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ARE THE DAYS OF THE MAIN BATTLE TANK OVER?

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ABSTRACT

The future of the Main Battle Tank is an issue that has attracted a lot attention over the past few years, especially since the end of the 1990-1991 Gulf War. This study argues that by 2020, second and third generation Main Battle Tanks will have become obsolete and that a new generation of combat vehicles will be required to fight in built-up areas. This study first provides an appreciation of the future security environment to illustrate the obsolescence of second and third generation Main Battle Tanks in 2020. Secondly, an analysis of the operating environment is then performed to demonstrate that a future combat vehicle will be required to operate in urban terrain. Thirdly, the study determines the capabilities and requirements of future combat vehicles. Finally, an assessment of the combat vehicle concepts of three of the most modern NATO armies is provided in order to determine if they meet future combat vehicles capabilities and requirements previously identified.

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CHAPTER 1

INTRODUCTION

> *Far from being the twilight of the tank, the new era could become a great age of armor, but only if proponents and practitioners of mounted combat are willing to engage the future in a spirit of honest inquiry*.[1]
>
> - Ralph Peters

The tank was first employed at the Somme in 1916 to break the stalemate of the trench warfare that had been ongoing since the outbreak of the First World War. It was introduced to traverse mud and shell-cratered battlefields, break through wire fortifications and overcome trenches.[2] Charles Fuller observed that at Cambrai the predominant value of the tank was its moral effect and that it showed clearly that terror and not destruction was the true aim and end of armed forces.[3] Although its employment failed to change the static nature of war, its potential had been discovered and the nature of warfare would never be the same again.

The American, British, French, German and Russian armies all undertook the development of light, medium and infantry tanks during the interwar period. Charles Fuller, Basil Liddell Hart and Heinz Guderian were some of the most influential proponents of the tank at that time. Guderian had observed that in order to achieve striking power, "tank forces must be concentrated in large formations, and provided with

[1] Ralph Peters, "The Future of Armored Warfare," *Parameters* 27, no. 3 (Autumn 1997): 50.
[2] T.W. Terry, et al, *Fighting Vehicles* (London: Brassey's, 1991), 3.

the complementary and auxiliary weapons they need for independence of action… they are employed 'en masse' and depth."[4] The Second World War saw formations of tanks combined with infantry, artillery and aviation used to achieve swift victories. "The tactics of the armoured formations were influencing the design of fighting vehicles. Each country was searching for a design which provided the optimum balance between firepower, mobility and protection and all at an acceptable cost."[5] The concept of the Blitzkrieg was born and the tank would play a key role on the various theatres of operation throughout the war.

The concept of the Main Battle Tank was developed following the end of the Second World War. Main Battle Tanks are "fully-tracked, armoured vehicles equipped with a turret mounting a medium caliber, high velocity, quick-firing gun."[6] Countries attempted to develop tanks with high velocity guns to match against any other armoured vehicles on the battlefield and sufficiently well balanced to provide good protection and mobility. "The line of development was set for the next 40 years or so with the majority of countries pursuing the same basic concept of a balanced design, tempered by their past experience and national concepts of operations."[7] The Canadian Directorate of Land Strategic Concept defines three generations of Main Battle Tanks. The first generation of post World War II Main Battle Tanks includes the U.S. M48/M60, the German Leopard 1 and the British Centurion and Chieftain. The second generation includes most of the 120mm Main Battle Tanks such as the American M1A1, the German Leopard 2 and the

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[3] J.F.C. Fuller, *The Decisive Battles of the Western World and their Influence upon History*, vol. III (London: Eyre & Spottiswoode), 279.
[4] Gen (ret.) Heinz Guderian, *Achtung Panzer,* trans. Christopher Duffy (London : Arms and Armour, 1995) 171.
[5] T.W. Terry, *et al*, *Fighting Vehicles* (London: Brassey's, 1991), 15.
[6] Department of National Defence, *DOR (J & L) ORD Project Report PR 9817 Quarré de Fer: Analysis of the ACV in Warfighting* Task (Ottawa, On, 1998), A-2.

British Challenger. As for the third generation Main Battle Tank, they include the latest 'digital' tank such as the French Leclerc and perhaps the American M1A2 and the German Leopard 2A5.[8] With these broad definitions and categories the relevance of the Main Battle Tank will more easily be understood.

During the Cold War, Main Battle Tanks were predominantly developed to fight on the open plains of Northwest Europe. NATO and Warsaw Pact armies had land formations pre-positioned forward ready to be deployed to counter any threat. A factor that affected the operating environment was the shift of population from the rural areas to urban centres. The vulnerabilities of the Main Battle Tank in built-up areas and the high levels of casualties contributed to cold war armies choosing to avoid cities whenever feasible. The new global environment and the Revolution in Military Affairs have since contributed to change the face of the modern battlefield.

The 1990-1991 Gulf War and the 2003 Iraq War have demonstrated the increasing impact of other force multipliers on the battlefield. Information dominance, precision-guided weapons and air power have played a key role in the Allied victory over the Iraqi forces. With the ongoing Revolution in Military Affairs, modern armies may soon dominate operations in open and rolling terrain to the point where any target that can be detected will be engaged. This is likely to result in weaker enemies opting to fight an asymmetric war in order to avoid the strengths of these modern armies and focus on their weaknesses. "Today's armor, designed for a war that, blessedly, never was, is ill-designed for urban combat."[9] Future enemies relying on less sophisticated tanks and

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[7] T.W. Terry, *et al*, *Fighting Vehicles* (London: Brassey's, 1991), 16.
[8] Department of National Defence, *DLSC Report Armour Combat Vehicle Concept Paper* (Kingston, On, 1998), B-3/3.
[9] Ralph Peters, "The Future of Armored Warfare," *Parameters* 27, no. 3 (Autumn 1997): 56.

equipment are therefore likely to choose to fight in urban and complex terrain. The new security environment and the operating environment will both compel modern nations to be capable of rapidly projecting combat power in austere and hostile theatres abroad. These modern armies will be required to transform to lighter forces capable of expeditiously deploying in the early stages of a conflict. In urban terrain, armies will have to be prepared to transition rapidly from mid-intensity battles to Operations Other Than War and vice versa during the same conflict. Modern armies will thus be forced to review their doctrine, training and equipment and revisit the need for a Main Battle Tank.

Scope

The future of the Main Battle Tank is an issue that has attracted a lot attention over the past few years, especially since the end of the 1990-1991 Gulf War. It is a topic that must be carefully studied in order to understand the full ramifications of changes required to operate on the future battlefield. **This study will argue that by 2020, second and third generation MBT will have become obsolete and that a new generation of Combat Vehicles will be required to fight in built-up areas.** This study contains four main chapters. In the first chapter, an appreciation of the future security environment will be provided with a view to illustrate the obsolescence of second and third generation Main Battle Tanks by 2020. The second chapter will analyze the operating environment and demonstrate that a future combat vehicles will be required to operate in urban terrain by 2020. The third chapter will define capabilities and requirements of future combat vehicles. Finally, an assessment of the combat vehicle concepts of three of the most

modern NATO armies will be provided in order to determine if they will meet future combat vehicles ‘capabilities and requirements previously identified.

CHAPTER 2

THE FUTURE SECURITY ENVIRONMENT

If you make concessions, lower your guards and show weakness, you invite war.[10]

- Charles Kraufthammer

Introduction

In order to investigate the future of the Main Battle Tank, one must first be clear on what the defining features of the future security environment are. The nature of war, the current Revolution in Military Affairs, the future threats and the risks of conflicts are some of the dominant features which will define the new security environment in 2020. This chapter will analyze each of these features and attempt to determine their impact on modern armoured warfare in order to demonstrate the obsolescence of second and third generation Main Battle Tanks.

The Nature of War

Rogue and Failed States

The nature of war has significantly changed over the past decades. Conflicts no longer simply involve legitimate states but often involve failed or rogue states. The Canadian Directorate of Land Strategic Concepts asserts that "failed states suffer the breakdown of government control and essential services. Rogue states are unwilling or

[10] Charles Krauthammer, "The Barak Paradox," *Time Magazine*, vol. 156, no. 17, October 23, 2000, 80.

unable to abide by international law. Failed states may become rogues out of desesperation."[11] Most of the rogue or failed states are unlikely to have the expertise and financial means of fielding and maintaining modern armies. The forces of these states are likely to rely on legacy combat systems such as Main Battle Tanks that were designed during and for the Cold War.

Within the context of discussing failed states, Mary Kaldor argues that a new type of violence, which she refers to as 'new wars', has emerged over the past two decades, mainly in Africa and Eastern Europe as a result of the current global era.[12] She goes on to argue, "new warfare borrows from both revolutionary warfare and counterinsurgency. It controls from revolutionary warfare the strategy of controlling territory through political control rather than capturing territory from the enemy forces."[13] Shaye Friesen suggests that "the most likely form of future conflict will be intra-state warfare in the developing world, fuelled by ethnic and religious hatred, population growth and environmental degradation."[14] An example of these changes can be found in the Middle East where "the countries hosting Palestinian refugees might be treated as another cluster; since Israel made peace with the neighboring states, the conflict is no longer expressed in terms of interstates war and has begun to exhibit some of the characteristics of the new types of conflict."[15] Samuel P. Huntington is of a similar opinion stating that "we are entering a multi-civilizational world in which culture rather than ideology will be the bonding

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[11] Department of National Defence, *DLSC Report 99-2 The Future Security Environment* (Kingston, On, 1999), 11.
[12] Mary Kaldor, *New and Old Wars: Organized Violence in a Global Era* (California: Stanford University Press, 1999), 1.
[13] Ibid, 97.
[14] Shaye K Friesen, Some Recent Trends in Major Armed Conflicts, ORA, DLSC Research Note 9802 (Kingston, Department of National Defence, 1998).
[15] Mary Kaldor, *New and Old Wars: Organized Violence in a Global Era* (California: Stanford University Press, 1999), 109.

mechanism for societies and groups of states."[16] The Canadian Directorate of Land Strategic Concept has echoed his vision by stating, "nationalism and tribalism have replaced ideology as the leading causes of regional and local disputes. Disregard for international law and the rules of war often characterize these conflicts"[17] Identification to an ethnicity, a race or religion rather than ideology becomes the means of unifying people around a common cause. In summary then, although warfare in the past was conducted between organized and legitimate states, the literature indicates that future conflicts are likely to involve failed and rogue states that will typically be ill equipped to face modern armies.

Public Sensitivity to Casualties

The use of force will remain key to success on the battlefield but how this force is applied will change. Modern societies such as the United States and Canada have become intolerant towards the loss of lives in combat. Benjamin C. Schwarz suggests that, in the case of the United States, "belligerents have discovered and will capitalize on the fact that the U.S. public's sensitivity to casualties is the American Achilles' heel."[18] A Time/CNN poll conducted during the first week of the 2003 Gulf War demonstrated that 59% of Americans would support the war in Iraq if it resulted in the deaths of as many as 500 U.S. troops but only 34% would support it if it resulted in as many as 5000 troops.[19]

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[16] Samuel Huntington, *The clash of civilization and the Remaking of the World Order,* (New York, Simon & Schuster, 1996) quoted in Mary Kaldor, *New and Old Wars: Organized Violence in a Global Era* (California: Stanford University Press, 1999), 142.
[17] Department of National Defence, *DLSC Report 99-2 The Future Security Environment* (Kingston, On, 1999), 10.
[18] Lefebvre, *et al*, "The Revolution in Military Affairs: Its Implication for Doctrine and Force Development within the U.S. Army" in *The Operational Art: Developments in the Theories of War* (Westport, Connecticut: Praeger, 1996), 176.
[19] S. MacLeod, *et al*, "The Push for Baghdad," *Time Magazine*, vol. 161, no.14, April 7, 2003, 28.

