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**Internal Audit: Tactical Armoured Patrol
Vehicle (TAPV)**

November 2011

7050-11-41 (CRS)



Canada 

Caveat

Contractors have not been included in the scope of this audit as the focus is on Department of National Defence (DND) contract management processes. This audit represents a high level of assurance.



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Acronyms and Abbreviations

1 PPCLI	First Battalion, Princess Patricia's Canadian Light Infantry
1 R22eR	1 Battalion, Royal 22 ^e Régiment
1 RCR	First Royal Canadian Regiment
2 PPCLI	Second Battalion, Princess Patricia's Canadian Light Infantry
2 R22eR	2 Battalion, Royal 22 ^e Régiment
2 RCR	Second Royal Canadian Regiment
3 PPCLI	Third Battalion, Princess Patricia's Canadian Light Infantry
3 R22eR	3 Battalion, Royal 22 ^e Régiment
3 RCR	Third Royal Canadian Regiment
ADM(Fin CS)	Assistant Deputy Minister (Finance and Corporate Services)
ADM(Mat)	Assistant Deputy Minister (Materiel)
ADM(Pol)	Assistant Deputy Minister (Policy)
CCV	Close Combat Vehicle
CDE	Concept Development and Experimentation
CFSEME	Canadian Forces School of Electrical and Mechanical Engineering
CID	Capabilities Investment Database
C Army	Chief of the Army Staff
CMTC	Canadian Manoeuvre Training Centre
CRS	Chief Review Services
Dir Cab Ln	Director Cabinet Liaison
DLCD	Director Land Capability Development
DLR	Director Land Requirements
DND	Department of National Defence
DRMIS	Defence Resource Management Information System
ELE	Equipment Life Expectancy
EPA	Effective Project Approval
FAA	<i>Financial Administration Act</i>
FLCV	Family of Land Combat Vehicles
HQ	Headquarters
IRM	Integrated Risk Management
LAV III	Light Armoured Vehicle III
LF	Land Force
LFDTs CTC	Land Force Doctrine and Training System Combat Training Centre
LoO	Lines of Operations



LUVW	Light Utility Vehicle Wheeled
MC	Memorandum to Cabinet
MCP	Major Crown Project
MID	Master Implementation Directive
MIP	Master Implementation Plan
MOTS	Military Off-the-Shelf
MRTF	Mobile Readiness Training Fleet
O&M	Operations and Maintenance
OPI	Office of Primary Interest
P&A	Price and Availability
PAD	Project Approval Directive
PAG	Project Approval Guide
PMB	Project Management Board
PMO	Project Management Office
PPA	Preliminary Project Approval
PPRA	Project Profile and Risk Assessment
PWGSC	Public Works and Government Services Canada
Recce	Reconnaissance
RFP	Request for Proposal
Res	Reserve
RMP	Risk Management Plan
ROM	Rough Order of Magnitude
RCD	Royal Canadian Dragoons
SOR	Statement of Requirement
SMP	Standard Military Pattern
SRB	Senior Review Board
TAPV	Tactical Armoured Patrol Vehicle
TC	Training Centre
TFA	Task Force Afghanistan
VCDS	Vice Chief of the Defence Staff
WBS	Work Breakdown Structure



Results in Brief

The |||||¹ Tactical Armoured Patrol Vehicle (TAPV) project was selected for audit based on an analysis of 298 equipment projects worth over \$92 billion. The project represents approximately 1 percent of the total value of the capital program; therefore, the audit findings do not necessarily reflect Department-wide project management practices.

In accordance with the 2008 *Canada First Defence Strategy*, the TAPV is one of four fleets in the \$5.02-billion Family of Land Combat Vehicles (FLCV) program to provide a robust and flexible capability for Canada’s soldiers on high-risk missions abroad. In June 2009, after completing a 14-month options analysis phase, the TAPV project was authorized to proceed with the definition phase of the acquisition of 500 vehicles with an option of 100 more vehicles. The new TAPVs will replace aging armoured reconnaissance vehicles and complement other fleets of vehicles that have insufficient protection and mobility.

Overall Assessment

Cost and scope management controls in the FLCV program provide flexibility to address the shortfall in the number of TAPVs required. However, with respect to schedule management, the

This audit assessed the adequacy of the TAPV management control framework, governance processes and risk management strategy to ensure a cost-effective acquisition.

Findings and Recommendations

Requirements Definition. The criteria have not been developed to determine what proportion of options will be exercised for each fleet in the FLCV program to ensure the fleet sizes meet the Canadian Army’s force structure requirements. The TAPV project was originally set to acquire ||||| vehicles, with a rough order of magnitude (ROM) estimate of ||||| To remain within the constraints of the Department’s Investment Plan, the TAPV project was reduced to 500 vehicles with an option for up to 100 more if affordable.

The descope and distribution of the TAPV and other FLCV fleets was addressed by the Land Force (LF) 2013 Master Implementation Plan (MIP) and subsequent Master Implementation Directive (MID).

¹ ||||| is an indicative project cost with a confidence level of 70 to 80 percent that was estimated at the outset of the definition phase in June 2009.

At the time of audit, the Army’s first priority with respect to exercising FLCV vehicle options was the Light Armoured Vehicle (LAV III) fleet; the TAPV fleet was the second. Criteria, such as the incremental cost increase over the operational minimum or the ratio of equipment in and out of Canada, could also be considered by the Army to determine what options need to be exercised in each fleet.

It is recommended that once the unit prices of all FLCV fleets are known, fleet requirements and funding be revisited prior to effective project approval (EPA) to address any distribution imbalances in the FLCV fleets relative to the LF 2013 force structure. Other criteria, such as incremental operational capability and equipment generation ratio should be considered to determine the proportion of each FLCV fleet option to exercise.

