

A large Leopard C2 tank is the central focus, its long barrel pointing upwards. Three soldiers in desert camouflage uniforms are positioned around the tank. One soldier stands on the ground to the left, holding a rifle. Two other soldiers are on top of the tank's turret, one appearing to inspect the barrel area. The tank is parked on a dusty, flat surface under a clear blue sky. The image is a full-page photograph with a blue text box overlaid on the upper left portion.

*Members of Bravo Squadron, from the Lord Strathcona's Horse (Royal Canadians) (LdSH(RC)), based out of Edmonton, Alberta do their final checks on their Leopard C2 tank at the Kandahar Airfield in Afghanistan.*

## THE LONG ENGAGEMENT

### The Case of the Canadian Army's Multi-Mission Effects Vehicles

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The Army's combat mission in Afghanistan ended in 2011, but both Canadian experience there, and the experiences of other countries' land forces in combat operations in Iraq and elsewhere, have sustained a perceived need for heavier direct fire ground combat vehicles. Since 2006 the Canadian Army has first leased, and then bought, Leopard-2 main battle tanks,<sup>1</sup> and has also considered acquiring a heavily armoured (25 to 45 ton) Close Combat Vehicle (CCV).<sup>2</sup> Between the mid-1990s and the mid-2000s, however, the situation was quite different. The army's most recent operational experience up to that point was based mainly on peacekeeping operations, and a commonly held political view that deploying heavy vehicles like tanks could be destabilizing in these types of missions. Also, the popularity of the concepts like the Revolution in Military Affairs (RMA) and transformation amongst Canada's main allies supported a belief that achieving information superiority during operations could eliminate the need for the protection of heavy armour on combat vehicles. Within this context, lighter vehicles appeared to allow for rapid strategic deployability and greater operational mobility.

Simple lessons might be drawn from this contrast. First, armies should not assume that the next major deployment will resemble the last one, and second, there is value in the careful analysis of approaches to the future nature of military-technological change emerging from allies. However, the history of the Canadian Army's planning for future armoured combat vehicles between the mid-1990s and the mid-2000s provides a more interesting perspective than such general observations. Records show that friction and misunderstandings between elements of the army leadership, the capability development system, and the combat arms can complicate planning for acquisitions that in many respects appear logical at the time. This was the case with the class of conceptual armoured vehicles generally known as "Multi-Mission Effects Vehicles," or MMEVs.

In 1998 the capability development system first studied light armoured vehicles which would have features that would later be characteristic of later MMEV plans. That year the Directorate of Land Strategic Concepts (DLSC)<sup>3</sup> produced an *Armour Combat Vehicle Concept Paper*. The author(s) of the paper proposed that a new "phase one" Armoured Combat Vehicle (ACV) replace the Army's 195 Cougars in the period 2002–2005, and that a "phase two" vehicle replace the Leopard-1 tanks "sometime after 2010."<sup>4</sup> The phase 1 vehicle was to have "accurate firepower, capable of destroying main battle tanks and lesser targets," and it was to "trade off" armour protection for "high strategic and operational mobility, high sustainability and low operating costs."<sup>5</sup> The authors commented that the phase two project should "leverage the experience gained during (phase) 1... and take advantage of the emerging technologies that will be available post-2010."<sup>6</sup>

The paper also stated that future ACVs should preferably be optimized for transport by strategic airlift,<sup>7</sup> reflecting the RMA-inspired idea that rapid worldwide strategic deployability would become a paramount concern—and a central feature of U.S. Army plans at the time for its Interim Combat Brigade Teams (ICBTs), which would later become Stryker brigades.<sup>8</sup> The view that lighter vehicles were needed for greater operational mobility also gained wide acceptance during these years, since 1990s peacekeeping operations in the Balkans, especially Kosovo, indicated that heavier NATO armoured vehicles were unable to operate effectively on relatively undeveloped infrastructure.<sup>9</sup> It was stated that ACVs should be light enough to operate on "third world country" infrastructure, and should be capable of travelling at the same speed as the Army's then-new LAV-III infantry fighting vehicle.<sup>10</sup> In order to compensate for its lighter armour, the paper's author(s) discussed the possibility that the ACV should use an indirect fire guided missile, either along with—or in place of—a direct fire cannon for stand-off capability against main battle tanks and other threats.<sup>11</sup> Consideration was given to incorporating a basic air defence capability into the vehicle, possibly using the same guided missile system.<sup>12</sup>

Other Army studies at the time, however, highlighted the drawbacks of light ACV concepts. Army war games held during 1997–1998, such as Exercise QUARRÉ DE FER, found that a 20 to 30 ton Armoured Combat Vehicle was too lightly armoured and, if equipped with wheels rather than tracks, lacked the tactical mobility to manoeuvre openly when in sight of the enemy.<sup>13</sup> The QUARRÉ DE FER war game analysis concluded that “the ACV could not be used boldly and aggressively in warfighting situations... The study recommends the MBT not be replaced by the ACV in the armoured regiment for warfighting.”<sup>14</sup>

Counters to identified concerns about a lack of armour protection soon emerged at a theoretical level. These arguments reflected RMA-inspired approaches of the late 1990s. In June 1999, for example, a *Future Army* planning team including academics and representatives from military allies held a conference in Kingston, Ontario. Its results were published by DLSC in a study titled, *Transforming an Army: Land Warfare Capabilities for the Future Army*. In one discussion, Don. L. Smith, then Director of Science and Technology Land (DSTL) at the National Defence Headquarters (NDHQ) Defence Research and Development Branch, described that organization’s views on armoured vehicles:

LAV III’s [sic.], Cougars, and Coyotes are extremely easy to kill. We are not going to armour them, but move into the notion of protect, sustain, act and sense. The protection issue of the Army is going to be a stealth issue... We are talking about... an Army with topsight [sic], one that sees and knows all. The Future Army will have an instantaneous vision of what is going on with the enemy... When you know your own situation and the enemy’s, you can have small units working in tightly orchestrated fashion.<sup>15</sup>

Another future army study by DLSC, published in 2001, stated that increased operational mobility was required in the present and near-term. It argued that the physical space which operations had to cover, or “battlespace,” had expanded significantly during the 1990s. It cited the 1990s example of the Canadian battlegroup area of operations in Bosnia-Herzegovina covering an area of approximately 250 kilometres by 70 kilometres. Such growing areas of operations, the argument went, indicated that the large quantities of fuel, ammunition, and equipment maintenance required by existing heavy forces would have to be reduced. A wide range of what were considered immature technologies, including electrical, hybrid electrical and hydrogen based power systems, were commented on as possible solutions. The possibility that greater use of precision weapons on future vehicles would reduce ammunition expenditures was also considered.<sup>16</sup>

In the May 2002 seminar war game *Future Army Experiment: Operations in the Urban Battlespace*, the term “Multi-Mission Effects Vehicle” was first applied to conceptual wheeled light armoured vehicles which incorporated precision missile weapons. Three brigade-sized “exercise force,” or EXFOR, constructs were studied. Students graduating from the Transition Command and Staff Course at the Canadian Land Forces Command and Staff College (CLFCS) served as the commanders and staff of the EXFORs. U.S. Army, Marine Corps, Department of Defense, and RAND Corporation personnel also participated, as well as representatives from other allies and non-governmental organizations (NGOs). The exercise examined whether a force designed for high intensity combat in open terrain could be adapted equally well to conflict in urban terrain.<sup>17</sup>

