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EXERCISE/EXERCICE MDS

THE WHEELED ARMIES OF THE FUTURE

By

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Fig 1.1: The LAV III (Purchased by the Canadian Government, Spring of 1999), Photograph taken from GM's web page (Photographer unknown).

ABSTRACT

This is a persuasive paper, which examines the present organization of armoured fighting vehicles within the Canadian Army. It recommends that the Canadian Army complete the transformation from a tracked fleet to a wheeled fleet of armoured fighting vehicles (AFVs). These changes are required, in order to ensure the Canadian Army remains a viable and multi-purpose combat capable force.

In order to support this recommendation, the paper examines how tomorrow's battlefields could potentially be structured and the nature of future conflicts. From this examination, a recommendation is made on which armoured fighting vehicle is best suited to complete the majority of future operations. It then compares the differences between tracked and wheeled armoured fighting vehicles using the six combat functions, as the criteria for comparison. Next, it examines the actual costs and lifecycle management of both tracked and wheeled AFVs. Finally, it examines how global trends are impacting on Canada's Army. The impact of these trends could ultimately determine whether Canada can continue to meet its collective objectives of remaining combat capable, inter-operable and rapidly deployable, anywhere in the world.

This paper concludes that although there may be some minor shortcomings that presently exist, with further research and development, wheeled AFVs will eventually surpass tracked AFVs in capability. The paper recommends that the Canadian Army complete the transformation from a tracked fleet to a wheeled fleet of armoured fighting vehicles now, in order to remain a viable and multi-purpose combat capable force in the future.

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CHAPTER 1

INTRODUCTION

More recently, the US Army Chief of Staff, General Eric K. Shinseki, has advanced a vision of future American ground forces that would ride entirely on wheels. Looking perhaps 15 years into the future, General Shinseki foresees even a wheeled main battle tank (MBT), weighing 25-30 t instead of the 60-65 t typical of current vintage tracked monsters. This vision relies on future technological breakthroughs to give the light MBT and wheeled armored vehicles supporting it a level of combat power (including survivability) that will exceed today's standard. In other words, technology is expected not simply to compensate for the weight loss, but actually to over-compensate for it.¹

The *1994 Defence White Paper* clearly articulated that Canada's Land Forces would remain a multi-purpose combat capable force. It further stated the requirement for the Land Forces to deploy on both domestic and international operations. In order to be capable of deploying on both domestic and international operations the *1994 Defence White Paper* recognized the requirement to upgrade major equipment namely, the infantry armoured personnel carrier (APC) and the direct-fire armoured training vehicle (Cougar).² Although the written text of the *1994 Defence White Paper* still remains important, it provided very little detail on how the future army would be equipped and organized. At the time the *1994 Defence White Paper* was published, Canada's senior leadership and elected government were not focused on the long-term; but rather, on the financial well being of the nation and reducing the deficit. Defence planning at that time was in essence very reactive.³ The Department of National Defence and Government of Canada were dealing primarily with issues as they arose and were not developing a long term vision for the future.

This inability to develop a long-term vision could only hurt the Army's capability to conduct multi-purpose combat operations during a period of time when a Revolution in Military Affairs (RMA) was occurring. In the Department of National Defence publication, *Shaping the Future of Canadian Defence: A Strategy for 2020*, (hereafter referred to as *Strategy 2020*), the RMA is defined as:

Reduced to its simplest, RMA is a major change in the nature of warfare brought about by the innovative application of new technologies which, combined with dramatic changes in military doctrine and operational and organizational concepts fundamentally alters the character and conduct of military operations. In addition the Revolution in Strategic Affairs calls attention to the concomitant changes in international behavior and hence to the spectrum of security challenges, risks or threats for which a nation must be prepared. In this environment, defence must, within the current policy framework, project forward to recognize a range of potential alternative futures and develop a robust strategy that delivers the essential defence capabilities.⁴

In June of 1999, the Canadian Forces released *Strategy 2020*. *Strategy 2020* is a forward looking document designed to ensure the Department of National Defence and Canadian Forces start to plan further into the future, in order to ensure the military is capable of meeting the requirements on the battlefield of tomorrow. *Strategy 2020* also explains in some detail how the Canadian Forces must modernize its force by focusing more on defence research and development. Under the topic of modernization, it specifically encourages more spending on Research and Development (R&D), in order to ensure that the Army remains at the leading edge of technology. This shift in priorities is required to ensure that the Canadian Army can deploy rapidly and adapt to the many different tactical environments it could be challenged with. In order to accomplish this, it is essential that the Canadian Army remains capable of fielding a multi-purpose force that is inter-operable in both a combined and joint theatre of operation.⁵ Although *Strategy*

2020 went considerably further in establishing a road map for the future, it falls short on outlining the actual structure of Canada's Army. One of the major faults of both the *1994 Defence White Paper* and *Strategy 2020* is that neither document adequately defines exactly what is meant by the phrase, multi-purpose combat capable force. The willingness to use such a vague definition leads to several different interpretations in the literature. For the purpose of this paper, a multi-purpose combat capable force will be defined as follows:

- a. A force capable of fighting in an armed conflict or war;
- b. A force capable of deploying on international peacekeeping and peacemaking operations; and
- c. A force capable of assisting both the Federal and Provincial Governments in domestic, humanitarian and aid to civil power operations.⁶

This definition is vital in determining the way ahead for the Canadian Army of tomorrow. Ultimately the structure, organization, and equipment purchased for the Army must reflect and compliment how this multi-purpose combat capable force is employed.

Prior to August 1995 when Canada purchased several new AFVs, the combat portion of the Canadian Army was predominately a tracked fleet of AFVs. A tracked AFV is defined by a propulsion system based on road wheels and sprockets that are linked together with a single track. Although the majority of armoured fighting vehicles were tracked, there were limited numbers of six wheeled armoured personnel carriers (called Grizzlies) and six wheeled direct fire training platforms (called Cougars) in service at the time. There were also eight wheeled armoured personnel carriers and command post vehicles (called Bisons) in service. In August of 1995 it was noted in the

Infantry School Journal that the Minister of National Defence announced the purchase of several new wheeled armoured fighting vehicles.⁷ A wheeled AFV is defined by a propulsion system based on four or more wheels. The acquisition of these new-wheeled armoured fighting vehicles split the army into two very distinct groups of armoured fighting vehicles, a wheeled fleet and a tracked fleet of AFVs. These two very different fleets have been forced to operate together within three Canadian Mechanized Brigade Groups (CMBGs), spread across the Land Forces.

In order to fully understand how these Brigade Groups are presently structured and equipped to meet Canada's strategic aim of maintaining a multi-purpose combat capable force, it is necessary to concentrate solely on the fighting echelons.⁸ For the purpose of this essay, the fighting echelon will include all infantry, armoured, artillery and engineer units. Each of the Brigade Groups in Canada's Army is equipped with three infantry battalions (one of which is a light infantry battalion without armoured fighting vehicles), an armoured regiment, an artillery regiment and an engineer regiment. Although there are several other units within these Brigade Groups that play instrumental roles, this paper will only deal with the vehicles specific to the fighting echelon. Table 1.1 outlines the type of armoured fighting vehicles found in each of these units.⁹

Table 1.1: Fighting Echelon Vehicle Types, by unit

SER	UNIT	FIGHTING ECHELON VEHICLES TYPES
1	Infantry Battalions (9 Total)	Light Armoured Vehicles III (Wheeled) Armoured Personnel Carriers (Tracked)
2	Armoured Regiments (3 Total)	Main Battle Tanks- Leopard C 2 Tanks (Tracked) and Cougars (Wheeled)

		Armoured Reconnaissance Vehicle- Coyotes (Wheeled)
3	Combat Engineer Regiments (3 Total)	Armoured Vehicle Bridge Layers (Tracked) Armoured Engineer Vehicles (Tracked) Armoured Personnel Carriers (Tracked)
4	Field Arty Regiments (3 Total)	Light Towed Howitzers- 105mm Howitzer Guns (Wheeled behind prime movers) Medium Self Propelled Howitzers- 155 mm Self Propelled Howitzers (Tracked)
5	Air Defence Artillery Regiment	Air Defence Anti Tank System (Tracked)

Source: Data collected from various army web pages, <http://www.army.forces.gc.ca/lf/equip/veh>.¹⁰

Table 1.1 helps to illustrate the fact that Canada's fighting echelons are presently equipped with a combination of both wheeled and tracked armoured fighting vehicles. This structure creates several training and inter-operability issues associated with having two distinctly different fleets of armoured fighting vehicles. These differences can negatively impact on training and operations in several areas, generally outlined as follows:

- a. Tracked and wheeled AFVs move on roads and across open terrain at different rates of speed (tracks normally move slower than wheeled AFVs);
- b. Tracked AFVs generally weigh more than their wheeled counterpart; this can become an issue with bridge classifications during road moves. There is also a greater risk of damage to infrastructure from tracked AFVs;
- c. Tracked and wheeled AFVs consume considerably different amounts of fuel, tracked AFVs normally consuming more fuel;

- d. The maximum range for tracked and wheeled AFVs are considerably different, wheeled AFVs normally having greater range;
- e. Tracked AFVs have better cross-country mobility; and
- f. The cost and training associated with maintaining several different fleets and scales of spare parts are considerably more than having one common fleet of armoured fighting vehicles.¹¹

The differences mentioned above are some of the common issues associated with having a mixture of tracked and wheeled AFVs operating together. These differences, along with several other factors, will be discussed in the chapters that follow.