The situation is not unique to North Americans but is common to most democratic countries around the world. Timothy L. Thomas argues that future enemies will attempt to capitalize on this vulnerability when he asserts that "long-term engagement works against the intruding force; as civilian casualties mount, every move is scrutinized in the media, and the international community bands together to scold the perpetrator."[20] The attractiveness for rogue countries to drag conflicts and fight in urban terrain where casualties are likely to be extremely high becomes obvious in the context of this study. One must therefore question the relevance of the current generations of Main Battle Tank designed to fight in open and rolling terrain in order to make use of the tanks' gun out to its maximum range. Irrespective of where future wars will take place, protection of soldiers will be paramount. How protection is achieved may differ from the conventional reliance on layers of armor.

Probability of Large Scale Conflicts

The nature of future warfare may have rendered the current Main Battle Tank obsolete. It is true that "the fact that technology has enhanced maneuverability and ranges has transformed the linear nature of the battlefield into a nonlinear or disengaged one."[21] Brigadier-General Steven Irwin convincingly argues that "large mechanized forces based on the Main Battle Tank are becoming but targets for smaller forces with enhanced situational awareness and lethality."[22] NATO's view is that "there is currently no

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[20] Timothy L. Thomas, "The Battle of Grozny: Deadly Classroom for Urban Combat," *Parameters* 29, no. 2 (Summer 1999): 100.
[21] Lefebvre, *et al*, "The Revolution in Military Affairs: Its Implication for Doctrine and Force Development within the U.S. Army" in *The Operational Art: Developments in the Theories of War* (Westport, Connecticut: Praeger, 1996), 177.
[22] BGen Steven Irwin. "A Multi-Purpose Capability and Advanced Technology," *Canadian Military Journal* 2, no. 4 (Winter 2001-2002): 54.

indication, not even in the long run, of a potential threat posed by a large-scale aggression using conventional and nuclear potentials that would endanger the very existence of one of NATO's member countries; such a probability is almost negligible. Also, conflicts like the 1990-1991 Gulf War can be considered as lower probability."[23] This assessment is therefore not likely to encourage countries to procure sophisticated and expensive second and third generation Main Battle Tanks knowing the high procurement cost and the logistics chain required to deploy these tanks to theatre of operations. [24] The nature of future wars is a key factor that will contribute to the obsolescence of second and third generation Main Battle Tanks.

The Threat - Asymmetric and Conventional

> *Now an army may be likened to water, for just as flowing water avoids the heights and hastens to the lowlands, so an army avoids strength and strikes weaknesses*.[25]
>
> - Sun Tsu

General

The Canadian Forces define asymmetric threats as "an attempt by a smaller, less powerful actor to inflict injury on a more powerful adversary by using surprise and deception to strike at targets that are difficult to defend by conventional means."[26] Since modern armies may soon dominate operations in open and rolling terrain, less powerful enemies will likely opt to fight an asymmetric war focusing instead on the weaknesses in

[23] NATO NAAG LG/2 Report, *Future of Armoured Forces*, PFP(NAAG)D(2002)22 (Brussels, 2002), 3.
[24] The 2003 Iraq War does not appear to contradict this statement as Iraqi conventional forces posed no threat to NATO nations. Although the coalition of the willing used the elimination of weapons of mass destruction as a premise for war, no such weapons had been used nor found two months after the beginning of the conflict.
[25] Sun Tsu, *The Art of War*, trans. Samuel B. Griffith (London: Oxford University Press, 1971), 101.
[26] Canadian VCDS testimony before SCONVA 6 May 02

order to avoid the strengths of modern armies. The idea of an asymmetric war is not new. As Sun Tsu stated, "when he (the enemy) concentrates, prepare against him; where he is strong, avoid him."[27] The September 2001 terrorist attacks on the World Trade Center in New York and the Pentagon in Washington highlight this threat in a more global manner.

Shift from Conventional to Asymmetric War

The 1990-1991 Gulf War demonstrated the vulnerability of a perceived well-equipped Iraqi Army against coalition forces that achieved air supremacy, information dominance and successfully deployed a very mobile land force. In a vast desert ideal for long-range sensors and weapon systems, the coalition A-10s alone destroyed more than 50 percent of all Iraqi Main Battle Tanks as well as 31 percent of all armoured personnel carriers.[28] The United States believe that future enemies will have learned key lessons from the 1990-1991 Gulf War and "are unlikely to confront us (the U.S.) conventionally with mass armour formations, air superiority forces, and deep-water naval fleets of their own, all areas of overwhelming U.S. strengths today. Instead, they may find new ways to attacks our interests, our forces, and our citizens. They will look for ways to match their strengths against our weaknesses."[29] During the 2003 Iraq War, Iraq employed the Fedayeen to "launch hit-and-run strikes. The Fedayeen and other Iraqi irregulars have employed deceptive tactics like shooting at allied forces while waving white flags."[30] Lieutenant-Colonel Brian McCoy was quoted as saying "the enemy has gone asymmetric

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[27] Sun Tsu, *The Art of War*, trans. Samuel B. Griffith, (London: Oxford University Press, 1971), 67.
[28] Capt Scott A. Fedorchak, "Close Air Support: Repeating the Past Again?," *Aerospace Power Journal* (Spring 1994); available from http://www.airpower.maxwell.af.mil/airchronicles/apj/apj94/fedor2a.html ; Internet; accessed 6 May 2003.
[29] National Defense Panel, *Transforming Defense: National Security in the 21st Century* (Washington, D.C.: Government Printing Office, December 1997), 11.
[30] S. MacLeod, *et al*, "The Push for Baghdad," *Time Magazine*, vol. 161, no.14, April 7, 2003, 23.

on us…There's treachery. There are ambushes. It's not straight-up conventional fighting."[31] This trend is likely to continue in the future.

LCol Newcombe, a U.S. Army officer, has argued that the current basic combat structure centered around the division is archaic and hardly relevant for the future types of war in which the army is likely to be involved. His proposal is to have smaller, flexible and easily deployed formations.[32] His view is shared by Andrew Krepinevich who stated, "given the likely continuing military superiority of the U.S., America will have great incentives to adopt a very unconventional approach."[33] Despite the identified need for change, "Twenty-eight non-NATO nations are currently assessed as possessing tank fleets of more than 1,000 Main Battle Tanks. Of these, 11 nations have more than 3,000 tanks."[34] There is an obvious disconnect between the needs and the reality. These Main Battle Tanks may very well become easy pray for modern armies in the future. It is therefore reasonable to assert that the structures of armoured formations and their role will have to be reviewed to reflect the realities of the modern battlefield.

Over the past few years, the U.S. have become more concerned with asymmetric threats than conventional ones. Joint Vision 2010 and 2020 are documents that guide the transformation of America's Armed Forces. "By developing and using approaches that avoid U.S. strengths and exploit potential vulnerabilities using significantly different methods of operation, adversaries will attempt to create conditions that effectively delay, deter, or counter the capabilities of the U.S. military. The potential of such military

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[31]Ibid, 23.
[32] Lefebvre, *et al*, "The Revolution in Military Affairs: Its Implication for Doctrine and Force Development within the U.S. Army" in *The Operational Art: Developments in the Theories of War* (Westport, Connecticut: Praeger, 1996), 182.
[33] Krepinevich, Andrew J. "The Clinton Defense Program: Assessing the Bottom-Up Review." *Strategic Review XXII* (1994), 20.

approaches is perhaps the most serious danger the U.S. faces in the immediate future and this danger includes long ballistic missiles and other direct threats to U.S. citizens and territory."[35] Potential adversaries are unlikely to be willing to face modern armies equipped with second and third generation Main Battle Tanks. Weapons of mass destruction which used to be weapons of last resort for conventional states may have become weapons of choice for rogue and failed states. As for armoured fighting vehicles designed for the Cold War, future combat vehicles will require the ability to fight in Nuclear, Biological and Chemical (NBC) conditions. Future enemies are also likely to choose to fight a defensive battle in an urban environment where "the sheer complexity of the network of roads, passages, squares, water barriers and bridges favour the defenders who are fully familiar with the area and have ample time to build defence works around and in the city."[36] As tanks are first and foremost designed to destroy other tanks, there is little incentive for modern nations to procure additional Main Battle Tanks that are especially vulnerable in cities.

An example that highlights the fact that Main Battle Tanks can be countered by less sophisticated means than a tank is the current conflict in the Middle East where a very modern and well-equipped Israeli army is facing off with the ill-equipped Palestinians. General Wesley K. Clark (ret.), formerly Supreme Allied Commander Europe, described the asymmetric nature of the conflict as follows:

> Israel developed new equipment, new forces and new tactics. To secure its borders, Israel deployed heavily armored tanks and troop-carrying vehicles.

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[34] Department of National Defence, *DLSC Report 99-2 The Future Security Environment* (Kingston, On, 1999), 58.
[35] Office of the Chairman of the Joint Chiefs of Staff, *Joint Vision 2020* (Washington, D.C.: Government Printing Office, June 2000), 4-5.
[36] Ralph Dykstra. "The Liberation of Groningen – An Urban Battlefield," *The Army Doctrine and Training Bulletin* 5, no. 3 (Fall 2002): 47-48.

> Apache helicopters, unmanned aerial vehicles and very long-range optics were procured. But for every action in military doctrine by one side there is a reaction by the other… the capabilities of the two sides, though totally asymmetric, were almost perfectly counterbalanced… For Israel, every street battle has to be tactical and defensive requiring responses aimed at protecting lives and property. For Israel, every casualty, even those among the Palestinians, is a loss. For the Palestinians, every clash is strategic and offensive, increasing the pressure on Israel, building support in the Arab world and, with every Israeli military response, affording the opportunity to further isolate Israel from its liberal, democratic and idealistic support. For the Palestinians, every casualty, even their own, can be a strategic gain.[37]

The 1995-1996 Chechnya War is a second example where the use of Main Battle Tanks by the Russians was easily countered by the Chechen forces. Colonel Vincent Goulding mentioned that "when the Chechens decided to use military means to achieve their independence, they did not hesitate for an instant to make their own capital city the battleground. Once forced to abandon Grozny, these hard-nosed fighters focused their efforts on other towns and villages in the region, some outside of their own borders."[38] Timothy Thomas added that the Chechens quickly realized that "they could accomplish two things with this tactic: they could negate Russian advantages of firepower in the open from helicopters, fixed-wing aircraft, and tanks, and they could blend in with local population to their advantage."[39] The war in Chechnya also demonstrates that by opting to fight in an asymmetric manner in urban terrain, an ill-equipped force does not require Main Battle Tanks to defeat Main Battle Tanks.

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[37] Gen (ret.) Wesley K. Clark, "How to Fight an Asymmetric War," *Time Magazine*, vol. 156, no.17, October 23, 2000, 30.
[38] Col Vincent Goulding. "Back to the Future with Asymmetric Warfare," *Parameters* 30, no. 4 (Winter 2000-01): 21.
[39] Timothy L. Thomas, "The Battle of Grozny: Deadly Classroom for Urban Combat," *Parameters* 29, no. 2 (Summer 1999): 91.

Some Technologies Required to Fight an Asymmetric War

General Wesley K. Clark (ret.) identified the key weapons to fight an asymmetric war as being intelligence assets and movement control.[40] There is a clear requirement for collection, processing and wide dissemination of intelligence at all levels. The battlefield of the future will require increased real time situational awareness. New tactics and procedures will need to be developed for movement control in order to identify snipers who mingled with the population. Ralph Peters, a retired American Army officer who has written frequently on modern warfare, offers a technological solution when he states that "population control might be established by electronically registering every inhabitant with whom the force comes in contact and alerting in response to any human concentrations that do not fit habitation profiles."[41] This solution would no doubt face ethical and legal challenges but remains one which should be considered.