EXFOR A was labelled an “evolutionary design.” It had 5200 men and three battlegroups using 25–40 ton “future armoured vehicles.”<sup>18</sup> These included two sub-units in each battlegroup using a MMEV designed around a LAV chassis, and two-sub units using a “close effect vehicle” (CEV).<sup>19</sup> The MMEV incorporated characteristics that would later appear on different developmental armoured vehicles. Like the Mobile Gun System (MGS) that the Canadian Army collaborated on with the U.S. Army between 2003–2006, and that the U.S. eventually incorporated into its Stryker brigades, this MMEV included a 105mm main gun, similar to that used on the Leopard-1. Like later variants of the MMEV concept, it also included low level air defence missiles for both anti-tank and short-range air defence. For the purposes of the seminar it was described as “the evolution of the tank.”<sup>20</sup> The CEVs resembled the LAV-IIIs then being acquired by the Army, being described as infantry carriers with a 25mm gun, general purpose machine guns, grenade launchers,

and also four low level air defence missiles each.<sup>21</sup> EXFOR A also had two flights of Griffon helicopters with reconnaissance, surveillance and target acquisition and attack functions, and artillery support from 155mm tube artillery and 120mm mortars designed to fire precision guided rounds.<sup>22</sup>

The 4500 man EXFOR B was described as the “revolutionary design.”<sup>23</sup> Vehicles were supposed to be smaller and lighter than those in EXFOR A and also to have greater endurance and range and better resolution in their sensing systems.<sup>24</sup> They were to be equipped with various small automated surveillance and combat vehicles systems, both Unmanned Ground Vehicles (UGVs) and Unmanned Aerial Vehicles (UAVs).<sup>25</sup> The individual soldiers in EXFOR B were simulated to have various technologies built into their clothing in order to further network them together, such as heads up displays in their helmets which would feed them real-time situational awareness data.<sup>26</sup> In addition, provision was made for multi launch rocket systems with a theoretical range of 100 kilometres, other artillery that fired precision munitions, and two flights of helicopters deemed to be able to process up to 200 targets at a time and to be able to kill T-90 main battle tanks at a range of eight kilometres.<sup>27</sup>

EXFOR C was a baseline similar to a standard Canadian brigade structure of the early 2000s, with three infantry battalions, an armoured regiment, an artillery regiment, a field engineer regiment, and combat service support, and assisted by an aviation squadron.<sup>28</sup> Although it had a data processing centre, the flow of information this centre provided, together with the brigade’s other information processing capabilities, were deemed to be “less sophisticated” than those in the two other EXFORs.<sup>29</sup>

The *Operations in the Urban Battlespace* war game was typical of the late 1990s and early 2000s in that it was organized to pair less sophisticated information processing capabilities with heavier armoured vehicles, while lighter vehicles would be part of a force capable of gaining greater information superiority. After working through the seminar play, the experiment concluded that while technology would enhance individual and collective force capabilities, it would not replace the need for large numbers of soldiers in urban or other complex terrains.<sup>30</sup> All three variants lacked sufficient dismounted soldiers, although EXFOR B suffered most significantly from this problem.<sup>31</sup> It was found that EXFOR A would have benefitted from replacing one sub-unit of MMEVs in each of its battlegroups with an extra sub-unit of CEV infantry carrier/support type vehicles. EXFOR C predictably was found to suffer from a lack of situational awareness and information dominance.<sup>32</sup> The game designers concluded that it is difficult to make “one size fits all” force structures, and suggested that creating a Future Army model optimized for complex terrain but adaptable to open terrain would be overly complicated.<sup>33</sup>

While DLSC and other branches of the Land Force Doctrine and Training System (LFDTS) in Kingston conducted studies of MMEVs and related vehicles, the office of the Director General Land Staff (DGLS) at NDHQ conducted its own analysis. It examined three alternatives for a wheeled Armoured Combat Vehicle (ACV) with a 105mm tank gun in November 1999. The first was to immediately replace both the six-wheeled LAV-I Cougar, which had a short turret-mounted 76mm gun, and the Leopard 1 with the ACV. The second was to delay ACV acquisition until 2015 to 2020. As in the DLSC 1998 study, the third was to replace the Cougar in the near term with the ACV and replace the Leopard at a later date.<sup>34</sup>

The DGLS study found that immediate advantages of ACV acquisition would be improved operational mobility, lower in-theatre logistic burden, and near-term interoperability with the U.S. Army (presumably in terms of the light armoured vehicle based Interim Combat Brigade/Stryker Brigade organizations that the Americans were then developing). However, it also found that the ACV would provide no significant improvement in tactical capability over the Leopard 1, and that it would have little “growth potential.”<sup>35</sup> As a result, given the Army’s “limited” capital procurement budget, DGLS judged that if the Land Force spent funds in the short term to acquire the ACV, it would be locked into a system that would lead to long term interoperability problems with the U.S. Army.<sup>36</sup> As a result, it recommended that option two be pursued, as a way of spending limited funds on “high payoff” equipment, and also as a way of further testing

and refining ACV designs in the context of possible future changes in the security/operating environment.<sup>37</sup> Like the capability development organization in Kingston, the NDHQ staff office concluded at the end of the 1990s that a long capability development process lay ahead for new generations of armoured vehicles.

Sometime in 2002, however, then Chief of Land Staff (CLS) Lieutenant General Jeffery, together with then Assistant Chief of the Land Staff (ACLS) Major General Hillier (promoted to Lieutenant General in December 2002), developed the idea of incorporating three different types of light armoured vehicles into a new Direct Fire Unit (DFU).<sup>38</sup> The MMEV version 1 (MMEVv1), as it came to be called, was one of these platforms, and was intended to cost-effectively reuse the Air Defence Anti-Tank System (ADATS) on a LAV chassis. Unlike in the *Operations in the Urban Battlespace* war game, the 105mm tank gun was reassigned to another vehicle, the Mobile Gun System (MGS). The third vehicle in the group was a LAV-III mounting the TOW-Under-Armour missile system. These three vehicles were intended to use overlapping ranges of fire, combined with greater information processing and precision targeting capabilities, to engage opponents at longer ranges and avoid the need for the protection of heavy armour.<sup>39</sup> In April 2003 Hillier wrote to other senior Army officers that:

Thus we really could replace the Leopard in the direct fire role with a veh [sic., abbreviation for vehicle] that is wheeled, can be carried in a Herc [sic., abbreviation for Hercules cargo aircraft] and that can deliver at least the same capability but, most importantly, deliver it in a theatre of operations where we cannot or don't want to get the Leo [sic., abbreviation for Leopard 1].<sup>40</sup>

In this context, development of a more specific type of MMEV—one designed around a missile based air defence / anti-tank capability—continued. Under the plan, the MMEV would still have been staffed by artillery personnel, but operationally integrated into the DFU organization. It was initially endorsed by at least some members of the Artillery branch, as can be seen in a position paper written at some point in 2002 or 2003. Entitled *Air Defence Anti-Tank System (ADATS) In The Line of Sight Precision Guided Missile Role – Like A Hot Knife Through Butter, And More...*, the paper extolled the capabilities



Source: Public Domain

The Mobile Gun System (MGS) mounted on a LAV chassis.