Given that Canada has, in the past decade, split its fleet of armoured fighting vehicles into a combination of wheeled and tracked AFVs, there exists a strong impetus to complete this transformation to wheeled AFVs. This impetus is based on the fact that Canada's Army has already purchased both wheeled armoured personnel carriers and wheeled reconnaissance vehicles in the past decade (LAV III and Coyote). Although the loss of a tracked AFV fleet would initially result in some degradation in tactical mobility, firepower, and protection, there are strong indications that many of these shortcomings can and will be overcome with further Research and Development (R&D). Deciding which vehicle is best suited to fulfill the Canadian Army's mandate of remaining a multi-purpose combat capable force must be addressed. This paper will argue that the Canadian Army needs to complete the transformation from a tracked fleet to a wheeled fleet of Armoured Fighting Vehicles in order to be a viable and multi-purpose combat capable force in the future.

The paper will first examine how tomorrow's battlefield will be structured and the types of conflict that are likely to take place around the world. From this examination, a

recommendation will be made on which type of armoured fighting vehicle will be best suited to fulfill the majority of operations presently occurring and likely to occur in the future. The paper will then compare the differences between tracked and wheeled armoured fighting vehicles using the Canadian Army's six combat functions as the criteria for comparison. From this comparison it will be possible to determine the strengths and weaknesses of both AFV fleets. Next, the paper will look at the actual costs and lifecycle management of both tracked and wheeled AFVs, in order to determine if there are any financial savings associated with selecting a wheeled fleet of AFVs. Finally, the paper will look at what is required to ensure the Canadian Army meets its collective objective, of being a combat capable and inter-operable force that can deploy rapidly anywhere in the world.

CHAPTER 2

TOMORROW'S BATTLEFIELD

The ability to define goals and objectives sufficiently far into the future can help align the activities across a very complex and multi-dimensional organization to achieve a common aim. Without such alignment, however, strategy defaults to being the unintended locus of incremental decisions that occur over time.¹²

Introduction

In the Canadian publication *Conduct of Land Operations-Operational Level Doctrine For The Canadian Army*, several enduring characteristics of all conflicts are listed: “friction, uncertainty, ceaseless change, violence, and the human dimension.”¹³ Although these characteristics cannot be ignored, they deal more with how one should think about conflict rather than how one should be equipped to fight. In order to make an informed decision on the type of armoured fighting vehicle that will best serve the requirements of Canada’s Army, it is necessary to define the type of battlefield that the Canadian Army will likely encounter in the future. Reviewing recent conflicts around the world and understanding the impact of the Revolution in Military Affairs (RMA), as defined in the introduction to this paper, can help to define tomorrow’s battlefield. Although much of the thinking on the RMA attempts to predict the future and how technology will impact on tomorrow’s battlefield, there are strong indications that several nations are now moving towards building lighter armies. The United States Army describes a light army as a force capable of deploying rapidly on short notice. This force must be well protected and capable of deploying with enough lethal force to deliver a decisive blow before a serious conflict has time to take root.¹⁴ This light army must also be capable of operating in many different types of environment that relate directly to the

present nature of war and armed conflict. The publication, *America's Army- Tomorrow and Into the 21ST Century*, promotes the idea that potential adversaries having witnessed the outcome of the 1991 Gulf War will avoid a conventional war and target what they believe to be American vulnerabilities.¹⁵ Asymmetric warfare is a common way to categorize the present nature of armed conflict.

Asymmetric warfare can be defined as attacking your enemy's weakness with an unconventional means in order to negate his advantage.¹⁶ In order to deal effectively with the asymmetric threat, armies will be forced to react quickly with incredible flexibility. This will become more essential as technology develops further into what Alvin and Heidi Toffler called the third wave of warfare. The third wave of warfare has been described by the Tofflers as the use of high tech weapons and information systems, created in high tech economies to attack the enemy.¹⁷ This method of warfare clearly incorporates the asymmetric threat.

Asymmetries of method and technology have become common forms of warfare since the end of the Cold War.¹⁸ Although asymmetric warfare has been around for several thousand years, it has become more prevalent since the United States emerged as the sole superpower of the 21st Century. A good example of this would be Al Qaeda's terrorist attack on the World Trade Center and Pentagon on 11 September 2001. Although this example may be extreme and has little relevance to the tracked versus wheeled debate, it serves to illustrate the importance of change and the employment of non-traditional techniques on the battlefield. Further, it is reasonable to conclude that, if the future battlefield changes, the tactics and equipment required for fighting on that battlefield may change as well.

Although it is impossible to predict the future, it is still worthwhile to attempt to discuss what the future security environment could involve. This chapter will examine where and by whom modern day conflicts are being fought. It will also look at how the RMA could change the way wars are being fought and how the battlefield in the future could be shaped. Understanding the nature of tomorrow's battlefield is essential before deciding how to equip and structure an army to fight on that battlefield.

The Nature of Future Conflict

Recent conflicts around the world have been characterized by a growth in cyber-based technology and the asymmetric threat.¹⁹ As well, in the past decade; a lot of armed conflicts have taken place in the built-up areas of third world nations. Cities such as Grozny, Sarajevo, and Mogadishu are just a few examples of built-up areas where fighting has taken place in the past decade. Many military strategists such as Robert Hahn are predicting that this trend will continue.²⁰ One possible explanation for this increase in fighting around built-up areas is that these conflicts often result in one party, normally controlled by the ruling government, being well equipped and the other not having the same capability. In order to neutralize this advantage, the weaker party will fight in built-up areas, countering some of the advantages of the better-equipped opponent. Shayne Friesen, an operational researcher with the Directorate of Land Strategic Concepts, completed a study in October 1998 that examined the nature of conflicts around the world during the period 1988-1997. He grouped all of the conflicts that took place during a ten-year study timeframe into one of six categories:

- a. Conventional (between states) - conflict between two or more states that involves one state crossing over a border into another state;
- b. Unconventional (between states) - conflict between two or more states that involves sub components of at least one of the two states crossing into the other states territory. This can occur either with the blessing of the state they claim to represent or not;
- c. Internal (with some external influence) - conflict internal to a state that involves support from a third party outside of the state;
- d. Internal (without external influence) - conflict internal to a state without outside involvement. They are normally directed at the ruling government or against a certain group within the state;
- e. Colonial - conflict involving a colony to a nation state; and
- f. Imperial – conflict involving the extension of one nations sovereignty by seizing territory of another state.²¹

Friesen's groupings were then applied to the following five global regions: Europe, Middle East, Asia, Africa, and Central/South America. The results from Friesen's research were summarized in order to indicate where in the world conflicts were occurring and what the nature of those conflicts was. The location of present conflicts can then be used to predict, with a certain degree accuracy, where and what type of conflicts will take place in the near future. The attempting to predict where future conflicts will occur and against whom they will be fought is extremely useful in determining the capability of your potential opponent to wage war. Knowing the capabilities of your opponent and how he could be equipped are also essential to determining how he might fight. Additionally, the information can be used to determine what type of equipment, including armoured fighting vehicles, will best serve the needs

of your military. The following is a general summary for each of the five regions studied by Shayne Friesen:

- a. Europe – conflicts in Europe during the late 1980s and early 1990s accounted for approximately 24 percent of the world’s unconventional conflicts. During the latter part of the study there were no conflicts. There are strong indications to believe that inter state relations and internal affairs are relatively stable in this area of the world;
- b. Middle East – conflicts in the Middle East have been relatively frequent with approximately 40 percent of all nations involved in a conflict during the past ten years. The conflicts are usually either unconventional between states or internal, with or without outside influence. There are no indications that the instability will improve in this area of the world;
- c. Asia – conflicts in Asia are mainly internal with the majority involving outside interference. Asia is distinct because it leads the world in internal conflicts. There are no indications that the instability will improve in this area of the world;
- d. Africa – conflicts in Africa are generally internal by nature with the majority involving outside interference. There are no indications that the instability will improve in this area of the world; and
- e. Central and South America – conflicts in Central and South America declined considerably during the latter part of the 1990s, Central and South America have become relatively stable areas. During the late 1980s and early 1990s, the conflicts were normally internal with some external involvement. There are strong indications to believe that inter state relations and internal affairs are relatively stable in this area of the world.²²

Friesen’s research indicates that the majority of conflicts around the world are taking place in Asia, Africa, and the Middle East. It is also evident from the study that the majority of these conflicts are internal state conflicts, with a combination of both inside and outside interference. Further, the data indicates that the majority of the

conflicts are taking place in third world countries.²³ Although it is unrealistic to conclude from this data that there is absolutely no risk of conventional war, it is possible to assume that there is a higher likelihood of NATO and United Nation Forces being deployed to deal with internal state conflicts against third world armies.²⁴ The location and nature of these future operations should be taken into consideration, when deciding how to equip units and formations tasked to complete these operations. Of note, the United Nations and NATO presently base force structure and size on the nature and location of the conflict. Many defence analysts, such as David Pyne and Jim Caldwell, have stated publicly that the tracked tank is best suited for conventional wars, whereas wheeled armoured fighting vehicles are best suited to perform the task of global police, because of their ability to manoeuvre more quickly.²⁵ Given that most future conflicts will likely be internal state conflicts against third world armies, it is reasonable to expect that wheeled armoured fighting vehicles will be better suited to complete these missions.

The Revolution in Military Affairs

The Revolution in Military Affairs will have a profound impact in three key areas pertaining specifically to armoured fighting vehicles. These areas include: increases to situational awareness, new technology in the areas of protective armour and the lethality of munitions, and finally, the impact of airpower on tomorrow's battlefield.

Situational awareness, which can be defined as the accurate collection and interpretation of timely battlefield intelligence, will be available to both tracked and wheeled AFVs.²⁶ The ability to use this information to gain a strategic or operational advantage will favour the force (friendly or foe) that is equipped with the AFV capable of

moving at the greatest speed relative to the opponent. Information obtained on the enemy will only be useful to the commander if he can react in a timely manner, in order to achieve an advantage. Wheeled AFVs can move within a theatre of operation quicker than their tracked counterparts.²⁷ The ability to manoeuvre quickly will allow the commander to take full advantage of situational awareness.

