach to dealing with the profound changes proffered by the RMA that dilutes scarce resources available to the CF and risks marginalization of military capability in areas of key RMA competencies.

The aim of this paper is to demonstrate that a Canadian strategy for exploiting the RMA must be centered on the development of two core capabilities. First, the Canadian Forces must have flexible and robust Command, Control, Computers, Communications and Intelligence (C4I) systems that are fully interoperable with those of allied coalition forces, regardless of their position on the RMA capability spectrum. Second, the Canadian Forces must establish flexible command and control structures underpinned by a cultural ethos that encourages continuous innovation and exploration, while accepting the concomitant risk of occasional failure.

To achieve this objective, the paper is divided into seven parts. Part One provides an overview of the RMA and introduces the thesis of the paper. Part Two presents the historical context of the current RMA through a discussion of several lessons learned from previous military revolutions. The global political, social and economic environment that is shaping the direction of the RMA is analyzed in Part Three and the

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[13] Andrew Richter, "The American Revolution? The Response of Advanced Western States to the Revolution in Military Affairs," <u>National Security Studies Quarterly</u>, Vol 5 (Autumn 1999), pp. 1-28, p. 10.
[14] Maloney, p. 12.
[15] Maloney, p. 12.

defining character of the RMA is identified in Part Four. Part Five synthesizes the

information from the three previous sections to predict the longer-term operational and

strategic implications of the RMA. These implications are applied in Part Six as a basis

for establishing the core components of a Canadian RMA strategy. Concluding remarks

are provided in Part Seven.

Part Two—Lessons from Previous Revolutions in Military Affairs

"What has been will be again, what has been done will be done again; there is nothing new under the sun."[16] Ecclesiastes' simple observation about the world in general is relevant to the understanding of the nature and character of the current RMA. Analysis of Krepinevich's ten RMAs reveals that fundamental change in the conduct and effectiveness of military operations is neither a new nor isolated occurrence. The impetus for this change, however, as well as its broader military, social and political implications does provide salient lessons with direct applicability to the contemporary RMA.

First, military revolutions have at least four constituent elements: technological change, systems development, operational innovation and organizational adaptation.[17] Each of these elements is a necessary, but not a sufficient condition to drive the radical changes in military effectiveness that characterize an RMA. The Mechanization RMA manifested in German *Blitzkrieg* warfare, for example, was not spawned by the development of the tank—tanks had been in existence since World War I. Nor was its success attributable to superior German tank numbers and quality—the Germans had fewer and in some respects inferior tanks in 1940 than the British and French. It was the development of a new military organization and command system which when combined with the application of innovative operational concepts and superior training, resulted in a fundamentally new way of waging war.[18]

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[16] Ecclesiastes 1:9, Revised Standard Version (RSV)
[17] Krepinevich, p. 30. The ten RMAs cited include: *Infantry Revolution (14th century), Artillery Revolution (15th centurty), Revolution of Sail and Shot (16th century), Fortress Revolution (16th century), Napoleonic Revolution (early 19th century), Land Warfare Revolution (mid 19th century), Naval Revolution (19th century), Interwar Revolutions in Mechanization, Aviation and Information (1917-40), Nuclear Revolution.*
[18] Eliot Cohen, "A Revolution in Warfare," Foreign Affairs, Vol 75 (March/April 1996), pp. 37-54, p. 46.

Military revolutions need not take place quickly. The significance of RMAs is in their impact on the conduct of military operations, not in the rate in which they take hold.[19] Three-dimensional manoeuvre-based warfare employing the coordinated use of combined-arms, amphibious and naval operations was introduced in the later stages of World War I.[20] It was not until World War II, however, that these operational concepts were sufficiently evolved within appropriate organizational frameworks to manifest realization of the Mechanization (Blitzkrieg), Aviation (strategic bombing, carrier warfare) and Information (radar, radio, signals intelligence) RMAs.[21]

The competitive advantage in military effectiveness facilitated by embracing an RMA is usually short-lived.[22] Having witnessed or experienced first-hand the powerful effects of a military revolution, other nations are generally quick to adapt to the new order. Often the technologies, operational and organizational concepts that enabled the RMA are copied and further innovated; thereby offsetting or even surpassing the originating nation's initial military advantage. Japan and Germany's respective development of the carrier-based aviation and mechanized blitzkrieg RMAs are good examples of this phenomenon. Both nations secured a considerable initial military advantage through their application of these novel methods of conducting war. After the initial setbacks, however, allied nations were able to apply similar technologies and

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[19] Patrick Morgan, "The Impact of the Revolution in Military Affairs," Journal of Strategic Studies, Vol 23 (March 2000), pp. 132-162, p. 135.
[20] Jonathan B. A. Bailey, "The First World War and the Birth of Modern Warfare," The Dynamics of Military Revolution, ed. MacGregor Knox and Williamson Murray, (New York: Cambridge University Press, 2001), p. 132. Bailey argues convincingly that that World War I was the genesis for modern three-dimensional concept of military submarine, land and carrier-based aviation, strategic bombing, information, amphibious, and coordinated combined-arms operations.
[21] The Mechanization, Aviation and Information RMAs all occurred more or less simultaneously during World War II. While these three revolutions may be considered as one RMA, Krepinevich, distinguishes each as meeting the criteria for a separate military revolution.
[22] Krepinevich, p. 37.

concepts to first offset, and then exceed the military advantage originally facilitated by these RMAs. This diffusion of military advantage caused by responsive adaptation need not occur during periods of war. The French development of the ironclad steam-driven warship (Naval RMA), for example, initiated a rapid and decisive British response that quickly obviated the French Navy's initial technical and operational superiority, sparking a naval arms race that eventually culminated in the British construction of *HMS Dreadought*.

While technological innovation is a key driver of military revolutions, the core facilitating technologies often originate in the commercial sector. The Artillery Revolution, for example, "was fueled by the discovery that the method being used to cast church bells could also be used for casting artillery."[23] Similarly, commercially driven developments in rail and telegraph were instrumental in enabling radical improvements in the capacity and speed with which mass armies could be commanded, moved and sustained in the field; capabilities which were manifested in the Franco-Prussian and American Civil Wars as the Land Warfare Revolution.

Another applicable lesson from history is that most successful RMA innovators "have always thought in terms of fighting wars against *actual* rather than *hypothetical* opponents, with *actual* capabilities, in pursuit of *actual* strategic and political objectives."[24] In other words, the ability to discern specific tactical and operational challenges against a known enemy in a known theater of war is fundamental to realizing the benefits of an RMA. The World War II German and Japanese innovations in

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[23] Krepinevich, p. 39.
[24] MacGregor Knox and Williamson Murray, "The Future Behind Us," The Dynamics of Military Revolution, ed. MacGregor Knox and Williamson Murray, (New York: Cambridge University Press, 2001), p. 192 (original emphasis).

mechanized and carrier-based warfare and the more recent United States and Soviet

Union development of nuclear warfare provide excellent confirming examples of this

causal relationship. In all of these examples, the respective nation was successful in

identifying and developing the military capabilities necessary to support attainment of a

specific strategic objective. In the case of Germany and Japan, this intense focus of effort

resulted in an initial significant military advantage over numerically superior and

economically more powerful adversaries. Both nations ultimately lost the war, however,

not because of poor application at the tactical and operational-level of the emerging

RMAs, but because their strategic objectives were flawed. Neither nation had the logistic

nor intelligence capabilities required for sustained campaigns against adversaries as large

and powerful as the United States and the Soviet Union. [25]

The final and most important lesson from history, however, is the significant

impact that contemporaneous social, economic and political transformations have on the

form and consequences of a military revolution. The Napoleonic RMA is the best case in

point of this complex relationship. In a strictly military context, the Napoleonic RMA

effectively synthesized technology (primarily artillery) with new military systems and

organizations, such as the staff officer system, to create "a dramatic leap in military

effectiveness over the military formations that existed only a short time before."[26] Of

themselves, these actions were sufficient to constitute an RMA. Yet, combined with the

social, political and economic transformations stemming from the French, Agricultural

and Industrial Revolutions, the tactical, operational and strategic consequences were far

more far-reaching. Revolutionary politics centered on protection and exportation of

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[25] Murray and Knox, p. 181.
[26] Krepinevich, p. 34.

secular ideology led to the creation of the "levée en mass" which, when combined with

the effects of the Agricultural Revolution, led to a quantum leap in the size of sustainable

field armies. Concurrent, powerful social change inspired tremendous national patriotism

that translated onto the battlefield as a willingness to endure considerable privations and a

commitment to press the attack "almost regardless of the cost in men."[27] Advances in

manufacturing technologies originating from the Industrial Revolution substantially

increased the effectiveness, affordability and availability of decisive weapon systems

such as artillery. These three revolutions coalesced to give rise to an unprecedented

upheaval in the form and conduct of military operations. As Jeffrey Cooper observes, the

consequences of the Napoleonic RMA remain relevant well into the twentieth century:

> This 150-year period marked an era or 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. 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.[28]

While a few of Krepinevich's RMAs, such as the Land Warfare and Nuclear

RMAs, originated in environments of massive social, economic or political change, only

the Napoleonic RMA combined all three. It is distinguished from the others in that its

impact on the manner in which militaries prepared for and conducted war was

"unpredictable and to a great extent *uncontrollable*."[29] This observation suggests that in

the presence of radical social, economic and political transformation, it may be difficult,

if not impossible, for military organizations to either predict or determine their own

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[27] Krepinevich, p. 34.
[28] Jeffrey R. Cooper, "Another View of the Revolution in Military Affairs," <u>Conference Proceedings of the Fifth Annual Conference on Strategy</u>, (U.S. Army War College: Strategic Studies Institute, 1994), p. 112. Accessed at http://www.rand.org/publications/MR/MR880/MR880.ch5.pdf, December 1.
[29] Murray and Knox, p. 176. (original emphasis)

destinies. Nevertheless, if the nature of such change can be reasonably discerned, then the uncertainty surrounding the impact on military affairs can be considerably lessened. Understanding the global, political, social and economic context affecting a military revolution, therefore, is essential to predicting what direction and form that revolution will take.