The Air Defence Anti-Tank System (ADATS) mounted on a LAV chassis.

of the ADATS but argued that the artillery should have operational control of the MMEV. As outlined in the paper, the ADATS was originally acquired through a 1986 low level air defence (LLAD) project to meet the late Cold War threat in Germany.<sup>41</sup> Mounted on M-113A3 tracked armoured personnel carriers, it was to provide short range air defence (SHORAD) to mobile troops and static installations in all weather conditions. The author(s) of the paper stated that it could guard against high speed aircraft, helicopters, drones or remotely piloted vehicles, and cruise missiles, and enthusiastically added that:

What has been not so well known is that the ADATS has an excellent anti-tank capability, which has until now been considered a largely self-defence capability within Canadian AD (Air Defence) doctrine. In fact, the ADATS is capable of destroying armoured ground targets with great precision out to 8 kilometres plus with a minimum engagement distance of 370 metres.<sup>42</sup>

The paper identified the ADATS as using an active X-band air search radar and passive electro-optic (EO) module using forward looking infrared (FLIR) and low light television (LLTV) for tracking and engagement of targets.<sup>43</sup> The FLIR and LLTV systems are described as “extremely effective” at line of sight detection of ground targets, although, being electro-optical devices, they could be limited by rain, mist, fog, smoke, and similar obscurants.<sup>44</sup> The effectiveness of the system’s load of eight missiles, capable of airspeed in excess of Mach 3, was emphasized, along with the missiles’ warheads being optimized for both air and ground targets.<sup>45</sup> The missiles were designed to have a range of ten kilometres, which was touted by the paper as: “much longer than any direct fire weapon in the Land Force inventory.”<sup>46</sup> It was further stated that since the missiles use rearward looking laser receivers to obtain guidance information from the ADATS, an enemy could not jam them without physically blocking the line of sight between the missile and the launcher, which was described as an “impossible feat” due to missile speed.<sup>47</sup> System accuracy was also highlighted, with the claim that the laser system was accurate to 1.5 square metres at distances of up to eight kilometres.<sup>48</sup>



A U.S. Stryker vehicle crew belonging to the 4th Brigade, 2nd Infantry Division, fires a TOW missile during the brigade's rotation through Fort Polk's, Joint Readiness Training Center.

As a result of the described capabilities, the author(s) of the paper argued that the ADATS would be both an excellent precision-guided direct fire system against both air and ground targets, and also an excellent intelligence, surveillance, target acquisition and reconnaissance (ISTAR) and command, control, communications, computing and intelligence (C4I) platform which could feed targeting data to all other systems tied into a tactical internet.<sup>49</sup>

Having made a case for the system, the paper also addresses its potential weaknesses. The writer(s) admitted that, since the ADATS does not have a feature such as gyro stabilization, it cannot acquire and fire on targets on the move.<sup>50</sup> However, they suggested that this is compensated for because the ADATS is capable of moving "cross country" in stand-by mode, which allows it to fire a missile approximately one minute after it has stopped on a firm and level piece of ground.<sup>51</sup> They also admitted that a "well placed" small arms shot or shrapnel from a mortar or other projectile can damage the turret relatively easily, rendering the system electro-optically "blind."<sup>52</sup> As a result, they recommended that the turret would require greater protection to allow it to "fight and survive in close contact with the enemy."<sup>53</sup>

A final concern expressed was that a system mounting the ADATS requires a generator to be run even while the vehicle is not moving, because its sensor capabilities consume a great deal of energy.<sup>54</sup> This drives up logistic requirements, and also means that the system produces significant noise and heat signatures.<sup>55</sup> However, the paper's author(s) took the view that this was a minimal drawback, with a short discussion of how much other "high tech" equipment in the Army required a lot of resources as well.<sup>56</sup> Reaching the crux of their argument, they presented both a problem and an opportunity:

...it is easier to assume a less demanding role or task, than it is to amass the significant experience that makes one an expert in a complex trade. The AD [air defence] has the more technically complex of the two tasks. The ADATS gunners and Detachment Commanders routinely train in the engagement of ground targets in both the simulator and during live fire exercises.

To assume a direct fire precision role requires no further training in the engagement sequence, only on the tactical battlefield and simply require [sic.] the leadership and planning of their officers and Senior NCMs in anti-armour tactics. The converse is not true. You cannot take an anti-armour squadron and employ it in the AD role with the requisite Command and Control skills and equipment to integrate into the theatre AD plan without replicating years of experience and training. No arrogance intended, just fact... ADATS should remain within the AD artillery in order to meet the broad range of missions which may be required...<sup>57</sup>

As can be seen in the paper, the MMEV concept could be quite attractive when an arm of the Land Force believed it might acquire a more significant role through the system. The artillery would be less enthusiastic when it found that the plan was to transfer operational control of the MMEV to the new "all arms" DFU. Its reticence to lose direct control of the MMEV was driven by the belief that a command structure which was familiar with existing procedures for employment of an AD system was necessary for a vehicle based on the ADATS. To some extent this could be taken as an example of inter-arm rivalry, but the artillery arm authors of the paper had a significant point which would recur over the following two to three years of MMEV development: combining air defence and ground-to-ground fire, while impressive on paper, is difficult in practice due to the multiple skill sets that the operators have to learn and maintain.

Outside of the artillery, arguments for the MMEV proceeded apace. A briefing note for the Minister of National Defence dated January 19, 2004, identified the "Army Requirement for a Multi-Mission Effects Vehicle." Prepared by the Directorate of Army Doctrine (DAD), it stated that the Army has identified the potential benefit of acquiring a MMEV as part of its Transformation process.<sup>58</sup> It was reported that Defence Research and Development Canada (DRDC) identified a capability to act in direct, indirect, and air-defence roles from a single platform as important during a Future Armoured Vehicle Systems technology demonstration project.<sup>59</sup> The note stated that war games subsequently organized by DLSC showed that the MMEV concept was "tactically decisive" based upon "improved understanding" of the battlespace and extended range fires.<sup>60</sup>

It was emphasized in the note that these studies coincided with a Ground Based Air Defence (GBAD) capabilities review which suggested that the "potential" of the ADATS should be "maximized" by increasing its capabilities in the direct and non line of sight fire roles.<sup>61</sup> The note stated that as a result, the Army would be "seeking authority to proceed with this project shortly after" procurement of the MGS vehicle was fully underway. It also advised that this would require "revisiting" Strategic Capabilities Investment Plan (SCIP) funding timelines to bring MMEV programming into line with Transformation plans, as "the current SCIP timelines are too far out."<sup>62</sup> More generally, it revealed that the Army was intending the ADATS based MMEV as a first step towards implementing more capable MMEVs like those first considered in late 1990s studies. The MMEV design for which approval was sought was described as MMEVv1, which was intended to address "immediate needs" of the Army, while additional comment indicated that MMEVv1 was equally important because it would lead towards "full development" of the MMEV concept.<sup>63</sup>

The capability development system, however, was also aware of the organizational difficulties in creating a combined air defence and direct ground fire system. A May 2004 Land Force Doctrine and Training System (LFDTS) capability development record of the MMEV had a positive outlook for the potential of the system, but noted that air defence systems must operate within a Joint Airspace Control Plan.<sup>64</sup> The document stated that if the MMEV was to retain any air defence capability, airspace control authority authorized command, control, communications and intelligence (C3I) would be required.<sup>65</sup> Future ground based air defence missile designs with capabilities exceeding the "standard" ADATS were also discussed.<sup>66</sup> The overall argument was that: "This future GBAD system embodies the flexibility; economy of effort and cooperation required in future operations. The GBAD functional adjustments create new resources and greatly enhance other... combat functions."<sup>67</sup>

Discussion between officers at the artillery, infantry and armoured schools in the spring of 2004 illustrated that concern recurred over how to manage the MMEV. In an April 2, 2004 e-mail, Major R. Lavoie of the Combat Training Centre (CTC) Artillery School at Gagetown stated that after an Artillery Advisory Board discussion: "...for some reason, we believe we are absolutely not being listened to, although we have the experience with the kit and we are the only Combat Arms [sic.] with concerns and appreciation of the complexity of the third dimension of the battlefield."<sup>68</sup> He wrote that the air defence community and Royal Canadian Artillery (RCA) had "totally accepted" that the ADATS and MMEV role was now anti-tank first, although there had been resistance within the artillery corps.<sup>69</sup> He also discussed three options concerning how to integrate the MMEV into the DFU, which at this point was intended to be based in western Canada.