The second major impact area of the RMA will occur in the development of new technology that increases the lethality of weapon systems and munitions. The increase in the lethality of new weapons and munitions will result in smaller lighter vehicles being capable of carrying munitions and weapons as lethal as any tracked armoured fighting vehicle munitions found on the battlefield today.²⁸ Another aspect of this area is the development of new protective armour, which will increase the survivability of all armoured fighting vehicles. Improvements to both weapon systems and munitions will have a profound effect on the design of future armoured fighting vehicles.

In the past, tracked armoured fighting vehicles were more useful for combat missions than wheeled armoured fighting vehicles, because they came with additional protective armour and firepower. They were the only vehicles capable of employing a heavy caliber weapon, in the direct fire role. Literature indicates that developments in new composite protective armours will result in lighter vehicles with equal or better protection from the anti-armour threat.²⁹ These arguments are of particular interest, because in the past, one of the main arguments used to justify a tracked main battle tank was that nothing else on the battlefield could provide the same firepower and protection.³⁰

The literature on the RMA clearly indicates that there will be increases in the lethality of munitions and armour protection. These new developments will make the tracked armoured fighting vehicle less viable in the future, as the wheeled armoured fighting vehicle begins to systematically eliminate the previous advantages associated with tracked AFVs.

The final impact resulting directly from the RMA was discussed by Doctor Thierry Gongora in his article on *Canada's Multi-Purpose Force of the Next Century*. Doctor Gongora argues that air power will have a major impact on the future battlefield. He believes that increases to land manoeuvre, complimented with modern attack air assets, will be essential for success on the future battlefield. He argues that units will operate very closely with air assets in the future. It is difficult to deny the importance of close air support during both Gulf Wars (Desert Storm and Iraqi Freedom). Close air support was an enabling asset that provided considerable direct fire support to advancing formations. Taking into consideration the speed at which tactical air assets can manoeuvre, Doctor Gongora further argues that the employment of tactical aviation will force ground forces to manoeuvre more quickly, in order to gain the full advantage of close air support in the direct fire role.³¹ The requirement to move quicker on the battlefield will shift attention further away from the slow moving tracked AFV and increase the importance of the faster moving wheeled AFV, as a possible solution in offensive operations.

Summary

This chapter has examined battlefield structure and the types of conflict that will be fought and against whom these conflicts will take place. These predictions are largely based on sound research conducted by Shayne Friesen at the Directorate of Land Strategic Concepts and Doctor Thierry Gongora in his report, *A Multi Purpose Force for the Next Century*. Although, it is impossible to predict the future, a review of recent conflicts is an educated way to assess how the future battlefield might be shaped. Although this is by no means the only way to examine the future, it does allow planners for tomorrow's armies to narrow the focus particularly since resources and time are always limited. General Shinseki (United States, Army Chief of Staff) was clearly heading down this road when he discussed the shift in focus of many nations towards developing expeditionary forces capable of deploying on short notice. He also believes that these expeditionary forces will travel in wheeled armoured fighting vehicles:

...light ground forces, and especially those riding on wheels, have gained a more prominent role. Underlying this development is the assumption that such light units are more appropriate than the traditional heavy mix for patrolling and controlling relatively large stretches of land. They supposedly are well suited to establish a sort of military omnipresence, which is essential to the restoration of law and order in peace support/peace enforcement operations.³²

If General Shinseki's vision is correct, wheeled forces should be more capable of deploying on short notice anywhere in the world by virtue of their mobility, air portability and size. This force would also be able to strategically influence the conflict before it has had time to take root and spread into neighbouring states. It is also important to note that he believes with further developments in technology (RMA) that this wheeled force will have equal or even increased lethality and protection when

compared to that of the more conventional tracked force used during the first Gulf War (Desert Storm).³³

Chapter 2 also discussed how the RMA is likely to result in increased munitions' lethality, better armour protection, and increased situational awareness. Once these changes have been implemented, it is reasonable to expect an increased demand for wheeled armoured fighting vehicles, as they will essentially neutralize most of the previously held rationale for tracked armoured fighting vehicles. Christopher Foss, editor Jane's Defence Weekly, recently reported this trend in a January 2001 article titled, *Light Armoured Vehicles*. Foss noted that in the past decade there has been a clear indication that many nations are starting to move towards lighter armoured vehicles.³⁴

CHAPTER 3

TRACKED VERSUS WHEELED

The controversy over the relative superiority of tracked or wheeled armored vehicles was revived during the recent US Light Armored Vehicle (LAV) competition. Comparative advantages and disadvantages of tracked and wheeled armored vehicles have been demonstrated experimentally in the field for over three-quarters of a century...³⁵

Introduction

The controversy mentioned in the opening quotation to this chapter has been raging for several decades and will likely continue for the foreseeable future. It is something that causes heated debates whenever two experts representing different perspectives of the argument discuss the topic.³⁶ It is controversial because there are advantages and disadvantages to taking either route. For this reason, it is necessary to look critically at both the advantages and disadvantages of tracked and wheeled armoured fighting vehicles, in order to make an informed decision within the context of what the Canadian Army requires for the future. The correct decision should ultimately allow the Canadian Army to train, operate and fight as a multi-purpose combat capable force within the context of the future security environment.

In order to provide the reader with a useful comparison, this chapter will examine both wheeled and tracked armoured fighting vehicles using the Canadian Army's six combat functions: command, information operations, manoeuvre (speed and mobility), firepower, force protection and sustainment.³⁷ Each of these combat functions will be analyzed using the data available, in order to determine which fleet of vehicles represents the best choice. The majority of the data referred to in this chapter originates from the

Mobile Automated Instrumentation Suite (MAIS) Trial conducted in September-December 2001, lessons learned by the Second Battalion, The Royal Canadian Regiment, and four separate trials. These four trials were conducted by research institutes in Canada, Britain and the United States conducted the four trials. The Land Engineering Test and Evaluation unit was the lead institute in Canada for two trials while Army Training and Doctrine Command at Fort Monroe and the Royal Military College of Science at Shrivvenham were the lead institutes for the trials conducted in the United States and Britain respectively. These trials also contained data and information from a variety of other trials conducted around the world that compared tracked and wheeled armoured fighting vehicles.

The Tactics School, located at Canadian Forces Base Gagetown, was tasked by Director Army Doctrine (DAD) to conduct the Mobile Automated Instrumentation Suite Trial, in order to verify proposed doctrine for the new-wheeled Light Armoured Vehicle III (LAV III), which replaced the tracked M113 Armoured Personnel Carrier (APC). The trial consisted of both tracked tanks (Leopard C 2 main battle tank) and the LAV III. These vehicles were put through a number of different scenarios, in order to verify the various Tactics, Techniques and Procedures (TTPs) utilized by the Canadian Army at the combat team level.³⁸

The Second Battalion, The Royal Canadian Regiment was Canada's first fully equipped LAV III battalion. Besides having considerable experience using the LAV III during field exercises at the battle group and combat team level, they also conducted two serials of the Combat Team Commander Course using LAV III in 2001 and 2002. This allowed the battalion to observe both, the Leopard C2 (tracked tank) and the wheeled

LAV III, working together within a battle group and combat team context. In December of 2000, the Second Battalion also deployed Canada's first equipped LAV III Company overseas as part of Task Force East Africa (TFEA). This tour lasted for six months and involved the use of the LAV III on the rugged terrain of Ethiopia and Eritrea. Prior to receiving the LAV III, the Second Battalion utilized the M113 tracked armoured personnel carrier. This unit has had the opportunity to work extensively with both tracked and wheeled armoured fighting vehicles.³⁹ The Second Battalion is familiar with and understands many of the difficulties associated with employing tracked and wheeled AFVs together. The training and operational experience that the Second Battalion has gained since they received the LAV III makes the battalion a reasonable and valid source for comparing tracked and wheeled AFVs.

The first of the four trials to be discussed was conducted in Fort Monroe, Virginia and compared the performance of tracked and wheeled armoured fighting vehicles.⁴⁰ The second trial was conducted in Canada using the armoured vehicle general purpose (AVGP) or wheeled Grizzly and the M113 tracked, armoured personnel carrier. This trial was significant because it is one of only two known trials that compares tracked and wheeled armoured personnel carriers that were designed to fulfill the same role on the battlefield.⁴¹ The United States conducted a trial very similar to the AVGP trial, however the results remain classified and were not available for this study. The third trial was actually a study conducted by the Canadian Department of National Defence on a possible wheeled replacement vehicle for the Leopard C2 and Cougar direct fire platforms. The fourth trial was conducted by the British Engineering Systems Department at Royal Military College of Science (Shrivenham, Swindon). This trial

focused primarily on comparing mobility, firepower and sustainment of both tracked and wheeled armoured fighting vehicles.⁴²

After reviewing each combat function, using the data mentioned above, a recommendation will be made to determine which fleet is superior and has demonstrated a distinct advantage in a particular area. Immediately following the analysis of each combat function a small table will summarize the results. There will also be a larger table at the end of this chapter that will be used to summarize all the results at a glance.

The tables that appear in this chapter will be quantified as follows:

- a. The term advantage will be used when the data indicates a significant advantage noted in one vehicle and absent in the other vehicle;
- b. The term slight advantage will be used to when the data indicates a capability found in both vehicles but slightly better in one vehicle; and
- d. An asterisk (*) will be used when there is data to indicate that technology is closing the gap.

