

Canadian
Forces
College

Collège
des
Forces
Canadiennes



THE LAND VEHICLE CREW TRAINING SYSTEM: INTEGRATING IT INTO CANADIAN ARMY INDIVIDUAL AND COLLECTIVE TRAINING

Major Daniel E. Hogan

JCSP 47

Service Paper

Disclaimer

Opinions expressed remain those of the author and do not represent Department of National Defence or Canadian Forces policy. This paper may not be used without written permission.

© Her Majesty the Queen in Right of Canada, as represented by the Minister of National Defence, 2021.

PCEMI 47

Étude militaire

Avertissement

Les opinions exprimées n'engagent que leurs auteurs et ne reflètent aucunement des politiques du Ministère de la Défense nationale ou des Forces canadiennes. Ce papier ne peut être reproduit sans autorisation écrite.

© Sa Majesté la Reine du Chef du Canada, représentée par le ministre de la Défense nationale, 2021..

CANADIAN FORCES COLLEGE - COLLÈGE DES FORCES CANADIENNES

JCSP 47 - PCEMI 47
2020 - 2021

SERVICE PAPER – ÉTUDE MILITAIRE

**THE LAND VEHICLE CREW TRAINING SYSTEM: INTEGRATING IT INTO
CANADIAN ARMY INDIVIDUAL AND COLLECTIVE TRAINING**

By Major Daniel E. Hogan

“This paper was written by a candidate attending the Canadian Forces College in fulfillment of one of the requirements of the Course of Studies. The paper is a scholastic document, and thus contains facts and opinions which the author alone considered appropriate and correct for the subject. It does not necessarily reflect the policy or the opinion of any agency, including the Government of Canada and the Canadian Department of National Defence. This paper may not be released, quoted or copied, except with the express permission of the Canadian Department of National Defence.”

Word Count: 2,577

« La présente étude a été rédigée par un stagiaire du Collège des Forces canadiennes pour satisfaire à l'une des exigences du cours. L'étude est un document qui se rapporte au cours et contient donc des faits et des opinions que seul l'auteur considère appropriés et convenables au sujet. Elle ne reflète pas nécessairement la politique ou l'opinion d'un organisme quelconque, y compris le gouvernement du Canada et le ministère de la Défense nationale du Canada. Il est défendu de diffuser, de citer ou de reproduire cette étude sans la permission expresse du ministère de la Défense nationale. »

Nombre de mots : 2.577

THE LAND VEHICLE CREW TRAINING SYSTEM: INTEGRATING IT INTO CANADIAN ARMY INDIVIDUAL AND COLLECTIVE TRAINING

AIM

1. The aim of this service paper is to advise Commander Canadian Army Doctrine and Training Centre (CADTC) on how the future Land Vehicle Crew Training System (LVCTS) can best be integrated into Canadian Army (CA) Individual Training (IT) and Collective Training (CT). The scope of this paper and the current status of the LVCTS Project make an exhaustive study of this topic unachievable at this time. That said, this paper will make initial recommendations on LVCTS integration and outline areas that require further study.

INTRODUCTION

2. Over the last 50 years, the CA has used some type of virtual or constructive simulation to support training.¹ These CA simulation systems have included the Teleflex for the Leopard C1, the Light Armoured Vehicle/Coyote Gunnery Trainer (LCGT) for the LAV (Light Armoured Vehicle) 3.0 and Coyote, the Joint Conflict and Tactical Simulation (JCATS) program and others; thus, the LVCTS has a long pedigree.