The first option, which had been preferred by the Army senior leadership since 2002–2003, was to create troops of four MGS, two LAV-TUA, and two MMEV vehicles. Lavoie commented that this option was "rejected immediately and reverently" by the Artillery Council.<sup>70</sup> Based on previous experience with artillery assets being under the operational control of other organizations, the Council believed that it would "fail" or "at least be inefficient and ineffective."<sup>71</sup> The artillery considered the second option, to create a MMEV sub-unit under the DFU, to have advantages and disadvantages. It preferred the third option, an organization independent of the DFU, but co-located with it.<sup>72</sup> Even in the case of option three, Lavoie reiterated early concerns about the drawbacks of the MMEV in a direct fire role:

The ADATS is not a LAV, a tank or even an APC. It is slow, hard to manoeuvre and requires specific technical aspects of the firing position to be effective. To expect to use the ADATS as a Tank or even a LAV is not possible. We can certainly trail it, but we should manage our expectation... We should expect the same differences between the MMEV and LAV as was the case with the M113 and ADATS; extremely top heavy and very slow moving... Trials will likely demonstrate that the skills required to manage such a system as the MMEV will demand a lot of training and generate a high risk of skill fade.<sup>73</sup>

The above positions, stated informally, were further outlined in an April 27 transition concept paper signed by Lieutenant-Colonel M. Lavoie, Commanding Officer of the 4th Air Defence Regiment, Royal Canadian Artillery (RCA) in Moncton, New Brunswick, sent to the Director Land Requirement/Director Artillery at NDHQ. In it, the perception emerged that the transition of the MMEV into the DFU was the result of the Army being forced through a period of "rationalization and realignment" of resources, equipment, and personnel.<sup>74</sup> It suggested that all Air Defence Artillery personnel and equipment be centralized in Edmonton. It described the ADATS operators as "the smallest yet most technically advanced combat arms trade," and once again underscored the difference of a system based on the ADATS compared to other armoured vehicles:

The MMEV primary role is anti-armour but... we must retain Air Defence Artillery capability as a secondary role. The MMEV concept cannot be examined in isolation as an Air Defence Artillery system, nor be seen as a LAV TUA with extended range. Our experience with ADATS has clearly demonstrated that when employing ADATS it must be used as a minimum in a troop of four due to high maintenance and support requirements, mainly fuel.<sup>75</sup>

Another untitled internal Canadian Forces (CF) document from the time provided additional detail concerning some of the points in the documents above. It stated that switching a MMEV from air defence to a ground engagement task could be as simple as a "sniping gun" scenario in which the vehicle would receive information about a target, rules of engagement, and proceed to engage.<sup>76</sup> It outlined, however, that completely re-tasking an entire troop would be more complex because additional information would have to be received and time taken by the troop to assimilate it.<sup>77</sup> Switching from ground fire to air defence was to be the most complex transition, since it would have likely required the vehicles to be repositioned, briefed on the air threat and rules of engagement, and then loaded with current identification friend or foe (IFF) data.<sup>78</sup> It was specified that any coalition Canada would likely be a part of would not allow the activation of an air defence umbrella without prior coordination at a formation level, and that if MMEVs were to activate their radars without prior warning they would likely be targeted by friendly anti-radiation missiles.<sup>79</sup> As a result, the document came to the conclusion that:

Although technology supports the simultaneous air/ground role MMEV concept, the procedures and human factors inherent in today's system and in the foreseeable near future (2010) limit the employment of ADATS/MMEV to one or the other. It is easier to move from an air defence task to a ground task than in the opposite direction.<sup>80</sup>

Resistance in the artillery to the changing role of the ADATS continued through the summer of 2004. For example, the concerns seen above were raised at an August 20, 2004 discussion of a Direct Fire System Working Group. At the meeting, Lieutenant Colonel Clarke of the 4th Air Defence Regiment reiterated concern over assigned sub-units of two MMEVs to troops of vehicles within the DFU, and "deep concern" that the Army leadership did not understand the "full implication" of transitioning ADATS to a primarily direct ground fire role.<sup>81</sup> He also discussed, however, future developments which could improve ADATS direct fire capability including using modified rockets and possibly launching Hellfire missiles for indirect precision fire.<sup>82</sup>

In July 2004 Exercise PERFECT KILL was held, using existing ADATS equipped vehicles to simulate the MMEV.<sup>83</sup> Initial test results produced 88% aircraft kills and 31% kills against armoured fighting vehicles, but final test results produced 95% kills against aircraft and 96% armoured fighting vehicle kills.<sup>84</sup> M113 ADATS limitations were found to be a limited field of view, a turret that was "locked in" while on the move, needing to engage with radar "up," vehicle orientation limiting field of fire, and the ADATS power unit exhaust being on the front of the vehicle and thereby creating a strong heat signature.<sup>85</sup> Logistics and missile load were additional concerns.<sup>86</sup> Further development and refinement of tactics, training and procedures (TTPs) for the ADATS in the ground role was found to be necessary.<sup>87</sup>

In his comments on Exercise PERFECT KILL, Colonel T.J. Grant, then the Commander of First Canadian Mechanized Brigade Group (1 CMBG) found many shortcomings in the implementation of the exercise, but commented that the soldiers and NCOs had "found solutions to problems that others had stated were insurmountable."<sup>88</sup> He added that the exercise had achieved a "much better understanding of the abilities and limitations of the ADATS" amongst the organizers of the Direct Fire Unit/Direct Fire System war game, and expressed confidence ADATS elements could be integrated into the new DFU armoured vehicle organization.<sup>89</sup>



Source: Combat Camera

Sergeant Stéphane Gauvreau and Bombardier Kevin Guy engage an air target with the Air Defence Anti-Tank System (ADATS).

Gradually, the chain of command asserted itself and acceptance of the changing role of ADATS developed in the artillery. A directive written by Colonel Gunn, then Director of Artillery, stated that the arm: "...cannot blindly fight for the continued existence of 4th Air Defence (4 AD) Regiment as a unit based on past missions or roles. The organizational models of the future must be based on first principles and mission requirements."<sup>90</sup> He outlined a discussion with Colonel Kampman, then the Director of Land Strategic Plans (DLSP) in Ottawa, in which it was decided that the Artillery needed to produce a position paper outlining proposals for organizations, roles, locations and details pertaining to future ADATS capabilities.<sup>91</sup> He reiterated that the primary role of the MMEV would be ground engagement, and that the artillery had to develop a plan to surge up to three rotations of MMEV troops in order to support a tactically self sufficient unit.<sup>92</sup> He also clarified that DLSP staff still envisioned a tactical organization of a six MMEV troop broken up into two MMEV per direct fire troop, for a total of three DFU troops deployed at a time.<sup>93</sup> He wanted proposals for alternatives to this organization with analysis on the best options.<sup>94</sup>