The Combat Functions

For the purpose of this chapter all the combat functions will be defined using approved Canadian Army definitions. These definitions can all be found in Canadian Forces Publication, *Conduct of Land Operation- Operational Level Doctrine For The Canadian Army*. In relation to the future securiapte2, to the

Command

Command can be defined in a variety of different ways. For the purpose of this study it will be defined as the ability to exercise authority, in order to control and coordinate military forces on the battlefield.⁴³ It is difficult to determine if command can be directly impacted by the use of tracked or wheeled armoured fighting vehicles. This is because command cannot be studied in isolation. Command must be studied collectively using all the combat functions, in order to best determine if either of the two vehicle types has an advantage on the battlefield.

Taking into consideration the definition mentioned in the paragraph above, the only true difference noted during the MAIS Trial and the Second Battalion's experiences pertaining to command was the ability of a commander with a wheeled fleet of AFVs to have greater influence, within his particular area of operational responsibility (AOR). The trial data indicates that a commander can manoeuvre his forces more quickly thereby increasing his capability to exercise greater influence. Tracked vehicles are capable of doing the same, however the ability to exercise this influence was slightly restricted by the time it took to arrive in location. The ability of wheeled vehicles to move more quickly affords the commander an increased level of control. No data was found that differentiates between tracked and wheeled AFVs in the coordination of military forces.⁴⁴ Under the category of Command, wheeled armoured fighting vehicles have a slight advantage over their tracked counterpart. Table 3.1 summarizes the results of the combat function of command.

Table 3.1: Combat Function of Command

<u>Serial</u>	<u>Combat Function</u>	<u>Wheeled AFVs</u>	<u>Tracked AFVs</u>
1	Command	Slight Advantage	

Information Operations

Information operations can be defined as the coordination of all intelligence assets, in order to support the other combat functions, which should lead to detecting and defining the enemy.⁴⁵ This particular combat function is more concerned with the sensors and component suites available within and outside the vehicle, in order to provide the best picture or situational awareness. No data was found in this area to differentiate between wheeled and tracked AFVs, therefore no further analysis was conducted. Tracked and wheeled AFVs were not assigned any rating under this category.

Manoeuvre

Manoeuvre can be defined as the movement of forces in conjunction with both direct and indirect fire, in order to gain an advantage against an adversary.⁴⁶ This combat function is one of the fundamental differences between tracked and wheeled armoured fighting vehicles and the most important combat function to be analyzed. In order to adequately study this combat function, it is necessary to further divide manoeuvre into three categories: strategic manoeuvre, operational manoeuvre, and tactical manoeuvre.

Strategic manoeuvre has been defined by Professor Richard Ogorkiewicz, a leading expert on tracked and wheeled armoured fighting vehicles, as the ability to move

vehicles into a theatre of operation. At this level vehicles are traditionally moved by rail, sea or air. Strategic manoeuvre can also involve a combination of two or more of the methods mentioned above.⁴⁷ The movement of tracked and wheeled armoured fighting vehicles by rail, sea and air has traditionally been slow and very time consuming. It is also extremely resource dependant and these resources normally come with a huge price tag. It should also be noted that in many conflicts and wars the control of strategic infrastructure such as airports, seaports and rail lines are often under the control of one party to the conflict and may not be readily available for use. The ability to use roads offers the commander a certain amount of flexibility.

Movement by sea and rail has traditionally been the only way to move tracked AFVs in volume because of their size and weight. The size and weight of many tracked vehicles prevents them from being air portable. The majority of wheeled AFVs can be more by rail or sea and in addition are air portable (LAV III for example).⁴⁸ From a strategic manoeuvre perspective, wheeled armoured fighting vehicles have a slight advantage, because they can move considerable distances on roads and are more often air portable. Tracked armoured fighting vehicles seldom conduct administrative moves more than 100 kilometers without being low-bedded or flat-bedded and are unlikely to conduct tactical road moves in excess of 300 kilometers.⁴⁹

Strategic manoeuvre has traditionally not involved manoeuvre by roads, because the distances involved normally exceed several thousand kilometers. Traveling these distances would be extremely time consuming (several days if not weeks) and the costs from a manpower and maintenance perspective would be high. However, the advent of the wheeled armoured fighting vehicle is starting to change this mindset. Many of the

wheeled fighting vehicles presently in service are capable of traveling at speeds in excess of 100 kilometers per hour.⁵⁰ The ability to travel on roads at these speeds has given the strategic commander increased flexibility, should time and the availability of strategic lift be major factors. This approach may not necessarily be relevant from a North American perspective, but could be extremely relevant in Europe or Africa, where a distance of a thousand kilometers could traverse several countries.

In the Spring of 2002, during a major exercise conducted between Halifax, Nova Scotia and Oromocto, New Brunswick, the Second Battalion, The Royal Canadian Regiment (LAV III Battle Group) conducted a 500 km road move in approximately 6.5 hours.⁵¹ It would take a tracked fleet at least twice as long to move the same distance.⁵² Although this may not meet the requirements of a strategic level move, it does open the doors to utilizing roads as a manner of moving wheeled armoured fighting vehicles. A Light Armoured Vehicle III (LAV III) Battle Group could easily move 2000 kilometers in a three-day period. The same mobility is not possible for tracked vehicles without additional support assets (tractor trailers etc).

The movement of tracked AFVs by road creates a number of different problems. Tracked AFVs move at considerably slower speeds, ranging between 20-65 kilometers per hour.⁵³ They also weigh more, which can result in less flexibility on route selection (due to the heavier bridge classification requirements) and a higher likelihood that infrastructure will be damaged by the heavier tracked AFV. This problem is further exacerbated when the tracked AFV is low-bedded on a tractor-trailer.

One step below Strategic is Operational Manoeuvre, which is the ability of armoured fighting vehicles to be allocated and reallocated within a theatre of operation.

At the operational level, the vehicles are already in theatre and will be assessed on their ability to manoeuvre effectively within their assigned area of operational responsibility. It is important to note that operational manoeuvre is normally conducted on roads, with some limited cross-country mobility involved.⁵⁴ The majority of the data provided on operational and tactical manoeuvre comes from two studies conducted in the early to late 1990s. The first study, *US Army Wheeled Versus Tracked Vehicle Mobility Performance Test Program*, was conducted by the United States Army in 1991 and compares the mobility of tracked and wheeled AFVs on various types of terrain.⁵⁵ The second study, *Armoured Combat Vehicle Mobility Development Study* was conducted in 1999 by the National Research Council of Canada. This study also analyzed and compared the combat mobility of tracked and wheeled armoured fighting vehicles.⁵⁶ Both studies focused on mobility at the operational and tactic level and evaluated a combination of tracked and wheeled armoured fighting vehicles. The vehicles evaluated included: armoured vehicle general purpose (AVGP), light armoured vehicle (LAV III), MII3 armoured personnel carrier (APC), M1 Abrams Tank and the M60A1. The findings in these two reports will be summarized under operational and tactical manoeuvre. Both reports provide very convincing data that outlines the strengths and weaknesses of the tracked and wheeled armoured fighting vehicle fleets.

Wheeled armoured fighting vehicles have a considerable advantage over tracked vehicles, at the operational level. The studies concluded that wheeled vehicles can move quicker (50-100 percent) from one location to the next, cover longer ranges and are less fatiguing on the troops in the back of the vehicle and their crews.⁵⁷ They can also accelerate faster than their tracked counterpart.⁵⁸ Many of the present day wheeled

armoured fighting vehicles employ high tech suspensions that reduce the inside vehicle vibration and make for a relatively comfortable ride. Tracked armoured fighting vehicles do not have this same capability. The data in both studies indicate that tracked AFVs move at a slower rate of speed, have less range and require more support. Tracked AFVs are generally very fatiguing on their crews and offer less comfort for the troops being transported inside the vehicle.⁵⁹ Wheeled AFVs are capable of dominating a larger area with quick timely manoeuvre. From the operational perspective, wheeled armoured fighting vehicles have a significant advantage over their tracked counterpart.

Tactical manoeuvre is the ability of vehicles to manoeuvre on and off road on the local battlefield, in order to evade the enemy's strengths and exploit his weaknesses from various approaches.⁶⁰ In this regard, wheeled armoured fighting vehicles have made considerable progress, in the past two decades. The central tire inflation system (CTIS) is presently available on many wheeled armoured fighting vehicles. This system allows wheeled AFVs to increase and decrease their level of tire inflation, in order to achieve greater tactical and battlefield mobility.⁶¹ There has also been considerable progress made with the development of eight-wheeled drive armoured fighting vehicles, that come equipped with quick turn suspensions and new run-flat tires. These improvements have certainly increased the battlefield mobility of wheeled armoured fighting vehicles.⁶²

Nevertheless, even after taking these improvements into consideration, most studies still indicate that tracked armoured fighting vehicles are superior in the area of tactical manoeuvre. This is mainly because the vehicle cone index (VCI) is slightly higher in wheeled vehicles, than it is in tracked vehicles. The VCI is an index established for vehicles in order to determine the performance of that vehicle on various types of

soil.⁶³ The higher the VCI the worse the vehicle will perform on soft soils, such as desert sand and wet swampy ground.⁶⁴ When the VCI is compared to the rating cone indexes (RCI) for different types of terrain, wheeled vehicles tend to have some limited mobility problems. The RCI is an index that rates the various types of soil and terrain that exist around the world.⁶⁵ The higher ground pressure ratings normally found in wheeled vehicles make them particularly vulnerable on soft soil, where the VCI is higher than the RCI. The central tire inflation system, if used correctly, can help to alleviate this problem somewhat. Although tracks consistently performed slightly better than their wheeled counterpart in tactical manoeuvre, the only soil type with a margin of difference that was significant was the desert, where tracks were clearly superior.⁶⁶ However, a well-trained crew can, with experience, overcome these shortcomings by selecting alternate routes and avoiding terrain, that may restrict the wheeled AFV when it moves cross-country. Previously tracked AFVs had a significant advantage in tactical manoeuvre but the gap is now much less significant. Tracked AFVs presently have a slight advantage in tactical manoeuvre.