Schedule Management. An accelerated project schedule for the options analysis phase delayed the determination of TAPV fleet size, vehicle specifications and operational research confirmation. Since the options analysis phase schedule was compressed by 10 months, activities that are normally performed in options analysis—such as a preliminary Statement of Requirement (SOR), Concept Development and Experimentation (CDE), and formal Price and Availability (P&A) studies—were delayed. These delays, and the need to re-engineer the military off-the-shelf (MOTS) candidates due to their technical readiness level, caused the extension of the definition phase from 15 months to 35 months.

Improved internal schedule control integration is also needed. There was no single master project schedule that provided the detailed work breakdown structure (WBS) for the definition phase, which could have an effect on tracking schedule performance. As well, there were 19 project interdependencies that could impact the project schedule that were not ranked in order of priority.

It is recommended that the project office improve schedule control integration and rank the impact and likelihood of project interdependencies in order of priority.

Financial Management. The confidence level of the project’s indicative cost estimates did not meet expected levels for preliminary project approval (PPA) as per DND policy. DND and Public Works and Government Services Canada (PWGSC) were directed to delay a formal P&A with industry until July 2009. Conducting this earlier would have allowed the project to be aware of the wide variance of \$760 million in potential project costs. This variance in price could have a significant impact on the size of the TAPV fleet which will be selected on the basis of best value versus least cost. Project estimates also excluded approximately ||| for infrastructure and ||| for ammunition.

It is recommended that in conjunction with Assistant Deputy Minister (Policy) (ADM(Pol))/Director Cabinet Liaison (Dir Cab Ln), the sequence of P&A activity be established by the VCDS in the Project Approval Directive (PAD) to identify confidence levels for Memorandum to Cabinet (MC) and PPA estimates. In addition, the Project Management Office (PMO) TAPV should include the full project ammunition and infrastructure shortfall cost estimates and revise the personnel, operations and maintenance (O&M) costs for the implementation phase approval.

Note: For a more detailed list of CRS recommendations and management response, please refer to [Annex A](#)—Management Action Plan.



Introduction

Background

In September 2010, a Chief Review Services (CRS) analysis of 298 equipment projects,² worth over \$92 billion, found the TAPV project to have attributes that merited an audit.³

Following an options analysis phase that began in March 2008, the TAPV project (with an indicative cost of |||||) was authorized in June 2009 to proceed with the definition phase of the acquisition of 500 vehicles with an option for 100 more vehicles. The TAPV will replace aging reconnaissance vehicles and complement other vehicles that lack armour protection and mobility.

The TAPV project definition phase was approved as part of the \$5.02-billion⁴ FLCV program that included three other related armoured vehicle fleets entering the definition phase at the same time. Prior to the implementation phase, authority has been provided to move funds between the four FLCV fleets. The three other fleets included the following:

- 108 new Close Combat Vehicles (CCV) to carry infantry in mechanized operations with main battle tanks |||||
- The upgrade of 550 LAV IIIs |||||
- Procurement of 15 Force Mobility Enhancement vehicles, 20 dozer blades, 20 mine plows, and 20 mine rollers. This project will replace aging armoured engineer and recovery vehicles, and will improve the mobility of main battle tanks and other armoured vehicles |||||

Management Letter

Early in the audit of the TAPV project, a draft RFP with associated project costs worth ||||| was reviewed by the audit team before it was issued to industry. In order to provide comments before the RFP's March release, CRS issued a management letter on 15 March 2011 that reported on key issues related to risk management, contract terms of payment, performance-based metrics, and data item descriptions. Based on these observations the project office made the following revisions to the RFP:

- The proposed cash flow was developed to ensure that a high proportion of payments were made on delivery of the vehicles.
- Extended warranty provisions were removed from the RFP, avoiding potential warranty premiums of approximately |||||⁵

² CRS *Analysis of Capital Equipment Projects*, September 2010 <http://www.crs-csex.forces.gc.ca/reports-rapports/2010/155P0926-eng.aspx>.

³ Attributes at the time of the analysis included high materiality, numerous project interdependencies, a high operational priority, a high-risk assessment rating, unfilled project office positions and a lack of team experience.

⁴ \$5.02 billion represents the indicative cost of the program. Only ||||| was authorized for the definition phase.

⁵ Based on 2 percent of the indicative ||||| equipment cost.



- Additional work requests with a fixed-time rate basis of payment were modified to include both time verification and audit clauses. These clauses were also included for subcontract work performed within the requests.
- Adjustments pertaining to performance-based agreement standards, penalties and incentives were made. Thresholds and penalties are now directly linked to the level of performance, critical spare parts and activities.
- A more specific risk management requirement for the vendor, such as the reporting of a complete list of risks, was added.

Objective

To assess the adequacy of the management control framework, governance processes and risk management strategy in place to ensure a cost-effective acquisition.

Scope

The scope of the audit included activities from the project identification in March 2008 with a focus towards current and planned activities. The impact of the other FLCV projects was included in the scope as the TAPV project was submitted as part of the FLCV program with the potential to move funds between the four projects prior to the project implementation phase.

Methodology

- The audit team examined project documents such as the SOR, Project Profile and Risk Assessment (PPRA), Project Charter and other project documentation available in the Department's Record Document Information Management System and Capabilities Investment Database (CID).
- Staff members from the TAPV project office and sponsor, Chief of the Army Staff (C Army), Director Land Force Development, and Director Land Requirements (DLR) were interviewed.
- Contract management practices such as payment certification in accordance with the *Financial Administration Act* (Section 34) were reviewed. A payment sample of \$2.28 million accounted for 41 percent of all payments that had been made at the time of audit.
- Project-related information was examined from the Financial Managerial Accounting System, the Defence Resource Management Information System (DRMIS), the Dynamic Object Oriented Requirements System and the PMO's Microsoft Project files.

Audit Criteria

The audit criteria are listed at [Annex B](#).