Future combat vehicles should have the capability to track 'tagged' non-combattants which is in turn should reduce the likelihood of collateral damages. As well, they should also incorporate scent detection systems to assist with roadblocks in order to identify enemy soldiers who have mingled with non-combattants. Overall, the shift from conventional to asymmetric means to wage war is an important factor that will contribute to the obsolescence of the Main Battle Tank by 2020.

[40] Gen (ret.) Wesley K. Clark, "How to Fight an Asymmetric War," *Time Magazine*, vol. 156, no 17, October 23, 2000, 30.
[41] Ralph Peters, "The Future of Armored Warfare," *Parameters* 27, no. 3 (Autumn 1997): 58.

Revolution in Military Affairs

General

During the 1990's, several nations have embarked on the development of emerging military technologies combined with doctrinal and organizational changes to their armies. Several authors and scholars are still debating whether these profound changes are revolutionary or simply evolutionary. Although it is not intended to debate this issue, in order to fully understand the implications of the Revolution in Military Affairs (RMA) in the context of this discussion of the future security environment, it is important to provide a brief definition. The definition that is used for the purpose of this study is from Benjamin S. Lambeth who defines RMA as "a major change in the nature of warfare brought about by the innovative application of technologies which, combined with dramatic changes in military doctrine and operational and organizational concepts, fundamentally alters the character and conduct of military operations."[42]

The perceived impact of the RMA and the relevancy of current Main Battle Tanks on the future battlefield are important in the context of this study. Colonel Howie Marsh, special advisor to the Canadian Chief of the Land Staff, argues that

> The Revolution in Military Affairs, fueled by the microchip, is forcing future conflict into two streams: one swift, highly lethal, long-range and two, low lethality, very close range. Current operations in Afghanistan (2001-2002) are illustrative. Cruise missiles (long range) and Special Operations (very close range) are the capabilities of choice. [43]

At the same time as the current RMA increases the combat power of modern militaries, it may very well force potential enemies to focus on the weaknesses of these modern militaries. As well, military historian Martin van Creveld argues that "the

[42] Benjamin S. Lambeth, "The Technology Revolution in Air Warfare," *Survival* (Spring 1997): 75.

weakening of the state system will lead to low-intensity conflicts in which irrelevancy will characterize advance military technology."[44] The effectiveness of the surveillance satellite, the airplane, the attack helicopter, and smart artillery munitions have reduced the dominance that the Main Battle Tank once enjoyed on the battlefield. This trend is likely to continue in the future. The next sections will demonstrate that although technological advances do not automatically mean better chances of succeeding on the battlefield, they in fact signify that the Main Battle Tank has become a 'prey' for other weapon systems.

Impact of Information Superiority

Information Superiority is at the crux of getting inside one's opponent's decision-action cycles. It is the "capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same."[45] An army that achieves information superiority has a key advantage as it forces its opponent to react to its moves. It is therefore a domain that modern armies are currently trying to improve. Jeffrey Cooper argues, "information technologies will, at the operational level, be used to synchronize integrated operations conducted at high-tempo, with high lethality and high mobility, through the depth and extent of the theater."[46] This view is shared by the United States which has enunciated its Joint Vision 2020 by stating

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[43] Col Howie Marsh. "Future of Armour: in Three Steps," *Armour Bulletin* 34, no. 1 (2002): 11.
[44] Lefebvre, *et al*, "The Revolution in Military Affairs: Its Implication for Doctrine and Force Development within the U.S. Army" in *The Operational Art: Developments in the Theories of War* (Westport, Connecticut: Praeger, 1996), 175.
[45] Office of the Chairman of the Joint Chiefs of Staff, *Joint Vision 2010* (Washington, D.C.: Government Printing Office, 1996), 16.
[46] Lefebvre, *et al*, "The Revolution in Military Affairs: Its Implication for Doctrine and Force Development within the U.S. Army" in *The Operational Art: Developments in the Theories of War* (Westport, Connecticut: Praeger, 1996), 176.

> The joint force of 2020 will use superior information and knowledge to achieve decision superiority, to support advanced command and control capabilities, and to reach the full potential of dominant maneuver, precision engagement, full dimensional protection, and focused logistics. The breadth and pace of this evolution demands flexibility and a readiness to innovate.[47]

In essence, future forces will have to have enhanced situational awareness systems as part of future combat vehicles. In this context, "simulations indicate that armour forces that really know where they are, know where their attachments and detachments are, and know precisely the enemy's location are at least 50% more effective. Future combat vehicles should therefore be connected to situational awareness systems in order to fully benefit from information superiority."[48] This will no doubt present some interoperability challenges for more modern nations because of the various types of command and control information systems currently being fielded by their armies.

Impact of Network Centric Warfare

Future network centric armies will link their various manned and unmanned, direct and indirect, surveillance and command and control systems through information systems in order to synchronize their deep, close, and rear operations on the battlefield. Therefore, "the development of information-distributed systems will be fundamental. Only these can put intelligence where it is needed in real-time."[49] The United States has

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[47] Office of the Chairman of the Joint Chiefs of Staff, *Joint Vision 2020* (Washington, D.C.: Government Printing Office, June 2000), 10.
[48] Col Howie Marsh. "Future of Armour: in Three Steps," *Armour Bulletin* 34, no 1, (2002): 14.
[49] Lefebvre, *et al*, "The Revolution in Military Affairs: Its Implication for Doctrine and Force Development within the U.S. Army" in *The Operational Art: Developments in the Theories of War* (Westport, Connecticut: Praeger, 1996), 176.

clearly enunciated the requirement for network-centric forces in Joint Vision 2010 by stating,

> Greater mobility and increased dispersion will, in turn, require additional communications and coordination capabilities since the synchronization of these dispersed elements will become even more important… improved command and control, based on fused, all-source, real-time intelligence will reduce the need to assemble maneuver formations days and hours in advance of attacks.[50]

An experiment conducted by the Canadian Directorate of Land Strategic Concept demonstrated that forces with a high level of situational awareness coupled with extended range assets have "considerable latitude in both composition and timing of establishing a reserve. This same situational awareness facilitated dispersion down to the sub-sub unit level for manoeuvre forces and down to individual systems for indirect assets. This dispersion enhanced security and survivability through negating counter-fire while still allowing the massing effects through the Effects Coordination Cell."[51] Network centric forces will therefore have a clear advantage over less modern forces. As such, forces equipped with future combat vehicles should therefore possess near-real time situational awareness systems in order to improve their decision-action cycles.

Impact of Future Weapon Systems on the Battlefield

The technological advance of some weapon systems will have a tremendous impact on the modern battlefield. "From a broad examination of twentieth-century warfare, two trends emerge. First, combat aircraft employed in a combined-arms maneuver-oriented campaign are tremendously effective. But the second major trend is

[50] Office of the Chairman of the Joint Chiefs of Staff, *Joint Vision 2010*, Washington, D.C.: Government Printing Office, 1996), 15, 18.

that aircraft operating independently of other arms generate mass destruction but little operational payoff."[52] Advances in advanced precision munitions, unmanned aerial vehicles, attack-helicopters, field artillery and anti-armour weapons and their synchronized employment with other arms will represent an increasing threat for current Main Battle Tanks.

The accuracy and employment of advanced precision munitions have increased tremendously over the past decade. They accounted for 6 percent of the munitions dropped over Iraq during the 1990-1991 Gulf War, 35 percent during the 1999 Kosovo War and 60 percent during the 2002 Afghanistan War.[53] During the first five days of the 2003 Iraq War, "80% of weapons dropped or launched were precision guided."[54] This trend is likely to continue in the future and should result in the reduction of collateral damage. Unmanned aerial vehicles are mainly designed to conduct surveillance, target acquisition and reconnaissance missions. The American forces in Afghanistan used the Predators and Global Hawks to successfully track movements of terrorists and Taliban forces. [55] On one occasion, the coordinates of suspected al Qaeda terrorists setting up ambushes were passed quickly to an orbiting B-52 which resulted in more than 200

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[51] Department of National Defence, *DLSC Report Future Army Experiment – Operations in the Extended Battlespace.* Kingston, On, 2001, 9-10.
[52] Robert R. Leonhard, *The Art of Maneuver: Maneuver-Warfare Theory and Air Land Battle* (California: Presidio Press, 1991), 161.
[53] Elinor Sloan, *The Revolution in Military Affairs: Implications for Canada and NATO* (Montreal: McGill-Queen's University Press, 2002),149.
[54] Nick Cook, "The First Week of the Air War. Shock and Awe," *Jane's Defence Weekly* 39, no. 13 (2 April 2003): 21.
[55] The RQ-1A Predator is a long endurance, medium altitude unmanned aircraft system for surveillance and reconnaissance missions. Surveillance imagery from synthetic aperture radar, video cameras and a forward looking infra-red (FLIR) can be distributed in real time both to the front line soldier and to the operational commander or worldwide in real time via satellite communication links. The RQ-4A Global Hawk is a high-altitude, long-endurance unmanned aerial reconnaissance system designed to provide military field commanders with high resolution, near-real-time imagery of large geographic areas. Advanced technology sensors, a range greater than half-way around the world, and the ability to remain in

terrorist deaths.[56] The American forces deployed in Afghanistan during OPERATION ENDURING FREEDOM went as far as using unmanned combat aerial vehicles such as their Predator armed with precision-guided munitions to carry out strikes against Taliban and Al-Quaida targets.[57] Colonel Howie Marsh asserts that "surveillance assets, both commercial and military can detect most warm objects in open terrain. If you can be seen, you can be hit, and if hit, destroyed."[58] Movements of second and third generation Main Battle Tanks will become more and more difficult to conceal especially in open terrain. Advanced precision munitions will therefore represent an increasing threat to current Main Battle Tanks that rely on passive protection such as rolled homogeneous armor[59]. Technological advances in the field of information superiority, network centric warfare and future weapon systems will contribute to render Main Battle Tanks obsolete by 2020.

Most Probable Threat Versus Highest Risk

General

The development of military technology must not only consider the most probable risk but also the highest one. "In an effort to look ahead, NATO has adopted a vision of the future operational environment that posits two forms of conflict: either a conventional

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flight for long periods of time, enables the Global Hawk to provide the war fighter with the essential intelligence needed to achieve information dominance throughout the ever-changing battle-space.

[56]Kenneth R. Israel, "No Place to Hide", *Unmanned Vehicles* 7, no. 5, 5.

[57] Elinor Sloan, *The Revolution in Military Affairs: Implications for Canada and NATO* (Montreal: McGill-Queen's University Press, 2002),149.

[58] Col Howie Marsh. "Future of Armour: in Three Steps," *Armour Bulletin* 4, no. 1 (2002): 11.

conflict between national entities assessed as highest risk or a asymmetric conflict which is assessed as being the most probable.[60] NATO has stated that "armies must remain capable of carrying out operations in various conflicts and scenarios, starting from the lowest intensity up to very high intensities."[61] As NATO countries struggle to precisely identify the threat for the next decades, their armies must therefore transform not based on a specific threat but based on a myriad of capabilities required to operate in the full spectrum of conflict.