Despite Colonel Gunn's acceptance of the Army leadership's plans for the ADATS, then Vice Chief of Defence Staff (VCDS), Vice-Admiral R.D. Buck, was not convinced. Although the land force capability development system had some flexibility within the Army, projects were still required to gain joint approval at the Joint Capability Requirement Board (JCRB). In September 2004 the JCRB deferred approval for the MMEV, with an explanatory letter from Buck to Lieutenant General Hillier, who was by then serving as Chief of the Land Staff (CLS), giving the reasons.<sup>95</sup> Buck made criticisms in four areas. First, he outlined how the MMEV project had identified capability deficiencies in GBAD, long-range direct fire, and precision indirect fire. He then commented that the proposed improvements would improve GBAD capability, but that he was concerned about the apparent relegation of GBAD to a secondary role behind direct fire. He asked:

Does this change in focus adequately address a key joint capability? I would be reticent to endorse any plan that would lead to the erosion of this key joint GBAD capability. Of note, from briefing material provided, the anticipated MMEV contribution to operations, in a CF context, suggests that the principal role in fact remains GBAD—related.<sup>96</sup>

In his second set of criticisms, Buck discussed the Army's concept of a direct fire system, stating that the articulation of a precision indirect fire capability deficiency raised further questions.<sup>97</sup> He pointed out that a number of indirect fire projects were rolled into a Future Indirect Fire Capability (FIFC) project in May 2003, and that it had yet to fully qualify a specific capability deficiency.<sup>98</sup> From this point he argued that it was important to clearly develop a broader, presumably joint, CF indirect fire capability before investing "strategic resources" to address "a possible component" of an "undefined deficiency."<sup>99</sup>

His third main area of criticism was that, although the MMEV Project only received Senior Review Board (SRB) endorsement to proceed with an options analysis phase in June 2004; "...the preferred solution to the capability deficiencies has already been identified, presented, and indeed, published for some time as the ADATS turret on a LAV III chassis. I am concerned that the scrutiny of possible choices may not yet have been conducted with the degree of rigour necessary."<sup>100</sup> His final concern had to do with the impact of Defence Force Structure reallocations which would have the effect of reducing the overall GBAD personnel establishment by 169 people.<sup>101</sup> He stated that: "Reinvestments to achieve the required GBAD structure must be substantiated with offsets identified."<sup>102</sup>

Nonetheless, the MMEV was ultimately endorsed by the JCRB on March 10, 2005. On April 12, 2005, the Senior Project Advisory Committee approved procurement of the MMEV on a sole-source basis from Oerlikon-Contraves Canada.<sup>103</sup> Acquisition of 33 MMEVs was officially announced on September 22, 2005.<sup>104</sup> The official press release claimed that the MMEV would improve situational awareness by providing around-the-clock surveillance and by sharing intelligence data between vehicles and command posts. It stated that:

The Canadian Forces are acquiring new, technologically advanced Multi-Mission Effects Vehicles... that will combine anti-tank and anti-air defence capabilities on one platform. Firing with its non line-of-sight weapons system, the MMEV will be able to engage targets that are hidden behind surrounding landscape features such as hills and buildings.<sup>105</sup>

The first phase of the project was expected to provide three prototypes and an initial fleet of six vehicles with interim logistics support, and full production of the MMEV was expected by 2010.<sup>106</sup>

Despite the announcement, ongoing capability development war game studies of the MMEV and its role alongside an MGS and a LAV-TUA in the DFU revealed continuing concerns. These included a Director General Land Combat Development war game seminar from May 3 to May 7, 2004, and Army Experiment 8A, a computer based simulation conducted at the Army Experimentation Centre.

A DAD summary of the May 3–7 event was that the war game illuminated many areas where the Army “clearly” didn’t know enough.<sup>107</sup> Communications difficulties for the MMEV in urban terrain were identified, because large buildings and other structures interfere with radio communications and block laser communications.<sup>108</sup> Reliance on sensors to constantly identify the enemy at a distance was found to be imperfect, and a “readily apparent” need for human intelligence was identified.<sup>109</sup> The capacity of the MMEV to leave and rejoin air defence networks was also questioned.<sup>110</sup> War game participants suggested that the MMEV could become a “transformational, battle winning capability” only if the potential of its precision indirect fire capability could be achieved,<sup>111</sup> and that it should perhaps operate independently from a distance, also performing the LAV-TUA’s missions and rendering that vehicle unnecessary.<sup>112</sup>

Like the May war game, Army Experiment 8A found that ideally the MMEV would operate independently from other armoured vehicles.<sup>113</sup> It was found that its non-line of sight fire capability was a “transformational attribute” especially if laser designators could be provided throughout the battlefield to guide its missiles.<sup>114</sup> Three MMEV variants were studied: one using a relatively unmodified ADATS system, one with laser designation capability, and one with “fire and forget” missiles.<sup>115</sup> The two latter versions were found to be “significantly” more effective, especially the fire-and-forget variant.<sup>116</sup> A DAD working group meeting from July 5 to July 9, 2004, came to the same conclusions, although, similar to Artillery concerns about the vehicle, it emphasized that significant planning and skill would be needed to use the MMEV effectively, operating it from a “considered position” and not exposing it to the enemy.<sup>117</sup> An August 2004 DAD briefing reiterated concerns about the limitations of the current version of the ADATS in “complex terrain” (such as urban areas).<sup>118</sup>

Both the July briefing, and another on September 1, 2004, also reiterated the belief that the MMEV was simply complementary to other armoured vehicles, but would not operate best closely integrated with them into direct fire troops.<sup>119</sup> This led DAD to begin a new study of armoured vehicle organizations, including proposals for MMEVs to be organized into squadrons separate from other systems.<sup>120</sup>

Ultimately, doubt that MMEVs grouped together with other LAV based armoured vehicles would be a financially and tactically effective solution affected the Army’s senior leadership. On January 20, 2005, Major-General Marc Caron was promoted to Lieutenant-General, and on February 3 of that year he replaced Lieutenant-General Hillier as CLS.<sup>121</sup> Hillier was at that time appointed to the position of Chief of Defence Staff (CDS).<sup>122</sup> A letter from Caron to the VCDS, dated March 8, 2006, explained that he was halting the movement of elements of the 4<sup>th</sup> Air Defence Regiment to the DFU in western Canada.<sup>123</sup> Referencing a meeting with the Director General Land Combat Development (DGLCD) on February 20, 2006, and a meeting with CDS Hillier and VCDS Buck on March 3, 2006, Caron indicated that the decision had been made to re-orient Canadian Forces GBAD capability “towards a less costly and more appropriate solution to meet present and future air defence requirements.”<sup>124</sup> Caron further indicated that during the meeting Hillier accepted that the Army should conduct an “in-depth review” of the MMEV project from a cost/performance basis.<sup>125</sup>





*A row of Leopard 2A6M Main Battle Tanks from the Lord Strathcona's Horse (Royal Canadians) (LdSH (RC)) and part of the 1st Battalion, The Royal Canadian Regiment Battle Group, prepares to depart a forward installation for operations in the volatile Panjwai and Zhari Districts of Kandahar Province.*



In a related official letter to Hillier, Caron wrote that Personnel, Research & Development, Infrastructure and Organization, Concepts, Doctrine and Collective Training, Information Management, and Equipment, Supplies and Services (PRICIE) analysis had established that the movement of GBAD to Edmonton would require \$40 million, which he called “extremely costly.”<sup>126</sup> He also wrote that analysis had revealed that the movement would be “impractical if not impossible” in the short term, since the operational, training and support components of air defence capability were interdependent and would need to be moved at the same time.<sup>127</sup>

In early 2006 two other changes took place. First, the Army’s task force in Afghanistan was redeployed from Kabul to a combat role in Kandahar, and combat casualties increased rapidly.<sup>128</sup> Second, the Liberal minority government under Paul Martin was replaced by a Conservative Minority government under Stephen Harper.<sup>129</sup> According to Hillier, the Conservatives appeared ready to spend unallocated money in the defence budget.<sup>130</sup> Under the circumstances, it appears that the Army leadership decided that reversing its armoured vehicle procurement policy—from buying lighter vehicles to buying Leopard 2 tanks, which were heavier than Leopard 1s—had become politically easier.