Part Three—Global Political, Social and Economic Context

Similar to the Napoleonic RMA, today's military revolution is being determined by a complex synthesis of concurrent technical, social, political and economic transformation. The relative stability of the Cold War bipolar global security paradigm has given way to a far more volatile geo-political environment characterized by "ethnic conflict, attempts at hegemony by regional states, and the actions of sub-state actors such as terrorists, separatists, and international criminal organizations."[30] In many parts of the world the Clauswitzian trinitarian concept of warfare—based on the primacy of the state and the symbiotic relationship between its government, military and population—is being supplanted by a new model in which the role of the state is becoming increasingly marginalized.[31] States that no longer embody the "essential authority of a country" are susceptible to "crises of legitimacy" leading to external conflict or internal fragmentation along ethnic, nationalistic and cultural lines.[32] Conflicts of this nature, as evidenced in the Balkans and Afghanistan, often transcend traditional geographic borders and conform to a "low-intensity" model of warfare.[33]

While the political and social landscape transitions from the relative Cold War stability to post Cold War volatility, economic globalization is continuing to change the manner in which the world generates and distributes wealth. The largely unrestricted flow of goods, services, people and information is fuelling unprecedented global

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[30] Robert Pfaltzgraff and Richard Shultz, introduction, War in the Information Age, ed. Robert Pfaltzgraff and Richard Shultz, (Washington DC: Brassey's Publishing, 1997), p. 3.
[31] Martin Van Creveld, The Transformation of War, (New York: The Free Press, 1991), p. 60.
[32] Phillipe Delmas, The Rosy Future of War, (New York: The Free Press, 1997), p. 137.
[33] Van Creveld, p. 20. Van Creveld describes low-intensity warfare as being characterized by regular military forces on one side fighting irregular forces comprised of guerillas, terrorists and civilians, including women and children, on the other. High technology weapon systems such as tanks, missiles aircraft frequently do not play a vital role as set piece conventional battles are normally avoided.

economic growth and prosperity. But similar to the economic growth experienced during

the 18th and 19th century colonial era, its benefits are not being conferred equally on all

regions and states, creating greater global economic disparity and instability. The

Information Revolution is exacerbating this trend. Fueled by capabilities enabled by

rapidly advancing computer, communications and network systems technologies,

advanced industrialized states are fundamentally transforming their economic and

political decision making structures to a more complex, information-centric model.[34]

States lacking the technological sophistication and economic resources to adopt similar

structural changes are increasingly unable to compete effectively in the global

marketplace. The result is a growing stratification between the world's wealthy,

information-based economies, and the poorer, less sophisticated societies with the low-

cost labour and cheap natural resources on which the affluence of the former depends.

The economic disparity caused by this stratification is a source of chronic regional

conflict and large-scale human migration from poorer to wealthier regions.[35] The most

recent Canadian navy policy document, *Leadmark, the Navy's Stategy for 2020*,

succinctly articulates this expanding threat:

> Resource shortages and environmental deterioration in the populous
> regions of the globe are potential long-term trends that may also
> exacerbate the gap between the have and have not nations, and thus see
> Western interests and citizens threatened by peoples desperate for
> survival.[36]

In this dynamic political, social and economic environment, the perception by a

state, sub-state or trans-state actor that its vital interests are being threatened is the

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[34] Peter Haydon, <u>Sea Power and Maritime Strategy in the 21st Century: a 'Medium' Power Perspective,</u> (Halifax: Centre for Foreign Policy Studies Dalhousie University, 2000), p. 98.
[35] Remarks by Honorable Lee H. Hamilton, "New World Coming," accessed at <u>http://wwics.si.edu/NEWS/speeches/leeclosup.htm</u>, Mar 10, 2002.

catalyst for going to war. How these organizations choose to conduct war, however, is largely determined by their level of economic and social development.[37] According to Toffler's model of modern civilizations, for example, "First Wave" agrarian societies similar to Afghanistan and Vietnam, that lack the complex social and economic structures required to field modern military forces, generally engage in a decidedly low-tech, low-intensity approach to warfare; often relying on a strategy based on mobile guerilla, terrorist or other asymmetric tactics. As demonstrated by the U.S. experience in Vietnam and the Soviet experience in Afghanistan, such tactics can be highly successful; particularly if the military forces are well motivated, well led and sufficiently patient. Conversely, Toffler's "Second Wave" industrial societies, such as Iraq, Pakistan and India, generally adopt the World War I paradigm of warfare based on the principle of massed forces of men and equipment being employed in a series of large, decisive and highly attritional battles. Despite the considerable size of Second Wave armed forces, the quality of the vast proportion of the equipment, personnel and leadership is often quite marginal. Nevertheless, such societies pose a considerable military threat to both regional and global security; especially, as Pakistan and India have proven, if they use their industrial capacity to develop Weapons of Mass Destruction. Politically, economically and militarily, "Third Wave" post-industrial, knowledge-based societies, like the United States and Western Europe, are the most sophisticated of Toffler's civilizations. With a strong diversified economic base and well-established political and social structures, Third Wave societies are capable of fielding large and powerful military forces that are orders of magnitude more effective than those of their agrarian and

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[36] Canada, Department of National Defence, Leadmark, the Navy's Stategy for 2020, (Ottawa: DND, 2001), p. 78.

industrialized counterparts. Yet, the application of these forces can be constrained by the same political, economic and social systems that facilitate their existence. The concepts of proportionality of force and limited war for limited objectives, for example, can render Third Wave forces, despite their military superiority, vulnerable to adversaries who are not likewise constrained. Maintaining superior military effectiveness within an acceptable political, economic and social framework is one of the primary challenges confronting all Third Wave military forces, thus providing the context for an effective RMA exploitation strategy.

In this trisected global security environment, future wars may be waged in all three of Toffler's waves of civilization, and across the broad spectrum of warfare types and intensities. At one end of the scale there will be continued "small-scale civil wars and violent conflicts in the poor or low-tech world, along with intermittent outbreaks of terror, drug-trafficking, environmental sabotage and similar crimes."[38] As demonstrated in the Balkans, such conflicts can easily escalate to the point where Second Wave and even Third Wave powers perceive their interests to be sufficiently threatened to warrant direct military intervention. Middle-scale wars involving the massed forces of Second Wave societies invite similar risks, but with potentially more dangerous consequences to global security—particularly if nuclear weapons become involved. Given the pervasive influence of economic globalization on the national interests of most Third Wave powers, such wars will almost inevitably compel a military response from the Western world. The scale of this response, however, will be directly proportional to the perceived value of the national interests being threatened.

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[37] Alvin and Heidi Toffler, <u>War and Anti-War</u>, (New York: Little, Brown and Company, 1993), p. 64.
[38] Toffler, p. 84.

Even high-end conflicts involving multiple technologically advanced Third Wave powers cannot be discounted. As Alvin and Heidi Toffler poignantly observe, "The air is teeming with trade war scenarios that could translate, if stupidly handled, into actual war between two trading [Third Wave] nations."[39] The tense confrontation between Canada and Spain over fishing rights on the Grand Banks is one recent example proving the viability of this type of conflict. Less likely in the short term, but potentially more dangerous, is the prospect of the emergence of a peer military competitor to the United States. As the lessons of previous military revolutions make clear, such a competitor is likely to adapt responsively and effectively to the U.S. led RMA by exploiting its potential in a manner that is not currently envisioned.

Further complicating the global strategic picture is the reality that future wars will not be constrained to conflicts between two or more adversaries at the same level of social, economic and military development. Moreover, while many of the post-Cold War conflicts can be expected to take place in agrarian and industrializing societies, the ability of these societies to wage war will not be limited to agrarian and industrial-level capabilities.[40] As the recent coordinated terrorist attacks on New York City and Washington DC have painfully demonstrated, economic globalization combined with the wide spread availability of information technologies and powerful weapon systems provide these actors with ample opportunity to devise new and innovative methods for pursuing their strategic objectives. Of particular serious concern is the spread of Weapons of Mass Destruction—and nuclear weapons in particular—amongst Second Wave states and possibly even First Wave states, sub-states and trans-state actors.

