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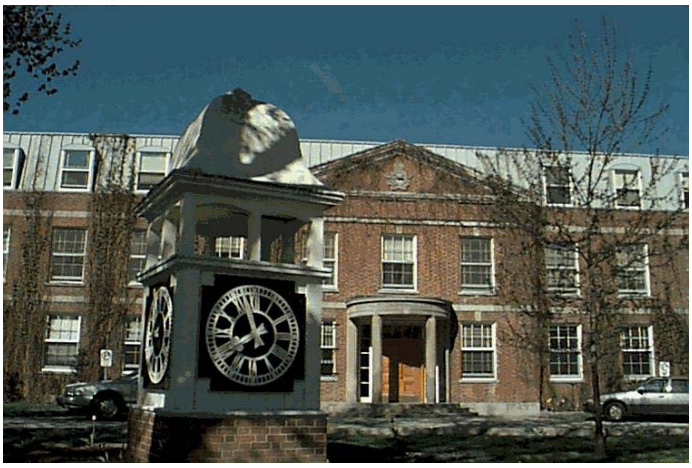

RELATIVE SYMMETRY: A "RATIONALISED" APPROACH TO THE MANAGED READINESS OF CANADA'S HEAVY ARMOUR CAPABILITY

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AIM

1. The aim of this service paper is to examine the organisation, force generation (FG) and sustainment of the Canadian Army's (CA) heavy armour capability for Canadian Armed Forces (CAF) *Force Posture and Readiness* (FP&R).

INTRODUCTION

2. Conflict in the 21st Century has become characterised by a multitude of threat types: from insurgent guerillas, to special operations forces, to modern heavily armoured conventional forces employing precision, and massed, direct and indirect fires. Moreover, there has been an increased potentiality of such forces operating together as a coordinated *hybrid threat*.[1] In future conflicts, Canada may face a *hybrid threat* that operates across the full spectrum of operations; and on any terrain imaginable, from mega-cities to the rolling steppe.

3. The CA's need for heavy armour was underscored at the outset of Canada's Kandahar mission, in 2006.[2] Urgent capital re-investment revived this nearly-divested capability, through the hastily designed Tank Replacement Project (TRP), with the German Leopard 2 Main Battle Tank (MBT).[3] By 2007, the CAF began fielding these tanks in Kandahar Province. Procurement and delivery speed notwithstanding, the CA's Leopard 2 Family of Vehicles (Leo 2 FoV) have been plagued with serviceability issues that impact the CA's capacity to sustain its operational and training needs. In the past 18 months, the CA Headquarters has conducted multiple studies to

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[1] Hetherington, S.C. Major-General. Contemporary Operations Working Group 2017 – Post Activity Report. (Canadian Army Doctrine and Training Command, Kingston: file 9920-4 (ALLC), 20 September 2018), A-2/4 & B-1/2.

[2] Canada. DND. Canadian Armed Forces Development Working Group on Leo 2 FoV. (Director Land Force Development. Ottawa: file 1901-1 (DLFD CI-3) 2017) 2-3.

[3] Canada. DND. Canadian Armed Forces Development Working Group on Leo 2 FoV. (Director Land Force Development. Ottawa: file 1901-1 (DLFD CI-3) 2017) 2.

improve Leo 2 FoV availability in order to meet the FP&R requirements mandated within *Strong Secure and Engaged* (SSE).[4]

4. This paper will adopt the same solution space established for these studies through planning guidance issued by the Commander of the Canadian Army (CCA). It included the following limitations:

a. Funding. The proposed solutions must be achievable within the existing procurement and operations funding. Proposals for minor budget increases may be considered, but additional National Procurement (NP) funds are not within scope.[5]

b. Manning. Organisation and establishment changes must be achievable within a CAF PY-neutral environment.[6]

c. Infrastructure and Range Training Area (RTA). Infrastructure and RTA improvements to accommodate the Leo 2 FoV were allocated through the Tank Replacement Project (TRP). These funds have now been exhausted, and additional infrastructure capacity is not anticipated prior to 2025-30.[7]

d. Deficiencies in spare parts and qualified technicians. From 2015-17, measures were put in place to remediate the spare parts deficiencies with additional funding for parts contracts. By 2018-19, parts availability will improve and start to