Findings and Recommendations

Requirements Definition

Criteria have not been developed to determine what proportion of the FLCV options for each fleet will be exercised in order to meet the full requirements of the Army force structure.

Due to the affordability issues of the FLCV program there was a considerable reduction in the number of armoured vehicles to be procured. The uncertainty of which candidates would win the competition led to the development of optional buys for each fleet that could accommodate both the needs of the Army and the final price of the solution offered by the defence industry.

Original Requirement

In 2008 the original scope of the FLCV program included ||||| armoured vehicles with a ROM cost of ||||||||| for all four FLCV fleets.⁶ Included in this program, the TAPV project was to acquire ||||| vehicles (ROM |||||||||) in order to do the following:

- replace 202 Coyote light armoured reconnaissance vehicles that were reaching the end of their equipment life expectancy (ELE);
- replace 76 RG-31 armoured patrol vehicles that were acquired as an unforecasted operational requirement for Task Force Afghanistan (TFA);
- replace in part the 200 Bison LAV fleet that had similar shortfalls in protection and mobility to the Coyote fleet; and
- replace in part the 1,039 Standard Military Pattern (SMP) Light Utility Vehicle Wheeled (LUVW) fleet which was replaced in TFA by the RG-31 due to the lack of protection to passengers.

Good Practices

- Prior to the FLCV program implementation phase, there is the flexibility to change the scope and funding of the four projects as long as the \$5.02 billion indicative estimate is not exceeded.
- Given the uncertainty of the unit cost per vehicle, option clauses exist in the TAPV, CCV, and LAV III RFPs to provide additional vehicles to meet full operational requirements.

⁶ ROM estimates in the Assistant Deputy Minister (Finance and Corporate Services) (ADM(Fin CS)) Costing Handbook are considered to be a 60-percent confidence level. The FLCV estimate and quantity of vehicles is based on the Synopsis Sheets Identification for each of the FLCV projects.

Descope Impact

Affordability. To remain within the constraints of the Department’s Investment Plan, the FLCV program was descope to 400 vehicles in 2009 and the budget reduced to \$5.02 billion.⁷ Accordingly, the TAPV project was reduced to 500 vehicles with an option for an additional 100 vehicles (if affordable) with an indicative project estimate of \$1.1 billion. Due to the reduction of the TAPV project scope, the Army also decided to retain the Bison and LUVW SMP fleets.⁸

Force Structure Plans. The descope of the TAPV project and the other FLCV fleets was addressed in August 2010 by the Army’s future force structure plan known as LF 2013. This document provides the rationale on how the Army will meet organizational changes needed to position itself for the future. The LF 2013 MIP included the distribution plans for the FLCV fleets and the other armoured and wheeled vehicles that were already in service in the Army. Based on the rationale in this document, the audit determined that a minimum of 400 TAPVs are needed to meet the requirements of the LF 2013 MIP.⁹ Subsequently, in June 2011 a LF 2013 MID provided more specific direction on the distribution of all Army vehicles that included only 500 TAPVs and other FLCV fleets.

Impact of TAPV Fleet Size Shortfall. The TAPV fleet size of 500 vehicles proposed in the LF 2013 MID does not meet the requirements of the LF 2013 MIP. Although the TAPV requirements were being met, the fleet size is insufficient (see Annex C). These include the following:

- The LF 2013 MID requires each TAPV light infantry company to be equipped with 10 TAPVs of which two are in the A-echelon to resupply fuel, water, rations and ammunition. The only additional vehicles resources planned for a light infantry battalion is 10 in total. According to the LF 2013 MIP the dismounted light infantry company is to be equipped with a “not LAV” vehicle.

⁷ In June 2009 the FLCV program cost represented an indicative estimate with a 70 to 80 percent confidence level in accordance with the ADM(Fin CS) Costing Handbook.

⁸ Although the 1 April 2011 Army Divestment Plan includes the divestment of the LUVW SMP fleet, its retention for four more years will take advantage of \$77.6 million in sunk capital costs (based on the current ELE which expires in 2019). The Army divestment plan should be changed accordingly. DLR staff agreed with this observation and plans to gradually replace the LUVW SMP fleet with a MOTS vehicle using Army non-strategic funding.

⁹ This does not include the 100 vehicles in the B-echelon to resupply fuel, water, rations and ammunition.

¹⁰ The CCV infantry battalions include CCV and LAV III infantry companies. Although 1 Princess Patricia's Canadian Light Infantry (PPCLI) is established for only 4 rifle companies it is being provided enough equipment for 10 TAPVs.

¹¹ The LF 2013 MID portrayed in Annex C requires each TAPV light infantry company to be equipped with 10 TAPVs of which two are in the A-echelon to resupply fuel, water, rations and ammunition. The only additional vehicles resources planned for a light infantry battalion is 10 in total. According to the LF 2013 MIP the dismounted light infantry company is to be equipped with a “not LAV” vehicle.

- In accordance with the LF 2013 MIP, |||
- The planned TAPV operational stocks ||| are only ||| of the fleet whereas the CCV fleet is |||
- The planned TAPV logistic stocks ||| are only ||| of the fleet whereas the CCV fleet is |||

Contract Options

There is an option in the March 2011 TAPV RFP to buy up to 100 additional TAPVs, which could address the minimum requirement of ||| TAPVs. Similar options are in place in other FLCV fleet RFPs for up to 30 more CCVs and 80 more LAV IIIs.¹² At the time of audit the following priorities had been set by the Army with respect to exercising each of the FLCV fleet options:

- The LAV III fleet, numbering 651 vehicles, is the Army’s top priority as the vehicles are already in service and it is the largest armoured fleet. According to DLR staff, |||¹³
- The second priority is the TAPV fleet that is needed to replace the Coyote vehicles and equip the light infantry battalions.