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[39] Toffler, p. 84.
[40] Pfaltzgraff and Shultz, p. 23.

Osama bin-Laden, for example, is widely suspected to be actively pursuing the acquisition of a nuclear weapon capability.[41]

The consequence of this volatile geo-strategic environment is the rapid proliferation of symmetric and asymmetric threats to global peace and economic security. From the perspective of a Third Wave information-age society, the scope and diversity of these threats are formidable, and exceptionally difficult to counter. In such an uncertain political environment characterized by many interdependent actors and other social and economic variables, it is impossible to make decisive assumptions about the exact identity of likely enemies and the precise nature of the imposed threats.[42] In other words, there are simply too many potential enemies able to realistically threaten the interests of Third Wave powers in too many different and effective ways. The unprecedented diversity and complexity of these threats means that no single state, not even the United States, will have the ability to tailor their force structure, operations doctrine and defence procurement processes to counter every conceivable contingency.[43] History warns that as the identity of the adversary and the character of the threat become more obscure, so too will the ability of military forces to respond to actual contingencies be adversely affected.[44]

An identical line of reasoning applies to the ability of military forces to capitalize on the opportunities afforded by the RMA. In the absence of a well-defined military

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[41] Stefan Leader, "Osama bin Laden and the terrorist search for WMD," Jane's Intelligence Review, 11, no. 6.
[42] Michael Mazaar, "The Revolution in Military Affairs: a Framework for Defense Planning," <u>Army War College Strategic Studies Institute</u>, Fifth Annual Strategy Conference, (Carlisle Barracks, PA, June 1994), accessed at http://carlisle-www.army.mil/usassi/ssipubs/pubs94/rma/rma.pdf, p. 2.
[43] Toffler, p. 85.
[44] Murray and Knox, p. 183.

problem, attempts to innovate tend to lack focus and clarity of purpose.[45] Although the

nature of the military threat confronting Third Wave societies is relatively clear, its scope

and diversity defy specificity. This lack of specificity of purpose is the essence of the

difficulty inherent in developing an optimum RMA exploitation strategy.

Notwithstanding, the considerable ambiguity surrounding the specific nature of

future threats to Third Wave interests, it is possible, however, to exploit the RMA in such

a manner as to minimize the attendant security risk. The key is not to designate specific

well-defined threat scenarios, but to ascertain the range of military capabilities—as

opposed to intention or actual force posture—available to all prospective enemies from

each level of Toffler's development spectrum.[46] By understanding the nature of the

current RMA in the context of the emerging dynamic global security paradigm, these

capabilities can be identified and prioritized according to particular national interests.

Resources can then be focused on developing the optimum mix of technology, force

structure and doctrine necessary to generate robust military forces with the flexibility to

respond effectively across the spectrum of likely contingencies. For example, while

states, such as North Korea and Iraq, pose a range of threats to Third Wave interests, their

actual military capabilities are finite and quantifiable. Moreover, many of the same

capabilities will be attributable to other potential state, sub-state, and trans-state

aggressors. Developing an effective counter to these capabilities, therefore, will provide

the basis for neutralizing a wide range of potential threat types at each level of warfare.

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[45] Williamson Murray, "Innovation: Past and Future," <u>Military Innovation in the Interwar Period</u>, ed.
Williamson Murray and Allan Millett, (New York: Cambridge University Press, 1996), p. 311.
[46] Stephane Lefebvre, Michael Fortmann, Thierry Gongora, "The Revolution in Military Affairs: Its
Implications for Doctrine and Force Development Within the U.S. Army," ed. B.J.C. McKercher and
Michael Hennessy, (Westport, CT: Praeger Publishers, 1996), p. 186.

The viability of this capability-based force planning method is highly dependent on an ability to accurately predict what potential aggressors will be able to do. In the context of the substantial increases in military effectiveness facilitated by the RMA, predictions of this nature are difficult, but not impossible. The key is to understand the character of the current RMA and its likely implications to the conduct of warfare in the context of the global political, social and economic environment.

Part Four—Character of the Current RMA

Just as the French, Industrial and Agricultural Revolutions served as catalysts for the Napoleonic RMA, so too the Information Revolution is enabling the current RMA.[47] During the past twenty years, rapid, commercially driven advances in information technologies—and in the microchip in particular—have facilitated substantive improvements in the speed and effectiveness with which military forces are able to collect, analyze, disseminate, and act upon information. In battlespace surveillance, for example, the ability to detect people and machines on a battlefield is outrunning the ability to hide them in all but the most complex of terrain.[48] This improved capability is being achieved simultaneously at all levels of warfare. At the tactical level, individual soldiers are being equipped with high fidelity, night-vision capable detection and tracking sensors. Networks of integrated ships and aircraft, such as the Airborne Warning and Control System (AWACS) and Joint Surveillance and Target Acquisition Radar System (JSTARS), are capable of generating an accurate real time tactical and operational-level common operating picture that can be transmitted to all actors in the battlespace. In space, multi-spectral satellite technology provides commanders ashore and afloat with near real-time intelligence and operational-level picture compilation, as well as real-time unit positional information and communications capability.

The technologies made possible by the Information Revolution are enabling military forces to collect and process vast quantities of data, but as Sun Tzu noted, "the ultimate goal of any struggle is to dominate the competitor not in information but in

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[47] Cooper, p. 127.
[48] Morgan p. 136. Urban, jungle and mountainous combat environments are examples of complex terrain.

knowledge."[49] One of the core characteristics of the RMA, therefore, is the ability to efficiently fuse, collate and synthesize data from all available sources into meaningful knowledge. Knowledge of this nature is not obtained through simple filtering and repackaging of available data. To effectively enhance the commander's situational awareness, the knowledge management function must be capable of analyzing and interpreting this data, as well as providing recommendations and projecting possible outcomes to various courses of action. As Lawrence Freedman notes:

> The objective is to achieve 'Dominant Battlespace Knowledge,' a capacity to process information in such a way that the overall operational environment, and the key relationships between the military units within it, can be described in as close to real time as possible.[50]

Knowledge management does not replace the command decision-making function. Its objective, however is to speed the commander's decision-making process by providing accurate and timely information to those who need it when they need it. While information dominance has always been key to success in warfare, two of the defining technology enabled elements of the new RMA are the rapid expansion of the battlespace within which information can be collected, processed and packaged, and the swiftness with which this information can be disseminated. High speed, high bandwidth data distribution systems that are capable of seamlessly integrating multiple diverse systems across all four dimensions of the modern battlespace (land, air, sea and space) are central to this capability.

Information technology greatly enhances the ability of military forces to collect data, transform it into knowledge, and quickly communicate that knowledge to

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[49] Cited in Captain James H. Patton, "The New 'RMA,' It's Only Just Begun," <u>Naval War College Review</u>, Spring 1996, Vol. 49, p. 26. Original emphasis.
[50] Freedman, p. 11.

appropriate recipients at all levels of the command structure. It also provides a

substantially more efficient and effective means of acting upon that knowledge. Stealth

technology coupled with precision weapon systems based on advanced microchips and

(UAV) is immediately dispatched from a nearby coalition member frigate to locate the

suspect agrarian forces and provide real-time classification and targeting data. This data

is then relayed to an orbiting B-1 bomber that launches two precision-guided munitions

with lethal effect. The integrated combined and joint capability illustrated by this

example has been successfully demonstrated in the Gulf and Kosovo wars, and is

currently being employed in the Afghanistan campaign. Thus, notwithstanding probable

responsive adaptation by the adversary, the utility of the emerging RMA is the increasing

speed, precision and lethality with which information can be collected, analyzed,

disseminated and acted upon. The combined effect of this capability has the potential to

have a formidable impact on military effectiveness. As Andrew Richter notes:

> If this "system of systems" works, the traditional use of force against an
> opponent equipped with advanced technology would essentially be
> suicidal. Moving targets generate copious radar signatures and well-
> armed standoff forces can intercept them with relative ease. Further, an
> RMA-equipped military will have immediate battlefield knowledge, and
> will be able to concentrate and use its forces in the areas where the enemy
> is most vulnerable.[52]

Many proponents of the new RMA assert that the technologically based

capabilities demonstrated during the Gulf War were its defining event.[53] The first lesson

of historical military revolutions indicates otherwise. Specifically, without the adoption

of complementary operational concepts and organizational structures, the full potential of

an RMA will not be realized. While technology was an integral contributor to the

impressive allied performance in the Gulf War, the victory was achieved with platforms,

force structures and doctrine that were mostly developed during the Cold War.[54] Further,

these systems were designed to counter the strategic problem of massed Soviet armoured

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[52] Richter, p. 4.
[53] Vickers, p. 31.