Also in 2006, a Director General Land Combat Development (DGLCD) briefing by Colonel Jim Simms recommended cancellation of the MMEV as well as the MGS. It indicated that the view had developed that analysis of both vehicles had occurred outside of the proper capability development process of identifying a needed future capability to fill a capability gap and then planning for procurement accordingly.<sup>131</sup> It included the revised analysis that “Low tech enemies can escape modern sensors—you need to lead with protection.”<sup>132</sup> Regarding the MMEV, the briefing concluded that: “Multi-mission platforms remain a viable concept, but there is significant work that must be completed before they can be employed effectively.”<sup>133</sup> The Army’s long interest in MMEVs, dating back to the pre-ADATS versions studied in the late 1990s, was therefore not outright rejected. However, it was lowered significantly in terms of priorities.

What had happened? Capability development organizations such as DLSC/DLCD had undertaken detailed study of possible future requirements for armoured vehicles in the late 1990s, and had continued detailed analysis of MMEVs through the mid-2000s. However, it had been difficult to arrive at detailed conclusions as to whether the multi-mission concept was viable based on seminar war games and computer simulations alone. Those studies had also been influenced by allies; as seen above, U.S. military personnel and RAND Corporation analysts were directly involved in some of the Canadian work. As a result, the mainstream approach of the time that the RMA would lead to armies being equipped with lighter armoured vehicles than during the Cold War was at least partially adopted by elements within the Canadian Army. These limitations were most likely the result of relatively constrained funding of the Canadian Forces in the 1990s, meaning that little money was left over for extensive research and development.

After the September 11, 2001 terrorist attacks on the U.S., Canadian military budgets began to increase gradually, and the likelihood increased that the Army would be committed to campaigns which would entail a greater element of combat than most of the 1990s peacekeeping operations. Also, while many studies suggested that the Leopard 1 tanks would remain usable until 2015, some senior Army leaders were concerned about the condition of the vehicles;<sup>134</sup> and may also have been influenced by the fact that some CF procurement projects have taken decades to complete. In these conditions, it appeared that vehicles such as the MMEV, which would reuse existing weapons such as the ADATS and which would also presumably have significant logistical commonality with other LAV-based vehicles in the Army fleet, would be a cost-effective option which would also make the Army more combat effective. As a result, pressure from the leadership to move from conceptual studies to procurement grew.

In the case of the MMEV, one of the combat arms which would have been most affected, the artillery, began to dispute the plan for reorganization and vehicle procurement that developed. For those involved in the debate at the time, it was perhaps difficult to see whether opponents of the plans for the MMEV in the artillery were raising legitimate concerns or “blindly” impeding an important new acquisition.

Changing political conditions and combat experience in Afghanistan, combined with continuing doubt about the effectiveness of a “version 1” ADATS based MMEV raised by capability development and the artillery, ultimately led the Army leadership to cancel the project. Although the specific outcome in this case was for the concept of multi-mission vehicles to be “shelved” for the immediate future, more generally what can be seen is that significant friction and confusion existed between capability development, the artillery, and the senior leadership.



Source: Combat Camera

A LAV III of Alpha Company, (A Coy), 1st Battalion, The Royal Canadian Regiment Battle Group (1 RCR BG) returns from one of the run-up positions at Forward Operating Base Ma'Sum Ghar (FOB MSG).

There is likely no simple solution to this type of friction, and moreover, it is likely that every major procurement will be different; in some cases an organization may raise legitimate concerns, while in others it may simply object because a proposed change seems to go against the traditional way of doing things. To use political science phrases, this type of friction can be described as a clash of bureaucratic politics and organizational logic.<sup>135</sup> While it may not be easy to resolve such friction, understanding that it happens can most likely help both in managing it and in encouraging senior leaders, analysts and members of combat arms to take others' objections seriously and attempt to gain fresh perspective on their own preferred positions. Today, Canada's LAV-III's, which were new in the late 1990s and early 2000s, have been run hard in Afghanistan and are undergoing major refurbishment and upgrade.<sup>136</sup> The Leopard 2s, not quite new when bought, have also seen extensive use in only a few years. Possible CCV studies aside, the bulk of the current armoured vehicle fleet will doubtless operate well into the 2020s or 2030s. However, that timeline means that today's generation of junior officers may find themselves in senior decision-making positions when the need to procure a new generation of armoured vehicles arises again. Perhaps multi-mission platforms will reappear, but more importantly, consideration of past procurement projects such as the MMEV may help future Army leaders understand and manage the friction of bureaucratic politics. 🍁

## ABOUT THE AUTHOR...

Dr. Robert Addinall is a graduate of Trinity College, University of Toronto, and the Royal Military College of Canada. A subject matter expert in military innovation, technology, and decision-making, his PhD dissertation was titled, *To Transform An Army: The Canadian Interpretation of the RMA and the Transformation of Armoured Vehicle Design, 1992–2008: The Case of the LAV-III*. Also during 1999 to 2001, he worked at the information technology start-up company Universal Software Builders/Myubi, which specialized in developing search technology. He has previously published an article in the *Canadian Army Journal*, “Transformations of War and Public Perception: Implications For 21st Century Warfare,” in the spring 2006 edition.

## ENDNOTES

1. The Army loaned twenty Leopard 2A6M tanks and two associated armoured recovery vehicles from the German government for operations in Afghanistan in 2007, and then purchased 100 surplus Leopard 2 tanks from the Netherlands. See: Letter from The Honourable Gordon O'Connor, Canadian Minister of National Defence, to Dr. Franz Josef Jung, German Federal Minister of Defence, April 3, 2007, Department of National Defence. Accessed through the Canadian Access to Information and Privacy Act, file number A0213219. See also: Department of National Defence, Canadian Forces, “Renewing the Canadian Forces’ Tank Capability,” <http://www.forces.gc.ca/site/news-nouvelles/news-nouvelles-eng.asp?cat=00&id=2252> (accessed September 28, 2010); and: Department of National Defence, Canadian Forces, “Protection the top priority with tank acquisition, posted April 12, 2007. <http://www.admpa.forces.gc.ca/site/news-nouvelles/news-nouvelles-eng.asp?cat=00&id=2251> (accessed September 28, 2010).
2. See, for example: Department of National Defence, Canadian Forces, “Close Combat Vehicle (CCV) Project,” <http://www.materiel.forces.gc.ca/en/ccvp.page> (accessed February 7, 2012).
3. DLSC evolved through a series of titles to eventually become the Directorate of Land Concepts and Designs in 2007. Effective 17 September 2012 this organization evolved again to become the Canadian Army Land Warfare Center.
4. Department of National Defence, *Armour Combat Vehicle Concept Paper* (Kingston, Ontario: Directorate of Land Strategic Concepts, 1998), 1.
5. *Ibid.*, 9.
6. *Ibid.*, 1.
7. *Ibid.*, 11–12.
8. Then U.S. Army Chief of Staff General Shinseki stated that there was a goal to be able to put a “combat-capable brigade anywhere in the world in 96 hours” without “pre-deployment planning and rehearsal” when formation of the IBCTs was announced in October 1999. Louis Caldera and Eric K. Shinseki, statements made during press conference, October 12, 1999. Transcript publication information: Association of the United States Army, *Press Conference Secretary of the Army Louis Caldera and Chief of Staff of the Army General Eric K. Shinseki* (Washington, D.C.: Association of the United States Army, 1999). Archived by the Federation of American Scientists: <http://www.fas.org/man/dod-101/army/unit/docs/r19991014 ausapress.htm> (accessed March 27, 2008).
9. See, for example: Don Snft, “Leopards in Kosovo: The Solution for an Armoured Combat Vehicle?” *The Army Doctrine and Training Bulletin*, spring 2000, 56–62. At 47 tons and with a relatively narrow hull the Canadian Leopard 1s were able to operate in areas where 60+ ton tanks like the Leopard 2, British Challenger, or American Abrams could not. The smaller Leopard 1s could navigate narrower roads, cross bridges and concrete culverts classed for 50 tons or less, and do minimal damage to the infrastructure used by the local populace.
10. Department of National Defence, *Armour Combat Vehicle Concept Paper*, 11–12.
11. *Ibid.*, 12.
12. *Ibid.*, 13.
13. *Ibid.*, D-1 to D-2.
14. *Ibid.*, D-1 to D-2.
15. Department of National Defence, Directorate of Land Strategic Concepts, *Transforming An Army: Land Warfare Capabilities For The Future Army*, edited by Shaye K. Friesen (July 1999), 17.
16. Department of National Defence, Directorate of Land Strategic Concepts, *Future Army Capabilities: Sustain, Sense, Command, Act, Shield* (January 2001), 24–36.
17. Department of National Defence, Directorate of Land Strategic Concepts and Fort Frontenac, *Future Army Experiment: Operations in the Urban Battlespace* (May 2002).
18. *Ibid.*, 4.
19. *Ibid.*, 6.
20. *Ibid.*, 6.