At the time of the audit, criteria for determining the Army’s plan to exercise the FLCV options were not found to be fully developed. As portrayed in Table 1, various criteria could be considered by the Army to determine what options need to be exercised in each fleet. Consideration of the unit price alone does not take into account the operational impact. Other possible analysis criteria could include the following:

- **Incremental Cost.** The incremental cost increase over the minimum buy is more representative of the relative cost of increased combat power. For example, a 1-percent increase (five vehicles) of the minimum buy of 500 TAPV would amount to |||. A 1-percent increase in the CCV baseline of 108 vehicles would amount to |||
- **Equipment Generation Ratio.** The equipment generation ratio compares the amount of equipment that remains in Canada to generate the next rotation(s)¹⁴ to the amount of equipment already deployed. A low equipment ratio provides fewer vehicles to train on in Canada before deployment and reduces the number of replacements for battle damage.

¹² In January 2009, there were several adjustments to the size of the fleet options without any evidence of supporting analysis. The TAPV option was reduced from 250 to 100 vehicles. The CCV option was increased from 12 to 30 vehicles. The value of each of these option changes was approximately \$210 million.

¹³ There will be ||| with the funds available in the current LAV III project budget, PMB briefing 15 September 2011.

¹⁴ The equipment generation ratio was based on the simultaneous execution of the Army’s LoO3 (Brigade minus) and LoO4 (Battalion Group) force employment model in the LF 2013 MID.

FLCV Fleet	Unit Price (\$M) ¹⁵	Minimum Buy (# of units)	Option Size (# of units)	Incremental Cost/% Increase (\$M/%)	Equipment Generation Ratio
TAPV		500	100		2.3:1
LAV III		550	80		3.8:1
CCV		108	30		3.3:1

Table 1. Options Analysis Criteria. Should funding be available to exercise FLCV options, this table provides possible alternatives to be considered. The equipment generation ratio portrayed is prior to the exercise of the options.

FLCV Funding Allocation

The availability of funds to exercise the options must be a consideration of the fleet options analysis. Currently, based on the indicative unit prices of each type of vehicle, if every fleet option was exercised in full, the total cost would be |||||¹⁶

- Given the provision in the FLCV program that allows funds to be reallocated between fleets prior to EPA, there may be an opportunity to address any imbalances between the four fleets. At the time of the audit, the CCV and TAPV projects were on schedule to request EPA concurrently in order to enable a reallocation of funds.
- The FLCV program currently has ||||| in contingency funds. Although contingency funds may be necessary to address shortfalls in infrastructure requirements, authority to utilize the unused portion of these funds could be obtained and used towards exercising FLCV options. CRS has observed in other programs, such as the ||||| where authority was given to move contingency money between || projects in order to exercise flexibility in the mitigation of risk. Such a provision at EPA would provide similar flexibility in the FLCV program to exercise option clauses.

Recommendation

1. Once the unit prices of all FLCV fleets are known, it is recommended that fleet requirements and funding be revisited prior to EPA to address any FLCV fleet distribution imbalances in the LF 2013 force structure. Other criteria, such as incremental operational capability and equipment generation ratio, should be considered to determine the proportion of the options to exercise for each FLCV fleet.

OPI: C Army

¹⁵ Unit price is based on projected equipment cost per fleet provided at the outset of the definition phase.
¹⁶ This does not include the Force Mobility Enhancement fleet option as it was already exercised to take advantage of an opportunity buy of main battle tank chassis.

Schedule Management

Accelerating the project schedule for the options analysis phase delayed the determination of the fleet scope, operational specification of the TAPV and the proof of concept by operational research. The lack of detail and integration of internal schedule controls does not enable the accurate forecasting of milestone slippage.

Planning Milestones

The original schedule for the TAPV project was much more aggressive than the typical capital acquisition milestones set by the Project Management Board (PMB) in 2003, as portrayed in Figure 1. In March 2008, the project planned to complete the options analysis phase by June 2009 (14 months) and the definition phase by September 2010 (15 months). The rationale for compressing the TAPV acquisition was

- to address the historical slippage of major equipment acquisitions;¹⁷
- the requirement for improved protection for Army personnel was urgent as the threat in Afghanistan was considered to be the norm for future operations; and
- the Coyote reconnaissance vehicle was reaching the end of its life cycle.¹⁸

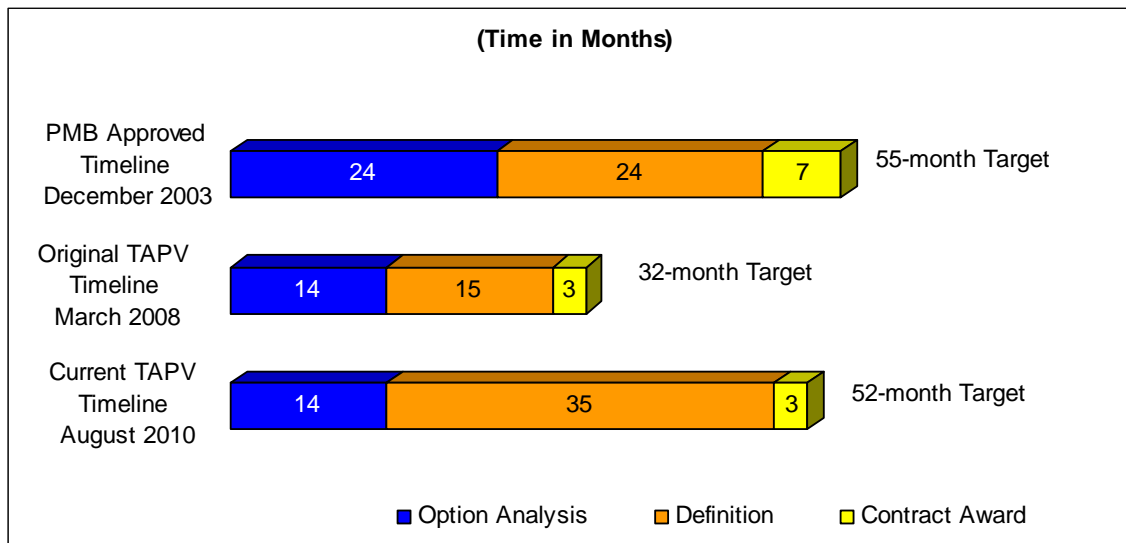


Figure 1. Acquisition Cycle. The PMB timeline was created in 2003 to streamline the acquisition process by reducing the time by 30 percent. The current TAPV schedule now reflects the PMB milestones. The data is shown in Table 2.