divisions advancing in depth across the open German Plain. The strategic and operational challenges posed by Saddam Hussein's armoured forces in the open desert were, in many ways, similar to this Cold War European scenario—with one vital difference: the forces of Iraq were fashioned according to Toffler's Second Wave paradigm. Although the quality of the Iraqi equipment was inferior to that of most of the allies, it was sufficiently modern and plentiful to pose a serious threat to allied objectives. If this equipment had been operated by the highly trained and motivated forces of a peer Third Wave competitor employing sophisticated organizational structures and operational concepts, the conflict's conduct, if not the outcome, would have been vastly different. Consequently, critics of the new RMA can justifiably claim that the Gulf War was little more than a conventional conflict fought in accordance with a largely traditional Cold War paradigm between two unequal civilizations. If, as Martin Van Creveld asserts, wars of this nature are doomed to extinction, then the formidable capabilities demonstrated during the Gulf War may represent no more than the conclusion of an evolutionary progression in the conduct of warfare that began in World War I.[55]

The root of this argument is that despite the impressive array of technology-based capabilities demonstrated during the Gulf War, there was little evidence of the concomitant changes in operational doctrine and organizational structures necessary to constitute a true RMA. Indeed, the war did appear to be conducted using the traditional Cold War platform-centric model centered on four discrete operational environments (army, airforce, navy and marines). Underlying the use of these forces, however, was a

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[54] Tom Donnelly, "Revolution—What Revolution?" Jane's Defense Weekly, 7 June 2000, p. 23.
[55] Van Creveld, pp. 205-212. Bailey, p. 153, Barry Watts and Williamson Murray, "Military Innovation in Peacetime," Military Innovation in the Interwar Period, ed. Williamson Murray and Allan Millett, (New York: Cambridge University Press, 1996), p. 377.

rigorous doctrinal framework that stressed conceptual evolution and substantial investment in training and experiment.[56] On the battlefield, U.S. led conceptual innovations were manifested in several fundamental ways that marked new roles for each of the services. For example, Special Operations Forces on the ground were used to coordinate precision bombing and enemy air defence suppression that maximized effect while minimizing collateral or indiscriminate damage. Ground, air and naval forces made extensive use of helicopters to effectively extend the battlespace.[57] Even the Marine Expeditionary Force was employed in a non-combatant, but highly successful information deception operation. Underpinning all of these conceptual innovations was the ability to collect, analyze, disseminate and act upon information faster, and with greater effect, than ever before.

The character of the current Afghanistan campaign further demonstrates that innovative operational concepts and organizational structures are being developed that both support and enhance the military capabilities enabled by advancing technology.[58] Moreover, in reviewing the early lessons learned from Operation Enduring Freedom, it is clear that many of the highly effective operational concepts being employed during this conflict had their genesis during the Gulf War. For example, the Gulf War "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."[59] This advantage was achieved through information dominance and the development of C4ISR systems that facilitated spatial and temporal

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[56] Murray and Knox, p. 189.
[57] Murray and Knox, p. 189.
[58] Bryan Bender, Kim Burger and Andrew Koch, "Afghanistan's First Lessons," Jane's Defence Weekly, December 19, 2001, p. 18.

constraints on simultaneous combined and joint operations to be reduced.[60] In Operation

Enduring Freedom, force structures and operations doctrine have been changed to further

exploit and maximize the impact of this capability. One manifestation of these changes is

the planned reduction in the achievable "sensor to shooter" decision cycle time to less

than ten minutes.[61]   Another, more profound manifestation, is the radical transformation

in the way in which ground forces are being employed. In the past, air strikes were used

to support the efforts of large ground forces. In Afghanistan, it is the smaller manoeuvre

forces on the ground that are supporting the joint operation. As Major General Robert

Scales observes:

> [This] is a tectonic shift in the nature and character of how ground forces
> fight. The purpose of a manoeuver force is now to find the enemy, to
> locate him, to determine the outline of the enemy force, to find those
> specific points on the ground that are most vulnerable to attack by fire, to
> observe it, to separate civilians from military, deception from real targets,
> and then to superintend going after those targets.[62]

Underpinning this change in doctrine is the concept of information dominance and the

ability to seamlessly transfer battlefield information to all levels of a combined and joint

command structure. Equally important is the complementary ability to act rapidly and

decisively upon this information, regardless of spatial and temporal constraints. In terms

of military effectiveness, therefore, a good operational-level definition of the new RMA

is 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.[63]

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[59] Cooper, p. 125.
[60] Cooper p. 126.
[61] Bender, p. 20.
[62] Kim Burger, Michael Sirak and Andrew Koch, "Afghanistan: The Key Lessons," Jane's Defence Weekly, January 2, 2002, p. 24.
[63] Cooper, p. 126.

The early success of Operation Enduring Freedom proves that a true RMA is taking place. Dramatic changes in technology, operational and organizational concepts are being synthesized to produce a substantial increase in military effectiveness. This new RMA has its genesis in the concepts and capabilities that were first demonstrated during the Gulf War and have since been refined into its present "adolescent" form.[64] Yet, history tells us that military revolutions can take several decades to take hold. Concurrent political, social and economic transformation will continue to profoundly influence both its direction and its eventual impact on the conduct of warfare. Nevertheless, the observable character of the current RMA, together with the social, political and economic pressures that continue to influence its direction, suggest several significant implications to the manner in which RMA-enabled forces will be structured and employed in the future.

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[64] Patton, p. 25.

Part Five—Future Implications of the RMA

The ability of military forces to maintain coherence of action across temporal and spatial dimensions, as well as across force type and nationality boundaries is a key component of the current RMA. As gains in the performance of sensor, data processing, communications and weapons systems are realized, the sheer volume of information available to commanders will compel transformation of existing organizational command and control structures. Essential to this process will be a fundamental reassessment of the nature and location of the command decision-making function.[65] Coherent operations, like those being conducted in Afghanistan, require a flexible and decentralized decision-making structure that facilitates effective command and control of multiple coordinated operations over a large battlespace and at each level of warfare. Reducing the total time required for a commander to observe the battlespace, orient himself to it, then decide and act upon an optimum course of action is critical to effecting this capability. To drive down this observe, orient, decide and act (OODA) decision loop cycle time, military command structures must be adapted to exploit the opportunities afforded by technology. Failure to do so will negate realization of the full potential of the RMA, as coherence across space and time will be impossible to maintain. Commercial industry provides a useful model from which to base these required organizational transformations. As Jeffrey Cooper points out,

> Many of the critical enhancements portended by coherent operations are already reflected in the 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-

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[65] Cooper, p. 129.

making in organizations. They are designed to improve dramatically the
speed of both decision and execution.[66]

Thus, another longer-term implication of the transformations affecting the RMA is a

radical streamlining of military organizations in a manner reflective of the experiences of

the private sector. This re-organization will almost certainly result in the use of

technology to replace many of the functions currently being conducted at the middle-

level staff officer positions. With a resultant flattened command structure, decision-

making authority will be increasingly decentralized in a shortened chain-of-command.

While the intent of this organizational transformation is to speed the OODA

decision loop cycle, two important considerations argue strongly for caution in its

implementation. First, the function of military forces is vastly different from that of

commercial industry. In the business profession, for example, the potential consequences

of imperfect decisions based on incomplete knowledge are far less severe or final than are

those of the military profession. Because of the gravity of these consequences,

accountability is essential; and that accountability must be held by someone at each level

of warfare with the appropriate experience and span of control to fully comprehend the

dynamics of a complex situation. Removing the middle layers of a command and control

structure may provide the speed advantage of devolving decision-making authority, but it

comes at the expense of experience and the attendant ability to grasp the higher-level

implications of each decision. Second, in order for the OODA decision cycle time to be

minimized, vast amounts of information need to be efficiently processed into productive

knowledge. While RMA technologies, such as data fusion, can assist in this process,

experienced and capable staffs are still necessary to support the decision-maker.

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[66] Cooper, p. 130.

Otherwise—as learned from Operation Allied Force in Kosovo—decision-makers can easily become overwhelmed by the quantity of available information, thereby obviating the benefits of information superiority.[67] Despite these legitimate concerns, however, the need for organizational transformation is indisputable. Traditional hierarchical military command structures will need to be re-assessed in the context of the capabilities enabled by the RMA and the pressing need to decrease the OODA decision loop cycle time. Given the inherent conservatism of most military organizations, this manifestation of the RMA will likely be a very lengthy and painful process.[68]

Force structures including platform size and unit composition will also continue to influence the character of the RMA. Miniaturization and improvements in the speed and processing power of sensor, communications and weapons systems will lead to increased decentralization and robustness of capability. For example, developing technologies, such as microbots, small reconnaissance platforms and intelligent munitions integrated into a highly interconnected network, can provide the capability to detect, track and target, with a high degree of lethality and accuracy, virtually anything in the battlespace. Moreover, because such a network has no physical center of gravity, it will be difficult for an adversary to detect and destroy.[69] Confronted with the robustness and effectiveness of such highly integrated sensor and weapon systems, it is difficult to justify the continued predominance of large and vulnerable system platforms.[70] Thus, another defining characteristic of the RMA is a reduced emphasis on the importance of

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[67]Brigadier-General G.E. Sharpe and Allan D. English, Principles for Change in the Post-Cold War Command and Control of the Canadian Forces, (Winnipeg: Canadian Forces Leadership Institute, 2002), p. 66.
[68] Cohen, p. 48.
[69] Lefebvre, p. 176.

large tanks, aircraft and ships, in favour of significant numbers of smaller, specialized platforms integrated into a highly effective network. In a historical context, this shift of emphasis is comparable to the decline of the influence of the battleship, and the corresponding rise of carrier-based aviation as the predominant form of naval military power during World War II.