[4] Canada, DND. Canadian Armed Forces Development Working Group on Leo 2 FoV. (Director Land Force Development. (Ottawa: file 1901-1 (DLFD CI-3), 2017) 1.
[5] Canada, DND. Canadian Armed Forces Development Working Group on Leo 2 FoV. (Director Land Force Development. (Ottawa: file 1901-1 (DLFD CI-3), 2017) 1.
[6] Wynnyk, P.F. Lieutenant-General. Leopard 2 Fleet of Vehicles Initiating Directive. (Canadian Army Headquarters Ottawa: file 1901-1 (DLFD CI-3) July 2018) 1-2. Additionally, the reference mentions that a limited margin for PY growth was permissible, but by exception only.
[7]Wynnyk, P.F. Lieutenant-General. Leopard 2 Fleet of Vehicles Initiating Directive. (Canadian Army Headquarters Ottawa: file 1901-1 (DLFD CI-3) July 2018) 2.

positively impact serviceability.[8] Deficiencies in the disposition of Leo 2 qualified technicians is being addressed separately by the Corps of Royal Canadian Electrical and Mechanical Engineers (RCEME). As such, these two issues will not be addressed in this paper.

5. At present, the CA is not generating the necessary Leo 2 FoV capacity to sustain the FP&R and the operational output mandated within *Strong Secure and Engaged (SSE)*.[9] The most cost-effective means of improving CA readiness is to maximise the fleet availability for combined arms training and operations by enabling all three CMBGs with an integral heavy armour capability. The most expedient way to increase fleet availability is to improve maintenance productivity within the existing capacity already in Edmonton and Gagetown.

DISCUSSION

Managed Readiness

6. Combined Arms Theory and the Contemporary Operating Environment (COE). The CA doctrine favours the Combined Arms Theory,[10] over the separate employment of the arms, because of the potential force-multiplication effect that it offers. Each combat arm and combat support enabler is characterised by a unique set of strengths and weaknesses. When these elements are organised into combined-arms teams, under a unified command, a complimentary overlap of capabilities occurs, with the strength of one compensating for the weakness of another. The resultant synergy imposes a dilemma on the opponent— in that any decision (or

[8] Canada. Department of National Defence. Tank Replacement Project Update 2018 (Canadian Army Equipment Working Group Ottawa: February 2018) 52-53.
[9] Wynnyk, P.F. Lieutenant-General. Leopard 2 Fleet of Vehicles Initiating Directive. (Canadian Army Headquarters Ottawa: file 1901-1 (DLFD CI-3) July 2018) 1-2.
[10] Leonhard, R.R. "The art of maneuver: Maneuver Warfare Theory and Airland Battle." *Presidio / Random House* (New York: United States, 2009) 92-98.

indecision) can be swiftly met, countered and exploited through the integral capabilities of the combined arms team.[11] Turning this theory into practice, however, is a challenging enterprise.

7. Combined arms expertise. The level of expertise needed for combined arms proficiency is developed over time with practice, proximity, and human interaction. The CA's keystone doctrinal publication for training clearly stresses the importance of early integration to develop common understanding and to maximise every opportunity for combined armed teams to train collectively.[12] In the successive RtHR phases of the MRP, each CMBG trains to the same collective training Battle Task Standards (BTS).[13] This is out of necessity for Army FG and is consistent with the Army training principle of training to "one standard."[14]

8. CA heavy armour capability distribution. Canada's heavy armour capability resides mostly within four locations (full asset distribution can be found at annex A):

a. Edmonton. 1 CMBG is home to two squadrons (sqn) of MBTs and a sqn of Armour Engineer Vehicles. The base is at its limit of infrastructure and maintenance capacity in sustaining its extant fleet size. Current plans are to augment this fleet with an additional eleven tanks.[15] Edmonton has no RTA, so all 1 CMBG collective training occurs in Wainwright.