¹⁷ As highlighted in the September 2010 CRS *Analysis of Capital Equipment Projects* report, the median slippage of equipment acquisition projects is 413 days.

¹⁸ Acquired in 1996, the Coyote's 17-year ELE will end in 2013.

Acquisition Cycle	Option Analysis Time in Months	Definition Time in Months	Contract Award Time in Months	Total Month Target
PMB Approved Timeline December 2003	24	24	7	55
Original TAPV Timeline March 2008	14	15	3	32
Current TAPV Timeline August 2010	14	35	3	52

Table 2. Acquisition Cycle.

In August 2010, the TAPV schedule for the definition phase was extended 20 months to May 2012. Although the short options analysis phase was completed on schedule, some of the activities normally done in this phase were delayed. Such activities include the following:

- The preliminary SOR was not completed until April 2010 due to the challenges associated with defining a single vehicle to fulfill both an armoured reconnaissance and a light infantry role. One major cause of delay was the insufficient technical readiness level of the TAPV candidates to meet the TAPV system specification. Further development, re-engineering, and testing of the existing MOTS was needed prior to contract award. As well, the Army had not finalized the LF 2013 table of organizations and equipment to determine the number of vehicles that were needed.
- The CDE, necessary to confirm the operational effectiveness of the TAPV, was not completed during the options analysis phase. The RFP, with the TAPV system specifications, was issued to industry three months before the June 2011 CDE was completed. Further CDE is planned to address the following concerns:¹⁹
 - Although the ||| light infantry section, equipped with ||| TAPVs, performed extremely well in the operational research war gaming, the |||
 - During the CDE, the TAPV light infantry company was equipped with || TAPV, ||| fewer than the || TAPVs provided to each company in the LF 2013 MID. The ||| additional TAPV in the administrative echelon may expedite the replenishment process, but it remains to be confirmed through operational research.

¹⁹ Capability Development Experiment 2010 3000-1 (DLCD), 14 June 2011.

²⁰ |||

Internal Schedule Controls

Although the project office had set a number of intermediate milestones for key activities, there was no single master project schedule in Microsoft Project or DRMIS that provided the detailed WBS for the definition phase. The audit noted the following observations that may impede the project team's ability to track schedule performance:

- Sections within the project office were using different formats to develop detailed schedules, making it difficult to create a single master project schedule.
- Early in the definition phase, the WBS dictionary did not include all of the activity start and end dates, resources required, costs, quality requirements and technical references. During the audit conduct a more detailed WBS and schedule was developed for the remainder of the definition phase.
- Project resource loading tools were not used to their full capability:
 - Some project resources were over-allocated.
 - Productivity levels in Microsoft Project were set at 100 percent rather than reflecting the experience level of the individual project staff. The industry norm is 75 percent.

Project Interdependencies

Project interdependencies that can represent risks to the project outcome need to be monitored. For example, the communication system for the TAPV is a separate project. While the number of project interdependencies in the capital program average is five per project, TAPV documentation listed up to 19 interdependencies that could impact schedule to some degree. The project office indicated that three or four of the interdependent projects would have a significant impact on the TAPV project schedule. Although the PMO has identified potential interdependent projects, the impact and likelihood of each of the interdependencies on the TAPV project reaching full operational capability was not placed in order of priority within any of the documentation reviewed.

Recommendation

2. The project office should improve schedule control integration and rank the impact and likelihood of project interdependencies in order of priority.

OPI: ADM(Mat)



Financial Management

The confidence level of the project’s indicative cost estimates was lower than the expected levels for the definition phase. Subsequent market surveys indicated a wide variance in price which could have significant impact on the size of the TAPV fleet. In addition, project cost estimates did not include the TAPV ammunition and full infrastructure requirements.

Price and Availability

DND’s PAG provides policy and procedural guidance on the approval process for projects and specifies the cost estimate rigor for each phase of the project life cycle. Prior to the approval of the TAPV definition phase in June 2009, the indicative total project cost should have had a confidence level of 70 to 80 percent.²¹ This required confidence level was not achieved because of the accelerated TAPV schedule, and a delay in P&A²² activities.

DND was ready to conduct a formal P&A request from industry through PWGSC as early as September 2008. However, the Department was directed to delay this process until July 2009.²³ Had a formal P&A been conducted earlier, the project office would have known of the wide variance in submitted prices. The quotes from the 16 contenders,²⁴ including project office and contingency costs,²⁵ ranged from approximately |||||²⁶ This information is most relevant to the bid evaluation plan where the higher weighting is on the technical criteria score (70 percent) versus the lower price criteria score (30 percent). This may result in a situation where a more expensive solution could be selected due to its technical merit.

Good Practices

Director Major Crown Project Services centralized support to Director General Major Project Delivery’s Major Crown Projects (MCP) for common support services has led to more effective and efficient service delivery.

²¹ ADM(Fin CS) Costing Handbook, Chapter 11, Annex A.

²² Normally a confidence level of 70 to 80 percent is achieved through formal P&A studies with the assistance of PWGSC during the options analysis phase, PAG, Article 2.1.12.