The same impetus for making platforms smaller also applies to the composition of tactical units. With the expansion of the battlespace and the concurrent decrease in the temporal dimension of military operations, the characteristics of manoeuverability, flexibility and survivability are the new keys to military effectiveness. Consequently, smaller, highly trained and easily deployable combat units, like Special Operations Forces, are good candidates to comprise the organizational model of the future:

> Special Operations units are small, agile, flexible, able to take on a wide range of missions, highly trained and motivated, and imbued with the need for decentralized initiative. They use stealth and guile rather than brute force to achieve their objectives. These same principles will dominate the doctrines of the regular U.S. military in the years to come.[71]

Substantial increases in the firepower available to smaller forces, both organically and externally, will inevitably lead to a movement away from "massed hierarchal forces towards small, dispersed and highly mobile units."[72] The brigade, for example, could replace the division as the basic combat unit.[73]

In this new operational and organizational environment shaping the RMA, the social impact will be equally as profound. Tactical and operational success in the complex, intensive and rapid tempo RMA battlespace requires highly intelligent,

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[70] Martin Libicki, "The Mesh and the Net: Speculations on Armed Conflict in a Time of Free Silicon," McNair Paper No. 28, (Washington, DC, March, 1994), accessed at http://www.ndu.edu/ndu/inss/macnair/mcnair28/m028ch07.html, 17 Mar 02, p. 50.
[71] Mazaar, p. 31.

superbly trained and well-motivated personnel. According to the conclusions of a recent

Canadian Forces study on strategic human resources issues:

> Key characteristics of those successful in this type of warfare will be:
> flexible, agile leaders able to rapidly adapt tactical, operational and
> strategic plans to stay inside the OODA loop of the enemy; [and] highly
> disciplined, psychologically hardened troops capable of dealing with
> uncertainty, information overload and high cognitive demands.[74]

Recruiting, training and retaining such highly qualified people will require substantial

reform of the current military personnel systems. This challenge will be compounded by

demographic shifts of population age and composition, as well as aggressive competition

from the private sector. Moreover, the skill sets needed to acquire, maintain and operate

the technologically intensive sensor, communications and weapons systems that

characterize the RMA will necessitate a further shift in the structure and relative

importance of military career lines. This is not a new phenomenon. Military

organizations have always adapted to the introduction of new technologies and

operational concepts. The difference with the current RMA, however, is the cultural

expectations on military professionals, the personal expectations of the prospective

recruit and the exponential increase in the complexity of war. [75]

Another certainty is that the pace of technological development is unlikely to

abate. Civil investment in research and development, particularly in the specialized fields

of information technology, is presently estimated to be ten times greater than that of

defence investment. Moreover, the computing power of information systems is doubling

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[72] Morgan, p. 137.
[73] Mazaar, p. 22.
[74] A. Okros, Defence Management Committee Discussion Paper, "Into the 21st Century: Strategic HR
Issues," accessed at http://www.vcds.forces.ca/dgsp/analysis/hr_e.asp, Mar 15, 2002.
[75] Okros.

every 18 months; implying a 100-fold increase over ten years.[76] The implication of this

growing trend will be profound. First, as the initiative for technological innovation

becomes more entrenched in the private sector, defence equipment systems will become

increasingly reliant on rapidly evolving commercial technology. Second, most of these

technologies will be freely available in the global marketplace for exploitation by

prospective adversaries. Technical innovations will diffuse rapidly, possibly blunting any

military advantage.[77] Finally, the complexity and cost of technologically intensive

information and weapons systems will hinder the ability of all but the richest states to

exploit many of the opportunities such systems afford. Because of competing national

interests, Middle Third Wave powers, such as Canada, will in all probability lack the

national will to invest the resources necessary to field military forces capable of

responding to all contingencies. Thus, such states may be compelled to selectively

participate in the RMA according to their own national strategic interests.[78] While such

decisions require conceding first-rate status in some capability areas, they also provide

opportunity for continued excellence, even dominance, in others.[79] The result of this

trend is that no single state—with the possible exception of the United States—will have

the military capability to wage war across the full spectrum of conflict scenarios and

intensities. Future RMA operations, therefore, will likely be comprised of "modular

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[76] John Leggat and Ingar Moen, Defence Management Committee Discussion Paper, "Challenges and Opportunities Posed by Emerging Technologies," accessed at http://www.vcds.forces.ca/dgsp/analysis/tech_e.asp, Mar 15, 2002.
[77] Colin Gray, "The Changing Nature of Warfare?" Naval War College Review, Spring 1996, Vol. 49, No. 2, p. 14.
[78] Colonel H.J. Marsh, "The Revolution in Military Affairs (RMA) Revisited," unpublished paper, (Ottawa: DND, July 2001).
[79] Dr. Elinor Sloan, "Canada and the Revolution in Military Affairs: Current Response and Future Opportunities," Canadian Military Journal, Vol. 1, No. 3, Autumn 2000, pp. 7-14, p. 13.

coalitions…with each ally sharing in the division of labour by providing specialized military forces and technologies that others may lack."[80]

History suggests that the most successful RMAs are borne out of the determination to find solutions to specific strategic problems. Because revolutions in military affairs "always occur within the context of politics and strategy,"[81] the more complicated the strategic problem is, the more profound the impact of the RMA will be. The nature of that impact, however, will be dependent on "perceptions of future contingencies and likely enemies"[82] as well as the priorities established by the force planners and decision-makers. In the context of a rapidly innovating adversary, technology, force structures, evolving operational and strategic concepts will all have an influence. Thus, the most important implications of the RMA to the conduct of war will take place at the strategic level and be manifested into specific military capabilities. While the scope and diversity of threats confronting Third Wave societies pose a considerable strategic problem that defies specificity, there are indications of three broader strategic trends influencing the direction of the current RMA.

First, from an Information Age perspective, the Napoleonic paradigm of warfare based on massed forces waging total war for essentially unlimited strategic objectives, such as the destruction of a state or regime, is likely at an end. Future RMA-enabled forces will be smaller, more mobile, more highly integrated and far more lethal than their pre-RMA predecessors. They will also be exceptionally expensive and perceived by their governments to be "too precious to waste in mass attrition-style warfare"[83] or on

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[80] Toffler, p. 85.
[81] Murray and Knox, p. 180.
[82] Krepinevich, p. 39.
[83] Cooper, p. 113.

objectives disproportionate to the means employed. Hence, in the absence of a direct threat to the vital interests of a state, limited war for limited ends will be the predominant Third Wave warfare model in the years ahead.[84]

Closely related to this vision of warfare is the expanding concept of legitimacy. Actors contemplating any form of economic or military aggressions are increasingly concerned with the perception such action will invoke from the international community. The consequences of not doing so can be severe. For example, evolving international political, social and economic pressures are continuing to weaken the legitimacy of armed conflict and geographic invasion as acceptable means of pursuing national strategic objectives. As Iraq discovered in Kuwait and al-Qaeda is now experiencing in Afghanistan, such aggressive action invites international repercussions that range from diplomatic and economic isolation, to full-scale military confrontation. This trend does not negate the possibility of one state or sub-state invading and attempting to annex portions of another, but it does significantly decrease the possibility of such a strategy being successful if the international community views the aggressive action as illegitimate. Nevertheless, potential actors contemplating such action—like China's stated intention to annex Taiwan—will only be dissuaded if the likelihood and cost of failure significantly outweigh the perceived benefits of success. By adequately justifying the action in the eyes of a substantial portion of the world community, and balancing the means of force employed with the value of the ends sought, future aggressors can increase the perceived legitimacy of their actions, while decreasing the attendant probability and cost of failure.

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[84] Cohen, p. 52.