However, as the LVCTS has not yet been fielded, knowledge of it is conceptual and largely limited to Directorate of Land Requirements (DLR) personnel and senior CA

¹ Canada, Department of National Defence, *A-FD-005-000/AG-001 - Future Integrated Training Environment (FITE)*, Ottawa, ON, CA: CADTC, 1 August 2019, 1-1. *FITE* defines live, virtual and constructive simulation as follows:

- Live Simulation: A simulation involving real people operating real equipment such as a field training exercise (FTX).
- Virtual Simulation: A simulation involving real people operating simulated systems such as the LVCTS.
- Constructive Simulation: A simulation involving simulated people (computer-generated forces) operating simulated systems, which are commanded by real people as is done during a computer-assisted exercise (CAX) using the JCATS or Advanced Battlefield Computer System (ABACUS).

leadership. Thus, it is important to first define it. The LVCTS is a virtual simulation system that will allow all crew members of the CA's principal armoured fighting vehicles (AFVs) and lower-level leadership to train up to CT Level 5 within a synthetic environment (SE). Supported AFVs will include the LAV 6.0 and its variants, Leopard 2 (Leo 2) Main Battle Tank (MBT), and Tactical Armoured Patrol Vehicle (TAPV).² The LVCTS will replicate said AFVs and scenarios to enable crews and leadership to learn, maintain and improve their skills, using one or a combination of Low, Medium and High Fidelity Simulators.³ The LVCTS will allow crews to practice their own Individual Battle Task Standards (IBTS Level 1), to work together with other crew members as a complete vehicle crew (CT Level 2), and to train collectively with other vehicle crews as a sub-subunit or subunit up to the Combat Team-level (CT Levels 3-5).⁴ LVCTS training

² Canada, Public Services and Procurement Canada (PSPC), *Solicitation Amendment No. 2 for Land Vehicle Crew Training System (W8476-175579/B)*, Gatineau, QC, CA: PSPC, 27 November 2020, 5. https://buyandsell.gc.ca/cds/public/2020/11/26/6499af794628438758dc457f94c1d7a2/ABES.PROD.PW_QT.B010.E27734.EBSU002.PDF. The LVCTS is meant to virtually simulate all crew positions in an AFV. For example, in a Leo 2 simulator, a position for the Crew Commander (CC), a Gunner (GNR), a Loader (LDR), and Driver (DRV) would be afforded.

³ Canada, Treasury Board of Canada Secretariat, *Business Case: Land Vehicle Crew Training System (LVCTS)*, Ottawa, ON, CA: Canadian Army – Director Land Requirements, 25 November 2015, 16. The Business Case for the LVCTS defines these simulator fidelity levels as follows:

- High Fidelity Simulator (HFS)/Full Mission Simulator (FMS): An exact geospatial replica of the complete corresponding vehicle crew station, including all vehicle systems, interfaces and controls. It simulates the entire crew station functionality available to that specific crew member. A HFS is so close to the actual vehicle that trained crew members can transition from the simulator to the actual vehicle, without noticeable changes.
- Medium Fidelity Simulator (MFS)/Reconfigurable Simulator (RS): A blend of real and simulated equipment together. It simulates the most important crew station functionality available to that specific crew member, but the location and the look and feel of all the vehicle systems, interfaces and controls are not all exact. A MFS enables trained crew members to achieve the required skills to operate as part of a crew, and can entirely transition these competencies to using the actual vehicles, but the technical proficiency will require further training.
- Low Fidelity Simulator (LFS)/Multi-Purpose Simulator (MPS): Uses commercial-grade computer and electronic equipment to broadly feature the corresponding vehicle crew station, systems and controls. It simulates the key crew station functionality. A LFS enables trained crew members to perform their key roles in the context of their numerous tactical employment scenarios, whether as part of a crew, groups of vehicle crews, or larger tactical units.