²³ Both PWGSC and DND were directed to delay a formal P&A until the government formally announced the project.

²⁴ There were 18 contenders, but two contenders (with quotes of |||||) were outliers from the rest of the quotes and were excluded from analysis. The vendor with the second highest quote qualified in the Statement of Intent and Qualification but is not expected to submit a bid.

²⁵ The indicative PMO and contingency costs were estimated to be ||||| respectively.

²⁶ The price quotations from the 2009 P&A data showed a median of ||||| with the distribution being right-skewed. The standard deviation was approximately |||||

For MCPs such as TAPV, the PAG is unclear regarding the sequence of P&A activities required in the options analysis phase to gain government approval through an MC and the approval of the definition funds in the PPA. Often the cost information required in the MC is the same as the PPA estimates. However, there is no clear direction pertaining to the timing of P&A activities and the associated levels of confidence required in the MC.

The outstanding P&A with industry was clearly reflected in the TAPV approval documentation but the associated risk to the project cost was not included. An extension of the options analysis phase after government approval to conduct the P&A would have provided a higher level of confidence prior to the approval of the definition phase.

The unknown variance in the TAPV project cost was addressed by the option of 100 more vehicles if the bid price is ||| than expected.²⁷ |||
|||
|||²⁸ The industry standard for projects entering the definition phase is a potential 25 percent cost growth or a decrease of 10 percent.²⁹

Definition Phase Estimates

Due to the urgency of improving protection for Canadian Forces soldiers in armoured vehicles, the Department was authorized to proceed with the definition phase of the TAPV project with an indicative estimate of |||. This amount was based on ||| of total estimated project funding,³⁰ rather than the normal substantive estimate which has a confidence level of || percent. An estimate of ||| definition funding was based on FLCV’s LAV III upgrade project’s substantive cost estimate of ||| and CCV project’s near substantive estimate of |||. If the ||| budget for definition was insufficient, the project would need to request additional funding.

At the time of the audit the TAPV project office forecasted that only || percent of the definition phase funding ||| would be spent. A minimum indicative confidence level of || percent was specified for the definition phase. However, using a ||| estimate of the total TAPV project cost estimate resulted in an inaccurate approximation of definition funding. This overestimation may have influenced the budgeting of project funds in the implementation phase.

²⁷ Based on an estimated unit price of ||| x 100.
²⁸ Although most cost elements had an estimated expected variance of 25 percent, the ||| for the TAPV project was based on percentages used by other FLCV projects (||| for CCV, ||| for FME and ||| for LAV).
²⁹ DND Project Management Intermediate Course, ESI International, January 2007.
³⁰ Definition funding of ||| was approved in June 2009 ||| of the ||| indicative total project costs).

Rigor of Other Cost Estimates

The estimated value of TAPV acquisition cost elements such as infrastructure and ammunition were found to be understated by ||| A shortfall in this funding could reduce the operational capability of the TAPV fleet and may impact the project’s ability to exercise vehicle options. Life cycle costs for personnel may also be understated.

Infrastructure. TAPV projected infrastructure costs of ||| have been underestimated and no new funding is expected outside the FLCV project budgets. At the Defence Capability Board in March 2011 an estimated FLCV infrastructure cost gap of ||| was briefed and the associated infrastructure was expected to be delayed until two years after the vehicles are in service. The current infrastructure will not be able to accommodate the replacement vehicles that are not additional to the existing fleet (approximately 300 of the 500 TAPVs and all 108 CCVs).³¹ Assuming that ||| of the new space requirement would be for TAPV, the project may need ||| in additional funding for infrastructure.³²

Ammunition. According to the PAG, combat system projects should acquire two years of training ammunition and sufficient operational stocks. Although the project had estimated ammunition costs of ||| this amount was not included in the joint FLCV indicative project estimate. As a result, current estimates must be adjusted to account for this omission. The audit also observed an over-estimation of funding related to annual ammunition consumption after the initial two-year training period has elapsed. Current project documentation states that the annual consumption of ammunition is expected to be ||| per year, well below the estimated ||| per year presented at the National Procurement Oversight Committee on 23 March 2011. This will also necessitate an adjustment to project O&M estimates.

Personnel. The TAPV acquisition is not expected to require any additional human resources. However, the LF 2013 light infantry battalion organizations will have to be revised to include ||| more personnel to accommodate the ||| infantry section. This may be partially offset by the smaller CCV ||| infantry section (||| personnel) which was found ||| from the standard infantry section of 10 personnel.³³

³¹ Without a controlled environment storage area, the electronics of the new fleet will be adversely affected by temperature and humidity which may increase in-service support costs.
³² The TAPV proportion of infrastructure estimates for the FLCV program, |||
³³ Infantry section size in the CCV is a rated criterion with additional points for a 10-person section.

O&M. Once the TAPV fleet is delivered, annual contracted O&M costs were estimated by the National Procurement Oversight Committee to be ||| (not including those vehicles being replaced). Using the historical cost baseline for a similar fleet of vehicles, CRS estimated that the annual increment for 500 TAPVs may be closer to |||

³⁴ If the option of 100 vehicles is exercised, these contracted maintenance costs should be adjusted accordingly. As a result, O&M costs may be over-estimated by the project and will need to be adjusted.

Recommendations

3. In conjunction with ADM(Pol)/Dir Cab Ln, recommend that the sequence of P&A activity be established in the PAD to identify confidence levels for MC and PPA estimates.

OPI: VCDS

4. PMO TAPV should include the full project ammunition and infrastructure cost estimates and revise the Personnel, O&M costs for the implementation phase approval.

OPI: ADM(Mat)

³⁴ The contracted maintenance costs estimate is based on a comparison with the Coyote fleet in the Cost Factors Manual where 64 percent of annual O&M was contracted maintenance.