The concept of legitimacy also applies to the conduct of interventionist, Third Wave powers. For example, while the actions of Serbian forces in Kosovo were widely condemned by the international community, NATO's coercive bombing campaign was not universally viewed as an acceptable and balanced response. Varying political agendas among many of the world's states, coupled with a concern that Western powers were inappropriately employing their superior military force in a sovereign state, threatened the cohesiveness of the NATO led coalition.[85] This example demonstrates the inherent complexity of balancing the concept of legitimacy of action with the limited war for limited ends model of conflict. Clearly, the strategic objectives of Third Wave states are not always consistent with those of their Second and First Wave counterparts. Moreover, each state's interpretation of the relative value of its strategic interests is likely to differ—sometimes, considerably. In this dynamic political environment, it is often difficult for Third Wave powers to maintain a consensus that aggressive interventionist action is both legitimate and proportional to the ends sought. Nevertheless, establishing and sustaining such a view amongst a multi-national coalition of forces will often be fundamental to the mission's success. Despite the formidable military effectiveness of Third Wave RMA-enabled forces, as Operation Enduring Freedom demonstrates, such forces often require the staging bases, over flight privileges, and organic intelligence capability afforded by regional coalition partners. Moreover, the weakening or dissolution of a broad consensus of legitimacy can adversely affect the domestic public

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[85] Alan Dowd, "NATO After Kosovo—'Toward Europe Whole and Free,'" Policy Review, No. 98 (December 1999 and January 2000), accessed at http://www.policyreview.org/dec99/dowd.html, 15 Mar 02.

opinion, and thus the political resolve of Third Wave participants to continue the operation.[86]

The broad strategic impact of these three considerations—coalition-based warfare; idea of legitimacy of actions; and concept of limited warfare for limited ends—is the creation of a critical vulnerability to Third Wave military operations.[87] Potential aggressors could nullify the military effectiveness of RMA-enabled forces by undermining the unity of an opposing coalition. Such aggressors, for example, could wage an extensive information campaign aimed at increasing the legitimacy of their own actions at the expense of that of the opposing coalition. Both Iraq and Serbia have employed this strategy by leveraging the Information Age resources of the international media to show powerful near real-time images of non-combatant casualties allegedly resulting from coalition action. Another effective strategy is to exploit the differing interpretations of "limited ends" and tolerances for "limited war" amongst coalition members. By ensuring that the economic, social and military cost of continuing participation in the coalition exceeds the perceived value of the strategic objectives sought, individual states may be persuaded to abandon the coalition effort; thereby weakening both its effectiveness and its legitimacy. Given the likelihood of this type of strategy being employed by prospective aggressors, future RMA-enabled capabilities should be directed at countering its efficacy.

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[86] Brigadier Mashud Choudry, "Coalition Warfare, Can the Gulf War-91 be the Model for the Future?" (Carlisle Barracks, PA, 1992), p. 12. Delmas, p. 195.

[87] These are not new trends. Coalition warfare, for example, characterized many of the Napoleonic wars as well as World War I and II. Similarly, the concepts of limited war (jus ad bellum) and legitimate war (jus in bello) were central to St Augustine's Just War theory written 1600 years ago. St Augustine articulates four criteria for a just war: proper authority, proper cause, proportionality and reasonable chance of success.

The second emerging strategic trend is a shift of the emphasis of warfare from terrain retention to information dominance and enemy destruction. As Patrick Morgan suggests,

> The object will be to inflict considerable harm and leave the opponent no way to disrupt or punish in return, weakening his resolve to continue fighting and negating the bargaining leverage that would otherwise accrue to him from his being able to continue to fight.[88]

The scale and effect of such military operations will blur the distinction between the three levels of war, enabling strategic results to be achieved from what was previously considered to be the domain of operational or tactical actions.[89] Moreover, given the formidable effectiveness of conventional RMA operations, large-scale open terrain warfare, similar to that waged in the Gulf War, will probably be avoided by Second and Third Wave actors as a viable means of achieving strategic objectives. As Colonel Howard Marsh adroitly observes,

> Who in their right mind would seek war with a C4ISR[90] superior combatant in open-terrain? War on the physical plan in open-terrain is no longer a fair fight when one opponent has Information Age capabilities. Warfare was probably never fair, but earlier conflict was perceived to be sufficiently equal to convince both opponents that fielding armies was better than suing for peace. This is no longer the case for large scale, state against state conflict.[91]

The impact of this trend is the movement of future combat to the extrema of the RMA-enabled battlespace: close-range, very long-range, and the electromagnetic spectrum.[92] Potential aggressors, for example, will attempt to exploit vulnerabilities in

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[88] Morgan, p. 139.
[89] Vickers, p. 33.
[90] C4ISR is the acronym for Command Control Communications Computers Intelligence Surveillance and Reconnaissance. Some add Target Acquisition to ISR to create the acronym ISTAR. Some hold that reconnaissance inherently implies target acquisition and the acronym can be shortened. In this quote, the functions of detection, decision and action are included as components of C4ISR.
[91] Marsh.
[92] Control of the electromagnetic spectrum impacts the ability of forces to collect, analyze, disseminate and act upon information.

the dominant C4ISR capability by employing close-range, low-intensity tactics that rely on complex terrain where it is easy to hide; like jungles, canyons and urban centers. As the U.S. experience in Vietnam and the Soviet experience in Afghanistan attest, this strategy has met with considerable success in the past. Moreover, critics of the RMA have long pointed to its apparent lack of effectiveness in coping with such asymmetric mechanisms. "Information warfare," Martin Libicki writes, "works best against industrial-based warfare and much less against pre-industrialized warfare."[93] Thus, if adversaries will be relying on close-range strategies that emphasize the inherent weakness of current RMA-enabled capabilities, then it follows that future RMA development should seek to reduce the scope of these deficiencies, and thus, the overall utility of terrorist or other low-intensity methods of warfare.

Another opportunity for prospective adversaries to exploit RMA deficiencies is found at the extreme ranges of the RMA battlespace. The current military revolution is characterized by the ability to accurately project force over extended distances. An emergent peer military competitor to the United States could conceivably counter this capability with weapon systems of superior range and lethality. Although this scenario is unlikely at present, less technically advanced adversaries may develop more innovative means of achieving the same objective. The application of air power over large distances, for example, is heavily dependent on organic air-to-air refueling capability. If an aggressor was successful in launching a coordinated attack that neutralized a significant proportion of available tanker aircraft, the ability of Third Wave militaries to project sustained extended force could be substantially disrupted. The ability of an aggressor to employ intercontinental or theater ballistic missile capability against Third

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[93] Libicki, p. 85.

Wave forces poses a similar and potentially more serious threat. To counter these likely capabilities and their attendant impact on Third Wave military operations, RMA developments should focus on improving the ability to defend force projection assets.

The final, and potentially most dangerous, vulnerability open for exploitation by prospective adversaries is the reliance of RMA-enabled capabilities on information dominance. As Michael Vickers observes,

> Over the next few decades, the capability of military organizations to acquire, process, and move information over wide areas will increase exponentially. As information increases in military importance, further advances in information denial and manipulation could follow. There is little indication that even the U.S. military, currently at the forefront of this change, has progressed much beyond the early stages of this process.[94]

The character of the current RMA is closely related to the ability of military forces to collect, analyze, disseminate and decisively act upon information. Central to this capability is control of the electromagnetic spectrum. By interfering with this control, innovative adversaries can find effective means for disrupting the flow of information and thereby denying information dominance. In the RMA battlespace, these types of operations could take many forms. Independent information operations could, for example, include coordinated computer virus attacks on critical infrastructure targets or military command and control nodes. High-power microwave jamming systems could be employed to disable specific sensor and communication networks, creating large gaps in the information coverage. Similarly, conventional electromagnetic pulse weapons could be used to disable all electronic systems over a wide area of the battlespace, thereby obviating much of the military effectiveness of RMA-enabled forces.

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[94] Vickers, p. 32.

Integrated information warfare operations are likely to gain increasing prominence in the future battlespace as opposing forces seek to either shape the information available to the adversary or paralyze their ability to achieve information dominance. "The ultimate goal of information warfare," writes Michael Vickers, "will be not only to desynchronize and disable enemy operations, but actually make the system turn against the enemy."[95] Consequently, an area of fundamental importance to the future direction of the RMA is the development of technology, organizational structures and operational concepts that both protect the ability of Third Wave forces to collect and process information, while denying the same capability to potential adversaries.

The third strategic trend has its basis in the lessons of history and serves as a warning to those who dispute the continued relevancy of aggressively pursuing the capabilities enabled by the RMA. History has repeatedly shown that the attendant benefits of a military revolution are often short-lived. While in the short-term, the military dominance of the United States is likely to remain unchallenged, diffusion of RMA technology and capabilities may eventually force a change of the global strategic balance. New capabilities inevitably bring new vulnerabilities, and potential adversaries are historically very quick to adapt to the new paradigms of warfare. Asymmetries in strategic objectives will likely cause some competitors to emphasize different aspects of the RMA for their own gain.[96] Denying information dominance, for example, would substantially nullify much of the operational and strategic advantages enjoyed by current RMA-enabled forces.[97] In this manner, it may be possible for small state, sub-state or trans state actors to successfully defy larger and far superior military forces. The possible

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[95] Vickers, p. 40.
[96] Vickers, p. 42.

emergence of a peer military competitor to the United States, such as China, further

complicates the strategic situation, especially if such a competitor chooses to aggressively

develop asymmetric responses to present RMA capabilities. In such a rapidly changing

and uncertain strategic environment, it may be impossible for any state, including the

United States, to maintain unequivocal military superiority in all possible contingencies.