⁴ Canada, Public Services and Procurement Canada (PSPC), *Solicitation Amendment No. 2....*, 3.

centres will be built at the five major CA garrisons: Gagetown, New Brunswick; Valcartier, Quebec; Petawawa, Ontario; Shilo, Manitoba; and Edmonton, Alberta. All LVCTS training centres and other CA simulation systems like the future Small Arms Trainer (SAT) will be networked together through the Virtual Training and Experimental Network (VTEN). The VTEN will allow for simultaneous, distributed training across Canada using a common SE.⁵ The LVCTS will be "the flagship interface" of virtual simulation for the CA's *Future Integrated Training Environment (FITE)*.⁶

3. Detailed work on the LVCTS Project has been ongoing since 2008.⁷ During this time, the project has evolved to meet the CA's changing requirements.⁸ Currently, Public Services and Procurement Canada (PSPC) is soliciting feedback and letters of interest from industry for the project. After bids are submitted, one contractor will be selected to build the LVCTS and provide enduring support over its 30-year life expectancy. Initial Operating Capacity (IOC) is anticipated to be achieved in FY2023/2024 with the completion of facilities at Gagetown.⁹ Final Operating Capability (FOC) is projected to be achieved by FY2027/28 with the completion of the other four LVCTS training centres.¹⁰ Estimated to cost between \$250-\$499 million CAD, the LVCTS Project represents a significant investment for the CA.¹¹ To get true value out of this investment,

⁵ Canada, Department of National Defence, *A-FD-005-000/AG-001 - FITE...*, 1-6.

⁶ *Ibid.*, GL-1. The *FITE* is the overall vision for the provision of an integrated CA training system, encompassing live, virtual and constructive simulation.

⁷ Ian Coutts, "Vehicle crew training: Welcome to a new (virtual) reality," *Canadian Army Today*, 5 September 2018. <https://canadianarmytoday.com/vehicle-crew-training-welcome-to-a-new-virtual-reality/>.

⁸ Originally, the LVCTS Project was envisioned to provide virtual simulators for IT courses only (LAV 3 and Leo 2). The project was expanded to include simulation for new vehicle platforms like the LAV 6.0 and TAPV, and to support lower-level CT.

⁹ Canada, Department of National Defence - Defence Capabilities Blueprint (DCB), "Land Vehicle Crew Training System," last accessed 21 January 2021. <http://dgpaapp.forces.gc.ca/en/defence-capabilities-blueprint/project-details.asp?id=1697>.

¹⁰ *Ibid.*

¹¹ *Ibid.*

the LVCTS will have to be deeply integrated into future IT and CT, and be thoroughly embraced by its users. To find a way to achieve these, this paper will examine the advantages of the LVCTS, the command direction required to facilitate its rollout, allied lessons learned with simulators, and the work already completed by the LVCTS Project.

DISCUSSION

4. Although simulation in CA training has a long history, its scope has always been limited. Older CA simulation systems like the LCGT, JCATS or Virtual Battle Space 2 (VBS2) have suffered from one or several of the following deficits: were stand-alone systems that were not networked; were low fidelity; were not available at all CA garrisons; were appended to real AFVs; or were expensive to use due to contractor support costs. In addition, there has always been a degree of cultural resistance to simulation amongst its users, who have preferred to train in actual AFVs as part of live field training. For them, anything other than live simulation seemed less beneficial and an affront to one's own Warrior Ethos. For all of these reasons, older CA simulation systems were not fully exploited. Being networked and boasting cutting-edge technology, the LVCTS will be a far more capable system. This, though, will not be enough. For the LVCTS to be deeply integrated into future IT and CT, and embraced by its users, its advantages and command direction for its usage must be clearly communicated to its users, as a culture change is required. This direction needs to be informed by the lessons learned of our allies and the detailed analyses already conducted by the LVCTS Project.