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[11] Leonhard, R.R. "The art of maneuver: Maneuver Warfare Theory and Airland Battle." *Presidio / Random House* (New York: United States, 2009) 97.
[12] Canada. Department of National Defence. B-GL-300-008-FP-002, *Training for Land Operations* (Ottawa: DND Canada, 2010) 1-10 - 1-11.
[13] Canada. Department of National Defence. B-GL-300-008-FP-002, *Training for Land Operations* (Ottawa: DND Canada, 2010) 6-1.
[14] Canada. Department of National Defence. B-GL-300-008-FP-002, *Training for Land Operations* (Ottawa: DND Canada, 2010) 1-11.
[15] Canada. Department of National Defence. 1 Canadian Mechanised Brigade Group Leopard 2 Family of Vehicles Technical Analysis (Edmonton: 1 Service Battalion Presentation to Commander 1 CMBG, 25 June 2018), 8-15.

b. Wainwright. This base has Leo 2-enabled maintenance facilities and the largest RTA in the CAF, but is geographically separated from any permanent Leo 2 FoV users.[16]

c. Valcartier. This base's maintenance facilities can accommodate tanks but lacks the Leo 2-qualified technician capacity. There are no lodger units on the base with integral heavy armour. The RTA has very limited capacity for combined arms maneuver.[17] 5 CMBG sometimes conducts collective training at the RTA in Gagetown.

d. Gagetown. Two tank lodger units reside at this base: 2 CMBG's armour sqn (C Sqn, The Royal Canadian Dragoons) and A Sqn, the Royal Canadian Armour Corps School, the Combat Training Center. Gagetown's infrastructure and maintenance resources sustains 39 Leo platforms, which is equivalent to two sqns of tanks. The RCACS 1st Line tank maintenance capacity is sourced from its 2nd Line support unit, the 5th Canadian Division Technical Services Branch.[18] Aside from Wainwright, Gagetown's RTA is best suited to accommodate combat team and battle group collective training.

9. Leo 2 FoV distribution and managed readiness. 5 CMBG, a third of the CA's combat power, has no integral heavy amour. It receives a tank sqn, detached from another brigade, for collective training. A Squadron, The Lord Strathcona's Horse was detached to 5 CMBG for the

[16] Canada. Department of National Defence. Canadian Armed Forces Development Working Group on Leopard Family of Vehicles – Annex C –PRICIE+G Matrix (Director Land Force Development, Ottawa: file 1901-1 (DLFD CI-3), November 2017), 2.
[17] Canada. Department of National Defence. Canadian Armed Forces Development Working Group on Leopard Family of Vehicles – Annex C –PRICIE+G Matrix (Director Land Force Development, Ottawa: file 1901-1 (DLFD CI-3), November 2017), 2.
[18] Canada. Department of National Defence. Canadian Armed Forces Development Working Group on Leopard Family of Vehicles – Annex C –PRICIE+G Matrix (Director Land Force Development, Ottawa: file 1901-1 (DLFD CI-3), November 2017), 1.

brigade's latest RtHR cycle in 2017-18. Aside from command and staff engagement, A Sqn's initial link-up with the infantry, artillery and engineer elements of 5 CMBG was at Ex MR 18, which was the culminating combined arms collective training event of RtHR.[19] By comparison, all of the combined arms elements of 1 CMBG trained together on multiple field exercises for nearly a year prior to the same event in 2016. The uneven distribution of heavy armour amongst the brigades is not conducive for training to a single standard. In the case of 5 CMBG, opportunities for tank-infantry cooperation in training are very limited prior to Ex MR 2018. These conditions are not favorable for developing the common understanding, the cohesion and the expertise necessary for combine arms synergy. The observer-controller reporting on tank-infantry cooperation, from the last three Ex MR serials, supports this argument. 1 CMBG, with two tank sqns, had the highest frequency of notable performance in tank-infantry cooperation during combat team CT.[20] 5 CMBG, with no integral tank sqn, had the highest frequency of reporting that noted a need for improvement on tank-infantry cooperation at levels of sub-unit and below.[21] 2 CMBG from Petawawa, with its integral tank sqn 1200 km away in Gagetown, fell somewhere in-between with a mix of positive and negative reviews.[22] Maintaining competency in tank-infantry cooperation within the context of combined arms warfighting skills is essential to Army readiness. The design of the MRP favours symmetrical brigades.