Requirement for Expeditionary Forces

Within the context of transforming towards capability-based armies, modern nations must ensure that their forces can be rapidly deployed into austere and/or hostile theatres in the early stages of a conflict and thus contribute to restoring or maintaining peace and security. "Some have emphasized the need for more light armored units as they will likely be the first to deploy in future contingency operations."[62] In doing so, they can be rapidly employed within a theatre of operations to defuse tensions, deter further aggressions, defend the territorial sovereignty of a nation or restore its international borders before adversaries have had the opportunity to strengthen their tactical positions and augment their combat power. Whereas during the Cold War, the emphasis was mostly placed on the tactical mobility of pre-positioned forces, the future security environment has shifted the emphasis to the strategic and operational mobility of future

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[59] Rolled Homogeneous Armor is a process of armor manufacturing that ensures its uniformity and enhances resistance to penetration.
[60] Department of National Defence, *DLSC Report 99-2 The Future Security Environment* (Kingston, On, 1999), 37.
[61] NATO NAAG LG/2 Report, *Future of Armoured Forces*, PFP(NAAG)D(2002)22 (Brussels, 2002), 3.

contingency forces while reducing the logistics tails. The requirement for speed appears to have overtaken the requirement for mass.

Risk Management

While NATO armies are transforming, it is important to point out that with the exception of the 1990-1991 Gulf War and the 2003 Iraq War, several of the past conflicts involving modern armies did not have a threat that required the intervention of Main Battle Tanks to defeat. The British and Argentinean forces did not deploy Main Battle Tanks to the Falklands in 1982. The M1 tank and its predecessor the M60 were not part of U.S. operations in Grenada (1983), Panama (1989) and Somalia (1993). Light infantry and helicopters were used in Grenada while infantry, helicopters, M551 Sheridans, and U.S. Marine Corps LAV-25s were used in Panama.[63] The Americans during OPERATION ENDURING FREEDOM deployed no Main Battle Tanks to Afghanistan in 2002. Considering that most conflicts over the past decades did not involve Main Battle Tanks, modern armies can potentially assume the risk of not retaining Main Battle Tanks as long as they have other assets that can counter the capabilities of the enemy. Nations assuming this risk are likely to declare their own fleet of Main Battle Tanks obsolete.

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[62] Lefebvre, *et al*, "The Revolution in Military Affairs: Its Implication for Doctrine and Force Development within the U.S. Army" in *The Operational Art: Developments in the Theories of War* (Westport, Connecticut: Praeger, 1996), 182.
[63] Major Harold L. Spurgeon and Stanley C. Crist. "Armor in the 21st Century," *Armor*, January/ February, 1994, 13.

Summary

This chapter has argued that within the context of the new security environment, second and third generation Main Battle Tanks will be obsolete in 2020. The analysis of the nature war has demonstrated that future conflicts are likely to involve failed and rogue states often ill-equipped to face modern armies. These states will not have the financial means of fielding modern military equipment and may at best rely on equipment dating back to the Cold War. The future security environment suggests that protection of soldiers will continue to be paramount and that armies will likely be smaller, more flexible, lethal and easily deployed contingency forces in order to have the ability to project power to austere theaters.

The study of the future threat has revealed that the dominance that modern armies will achieve on the battlefield will force their future adversaries to avoid their strengths and focus instead on their weaknesses. The 1995-1996 Chechnya War and the current conflict in the Middle East between Israel and Palestine highlight the fact that, by opting to fight in an asymmetric manner, Main Battle Tanks can be countered by less sophisticated means than a tank in urban terrain. There will therefore be little incentive for modern nations to procure additional Main Battle Tanks that are especially vulnerable in cities.

The technological development which are taking place in the current Revolution in Military Affairs highlight the fact that the effectiveness of the surveillance satellite, the airplane, the attack helicopter, and smart artillery munitions have reduced the dominance of the Main Battle Tank on the battlefield. The Main Battle Tank has in fact become a 'prey' for other weapon systems.

Finally, future armies will need to be capability-based instead of threat-based in order to face both most probable and highest threats. Future contingency forces will require a high degree of strategic and operational mobility to be prepared to face the challenges of the new security environment. As most conflicts over the past decades did not involve Main Battle Tanks, modern armies can risk not having Main Battle Tanks as long as they have other combat systems that can target enemy armoured formations. Overall, we can logically anticipate that second and third generation Main Battle Tanks will be rendered obsolete by 2020.

CHAPTER 3

THE OPERATING ENVIRONMENT

The worst policy is to attack cities. Attack cities only when there is no alternative.[64]

- Sun Tsu

Introduction

An understanding of the operating environment is key to comprehending the capabilities and vulnerabilities of the current generations of Main Battle Tanks. The U.S. Army Training and Doctrine Command identifies three broad categories of terrain as open and rolling, urban and complex such as forest, jungle, and mountains. Complex terrain is characterized by steep and heavily dissected terrain containing steep slopes with sudden elevation changes, circuitous gaps and passes with a large number of severe slope variation. [65] The reduced line-of-sight and the requirement to dismount from the vehicles are the key differences between urban and complex terrain, and open and rolling terrain. Complex terrain is a unique environment requiring specialized training and skills that are beyond the scope of this study. This chapter will therefore focus on open and rolling and urban terrain.

The capabilities required to fight in urban terrain are quite different from those required in open and rolling terrain. Open and rolling terrain allows armoured formations

[64] Sun Tsu, "The Art of War", trans. Samuel B. Griffith (London: Oxford University Press, 1971), 78.

to manoeuvre, detect and engage targets at long range which is not the case in urban terrain when units and sub-units engaged often have little or no mutual support. The conduct of armoured warfare in urban terrain highlights the vulnerabilities of the Main Battle Tank, which will have to be overcome in the future. Although the Main Battle Tank has since the Second World War dominated the battlefield in open and rolling terrain, this situation is about to change.

This chapter will analyze the operating environment and demonstrate that future combat vehicles will be required to operate in urban terrain in 2020. Some characteristics of open and rolling terrain and urban terrain and their impact on the Main Battle Tank will be analyzed using historical references and focusing on past conflicts in Iraq and Chechnya.

Open and Rolling Terrain

General

Open and rolling terrain includes the physical characteristics of flat desert and vegetated plains.[66] The progress achieved in target acquisition and surveillance systems have made it extremely difficult to mask the movements of armoured formations in open and rolling terrain.

Vulnerabilities of Armoured Formations in Open and Rolling Terrain

The 1990-1991 Gulf War was an example that supports this theory as hundreds of Iraqi tanks were left to the mercy of allied air power and artillery assets at maximum

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[65] U.S. Army Training and Doctrine Command, *PAM 525-3-90 O & O* (Fort Monroe, Virginia, 22 Jul 2002), E-2.

range. "As Iraqi tank crews learned through bitter experience, the tank has no effective defence against attack from the air."[67] Some analysts share this assumption asserting that "with the benefit of 20/20 hindsight, it can be argued that the ground phase of DESERT STORM could have proceeded apace without the presence of the M1; missile-firing Apaches and Cobras could have eliminated any Iraqi tanks foolish enough to offer resistance, while Bradley-mounted infantry collected surrendering enemy soldiers."[68] A similar scenario took place during the 2003 Iraq War where U.S. forces quickly established air supremacy. "As ground forces moved closer to Baghdad, the Army's AH-64 and Marine AH-1 helicopter gunships that accompanied them north began pulverizing Iraqi armor and the troops around them."[69]

Ralph Peters has enunciated an interesting vision of the future which is as follows

> The long-term trend in open-area combat is toward overhead dominance by U.S. forces. Battlefield awareness may prove so complete, and precision weapons so widely-available and effective, that enemy ground-based combat systems will not be able to survive on the deserts, plains and fields that have seen so many of history's great battles. Our enemies will be forced into cities and other complex terrain, such as industrial developments and inter-city sprawl, where our technical reconnaissance means cannot penetrate or adequately differentiate and our premier killing systems cannot operate as designed. We will become victim of our success. We are becoming so powerful at traditional modes of warfare that we will drive our enemies into environments where our deficiency plummets, our effectiveness drops, and close combat remains the order of the day. We will fight in cities, and we need tanks that can fight and survive in their streets.[70]

This view corresponds to the analysis of the future security environment completed in Chapter 2. Main Battle Tanks moving in open and rolling terrain are now

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[66]Ibid, E-2.
[67] Major Harold L. Spurgeon and Stanley C. Crist. "Armor in the 21st Century," *Armor*, January/ February, 1994, 12.
[68]Ibid, 13.
[69] S. MacLeod, *et al*, "The Push for Baghdad," *Time Magazine*, vol. 161, no.14, April 7, 2003, 26.
[70] Ralph Peters, "The Future of Armored Warfare," *Parameters* 27, no. 3 (Autumn 1997): 53-54.

easily detected and engaged by emerging surveillance and weapon systems. Future adversaries are likely to position their legacy Main Battle Tanks near inhabited areas in order to overcome their vulnerability to surveillance, direct and indirect fire systems when employed in open and rolling terrain.

Role of Future Combat Vehicles in Open and Rolling Terrain

But will there be a role for a future combat vehicle in open and rolling terrain? The analysis of the current Revolution in Military Affairs has highlighted the capabilities of various military technologies against moving Main Battle Tanks. Should future adversaries choose to fight a conventional war, future combat vehicles could be employed to force the movement of enemy Main Battle Tanks so that they become predictable and vulnerable. Infantry units, supported by combat systems such as attack helicopters, artillery, unmanned combat aerial vehicles and unmanned ground vehicles could then attack these legacy Main Battle Tanks.

Up to this stage, it has been demonstrated that Main Battle Tanks have become extremely vulnerable to combat systems other than tanks in open and rolling terrain over the past years. The ability of air and artillery assets to detect and engage moving legacy Main Battle Tanks has greatly improved over the past decade. There is therefore no requirement for modern militaries to continue to field their forces with Main Battle Tanks for operations in open and rolling terrain.

Urban Terrain

General

Urban terrain is characterized by the "multi-dimensional aspects of the terrain: airspace, super surface, intra-surface, surface and ground and subterranean corridor."

Vulnerabilities of Main Battle Tanks in Urban Terrain

The use of Main Battle Tanks in urban terrain is more limited than in open and rolling terrain. NATO Land Force Tactical Doctrine states that "although the brunt of operations in built-up areas falls on the infantry, their success will depend on all arms cooperation. This includes the use of armour which, with close infantry protection, can provide intimate direct fire support."[75] They will be of particular value in the assault as cut-off troops and in dominating open areas[76] An urban battle which highlights the vulnerabilities of Main Battle Tanks is the first battle of Grozny. This took place in January 1995 when the Chechens held their own for three weeks but eventually lost the city to the Russian armed forces in late January. They quickly and effectively adapted their tactics to counter the Russian threat and managed to retake the city in August 1996.

Main Battle Tanks are vulnerable to short range anti-tank weapons due to their lack of mobility in built-up areas as they are confined to roads and streets often filled with obstacles such as rubbles, anti-tank mines and wire obstacles. This was evident during the battle of Grozny. Chechen soldiers testified that "the Russian soldiers stayed in their armour, so we just stood on the balconies and dropped grenades onto their vehicles as they drove underneath."[77] In addition to grenades, the Chechens extensively employed the rocket propelled grenade launcher (RPG). "The RPG was the most feared by the Russians because of its multiplicity of uses. It could be used to shoot over buildings like a

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[74] Lefebvre, *et al*, "The Revolution in Military Affairs: Its Implication for Doctrine and Force Development within the U.S. Army" in *The Operational Art: Developments in the Theories of War* (Westport, Connecticut: Praeger, 1996), 175.
[75] NATO Allied Tactical Publication 35(B), *Land Force Tactical Doctrine* (Brussels, December 1995), 11-16.
[76] Ibid, 11-16
[77] Col Vincent Goulding. "Back to the Future with Asymmetric Warfare," *Parameters* 30, no. 4 (Winter 2000-01): 27.

high-trajectory mortar, and it could be used either as an area weapon when fired over troop formations or as a precision weapon when fired directly at armored vehicles. Some destroyed Russian tanks were hit more than 20 times by RPGs.[78] Similar vulnerabilities were witnessed in Southern Lebanon where Israeli Main Battle Tanks were attacked "from above or from the side by RPGs and anti-tank missiles posed a substantial threat. These situations led to add-on armour packages and also to an Israeli development of heavy Armoured Personnel Carriers."[79] The turrets of future combat vehicles should therefore have enough protection to counter anti-tank rockets fired from the heights.