5. The LVCTS will offer several advantages to the CA; these advantages need to be communicated to its users to ensure their buy-in and high system usage. Firstly, the LVCTS will improve training throughput times, as simulation does not require the

preparation, travel or set-up time that an FTX does, while trainees can also complete multiple training iterations without having to move back to a physical start point. Secondly, the LVCTS will improve training quality as it will be able to record, replay and receive objective feedback, while training parameters such as weather conditions, terrain and enemy reactions will be able to be altered. Thirdly, the LVCTS will improve operational outcomes as difficult, complex or risky operations can be reproduced and attempted in various ways to better understand risks and success factors. Fourthly, the LVCTS will be able to replicate training environments that are free of actual physical hazards encountered on FTXs (E.g.: uneven ground causing AFV rollovers). Fifthly, the LVCTS will provide vehicle lifecycle cost savings as training will occur without real AFVs.¹² Sixthly, as LVCTS training occurs in a SE, environmental impacts on training areas will be eliminated. Seventhly, the LVCTS will enable asset optimization as it will not be appended to actual AFVs, allowing for their employment elsewhere (E.g.: maintenance). Lastly, the LVCTS will improve member work/life balance, as less time will be spent on FTX and away from one's family. These LVCTS advantages are tangible and significant; communicating these advantages to users will convince them of the value of using the LVCTS as part of a progressive training plan.

6. To some degree, the CA has lagged behind some allies when it comes to fully leveraging training simulation. Allied armies from France, the Netherlands, Australia and the United States (US) have all invested heavily in said systems, improved their training results and achieved significant cost savings. The CA, maintains strong visibility on

¹² Canada, Treasury Board of Canada Secretariat, *Business Case: LVCTS...*, 9. Cost savings will be generated through reduced vehicle wear-and-tear, vehicle operation costs (E.g.: oils, fuels and spares) and training costs (E.g.: live ammunition).

allied use of training simulation systems as CADTC and DLR personnel regularly participate in associated working groups.¹³ One of these allied systems, the Close Combat Tactical Trainer (CCTT), has been used extensively by the US Army and Marine Corps since 1992.¹⁴ The current CCTT's capabilities mirror those planned for the LVCTS; thus, much can be learned from the American experience with it.

7. A 2003 study conducted by the Army Research Institute (ARI) did examine CCTT use by US Army units following its rollout. Firstly, the study noted that published command guidance for CCTT use was "non-existent" and this resulted in "a disparity of [CCTT] usage levels between battalions."¹⁵ Units that did use the CCTT and understood its capabilities did become "enthusiastic supporters" of it, building CCTT time into their training schedules.¹⁶ The study recommended that the US Army either publish standard requirements for CCTT unit usage or use "a gated strategy" wherein units must complete CCTT training prior to signature training events or foreign deployments.¹⁷ Secondly, the study noted that subunit CCTT training was almost always conducted in pure armor or

¹³ Canada, Department of National Defence, *A-FD-005-000/AG-001 - FITE...*, iii/iv. Said allied working groups on training simulation were created through the Australia/Canada/United Kingdom/US Modeling, Instrumentation and Simulation for Training Systems (MIST) Memorandum of Understanding and the Canada/United Kingdom Combined Arms Staff Training (CAST) Memorandum of Agreement.

¹⁴ Lockheed Martin, "Close Combat Tactical Trainer: Real-time Collective Training Environment," Washington, DC, USA: Lockheed Martin Mission Systems and Training, 2015, last accessed 21 January 2021. https://www.lockheedmartin.com/content/dam/lockheed-martin/rms/documents/close-combat-tactical-trainer/CCTT_Product_Card_2015.pdf. The CCTT includes HFSs used to train crews on the M1 Abrams MBT, M2 Infantry Fighting Vehicle (IFV) variants, M3 Cavalry Fighting Vehicle (CFV), and the High Mobility, Multipurpose, Wheeled Vehicle (HMMWV) Fighting Vehicle. The CCTT was developed by Lockheed Martin. Over 500 CCTT systems have been delivered to installations in the US, Europe and South Korea.