Risk Management

The identification, ranking and monitoring of risks would be improved by the full implementation of the project's Risk Management Plan (RMP) and the endorsement of impact threshold criteria and tolerance levels by the Senior Review Board (SRB).

The risk management methodology and tolerance levels were decided by the project office and were not endorsed by the SRB.³⁵ The project RMP showed considerable initiative by including the plan to set risk tolerance levels, but without oversight by senior management, the approach could be either too risk averse or simply accept risks that may have a significant impact on the project. Although it is normal practice for the RMP to be approved by the project office early in a project, the criteria for the five risk impact thresholds were a significant departure from the standard criteria established in September 2005 on the ADM(Mat) Knowledge Network and could reduce the number of significant risks that would require mitigation measures.

An accelerated project schedule did not allow the TAPV PMO to fully document risk management activities. The complete documentation of risk identification and risk management factors is important to ensure project risks are understood by everyone in the project, including future PMO members.

Risk Identification. Although the project RMP had many areas of good practice that reflected the DND Integrated Risk Management (IRM) Policy, there were areas for improvement that could enhance risk identification. These improvements include the following:

- utilizing tools such as Strengths and Weaknesses, External Opportunities and Threats or Political, Economic, Sociological, Technological, Environmental sectors to aid project team members in identifying inherent risks;
- identifying a full range of stakeholders to assess their interests, involvement, and influence, in order to place them in priority of risk severity;
- conducting formal risk workshops, as identified in the RMP, at critical points in the project; and
- greater detail in risk identification sheets to provide more context as to why a risk was identified and its level of impact.³⁶

Good Practices

- Impact thresholds were established for the expected lead times of a risk occurrence, as well as cost, schedule, and performance.
- Risk assessments in the PPRA clearly distinguish between inherent risks and the residual risk after mitigation.
- Risk impact thresholds were also developed for positive outcomes.

³⁵ An RMP is an annex to the project management plan and is approved by the project manager. SRB roles and responsibilities do not include the approval of an RMP.

³⁶ Information related to these risks was found dispersed in other project documents.



Risk Assessment and Prioritization. For the most part TAPV risk management is consistent with the IRM Guide but did not include all the ADM(Mat) risk management guidance with respect to impact threshold criteria. Full implementation of the project RMP and improvement in the methodology would assist in the ranking of risk. In particular, the project did not do the following:

- assess residual risk levels after considering standard DND internal controls;
- with SRB endorsement, set risk tolerances, a requirement in the RMP, which are used to determine whether a risk should be accepted or not; and
- set appropriate criteria for the cost impact thresholds in accordance with ADM(Mat) risk management guidance. An impact cost threshold, based on a percentage of total budget makes most risks insignificant. For example, a risk with a \$50-million cost impact would be ||| of the ||||| project, and would be assessed as minor as the threshold criteria was set at less than ||| ||||| of the project budget. The project should set the impact level thresholds based on the value of the cost element, not the project value.

Risk Response and Monitoring. Based on the examination of risk response plans and their evaluation, the following observations were made:

- there were no risk triggers identified for risk responses, such as timelines or significant events; and
- there was little evidence that risk monitoring activities were effective since there were no indicators identified to measure risk response effectiveness, such as, timeliness and cost performance. Such measures could include:
 - quantitative indicators such as the Cost Performance Indicator,³⁷ Schedule Performance Indicator,³⁸ or
 - qualitative measures such as the achievement of milestones that were at risk, or the successful leveraging of an identified opportunity.

Recommendation

5. With endorsement of risk tolerance and impact thresholds by the SRB, adopt a more robust risk identification, ranking and monitoring process to ensure there are sufficient risk indicators to measure the effectiveness of risk responses.

OPI: ADM(Mat)

³⁷ Cost Performance Index = Budgeted cost of work performed/Actual cost of work performed.

³⁸ Schedule Performance Index = Budgeted cost of work scheduled/Budgeted cost of work performed.

Annex A—Management Action Plan

Requirements Definition

CRS Recommendation

1. Once the unit prices of all FLCV fleets are known, it is recommended that fleet requirements and funding be revisited prior to EPA to address any FLCV fleet distribution imbalances in the LF 2013 force structure. Other criteria, such as incremental operational capability and equipment generation ratio, should be considered to determine the proportion of the options to exercise for each FLCV fleet.

Management Action

Once FLCV fleet unit prices are known by February 2012, fleet requirements and funding will be revisited prior to EPA to address any FLCV fleet distribution imbalances in the LF 2013 Force Structure. Should funding be available, the first priority with respect to fleet options will be the LAV III fleet upgrade. The second priority will be the largest quantity of the 100 TAPV option as both the LAV III and TAPV fleets will provide the most flexibility for force generation and employment. The option of providing additional CCVs requires further review.

OPI: C Army

Target Date: April 2012

Schedule Management (Internal Project Schedule)

CRS Recommendation

2. The project office should improve schedule control integration and rank the impact and likelihood of project interdependencies in order of priority.

Management Action

More detailed schedules have and will continue to be produced for each major activity. There are only three dependencies on other projects which are being monitored as risks within the project's RMP. Prioritization of dependencies has occurred.

OPI: ADM(Mat)

Target Date: 30 November 2011



Financial Management (P&A Confidence Level)

CRS Recommendation

3. In conjunction with ADM(Pol)/Dir Cab Ln, recommend that the sequence of P&A activity be established in the PAD to identify confidence levels for MC and PPA estimates.

Management Action

It is agreed that the sequencing of P&A, where possible, should be planned early in the life of a project so that the MC and definition costs will be better informed. Consultation with ADM(Mat), ADM(Pol) and Dir Cab Ln will occur in order to have this amendment made to the PAD.

OPI: VCDS

Target Date: 31 March 2012

Financial Management (Estimate Shortfalls)

CRS Recommendation

4. PMO TAPV should include the full project ammunition and infrastructure cost estimates and revise the Personnel, O&M costs for the implementation phase approval.