In summary wheeled vehicles have a slight advantage in strategic manoeuvre and a considerable advantage in operational manoeuvre. Meanwhile, tracked AFVs have a slight advantage in tactical manoeuvre. Although it is possible to argue that tactical manoeuvre could be more important than strategic and operational manoeuvre, the fact remains that wheeled AFVs have made considerable progress in recent years at the tactical level of manoeuvre. The LAV III, with a functioning central tire inflation system (CTIS) for example, performed extremely well during the LAV III mobility trial conducted in August 1996.⁶⁷ This progress, in conjunction with the nature of the future

security environment, could eventually result in wheeled AFVs having an advantage at the tactical level. After taking into consideration all three levels of manoeuvre, wheeled armoured fighting vehicles have an overall advantage. Table 3.2 summarizes the results of the combat function of manoeuvre.

Table 3.2: Combat Function of Manoeuvre

<u>Serial</u>	<u>Combat Function</u>	<u>Wheeled AFVs</u>	<u>Tracked AFVs</u>
1	Strategic Manoeuvre	Slight Advantage	
2	Operational Manoeuvre	Advantage	
3	Tactical Manoeuvre		*Slight Advantage
4	Manoeuvre Overall	Advantage	

Firepower

Firepower can be defined as the use of fire to suppress, neutralize and destroy a target.⁶⁸ Traditionally speaking, wheeled AFVs have been inferior in the area of firepower. They were normally fitted with small caliber weapons designed to compliment the role of the vehicle.⁶⁹ In fact, the use of small caliber weapons on wheeled AFVs has more to do with the role of the vehicle than any inherent design flaw. Prior to the early 1990s, wheeled AFVs were predominately employed as troop carrying and reconnaissance vehicles. Recently, there have been several companies exploring the possibility of a wheeled tank (direct fire vehicle). In Canada, General Motors (GM) Defense has developed a 105mm direct fire prototype (figure 3.1) and in Italy, the Italians

have developed the Centauro, a 105mm wheeled direct fire prototype (figure 3.2). The French and German militaries have also recently conducted trials on the 105mm and 120mm direct fire platforms (figures 3.3 and 3.4 respectively).



Fig. 3.1: The General Motors Defense 105mm prototype (Light Armoured Tank with 105mm cannon). Photo taken from GM's web page (photographer unknown).



Fig 3.2: The Italian Centauro 105 mm prototype (Light Armoured Tank with 105 mm cannon). Photo taken from Centauro web page (photographer unknown).



Fig 3.3: The French Vextra Prototype (Light Armoured Tank with 105 mm cannon). Photo taken from Vextra's web page (photographer unknown).



Fig 3.4: The Piranha III Prototype (Light Armoured Tank with 120 mm smooth bore cannon). Photo taken from Piranha's web page (photographer unknown).

Although the trials on wheeled tanks have reported some success, there are still a variety of issues that must be resolved before a wheeled vehicle can handle a gun heavier than the 105mm, presently being developed by GM Defense.⁷⁰ There are however, strong

indications that advances in technology and munitions will eventually lead to new and improved lethality that can overcome these shortcomings.⁷¹ Although these changes and modifications could become a reality shortly, the heavier tracked armoured fighting vehicle still has a significant yet diminishing advantage in the area of firepower.⁷² Prior to the 1990s few nations considered the wheeled tank viable or realistic. This lack of foresight meant that very little research and was conducted to overcome the firepower issues. Table 3.3 summarizes the results of the combat function of firepower.

Table 3.3: Combat Function of Firepower

<u>Serial</u>	<u>Combat Function</u>	<u>Wheeled AFVs</u>	<u>Tracked AFVs</u>
1	Firepower		*Advantage

Force Protection and Survivability

Force protection and survivability can be grouped together and are defined as all the measures taken in order to protect armoured fighting vehicles from the enemy's detection and weapon systems. In this particular category, it is necessary to include: protective armour, shape and silhouette of the vehicle, and acoustic signature. Although there are several other vulnerabilities unique to individual vehicle variants, they can normally be overcome with upgrades and are not applicable to the tracked versus wheeled AFV debate.⁷³ The issues to be compared and analyzed are specifically inherent to all wheeled and tracked AFVs as a result of their fundamental differences.

In the past, protective armour was considered to be superior in tracked AFVs. Although there is considerable data to support this conclusion, it is important to note that

technology in protective armour dealt essentially with the thickness and weight of the armour. Tracked AFVs were, and continue to be, capable of carrying additional weight, in comparison with their wheeled counterpart; therefore, they have the option of additional armour protection and the associated increase in mass. In the early 1970s, the Soviets began to develop active protection in their armoured fighting vehicles. Active protection involves the use of both soft and hard kill defensive systems. Soft kill systems focused on using anti-laser smoke and jamming devices, in order to divert the path of incoming guided weapons. The hard kill systems focused on the use of explosive devices to destroy incoming guided and non guided missiles.⁷⁴ These systems are just a few examples of how developing technology could eventually even the playing field regarding protective armour and AFV weight. Of note, regarding protection, wheeled AFVs do, however, provide a better level of protection for mine strikes. Their underbody is generally less restrictive and allows the blast to move more freely whereas the tracked vehicle is more restrictive which increases the effectiveness of the explosion.⁷⁵

Wheeled armoured fighting vehicles have also been criticized because their wheels are vulnerable to small-arms fire and fragmentation. Although this problem has been a relatively well-known and serious issue, recent developments in the area of run-flat and self-sealing tires have reduced this problem to the point that it is now considered only a minor issue. The run-flat and self-sealing tires are designed to allow the vehicle to continue moving on the battlefield until an appropriate time is available to conduct the repairs (normally after consolidation).⁷⁶ As mentioned previously, many wheeled armoured fighting vehicles, such as the LAV III, are equipped with a CTIS that can also help to alleviate this problem by allowing the driver to increase tire inflation.⁷⁷

The shape and silhouette of armoured fighting vehicles are key components in stealthiness. Tracked AFVs are normally more compact because they have less of a requirement for suspension and turning wheel clearance. There are also less drive shafts and transfer cases to deal with on tracked AFVs.⁷⁸ The compactness of the tracked AFV reduces the size of its silhouette and makes it a harder target to observe and detect. Wheeled armoured fighting vehicles are traditionally larger with a higher silhouette than their tracked counterpart and are therefore more vulnerable to enemy detections and observation.⁷⁹

The acoustic signature for the wheeled armoured fighting vehicle is significantly lower than its tracked counterpart. The increased acoustic signatures heard in tracked AFVs are the result of track noise, increased vibration and the vehicle exhaust. The vehicle exhaust on a tracked vehicle is not normally muffled. Although there have been some recent improvements in these areas, wheeled AFVs still hold a considerable advantage in the area of reduced acoustic signature.⁸⁰ The noise made by tracked AFVs is easily recognizable for the enemy. The enemy is capable of determining very quickly that the vehicles moving are tracked armoured fighting vehicles. Meanwhile, the noises caused by most wheeled AFVs are very similar to that of civilian trucks and automobiles.⁸¹

In summary, the tracked AFV generally has a slight advantage in the areas of protective armour and vehicle shape and silhouette.⁸² Wheeled AFVs tend to have a lower acoustic signature.⁸³ Wheeled AFVs also have less armour protection and a larger vehicle silhouette. Overall, tracked AFVs have a slight advantage in protection but the

gap is diminishing. Table 3.4 summarizes the results of the combat function of force protection and survivability.

Table 3.4: Combat Function of Force Protection and Survivability

<u>Serial</u>	<u>Combat Function</u>	<u>Wheeled AFVs</u>	<u>Tracked AFVs</u>
1	Armour Protection		*Advantage
2	Shape and Silhouette		Slight Advantage
3	Acoustic Signature	Advantage	
4	Protection and Survivability Overall		*Advantage

Sustainment

Sustainment will be defined as the logistic and maintenance support required to ensure AFVs are ready and capable of fighting in a protracted campaign. For the purpose of assessing sustainment, it is necessary to look closely at the fuel consumption and reliability of both tracked and wheeled armoured fighting vehicles.⁸⁴ At the operational and tactical level, fuel consumption and reliability become key criteria in assessing the performance of armoured fighting vehicles. AFVs that consume less fuel and are more reliable, offer the commander increased flexibility because he is capable of doing more with less of a reliance on the supply chain.

Fuel consumption is a major factor in all spectrums of conflict. Lack of fuel can limit exploitation after a successful attack and even lead to disaster on the battlefield. A good example of this would be during World War II when the German Armies at the Battle of the Bulge ran out of fuel. The consumption of fuel is directly related to rolling

resistance. Rolling resistance is defined as “the resistance to motion due to the deformation of the soil.”⁸⁵ The rolling resistance for most tracked AFVs is approximately 4 percent, by comparison, it is normally only 2 percent for wheeled AFVs, representing a 50 percent reduction for wheeled AFVs. In the simplest terms, the higher the rolling resistance, the higher fuel consumption will be. Therefore, wheeled armoured fighting vehicles will generally consume less fuel and can travel further before requiring refueling.⁸⁶ The savings in fuel consumption are believed to be in the vicinity of 50 percent, clearly favoring wheeled AFVs.⁸⁷ This gives a commander incredible flexibility on the battlefield and can have a major impact on operational and tactical manoeuvre.