¹⁵ Thomas Mastaglio, Stephen Goldberg, Michael McCluskey, and Navair Orlando, *Assessing the Effectiveness of A Networked Virtual Training Simulation: Evaluation of the Close Combat Tactical Trainer*, Alexandria, VA, USA: Army Research Institute for the Behavioural and Social Sciences, January 2003, last accessed 21 January 2021.

https://www.researchgate.net/publication/228830128_Assessing_the_Effectiveness_of_A_Networked_Virtual_Training_Simulation_Evaluation_of_the_Close_Combat_Tactical_Trainer.

¹⁶ *Ibid.*

¹⁷ *Ibid.*

mechanized infantry configurations.¹⁸ Brigade units not synchronizing their training calendars was highlighted as the key factor that inhibited combined arms team training from occurring in the CCTT. Lastly, the study noted that local CCTT users had developed creative ways of using the system; however, these were not widely disseminated across the US Army as best practices.¹⁹ Assimilating these particular lessons learned along with others from our allies does make sense and would facilitate the LVCTS rollout.

8. Immense staff work was completed by DLR personnel during the LVCTS Project's definition phase, as evidenced by the detail in the LVCTS Training Analysis and Business Case documents.²⁰ Leveraging historical figures, these documents outline the exact LVCTS simulator requirements (E.g.: capabilities, type and quantity by location) and provide a thorough LVCTS cost/benefit analysis. Both documents are important to this discussion, as they provide insight into the proposed design of LVCTS and the initial expectations for its use: in short, they hint at how it could be integrated into IT and CT. Notably, the LVCTS is projected to pay for itself and generate an overall savings of \$140 million CAD over its 30-year life span through reductions to Operating and Maintenance (O&M) and National Procurement (NP) costs.²¹ This top-line figure is based on transitioning some current live training to virtual simulation and consolidating simulation systems. In terms of IT courses, the Business Case highlights efficiencies created by the

¹⁸ *Ibid.*

¹⁹ *Ibid.*

²⁰ Canada, Department of National Defence. *Training Analysis - Land Vehicle Crew Training System (LVCTS)*, Ottawa, ON, CA: DLR, 1 March 2014, 1-Annex C; Canada, Treasury Board of Canada Secretariat, *Business Case: LVCTS...*, 1-77.

²¹ Canada, Treasury Board of Canada Secretariat, *Business Case: LVCTS...*, 5 and 40. O&M training costs include fuel, consumables, fresh rations, etc. NP costs include ammunition, spare parts, repair work to vehicles, and combat rations.

LVCTS, including: transitioning 50% of current live driver training on targeted IT courses to the LVCTS; transitioning 50% of live practices on gunnery courses to LVCTS shoots; and divesting legacy CA simulation systems (E.g.: JCATS and VBS2) and using the LVCTS to support the IT courses that these former systems supported.²² In terms of CT, the Business Case recommends that 20% of live field training be transitioned to the LVCTS once it is fielded.²³ This 20% target is a minimum. The CA's new *Advancing with Purpose: The Canadian Army Modernization Strategy* publication has hinted that this target can indeed be increased:

The Canadian Army will rationalize and increase its use of virtual and constructive simulation for both Collective Training and Individual Training, as well as distributed learning in order to ensure that basic skills have been learned before engaging in live simulation events like field exercises. Whenever it makes sense, the synthetic training environment should be used as a confirmation gateway before transitioning to live simulation events.²⁴

Using the LVCTS to achieve CT training gateways could lead to more focused live confirmation events (E.g.: CT Level 5-6) and dramatically reduce the length of FTXs. All of these efficiencies require further study and will need to be codified in future CA command direction concerning the LVCTS.

CONCLUSION

9. In summary, the LVCTS represents a significant investment for the CA and a game-changing training support capability that will be fielded in the immediate future. To get true value out of it and to have it succeed where other, older CA simulation systems

²² *Ibid.*, 59-63.

²³ *Ibid.*, 62 and 69.