Structure and Capacity

[19] Based on the Author's first-hand knowledge as a Tank Squadron advisor to 5 CMBG during RtHR, prior to Ex MR 18. The Author's position at the time was Officer Commanding C Squadron, The Royal Canadian Dragoons, 2 CMBG.

[20] Pelletier, R. Colonel. Take Home Package – Exercise MAPLE RESOLVE [20]16 (Canadian Manoeuvre Training Center, Wainwright: file 3500-1 (Chief OCT), 19 July 2016). Based on the formation and unit level post-Ex MR 16 Take Home Packages prepared by the Chief Observer Controller, Canadian Manoeuvre Training Center.

[21] Scott, P.K. Colonel. Take Home Package – Exercise MAPLE RESOLVE 2018 (Canadian Manoeuvre Training Center, Wainwright: file 3500-1 (Chief OCT), July 2018). Based on the formation and unit level post-Ex MR 18 Take Home Packages prepared by the Chief Observer Controller, Canadian Manoeuvre Training Center.

[22] Scott, P.K. Colonel. Take Home Package – Exercise MAPLE RESOLVE [20]17 (Canadian Manoeuvre Training Center, Wainwright: file 3500-1 (Chief OCT), 17 August 2017). Based on the formation and unit level post-Ex MR 17 Take Home Packages prepared by the Chief Observer Controller, Canadian Manoeuvre Training Center.

10. The limited number of bases that can accommodate the Leo 2 FoV fleet combined with the current distribution of heavy armour sqns within the RCAC imposes unnecessary limitations on the CA's capacity to force generate the required heavy armour capability throughout all phases of the MRP. This capacity could be improved through the reorganisation of existing RCAC equipment and manning within the RCACS and regular force Armour Regiment establishments. Key to increasing availability for managed readiness is achieving this reorganisation without impact to infrastructure and tank 1st and 2nd line technical maintenance support in Gagetown and Edmonton.

11. The 12e Régment blindé du Canada (12e RBC), part of 5 CMBG, possesses nearly fifty percent of the Person Year (PY) manning allocation within C Sqn, RCD. The rotation of 12e RBC personnel through C Squadron facilitates the sustainment heavy armour expertise within the 12e RBC. In terms of managed readiness, due to 2 CMBG and 5 CMBG's sequential order in the MRP rotation, it is unlikely that C Squadron could be committed for 5 CMBG's High Readiness in the future. Because of 5 CMBG's geographic proximity to Gagetown (650 km), 5 CMBG frequently uses the Gagetown Training Area for exercises. Besides Shilo and Wainwright, it is the only base in the country capable of realistic open terrain for combat team maneuver.[23] Furthermore, Gagetown and Edmonton are the only bases capable of maintaining and sustaining the Leo 2 FoV without significant infrastructure capitalisation or PY establishment changes, particularly for RCEME Leo 2-qualified technicians.[24] With the existing capacity within Gagetown, there is scope to establish a fourth operational heavy armour sqn for 5

[23] Canada. Department of National Defence. Canadian Armed Forces Development Working Group on Leopard Family of Vehicles – Annex C –PRICIE+G Matrix (Director Land Force Development, Ottawa: file 1901-1 (DLFD CI-3), November 2017), 3.
[24] Canada. Department of National Defence. Canadian Armed Forces Development Working Group on Leopard Family of Vehicles – Annex C –PRICIE+G Matrix (Director Land Force Development, Ottawa: file 1901-1 (DLFD CI-3), November 2017), 1-2.

CMBG. The existing tank capacity (crewmen PYs, vehicles and equipment) presently integral to the RCACS combined were to be combine with the 12e RBC PYs existent within in C Sqn, RCD. Provided the sequence of 2 and 5 CMBG on the MRP, there's scope for one of the tank sqns to assume tank Individual Training tasks through the RCACS while the other sqn is committed to RtHR. Besides PY transfers internal to the Royal Canadian Armour Corps, there's little requirement for establishment transfers.

Maintenance and Tempo

12. Serviceability. From Fiscal Year (FY) 2014/15 until FY 2017/18, aside from spare parts deficiencies and a lack of facilities, the maintenance production deficit is the most significant limiter of Leo 2 FoV serviceability rates.[25] Inefficient organisation of preventative and repair maintenance has caused a build-up of outstanding labour production. As such, availability is greatly impacted unserviceable tanks sitting in hangars waiting an unacceptable period of time to be inspected or fixed.