The maintenance and reliability of vehicle fleets in a theatre of operation is one of the most difficult aspects of service support to execute. Because maintenance is essential to keeping a fleet operational and available to support the mission, it is necessary to take every step to minimize the amount of maintenance required. This can be accomplished in two ways; the first method being the conduct of preventative maintenance programs during times when vehicles are outside combat. Good preventative maintenance will result in higher reliability, which can increase the likelihood of success during the operation. Tracked AFVs generally require more preventative maintenance than their wheeled counterparts.⁸⁸ The second method is to purchase vehicles with proven records of reliability. Prior to the purchase, it is necessary to research reliability in the same manner as a consumer would before purchasing a domestic vehicle.⁸⁹ Although it is difficult to compare the reliability between wheeled and tracked armoured fighting vehicles, a study conducted in Fort Monroe, Virginia, found that wheeled AFVs were 100 percent more reliable than tracked AFVs. Vehicles that are more reliable require less

spare parts, which further serves to reduce the burden on the supply chain. These statistics although supportive of this paper’s thesis, must be put into context, in order to protect the credibility of this argument. These statistics do not take into account that wheeled and tracked AFVs may be employed slightly different by crews who understand both the strengths and limitations of each vehicle.⁹⁰ Many of the current wheeled armoured fighting vehicles in production, such as the LAV III, require maintenance personnel who are more qualified. Although these wheeled AFVs are more complicated technically than the legacy tracked AFVs they replaced, there is no data to indicate that their tracked counterparts currently in production are any less complicated.

In summary wheeled armoured fighting vehicles tend to be more economical in the areas of fuel consumption with up to 50 percent better mileage on similar terrain. Indicators also point to greatly reduced maintenance for higher reliability rates on wheeled AFVs. Therefore, wheeled AFVs place less of a burden on the supply and maintenance system. Wheeled armoured fighting vehicles have a considerable advantage in the area of sustainment. Table 3.5 summarizes the results of the combat function of sustainment.

Table 3.5: Combat Function of Sustainment

<u>Serial</u>	<u>Combat Function</u>	<u>Wheeled AFVs</u>	<u>Tracked AFVs</u>
1	Sustainment	Advantage	

Summary

Table 3.6 summarizes the data for each of the combat functions discussed in chapter 3.

Table 3.6: Summary of Combat Functions

<u>Serial</u>	<u>Combat Functions</u>	<u>Wheeled AFVs</u>	<u>Tracked AFVs</u>
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concerned with conventional warfare, between the East and the West. Once the threat of a conventional war between the East and West disappeared, the nature of warfare changed. Given that wheeled AFVs will soon be able to accomplish what their tracked counterparts can do on the conventional battlefield, they will continue to increase in popularity because of their added flexibility for employment during UN, urban and domestic operations.⁹¹ Given the nature of the future security environment discussed in chapter 2, wheeled armoured fighting vehicles seem the logical choice for any army that must maintain a multi-purpose combat capable force, including Canada's.

Given that as technology and industry focuses more on wheeled armoured fighting vehicles, there will continue to be further improvements. It is likely that these improvements will assist in bridging the gap between tracked and wheeled AFVs. With this shift in focus, new technology will take a wheeled armoured fighting vehicle that can already compete with its tracked counterpart and catapult it ahead, as the obvious choice for most nations. From a purely Canadian context, which takes into consideration both the *1994 Defence White Paper* and *Strategy 2020*, it remains essential that Canada's Army selects and eventually procures an armoured fighting vehicle that is affordable and best suited to fill a variety of roles that may be assigned to the Canadian Army.

CHAPTER 4

COST ANALYSIS AND LIFECYCLE MANAGEMENT

The current requirement for both high protection and high mobility and the corresponding high firepower are in competition with each other. To maximize each of these factors has, in the past, resulted incompatibilities within a total system and a somewhat speculative “compromised vehicle”. This “specialization of” vehicle types has led to an increase in cost. In view of a looming spread of missions for the army, and a financial situation, which is unlikely to improve, the tank and combat vehicle must be defined according to the main task the vehicles are expected to be assigned to.⁹²

Introduction

Taking into consideration the reluctance of many nations, such as Canada, to increase defence spending, it remains paramount that the funds allocated to defence are closely scrutinized in order to ensure the long-term viability of the Canadian Army. Recently in an address to the Canadian Forces Command and Staff College, the Chief of Land Staff, Lieutenant-General Mike Jeffery stated that Canada had “too much of an Army for its budget and too little of an Army for its workload.”⁹³ Even the newly appointed Minister of Finance for Canada, John Manley, after receiving considerable pressure from Canada’s allies, notably the United States, to increase defence spending, allocated only an additional \$1.6 billion dollars over two years. This increase barely addresses the costs associated with sustaining the present military capability, let alone completing the transformation.⁹⁴

Although future budgets may increase defence spending, it remains unrealistic to expect major increases to defence budgets. According to the Tofflers, most nations are reluctant to spend more on defence.⁹⁵ This reluctance is directly related to the enormous

pressure on elected governments to place issues such as healthcare higher on the agenda than defence.⁹⁶ Given this fact, there is now even a greater requirement to look closely at how the present budget allocated to the Army is spent.

In order to determine if there are savings in manpower and resources as a result of selecting a wheeled or tracked armoured fighting vehicle, this chapter will examine some of the costs associated with the lifecycle of the two fleets. This chapter will also compare the operating and procurement costs of the two fleets. The majority of the information to be used in this chapter comes from two studies conducted in the mid 1980s and one conducted in 2000. The first study, *Wheeled Versus Tracked Vehicle Study* was conducted by the United States, Army Training and Doctrine Command, and compared wheeled armoured fighting vehicles with their tracked counterpart.⁹⁷ The second study, *Armoured Vehicle General Purpose Evaluation Report* was conducted in Canada at the Land Engineering Test Establishment (LETE) comparing the M113 Armour personnel carrier to the Armoured Vehicle General Purpose (AVGP). The value of this particular study is worthy of note because it was conducted after the Canadian Military had already purchased both vehicles.⁹⁸ The third study, *Wheels and Tracks Study* was conducted by the Engineering Systems Department of Cranfield University.⁹⁹

Discussion

The Canadian Forces presently spends 20 percent or approximately \$2.4 billion of its annual budget to maintain military equipment. Approximately \$1.5 billion of this amount goes towards the purchase of parts and \$0.9 billion is used to pay the 15 thousand personnel employed to support and repair the military's equipment as of 2001.¹⁰⁰

Although these figures represent what the Canadian Forces spends to maintain military equipment across all services, it is reasonable to conclude that the amount of money and personnel employed in this capacity must be carefully monitored and scrutinized as it represents a significant portion of the annual defence budget in the Canadian Forces. The costs associated with maintenance make it worthwhile to examine and compare the lifecycle costs of the tracked and wheeled AFVs. The amount of maintenance required to keep a fleet operational will have a direct impact on the cost and availability of the vehicle. Vehicles that require extensive maintenance normally have increased restrictions on the number of miles driven. As well, there is considerable evidence to indicate that tracked and wheeled armoured fighting vehicles require different levels of maintenance.¹⁰¹

A study conducted by the Canadian Forces in the early 1980s compared the maintenance requirement of the six-wheeled Grizzly and tracked M113A1 armoured personnel carriers. The study found that the wheeled Grizzly armoured personnel carrier required less overall maintenance. It also found that the engine in the Grizzly lasted twice as long as the engine in the tracked M113A1. There are also several articles recently published in both, *Jane's Defense Weekly* and *Armor* magazines that provide similar arguments.¹⁰² For example, a recent article written in *Armor*, by Paul Hornback stated "Previous articles and studies have concluded that wheeled vehicles are intrinsically more reliable than tracked vehicles and, therefore, require less maintenance and supply support (spare parts)."¹⁰³ In essence then, the literature indicates that wheeled vehicles are more reliable, require less maintenance, and are therefore cheaper to operate. Given that wheeled AFVs require less maintenance and last longer, there should also be a

reduced burden to the supply system.¹⁰⁴ The main arguments of those who disagree with these findings are that wheeled AFVs spend more time driving on roads and less time driving cross-country than their tracked counterparts. Naturally, driving on roads reduces the amount of wear and tear on the vehicle, which in turn results in less maintenance being required. The wear and tear of vehicles moving cross country has always been higher than that of vehicles moving on hard surfaced roads.¹⁰⁵ Although there is some truth to this argument, it must be noted that wheeled AFVs, such as the LAV III, are very capable of moving cross-country.¹⁰⁶ Wheeled AFVs use roads more than tracked AFVs because they want to take full advantage of their mobility (speed), in order to reach the objective as quickly as possible. A wheeled AFV, because of its speed, has the flexibility to select a longer route that incorporates hard surface roads and still reach the objective on time. A smart commander would naturally take advantage of any opportunity to reduce wear and tear.