²⁴ Canada, Department of National Defence, *A-PP-106-000/AF-001 - Advancing with Purpose: The Canadian Army Modernization Strategy*, 4th Ed., Ottawa, ON, CA: Canadian Army Headquarters, December 2020, 33. http://www.army-armee.forces.gc.ca/assets/ARMY_Internet/docs/en/national/2021-01-canadian-army-modernization-en.pdf.

were not fully exploited, it is essential that the LVCTS be deeply integrated into future IT and CT, and be thoroughly embraced by its future users. To do this, the advantages of the LVCTS and direction for its usage must be clearly communicated to users, allied lessons learned assimilated, and the original vision of the LVCTS Project followed in good faith.

RECOMMENDATION

10. To best integrate the LVCTS into CA IT and CT, it is recommended that the following actions be considered:

- a. Master Implementation Directive (MID). It is recommended that CADTC draft a LVCTS MID that will be issued by CA Headquarters prior to IOC, so that detailed information, tasks and direction can be provided to CA formations on the LVCTS fielding. Additional tasks and guidance should be disseminated via Fragmentary Orders (FRAGOs) to this MID as needed and up until FOC.
- b. Centre of Excellence (CoE) Tasks. It is recommended that CADTC task IT course CoEs with conducting Training Plan Writing Boards (TPWBs) to amend the Training Plans (TPs) of IT courses, which are targeted to use the LVCTS.²⁵ Specifically, CoEs should determine the maximum amount of course time that the LVCTS can be leveraged, and then amend the optimal timetables and training resources in said TPs accordingly. For gunnery and leadership courses, this should be a straightforward task. However, as the LVCTS is the first CA virtual simulator that is capable of supporting driver training, CoEs of driver

²⁵ Canada, Treasury Board of Canada Secretariat, *Business Case: LVCTS...*, 59-68. The list of IT courses that the LVCTS is targeted to support is extensive and can be found in Annex C of this reference.

IT courses will need to conduct more in-depth TPWBs to integrate the LVCTS and reduce live driving by 50%. The product of these TPWBs - revised TPs or Training Plan Change Requests (TPCRs) - will then need to be submitted to the Army Individual Training Authority (AITA) for approval.

c. Performance Checks (PCs) on IT Courses. It is recommended that the MID and amended TPs state that IT course PCs evaluated in the LVCTS be completed on HFSs only. Thus, passing said PCs on HFSs will be the training gateway for trainees to conduct live simulation.

d. LVCTS Bookings and IT Scheduling. As demand for LVCTS simulators will be high and because CA formations tend to follow similar IT trimesters, LVCTS bookings will need to be carefully managed and increased scheduling flexibility given to units.²⁶ Although LVCTS bookings will likely be made via the Canadian Forces Range Information System (CFRIS) to Base HQs, CA formations will have to plot out IT course schedules and deconflict LVCTS usage during their training conferences. As well, to achieve LVCTS booking efficiency, units should be permitted to schedule pauses in their IT course schedules without having to obtain approval via a Training and Exception Waiver Request. This measure will enable units to schedule courses on the fringes of IT trimesters, minimize administration, and ensure that LVCTS usage is largely confined to contractor-serviced business hours. Lastly, LVCTS bookings in support of high

²⁶ IT trimesters commonly used by the Combat Training Centre (CTC) and CA brigades include: Fall (September-December), Winter/Spring (January-April) and Summer (May-August).

readiness (HR) training and IT courses should be privileged over foundation and continuation training when booking conflicts do occur.

e. Flexibility. Mirroring direction found in *CA Order 28-01 - CA Simulation Policy*, it is recommended that the MID and amended TPs also clearly communicate that LVCTS use is to be maximized.²⁷ That said, when circumstances require it (E.g.: an LVCTS training centre is non-serviceable or is not located near a Reserve Force unit), unit leadership should be afforded the necessary flexibility to conduct what would normally be LVCTS-supported training as live simulation. Such instances should be the exception and will need to be well-justified, as they will increase training costs.