13. Maintenance. Preventative Maintenance (PM) is a deliberate task to pre-empt equipment failure.[26] Leo 2 preventative maintenance is a shared operator and technician responsibility. The RCEME Leo 2 Vehicle, Weapons and Electrical-Optical Technicians conduct technical inspections according to the permissive repair schedule.[27] Accordingly, AFV crews conduct

[25] McGinlay, Major D. (Deputy Project Manager, Tank Replacement Project and Force Mobility Enhancement, Director General Land Equipment Program Management), telephone conversation with the author, 12 October 2008. Based on-going data-analysis of Leo 2 FoV fleet DRMIS data pulls from FY 14/15 to FY 17/18. At this point in the analysis, Major McGinley could confirm that maintenance time constituted only 40% of the total recorded downtime. Waiting parts, facilities and/or labour accounted for the remaining 60%.
[26] Wenz, Christopher. Maintenance Life Cycle Planning – An Introduction. (Chesapeake, VA: American Public Transportation Association Paper, 2014). 3-5.
[27] Canada. DND. C-30-B57-AOO/NP-000, Technical Manual 2350/033-31 Work Items, Maintenance Levels, Standard Required Times Main Battle Tank Leopard 2 A4 CAN (Ottawa: 2013). The Leo 2A4 permissive repair schedule was adapted from German Leo 2 data and Leopard C1/C2 schedules.

routine "roll-outs,"[28] equipment verifications and monthly vehicle inspections. The Leo 2 has proven to be especially prone to increased faults and equipment failure when preventative maintenance is neglected. It is linked to spikes in corrective maintenance, parts consumption, and increased risk of crew injury. When compared to other factors affecting the fleet availability, such as trained technician capacity, spare parts, equipment obsolescence and infrastructure,[29] enabling preventative maintenance is far a less challenging endeavour.

14. Tempo. Maintainability and tempo are managed by programming maintenance time around peak operating periods. Success is dependent on the synchronisation of technicians, crews, vehicles, facilities, and parts focused within time and space. Ineffective synchronisation of these resources prolongs "Delay Times,"[30] which reduces vehicle availability. Over the course of the last four years, the time that grounded tanks sat waiting for labour is more than double the time that work was actually done on them (full details can be found in figure 1 of annex A).[31] Canadian Forces Tasking's, Plans and Operations (CFTPO) incremental augmentation tasks, issued to formations during scheduled reconstitution periods, has a major impact on maintenance production. The time that AFV crew members and technicians are tasked-away from their primary place of duty represents a loss of potential labour time, which has a compounding effect on maintenance build-up. A labour productivity analysis at C Sqn, RCD identified a trend of spikes in supervisor task attrition that coincided with degraded tank serviceability (full details

[28] Roll-out: operator verification of equipment completed on a monthly basis. It includes monthly inspections followed by lengthy road-tests to prove the operability of the Leo 2 turret and chassis systems.
[29] Canada. Department of National Defence. *Armoured Direct Fire Integration*. Presentation to the Army Capability Development Board. Director Land Force Development (Ottawa: DND Canada, 2018) 3-4 [slide notes].
[30] DND,Canada. B-GL-342-001-FP-000 Land Equipment Maintenance System. (Ottawa: 2000), 95.
[31] McGinlay, D., Leopard 2 Family of Vehicles Tank Usage and Maintenance Analysis —Tank Replacement Project and Force Mobility Enhancement (Director General Land Equipment Program Management, Ottawa, 20 September 2018).

can be found in figure 2 of annex A).[32] Also of note, there were significant fluctuations in serviceability when task-attrition exceeded thirty percent.

CONCLUSION

15. The current asymmetric heavy armour distribution is not conducive to training to one standard for managed readiness across the field force. Enabling all three CMBGs with an integral heavy armour capability is the most cost-effective way of improving this situation. The is possible causation between increased task tempo and decreased tank availability as a result of degraded maintenance productivity. The impact of Leo 2 operator and technician task tempo to platform availability must be made transparent in order enable the chain of command to make informed decisions weighing the risks. The most expedient way to increase fleet availability is to improve maintenance productivity within the existing capacity in Edmonton and Gagetown.