The actual procurement costs associated with the purchase of tracked and wheeled armoured fighting vehicles are very similar, when both vehicles are designed for the same mission and purpose. The only noticeable saving that favours wheeled armoured fighting vehicles is the availability of parts, such as suspensions and tires, that are already available and can be taken off the shelf. A good example of this would be the LAV III which uses the same tire as the Heavy Lift Vehicle Wheeled (HLVW). Tracked AFVs tend to be more specialized which restricts the ability to use parts already in production.¹⁰⁷ It is, however, believed that these savings would be just under ten percent of the procurement cost, which is a considerable amount when you consider the purchase of several hundred vehicles.¹⁰⁸

Several studies assessing the Operating and Support (O&S) costs associated with tracked and wheeled armoured fighting vehicles consistently indicate that wheeled AFVs are cheaper to operate and support. The majority of these savings are in the cost of fuel and various other petroleum products. Canada conducted a study on the M113 armoured personnel carrier and the Grizzly 6 x 6 wheeled drive armoured personnel carrier. The Wheeled Grizzly AFV was 28 percent cheaper to operate and maintain than the tracked M113 AFV.¹⁰⁹ The Canadian study compared fuel consumption when the vehicles were idling, moving on a hard surface road and moving cross-country. Although there was no noticeable difference in savings when the two vehicles were idling, there were considerable savings favoring the wheeled Grizzly AFV when moving on a hard surface road or cross-country. In 1982 the Dutch conducted a study very similar to the Canadian study on their tracked and wheeled armoured personnel carriers. Their study found operational and support savings in the area of 25 percent. A study conducted by the United States Army, Training and Doctrine Command on their Mobile Protected Gun Systems, found operating and support cost savings in the vicinity of 32 percent favouring the wheeled AFV fleets. The French found that their wheeled armoured vehicles were 33 percent lower in operating and support costs. In general, the data indicates that wheeled armoured fighting vehicles are 25-33 percent cheaper to operate than their tracked counterparts.¹¹⁰

These savings are important from two different perspectives. First, the actual financial savings could give the Army additional funds, which would directly benefit the Canadian Army over the lifespan of the vehicle. Given that Canada traditionally keeps vehicles in service for 25-30 years, the savings realized over this timeframe, would be

significant. Second, there would be increased flexibility for the commander on the battlefield. Wheeled AFVs supplied with the same amount of fuel would be able to operate without refueling for approximately one third longer. This could give a commander a tactical advantage against his enemy, if the enemy is not equipped in a similar manner. From the opposite perspective the consequences of fighting against an adversary equipped with wheeled armoured fighting vehicles could be severe, if we were not similarly equipped.

Summary

In order to remain a multi-purpose combat capable force, it is necessary to have a AFV that is affordable, reliable and capable of filling the majority of tasks assigned. It is clear that wheeled armoured fighting vehicles are cheaper to operate and support. They consume less fuel, require less maintenance and last longer than their tracked counterparts. Although their procurement costs may be similar, savings in the vicinity of 25-33 percent in maintenance and support are considerable when taken over the lifespan of a vehicle. In this context, wheeled AFVs are more affordable than their tracked counterparts. Although price should not be the sole factor that drives a nation or army towards the purchase of a wheeled AFV fleet, it must be taken into consideration during this era when many nations, such as Canada, are reluctant to make major increases to defence spending. Although in the past governments have sometimes chosen to ignore such issues, the impact of doing nothing could be severe.

CHAPTER 5

THE GLOBAL MOVEMENT TOWARDS WHEELED

AFVs AND THE IMPACT ON CANADA'S ARMY

The Defence Team will generate, employ and sustain high-quality, combat-capable, inter-operable and rapidly deployable task-tailored forces. We will exploit leading-edge doctrine and technologies to accomplish our domestic and international roles in the battle space of the 21st century and be recognized, both at home and abroad, as an innovative, relevant knowledge-based institution. With transformational leadership and coherent management, we will build upon our proud heritage in pursuit of clear strategic objectives.¹¹¹

Introduction

The key aspect of the above quotation is the importance of employing a force that is combat-capable, inter-operable and rapidly deployable.¹¹² If this is the stated strategy of the Canadian Forces, then a long-term procurement plan must be developed to ensure that we meet and continue to meet these strategic objectives. According to the *1994 Defence White Paper*, the Canadian Army must maintain the capability of deploying a brigade group plus an infantry battalion group.¹¹³ The present state of the Canadian Army has deteriorated to the point that we are unable to sustain the simultaneous deployment of two battle groups abroad. This was evident when the Minister of National Defence, The Honourable Art Eggleton in consultation with the Federal Government, ordered the withdrawal of the Third Battalion PPCLI Battle Group stationed in Afghanistan and did not replace it with another battle group. The Minister of National Defence claimed, in an article written in the *Washington Post*, the “need to provide a rest and training period for our troops” as the rational for pulling the battle

group out of Afghanistan.¹¹⁴ At that particular time, Canada only had two battle groups deployed overseas (one in Bosnia and one in Afghanistan).

In the past ten years, the structure of these battle groups has generally been based on infantry battalions with an armoured reconnaissance squadron, consisting of either wheeled Cougar or the recently purchased Coyote. The Canadian Forces have not deployed any tracked tank squadrons abroad since the withdrawal of Canadian Forces from Europe in the early 1990s. This is an important distinction because the Canadian Army has inadvertently moved towards deploying only wheeled battle groups abroad. Although the Army appears to only be willing to deploy with wheeled battle groups, they still maintain and train at the combat team and battle group level with a combination of tracked and wheeled armoured fighting vehicles.¹¹⁶

In the *1994 Defence White Paper*, the Canadian Government stated that it wanted the Canadian Army to be able to deploy three battle groups simultaneously for six months.¹¹⁵ In the publication, *The Battle Group in Operations*, Canada's Army define a battle group as having a combination of infantry rifle companies and armoured tank squadrons.¹¹⁷ The unwillingness to deploy tank squadrons on operations, can be interpreted as meaning that we can no longer field battle groups in accordance with our doctrine. Many of the Coyote Squadron Commanders employed in these battle groups argue that we have not sent tanks on these operations because additional firepower, in the form of direct fire, has not been required and that the mobility of a tracked tank seriously limits its employment.¹¹⁸ A wheeled tank would offset the mobility issue and allow Canada to continue employing battle groups that are properly equipped in accordance with our doctrine.

This chapter will focus the discussion on the total number of tracked AFVs presently in service and the approximate cost to replace them with a wheeled AFV version. It will also examine the consequences of not committing to proactive change and how this could potentially impact on the future of Canada's Army.

The Cost of a Wheeled Army

In the mid to late 1990s, Canada committed to purchasing 203 Coyote wheeled reconnaissance vehicles for a total cost of \$884 million. This worked out to a vehicle price of \$4.4 million per vehicle.¹¹⁹ Canada also purchased 360 Light Armoured Vehicles (LAV III) for a total cost of \$1.1 billion. This worked out to a vehicle price of \$3.1 million per vehicle.¹²⁰ It is important to note that the costs per vehicle for both the Coyote and LAV III include support costs (spare parts etc).¹²¹ Table 5.1 outlines the number of tracked vehicles in combat units that presently remain in service and have not been earmarked for replacement, once the initial purchase of the LAV III has been completed.¹²² The replacement of these vehicles would allow the Canadian Forces to deploy on operations with wheeled battle groups that can operate together in accordance with Canadian Army doctrine. Although our doctrine does not specify that battle groups must be wheeled or tracked, the presence of a direct fire platform that is deployable (a wheeled tank) would allow the Army to meet the doctrinal definition.

Table 5.1: Tracked Vehicles that presently remain in Canadian Combat Units

<u>Serial</u>	<u>Tracked Vehicle Type</u>	<u>Total in Service</u>	<u>Approximate Cost to Replace</u>
1	Leopard C 2 Tanks	122 (this includes 8 Taurus)	\$378-537 million
2	Armoured Vehicle Bridge Layers	9	\$28-40 million
3	Armoured Engineer Vehicles	9	\$28-40 million
5	Self Propelled Howitzers	76	\$236-334 million
6	Air Defence Anti Tank System	34	\$105-150 million
7		Total: 250 vehicles	Total: \$775 million to \$1.1 billion

Source: Data collected from various army web pages, <http://www.army.forces.gc.ca/lf/equip/veh>.¹²³

It is important to note that the costs mentioned in table 5.1 are approximate costs using the LAV III hull as the chassis of choice. These prices include the actual costs charged by GM Defense for the purchase of the LAV III and Coyote fleets, which were based on a cost per vehicles of \$3.1 million and \$4.4 million respectively. It is important to note once again that the costs per vehicle for both the Coyote and LAV III include support costs (spare parts etc). The two figures were then multiplied against the number of tracked armoured fighting vehicles still in service, to determine the approximate cost of replacing the tracked fleet of AFVs. Although the overall capital expenditures would be enormous for a one-time purchase, it is something that could be realized with good

long term financial planning, which was one of the key points stressed in *Strategy 2020*.¹²⁴

The total costs of completing the transition to a totally wheeled fleet of armoured fighting vehicles would be approximately \$775 million to \$1.1 billion Canadian dollars. This cost, albeit significant, would result in considerable savings in many other areas over the lifespan of the wheeled AFV fleet.¹²⁵

The savings associated with reducing the number of different fleets presently operated by the Canadian Forces would result in further savings in the following areas:

- a. Occupational trade specification training courses for maintenance personnel would be reduced from four completely different fleets to one fleet. This would allow maintenance personnel to be employed in any combat units regardless of training and previous experience;¹²⁶
- b. A reduction in the amount of capital tied up in spare part inventories required for the various different fleets. Besides reducing the amount of money tied up in inventories, there would be significant savings on deployments when scales of spare parts and space available become issues. It is important once again to note that the Defence Budget allocates \$2.4 billion dollars to maintaining military equipment of which \$1.5 billion goes towards the purchase of parts; and¹²⁷
- c. There are also the savings previously mentioned in other chapters, such as fuel consumption and reduced vehicle maintenance.¹²⁸

Although it is difficult to accurately extrapolate these savings over the lifespan of the wheeled AFV fleet (approximately thirty years), it is reasonable to assume that the savings would help to offset the initial capital acquisition of the new-wheeled AFVs. Essentially, by purchasing a vehicle that is cheaper to maintain and operate, the Army could actually reduce spending over a number of years. The most costly option could be doing nothing and maintaining a combination of both wheeled and tracked AFVs.