f. Continuation and HR CT Gateways. As an example, for personnel re-qualifying on their Personal Weapons Test (PWT) as part of IBTS during Continuation and HR training, they are authorized to complete lower PWT levels on the SAT and only have to fire the required PWT level live.²⁸ This practice saves resources and time. As the LVCTS boasts HFSs, a similar resource and time-saving practice could be applied to crew-based Battle Task Standards. For example, a Leo 2 crew could complete Levels 1-3 in the LVCTS as their training gateway to firing CT Level 5 live. Although not without risk, such a measure could significantly shorten FTXs. As LAV 6.0 and TAPV dismounts cannot be

²⁷ Canada, Department of National Defence, *Canadian Army Order (CAO) 28-01 - Canadian Army Simulation Policy*, Ottawa, ON, CA: Canadian Army Headquarters (CA HQ), 19 October 2015, 3.

²⁸ Canada, Department of National Defence, *B-GL-382-001/FP-001 - Canadian Forces Operational Shooting Programme*, Kingston, ON, CA: Director of Army Training (DAT), 1 April 2007, 4. For example, a soldier may complete their C7 PWT Levels 1-2 on the SAT and fire their C7 PWT Level 3 live if that is the highest standard that they must achieve.

exercised in the LVCTS, they would still need to complete live CT Levels 2-5 ranges. LAV 6.0 and TAPV crews could, though, complete IBTS Level 1 and CT Level 2 in the LVCTS. Also, CA brigades should be encouraged to complete CT Level 5 training in the LVCTS first as a training gateway leading to dry rehearsals and live confirmation on an FTX; this would enable earlier infantry/armour integration. Further CA Corps-level study of these CT recommendations is obviously required and consensus should be codified in an update to *B-GL-383-002/PS-002 - Battle Task Standards*.

g. LVCTS Lessons Learned. Lastly, it is recommended that the Canadian Army Lessons Learned Centre (CALLC) be tasked to study LVCTS use in Gagetown after IOC and then widely disseminate best practices in their publications (E.g.: *Dispatches*, *Bulletin*, etc.).

BIBLIOGRAPHY

- Bray, Richard. "From the road to the simulator: Combat vehicle training in a virtual environment." *Canadian Army Today*. 18 March 2020.
<https://canadianarmytoday.com/from-the-road-to-the-simulator-combat-vehicle-training-in-a-virtual-environment/>.
- Canada. Department of National Defence. *A-FD-005-000/AG-001 - Future Integrated Training Environment*. Ottawa, ON, CA: CADTC. 1 August 2019.
- Canada. Department of National Defence. *A-PP-106-000/AF-001 - Advancing with Purpose: The Canadian Army Modernization Strategy*. 4th Ed. Ottawa, ON, CA: CA HQ. December 2020. http://www.army-armee.forces.gc.ca/assets/ARMY_Internet/docs/en/national/2021-01-canadian-army-modernization-en.pdf.
- Canada. Department of National Defence. *B-GL-300-008/FP-001 - Training for Land Operations*. Kingston, ON, CA: Director of Army Training (DAT). 2014.
[http://armyapp.forces.gc.ca/SOH/SOH_Content/B-GL-300-008-FP-001%20\(2014\).pdf](http://armyapp.forces.gc.ca/SOH/SOH_Content/B-GL-300-008-FP-001%20(2014).pdf).
- Canada. Department of National Defence. *B-GL-382-001/FP-001 - Canadian Forces Operational Shooting Programme*. Kingston, ON, CA: DAT. 1 April 2007.
- Canada. Department of National Defence. *B-GL-383-002/PS-002 - Battle Task Standards*. Kingston, ON, CA: DAT. 15 January 2007.
[http://cadtc.kingston.mil.ca/soh/SOH_Content/B-GL-383-002-FP-001%20\(2014\).pdf](http://cadtc.kingston.mil.ca/soh/SOH_Content/B-GL-383-002-FP-001%20(2014).pdf).
- Canada. Department of National Defence. *B-GL-383-003/FP-001 - Individual Battle Task Standards for Land Operations*. Kingston, ON, CA: DAT. 3 October 2012.
[http://cadtc.kingston.mil.ca/soh/SOH_Content/B-GL-383-003-FP-001%20\(2012\).pdf](http://cadtc.kingston.mil.ca/soh/SOH_Content/B-GL-383-003-FP-001%20(2012).pdf).
- Canada. Department of National Defence. *B-GL-310-001/AG-003 - Close Engagement: Land Power in an Age of Uncertainty: Evolving Adaptive Dispersed Operations*. Kingston, ON, CA: Canadian Army Land Warfare Centre. 2019.
http://publications.gc.ca/collections/collection_2019/mdn-dnd/D2-406-2019-eng.pdf.