Thus, constant transformational change will continue to be a defining characteristic of the

current RMA. Moreover, as Patrick Morgan writes, "only those political, military and

social systems configured for and comfortable with [this] constant change will be able to

embrace it effectively."[98]

Collectively, these three strategic trends—limited coalition-based warfare based

on the concept of legitimacy; information dominance at the extrema of the current

battlespace; and constant transformational change—will determine the future direction

and impact of the RMA. An effective RMA exploitation strategy, therefore, should

establish the organizational and operational structures as well as the competencies

necessary to address these trends.

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[97] Gray, p. 15.
[98] Morgan, p. 158.

Part Six—Canadian Strategy for Exploiting the RMA

The Canadian Forces is mandated by the Canadian government in the *1994 Defence White Paper* to provide multi-purpose, combat capable forces with the ability to respond quickly and flexibly to a broad spectrum of contingencies up to, and including, high-intensity conflict.[99] Acknowledging the challenges proffered by the RMA, the CF policy document *Shaping the Future of the Canadian Forces: a Strategy for 2020*, provides more specific direction:

> The Defence Team will generate, employ and sustain high-quality, combat-capable, interoperable and rapidly deployable task-tailored forces. We will exploit leading-edge doctrine and technologies to accomplish our domestic and international roles in the battlespace of the 21st century and be recognized, both at home and abroad, as an innovative, relevant knowledge-based institution.[100]

The premier Canadian Forces RMA policy document, *Canadian Defence Beyond 2010*, recommends an exploitation strategy based on patience with a bias towards selective innovation in core competency areas. Although the document provides eleven recommendations, it fails to identify, let alone prioritize, specific changes to organizational structures and operational concepts that are necessary to realize the benefits of the RMA. Jointery and interoperability with United States forces, for example, are singled out in both *Strategy 2020* and *Canadian Defence Beyond 2010* as primary competencies. Yet, despite this declaration, neither document provides any indication of how jointery or interoperability is to be achieved—"a major oversight given

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[99] Canada, Minister of National Defence, "1994 Defence White Paper," (Ottawa: PWGSC, 1994).
[100] Canada, Minister of National Defence and the Chief of the Defence Staff, "Shaping the Future of the Canadian Forces: a Strategy for 2020," (Ottawa: PWGSC, 1999), p. 7.

the challenges advanced technologies pose."[101] This lack of focus and clarity of direction characterizes the Canadian Force's approach to the RMA.

Nevertheless, given the definable character of the current military revolution and the predictable direction in which future RMA-enabled capabilities will be driven, the CF is particularly well positioned to benefit from the RMA's operational and strategic possibilities. Specifically, Canada has the diverse sophisticated civilian-based high technology infrastructure, highly educated workforce and stable political regime necessary to effectively participate in the RMA. The key is to identify the core RMA-enabling competencies that complement the Canadian strategic vision laid out in *Strategy 2020* and address the three strategic trends of the ongoing Revolution in Military Affairs. The ability to establish efficient and adaptable command and control structures that facilitate rapid processing and seamless dissemination of knowledge across spatial, environmental and national boundaries is that key. Collectively, these capabilities are combined under the command, control, computer, communications and intelligence (C4I) designation. Functionally, however, they are encapsulated into two separate but highly synergistic areas. First, command and control (C2) refers to the human and doctrinal dimension of translating information into executable decisions through "the establishment [at each level of warfare] of common intent to achieve coordinated action."[102] The second area is the technical architecture based on networks of computers, communications and intelligence systems that provide the framework through which effective command and control is exercised. The priority of C4I does not suggest that the other defining RMA-enabled capabilities—Intelligence, Surveillance and Reconnaissance

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[101] Richter, p. 12.

(ISR), stealth, coordinated long-range strike, and precision weaponry—will lose their importance. On the contrary, the full realization of the potential benefits of the RMA will continue to be dependent on these capabilities. The difference, however, is that C4I is the common essential element that synthesizes all of these discrete capabilities into a greater and more effective whole. Excellence in C4I, therefore, is a core enabling competency of the RMA.

The RMA is changing the way in which command and control is applied to the conduct of warfare. The size of the battlespace, tempo of operations and quantity of information available to decision makers are forcing a transformation of the organization and culture through which command and control is exercised. One of the defining characteristics of the RMA is the constant pressure to reduce the OODA decision loop cycle time in joint and combined multi-national coalition operations. Resolving disparate organizational structures, cultures and technical capabilities is critical to achieving this objective. Some analysts believe that the best course of action is to decentralize decision-making authority amongst the various participants in accordance with Thomas Czerwinski's "command-by-influence" model of command and control.[103] Others contend that given the information dissemination capability enabled by technology, this devolution of responsibility is both unnecessary and risky as the decision-maker may lack the breadth of experience and broader operational or strategic perspective.[104] Such critics advocate Czerwinski's "command-by-direction" or "command-by-plan" model of

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[102] Carol McCann and Ross Pigeau, "A Conceptual Framework for Discussing Command and Control," a paper prepared for the DCDS Retreat, 6-8 Feb 2001, Kingston, ON, cited in Sharpe, p. 79.
[103] Czerwinski's command-by-influence style "attempts to deal with uncertainty by moving decision thresholds to lower command levels, thereby allowing smaller units to carry out missions bounded by the concept of operations derived from the commander's intent." Cited in Sharpe, p. 68.

command and control.[105] While each of these perspectives has advantages and disadvantages, attendant complexities of the coalition C2 model combined with the scope and pace of transformational change portended by the RMA defy identification of one optimum command and control solution. In a future security environment characterized by diverse threats opposed by coalitions of like-minded states, the key characteristics of the command and control structure will be flexibility and adaptability. As William Lescher asserts,

> [A] critical characteristic of any effective C2 system is its ability to learn while it executes its missions. To acquire this ability in peacetime or in times of relative calm, staffs need to practice not so much *what to do* in war or other operations, but *how to learn quickly* what to do quickly when the time comes.[106]

Establishing and fostering a leadership culture based on creativity, innovation and continuous education is essential to Lescher's vision of effective command and control. Moreover, this type of dynamic culture is essential to addressing the third strategic trend of the RMA: constant transformational change. The Canadian Forces are well positioned to adopt such a vision. The CF policy documents *Shaping the Future of the Canadian Forces: a Strategy for 2020* and *Canadian Defence Beyond 2010* both emphasize innovation and knowledge-based learning as necessary CF competencies. Moreover, the advantages of these initiatives will not accrue solely to command and control. All defence related functions ranging from procurement, to human resources, to training, will

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[104] Simon Naveh, In Pursuit of Military Excellence: the Evolution of Operational Theory, (London: Frank Cass, 1997), p. 2. Michael Geyer, "German Strategy in the Age of Machine Warfare, 1914-45," Makers of Modern Strategy ed. Peter Paret, (Princeton: Princeton University Press, 1986), p. 585-588.

[105] Czerwinski's command-by-direction is based on a model through which commanders attempt to direct all of their forces all of the time. Command-by-plan is the current predominant model for command and control characterized by adherence to a pre-determined design, thereby trading-off flexibility in favour of focus.

[106] William K. Lescher, "Network-Centric: Is it Worth the Risk?" US Naval Institute Proceedings 125, no. 7 (July, 1999), p 58-63. Cited in Sharpe, p. 69.

benefit from a more innovative, intelligent and educated armed forces. Nevertheless,

realization of these benefits will necessitate a change of command culture, whereby a

"zero-defect" mentality is replaced with a greater acceptance of risk, encouragement of

innovative thinking, and acceptance of failure. To this end, the establishment of a

dedicated Concept Development and Joint Experimentation Centre (CDE/JEC) in

summer 2002 is a positive move forward for the CF. By facilitating a constructive

environment where novel operational concepts can be identified, developed, explored and

evaluated, the CDE/JEC is reflective of similar organizations established by German,

Japanese and Allied forces prior to World War II that were highly successful in fostering

innovation.[107] Despite this tangible progress, however, barriers to change still exist that

may hinder the CF's ability to establish the C2 structure and culture necessary to exploit

the RMA. Noting the work that still needs to be done, delegates at the human resources

workshop of the April 2000 Symposium offered the following observations:

> There was a consensus…that the CF, as an institution, has a low tolerance
> for errors: that it is risk-averse and discourages—rather than
> encourages—exploration of ideas. If this is indeed the case, then it raises
> several further questions: Is creativity and innovation actually being
> culled out, rather than rewarded? Can the CF really be a "learning
> organization? What is the appropriate balance between error-tolerance
> and risk taking?[108]

A flexible and adaptable command and control structure that emphasizes

innovation is well suited to respond to the anticipated future geo-strategic environment

driving the evolution of the RMA. Without an equally flexible and adaptable C4I

infrastructure, however, future coalition operations will be vulnerable to the innovative

actions of competitive states, sub-state and trans state actors seeking to exploit the RMA

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[107] Murray, "Innovation: Past and Future," pp 300-328.

for their own strategic ends. Both the command and control doctrine and the technical systems used to collect, process and disseminate battlespace information must be interoperable with the heterogeneous counterparts of other services and coalition partners. Without seamless interoperability, the flow and availability of critical information is degraded, thereby adversely affecting the speed and effectiveness of the OODA decision loop cycle. Critical targeting information from an airborne UAV sensor system, for example, must be compatible with the communications and information processing systems of other air, sea or land based weapons systems if the target is to be quickly and decisively engaged. Creating and exploiting this seamless interoperability is central to the U.S. armed forces future vision of the RMA being defined by Network-Centric Warfare (NCW). It is the core capability that enables quick and effective communication and dissemination of information amongst coalition partners.