The cost of maintaining the status quo and doing nothing will eventually result in the Canadian Forces losing its direct fire platform by 2010, when the aging Leopard Fleet is retired after 35 years of service.¹²⁹ This could eventually result in the Canadian Government deploying battalions and battalion groups, vice battle groups with direct fire assets. Without the requisite direct fire support, there could be serious employment restrictions placed on these battalions. Additionally, without a direct fire system to train with, it will be extremely difficult to conduct training at the combat team and battle group levels. Without this training, which is fundamental, the Canadian Forces could lose the ability to maintain a multi-purpose combat capable force. Training at the combined arms level involves all elements of the combat arms working together in order to achieve success. If you remove any element you risk failure.¹³⁰

Summary

The opening quotation to this chapter stresses the importance of employing a force that is combat capable, inter-operable and rapidly deployable.¹³¹ If this is the stated strategy of the Canadian Forces, then a long-term procurement plan must be developed to ensure that the Canadian Forces can meet these strategic objectives.

This chapter also looked at the approximate costs associated with completing the transformation to a totally wheeled fleet of AFVs. Although the costs, which range from \$775 million to \$1.1 billion, are significant, there are several cost savings associated with the purchase of the new fleet and the overall reduction of a number of different vehicle variants, presently in service. Finally, this chapter looked at some of the consequences of

doing nothing and losing our direct fire capability as soon as 2010, when the aging Leopard fleet is retired.¹³²

CHAPTER 6

CONCLUSION

As the world enters the information age, the Army must stay ahead of changes in warfare. The future force must be prepared to conduct quick, decisive, highly sophisticated operations. It must also be ready to execute peace operations and limited, often protracted, operations against less sophisticated enemies. In the past five years, the Army has accomplished much towards building a capable and versatile 21st Century Army, but there is still much to do. The Army fully intends to remain the world's most formidable land force in the next century and has developed a plan to convert that vision into reality by taking advantage of the revolution in information technology. America's 21st Century Army will integrate emerging information technologies with sound doctrine, reinvented organizations, and quality people to make a smaller force more lethal, more survivable, more versatile, and more deployable.¹³³

In the opening quotation to this paper, General Shinseki, United States Army Chief of Staff, offered a visionary theory on how tomorrow's armies would be structured, equipped, and organized. General Shinseki believes that the armies of the future will predominantly move on wheeled fighting platforms. His rationale for this thought process is based on several changes that he has identified and observed, in the way conflicts and wars are currently being waged around the world. He also has strong opinions on how future conflicts will be fought on the battlefields of tomorrow. General Shinseki's vision is reinforced and complimented by several additional documented arguments covered in this paper. The opening quotation to this chapter, taken from *America's Army Tomorrow and Into The 21st Century*, clearly reflects this mindset.

Canada's Army, which is presently equipped with wheeled and tracked armoured fighting vehicles, has reached a crossroads where a decision fundamental to the Army's future and survival must be made. In order to continue meeting the stated aim of the *1994 White Paper on Defence*, Canada must complete the transformation from tracked to

wheeled armoured fighting vehicles. This paper provides the rationale for why wheeled armoured fighting vehicles are the preferred choice of the future and why the transformation should take place now.

The first chapter to this paper examined the *1994 Defence White Paper* and *Strategy 2020*. From this examination, it was concluded that the Canadian Army has a mandate to maintain a multi-purpose combat capable force that is capable of meeting the requirements on the battlefield of tomorrow. Chapter 1 also outlined the present structure of the Canadian Army's fighting echelon. It argued that the present policy of equipping combat units with both tracked and wheeled AFVs creates several inter-operability issues. Chapter 1 concludes that the Canadian Army needs to complete the transformation from a tracked fleet to a wheeled fleet of Armoured Fighting Vehicles in order to be a viable and multi-purpose combat capable force in the future.

Chapter 2 examined how tomorrow's battlefield will be structured and the types of conflicts that are presently taking place around the world. Chapter 2 argued, based on research conducted by the Directorate of Land Strategic Concepts, that future conflicts are likely to take place in Asia, Africa, and the Middle East. It also argued that most of these conflicts would be internal state conflicts, with a combination of inside and outside interference. The data also indicated that the majority of these conflicts would take place in third world countries. Although it cannot be concluded that there is no risk of conventional war, it is possible to conclude that there is a higher likelihood of NATO and United Nation Forces being deployed to deal with internal state conflicts, against third world armies. The locations where friendly forces are likely to deploy was then be taken into consideration, in order to determine how these forces should be equipped to fulfill

their potential mandates. Defence analysts, such as Jim Caldwell and David Pyne, have stated publicly that the tracked tank is best suited for conventional wars whereas the wheeled armoured fighting vehicles are better suited to perform the task of global police.¹³⁴ Given that there is a higher likelihood for the latter, Chapter 2 concludes that wheeled fighting vehicles are better suited to meet and fill these requirements on the battlefield of tomorrow. Although it is impossible to be prepared for all the different types of conflict that may arise, studying recent conflicts is one of the best ways to predict the future. Given that very few nations can afford to be equipped and structured for all types of warfare, focusing on the most common types of conflict seems to be the most logical option when deciding how to be structured and equipped.

Chapter 2 also argued that the revolution in military affairs is likely to result in more lethal munitions, better protective armour and increased situational awareness. These changes are expected to increase the capability and popularity of wheeled armoured fighting vehicles. They will essentially neutralize many of the advantages previously associated with tracked armoured fighting vehicles, giving wheeled AFVs virtually the same capabilities. Although this paper recognizes that wheeled armoured fighting vehicles are not superior in all aspects, it concluded that wheeled armoured fighting vehicles are superior in a majority of areas. It also stated that most of the wheeled AFV shortcomings could be overcome as technology develops further into the 21st Century.

Chapter 3 compared wheeled and tracked armoured fighting vehicles using the Canadian Army's six combat functions (command, information operations, manoeuvre, firepower, force protection, and sustainment). Each of the combat functions was

analyzed using the data available from several studies in order to determine which of the two fleets was superior. The paper argued that wheeled AFVs were superior to tracked AFVs in the areas of command, manoeuvre and sustainment. It also found that tracked AFVs were superior in firepower and protection. There was no data to indicate which vehicle fleet was superior in the combat function of information operations. The paper did, however, argue that the lack of firepower and protective armour found in most wheeled AFVs could be overcome with further research and development. Chapter 3 concluded that when the six combat functions are used to compare wheeled and tracked AFVs that wheeled AFVs are superior. When the combat functions are taken in consideration with the future security environment discussed in Chapter 2, wheeled armoured fighting vehicles seem to be the only logical choice for an army that must maintain a multi-purpose combat capable force within limited financial restraints.

Chapter 4 examined the cost and lifecycle management of both tracked and wheeled armoured fighting vehicles. Chapter 4 argued that given the reluctance of most nations to spend more on defence, it has become essential to ensure that the limited funds available are spent as effectively as possible. In order to remain a multi-purpose combat capable force it was argued that it is necessary to have a vehicle that is affordable, reliable and capable of filling the majority of tasks. Chapter 4 concluded that wheeled armoured fighting vehicles are cheaper to operate and support, they consume

less fuel, require less

Chapter 5 examined the Canadian Forces publication, *Strategy 2020* and how it affects the future of Canada's Army. Chapter 5 argued the importance of employing a force that is combat-capable, inter-operable and rapidly deployable is fundamental to the continued survival of the Canadian Army. If this is the stated strategy of the Canadian Forces, then a long-term procurement plan must be developed to ensure that we meet these strategic objectives. Chapter 5 also examined the approximate cost associated with completing the transformation to a totally wheeled fleet of AFVs. Although the costs, which would range somewhere between \$775 million and \$1.1 billion Canadian dollars are significant, there are several cost savings associated with the transformation. The savings associated with reducing the number of vehicle fleets and the training requirement to maintain these fleets would be significant over the lifespan of the fleet. Finally, Chapter 5 examined the consequences of not committing to a wheeled AFV fleet now and the consequences of losing our direct fire capability when the aging Leopard fleet is retired in 2010. Chapter 5 concluded that wheeled AFVs are the best option for a nation that wants to remain combat capable, inter-operable and rapidly deployable.

Selecting a vehicle that is capable of filling the majority of tasks that the Canadian Army is likely to be assigned in the future security environment is key to selecting the best vehicle for the Canadian Forces.¹³⁵ Although both wheeled and tracked AFVs have limitations on their employment, the requirement to focus capabilities in a particular direction is no less relevant. Admiral Garnett, Chief of Staff, Supreme Headquarter Allied Command Europe (SHAPE), recently stated during a question and answer period that many nations were facing similar decisions in regard to how their limited defence

budgets should be allocated. Although there is a reluctance to lose certain capabilities, few nations are capable of fielding armies to deal with every situation imaginable.¹³⁶

In the mid 1990s, Canada started to head in the right direction when the Canadian Government directed the Department of National Defence to purchase the Light Armoured Vehicle (LAV III), armoured personnel carrier and the wheeled Coyote reconnaissance vehicle.¹³⁷ Wheeled AFVs will increase mobility and allow commanders to deploy rapidly, in order to influence a conflict before it has had time to take root and spread into neighboring states. Although they have some minor shortcomings, with further research and development, wheeled AFVs will have similar lethality and protection to that of the conventional tracked AFV. The wheeled AFV already performs better than its tracked counterpart on UN and domestic/humanitarian operations. Given the nature of the future security environment a common fleet of wheeled armoured fighting vehicles seems the only logical choice.

The six chapters to this paper provide the supporting arguments for why the Canadian Army needs to complete the transformation from a tracked fleet to a wheeled fleet of Armoured Fighting Vehicles (AFVs), in order to be a viable and multi-purpose combat-capable force in the future.

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