- Canada. Department of National Defence. *Canadian Army Order (CAO) 28-01 - Canadian Army Simulation Policy*. Ottawa, ON, CA: Canadian Army Headquarters (CA HQ). 19 October 2015.
- Canada. Department of National Defence. *D2-386/2017E - Strong, Secure, Engaged (SSE)*. Ottawa, ON, CA: CAF. 2017. <http://dgpaapp.forces.gc.ca/en/canada-defence-policy/docs/canada-defence-policy-report.pdf>.
- Canada. Department of National Defence. *Training Analysis - Land Vehicle Crew Training System (LVCTS)*. Ottawa, ON, CA: DLR. 1 March 2014.
- Canada. Department of National Defence - Defence Capabilities Blueprint (DCB). "Land Vehicle Crew Training System." Last accessed 21 January 2021. <http://dgpaapp.forces.gc.ca/en/defence-capabilities-blueprint/project-details.asp?id=1697>.
- Canada. Public Services and Procurement Canada (PSPC). "Land Vehicle Crew Training System (W8476-175579/B)." Last accessed 21 January 2021. <https://buyandsell.gc.ca/procurement-data/tender-notice/PW-QT-010-27734>.
- Canada. Public Services and Procurement Canada (PSPC). *Solicitation Amendment No. 2 for Land Vehicle Crew Training System (W8476-175579/B)*. Gatineau, QC, CA: PSPC. 27 November 2020. https://buyandsell.gc.ca/cds/public/2020/11/26/6499af794628438758dc457f94c1d7a2/ABES.PROD.PW__QT.B010.E27734.EBSU002.PDF.
- Canada. Treasury Board of Canada Secretariat. *Business Case: Land Vehicle Crew Training System (LVCTS)*. Ottawa, ON, CA: DLR. 25 November 2015.
- Coutts, Ian. "Vehicle crew training: Welcome to a new (virtual) reality." *Canadian Army Today*. 5 September 2018. <https://canadianarmytoday.com/vehicle-crew-training-welcome-to-a-new-virtual-reality/>.
- Lockheed Martin. "Close Combat Tactical Trainer: Real-time Collective Training Environment." Washington, DC, USA: Lockheed Martin Mission Systems and Training. 2015. Last accessed 21 January 2021. https://www.lockheedmartin.com/content/dam/lockheed-martin/rms/documents/close-combat-tactical-trainer/CCTT_Product_Card_2015.pdf.
- Mastaglio, Thomas, Stephen Goldberg, Michael McCluskey, and Navair Orlando. *Assessing the Effectiveness of A Networked Virtual Training Simulation: Evaluation of the Close Combat Tactical Trainer*. Alexandria, VA, USA: Army Research Institute for the Behavioural and Social Sciences, January 2003. Last accessed 21 January 2021. https://www.researchgate.net/publication/228830128_Assessing_the_Effectiveness

s_of_A_Networked_Virtual_Training_Simulation_Evaluation_of_the_Close_Co
mbat_Tactical_Trainer.