The employment of Main Battle Tanks in built-up areas is also restricted by buildings which hinder the full traverse of turrets and the limitations in the elevation of the gun which is often insufficient to reach top floors and roof tops.[80] "Grozny was a three tiered fight (upper floors of buildings, street level, and subterranean or basement), and the weapons had to fit. Russian tanks could not lower their main gun tubes and coaxial machine guns low enough to shoot into basements harboring Chechen fighters.

To correct this problem, the Russians put ZSU-23-4 self-propelled, multi-barreled, antiaircraft machine guns forward with columns to fire at heights and into basements."[81] Future combat vehicles will require weapons systems that allow all around engagement as well as the capability to engage the top and basement of buildings.

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[78] Timothy L. Thomas, "The Battle of Grozny: Deadly Classroom for Urban Combat," *Parameters* 29, no. 2 (Summer 1999): 93-94.
[79] NATO NAAG LG/2 Report, Future of Armoured Forces, PFP(NAAG)D(2002)22 (Brussels, 2002), 4.
[80] NATO Allied Tactical Publication 35(B), *Land Force Tactical Doctrine* (Brussels, December 1995), 11-16
[81] Timothy L. Thomas, "The Battle of Grozny: Deadly Classroom for Urban Combat," *Parameters* 29, no. 2 (Summer 1999), 95.

Counter Arguments

Proponents of the Main Battle Tank may use the example of the 2003 Iraq War to highlight the success that the Abrams M1A1 Main Battle Tank had in Baghdad. Some claimed that "the heavily-armoured Abrams, which has been updated many times, proved invaluable in the risky urban battles that coalition forces fought."[82] A careful analysis must first be done before drawing hasty conclusions.

The battle of Baghdad did not seek to exploit the vulnerabilities of the Main Battle Tank. It is important to first state that the city itself is not representative of most major cities found in rogue and failed states. Baghdad is separated by distinct geographical features such as the Tigris River which allows the city to be isolated into sectors. The city is not made up of 'urban canyons' as "much of Baghdad has been paved to make way for two-storey, western-style cement housing and low-slung commercial areas."[83] These low buildings with no basement did not allow the Iraqi forces to fully exploit the Main Battle Tank's limitations in the elevation of the gun and allowed A-10 airplanes and AH-1 and AH-64 helicopter gunships to provide support to U.S. armoured formations operating in Baghdad.[84] Vincent Hugeux asserts that "Baghdad is made up of large and rectilinear avenues which do not advantage guerilla actions (liberal translation)."[85] These large streets which allowed turrets to fully traverse combined with the absence of obstacles and the reliance of Iraqi forces on rudimentary short range anti-armour weapons allowed the U.S. forces to exploit the mobility and firepower of their

[82] Peter Cheney, "Iraq Combat Shows Strengths, Flaws of Tanks, Aircraft, Other Systems," *Globe and Mail*, 21 April 2003, A6 .
[83] Johanna McGreary, "Inside Baghdad," *Time Magazine*, vol. 161, no.15, April 14, 2003, 29.
[84]Ibid, 24.
[85] Vincent Hugeux, "Comment Saddam Mène son Dernier Combat," *L'Express International*, no. 2700 (Semaine du 3 au 9 avril 2003), 46.

M1A1 Abrams. This may explain why on one instance, "more than 50 U.S. Army vehicles, led by M1 tanks and Bradleys, suddenly powered into the center of Baghdad. Cruising at 40 km/h, the patrol shredded the enemy, killing perhaps more than 1,000 Iraqis who dared to take it on."[86] It can therefore be asserted that the absence of obstacles, the lack of more modern short range anti-armour weapons, the large streets and low buildings combined with poor defensive tactics are all contributing factors which did not allow Iraqi troops to exploit the inherent weaknesses of the M1A1 Abrams Main Battle Tank. The battle of Baghdad does not in itself constitute a proof that the Main Battle Tank can operate in urban terrain.

Likelihood of Future Conflicts Taking Place in Urban Terrain

It is reasonable to assert that the future battlefield will increasingly take place in built-up areas. Urban combat may very well be unavoidable in 2020. Although several vulnerabilities must still be overcome, Vincent Goulding convincingly argues that

> Preoccupation with the tactical level of fighting in Grozny is dangerous if it serves only to convince U.S. military planners that their limited number of very expensive forces should avoid future urban fights at all costs. The very best way to surprise future enemies is to fight them well where they least expect it. The lesson of Grozny is not that we should not fight in the city, but that we must… The constant linking of urban warfare and casualties will become a self-fulfilling prophecy only if we allow it to.[87]

As future adversaries are likely to exploit the weaknesses of modern nations and attempt to neutralize the technological advantages that will result from the current

[86] Johanna McGreary, "Target: Saddam," *Time Magazine*, vol. 161, no.15, April 14, 2003, 21.
[87] Col Vincent Goulding, "Back to the Future with Asymmetric Warfare," *Parameters* 30, no. 4 (Winter 2000-01): 25, 29-30.

Revolution in Military Affairs, modern nations must be ready and willing to fight in urban terrain.

The 'Three Block War'

While during the Cold War, armies mainly trained to prepare for high intensity conflict, a great percentage of training is today dedicated to Operations Other Than War. This is in part due to the increase in UN operations around the world which most often requires the deployment of peacekeepers in urban centres. An interesting view of future urban warfare is the "three-block war" described by General Charles Krulak, the former commandant of the Marine Corps. General Krulak describes the future of urban operations as "the three-block war" where "we can expect to be providing humanitarian assistance in one part of the city, conducting peacekeeping operations in another and be fighting a lethal mid-intensity battle in yet a third part of the city."[88] This has been the case for the British Forces during the battle of Basra during the 2003 Iraq War. The 1st UK Armoured Division was simultaneously fighting the Fedayeen in Basra, supporting humanitarian assistance such as the distribution of food and water on the outskirt of the city while providing security patrols elsewhere. Future combat vehicles should have a high level of adaptability in order to allow formations to be capable of operating in a 'three-block war'.

It has so far been demonstrated that in the future, the main role of fighting vehicles in urban terrain will be to protect manoeuver, movement, and resupply. Future

[88] Charles C. Krulak, "The Three Block War: Fighting in Urban Areas," National Press Club, Vital Speeches of the Day, 15 December 1997.

fighting formations should be equipped with combat vehicles that will allow them to successfully conduct urban operation across the full spectrum of conflict.

Summary

The study of open and rolling terrain has demonstrated that the Main Battle Tank has become extremely vulnerable to combat systems other than tanks over the past few years. Air and artillery assets now possess superior ability to detect, engage and kill moving legacy Main Battle Tanks. This highlights the fact that there is no more a requirement for modern militaries to continue to field their forces with Main Battle Tanks for operations in open and rolling terrain.

The analysis of the first battle of Grozny has highlighted the vulnerabilities of the Main Battle Tanks in urban terrain and that a future combat vehicle will be required to support dismounted troops. The turrets of future combat vehicles will require protection to counter short range anti-tank weapons fired from the heights. Future combat vehicles will require weapons systems that allow all around engagement as well as the capability to engage the top and basement of buildings. Future combat vehicles should also possess a high level of adaptability in order to allow formations to be capable of simultaneously fighting in built-up areas, enforcing peace and supporting humanitarian assistance in different parts of a city.

As the analysis of the future security environment demonstrated in Chapter 2, future adversaries from rogue and failed states are likely to choose to fight an asymmetric war instead of a more conventional war. Urban terrain offers great potential for less modern forces as it diminishes the technological advantages that modern nations will

inherit from the current Revolution in Military Affairs. Urban terrain has the potential to cause a high level of casualties within modern forces whilst their respective nations are less tolerant towards losses in human lives. This chapter has argued that a future combat vehicle will be required to fight both in urban terrain and in open and rolling terrain. In open and rolling terrain the future combat vehicle should be employed mainly to force adversary forces to move and thus be detected and engaged by other friendly weapon systems. Future combat vehicles should have a high level of adaptability in order to allow formations to be capable of operating in a 'three-block war'. The next chapter will look at what capabilities will be required by future combat vehicles in order to operate in urban and open and rolling terrain.

CHAPTER 4

THE REQUIREMENTS AND CAPABILITIES OF FUTURE COMBAT VEHICLES

Change encounters less obstacles shortly before the outbreak of a war… A danger sensed by all muffles the voice of intrigue, and the innovation appears as a smaller evil that must be accepted to avoid a greater.[89]

- Frieddrich von Decken, 1800

Introduction

The main characteristics of Main Battle Tanks that will be discussed in this chapter are mobility, firepower, protection and adaptability.[90] Communication, surveillance and sustainment are secondary characteristics which will not be analyzed as their importance is similar for most families of armoured fighting vehicles. The weight of Main Battle Tanks is a limiting factor that influences the balance between mobility, firepower, protection and adaptability. Current Main Battle Tanks that offer a high level of protection have to pay a hefty penalty in weight. The key characteristics of future combat vehicles are unlikely to change in the future. However, the weight will have a greater influence on these characteristics due to the requirement for modern armies to more rapidly project power abroad with a higher 'teeth-to-tail' ratio. This chapter will

[89] Bryon E. Greenwald. "The Anatomy of Change: Why Armies Succeed of Fail at Transformation," *The Land Warfare Papers* 35 (September 2000): 15.

analyze each of these characteristics and determine the operational capabilities required by future combat vehicles to operate in open and rolling and urban terrain.

Mobility

General

Mobility represents a "quality or capability of military forces which permits them to move from place to place while retaining the ability to fulfill their primary mission."[91] The study of the future security environment completed at Chapter 2 has revealed that as modern armies evolve from threat to capability based forces, overseas deployment to austere theatres will occur more often. Modern forces will be required to be more mobile in order to achieve dispersion within theaters of operations and maintain a higher tempo than hostile forces. This section will analyze the level of strategic, operational and tactical mobility required by expeditionary forces equipped with future combat vehicles.

Strategic Mobility

Strategic mobility is defined as "the capability to move forces and associated logistic support quickly and effectively over long distances; between theatres, regions or out of area."[92] The examination of the most probable threat and of the highest risk has highlighted the importance for nations to be able to deploy contingency forces as early as possible to austere theatre of operations while reducing the logistics tails. The requirement for strategic mobility becomes paramount and must be considered for the

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[90] Adaptability is a characteristics required to transition from mid-intensity operations to Operations Other Than War and back as required.
[91] NATO Allied Administrative Publication no. 6, *Glossary of Terms and Definitions* (Brussels, 2002), 2-M-7.

development of future combat vehicles. The movement of forces from homeland to theatres of operations can be done using train, sealift and airlift. The most expeditious way of deploying a force in the early stages of a conflict, particularly to deter and defend, remains airlift as sealift is much slower and deployment by train is most often not possible.

Lighter vehicles are easier to deploy strategically by air than heavier Main Battle Tanks. Spurgeon and Crist argue, "air-transportability is an obvious requirement, one easily met by minimizing the weight factor. A comparison between the Light Armoured Vehicle (LAV) III and the M1A1 Abrams supports this statement. C5A and C-17A airlifters can respectively transport four and two LAV III (14.2 tonnes unloaded) on board but only a single M1A1 Abrams (63 tonnes). [93] The airlift of a squadron of 18 future combat vehicles similar to the LAV III would therefore require four C5A lifts while the same squadron equipped with M1A1 Abrams would require 18. The advantages of lighter vehicles from a strategic mobility point of view are evident. The unloaded weight and dimension specifications of future combat vehicles should therefore be similar to those of the LAV III in order to minimize the strategic mobility requirements of modern forces.