RECOMMENDATIONS

16. 12e RBC heavy armour sqn. Reorganise the current RCAC Table of Organisation and Equipment to create a 12e RBC heavy armour sqn, based in Gagetown. This is achievable in a NP, PY and infrastructure-neutral environment through internal reorganisation of the RCACS, RCD and 12e RBC establishments. Building an organic tank sqn within 5 CMBG would favour a more balanced heavy armour capability distribution.

17. RCAC Leo 2 FoV IT. To stand-up a 12e RBC heavy armour sqn, A Sqn, RCACS would be stood-down, or transformed. The RCACS tank crewmen PYs (save instructors), equipment, echelon and infrastructure must be re-distributed amongst the RCD or 12e RBC armour sqns. Support tasks related to tank IT will be assumed by the Gagetown-based armour sqn that is

[32] Inglis, C.T. et al. Leopard 2 Family of Vehicles operator and technician task analysis (The Royal Canadian Dragoons, Orormocto: March 2018). This study was conducted by the author, and his staff, while serving at C Sqn, RCD.

outside of the HR bubble. The RCACS retains the control of the associated IT, as well as the training staff. The vehicles and crews would be provided to the RCACS by either the RCD or the 12e RCB, on a rotational-basis. Further analysis is necessary to determine how to meet the tank IT and CT needs through the synchronisation of the Army National Training Calendar with the MRP. Additionally, further analysis is necessary to further identify how this reorganisations impacts resources, manning and posting funds internal to the RCAC.

18. Managing Leo 2 FoV maintenance labour production. Further analysis is necessary to confirm the relationship between task-tempo and tank serviceability. The strength of this relationship during maintenance surges should be the focus of this analysis. Pending the results of subsequent analysis, it is recommended that the CA HQ implement measures guiding the employment and management of the personnel responsible for the tank 1st Line and 2nd Line preventative and corrective maintenance. This labour production capacity must be deliberately prioritised in favour of tank availability, above all other national tasks.

BIBLIOGRAPHY

Canada. Department of National Defence. *Armoured Direct Fire Integration*. Presentation to the Army Capability Development Board. Director Land Force Development. Ottawa: DND Canada, 2018.

Canada. Department of National Defence. Tank Replacement Project Update 2017. Canadian Army Equipment Working Group, Ottawa: March 2017.

Canada. Department of National Defence. Tank Replacement Project Update 2018. Canadian Army Equipment Working Group, Ottawa: February 2018.

Canada. Department of National Defence. B-GL-300-001/FP-001, *Land Operations*. Ottawa: DND Canada, 2008.

Canada. Department of National Defence. B-GL-342-001-FP-000, *Land Equipment Maintenance System*. Ottawa: DND Canada, 2000.

Canada. Department of National Defence. B-GL-300-008-FP-002, *Training for Land Operations*. Ottawa: DND Canada, 2010.

Canada. Department of National Defence. C-30-B57-AOO/NP-000, *Technical Manual 2350/033-31 Work Items, Maintenance Levels, Standard Required Times Main Battle Tank Leopard 2 A4 CAN*. Ottawa: DND Canada, 2013.

Canada. Department of National Defence. *Land Operations 2021 Adaptive Dispersed Operations - the Force Employment Concept for Canada's Army Of Tomorrow.* Directorate of Land Concepts and Design. Kingston: DND Canada, 2007.

Canada. Department of National Defence. Canadian Armed Forces Development Working Group on Leo 2 FoV, Annex C – Leo 2 FoV PRICIE+G Matrix. Director Land Force Development. Ottawa: file 1901-1 (DLFD CI-3), 2017.

Hetherington, S.C. Major-General. Contemporary Operations Working Group 2017 – Post Activity Report. Canadian Army Doctrine and Training Command, Kingston: file 9920-4 (ALLC), 20 September 2018

Leonhard, R.R. "The art of maneuver: Maneuver Warfare Theory and Airland Battle." *Presidio / Random House*. New York: United States, 2009.