NCW is a C4I concept predicated on the idea of all battlespace information being manipulated through a series of dynamic and interlinked grids. First, all participating sensors contribute information to a common sensor grid. This information is then fused and processed by an information grid and operations are determined via an engagement grid.[109] The envisioned advantages of this ubiquitous architecture are increased speed and synchronization of multiple operations across spatial, temporal and physical boundaries. In the context of the predicted strategic implications of the RMA, the capability provided by NCW operations could effectively counter aggressive actions conducted at the extrema of the current RMA battlespace. Networks of miniature sensors

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[108] Canada, Vice Chief of the Defence Staff, "Creating the CF of 2020—Concept Development and Experimentation and Modelling and Simulation," (Ottawa: PWGSC, Nov, 2000), p. 36.
[109] Canada, Department of National Defence, "The Canadian Navy's Command and Control Blueprint to 2010," (Ottawa: NDHQ, June 2001), p. 12.

integrated into a common surveillance and intelligence network, for example, could counter the advantage of obscurity specific to close-in urban warfare. Linking this network to information fusion, processing and engagement grids has the potential to significantly reduce the OODA or "sensor to shooter" decision loop cycle time. Similarly, at the opposite end of the current RMA battlespace, NCW architectures can provide the necessary surveillance, threat assessment, weapon assignment and engagement capability to counter theatre and inter-continental ballistic missile threats. A potential weakness, however, is the possible vulnerability of such highly integrated networks to information warfare. Denial of use of the electromagnetic spectrum or a coordinated computer virus attack, for example, could severely degrade the ability of military forces relying on the network architecture to achieve their mission. A further problem with the NCW concept is the increasing disparity between the technical and doctrinal abilities of coalition members to connect to and participate in the U.S. dominated network infrastructure.

The U.S. Navy Cooperative Engagement Capability (CEC) initiative is a good example of this growing discrepancy. Based on the NCW concept, CEC fuses and processes the sensor data from multiple contributing sensors to produce a high fidelity composite picture of the battlespace. Data from this picture is of sufficient quality to enable other weapons systems on the network to independently engage a target, even if that system is unable to track the target itself. Characteristic of the network-centric approach to warfare, C4I systems like CEC pose two significant challenges to future coalition operations. First, the integration of C4I systems from different states creates an issue of who and who is not cleared to have access to the composite information. Paul

Mitchell points out, "NCW operations in a coalition or alliance environment may ultimately hinge on information releaseability rules and the ability to send information between networks with different security classifications."[110]

Second, network-centric systems are technically complex and expensive. Technical or doctrinal incompatibilities between different C4I architectures can hamper the ability to efficiently integrate these systems into the overall network. Moreover, few states are likely to have the resources or technological capacity to upgrade their current C4I capability to a level compatible with the technical and doctrinal standards laid down by the United States. Consequently, as the United States upgrades their C4I systems and doctrine to exploit the capabilities proffered by NCW, there is an increasing risk that future coalitions will be divided into those who can integrate into the network and those who cannot. Given that the purpose of NCW is to increase the tempo and effectiveness of military operations, such a division may deny willing coalition partners access to critical information, thereby hindering their ability to provide a salient and relevant contribution. Joseph Nye asserts, "accurate, real-time, situational awareness is the key to reaching agreement within coalitions on what to do and is essential to the use of military forces, whatever their roles and missions."[111] It follows that if C4I incompatibility between coalition partners restricts access by some of those partners to critical situational awareness information, then the cohesiveness of the coalition may be threatened. Further, such technical and doctrinal constraints may limit the composition of future coalitions to the United States and a handful of other allies with proven interoperable

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[110] Paul Mitchell, "Small Navies and Network Centric Warfare: Is thee a Role?" (Toronto: Canadian Forces College), unpublished paper, (Toronto: Canadian Forces College, March, 2002).

[111] Joseph S. Nye and William A. Owens, "America's Information Edge," Foreign Affairs, Vol. 75, No. 2, (March/April 1996), p. 27.

forces. A good niche opportunity for the CF, therefore, is the development of a flexible

C4I "gateway" capability that enables less technically advanced coalition members to

have timely access to critical information on the network. If realized, this capability

could accrue the dual benefit of strengthening coalition cohesiveness while enhancing

Canada's influence in the conduct of coalition operations.[112]

       With the advent of network-centric warfare, C4I will be the core system in

Owen's "system of systems." It will provide the critical framework through which other

sensor, weapons and intelligence systems are integrated. Moreover, C4I system

interoperability will be the decisive capability determining the ability of other states,

including Canada, to participate in coalition operations. Fulfilling the White Paper's

mandate to "fight alongside the best, against the best,"[113] therefore, will be highly

contingent on the CF's ability to develop C4I systems that are interoperable with those of

its allies, especially the United States. Further, "[i]f Canada wants operational influence

within a coalition/alliance, its forces must be capable of participating in a salient way."[114]

The key to achieving this saliency is proficiency in C4I. During the Gulf War, for

example, the ability of the Canadian navy to operate with the other participating forces

was the decisive factor in selecting Canada to lead the Combat Logistics Force.[115]

Similarly, interoperability with U.S. forces was fundamental to Canada's meaningful

contribution during Operation Allied Force and is continuing to be crucial to the very

salient contribution currently being rendered in Operation Enduring Freedom.[116]

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[112] "Creating the CF of 2020: Concept Development and Experimentation and Modelling and Simulation,"
p. 6.
[113] "1994 Defence White Paper."
[114] Maloney, p. 460.
[115] Jean Morin and Richard Gimblett, Operation Friction, (Toronto: Dundern Press, 1997), pp. 181-182.
[116] Sloan, p. 12.

C4I competency and the ability to innovate in the face of constant transformational change will increasingly be the essential force enablers that break down spatial, temporal and national boundaries in coalition-based network-centric operations. Combined with robust and adaptable command and control structures, equally robust and adaptable C4I systems will provide the foundation upon which future RMA-enabled capabilities will be implemented. In the context of an optimum RMA exploitation strategy, therefore, it follows that the CF should establish C4I, including flexible command and control structures underpinned by a cultural ethos that encourages innovation, as priority capability emphases.

Part Seven—Conclusion

A Revolution in Military Affairs is under way. Driven by rapid advances in weapons, communications, surveillance and information systems technologies, formidable new military capabilities are being introduced to an ever-expanding battlespace. Yet, similar to the Napoleonic RMA two hundred years ago, the impetus for the current military revolution is not the evolution of technology, but the synthesis of the military capabilities that technology enables with the profound political, social and economic changes affecting the global security environment. Thus, the RMA is not only changing the way in which war is conducted, but also why it is fought and by whom. The key to developing a sound RMA exploitation strategy, therefore, is to understand the scope of military capabilities made possible by technology and then to identify which of these capabilities are most likely to be employed by potential adversaries in pursuit of their strategic objectives.

In a complex multi-threat environment characterized by conflicts amongst and between each of Toffler's three waves of civilizations, designing the right balance of military forces and capabilities is a challenging task. Nevertheless, the Gulf, Kosovo and current Afghanistan campaigns provide useful insight into the likely force structures and core military competencies necessary to exploit the RMA. Future military forces will be highly educated, smaller, more lethal and more mobile than before. There will be less distinction between the traditional air, land and sea elements, as joint and combined operations become standard. As it was during Sun Tzu's time, information will continue to be the key battlespace commodity. The ability to rapidly collect, process, disseminate and act upon that information, however, will be the essential RMA competency. Central

to this competency will be flexible and robust C4I systems that are able to integrate the various sensors, weapons and information processing systems of multiple coalition partners into a cohesive military force capable of responding effectively to a broad range of contingencies. Moreover, as potential adversaries are likely to adapt quickly to the changes in military effectiveness enabled by the RMA, command and control structures will need to be equally flexible and tolerant to unexpected change.

Canada is committed to having multipurpose, combat-capable armed forces able to provide a salient and relevant contribution to both domestic and collective multinational security operations. In the context of the uncertain and dynamic global security environment and the dramatic changes in military effectiveness portended by the RMA, realization of this commitment will be contingent on a rational RMA strategy that emphasizes two core capabilities. First, the CF must develop C4I systems that are capable of seamlessly operating with those of its allies, regardless of their position on the RMA capability spectrum. Second, the CF must implement flexible command and control structures based on a culture of constant innovation, exploration and acceptance of risk. Implementing this vision will not be easy. Failure to do so, however, could result in a degradation of the CF's capacity to meet its future collective security obligations.

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