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[92] NATO MC 336/1 The Movement and Transportation Concept for NATO. Web site; available online from http://www.nato.int/docu/logi-en/1997/defini.htm ; Internet; accessed 4 Feb 03.
[93] Jane's, *Armour and Artillery*, ed. Christopher F Foss (Surrey, U.K.: Jane's Information Group Limited, 2002), 154, 193, 430, 433.

Operational Mobility

Operational mobility is defined as "the capability to move forces and logistic support within a region."[94] Operational airlift is most often carried out by C-130 Hercules which is normally used as the norm for operational mobility by air. As well, helicopters such as the Sikorsky CH53E employed by the U.S. Marines can provide operational mobility as it can lift vehicles such as the LAV within a theatre of operation.[95] The C-130 (maximum allowable payload 20.4 tonnes) and the CH-53 (maximum payload 16 tonnes) in the sling position) can each transport one LAV III.[96] Future combat vehicles should be air-deployable by C-130 as well as by CH-53E. Their weight must therefore be no more than 20.4 tonnes and should ideally be less than 16 tonnes once equipment such as up armour packages, spare tires, etc. have been removed.

The weight of the current Main Battle Tanks also restricts their movements within a theatre of operations not only by air but also by roads. Main Battle Tanks often tear up roads and break down bridges. The experi

future combat vehicles weight less than 30 tonnes including up armour packages, spare tires and other equipments in order to deploy using restricted roads and bridges .

Tactical Mobility

Tactical mobility is defined as "the capability to concentrate regional in-place forces up to divisional level against the major local enemy thrust."[98] The analysis of the operating environment completed at Chapter 3 has revealed that a future combat vehicle will be required to operate in urban terrain. Future combat vehicles may also be required to operate in open and rolling terrain to force adversaries to move in order to become vulnerable to weapon systems developed under the current RMA. Tactical mobility will thus remain an important requirement for any future combat vehicles.

Tactical mobility has been extensively studied during and after the Cold War. The track versus wheel debate that resulted has been going-on for several years. "Tracks will always provide better (tactical) mobility over the worst types of ground such as wet clay soils; however, advances in wheeled drive train technology permit wheeled vehicles to have good cross-country mobility in most conditions. Advanced suspensions, advanced tire designs and central tire inflation give wheeled vehicles (up to 30 tonnes) comparable tactical mobility and endurance to tracked vehicles."[99] Studies have revealed that light armoured vehicles requiring speed and quietness are better served with wheels. In addition, "current wheeled vehicles have superior operational mobility including road

[98] NATO MC 336/1 The Movement and Transportation Concept for NATO. Web site; available online from http://www.nato.int/docu/logi-en/1997/defini.htm ; Internet; accessed 4 Feb 03.
[99] Department of National Defence, *DLSC Report Armour Combat Vehicle Concept Paper* (Kingston, On, 1998), B-1.

speed, range and endurance over tracked vehicles."[100] However, "tactical vehicles over 30 tonnes must be tracked due to tire limitations."[101] These factors combined with the lower operating and maintenance costs and cheaper procurement costs of wheeled vehicles make them a better alternative than tracked vehicles.[102] Chapter 2 concluded that expeditionary forces will be required to be rapidly deployed in the early stage of a conflict. Chapter 3 identified the requirement for forces to operate in a 'three-block war'. It is therefore logical to assert that future combat vehicles should be wheeled to best meet the challenges of the future security environment and those of the operating environment.

Firepower

General

The analysis of urban terrain revealed that narrow streets, basements, high top floors and roof tops hinder the firepower of Main Battle Tanks as they limit the traverse of the turret and the elevation of the gun. Future combat vehicles should have the required firepower to fight in both built-up areas and open and rolling terrain. There will in fact be a requirement to mass effects in all types of terrain as opposed to simply mass forces. The Canadian Directorate of Strategic Concepts asserts that "future weapons will use precision instead of massed firepower to destroy targets."[103] Thus the importance of more lethal and more precise firepower. This section will analyze the firepower required by future combat vehicles to operate in urban and open and rolling terrain. Some of this

[100] Ibid, B-1.
[101] Ibid, B-1.
[102] William E. Willoughby, *et al*, *US Army Wheeled Versus Tracked Vehicle Mobility Performance Test Program*, Technical Report GL-91-2 (Mississipi, 1991), 55-56.
[103] Department of National Defence, *DLSC Report Armour Combat Vehicle Concept Paper* (Kingston, On, 1998), 3, 20.

firepower may be obtained from other weapon systems when operating as part of a network centric force.

Choice of Gun Calibre

The analysis of the operating environment concluded that future combat vehicles could be employed in open and rolling terrain to force enemy Main Battle Tanks to move so that they can be detected and engaged by other friendly weapon systems. The gun is therefore likely to remain one of main options available to future combat vehicles to deliver firepower on the future battlefield. NATO does not foresee calibres other than 120 mm for the next twenty years due to the assumed reduced threat resulting from the new security environment.[104] At present the recoil forces of 120mm guns capable of defeating Main Battle Tanks are too high to be safely mounted on a tactical vehicle in the 20 to 30 ton range."[105] Unless the recoil problem is solved, future combat vehicles will be equipped with 105mm guns in combination with other firepower technology.

An analysis of a future combat vehicle known as the Armoured Combat Vehicle (ACV) in warfighting was conducted by the Canadian Directorate of Operational Research (Joint & Land) in 1998. The aim of the study was to determine the effectiveness of an ACV based on an eight wheeled vehicle mounted with a stabilized 105 mm gun in comparison with a T-80U MBT (125 mm gun) in warfighting and Operations Other Than War (OOTW) tasks in the year 2006. The study revealed that the ACV did not have the firepower and protection to carry out a direct assault and was ill-suited for static defence. Interestingly, using ambush tactics at the flank or rear of the adversary at close range

[104] NATO NAAG LG/2 Report, *Future of Armoured Forces*, PFP(NAAG)D(2002)22 (Brussels, 2002), 11-12.

demonstrated that the ACV equipped with a digitized situational awareness system was successful at destroying T80U Main Battle Tanks as long as the ACVs were not detected.[106] Future combat vehicles operating against this type of adversary should therefore be integrated with other direct and indirect fire systems in order to overcome their lack of firepower and protection. They should be employed in mobile defence if facing second and third generation Main Battle Tanks. In offensive operations, enemy defensive positions reinforced with Main Battle Tank should be bypassed if feasible. Future combat vehicle should be employed to force the enemy to move in order for enemy Main Battle Tanks to become vulnerable and predictable. Infantry units, supported by combat systems such as attack helicopters, artillery, unmanned combat aerial vehicles and unmanned ground vehicles can then attack. Future armament such as 105 mm lector-thermal-chemical gun should provide the firepower required to engage light armoured fighting vehicles and some Main Battle Tanks. Future combat vehicles should therefore be equipped with a 105mm guns and should be complemented with other combat systems to operate in urban and open and rolling terrains.

Through-the-Barrel-Missiles

Future combat vehicles equipped with 105mm guns may be outgunned by some second and third generation Main Battle Tanks equipped with 120 mm guns. However, the employment of Through-The-Barrel-Missile (TBM) munitions can increase the firepower effectiveness of future combat vehicles. Studies have demonstrated that the

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[105] Department of National Defence, *DLSC Report Armour Combat Vehicle Concept Paper* (Kingston, On, 1998), B-2.
[106] Department of National Defence, *DOR (J & L) ORD Project Report PR 9817 Quarré de Fer: Analysis of the ACV in Warfighting Tasks* (Ottawa, On, 1998), 19-29.

employment of TBM munitions combined with the use of stand-off tactics improved the loss-exchange-ratio by almost 100% when terrain permitted its use.[107] The employment of TBM munitions in combination with other weapons systems should provide future combat vehicles with the required firepower to engage second and third generation Main Battle Tanks for specific roles. TBM munitions should enhance significantly the firepower required by future combat vehicl

the firepower vulnerabilities inherent to the Main Battle Tank in built-up areas, the firepower of future combat vehicles should be greatly enhanced through the ability to fire blast munitions in order to target dismounted infantry in the open and inside buildings.

In summary, future combat vehicles should be equipped with a combination of a 105 mm gun, TBM munitions as well as blast weapons. This should provide future combat vehicles with the firepower required to operate in urban terrain against dismounted infantry and in open and rolling terrain against legacy Main Battle Tanks when supported by other friendly weapon systems.

Protection

General

Knowing the requirements for mobility and firepower, we can now look at the requirements for protection. As the public's sensitivity to casualties increase, protection may represent one of the most important operational requirements of future combat vehicles. It will be paramount to ensure that the protection level of crews operating in open and rolling and complex terrain be increased. This vision is shared by Ralph Peters who suggested, "despite protection advances, crews will remain the most vulnerable link in the armored warfare system."[110] "During all operations, advanced technology in the hands of an adversary will increase the importance of force protection at all echelons."[111] Some protection will be obtained through "stealth, mobility and dispersion."[112] Future combat vehicles will require increased levels of protection from enemy direct and indirect

[110] Ralph Peters, "The Future of Armored Warfare," *Parameters* 27, no. 3 (Autumn 1997): 52.
[111] Office of the Chairman of the Joint Chiefs of Staff, *Joint Vision 2010* (Washington, D.C.: U.S. Government Printing Office, 1996), 14.

fire as well as from anti-tank mines and weapons of mass destruction. This section will analyze the protection requirements of future combat vehicles to operate in urban and open terrain. However, as the threat of weapons of mass destruction is identical for all armoured fighting vehicles, this threat will not be covered in this section.

Protection Through Other Combat Systems

Modern armies benefiting from the technological changes resulting from the current Revolution in Military Affairs have become an overmatch for ill-equipped adversaries. As such, the link between precision firepower and protection must not be undermined. In Afghanistan, "small U.S. ground teams nullified numerical differences in tactical engagements by exploiting the routine precision of aerial attack; moreover, their lack of armour protection was irrelevant because they did not need the tactical mobility under fire that only armored vehicles can provide – the aerial attack replaced that as well. The implication is that armies that have their own precision air support, or can rely on allies to provide it, can reduce their costly and logistically heavy armored forces to rely instead on light-infantry forces, further economizing on the supporting overhead as well."[113] For this to work, it will be essential that air superiority be achieved by the air component prior to committing future combat vehicles in operations conducted in open terrain. Protection does not necessarily have to be totally integral to the future combat vehicle. It should partially be obtained by operating in close proximity to other combat systems.

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[112] Department of National Defence, *DLSC Report Armour Combat Vehicle Concept Paper* (Kingston, On, 1998), 3.

Protection against Direct and Indirect Fire

Within the context of the future operating environment, direct fire weapons such as small arms, anti-armour systems and indirect fire weapons such as mortar and artillery fire will remain the main threats of future combat vehicles in contact with an enemy opting to fight an asymmetric war. Current Main Battle Tanks rely mainly on armour protection to counter these threats. The result is that Main Battle Tanks such as the M1A1, Challenger II and Leclerc weigh up to 70 tons which seriously hinder their ability to be deployed strategically by air. Another disadvantage generated by the heavy weight of armour is the fact that these Main Battle Tanks have a high rate of fuel consumption that often causes logistics challenges. For example, the combat consumption rates of the M1A1 are extremely high as it consumes 44.64 gallons per hour cross-country and 56.6 on the road.[114] NATO asserts that

> Recent developments in reactive and active armour systems seem to indicate that it will be possible to protect light armoured vehicles (less than 20 tonnes) against missile threats in the near future (less than 5 years). Some of these systems are also effective against kinetic threats. The fielding of such systems will allow use of much lighter armoured platforms, which will help address the requirement for more deployable forces.[115]

By 2020, Ceramic and Titanium, two materials capable of defeating both chemical energy and kinetic energy weapons, may be able to achieve not only unprecedented impact resistance but will also be more affordable for battlefield use as

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[113] Edward Luttwark, "Power Relations in the New Economy," *Survival* 44, no. 2 (Summer 2002): 17.
[114] U.S. Army Command and General Staff College. *Combat Service Support Battle Book* (Fort Leavenworth, Kansas, July 2002), 4-9.
[115] NATO NAAG LG/2 Report, *Future of Armoured Forces*, PFP(NAAG)D(2002)22 (Brussels, 2002), 9.

their cost continue to decline.[116] Reactive and active armour systems will continue to be key to the protection of future combat vehicles.