Management Action

The full project ammunition, infrastructure, personnel, and O&M cost estimates for the implementation phase will be included in the Treasury Board submission for EPA once the winner has been selected and costs are known.

OPI: ADM(Mat)

Target Date: 31 March 2012

Risk Management

CRS Recommendation

5. With endorsement of risk tolerance and impact thresholds by the SRB, adopt a more robust risk identification, ranking and monitoring process to ensure there are sufficient risk indicators to measure the effectiveness of risk responses.

Management Action

PMO TAPV has already amended the TAPV Risk Management Plan by setting more appropriate criteria for cost impact thresholds. PMO TAPV will further review the TAPV Risk Management Plan to develop clear risk tolerance thresholds. In addition, PMO TAPV will review all risk identification sheets to

- improve the level of detail in risk identification;
- identify risk triggers where applicable;
- re-assess residual risk levels in light of standard DND internal controls; and
- develop risk indicators to better measure the effectiveness of risk responses.

OPI: ADM(Mat)

Target Date: 30 November 2011



Annex B—Audit Criteria

Objective

To assess the adequacy of the management control framework, governance processes and risk management strategy in place to ensure a cost-effective acquisition.

Criteria Assessment

Level 1 (Satisfactory); Level 2 (Needs Minor Improvement); Level 3 (Needs Moderate Improvement); Level 4 (Needs Significant Improvement); Level 5 (Unsatisfactory)

Governance/Monitoring

1. **Criteria.** Governance roles and responsibilities are defined (PMO, project director, PWGSC, Prime and Interdependent Contractors) and necessary skills, staff and resources are available to govern the project.
2. **Criteria.** Adequate monitoring in place that utilizes high-quality, up-to-date and accurate information as the basis for decision making.

Assessment. Level 2 – The human resources plan lacks some detail (briefed), CID monthly progress report not complete, inconsistent performance reporting criteria for cost schedule and technical issues (briefed).

Risk Management

3. **Criteria.** Risks are identified, assessed, ranked, responded to, monitored, quantified with cost impact and reported in accordance with relevant policy and best practices (i.e., stakeholder analysis).

Assessment. Level 3 – The TAPV RMP was not fully implemented such that risks are not fully identified, assessed, ranked, responded to, monitored, quantified with cost impact and reported in accordance with relevant policy and best practices. Criteria for risk impact thresholds reduced the significance of the risk.

Project Schedule

4. **Criteria.** Project schedule is achievable and is managed to avoid impact on operational requirements.

Assessment. Level 3 – Original project schedule too aggressive, project expenditure approval delay of 18 months, and PMO resource scheduling not integrated.



Project Requirements

- 5. **Criteria.** Requirements are in accordance with defence policy, clearly defined, complete, prioritized, consistent and traceable throughout the project activities from SOR development to performance specifications test, evaluation and training plans.

Assessment. Level 3 – Number of TAPVs ||| but may be satisfied with option clauses or rescoping other FLCV fleets.

Financial Management

- 6. **Criteria.** Financial management and materiel asset accountability is in accordance with the *Financial Administration Act (FAA)*, DND and Treasury Board regulations while ensuring best value total cost of ownership and facilitated with reliable and relevant cost estimates.
- 7. **Criteria.** Contract terms and conditions optimize value for money.

Assessment. Level 3 – Financial management and materiel asset accountability is in accordance with the FAA. Competitive tender should achieve best value. Draft RFP required revision to address warranty, terms of payment, performance metrics and risk management concerns. Delay in P&A reduced confidence level of indicative project estimates. Ammunition and infrastructure estimates understated.

Annex C—Planned TAPV Distribution

Unit Allocation	LF 2013 MIP	LF 2013 MID	Distribution Rationale
Operational Stock			of total stock versus for CCV fleet
Logistics Stock			of total stock versus for CCV fleet
CFSEME			Baseline for fleet modification
Mobile Readiness Training Fleet (MRTF) ⁽⁴⁾			None at CMTC. Mobile pool of training vehicles
Area Training Centres (TC) (Reserve)			TAPV for each area TC to train Reserves
3 PPCLI ⁽³⁾			for battalion headquarters (HQ), for reconnaissance (recce) platoon
2 PPCLI ⁽²⁾			Recce platoon
1 PPCLI			Recce platoon
Lord Strathcona's Horse Regiment			tank squadrons
3 Royal Canadian Regiment (RCR)			for battalion HQ, for recce platoon
1 RCR ⁽¹⁾			Recce platoon
2 RCR ⁽¹⁾			Recce platoon
Royal Canadian Dragoons			recce squadrons,
3 Royal 22 ^e Régiment (R22 ^e R)			for battalion HQ, for recce platoon
2 R22 ^e R ⁽¹⁾			Recce platoon
1 R22 ^e R ⁽¹⁾			Recce platoon
12 Régiment blindé du Canada			Three recce squadrons,
LFDTS CTC			Resources for regular force training
Total	593	500	

Table 3. Planned TAPV Distribution.

Notes:

- (1) These LAV III infantry battalions will each be equipped with || LAV IIIs.
- (2) 1 PPCLI is being equipped with one company of LAV IIIs (|| vehicles) and the equivalent of ||||| companies of CCVs (| vehicles). Unlike other FLCV fleets, this unit would be the first to deploy a CCV company and the vehicles would remain in theatre.
- (3) 2 PPCLI is being equipped with two companies of LAV IIIs (| vehicles) and ||||| of CCVs (| vehicles).
- (4) The MRTF allowed for a pool of vehicles to be moved to units that were preparing for deployment rather than moving the unit to the CMTC in Camp Wainwright Alberta. At the time of the audit, there were 30 armoured vehicles at CMTC; however, according to LF 2013 MID there will only be || CCV assigned to the CMTC.