United States of America. Headquarters, Department of the Army. *Field Manual 7.0 (25-100), Training the Force*. Washington: United States, 2002.

Wenz, Christopher. The McHenry Management Group. *Maintenance Life Cycle Planning – An Introduction*. Chesapeake, VA: American Public Transportation Association Paper, 2014.

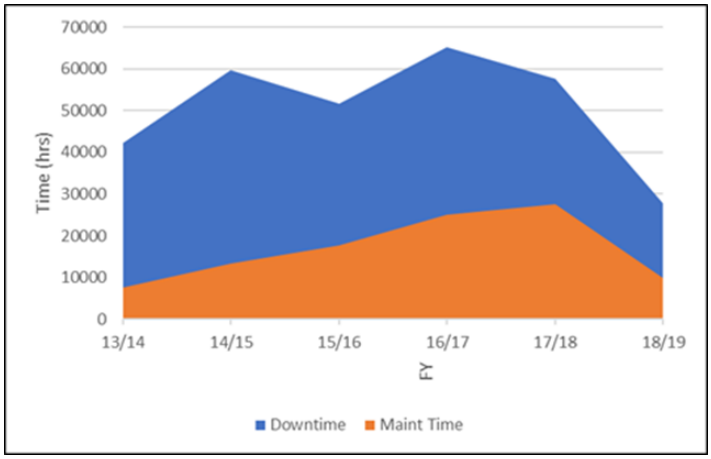
Wynnyk, P.F. Lieutenant-General. Leopard 2 Fleet of Vehicles Initiating Directive. Canadian Army Headquarters, Ottawa: file 1901-1 (DLFD CI-3), July 2018.

Figure 1 – Leo 2 FoV Distribution

Location	Unit	Leopard 2 Variants					
		2A4	2A4M	2A6M	ARV	AEV	Total
Edmonton	LdSH(RC) (2x Sqns)	20	11	11	3		45
	1 CER				2	17	19
	1 Svc Bn				2		2
Gagetown	2 CMBG / RCD (C Sqn)	11	5	5	1		22
	RCACS	9	2	2			13
	5 CDSG				2		2
Borden	RCEMES	1	1	1	1	1	5
KMW	Reference Tanks	1	1	1	1	1	4
Total		42	20	20	12	18	112

Source: DND: Canadian Army Equipment Working Group 2017 – *Tank Replacement Project Update*. Ottawa: 12 June 2017.

Figure 1 – Leo 2 FoV Maintenance Time vs Downtime – FY14/14 to FY18-19

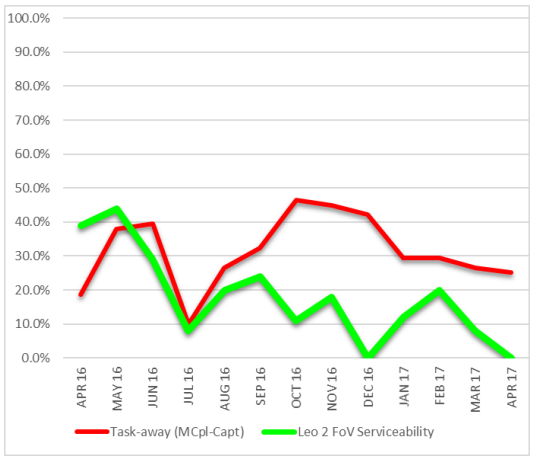


Source: DND: Director General Land Equipment Program Management, 2018.

In 2017, an analysis of the impact of tempo to Leo 2 serviceability was identified in a study conducted by the author, and his staff, while serving as the Officer Commanding C Sqn, the RCD. It illustrated a trend of spikes in supervisor attrition coincided with degradation in Leo 2 serviceability, and *vice-versa*.[33] Also of note, there were significant fluctuations in serviceability when task-attrition exceeded thirty percent. The only glaring exceptions occur during

maintenance pauses during sqn block-leave periods (July 2016 and December 2016 to January 2017).

Figure 3 – Armour and RCEME supervisors tasked-away vs Leo 2 serviceability (C Sqn RCD), July 2016-July 2017.



Source: DND: CA, The Royal Canadian Dragoon, 2018.