Stealth Technology

In addition to reactive and active armour, stealth represents a promising technology for protection. Joint Vision 2010 asserts that "stealth will strengthen the ability to accomplish surprise, reduce overall force requirements in many operations, and make forces less visible to an unsophisticated or disoriented adversary."[117] NATO estimates that "by 2020 it is possible that tunable, multi-spectral coatings will be available which will allow the signature of key assets to be changed according to their particular environment, achieving a chameleon effect."[118] Stealth technology should increase the ability of future combat vehicles to avoid detection and thus reduce the possibility of being engaged by enemy weapons systems. Future combat vehicles would thus greatly benefit from stealth technology.

Protection Against Anti-Tank Mines

Anti-tank mines remain one of the cheapest weapons that an enemy using asymmetric tactics can employ to target armoured fighting vehicles moving within a theatre of operations and within built-up areas. Mines not only have an effect on the physical plane but also on the moral plane as the mere possibility of encountering them

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[116] NATO RTO Technical Report 8, *Land Operations in the Year 2020 (LO 2020)*, RTO-TR-8 AC/323 (SAS) TP/5 (Brussels, 1999), 27.
[117] Office of the Chairman of the Joint Chiefs of Staff, *Joint Vision 2010* (Washington, D.C.: U.S. Government Printing Office, 1996), 13.
[118] NATO RTO Technical Report 8, *Land Operations in the Year 2020 (LO 2020)*, RTO-TR-8 AC/323 (SAS) TP/5 (Brussels, 1999), 26.

can generate hesitation and fear in soldiers. NATO has assessed that "80% of all types of mines are blast mines … mines up to 8 kg TNT represent around 85% of the threat imposed by landmines."[119] Technologies such as ultra-wide band radar, micro electrical mechanical systems and multi-spectral sensors mounted on UAVs will ensure that minefields are detectable in 2020.[120] Future combat vehicles should be capable of operating UAVs mounted with sensors to detect minefields and provide the necessary level of protection to protect their crews from the detonation of a blast anti-tank mine containing up to 8 kg TNT. The detection and clearance of anti-tank mines will remain an important task in the future.

Future adversaries are also likely to use artillery delivered scatterable mines in order to counter the inherent operational mobility that modern forces will have. Their employment on roads and other avenues of approach will hinder the operational and tactical deployment of our forces. Although their explosive content is generally small, scatterable mines will represent a real threat future combat vehicles as most of them employ a shape charge to target the bottom of Main battle Tanks. Future Combat Vehicles will therefore require the ability to mount Surface Munition Clearance Devices should future adversaries possess artillery delivered scatterable mines.

Hostile forces may very well employ off-route mines with both rudimentary and sophisticated sensors in order to attack the lines of communications of modern forces. The future battlefield may witness the appearance of unmanned ground vehicles. Ralph Peters argues that "eventually we will see a variant of remote-control tanks operated by

[119] NATO NAAG LG/2 Report, *Future of Armoured Forces*, PFP(NAAG)D(2002)22 (Brussels, 2002), 6.
[120] NATO RTO Technical Report 8, *Land Operations in the Year 2020 (LO 2020)*, RTO-TR-8 AC/323 (SAS) TP/5 (Brussels, 1999), 22.

displaced crews that remain well apart from the advance; perhaps as a continent away."[121] He goes on to say that "tomorrow's layers of armor will begin with spoofing techniques that complicate target detection on the part of enemy systems, before proceeding to environmental or atmospheric modification capabilities that defeat mines, distort the enemy's perceptions, and disrupt the trajectory and integrity of enemy munitions."[122] The Canadian Improved Landmine Detection System demonstrates that the technology currently exists to develop spoofing vehicles. The ability to operate spoofing vehicles from line-of-sight should enhance the protection level of future combat vehicles.

Adaptability

General

Adaptability is defined as "the quality of being adaptable; the capacity of being adapted or of adapting oneself."[123] Within the context of the new security environment and more specifically 'the three-block war,' it is desirable that future combat vehicles have the capability to adapt to operate across the full spectrum of conflict.

Rapid Transition Across the Spectrum of Conflicts

Several armies have developed doctrine which emphasize the requirement for rapid transition across the spectrum of conflict. Canadian Army doctrine states that "Operations Other Than War may precede and/or follow war, or occur simultaneously with warfighting in the same theatre…There will always be an overlap between combat

[121] Ralph Peters, "The Future of Armored Warfare," *Parameters* 27, no. 3 (Autumn 1997): 52.
[122] Ibid, 57.
[123] The Oxford English Dictionary, 2d ed., vol. I (Oxford: Clarendon Press, 1989).

and non-combat operations in operations other than war."[124] It also states that there may be a requirement "to transition from non-combat to combat operations and back as circumstances change."[125] This view is similar to U.S. Army doctrine which states that "Operations Other Than War can occur unilaterally or with other military operations. It is possible that U.S. Forces could be involved in operations other than war while the host nation is at war. Operations Other Than War can evolve to war; be prepared for the transition."[126] Both Canadian and American doctrine support General Krulak's view of 'the three-block war'.

Current Main Battle Tanks do not fully support this doctrine as they are most often ill-suited for operations other than war due to their excessive weight and dimensions that restrict their operational mobility. In Kosovo, "many of the large and heavy Main Battle Tanks [Leopard 2A5, Challenger 1 and M1A1] found it impossible to adapt to the constraints of the peace support mission and were simply parked and held as a contingency force."[127] The analysis of information superiority and network centric warfare completed in Chapter 2 recommended that future combat vehicles be connected to near-real time situational awareness systems in order to benefit from information superiority and to improve their decision-action cycles. The study of asymmetric warfare recommended that future combat vehicles be equipped with the capability to track 'tagged' non-combattants and in order to reduce the likelihood of collateral damages. As well, future combat vehicles should also incorporate scent detection systems to assist

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[124] Department of National Defence, *B-GL-300-001/FP-000 Conduct of Land Operations – Operational Level Doctrine for the Canadian Army* (Kingston: DND, 1998), 115.
[125] Ibid, 115.
[126] Department of the Army, *Field Manual FM 34-130 Intelligence Preparation of the Battlefield*, (Washington, D.C., 1994). Web site; available online http://155.217.58.58/cgi-bin/atdl.dll/fm/34-130/Ch6.htm ; Internet; accessed 5 May 03.

with roadblocks in order to identify enemy soldiers who have mingled with non-combattants. These capabilities should allow forces to operate in a 'three block war' environment and quickly adapt to changing circumstances. Future combat vehicles possessing the mobility characteristics previously identified, the technology to discriminate between combatants and non-combatants and near-real time situational awareness should be capable of transitioning quickly within the spectrum of conflicts and conduct simultaneous different types of operations when conducting a 'three-block war' in urban terrain.

Summary

The requirement for contingency forces to deploy and project power in the early stages of conflicts demands that future combat vehicles be strategically and operational deployable by C-17, C-5 and C-130 aircrafts or similar future variants such as the Airbus A400M. The study of mobility requirements has demonstrated that the unloaded weight and dimension specifications of future combat vehicles should be similar to those of the LAV III. Future combat vehicles should weight between 16 and 20 tonnes (unloaded) and no more than 30 tonnes (loaded) in addition to being wheeled.

The analysis of firepower requirements and technological limitations has revealed that future combat vehicles should be equipped with a 105mm guns, TBM munitions and blast weapons in order to operate in urban and open and rolling terrain. These technologies complemented by other combat systems should provide future com 5718es

The detailed examination of protection has demonstrated that air superiority may be necessary for future combat vehicles to operate in open terrain. Reactive and active armour materials such as ceramics and titanium combined with stealth technology should increase the ability of future combat vehicles to counter enemy direct and indirect fire systems. Future combat vehicles should have the capability to operate UAVs mounted with sensors to detect minefields and provide the necessary level of protection to protect their crews blast anti-tank mine containing up to 8 kg TNT. They should have the ability to be mounted with Surface Munition Clearance Devices to clear scatterable mines as well as the ability to operate spoofing vehicles to counter the threat of off-route mines.

The examination of adaptability has clearly revealed that there is a requirement for forces to rapidly transition from non-combattant to combat operations and back as circumstances change. Current Main Battle Tanks are ill-suited for Operations Other Than War as they most often remain held as contingency forces. Future combat vehicles must have the ability to rapidly adapt and transition through the spectrum of conflict. They should be equipped with near-real time situational awareness systems to fully exploit information superiority and to improve the decision-action cycles of formations.

CHAPTER 5

COMBAT VEHICLE CONCEPTS OF THREE OF THE MOST MODERN NATO ARMIES BEYOND 2020

Introduction

The assessments of the future security environment and of the operating environment have demonstrated that fundamental changes that are taking place may soon threaten modern nations and their armies. New doctrine, equipment and organizations will be required to face these challenges. This chapter will investigate the combat vehicle concepts of three of the most modern NATO armies in order to determine if they will meet future combat vehicles' capabilities and requirements identified in Chapter 4.

US Army Concept

General

The 63 ton M1, M1A1 and M1A2 Abrams Main Battle Tanks equipped with a 120 mm smoothbore gun entered into service in the 1980's and represent the cornerstone of the American land forces. Based on the U.S. Army's analysis of future warfare which foresees America's future opponents opting to fight an asymmetric war, the U.S. Army has recently embarked on a series of major doctrinal, equipment and organizational changes which will drastically transform the way it will fight in the future. This transformation is aimed at providing the U.S. Army with a rapidly deployable force

equipped and trained to face the challenges of the new security environment. The envisioned Objective Force will be based on the Future Combat System (FCS), "a network-centric system of systems, which will involve developing a new family of medium-weight vehicles."[128] One of its vehicles, the Mobile Gun System (MGS), is similar to what has been referred to as the future combat vehicle.

Mobility

The ability to rapidly deploy abroad to and within a theatre of operations will be key characteristics of the MGS. The goal of the US army is to be able to deploy a brigade within 96 hours, a division within 120 hours and five divisions within 30 days. The MGS will be wheeled, weight approximately 20 tonnes and be air transportable with current transport aircraft such as C-130.[129] As for strategic mobility, C-17 and C-5 aircraft can transport four and seven MGS respectively.[130] The US Army has selected the General Motor Defense LAV III as the chassis for its Interim Force Brigade Combat Teams.[131] The MGS will therefore be lighter, faster and easier to deploy than the current M1A1 and M1A2 Abrams Main Battle Tanks. A study conducted by the RAND Arroyo Center has concluded that, "as a result of this dramatic reduction in weight, the force may have to rely more on surprise, dispersion, and standoff with massed effects to achieve its goals."[132] This requirement should be met by its ability "to sustain speeds of 100 km/h

[128] Matsumara, *et al*. *Exploring Advanced Technologies for Future Combat Systems Program*, Santa Monica, RAND, 2002, xiii.
[129] Jane's. *Armour and Artillery*, ed. Christopher F. Foss (Surrey, U.K.: Jane's Information Group Limited, 2002, 148.
[130] Dr Roger Thornhill. "AFV Developments: Lighter May be Better," *Asia-Pacific Defence Reporter*, March/April 2003, 8.
[131]Matsumara, *et al*. *Exploring Advanced Technologies for Future Combat Systems Program*, Santa Monica, RAND, 2002, 2.
[132]Ibid, 2.

with a range of approximately 600 kms."[133] The MGS should possess the strategic, operational and tactical mobility required by future combat vehicles to operate in urban and open and rolling terrain.