21. *Ibid.*, 6.
22. *Ibid.*, 6.
23. *Ibid.*, 7.
24. *Ibid.*, 7.
25. *Ibid.*, 7 and 11.
26. *Ibid.*, 7 and 13.
27. *Ibid.*, 7.
28. *Ibid.*, 7-8.
29. *Ibid.*, 8.
30. *Ibid.*, 17.
31. *Ibid.*, 12.
32. *Ibid.*, 18.
33. *Ibid.*, 19.
34. Directorate of Army Doctrine (DAD) comments on the second draft of the *Mobile Gun System Statement of Operational Requirements* (MGS SOR), fall 2003. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0109893.
35. *Ibid.*
36. *Ibid.*
37. *Ibid.*
38. This account is given in a chain of e-mails between then Director Land Strategic Planning (DLSP) M.D. Kampman and a number of other Army officers. M.D. Kampman, e-mail to other senior land force officers, Friday February 27, 2004. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0109954.
39. The organization, expected tactical employment of, and expected operational capability of, the DFU are best illustrated in the following April 2003 CLS briefing: Department of National Defence, Chief of Land Staff, *Implementing Army Transformation (Opportunities, Limitations & Risks)* (Ottawa: April 30, 2003). Accessed through the *Canadian Access to Information and Privacy Act*, file number A0042354
40. Rick Hillier, e-mail to Mike Jeffery, P.J. Holt, M.D. Kampman and others, Monday April 28, 2003. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0032670.
41. Department of National Defence, (Land Force, presumably Artillery Branch, given statements in the paper) *Air Defence Anti-Tank System (ADATS) In The Line Of Sight Precision Guided Missile Role – Like A Hot Knife Through Butter, And More...* (Ottawa), 1-2. Undated, but from historical context appears to be written in 2002 or 2003. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0109843.
42. *Ibid.*, 1.
43. *Ibid.*, 1-2.
44. *Ibid.*, 2.
45. *Ibid.*, 2. This effectiveness is described as due to the missiles having a dual purpose blast / fragmentation charge. These characteristics are stated to enable the missile to penetrate up 1 metre of Rolled Homogenous Armour, and make it deadly within fifteen metres of an air target.
46. *Ibid.*, 2. By contrast, the indirect fire 105 mm howitzer has an 11 km range.
47. *Ibid.*, 2.
48. *Ibid.*, 2.
49. *Ibid.*, 3 and 7.
50. *Ibid.*, 2.
51. *Ibid.*, 2.
52. *Ibid.*, 3.
53. *Ibid.*, 3.
54. *Ibid.*, 4.
55. *Ibid.*, 3-4.

56. *Ibid.*, 4.
57. *Ibid.*, 6-7.
58. Department of National Defence, Directorate of Army Doctrine, *Briefing Note For The MND Through DM/CLS – Army Requirement For A Multi-Mission Effects Vehicle* by R.C. Rankin (Kingston, Ontario: January 19, 2004). Accessed through the Canadian Access to Information and Privacy Act, file number A0283157.
59. *Ibid.*
60. *Ibid.*
61. *Ibid.*
62. *Ibid.*
63. *Ibid.*
64. Department of National Defence, Director General Land Combat Development, Land Force Doctrine and Training System, *Capability Development Record (MMEV)* (Kingston: May 2004), 5. The document information/tracking block notes that it was prepared by Major C.F. Leeming of the Directorate of Army Doctrine, but it is unclear whether he has authored or edited the document or re-edited it. Accessed through the *Canadian Access to Information and Privacy Act*, file numbers A0110349 and A0110355.
65. *Ibid.*, 5.
66. *Ibid.*, 31.
67. *Ibid.*, 8-11.
68. Major R. Lavoie at the CTC Artillery School in Gagetown, Lieutenant Colonel S.J. Bowes at CTC Armoured School Gagetown, Lieutenant Colonel M.J. Pearson at CTC Infantry School Gagetown, Lieutenant Colonel I.R. Creighton at CTC headquarters, Gagetown, Colonel C.J.R. Davis at CTC headquarters Gagetown, and Major L.J. Hammond at CTC Artillery School Gagetown, e-mail correspondence. Subject line: *MMEV Force Generation – Position Of The Royal Regiment Of Artillery*. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0109924.
69. *Ibid.*
70. *Ibid.*
71. *Ibid.*
72. *Ibid.*
73. *Ibid.*
74. No author, *ADATS/MMEV – A Transition Concept*. Moncton, New Brunswick: 4th Air Defence Regiment, RCA, April 27, 2004. Signed by Lieutenant-Colonel M. Lavoie, unit commanding officer. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0109944, 1.
75. *Ibid.*
76. No author, untitled internal document (or possibly this information has been redacted) regarding the ability of an ADATS/MMEV detachment or troop to switch between direct fire ground task and air defence task. Ottawa: Canadian Forces, undated. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0109842, 1.
77. *Ibid.*, 1.
78. *Ibid.*, 1.
79. *Ibid.*, 1.
80. *Ibid.*, 2.
81. Department of National Defence, CFB Suffield, *Record Of Discussion – Direct Fire System Working Group (DFS WG) – 20 August 2004*, edited by S. Schreiber (Alberta: 2004), 1. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0109910, 3.
82. *Ibid.*, 3.
83. The war game is dated to July 5, 2004 in: Department of National Defence, *Comments on Exercise Perfect Kill (EX PK)* by T.J. Grant (Alberta: September 2004). Accessed through the *Canadian Access to Information and Privacy Act*, file number A0109936, 1.
84. Department of National Defence, 4th Air Defence Regiment, RCA, *Ex Perfect Kill 2004 Brief To Comd 1 CMBG*. (Moncton, New Brunswick: 2004). Accessed through the *Canadian Access to Information and Privacy Act*, file number A0109852, 5.
85. *Ibid.*, 10-11.
86. *Ibid.*, 11.