Protection

The MGS is designed to operate within the FCS as part of a network centric force and should therefore benefit from the protection provided by other weapon systems. In addition, its dense ceramic armour is "meant to withstand 7.62mm AP and 12.7 mm strikes and give 360-dgree protection from RPG-7s."[134] The fact that the MGS is wheeled should provide limited protection for the crew against anti-tank blast mines containing up to 8kg of TNT. Another interesting fact is that "the U.S. congress has mandated that a third of the U.S. services' ground combat vehicles be remotely operated by 2015."[135] This could be useful when a threat of anti-tank mines exists. Except for stealth technology, the FCS and most specifically the MGS appear to possess similar capabilities as the future combat vehicle described in this paper.

Firepower

Although the MGS is equipped with a 105mm M68 gun, "to date, the largest gun successfully integrated with a LAV hull has been a 90mm Cockerill Mk-8 on the Saudi Arabian Army's LAVs."[136] The excess of stress on the hull is expected to be overcome

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[133] Dr Roger Thornhill. "AFV Developments: Lighter May be Better," *Asia-Pacific Defence Reporter*, March/April 2003, 7.
[134]Ibid, 7.
[135] Elinor Sloan, *The Revolution in Military Affairs: Implications for Canada and NATO* (Montreal: McGill-Queen's University Press, 2002), 11.
[136] Dr Roger Thornhill. "AFV Developments: Lighter May be Better," *Asia-Pacific Defence Reporter*, March/April 2003, 8.

by 2020. Although there are at this time no plan for TBM munitions and blast weapons, some of the gaps in firepower should be filled by those of other weapon systems that are part of the network-centric FCS. The MGS will therefore only possess some of the firepower capabilities required by future combat vehicles to fight in the future operating environment.

Adaptability

This chapter has already demonstrated that the MGS will have superior mobility at all levels of operations. This combined with its near-real time situational awareness system should provide it with the required ability to transition within the spectrum of conflict. Except for the capability to control movement of combatants and non-combattants in urban centres, the MGS appears to have the required level of adaptability to fight a 'three block war' in urban terrain.

Canadian Army Concept

The Canadian Army is currently equipped with 42 ton *Leopard I* Main Battle Tanks equipped with a 105 mm gun which entered into service in 1978. The *Leopard I* is not air transportable by C-130 and Main Battle Tanks such as the T-72, T-80 and T-90 are assessed as being capable to 'out gun' the Canadian *Leopard I* in head-to-head fights. David Pugliese, who often writes on military issues, has described the *Leopard* I as "a Cold War relic ill-suited to the requirements of rapid deployment to a theatre and

increased mobility within a theatre."[137] The *Leopard 1* is therefore ill-suited for the future battlefield and lacks many of the capabilities discussed in Chapter 4.

"In 1996, the Army 2000 Campaign Plan stated that the *Leopard 1* would not be replaced with a heavy tracked tank but by a modern, mobile, armoured direct fire support vehicle to complement the wheeled APC [LAV III] and *Coyote*"[138] As well, Elinor Sloan asserts that

> The (Canadian) army is also planning to acquire a new armoured combat vehicle as a replacement for both the *Cougar* direct-fire support vehicle and the *Leopard I* main battle tank. One possible solution may be America's Future Combat System, expected to be available around 2012. Until then, however, the *Leopard I* is being upgraded with new thermal sights for improved night-fighting capability and computerized systems for enhanced weapons control.[139]

Canada will therefore have no Main Battle Tank in its inventory in 2020 and appears to be leaning towards the U.S. Army FCS project. In doing so, Canada would ensure that it has a fleet of fighting vehicles possessing similar mobility, protection, firepower and adaptability as those previously identified for future combat vehicles to operate in both urban and open and rolling terrain.

British Army Concept

The 70 ton *Challenger II* equipped with a 120 mm rifled gun entered into service in 1995 and represents the principal Main Battle Tank of the British Army. The 1998 Strategic Defense Review has enunciated the following vision

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[137] David Pugliese, "140 Million Upgrade Called a Waste," *National Post*, 23 November 1999.
[138] Department of National Defence, *DOR (J & L) ORD Project Report PR 9817 Quarré de Fer: Analysis of the ACV in Warfighting Tasks* (Ottawa, On, 1998), 1.
[139] Elinor Sloan, *The Revolution in Military Affairs: Implications for Canada and NATO* (Montreal: McGill-Queen's University Press, 2002), 134.

> For the land battle, we will continue to need a full range of war fighting capabilities. Scale is likely to be less important but we need to be capable of offensive, mobile operations. Key requirements will be firepower with greater emphasis on precision and range to maximize military impact and minimize civilian casualties, and protection for our forces in a wide range of circumstances to make their deployment an acceptable risk. But both firepower and protection must be more deployable and more mobile on the battlefield… The [1990-1991]Gulf War and Bosnia have demonstrated that tanks have a continuing importance although the ways in which they are used may vary considerably [140]

The United Kingdom Ministry of Defence is currently studying a replacement for the *Challenger 2* called the Mobile Direct Fire Equipment Requirement (MODIFIER). The British Army "is looking to replace these tanks (*Challenger 2*) with a variant of the Future Rapid Effect System, a family of vehicles that could enter service as early as 2007 or 2008. The twenty-ton tank version will incorporate plastic armour and stealth technology and move twice as fast as the *Challenger 2*."[141] The MODIFIER is to be equipped with a digitized command and control information system and be transportable by sea as well as by C-17 and C-5 transport aircraft while possessing superior operational mobility by rail and road than the *Challenger 2*.[142] As for the Canadian Army, the British Army is likely to be equipped by 2020 with a vehicle possessing the mobility and adaptability required by future combat vehicles.[143]

Summary

This chapter has demonstrated that the U.S. forces intend to procure a fleet of vehicles that will allow its formations to rapidly deploy abroad in austere and hostile

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[140] United Kingdom. Ministry of Defence, *The Strategic Defence Review*. London, July 1998, 22, 28.
[141] Elinor Sloan, *The Revolution in Military Affairs: Implications for Canada and NATO* (Montreal: McGill-Queen's University Press, 2002), 59.
[142] Jane's. *Armour and Artillery*, ed. Christopher F. Foss (Surrey, U.K.: Jane's Information Group Limited, 2002), 130.

conditions. The MGS should possess the mobility, protection and level of adaptability similar to those required by future combat vehicles to operate in urban terrain. The current lack of firepower will represent an important challenge that may be addressed either by emerging firepower technologies or through other weapon systems available within a network-centric force.

This chapter also revealed that Canada and the United Kingdom do not intend to replace their existing fleet of Main Battle Tanks by another tank. Instead Canada is looking at the possibility of procuring systems similar to the American FCS while the United Kingdom is pursuing the MODIFIER project. If they choose to opt for these options, Canada and the United Kingdom would possess a fleet of fighting vehicles with similar characteristics as those identified for future combat vehicles.

[143] No information pertaining to firepower and protection could be obtained.

CHAPTER 6

CONCLUSION

The study of the new security environment demonstrated that due to the changes in the nature of war, future adversaries are likely to originate from rogue and failed states. As they are most often ill-equipped to face more modern nations, these rogue and failed states will attempt to exploit the public sensitivity to casualties using asymmetric means to do so. The technological advantages originating from the current Revolution in Military Affairs will ensure the superiority of modern nations in open and rolling terrain where legacy Main Battle Tanks will become prey for other combat systems.

Future armies will need to be capability-based instead of threat-based in order to face both most probable and highest threats. Future contingency forces will require a high degree of strategic and operational mobility to be prepared to face the challenges of the future security environment. As most conflicts over the past decades did not involve Main Battle Tanks, modern armies can risk not having Main Battle Tanks as long as they have other combat systems that can target enemy armoured formations. Overall, we can logically anticipate that second and third generation Main Battle Tanks will be rendered obsolete by 2020.

The detailed analysis of the operating environment demonstrated that Main Battle Tanks have become extremely vulnerable to combat systems other than tanks in open and rolling terrain. Air and artillery assets now possess superior ability to detect, engage and destroy moving legacy Main Battle Tanks. This highlights the fact that there will no more be a requirement for modern militaries to continue to field their forces with Main Battle

Tanks for operations in open and rolling terrain. The analysis of the first battle of Grozny highlighted the vulnerabilities of Main Battle Tanks in urban terrain and demonstrated that a future combat vehicle will be required to support dismounted troops. As future adversaries opt to fight asymmetric wars, urban terrain offers great potential for less modern forces as it diminishes the technological advantages that modern nations will inherit from the current Revolution in Military Affairs. Urban terrain has the potential to cause a high level of casualties within modern forces whilst their respective nations are less tolerant towards losses in human lives. Forces engaged in urban terrain will require a high level of adaptability in order to fight a 'three-block war'.

The detailed examination of the capabilities and requirements of future combat vehicles concluded that future combat vehicles needed to be strategically and operationally deployable by C-17, C-5 and C-130 aircrafts or similar future variants such as the Airbus A400M. Future combat vehicles should weigh between 16 and 20 tonnes (unloaded) and no more than 30 tonnes (loaded). They should also be wheeled to facilitate transition within the spectrum of conflict. The study also concluded that future combat vehicles should be equipped with a 105mm gun, through-the-barrel missiles and blast weapons in order to operate in urban terrain as well as in open and rolling terrain. The detailed examination of protection demonstrated that air superiority will be necessary for future combat vehicles to operate in open terrain and that reactive and active armour materials such as ceramics and titanium combined with stealth technology should increase the ability of future combat vehicles to counter enemy direct and indirect fire systems. Future combat vehicles should have the capability to operate UAVs mounted with sensors to detect minefields and provide the necessary level of protection to protect

their crews blast anti-tank mine containing up to 8 kg TNT. The examination of adaptability clearly revealed that future combat vehicles should have the ability to rapidly adapt and transition through the spectrum of conflict. They should also be equipped with near-real time situational awareness systems to fully exploit information superiority and to improve the decision-action cycles of formations.

The investigation of U.S. combat vehicle concept revealed that the Mobile Gun System should possess the mobility, protection and level of adaptability similar to those required by future combat vehicles to operate in urban and open and rolling terrain. The MGS apparent lack of firepower will represent an important challenge, which will have to be overcome in the future. Canada and the United Kingdom do not intend to replace their existing fleet of Main Battle Tanks by another tank. Both countries are contemplating systems similar to the U.S. MGS which should provide them with a fleet of fighting vehicles with similar characteristics as those required by future combat vehicles.

This study highlighted key limitations of the Main Battle Tank that reduce its ability to meet the challenges of the future security environment and to operate in urban terrain. Not only does it lack the strategic mobility necessary to be rapidly deployed abroad but it also lacks the adaptability required to fight a 'three–block war'. The Main Battle Tank is also vulnerable to short range anti-tank weapon due to its lack of mobility in built-up areas. Its employment is restricted by buildings which hinder the full traverse of its turrets. It is also restricted by the limitations in the elevation of the gun which is often insufficient to reach heights and basements. Current Main Battle Tanks are ill-suited for the future battlefield.

Overall, the study demonstrated that by 2020, second and third generation Main Battle Tanks will have become obsolete and that a new generation of combat vehicles will be required to fight in built-up areas. The days of the Main Battle Tank may soon be over.

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