87. *Ibid.*, 17.
88. Department of National Defence, *Comments On Exercise Perfect Kill*, 2.
89. *Ibid.*, 1.
90. Department of National Defence, untitled directive by R.D. Gunn. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0109852, 1.
91. *Ibid.*, 1.
92. *Ibid.*, 1.
93. *Ibid.*, 2.
94. *Ibid.*, 2.
95. R.D. Buck to Rick Hillier, *Joint Capability Requirement Board Deferral – Multi-Mission Effects Vehicle* Official explanatory letter, September 2004, Department of National Defence. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0101639, 1.
96. *Ibid.*, 1.
97. *Ibid.*, 2.
98. *Ibid.*, 2.
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101. *Ibid.*, 2.
102. *Ibid.*, 2.
103. Department of National Defence, *Briefing Note For The Minister Multi-Mission Effects Vehicle (MMEV) Project Update* by P.V. Romeo (Ottawa: April 15 2005), 1. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0283178.
104. Department of National Defence, “Multi-Mission Effects Vehicle,” *Canadian Forces News*, September 22, 2005. <http://www.forces.gc.ca/site/news-nouvelles/news-nouvelles-eng.asp?cat=03&id=1767> (accessed September 10, 2010)
105. *Ibid.*
106. *Ibid.*
107. Department of National Defence, Director General Land Combat Development, May 3–7 Seminar War Game report/slide show briefing, 3. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0109841.
108. *Ibid.*, 4.
109. *Ibid.*, 6-7.
110. *Ibid.*, 20.
111. *Ibid.*, 16 and 26.
112. *Ibid.*, 15.
113. Department of National Defence, Army Experimentation Centre, *Report AEC-R 0401: Army Experiment 8A Multi-Mission Effects Vehicle In The Direct Fire System* by James S. Denford, John Steele, Roger L. Roy, Eugenia Kalantzis (Kingston, Ontario: December 2004).
114. *Ibid.*, see, for instance, the Abstract.
115. *Ibid.*, i.
116. *Ibid.*, i.
117. *Ibid.*, Department of National Defence, Directorate of Army Doctrine, *Memorandum 11000-1 (Adjit)* by J.J. Schamehorn, January 11, 2005. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0109876.
118. Department of National Defence, Directorate of Army Doctrine, *Doctrine For The DFS*, presentation by Lieutenant-Colonel Hunt to 1 CMBG DFS WG 20 August 2004. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0109865, 10.
119. Department of National Defence, Directorate of Army Doctrine, *DF TTP Development Brief to LdSH (RC)* by Chris Rankin, Kingston, Ontario, September 1, 2004, 57 and 63-71. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0109851.

120. Department of National Defence, Directorate of Army Doctrine Direct Fire survey, 1. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0109870.
121. See: Department of National Defence, "From a young platoon commander to head of the Army," DND/CF Army News website, press release February 4 2005 <http://www.army.forces.gc.ca/land-terre/news-nouvelles/story-reportage-eng.asp?id=407> (accessed September 23, 2010).
122. Department of National Defence, Land Force, "New Army commander appointed," Canadian Land Force news site, press release, January 21, 2005. <http://www.army.dnd.ca/land-terre/news-nouvelles/story-reportage-eng.asp?id=392&sortOrder=desc> (accessed September 23, 2010).
123. J.H.P.M. Caron, "Multi-Mission Effects Vehicle (MMEV) And Ground Based Air Defence (GBAD)," letter from the Chief of Land Staff to the Vice Chief of Defence Staff, also distributed to the Chief of Defence Staff and Director General Strategic Planning, March 8, 2006, Department of National Defence. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0283179.
124. *Ibid.*
125. *Ibid.*
126. J.H.P.M. Caron, "Future Of The MMEV And The Direct Fire Unit (DFU)," letter from the Chief of Land Staff to the Chief of the Defence Staff, also distributed to the Vice Chief of the Defence Staff and the Assistant Chief of Land Staff, February 20, 2006, Department of National Defence. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0283179 (Contained in same file as the previous letter).
127. *Ibid.*
128. On non-continuous deployments between April 2002 and November 2005, a total of eight Canadian military personnel were killed in Afghanistan. Between March 2006 and May 2006, another eight died. Statistics compiled by CBC: Canadian Broadcasting Corporation, "In the line of duty: Canada's casualties," <http://www.cbc.ca/news/background/afghanistan/casualties/list.html> (accessed September 25, 2010).
129. Canadian Broadcasting Corporation, "Harper sworn in as 22nd prime minister," <http://www.cbc.ca/story/canadavotes2006/national/2006/02/06/harper-ottawa060206.html> (accessed September 25, 2010).
130. Rick Hillier, *A Soldier First* (Toronto: HarperCollins Publishers, 2009), 348-350. Specifically, Hillier writes that in 2005-2006, funding had been allocated for a number of projects that the military considered high priority, including replacement of the C130 Hercules transport aircraft fleet, heavy lift helicopters, a new fleet of transport trucks, and new naval replenishment ships. However, he describes that at a meeting during which he laid out plans to proceed with the purchases, he was faced with an indecisive Liberal Cabinet. Concerns were raised about such things as the appearances of spending large sums of money and appearing to be sole-sourcing contracts. This situation, Hillier believes, provided the Conservatives with an opportunity to demonstrate their support of the military without having to find additional money in the federal budget. \$13 billion had been allocated to defence, but it had not been spent. He states that: "The Conservatives, on election, were presented with this plum, organized themselves to spend it and branded themselves as the party to support the CF"
131. Department of National Defence, Director General Land Combat Development, *Recommendations to Cancel MGS and MMEV* by Jim Simms (Kingston, Ontario: undated but from the context must have been produced during the spring of 2006), 4. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0283169.
132. *Ibid.*, 8.
133. *Ibid.*, 12.
134. Some internal Army correspondence from 2004 indicates concern about tanks with "thin hulls." For example: Christopher Hunt, e-mail to a number of other land force officers, March 1, 2004. Accessed through the *Canadian Access to Information and Privacy Act*, file number A0109885. "Thin hulls" likely refers to the concern in the Army that the underside or "belly" armour of many Canadian Leopard 1 tanks had been worn thin between the late 1970s and the early 2000s during training exercises and deployments, when the vehicles were scraped over rough and uneven terrain. Former CDS Rick Hillier discusses this in his autobiography: "The Leopard tank was completing a significant upgrade program, but it remained an old tank, with belly armour that had been scraped over the ground until it was paper thin. We knew we faced major challenges just to keep those beasts running," Hillier, *A Soldier First*, Toronto, HarperCollins Publishers, 2009, 262.
135. A significant work concerning bureaucratic politics, and a good introduction to the concept, is: Graham Allison and Philip Zelikow, *Essence of Decision: Explaining the Cuban Missile Crisis* (New York: Longman, an imprint of Addison Wesley Longman Educational Publishers, 1999).
136. The Project Management Office Light Armoured Vehicles "is now developing and executing" procurement of the LAV III Upgrade project, currently valued at \$1.4 billion. See: <http://www.tpsgc-pwgsc.gc.ca/app-acq/stampg-lamsnp/pvb-avp-eng.html> (Accessed February 7, 2012).



*A Coyote armoured reconnaissance vehicle with the Kabul Multinational Brigade (KMNB) armoured reconnaissance squadron, drives past the ruins of the King's Palace enroute to a Vehicle Check Point (VCP) outside of Kabul, Afghanistan.*